Site Management Plan

Carol Cleaners, Staten Island Mall Site
Staten Island
Richmond County, New York
Site No. 243020

JANUARY 21, 2026
PROJECT NUMBER 209-4213307

PREPARED FOR

Brookfield Properties
350 N Orleans Street, Suite 300
Chicago, IL 60654

PREPARED BY

Cornerstone Engineering and Geology, PLLC
100 Crystal Run Road, Suite 101
Middletown, NY 10941

P +1.877.294.9070
F +1.877.845.1456
tetratech.com

Revisions to Final Approved Site Management Plan:

Revision No.	Date Submitted	Summary of Revision	NYSDEC Approval Date

REPORT CERTIFICATION

Site Management Plan

Carol Cleaners, Staten Island Mall Site

Staten Island, Richmond County, NY

I, Erich Zimmerman, certify that I am currently a NYS registered professional engineer, and that this Site Management Plan was prepared in accordance with applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and Green Remediation (DER-31).



Cornerstone Engineering and Geology, PLLC

01/21/2026

Erich Zimmerman, P.E. Date
NY PE License No. 081831-01

It is a violation of Article 145 of the New York State Education Law; unless acting under the direction of a licensed Professional Engineer who affixes signature, date, seal and the words "altered by"; for any person to alter this document in any way.

TABLE OF CONTENTS

LIST OF ACRONYMS

EXECUTIVE SUMMARY 1-1

1.0 INTRODUCTION 1-4
1.1 General 1-4
1.2 Revisions 1-4
1.3 NotificationS 1-5

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS 2-1
2.1 Site Location and Description 2-1
2.2 Physical Setting 2-1
2.2.1 Land Use 2-1
2.2.2 Geology and Hydrogeology 2-1
2.3 Investigation and Remedial History 2-2
2.4 Remedial Action Objectives 2-8
2.5 Remaining Contamination 2-9
2.5.1 Soil 2-9
2.5.2 Groundwater 2-10
2.5.3 Soil Vapor 2-11

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN 3-1
3.1 General 3-1
3.2 Institutional Controls 3-1
3.3 Engineering Controls 3-2
3.3.1 Cover 3-2
3.3.2 Sub-slab Depressurization System 3-2
3.3.3 Criteria for Completion of Remediation/Termination of Remedial Systems 3-3

4.0 MONITORING AND SAMPLING PLAN 4-1
4.1 General 4-1
4.2 Site – Wide Inspection 4-1
4.3 Treatment System Monitoring and Sampling 4-2
4.3.1 Remedial System Monitoring 4-2
4.3.2 Remedial System Sampling 4-3
4.4 Post-Remediation Media Monitoring and Sampling 4-3
4.4.1 Groundwater Sampling 4-4
4.4.2 Monitoring and Sampling Protocol 4-6

5.0 OPERATION AND MAINTENANCE PLAN 5-1
5.1 General 5-1
5.2 Remedial System (or other Engineering Control) Performance Criteria 5-1
5.3 Operation and Maintenance of the Sub-Slab Depressurization System 5-1
5.3.1 System Start-Up and Testing 5-1
5.3.2 Routine System Operation and Maintenance 5-2

5.3.3 Non-Routine Operation and Maintenance 5-2
5.3.4 System Monitoring Devices and Alarms 5-2
5.3.5 Fire Safety 5-2

6.0 PERIODIC ASSESSMENTS/EVALUATIONS 6-1
6.1 Climate Change Vulnerability Assessment 6-1
6.2 Green Remediation Evaluation 6-1
6.2.1 Timing of Green Remediation Evaluations 6-1
6.2.2 Remedial Systems 6-2
6.2.3 Building Operations 6-2
6.2.4 Frequency of System Checks, Sampling and Other Periodic Activities 6-2
6.2.5 Metrics and Reporting 6-2
6.3 Remedial System Optimization 6-2

7.0 REPORTING REQUIREMENTS 7-1
7.1 Site Management Reports 7-1
7.2 Periodic Review Report 7-2
7.2.1 Certification of Institutional and Engineering Controls 7-3
7.3 Corrective Measures Work Plan 7-5
7.4 Remedial SYSTEM Optimization Report 7-5

8.0 REFERENCES 8-1

TABLES

Table 1 Monitoring Well Construction and Groundwater Elevation Data
Table 1.1 Notifications
Table 2 Pre- and Post-Injection CVOC Data
Table 2.1 Injection Locations and Quantity (gallons) Injected – 2018 Through 2020
Table 2.2 Pre- and Post-Injection Groundwater Sampling Summary
Table 2.3 PCE, TCE and Cis-1,2-DCE Detects
Table 3.1 Summary of Soil Boring Sampling Results - For September 17-20, and October 31, 2002
Table 3.2 Summary of Soil Boring Sampling Results - May 11 - 12, 2006
Table 3.3 Summary of Soil Boring Sampling Results - May 2011
Table 3.4 Summary of Soil Boring Sampling Results - May and June 2017
Table 3.5 Summary of Reductive Dechlorination Indicator Parameter
January 2013 Pre-Injection through December 2023 Post-Injection
Table 4 Summary of Metals Exceedances and Field Parameters
Table 4.1 Remedial System Monitoring Requirements and Schedule
Table 4.2 Post Remediation Sampling Requirements and Schedule
Table 4.3 Monitoring Well Construction Details
Table 5 Indoor Air and Sub Slab Volatile Organic Compounds - March 2025
Table 5.1 Summary of the vacuum readings
Table 6 January 2024 Sub-Slab Vacuum Testing Results
Table 7.1 Schedule of Interim Monitoring/Inspection Reports

FIGURES

Figure 1 – Site Location Map
Figure 2 – Site Layout Map
Figure 3 – Geologic Cross Section
Figure 4 – Groundwater Contour Map for March 3, 2025
Figure 5A – Historical 2002 Soil Boring Locations
Figure 5B – Historical 2006 Soil Boring Locations
Figure 5C – Historical 2011 Soil Boring Locations
Figure 5D – Historical 2017 Soil Boring Locations Associated with Catch Basin Investigation
Figure 6 – PCE Isopleth Map – July 2017
Figure 7 – PCE Isopleth Map – March 2025
Figure 8a – Groundwater Sampling Results July 2017 through March 2025
Figure 8b – Groundwater Sampling Results July 2017 through March 2025
Figure 9 – Institutional and Engineering Control Boundaries
Figure 10 – June 2022 Sampling Results
Figure 11 – March 2025 Sampling Results

APPENDICES

Appendix A	Environmental Easement
Appendix B	List of Site Contacts
Appendix C	Monitoring Well Logs
Appendix D	SSD System As - Built
Appendix E	Soil Boring Logs
Appendix F	Historical Soil Sampling Results
Appendix G	Indoor Air and Sub-slab Vapor Sampling Report/Sub- slab Depressurization System Installation Memorandum
Appendix H	Excavation Work Plan
Appendix I	Health and Safety Plan/Community Air Monitoring Plan
Appendix J	UIC Approval Appendix
Appendix K	Quality Assurance Project Plan
Appendix L	Site Management Forms
Appendix M	Field Activities Plan
Appendix N	Remedial Party Responsibilities
Appendix O	Remedial System Optimization Outline

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
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
DUSR	Data Usability Summary Report
EC	Engineering Control
ECL	Environmental Conservation Law
ELAP	Environmental Laboratory Approval Program
ERP	Environmental Restoration Program
EWP	Excavation Work Plan
GHG	Greenhouse Gas
GWE&T	Groundwater Extraction & 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	Operation and Maintenance
OM&M	Operation, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
P.E. or PE	Professional Engineer

Acronyms/Abbreviations	Definition
PFAS	Per and Polyfluoroalkyl Substances
PID	Photoionization Detector
PRP	Potentially Responsible Party
PRR	Periodic Review Report
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
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	Site 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
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristics 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 (SMP):

Site Identification:	243020 - Carol Cleaners, Staten Island Mall - 280 Platinum Avenue, SI, NY

Institutional Controls:	1. The property may be used for commercial and industrial use;
	2. An Environmental Easement (EE) has been established for the southern portion of the property along Platinum Avenue.
	3. All ECs 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 Richmond 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 this SMP.
	6. Data and information pertinent to site management of the Controlled Area must be reported at the frequency and in a manner as defined in this SMP.
	7. All future activities that will disturb remaining contaminated material must be conducted in accordance with this SMP.
	8. Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in this SMP.
	9. Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical component of the remedy shall be performed as defined in this 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 the Environmental Easement.

Site Identification: 243020 - Carol Cleaners, Staten Island Mall - 280 Platinum Avenue, SI, NY

	11. The potential for vapor intrusion must be evaluated for any buildings developed in the area within the IC boundaries noted on Figure 9, and any potential impacts that are identified must be monitored or mitigated. As stated within the March 2012 Record of Decision, all existing and any new on-site buildings will be required to have a sub-slab depressurization system, or a similar engineered system, to prevent the migration of vapors into the building from soil and/or groundwater.	
	12. Vegetable gardens and farming on the site are prohibited.	
	13. An evaluation shall be performed to determine the need for further investigation and remediation should large scale redevelopment occur, if any of the existing structures are demolished, or if the subsurface is otherwise made accessible.	
Engineering Controls:	1. Cap/Cover (asphalt and buildings)	
	2. Sub-Slab Depressurization (SSD) System	
Inspections:		Frequency
1. Cover/Cap inspection		Annually
2. SSD System inspection		Annually (gauge readings collected and recorded weekly)
Monitoring:		
1. Groundwater Monitoring Wells		Last Conducted during March 2025 Annually thereafter
1. SSD System		Evaluation of blower fan vacuum readings upon restart if shutdown occurs. Indoor Air and Sub Slab Vapor sampling during heating season to evaluate the efficacy of shutting the system down. Annually
Maintenance:		
1. Cover/Cap		As needed
2. SSD System Blower maintenance		As needed
Reporting:		

Site Identification: 243020 - Carol Cleaners, Staten Island Mall - 280 Platinum Avenue, SI, NY

1. Groundwater and SSD System Data	Annually
2. 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 is a required element of the remedial program for the Carol Cleaners, Staten Island Mall Site located in Staten Island, New York (hereinafter referred to as the "site"). See Figure 1. The site is currently in the New York State (NYS) Inactive Hazardous Waste Disposal Site Remedial Program, Site No. 243020, which is administered by New York State Department of Environmental Conservation (NYSDEC or Department).

Brookfield Properties (Brookfield) formerly General Growth Properties, Inc. (GGP) formerly the Rouse Company entered into an Order on Consent (Index #D2-002-02-08) on October 4, 2002 (last amended on November 4, 2011) with the NYSDEC to remediate the site. The site location and boundaries of this site are shown on 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 Office of the Richmond 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 in consultation with NYSDOH's approval.

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); and
- Failure to comply with this SMP is also a violation of Environmental Conservation Law, 6 NYCRR Part 375 and the Order of Consent Index #D2-002-02-08, Site #243020 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 Tetra Tech (Tt), on behalf of Brookfield Properties, in accordance with the requirements of the NYSDEC's DER-10 ("Technical Guidance for Site Investigation and Remediation"), dated May 2010, 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. The NYSDEC can also make changes to the SMP or request revisions from the remedial party. Revisions will be necessary upon, but not limited to, the following occurring: a change in media monitoring requirements, upgrades to or shutdown 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 project manager 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:

1. 60-day advance notice of any proposed changes in site use that are required under the terms of the Order on Consent, 6 NYCRR Part 375 and/or Environmental Conservation Law.
2. 7-day advance notice of any field activity associated with the remedial program.
3. 15-day advance notice of any proposed ground-intrusive activity pursuant to the Excavation Work Plan. If the ground-intrusive activity qualifies as a change of use as defined in 6 NYCRR Part 375, the above mentioned 60-day advance notice is also required.
4. 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.
5. Notice within 48 hours of any non-routine maintenance activities.
6. 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.
7. 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:

8. 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 Order on Consent, and all approved work plans and reports, including this SMP.
9. 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.

The following table summarizes contact information for the above notifications. 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 1.1 Notifications*

Name	Contact Information	Required Notification**
NYSDEC Project Manager – Yildiz Palumbo	(718) 482-4891 yildiz.palumbo@dec.ny.gov	All Notifications
NYSDEC Project Manager's Supervisor – Andre Obligado	(718) 482-6412 andre.obligado@dec.ny.gov	All Notifications

NYSDEC Site Control – Kelly Lewandowski	(518) 402-9553 Kelly.lewandowski@dec.ny.gov	Notifications 1 and 8
NYSDOH Project Manager – Sarita Wagh	(518) 402-7817 sarita.wagh@health.ny.gov	Notifications 4, 6, and 7

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

**Note: Numbers in this column reference the numbered bullets in the notification list in this section.

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

2.1 SITE LOCATION AND DESCRIPTION

The site is located in Staten Island, Richmond County, New York and is identified as Block 2400 and Lot 300 on the Richmond County Tax Map (Figure 2). The EE portion of the site is an approximately 1.821-acre area and is bounded by The Crossings Center to the north, Platinum Avenue to the south, Marsh Avenue to the east, and Ring Road to the west (Figure 2). The boundaries of the site are more fully described in Appendix A – Environmental Easement. The owner of the site parcel(s) at the time of issuance of this SMP is Brookfield Properties Retail.

2.2 PHYSICAL SETTING

2.2.1 Land Use

The site consists of the following: a commercial mall building and associated parking areas. The site is zoned commercial and is currently utilized for commercial uses. Site occupants include a nail salon and an ice cream store with other commercial operators further north within the Crossings Center.

The properties adjoining the Site and, in the neighborhood, surrounding the site primarily include commercial and residential properties. The properties immediately south of the Site include commercial properties; the properties immediately north of the site include commercial properties; the properties immediately east of the site include residential properties; and the properties to the west of the site include commercial properties.

2.2.2 Geology and Hydrogeology

The prevailing depths to groundwater and bedrock at the site range from about 8 feet below grade (ft bg) to 14 ft bg, and 12 ft bg to 28 ft bg, respectively. The naturally occurring geologic materials at the site consist mainly of fine grain-size deposits of clay, silt and fine sand (overburden), which are underlain by bedrock. The corresponding bedrock surface generally slopes downwards in elevation from the vicinity of monitoring Well MW-1 where the bedrock elevation is 31 feet above mean sea level (msl) towards the southwest, proximal to monitoring well MW-16 where the bedrock elevation is 2 feet above msl. The generally southwestward slope of the bedrock surface is locally accentuated by several buried “channels” in the bedrock surface in the vicinity of Platinum Avenue. These channels are anticipated to impart a localized influence on the groundwater flow in the overburden.

Boring and monitoring-well logs were used to prepare a hydrogeologic cross-section that illustrates the vertical distribution (stratigraphy) of encountered geologic and hydrogeologic features across the site. The cross-section illustrates the general slope of the bedrock surface from northeast to southwest, and a similar slope in groundwater surface. The cross-section also illustrates the increase in thickness of the naturally occurring overburden materials (primarily fine sand and silt) from northeast to southwest. The geologic cross section is provided as Figure 3. A groundwater contour map from the most recent groundwater sampling round is provided as Figure 4. Groundwater elevation data are provided in Table 1. Groundwater monitoring well construction logs are provided in Appendix C.

2.3 INVESTIGATION AND REMEDIAL HISTORY

The following is a summary of the remedial history of the site and 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.

Following the NYSDEC issuance of the Order on Consent in 2002, Leggette, Brashears & Graham Engineering Services (LBGES) conducted an Interim Remedial Measure (IRM) investigation, followed by a Remedial Investigation (RI), on behalf of General Growth Properties (GGP) (formerly the Rouse Company). The IRM investigation and RI focused on identifying and locating the general source area and extent of tetrachloroethylene (PCE) and related chlorinated volatile organics (CVOCs) detected in the subsurface environment at the site. The investigative work addressed the following: 1) delineating the horizontal and vertical extent of CVOCs in soil and groundwater in the vicinity of the Carol Cleaners and Tumble Dry Cleaners (aka Damowa Laundry & Dry Cleaning) facilities; 2) assessing migration pathways for detected constituents; and 3) determining whether dense non-aqueous phase liquid (DNAPL) existed at the potential release location.

The IRM investigation and RI results indicated that the “source area” roughly corresponded to a parking/driveway area of broken-up asphalt at the rear of the Carol Cleaners tenant space [near existing monitoring well MW-3 (Figure 2)]. Based on the IRM and RI results, it was determined that no remediation of the overburden (soil) material was warranted due to: 1) the singular encounter of a slightly elevated PCE concentration detected at a depth above the groundwater surface at only one location; 2) the comparatively lower concentrations of PCE [all below the respective NYSDEC “TAGM” objective of 1.4 parts per million (ppm)] detected in the immediately surrounding overburden; 3) the prevailing composition of the overburden (primarily fine sand and silt); 4) the absence of CVOC DNAPL; and 5) the isolation afforded by the prevalence of primarily impervious surfaces (e.g., roofs, parking lot, walkways) at the Site.

Results of groundwater sampling rounds conducted between 1995 and 2011 indicated the presence of dissolved PCE and one or more related CVOCs [trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE) and vinyl chloride (VC)] at concentrations above their respective NYSDEC groundwater/surface-water standards, as defined by 6 NYCRR Part 703, at several of the on-site and off-site monitoring wells. Groundwater monitoring also did not identify any potential DNAPL in the local groundwater bearing formations underlying the site. The groundwater flow direction, in conjunction with the distribution of the respective CVOCs dissolved in groundwater at the site, support the conclusions that the apparent source area occurs proximal to the Carol Cleaners tenant space, and the resulting plume extended off-site towards Platinum Avenue. The investigation also indicated that contaminant flow may have been influenced by the route of local subsurface utilities.

Based on in-situ hydraulic (“slug”) testing conducted at several on-site monitoring wells, it was determined that the hydraulic conductivity of the overburden at the site is low to moderate [0.4 feet per day (ft/d) to 30 ft/d]. These values, along with the relatively consistent hydraulic gradient exhibited by the local groundwater, support the characterization that CVOC plume movement through on-site overburden is expected to occur at a slow rate, which in turn affords the potential for natural degradation (e.g., biologically-driven reductive dechlorination) of the respective constituents to occur. The analytical results for groundwater samples collected since 1995 indicate that PCE related to the on-site source area is clearly undergoing reductive dechlorination (i.e., breakdown to TCE, cis-1,2-DCE, and VC), which substantiates the occurrence of natural degradation at the site. The occurrence of natural degradation of PCE was further corroborated by the general detection of methane, ethane, and/or ethene in groundwater samples collected from most of the monitoring wells in the plume area.

The RI report associated with the previously completed investigations was submitted to the NYSDEC in October 2011, followed in November 2011 by the Feasibility Study (FS) associated with the identification of potential future remedial activities. The FS established the Remedial Action Objectives (RAOs) for the site and identified in-situ bioremediation as the proposed selected remedial technology. The Record of Decision (ROD) for the site was issued in March 2012 and required completion of a pilot study prior to the implementation of any full-scale remedial efforts. As per the ROD, a workplan for a Pilot Study (the Workplan) to evaluate in-situ bioremediation as a possible remedial technology was submitted to and approved by the NYSDEC in September 2013. In addition, the ROD indicated that any indoor air impacts potentially resulting from existing conditions and/or future remedial efforts as identified in the RI and FS would need to be addressed prior to beginning the pilot study.

The results of the April 2006 and February 2008 indoor air and sub-slab air sampling, summarized in the RI report submitted in 2008, indicated that PCE and related CVOCs had impacted the indoor air in the Babies R Us space, and the adjacent strip mall spaces occupied by SI Shoe Repair, Carol Cleaners, Mon Amie Nails and Carvel (the focus area). The areas where indoor air impacts appear to be greatest generally coincided with areas corresponding to the nearby groundwater plume. Based on the detected concentrations and respective New York State Department of Health (NYSDOH) guidelines, an SSD system was installed to mitigate these impacts.

The initial round of post-mitigation heating season indoor air sampling results indicated that concentrations of PCE and related CVOCs still exceeded their respective NYSDOH guidelines within multiple tenant spaces. Additional investigation into the cause of the persistent elevated PCE and related CVOC concentrations determined that the dry cleaning tenant (French Cleaning by Carol) occupying the Carol Cleaners tenant space was using equipment which was emitting PCE into the indoor air at concentrations in exceedance of the respective NYSDOH guideline. The tenant was subsequently vacated from the property by GGP. Follow-up indoor air sampling indicated that PCE vapor remained an indoor air issue at the Carvel tenant space. As a result, an additional SSD suction point was installed within the Carvel tenant space in February 2015. Subsequent heating season indoor air sampling at the Carvel tenant space indicated compliance with the respective NYSDOH guidelines.

The SSD system is currently operating and maintaining depressurization of the targeted tenant spaces. The SSD system is inspected weekly by Brookfield representatives and, as of the October 26, 2024 reading, was operating normally, with each of the three SSDS fans achieving the vacuums identified during re-commissioning (February 27, 2015) after installation of an additional suction point within the Carvel store. As identified on the Sub-Slab Depressurization Reading form completed weekly by Brookfield, the commissioned suction values for each of the three blowers was as follows:

- Blower 1 Hobby Lobby (Fantech 225): 2.65 inches of water column (WC);
- Blower 2 Carol Cleaners (GBR 76): 17 inches WC; and
- Blower 3 Carol Cleaners (GBR 76): 15 inches WC.

The as-built drawing for the SSDS is provided in Appendix D.

As part of baseline groundwater monitoring activities, grab samples of standing water were obtained from several catch basins at the site during October 2016. Analytical results indicated that chlorinated VOCs (primarily PCE and cis-1,2-dichloroethene) were identified in several catch basins at concentrations above NYSDEC Surface water and/or groundwater standards, with a maximum detected PCE concentration of 272 micrograms per liter. In response to the detection of PCE in the standing water samples collected from the stormwater system, and in connection with the Interim Site Management Plan (Interim SMP) activities identified for the site, stormwater system cleaning activities were initiated in November 2016. The cleaning activities involved the removal of sediment from each of the accessible catch basins associated with the on-site stormwater system. Approximately two to three feet of sediment was encountered at each of the accessed catch basins. Sediment was removed and

placed into roll off boxes for subsequent characterization and disposal. Based on the results of waste characterization sampling, approximately 22 tons of non-hazardous sediment was transported to Cycle Chem in Elizabeth, New Jersey, and approximately 11.5 tons of sediment was transported to Michigan Disposal, Inc. in Belleville, Michigan for disposal as hazardous waste.

Eighteen (18) soil borings (SWB-1 through SWB-18) were advanced in June 2017 using a Geoprobe® rig. The borings were advanced at locations intended to assess the potential for CVOC-impacts to soil from on-site subsurface utility routes, specifically storm water lines, and as such were advanced in the parking areas on the eastern and southern sides of The Crossings Mall building proximal to storm drain catch basins (Figure 5).

The borings were mostly advanced to the top of bedrock with completion depths ranging from approximately 3 to 19 feet below grade (ft bg). Soil samples were continuously collected from the respective boreholes using a macro-core device with dedicated, disposable, clear-acetate sleeves. The respective soil boring logs are provided in Appendix E. The overburden materials encountered at each of the boring locations were consistent with those encountered during previous on-site subsurface explorations elsewhere at the Site. The naturally occurring materials generally consisted of fine-grained deposits of clay, silt, and fine sand with varying amounts of gravel. A total of thirty-six (36) soil samples were collected for subsequent laboratory analyses at depths corresponding to immediately above the encountered groundwater surface (typically about 5 ft bg) and/or above refusal at each boring location.

The analytical results for the respective soil samples did not indicate the occurrence of any of the CVOCs of interest at concentrations in exceedance of the respective NYSDEC Restricted Use Commercial Soil Cleanup Objectives (SCOs). No evidence of DNAPL was encountered at any of the boring locations. Based on the results of the soil sampling efforts, the implementation of sub-slab vapor sampling at the nearby tenant spaces was not warranted. Historical soil sampling results are provided in Appendix F.

In-situ bioremediation pilot testing was conducted between November 2014 and October 2015 in accordance with the approved Work Plan. The injectant (WILCLEAR PLUS®) was a sodium lactate mixture consisting of a blend of fatty acids and fermentables (e.g., sodium lactate) manufactured by JRW Bioremediation, LLC (JRW). WILCLEAR PLUS® is designed specifically for bioremediation use, and is a light to dark brown, low viscosity, miscible liquid with a pH between 6 and 8. It is manufactured from food-grade ingredients, primarily fatty acids and fermentables, which eventually get consumed by natural microbes in the subsurface and groundwater. The injectant was mixed with 9 parts of water to one part of sodium lactate to facilitate the injection process. Once the reductive dechlorination (anaerobic driven) process is completed, only the innocuous end products consisting of carbon dioxide, ethene, ethane, water, and chloride ions remain in the groundwater. Following completion, a Pilot Test Summary Report was prepared and submitted to the NYSDEC in December 2015. The Pilot Test Summary Report was approved by the NYSDEC on April 13, 2016, and a Full-Scale Remedial Design Work Plan was prepared and submitted to the NYSDEC in May 2016. The Full-Scale Remedial Design Work Plan was approved by the NYSDEC on June 29, 2016.

The full-scale remediation commenced in October 2018 following the previously discussed storm drain investigation/remediation activities using Monitoring Wells MW-3, MW-5, MW-7, MW-16 through MW-24 as injection wells. The injectant (treatment solution) used in connection with the full-scale remedial activities is the same product used during the pilot test.

Follow up injections were conducted in December 2018, October 2019 and October 2020. The 2018 and 2019 injection events consisted of injecting 4,400 gallons of sodium lactate solution, while the 2020 injection round consisted of injecting 2,200 gallons of sodium lactate solution. Injection locations and amounts are summarized on the following table:

Table 2.1 Injection Locations and Quantity (gallons) Injected – 2018 Through 2020

Injection Well	10/2018 Injection Event Quantity	12/2018 Injection Event Quantity	10/2019 Injection Event Quantity	10/2020 Injection Event Quantity
MW-3	400	400	400	250
MW-5	400	320	300	350
MW-7	360	400	300	400
MW-16	360	320	450	375
MW-17	360	370	500	425
MW-18	360	400	500	400
MW-19	360	430	500	0
MW-20	360	350	400	0
MW-21	360	350	400	0
MW-22	360	360	400	0
MW-23	360	400	125	0
MW-24	360	300	125	0
Totals	**4,400**	**4,400**	**4,400**	**2,200**

The initial baseline pre-injection groundwater sampling round was conducted in October 2016. The baseline sampling event consisted of sampling all monitoring wells for VOCs, metals, dissolved metals, nitrite, nitrate, sulfate, methane, ethane, ethene, carbon dioxide, chemical oxygen demand, biological oxygen demand, total organic carbon, and alkalinity. Additional field analyses included dissolved oxygen, oxidation-reduction potential, pH, temperature and specific conductance. Follow-up post-injection sampling on a quarterly basis generally consisted of sampling fifteen monitoring wells for the above-referenced analyses and three monitoring wells for VOCs and metals only. The table below summarizes the sampling pre- and post-injection sampling regimen.

Table 2.2 Pre- and Post-Injection Groundwater Sampling Summary

Monitoring Well ID	Injection Monitoring		
	Pre-Injection Baseline	Monitoring Wells Within Treatment Area	Monitoring Wells Outside Treatment Area
MW-1	X	---	---
MW-2	X	---	X
MW-3 (Zone 1 injection)	X	X (injection)	---
MW-3D	X	X	---
MW-4	X	X	---

MW-5 (Zone 1 injection)	X	X (injection)	---
MW-6R	X	---	X
MW-7 (Zone 2 injection)	X	X (injection)	---
MW-8	X	X	---
MW-9 (Abandoned)	---	---	---
MW-10	X	---	X
MW-11	X	---	---
MW-12	X	---	---
MW-13	X	---	---
MW-14	X	---	---
MW-15	X	---	---
MW-16 (Zone 3 injection)	X	X (injection)	---
MW-17 (Zone 3 injection)	X	X (injection)	---
MW-18 (Zone 3 injection)	X	X (injection)	---
MW-19 (Zone 3 injection)	X	X (injection)	---
MW-20 (Zone 2 injection)	X	X (injection)	---
MW-21 (Zone 2 injection)	X	X (injection)	---
MW-22 (Zone 2 injection)	X	X (injection)	---
MW-23 (Zone 2 injection)	X	X (injection)	---
MW-24 (Zone 2 injection)	X	X (injection)	---

Post-injection quarterly groundwater sampling rounds commenced in January 2019 following the second injection event that occurred in December 2018. The pre- and post-injection quarterly groundwater sampling data are summarized in Tables 2 and 3. Based on the data, the sodium lactate injections have been successful, as CVOC concentrations have significantly decreased. Specifically, the previously elevated source area monitoring wells, MW-3, MW-4 and MW-5 have exhibited a decrease in PCE concentrations when comparing the pre- and post-injection laboratory analyses. Monitoring well MW-3 exhibited a decrease in PCE concentrations from 8,340 ug/l in July 2004 (pre-injection baseline of 89 ug/l in July 2017) to 1.0 ug/l in September 2021. Monitoring well MW-4 exhibited a decrease in PCE concentrations from 8,810 ug/l in April 2008 (pre-injection baseline of 1.4 ug/l in July 2017) to non-detect in September 2021. Monitoring well MW-5 exhibited a decrease in PCE concentrations from 72.4 ug/l in September 2009 (pre-injection baseline of 4.2 ug/l in July 2017) to non-detect in September 2021. The latest quarterly sampling round showed that PCE and TCE were either non-detect or below the NYSDEC groundwater standards in monitoring wells that are part of the monitoring program. The concentration of PCE breakdown products (such as TCE, DCE and VC) tended to increase early in the injection process followed by a subsequent decrease to below the NYS groundwater quality standard (GQS), or to below the laboratory detection limit. This is an expected result of the reductive dichlorination process. Based on the data, the sodium lactate injections have been successful at reducing the CVOC concentrations associated with the former Carol Cleaners.

The NYSDEC/NYSDOH requested that Brookfield conduct an investigation to assess the potential offsite migration of PCE-impacted groundwater from the former Carol Cleaners to the Pergament Mall property located south of Platinum Avenue. Tetra Tech mobilized to the site on July 26, 2022 to perform groundwater sampling. Groundwater samples were collected from a total of nine (9) on-site monitoring wells and submitted to SGS Laboratory (SGS) in Dayton, New Jersey. Samples were obtained from monitoring wells MW-3, MW-3D, MW-5, MW-7, MW-8, MW-17, MW-18, MW-19, and MW-23. All nine (9) groundwater samples were analyzed for Volatile Organic Compounds (VOCs) by USEPA Method 8260, TAL Metals (both filtered and unfiltered), Nitrate/Nitrite, Sulfate, Hardness, Alkalinity, Chemical Oxygen Demand, Biochemical Oxygen Demand, Total Organic Carbon, Carbon Dioxide, Methane, Ethane, and Ethene.

Groundwater sampling was conducted on the Pergament Mall property on July 28 and 29, 2022 and consisted of the installation of temporary groundwater sampling points. Tetra Tech attempted to collect samples from 10 locations within the Pergament Mall parking area; however, only three locations could be completed as temporary well locations due to subsurface refusal (thought to be a concrete slab). Each temporary well was constructed with a 1-inch diameter PVC riser and a 5-feet length of slotted screen. Groundwater samples were collected from the three wells using a peristaltic pump after purging three well volumes. The collected groundwater samples were analyzed for VOCs via EPA Method 8260 and one trip blank was submitted each day for VOC analysis. Each temporary well was removed after sampling was completed and the borehole (along with the other 7 attempted locations) filled with cuttings and/or a bentonite hole plug per NYSDEC requirements. The backfilled boreholes were covered with asphalt patch. Purge water generated from this sampling event was discharged to a carbon bucket prior to release on site. Results of this work were submitted under separate cover to the NYSDEC and NYSDOH.

During this sampling event, the only constituent of concern detected on the former Carol Cleaners Site (north of Platinum Avenue) at a concentration above New York Groundwater Quality Standards (GWQS) was Vinyl Chloride. It was identified in MW-3 and MW-8 at concentrations of 3.0 ug/l and 2.2 ug/l, respectively, which is above the GWQS of 2.0 ug/l for this constituent.

The highest concentration of vinyl chloride was identified in MW-19 just south of Platinum Avenue, at a concentration of 16.1 ug/l. MW-19 also exceeded the GWQS of 5.0 ug/l for cis-1,2-Dichloroethene with a result of 27.8 ug/l. There were no additional exceedances of the GWQS for VOCs in samples obtained from existing monitoring wells.

Tetrachloroethene, Trichloroethene and cis-1,2-Dichloroethene were each detected in two of the three temporary wells (TW-9 and TW-1) at concentrations above the GWQS of 5 ug/l for these constituents, with the exception of TCE at TW-9. No chlorinated constituents were detected in temporary well TW-7, which is located closest to the former Corniche Dry Cleaners on the Pergament Mall property.

Table 2.3 PCE, TCE and Cis-1,2-DCE Detects

Well Location	PCE	TCE	Cis-1,2-DCE
TW-1	23.3	7.6	12.7
TW-9	7.5	3.7	13.7

Note: Results provided in ug/l

An additional round of groundwater sampling was conducted at the Carol Cleaners Site during March 2025. Tetra Tech mobilized to the site on March 3, 2025 and collected groundwater samples from seventeen (17) monitoring wells. All samples were submitted to SGS Laboratory (SGS) in Dayton, New Jersey. Samples were obtained from monitoring wells MW-2, MW-3, MW-4, MW-5, MW-6R, MW-7, MW-8, MW-10, MW-16, MW-17, MW-18, MW-19, MW-20, MW-21, MW-22, MW-23, and MW-24. All 17

groundwater samples were analyzed for Volatile Organic Compounds (VOCs) by USEPA Method 8260, TAL Metals (unfiltered), Nitrate/Nitrite, Sulfate, Hardness, Alkalinity, Chemical Oxygen Demand, Biochemical Oxygen Demand, Total Organic Carbon, Methane, Ethane, and Ethene. Monitoring wells MW-3, MW-16, MW-17, MW-19, MW-22 and MW-3 were also sampled for 1,4-Dioxane and PFAS.

Prior to sampling, a synoptic round of depth to groundwater (DTW) measurements were obtained from each of the 17 sample locations.

Sampling was conducted from March 3 to March 7, 2025, using low-flow sampling methodology. Peristaltic pumps were used to purge each location until stable water quality readings were attained over three successive readings.

Results of this work were submitted to the NYSDEC in a draft report dated July 18, 2025. As indicated within that report, Tetrachloroethene (PCE) was identified in monitoring wells MW-3, MW-8, MW-18, MW-19, MW-22 and MW-23 at estimated concentrations of 3.4 µg/l, 1.4 J µg/l, 1.5 µg/l, 1.7 J µg/l, 3.3 J µg/l, and 1.1 µg/l, respectively. These concentrations are below the groundwater quality standard (GWQS) of 5 µg/l for this compound.

Trichloroethylene (TCE) was identified in monitoring well MW-3 at concentrations of 50.9 µg/l, which exceeded the GWQS of 5 µg/l for this compound. Trichloroethylene (TCE) was also detected; but at concentrations below the GWQS, in monitoring wells MW-17, MW-18, MW-19, and MW-23 at concentrations of 1.5 µg/l, 1.4 µg/l, 2.3 µg/l, and 0.54 J µg/l, respectively. Cis-1,2-dichloroethene (Cis-1,2-DCE) was identified in monitoring wells MW-3 and MW-17 at concentrations of 156 µg/l, and 71.9 µg/l, respectively, which exceeded the GWQS of 5 µg/l for this compound. Cis-1,2-DCE was also detected; but at concentrations below the GWQS, in monitoring wells MW-7, MW-16, MW-18, MW-19, MW-22, and MW-23 at concentrations of 2.2 µg/l, 0.80 J µg/l, 2.5 µg/l, 1.4 µg/l, 0.64 J µg/l, and 0.85 J µg/l, respectively. Trans-1,2-Dichloroethene (Trans-1,2-DCE) was detected in monitoring wells MW-3 and MW-17 at concentrations of 1.4 µg/l, and 1.9 µg/l, respectively. These concentrations are below the GWQS of 5 µg/l for this compound. Vinyl chloride (VC) was detected in monitoring wells MW-3 and MW-17 at concentrations of 25.2 µg/l and 24.8 µg/l, respectively, which exceeded the GWQS of 2 µg/L for this compound. VC was also detected; but at concentrations below the GWQS, in monitoring wells MW-7, MW-18 and MW-19 at concentrations of 1.1 µg/l, 1.5 µg/l, and 0.54 J µg/l, respectively.Several Inorganics (the TAL metals aluminum, barium, iron, manganese and sodium) also exceeded their respective GWQS in most wells; however, none of the exceedances are believed to be related to previous dry-cleaning activities. A summary of results for site-related compounds is provided on Figure 7.

1,4 Dioxane was not detected in any of the six (6) monitoring wells that were sampled (MW-2, MW-3, MW-16, MW-17, MW-19, and MW-22).

Perfluorooctanoic acid (PFOA) was detected in all six (6) monitoring wells (MW-2, MW-3, MW-16, MW-17, MW-19 and MW-22) at concentrations of 0.266 µg/l, 0.0287 µg/l, 0.0169 µg/l, 0.0331 µg/l, 0.014 µg/l, and 0.0257 µg/l, respectively, which exceed the GWQS of 0.0067 µg/L for this compound.

Perfluorooctanesulfonic acid (PFOS) was detected in three (3) monitoring wells (MW-2, MW-3 and MW-17) at concentrations of 0.14 µg/l, 0.0087 µg/l, and 0.0043 µg/l, respectively, which exceed the GWQS of 0.0027 µg/L for this compound. PFOS was also detected in the remaining three (3) monitoring wells sampled (MW-16, MW-19, and MW-22) at concentrations below the GWQS for this compound.

2.4 REMEDIAL ACTION OBJECTIVES

The Remedial Action Objectives (RAOs) for the site as listed in the March 28, 2012 Record of Decision are as follows:

Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.

RAOs for Environmental Protection

- Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Remove the source of ground or surface water contamination.

Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

RAOs for Environmental Protection

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

Soil Vapor

RAOs for Public Health Protection

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a site.

2.5 REMAINING CONTAMINATION

2.5.1 Soil

Based on analytical results for eighty-nine soil samples collected on and off-site between 2002 and 2011 near the suspected “source area”, only one exceedance of the NYSDEC SCOs was encountered for PCE and related CVOCs. The results are shown on Figure 5A and Table 3.1. PCE was detected in soil boring B-1-6” during the initial IRM investigation conducted during 2002 by Legette, Brashears & Graham, Inc. and the results of this work were outlined in a July 2003 report (LBG, 2003). The detected exceedance was minor (2.05 mg/kg) and isolated, occurring in only one soil sample (B-1-6') collected at a depth of about 6-feet below ground surface (bgs), just above the local ground-water surface. The boring from which the sample was collected was completed at a location proximal to the suspected “source” area (area of concentrated asphalt breakage near a building rooftop storm water leader) at the rear of the Carol Cleaners (near Monitoring Well MW-3).

In May 2006, eight (8) soil borings (B-26 through B-33) were advanced by S2C2, of Warren, New Jersey, and used to assess the potential for residual CVOCs in the on-site overburden. The results are shown on Figure 5B and Table 3.2.Eleven soil borings (SB-1 through SB-11) were advanced between May and July 2011 (Figure 5C). Soil samples were collected from depths of approximately 1.5 to 18 ft bg. Out of the nineteen samples collected, the results indicated low-level CVOC-impacts in the soil samples collected adjacent to the sampled storm water catch basins (Table 3.3).

In June 2017, eighteen (18) soil borings (SWB-1 through SWB-18) were advanced using a Geoprobe® rig at locations intended to assess the potential for CVOC-impacts to soil from on-site subsurface utility routes, specifically storm water lines, and as such were advanced in the parking areas on the eastern and southern sides of The Crossings Mall building proximal to storm drain catch basins (Figure 5D).

The analytical results for the respective soil samples did not indicate the occurrence of any of the CVOCs of interest at concentrations in exceedance of the respective NYSDEC Restricted Use Commercial SCOs. These results are shown in Table 3.4. Also, no evidence of DNAPL was encountered at any of the boring locations. Based on the results of the soil sampling efforts.

The extent and degree of PCE-impacted soil at the site is minimal, localized, and does not appear to be acting as a continuing source of groundwater impacts. The soil in the corresponding area is effectively capped, as the entire property is covered by asphalt, concrete, and the footprint of the mall building. As such, this SMP assumes the use of this site cover to address the impacted soil is an appropriate Engineering Control (EC) for the Site.

2.5.2 Groundwater

The source of PCE and related CVOC contamination at the site appears to be related to a historic point source discharge event associated with activities at the former Carol Cleaners tenant space. Based on historical distribution of PCE and related breakdown products (TCE, cis-1,2-DCE, and VC) in groundwater, the corresponding plume generally followed the local direction of groundwater flow, which is southwesterly from the site towards Platinum Avenue.

A summary of historical CVOC-impacted groundwater sampling results is provided in Table 2. Figure 6 depicts the extent of the PCE plume in July 2017, which represents pre-injection conditions. More recent post-injection groundwater sampling results show that PCE and TCE have been remediated to below their respective GQSs on site as shown in the most recent groundwater sampling data from the post-injection quarterly sampling rounds conducted between January 2019 and Sept 2021, and in subsequent sampling conducted during 2021 and 2025. Figure 7 shows the extent of the PCE during the most recent round of post-injection monitoring. The remaining CVOC concentrations are associated with daughter break-down constituents, mainly cis-1,2-DCE and vinyl chloride. Figure 8a and 8b shows the most recent CVOC distribution in the monitoring wells that are part of the injection monitoring program. Table 2 summarizes the historical CVOC impacted groundwater concentrations over time. Table 3.2 summarizes the anaerobic bioremediation indicator parameters over time. The data in this table confirm the decrease in PCE and TCE concentrations on site, the increase and subsequent decrease in break-down constituent concentrations at the various monitoring wells that are part of the monitoring program.

Water samples previously collected from the eastern and southern portions of the on-site storm drain catch basin system indicated the presence of PCE and related CVOCs at concentrations above their respective GQSs. In response to the detection of PCE in the standing water samples collected from the stormwater system, and in connection with the Interim Site Management Plan (Interim SMP) activities identified for the Site, stormwater system cleaning activities were initiated in November 2016. The cleaning activities involved the removal of sediment from each of the accessible catch basins associated with the on-site stormwater system. Impacted sediment and standing water was identified and removed from the system. Approximately two to three feet of sediment was encountered at each of the accessed catch basins. Subsequent stormwater system investigation activities included the installation of three monitoring wells along the eastern side of The Crossings building proximal to the most impacted catch basins. These monitoring wells did not exhibit CVOC-impacts in groundwater in this area of the Site.

In-situ lactate injections have been conducted to address impacted groundwater at the site as detailed in the Full-Scale Remedial Design Workplan submitted to the NYSDEC in May 2016 and approved by the NYSDEC on June 29, 2016. The USEPA Underground Injection Control (UIC) Authorization-By-Rule issued in connection with the full-scale treatment effort is included as Appendix J.

The sodium lactate injections have had the desired effect of stimulating accelerated monitored natural attenuation (MNA). Most of the CVOC concentrations observed in the sampling data from the site monitoring well network is either non-detect or below the applicable NYSDEC groundwater standards.

Should additional injection treatments be required to address CVOC exceedances, up to 2,200 gallons of sodium lactate solution may be injected into the selected injection wells identified within Section 2.3 to aid in the continued reductive dichlorination of impacted groundwater. This portion of the site is located in a non-groundwater use area. Accelerating MNA and monitoring groundwater constituent concentrations has been selected as the appropriate remedy to protect human health at this site. The monitoring plan to be conducted is provided in the Monitoring and Sampling Plan located in Section 4.0.

2.5.3 Soil Vapor

CVOC impacted groundwater, proximal to the Carol Cleaners, acted as a source for CVOCs in the soil vapor (the air spaces between particles) in the unsaturated (vadose) zone beneath the building slab. Through pressure differences between the indoor building space and the unsaturated zone, the PCE and related CVOC vapors are able to migrate through preferential pathways such as cracks and holes in the foundation slab into indoor air. The analytical results for indoor air and sub-slab air samples collected at the mall building in 2006 and 2008 indicated that VOCs were present at concentrations above NYSDOH Air Matrix guidance values, indicating the potential need for reducing exposure to PCE and TCE at the breathing level. Historical analytical results for indoor air and sub-slab air samples are provided in Appendix G.

A sub-slab depressurization (SSD) system was installed at the Crossings between March and April 2014. The SSD system became operational in April 2014. Indoor air sampling following start-up of the system indicated that the Carvel tenant space required additional action. As a result, the SSD system was modified in February 2015 to include installation and connection to a new suction point in the Carvel tenant space. Indoor air sampling following installation of the additional suction point indicated compliance with the respective NYSDOH Air Matrix Guidelines.

The SSD system was shut down on May 5, 2022 in preparation for subsequent indoor air and sub-slab vapor sampling, and due to damage suffered during building renovation activities. Indoor air and sub-slab vapor sampling were performed during June 2022, and the results of this work indicated that chlorinated VOCs were detected in several sub-slab and indoor air sampling locations; however, detected compounds were not identified at concentrations above “No Further Action” guidance values within Air Matrices A, B and C. The sample results are shown on Figure 10. The SSD system was repaired on August 18, 2022, and fan inspections conducted since that time indicate the system is operating as intended.

A conference call was held on 11/01/2023 between the NYSDEC, the NYSDOH, Brookfield and Cornerstone to discuss the status of the existing SSDS in light of recent renovations to the former Carol Cleaners building by Hobby Lobby. During this call, the NYSDEC indicated that documentation related to the 2014 system installation and vacuum confirmation testing had never been submitted. The NYSDEC also indicated that a Change of Use Notification form was required based on renovations to the building by the new tenant (Hobby Lobby). Cornerstone located the pertinent information and submitted documentation of system installation and vacuum confirmation testing to the NYSDEC on 11/02/2023. A Change of Use Notification form was subsequently submitted to the NYSDEC by Brookfield on 11/08/2023.

The NYSDEC confirmed that, based on information provided by Cornerstone, the SSDS was installed and tested properly; however, based on the potential for recent building renovations to impact the effectiveness of the SSDS, the Department requested that Brookfield perform vacuum radius of influence testing of the SSDS. In addition, the NYSDOH requested that at least two or three additional rounds of indoor air/sub-slab vapor sampling be performed under the recertified SSDS to confirm the efficacy of the system, and that the two rounds of sampling be performed over two heating seasons rather than one season as previously approved.

SSDS vacuum radius of influence testing was performed on January 15, 2024, and a memo outlining the results of vacuum testing and indoor air/sub-slab vapor sampling was submitted to the Department on February 21, 2024. Results of vacuum radius of influence testing are provided within Table 6.

Cornerstone mobilized to the site and performed indoor air/sub-slab vapor sampling on March 6 and March 7, 2025. Results of indoor air/sub-slab vapor sampling are provided within Table 5, for indoor air samples, the site-related constituents tetrachloroethene (PCE) and methylene chloride (MC) were each identified. Trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-DCE), trans-1,2-dichloroethene (trans-DCE), and vinyl chloride (VC) were not detected in indoor air samples. For sub-slab samples, PCE, TCE, cis-DCE, trans-DCE and MC were each identified within sub-slab vapor samples. VC was not detected in any of the sub slab samples. The sample results are shown on Figure 11.

As recertification of the SSDS occurred after completion of the most recent round of indoor air/sub-slab vapor sampling at least two to three rounds of sampling will be required before a system deactivation request may be submitted. The next round of indoor air/sub-slab vapor sampling is proposed during the 2025/2026 heating season.

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN

3.1 GENERAL

Since remaining contamination exists at the site, Institutional Controls 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 project manager.

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; 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 project manager.

3.2 INSTITUTIONAL CONTROLS

A series of ICs is required by the ROD 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 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 9. These ICs are:

- The Controlled Area (property, specifically a portion thereof) may be used for commercial and 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 this SMP.
- The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the Richmond 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;
- Groundwater and other environmental or public health monitoring must be performed as defined in this SMP.
- Data and information pertinent to site management of the Controlled Area 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.
- Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in 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.
- The potential for vapor intrusion must be evaluated for any buildings developed in the area within the IC boundaries noted on Figure 9, and any potential impacts that are identified must be monitored or mitigated;
- Vegetable gardens and farming on the site are prohibited; and
- An evaluation shall be performed to determine the need for further investigation and remediation should large scale redevelopment occur, if any of the existing structures are demolished, or if the subsurface is otherwise made accessible.
- All existing and any new on-site buildings will be required to have a sub-slab depressurization system, or a similar engineered system, to prevent the migration of vapors into the building from soil and/or groundwater.

3.3 ENGINEERING CONTROLS

3.3.1 Cover

Exposure to remaining contamination at the site is prevented by a cover system placed over the site. This cover system is comprised of existing asphalt-covered roads and parking lot, concrete-covered sidewalks, and concrete building slabs. The thickness of the cover system ranges, generally, from four to six inches asphalt roads and parking lots, and four to eight inches for typical concrete sidewalks and concrete building slabs.

Based on analytical results for soil samples collected on and off-site near the suspected “source area”, only one soil sample exhibited an exceedance of the NYSDEC SCOs for PCE of 1.4 milligram per kilogram (mg/kg) at Soil Boring B-1 with a concentration of 2.05 mg/kg at a depth of approximately 6 feet below grade.

Most of the Site is covered with buildings and asphalt paving. In order to prevent exposure to any residual soil contamination, the EC for this site is the existing buildings and pavement.

Figure 9 presents the location of the cover system and applicable demarcation layers. The Excavation Work Plan (EWP) provided in Appendix H outlines the procedures required to be implemented in the event the cover system is breached, penetrated or temporarily removed. 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 I. Any disturbance of the site’s cover system must be overseen by a qualified environmental professional as defined in 6 NYCRR Part 375, a Professional Engineer (PE) licensed in New York State, or a qualified person who reports directly to a PE licensed in New York State.

3.3.2 Sub-slab Depressurization System

The SSD system was permitted by the New York City Department of Buildings (NYCDOB) on February 19, 2014. The SSD system began operating in April 2014 and was supplemented with the incorporation of a new suction point at the Carvel tenant space in February 2015. Currently, the SSD system uses three suction points in the former Carol Cleaners space, three suction points in the former baby supply retail store (Babies R Us), and one suction point in the ice cream store (Carvel), all of which occupy the southern end of The Crossings building

which parallels Platinum Avenue. The associated blowers (fans) are located on the roof of the building and the vacuum gages are located on the building's southern wall which faces Platinum Avenue. The specifications for these fans as installed and commissioned by the subcontractor to Legette, Brashears & Graham (Obar Systems) are as follows:

- Blower 1 Hobby Lobby (Fantech 225): Rated for 215 CFM @1.27 inches of water column (WC);
- Blower 2 Carol Cleaners (Obar GBR 76UD): Rated for 90 CFM @16 inches WC; and
- Blower 3 Carol Cleaners (Obar GBR 76UD): Rated for 90 CFM @ 16 inches WC.

Procedures for operating and maintaining the SSD system are documented in the Operation and Maintenance Plan (Section 5.0 of this SMP). An as-built drawing of the SSDS prepared by Leggett, Brashears & Graham, Inc.; but reviewed and certified by Cornerstone Engineering and Geology, PLLC is included in Appendix D. As part of this certification, Cornerstone conducted a vacuum test during January 2024 to confirm that the radius of influence associated with the SSDS suction points remained consistent with the initial installation. A summary of the results of this testing is provided within Table 6.

Figure 9 shows the location of the ECs for the site. The SSDS will remain in-place and operational until permission to discontinue its use is granted in writing by the NYSDEC project manager in consultation with the NYSDOH project manager.

3.3.3 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. Unless waived by the NYSDEC, confirmation samples of applicable environmental media are required before terminating any remedial actions at the site. Confirmation samples require Category B deliverables and a Data Usability Summary Report (DUSR).

As discussed below, the NYSDEC in consultation with NYSDOH may approve termination of a groundwater monitoring program. When a remedial party receives this approval, the remedial party will decommission all site-related monitoring, injection and recovery wells per NYSDEC CP-43 policy.

The remedial party will also conduct any needed site restoration activities, such as asphalt patching and decommissioning treatment system equipment. In addition, the remedial party will conduct any necessary restoration of vegetation coverage, trees and wetlands, and will comply with NYSDEC and United States Army Corps of Engineers regulations and guidance. Also, the remedial party will ensure that no ongoing erosion is occurring on the site.

3.3.3.1 Cover (or Cap)

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

Exposure to any residual contaminated soil is prevented by engineered composite cover system. This composite cover system is comprised of existing asphalt-covered roads and parking lots, concrete-covered sidewalks, and concrete buildings slabs.

As stated in the January 2016 Final Engineering Report, the cover system is comprised of a minimum of 12 inches of clean soil or 4 inches of asphalt pavement, concrete-covered sidewalks, and concrete buildings slabs.

3.3.3.2 Sub-Slab Depressurization (SSD) System

The active SSD system will not be discontinued unless prior written approval is granted by the NYSDEC and NYSDOH.

Based on the lack of CVOC-impacted soil and the observed decrease in CVOC concentrations in groundwater proximal to the on-site buildings as a result of the recent groundwater bioremediation activities, testing of the sub-slab vapor and indoor air located in the premises that have the active SSD system in use will be conducted to determine the need for on-going operation of the SSD system. This includes shutting down the system for a period of 30 days subsequent to authorization from the NYSDEC and then conducting the testing by having sub-slab and indoor air samples collected from the Carvel, former Carol Cleaners, and former Babies R Us tenant spaces. Two to three additional heating season sampling events will be conducted under the recertified SSDS prior to submitting a system deactivation/decommissioning proposal to NYSDEC/NYSDOH for review.

If monitoring data indicate that the SSDS may no longer be required, a proposal to discontinue the SSDS will be submitted by the remedial party to the NYSDEC and NYSDOH.

3.3.3.3 Monitoring Wells associated with Bioremediation & MNA

Groundwater monitoring activities to assess the success of bioremediation activities will continue, as determined by the NYSDEC project manager in consultation with the NYSDOH project manager, until residual groundwater concentrations are found to be consistently below GQSs, the site SCGs, or have become asymptotic at an acceptable level over an extended period. In the event that monitoring data indicate that monitoring for natural attenuation may no longer be required (i.e., two consecutive annual sampling rounds that exhibit groundwater sample results at or below the respective NYS TOGs for the CVOCs of concern – PCE, TCE, cis-1,2-DCE and VC), a proposal to discontinue the monitoring will be submitted by the remedial party. Monitoring will continue until permission to discontinue is granted in writing by the NYSDEC. If groundwater contaminant levels become asymptotic at a level that is not acceptable to the NYSDEC, additional injections, source removal, treatment and/or control measures will be evaluated.

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 project manager in consultation with NYSDOH. 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 K

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

- Sampling and analysis of all appropriate media (e.g., groundwater, indoor air, soil vapor, soils);
- Assessing compliance with applicable NYSDEC standards, criteria and guidance (SCGs), particularly groundwater standards and Part 375 SCOs for soil; 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. These periodic inspections must be conducted when the ground surface is visible (i.e. no snow cover). Site-wide inspections will be performed by a qualified environmental professional as defined in 6 NYCRR Part 375, a PE who is licensed in New York State, or a qualified person who reports directly to a PE licensed in New York State. 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 L – 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;
- Whether stormwater management systems, such as basins and outfalls, are working as designed;

- 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.

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 project manager 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 defined in 6 NYCCR Part 375. Written confirmation must be provided to the NYSDEC project manager 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. The remedial party will submit follow-up status reports to the NYSDEC within 45 days of the event on actions taken to respond to any emergency event requiring ongoing responsive action, describing and documenting actions taken to restore the effectiveness of the ECs.

4.3 TREATMENT SYSTEM MONITORING AND SAMPLING

4.3.1 Remedial System Monitoring

Monitoring of the SSD system gages will be performed on a weekly basis with annual inspections of the fans and piping on an annual basis, as identified in the table below. The monitoring of remedial systems must be conducted by a qualified environmental professional as defined in 6 NYCRR Part 375, a PE who is licensed in New York State, or a qualified person who reports directly to a PE licensed in New York State. Modification to the frequency or sampling requirements will require approval from the NYSDEC in consultation with NYSDOH's approval. A visual inspection of the complete system will be conducted during each annual inspection. Unscheduled inspections and/or sampling may take place when a suspected failure of the SSD system has been reported or an emergency occurs that is deemed likely to affect the operation of the system. SSD system components to be monitored include, but are not limited to, the components included in the table below.

Table 4.1 Remedial System Monitoring Requirements and Schedule

Remedial System Component	Monitoring Parameter	Operating Range	Monitoring Schedule
Vacuum Blowers: Fantech 225 CCGB76 BRUGBR76	Vacuum	 2" to 3" WC 15" to 22" WC 14" to 21" WC	Weekly
Vacuum Monitoring Points (VT-1 through VT-8)	Vacuum Pressure	-0.041" WC to -2.274" WC based on prior sampling	Annually
Exhaust Points	Motor Operation and Air Flow	Visually Assessed	Weekly
General System Piping	Functionality, Integrity & Labeling	Visually Assessed	Weekly
Building Slab	Integrity Test	Visually Assessed	Annually

A complete list of components to be inspected is provided in the Inspection Checklist, provided in Appendix L–- Site Management Forms. If any equipment readings are not within their specified operation range, any equipment is observed to be malfunctioning or the system is not performing within specifications; maintenance and repair, as per the Operation and Maintenance Plan, is required immediately.

4.3.2 Remedial System Sampling

The required sampling for the operation of the SSD system has been completed. Future sampling will be conducted to determine the efficacy of keeping the system in operation since the groundwater treatment in the vicinity of the on-Site buildings is considered complete. As per Section 3.3.5.2 above, this includes shutting down the system for a period of 30 days and then conducting the testing by having one sub-slab and one indoor air sample collected from the Carvel, Mon Amie Nails, former Carol Cleaners, and Hobby Lobby tenant spaces. Table 5 shows the summary of Indoor Air and Sub-Slab Vapor Sampling Results for Site-Related Compounds collected in March 2025. At least two to three additional sampling events may be performed if required by the NYSDEC and NYSDOH.

The samples will be analyzed for volatile organics via USEPA Method TO-15. Detailed sample collection and analytical procedures and protocols are provided in Appendix K – Quality Assurance Project Plan.

4.4 POST-REMEDIATION MEDIA MONITORING AND SAMPLING

Samples will be collected from select monitoring wells on a routine basis. Sampling locations, required analytical parameters and monitoring schedule are provided in the Remedial System Sampling Requirements and Schedule below. Modification to the frequency or sampling requirements will require approval from the NYSDEC in consultation with NYSDOH.

Table 4.2 Post Remediation Sampling Requirements and Schedule

Sampling Location	Analytical Parameters	Schedule
MW-2, MW-3, MW-3D, MW-5, MW-8, MW-16, MW-17, MW-18, MW-19, MW-20, MW-21, MW-22, and MW-24	VOCs (EPA Method 8260)	Annually
MW-2, MW-3, MW-16, MW-17, MW-19, and MW-22	1,4 Dioxane using MS Volatiles (SW846 8260D BY SIM), PFAS using EPA method 1633	Annually

The groundwater sampling will be conducted utilizing USEPA low-flow sampling techniques. Groundwater samples will be collected using dedicated tubing and placed into laboratory-supplied bottles. The collected samples will be submitted to a New York-certified laboratory for analyses of VOCs via USEPA Method 8260 and several bioremediation-related indicator parameters.

As part of the groundwater sampling task, Tetra Tech will collect water-level measurements at each monitoring well utilizing an electric water-level probe, with measurements taken from the water surface to the top of the well casing or survey point. The corresponding elevation of the groundwater surface at each monitoring location will be recorded to determine groundwater flow direction in the overburden aquifer.

4.4.1 Groundwater Sampling

Commencing in 2023, groundwater monitoring has been performed annually to assess the performance of the remedy. Modification to the frequency or sampling requirements will require approval from the NYSDEC in consultation with NYSDOH.

The network of monitoring wells has been installed to monitor upgradient, on-site and downgradient groundwater conditions at the site. The network of on-site and off-site wells has been designed based on the following criteria:

The monitoring well network includes four sentinel wells that monitor downgradient plume migration. Sentinel wells are uncontaminated wells located directly downgradient of the plume and upgradient of sensitive receptors. The monitoring well network for this site includes the following sentinel wells: MW-16, MW-17, MW-18, and MW-19.

The table below summarizes the wells' identification number, as well as the purpose, location, depths, diameter and screened intervals of the wells. As part of the groundwater monitoring, one upgradient well, one source well, two downgradient, five side gradient and four sentinel wells are sampled to evaluate the effectiveness of the remedial system. The remedial party will measure depth to the water table for each monitoring well in the network before sampling.

Table 4.3 Monitoring Well Construction Details

Monitoring Well ID	Well Location	Coordinates (longitude/ latitude)	Well Diameter (inches)	Elevation (feet above mean sea level)			
				Casing	Surface	Screen Top	Screen Bottom
MW-2	upgradient	40.577867° N, 74.164678° W	4	37.74	37.97	30.74	25.74
MW-3	source	40.577411° N, 74.165089° W	4	32.12	32.59	22.32	17.32
MW-3D	downgradient	40.577372° N, 74.165017° W	4	32.46	32.85	-3.04	-11.04
MW-5	downgradient	40.577383° N, 74.165267° W	4	31.60	31.98	22.6	17.6
MW-8	side gradient	40.577531° N, 74.165433° W	4	31.31	31.86	21.31	16.31
MW-16	sentinel	40.577689° N, 74.166308° W	2	29.46	29.72	6.46	1.46
MW-17	sentinel	40.577442° N, 74.165850° W	2	30.05	30.47	9.05	4.05
MW-18	sentinel	40.577292° N, 74.165561° W	2	30.67	31.05	15.17	10.17
MW-19	sentinel	40.577147° N, 74.165294° W	2	31.82	32.37	16.32	11.32
MW-20	side gradient	40.577929° N, 74.166122° W	4	29.53	29.79	9.03	4.03
MW-21	side gradient	40.577764° N, 74.165778° W	4	30.19	30.48	18.19	13.19
MW-22	side gradient	40.577776° N, 74.165564° W	4	31.31	31.65	21.81	16.81
MW-24	side gradient	40.577139° N, 74.164758° W	4	33.28	33.90	25.28	20.28

Monitoring well locations are shown on Figure 2. A cross-section is provided as Figure 3. Groundwater flow is generally to the southwest as shown on Figure 4. 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 project manager 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 project manager in consultation with NYSDOH. 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 project manager.

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

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

4.4.2 Monitoring and Sampling Protocol

All sampling activities will be recorded in a field book and associated sampling log as provided in Appendix L- Site Management Forms. Other observations (e.g., groundwater monitoring well integrity) will be noted on the sampling log. The sampling log will serve as the inspection form for the monitoring network. Additional detail regarding monitoring and sampling protocols are provided in the site-specific Field Activities Plan provided as Appendix M of this document.

5.0 OPERATION AND MAINTENANCE PLAN

5.1 GENERAL

This Operation and Maintenance Plan provides a brief description of the measures necessary to operate, monitor and maintain the mechanical components of the remedy selected for the site. This Operation and Maintenance Plan:

- Includes the procedures necessary to allow individuals unfamiliar with the site to operate and maintain the SSD systems.
- Will be updated periodically to reflect changes in site conditions or the way the SSD system is operated and maintained.

Instructions on system startup and operation were not included within this document due to the simplicity of the system. The system operates only in on/off mode with activation at the fan panels and always runs at 100% capacity. There are no system alarms or visual indicators of system operation within the building. When operating, vacuum gauges associated with each of the three fans are checked on a weekly basis and the results recorded in a checklist. Any irregularities are addressed by contacting a subcontractor for repairs.

5.2 REMEDIAL SYSTEM (OR OTHER ENGINEERING CONTROL) PERFORMANCE CRITERIA

The minimum operating requirements for the SSD system blowers are provided in Section 4.3.1.

5.3 OPERATION AND MAINTENANCE OF THE SUB-SLAB DEPRESSURIZATION SYSTEM

5.3.1 System Start-Up and Testing

The SSD system is currently in operation. Should the system need to be restarted following a planned shutdown (e.g., repair, replacement of a blower, etc.) or unplanned system shutdown, subsequent re-startup system readings will be collected. If system readings differ from the pre-shutdown or design operating conditions, test point readings will be collected across the vapor mitigation focus area to ensure the new operating conditions provide sufficient vapor mitigation with a minimum of 0.004 inches of vacuum exerted across the focus area.

The following table provides a summary of the vacuum readings collected during recertification of the SSDS in January 2024:

Table 5.1 Summary of the vacuum readings

Test Point	Vacuum Reading (inches w.c.)
VT-1 (Hobby Lobby)	-0.032
VT-2 (Hobby Lobby)	-0.102
VT-3 (Hobby Lobby)	-0.651
VT-4 (Hobby Lobby)	-0.158
VT-5 (Hobby Lobby)	-0.085
VT-6 (Carol Cleaners)	-2.275
VT-7 (Carol Cleaners)	-0.040
VT-8 (Carvel)	-0.041

The system testing described above will be conducted if, in the course of the SSD system lifetime, the system goes down or significant changes are made to the system and the system must be restarted.

5.3.2 Routine System Operation and Maintenance

As described previously, the SSD system fans are designed to operate continuously. Brookfield performs an inspection of visible components of the SSDS each week and records the vacuum levels induced by each of the three blowers. In the event of a shutdown, or if a significant deviation from specified performance is observed the startup procedures described in Section 5.3.1 will be followed. Any damage to system components will be repaired by Brookfield or their subcontractor to assure ongoing system operation. In addition, the SSDS will be inspected on an annual basis by a qualified environmental professional as part of the certification of engineering controls at the site.

5.3.3 Non-Routine Operation and Maintenance

Should the SSD system need to be shut down or shut down suddenly, non-routine O&M including fan replacement may be necessary. If shutdown, the SSD system will require system restarting as per Section 5.3.1.

5.3.4 System Monitoring Devices and Alarms

Due to electrical issues within the mall building, the SSD system does not have an audible or visual fault alarm. Vacuum readings are collected from exterior magnahelic gages on a weekly basis by Brookfield security personnel and provided to Tetra Tech to ascertain whether the SSD system is operating properly.

In the event that the SSD system is not functioning properly, the SSD system will be inspected, and applicable maintenance and repairs will be conducted, as specified in the Operation and Maintenance Plan, and the SSD system will be restarted. Operational problems will be noted in the Periodic Review Report to be prepared for that reporting period.

5.3.5 Fire Safety

The remedial party will conduct an annual facility walk with the local fire chief and/or fire suppression team. The site walk will allow for the addition of the facility to any local preplanning efforts. The NYSDEC project manager will be provided with the local fire chief's/fire suppression team's recommendations as soon as they become

available. Following review, the NYSDEC project manager may direct the remedial party to implement the recommendations and/or revise the 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.

A Vulnerability Assessment is not warranted for the site. Though the site is not located in a floodplain, it does border a Zone 5 flood zone which is proximal to Platinum Avenue. The site is almost entirely paved and/or covered by buildings so the potential for erosion is very low. The SSD system fans are located on the building roof and are anchored to protect them from high winds. In addition, they are adequately elevated to protect them from falling objects such as trees and utility lines as these items are located below the roof level. In the event of a loss of power, the fans will turn off and automatically restart once power returns. In the event they do not restart, the startup procedures described in Section 5.3.1 will be followed. There are no SSD system components that contain liquids so there is no threat of a spill in the event of impact during a storm.

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).

Waste generation (soil) is only anticipated to occur in connection with any future construction of monitoring/injection wells and cleanout of the storm sewer catch basins. The amount of soil will be limited in quantity, drummed, and disposed off-site as non-hazardous waste.

In-situ bioremediation for groundwater remediation has been conducted at the site. This technology does not produce waste or use energy. Water is required for mixing of the injectant and is brought on-site only in the quantities needed for mixing. A small amount of electricity is required to run the injectant mixer unit, which is provided by portable generators. The discussed inspections at the site will be scheduled to coincide with sampling events to reduce travel to and from the site. Water used for equipment decontamination is purchased in small volumes and does not include potable water.

The SSD system operates 24-hours per day with limited electrical consumption. The SSD system does not produce waste, and the produced emissions do not contribute to the formation of greenhouse gases. The system is monitored by on-site staff as part of routine security operations limiting travel to and from the site.

No land or ecosystems have been disturbed as part of the full-scale remedial effort. As such, no land restoration activities are anticipated to be necessary.

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 NYSDEC project

manager feels appropriate (e.g., during significant maintenance events or in conjunction with storm recovery activities).

Modifications resulting from green remediation evaluations will be routinely implemented and scheduled to occur during planned/routine operation and maintenance activities. Reporting of these modifications will be presented in the PRR.

6.2.2 Remedial Systems

Remedial systems will be operated properly considering the current site conditions to conserve materials and resources to the greatest extent possible. Consideration will be given to operating rates and use of reagents and consumables. Spent materials will be sent for recycling, as appropriate.

6.2.3 Building Operations

There are no structures associated with the remedial activity at the Site.

6.2.4 Frequency of System Checks, Sampling and Other Periodic Activities

Transportation to and from the site, use of consumables in relation to visiting the site in order to conduct system checks and/or collect samples, and shipping samples to a laboratory for analyses have direct and/or inherent energy costs. The schedule and/or means of these periodic activities have been prepared so that these tasks can be accomplished in a manner that does not impact remedy protectiveness but reduces expenditure of energy or resources.

6.2.5 Metrics and Reporting

As discussed in Section 7.0 and as shown in Appendix L – Site Management Forms, information on energy usage, solid waste generation, transportation and shipping, water usage and/or land use and ecosystems will be recorded, as appropriate, to facilitate and document consistent implementation of green remediation during site management and to identify corresponding benefits. A set of metrics will be developed and evaluated over time to ensure that green remediation actions are achieving the desired results.

6.3 REMEDIAL SYSTEM OPTIMIZATION

A Remedial Site Optimization study will be conducted any time that the NYSDEC project manager or the remedial party requests in writing that an in-depth evaluation of the remedy is needed. Responsibilities of Owner and Remedial Party are shown in Appendix N. An RSO may be appropriate if any of the following occur:

- The remedial actions have not met or are not expected to meet RAOs in the time frame estimated in the Decision Document.
- The management and operation of the remedial system is exceeding the estimated costs.
- The remedial system is not performing as expected or as designed.
- Previously unidentified source material may be suspected.
- Plume shift has potentially occurred.
- Site conditions change due to development, change of use, change in groundwater use, etc.
- There is an anticipated transfer of the site management to another remedial party or agency; and
- A new and applicable remedial technology becomes available.

An RSO will provide a critique of a site's conceptual model, give a summary of past performance, document current cleanup practices, summarize progress made toward the site's cleanup goals, gather additional performance or media specific data and information, and provide recommendations for improvements to enhance the ability of the present system to reach RAOs or to provide a basis for changing the remedial strategy.

The RSO will focus on overall site cleanup strategy, process optimization and management with the intent of identifying impediments to cleanup and improvements to site operations to increase efficiency, cost effectiveness and remedial time frames. Green remediation technology and principals are to be considered when performing the RSO.

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 L. These forms are subject to NYSDEC revision. All site management inspection, maintenance, and monitoring events will be conducted by a qualified environmental professional as defined in 6 NYCRR Part 375, a PE who is licensed in New York State, or a qualified person who reports directly to a PE licensed in New York State.

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 presented in the table below and summarized in the Periodic Review Report.

Table 7.1 Schedule of Interim Monitoring/Inspection Reports

Task/Report	Reporting Frequency*
Inspection Report – Covers assessment of engineering controls, including cover system, SSDS vacuum blowers, SSDS exhaust points, SSDS piping and building slab integrity.	Annually, or as otherwise determined by the NYSDEC
Periodic Review Report	Annually, or as otherwise determined by the NYSDEC
Post-Remediation Groundwater Monitoring and Sampling	Annually, or as otherwise determined by the NYSDEC

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

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).
- Copies of all field forms completed (e.g., well sampling logs, chain-of-custody documentation).
- 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 will be submitted to the NYSDEC project manager beginning sixteen (16) months after the Certificate of Completion is issued. After submittal of the initial Periodic Review Report, the next PRR will be submitted annually to the NYSDEC project manager or at another frequency as may be required by the NYSDEC project manager. 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, fire 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.
- Identification of any wastes generated during the reporting period, along with waste characterization data, manifests, and disposal documentation.
- 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 tables and figures will include a presentation of past data as part of an evaluation of contaminant concentration trends, including but not limited to:
    - Trend monitoring graphs that present groundwater contaminant levels from before the start of the remedy implementation to the most current sampling data.
    - Trend monitoring graphs depicting system influent analytical data on a per event and cumulative basis.
    - O&M data summary tables.
    - A current plume map for sites with remaining groundwater contamination; and
    - A groundwater elevation contour map for each gauging event.
- Results of all analyses, copies of all laboratory data sheet, 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.
- A site evaluation, which includes the following:
    - The compliance of the remedy with the requirements of the site-specific Remedial Action Work Plan (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.
    - An evaluation of trends in contaminant levels in the affected media to determine if the remedy continues to be effective in achieving remedial goals as specified by the RAWP, ROD or Decision Document; and
    - 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 as defined in 6 NYCRR Part 375 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 and DER Green Remediation (DER-31):

“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 generally accepted engineering practices; 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, Erich Zimmerman, of Cornerstone Engineering and Geology, PLLC, am certifying as Owner's/Remedial Party's Designated Site Representative."

I certify that the New York State Education Department has granted a Certificate of Authorization to provide Professional Engineering services to the firm that prepared this Periodic Review Report.

The major green remediation components are as follows:

- Considering the environmental impacts of treatment technologies and remedy stewardship over the long-term;
- Reducing direct and indirect greenhouse gases and other emissions;
- Increasing energy efficiency and minimizing use of non-renewable energy;
- Conserving and efficiently managing resources and materials;
- Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste; and
- Additionally, to incorporate green remediation principles and techniques to the extent feasible in the future development at this site, any future on-site buildings shall be constructed, at a minimum, to meet the 2020 Energy Conservation Construction Code of New York (or most recent edition) to improve energy efficiency as an element of construction.

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

The Periodic Review Report will be submitted, in electronic format, to the NYSDEC project manager and the NYSDOH project manager. The Periodic Review Report may also need to be submitted in hard-copy format if 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 or failure to conduct site management activities, a Corrective Measures Work Plan will be submitted to the NYSDEC project manager for approval in consultation with NYSDOH. 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 project manager.

7.4 REMEDIAL SYSTEM OPTIMIZATION REPORT

If an RSO is to be performed (see Section 6.3), upon completion of an RSO, an RSO report must be submitted to the NYSDEC project manager for approval in consultation with NYSDOH. A general outline for the RSO report is provided in Appendix O. 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 in consultation with NYSDOH. 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 project manager and the NYSDOH project manager.

8.0 REFERENCES

6 NYCRR Part 375, Environmental Remediation Programs. December 14, 2006.

NYSDEC DER-10 – “Technical Guidance for Site Investigation and Remediation”.

NYSDEC, 1998. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1. June 1998 (April 2000 addendum).

Legette, Brashears & Graham, Inc., 2003. Remedial Investigation Report, Summary of Tasks 1 Through 6 of the IRM Work Plan, Carol Cleaners Site, Staten Island Mall-Convenience Center, Staten Island, New York, NYSDEC IHWDS Site #2-43-020. July 2003.

TABLES

TABLE 2

CAROL CLEANERS -THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Historical Groundwater Sampling Results for Select CVOCs

Well ID	Sample Date	Concentration (ug/L)[3] Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
MW-3						
	7/31/1995	**25**	**3.7**	**6.9**	ND	ND
	11/20/2002	**2,030**	**323**	**205**	ND	**4.8**
	7/31/2003	**7,290**	**1,370**	**645**	ND	ND
	10/16/2003	**5,090**	**934**	**707**	**5.4**	**10.8**
	1/20/2004	**2,770**	**433**	**352**	**11.4**	ND
	4/26/2004	**5,170**	**540**	**368**	ND	ND
	7/21/2004	**8,340**	**1,550**	**1,040**	**8.5**	**22.1**
	4/7/2008	**442**	**112**	**110**	0.8 J	**3.9**
	9/29/2009	**993**	**191**	**210**	1.8	**3.2**
	8/3/2011	**694**	**146**	**115**	1	**3.2**
	1/30/2013	**478**	**110**	**85**	0.69 J	0.96 J
	5/20/2014	**459**	**96.1**	**66.2**	0.73 J	ND
	11/18/2014	**396**	**80.9**	**44.6**	ND	ND
	1/20/2015	**1,000**	**714**	**1,030**	ND	**22.8**
	4/7/2015	**9.8 J**	2.7 J	**2,840**	**7.7 J**	**307**
	6/30/2015	**15.3**	2.9	**161**	2.8	**189**
	10/7/2015	**16.2**	**5.1**	**9.6**	ND	**7**
	10/5/2016	**26.2**	3.4	**16.8**	0.69 J	**6.8**
	7/19/2017	**89**	**91.4**	**132**	1.7	**24.9**
	1/10/2019	ND	ND	ND	ND	ND
	4/18/2019	ND	1.5 J	**5.6**	ND	ND
	7/18/2019	ND	ND	ND	ND	ND
	10/25/2019	ND	ND	ND	ND	ND
	1/29/2020	ND	ND	ND	ND	ND
	4/21/2020	4.1	1.7	1.4	ND	ND
	7/7/2020	ND	ND	1.3 J	ND	ND
	10/20/2020	ND	ND	2.1	ND	ND
	3/18/2021	ND	1.5	3.6	ND	ND
	5/27/2021	ND	0.58	4.6	4.3	**5.2**
	9/29/2021	1	ND	0.55	ND	ND
	7/26/2022	ND	ND	3	ND	**3.1**
	12/6/2023	ND	ND	**66.3**	ND	**59.4**
	3/4/2025	3.4	**50.9**	**156**	1.4	**25.2**
MW-3D						
	4/7/2008	2.7	ND	0.95 J	ND	ND
	9/29/2009	1	0.4 J	4.1	ND	ND
	8/3/2011	1.7	0.51 J	3.6	ND	ND
	2/1/2013	3.4	0.49 J	2.8	ND	ND
	5/20/2014	**6.2**	0.8 J	2.4	ND	ND
	1/20/2015	**5**	0.68 J	1.7	ND	ND
	4/7/2015	4.8	1	2	ND	ND
	6/30/2015	**5.7**	0.95 J	2.4	ND	ND
	10/7/2015	3.9	1.1	2.2	ND	ND
	10/5/2016	**7.2**	0.57 J	2	ND	ND
	7/19/2017	1.5	0.77 J	ND	ND	ND
	1/10/2019	**5.4**	0.60 J	0.78 J	ND	ND
	4/18/2019	3.4	ND	0.65 J	ND	ND
	7/18/2019	2.9	ND	0.77 J	ND	ND
	10/25/2019	**6.3**	ND	0.75 J	ND	ND
	1/29/2020	3.7	ND	ND	ND	ND
	4/21/2020	2.9	ND	ND	ND	ND
	7/7/2020	4.6	ND	0.52 J	ND	ND
	10/20/2020	3.3	ND	ND	ND	ND
	3/18/2021	3	ND	ND	ND	ND
	5/27/2021	2.8	ND	ND	ND	ND
	7/26/2022	2.2	ND	ND	ND	ND
NYSDEC Groundwater Standards		**5**	**5**	**5**	**5**	**2**

Notes:

[1] Feet below top of casing.

[2] Feet above mean sea level.

[3] All concentrations are presented in units of micrograms per liter. Bold values indicate the concentrations exceed the respective NYSDEC Groundwater Standards.

[4] ND - Compound not detected at laboratory detection limits.

[5] J - Estimated value.

[6] NS - Not Sampled. Wells damaged by street paving and properly abandoned.

TABLE 2

CAROL CLEANERS -THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Historical Groundwater Sampling Results for Select CVOCs

Well ID	Sample Date	Concentration (ug/L)[3] Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
MW-4						
	7/31/1995	ND	ND	2.9	ND	ND
	9/14/1995	0.56	ND	2.4	ND	ND
	11/20/2002	**137**	**105**	**747**	**10**	**73.6**
	7/31/2003	**41.2**	**43.7**	**394**	**5.5**	**49.5**
	10/16/2003	**83.1**	**69**	**299**	4.7	**30.1**
	1/20/2004	**74.6**	**77.3**	**182**	3.9	**23.8**
	4/26/2004	**52.8**	**60.3**	**121**	2.5	**21.3**
	7/21/2004	**33.1**	**36.8**	**78.9**	2.3	**10.7**
	4/7/2008	**8,810**	**2,490**	**2,200**	**18.2 J**	**67.7**
	9/29/2009	**3,850**	**828**	**543**	**14.9**	**7.4 J**
	8/3/2011	**2,490**	**694**	**696**	**7.9**	**10.2**
	1/30/2013	**886**	**415**	**928**	**9.2**	**2.7**
	5/20/2014	**898**	**378**	**3,180**	**20.3**	**160**
	11/18/2014	**444**	**141**	**634**	**12.1**	ND
	1/20/2015	**70.3**	**12**	**2,320**	**12.1**	**132**
	4/7/2015	**28.5**	**6.4 J**	**2,580**	**14.3**	**209**
	6/30/2015	**20.8**	**8.4**	**1,090**	**13.7**	**293**
	10/7/2015	**39.7**	**40.5**	**153**	**6.7**	**136**
	10/5/2016	**22.9**	**24**	**55.1**	2.5	**26.6**
	7/18/2017	1.4	2.8	**23.7**	4.7	**16.7**
	1/8/2019	ND	ND	ND	ND	ND
	4/18/2019	ND	ND	**20.6**	ND	ND
	7/18/2019	ND	ND	ND	ND	ND
	10/29/2019	ND	ND	ND	ND	ND
	1/28/2020	ND	ND	ND	ND	ND
	4/21/2020	ND	ND	**6.0 J**	ND	ND
	7/7/2020	ND	ND	**8.5 J**	ND	ND
	10/23/2020	ND	ND	1.5 J	ND	ND
	3/19/2021	ND	ND	ND	ND	ND
	5/27/2021	ND	ND	ND	ND	ND
	9/29/2021	ND	ND	ND	ND	ND
	12/6/2023	ND	ND	ND	ND	ND
	3/7/2025	< 2.2	< 2.1	< 2.0	< 2.1	< 2.1
MW-5						
	7/31/1995	**71**	**24**	**82**	ND	ND
	9/14/1995	**660**	**500**	**2,300**	**21**	ND
	11/20/2002	**32.9**	**11.7**	3	ND	ND
	7/31/2003	**38.6**	**9.3**	2	ND	ND
	10/16/2003	**32.7**	**8.1**	4.6	ND	ND
	1/20/2004	**35.5**	**10.1**	**5.4**	ND	ND
	4/26/2004	**41.4**	**13.5**	**13.5**	ND	ND
	7/21/2004	**50.2**	**20.3**	**20**	ND	ND
	4/7/2008	**57.1**	**9.9**	4.1	ND	ND
	9/29/2009	**72.4**	**7.2**	3.9	ND	ND
	8/3/2011	**43.3**	2.4	0.42 J	ND	ND
	1/30/2013	**41.1**	2.2	1.6	ND	ND
	5/20/2014	**6.7**	2.3	0.96 J	ND	ND
	11/18/2014	**12.3**	2.8	1.5	ND	ND
	1/20/2015	0.65 J	0.52 J	**13.2**	ND	0.22 J
	4/9/2015	**5.2**	3	3.7	ND	ND
	6/30/2015	0.55 J	**7.4**	**9.3**	ND	0.29 J
	10/7/2015	0.68 J	4.5	**13.5**	ND	1.5
	10/6/2016	1.1	1.7	3.8	ND	**2.3**
	7/19/2017	4.2	**5.2**	4.8	ND	ND
	1/9/2019	4.3	2.2	2.1	ND	ND
	4/18/2019	ND	ND	**5.5**	ND	ND
	7/18/2019	ND	ND	**6.5**	ND	0.62 J
	10/29/2019	ND	3.1	**6.6**	ND	0.84 J
	1/28/2020	ND	ND	2.3	ND	ND
	4/21/2020	ND	ND	1.3	ND	ND
	7/7/2020	ND	0.97 J	**6.5**	ND	ND
	10/23/2020	ND	ND	ND	ND	ND
	3/19/2021	ND	ND	ND	ND	ND
	5/27/2021	ND	ND	0.63	ND	ND
	9/29/2021	ND	ND	2.7	ND	ND
	7/27/2022	ND	ND	1.3	ND	ND
	12/5/2023	ND	ND	1.2	ND	ND
	3/5/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52
NYSDEC Groundwater Standards		**5**	**5**	**5**	**5**	**2**

Notes:

[1] Feet below top of casing.

[2] Feet above mean sea level.

[3] All concentrations are presented in units of micrograms per liter. Bold values indicate the concentrations exceed the respective NYSDEC Groundwater Standards.

[4] ND - Compound not detected at laboratory detection limits.

[5] J - Estimated value.

[6] NS - Not Sampled. Wells damaged by street paving and properly abandoned.

TABLE 2

CAROL CLEANERS -THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Historical Groundwater Sampling Results for Select CVOCs

Well ID	Sample Date	Concentration (ug/L)[3] Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
MW-6R						
	7/31/1995	1.1	ND	ND	ND	ND
	9/14/1995	ND	ND	ND	ND	ND
	11/20/2002	ND	ND	ND	ND	ND
	7/31/2003	ND	ND	ND	ND	ND
	10/16/2003	ND	ND	ND	ND	ND
	1/20/2004	ND	ND	ND	ND	ND
	4/26/2004	ND	ND	ND	ND	ND
	7/21/2004	ND	ND	ND	ND	ND
	4/7/2008	1	ND	ND	ND	ND
	9/29/2009	ND	ND	ND	ND	ND
	8/2/2011	ND	ND	ND	ND	ND
	2/1/2013	ND	ND	ND	ND	ND
	5/19/2014	ND	ND	ND	ND	ND
	10/7/2015	ND	ND	ND	ND	ND
	10/5/2016	ND	ND	ND	ND	ND
	7/17/2017	ND	ND	ND	ND	ND
	1/9/2019	ND	ND	ND	ND	ND
	4/19/2019	ND	ND	ND	ND	ND
	7/18/2019	ND	ND	ND	ND	ND
	10/25/2019	ND	ND	ND	ND	ND
	1/29/2020	ND	ND	ND	ND	ND
	4/22/2020	ND	ND	ND	ND	ND
	7/8/2020	ND	ND	ND	ND	ND
	10/21/2020	ND	ND	ND	ND	ND
	3/18/2021	ND	ND	ND	ND	ND
	5/24/2021	ND	ND	ND	ND	ND
	9/29/2021	ND	ND	ND	ND	ND
	12/6/2023	ND	ND	ND	ND	ND
	3/5/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52
MW-7						
	11/20/2002	**5.4**	0.61	ND	ND	ND
	7/31/2003	2.7	ND	ND	ND	ND
	10/16/2003	4.9	ND	ND	ND	ND
	1/20/2004	**6.8**	0.67	ND	ND	ND
	4/26/2004	**5.9**	0.53	ND	ND	ND
	7/21/2004	**7.3**	0.81	ND	ND	ND
	4/7/2008	**10.3**	0.96 J	0.59 J	ND	ND
	9/29/2009	**6.5**	0.57 J	ND	ND	ND
	8/3/2011	**6.9**	0.52 J	ND	ND	ND
	1/30/2013	**9.5**	0.72 J	0.22 J	ND	ND
	5/19/2014	**14.2**	0.56 J	ND	ND	ND
	10/7/2015	**18.5**	0.46 J	0.38 J	ND	ND
	10/6/2016	**30.1**	0.47 J	ND	ND	ND
	7/19/2017	**29.7**	0.68 J	ND	ND	ND
	1/9/2019	ND	ND	ND	ND	ND
	4/17/2019	ND	ND	ND	ND	ND
	7/18/2019	ND	ND	ND	ND	ND
	10/25/2019	ND	ND	ND	ND	ND
	1/28/2020	ND	ND	ND	ND	ND
	4/21/2020	ND	ND	ND	ND	1.7
	7/7/2020	ND	ND	1.8	ND	1.8
	10/23/2020	ND	0.96 J	ND	ND	ND
	3/17/2021	ND	ND	ND	ND	ND
	5/26/2021	ND	ND	ND	ND	ND
	9/28/2021	ND	ND	ND	ND	ND
	7/26/2022	ND	ND	ND	ND	ND
	12/7/2023	ND	ND	ND	ND	ND
	3/5/2025	< 0.56	< 0.53	2.2	< 0.54	1.1
NYSDEC Groundwater Standards		**5**	**5**	**5**	**5**	**2**

Notes:
[1] Feet below top of casing.
[2] Feet above mean sea level.
[3] All concentrations are presented in units of micrograms per liter. Bold values indicate the concentrations exceed the respective NYSDEC Groundwater Standards.
[4] ND - Compound not detected at laboratory detection limits.
[5] J - Estimated value.
[6] NS - Not Sampled. Wells damaged by street paving and properly abandoned.

TABLE 2

CAROL CLEANERS -THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Historical Groundwater Sampling Results for Select CVOCs

Well ID	Sample Date	Concentration (ug/L)[3] Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
MW-8						
	11/20/2002	**39.8**	**6.6**	3.1	ND	ND
	7/31/2003	**35.1**	**5**	2.2	ND	ND
	10/16/2003	**52.6**	**8.4**	3.8	ND	ND
	1/20/2004	**49.9**	**8**	3.7	ND	ND
	4/26/2004	**37**	**6**	2.5	ND	ND
	7/21/2004	**51.8**	**9.4**	4.3	ND	ND
	4/7/2008	**35.5**	**5.7**	2.6	ND	ND
	9/29/2009	**24.7**	4.9	2.9	ND	ND
	8/3/2011	**37.1**	**6.4**	3.2	ND	ND
	1/30/2013	**29.1**	**5.3**	2.3	ND	ND
	10/7/2015	**25.5**	**5.3**	2.6	ND	ND
	10/6/2016	**41.6**	**6.4**	2.4	ND	ND
	7/20/2017	**24**	3.2	1.6	ND	ND
	1/9/2019	**17.2**	2	0.87 J	ND	ND
	4/17/2019	**31.5**	3.2	1.2	ND	ND
	7/18/2019	**32.3**	3.1	1.3	ND	ND
	10/29/2019	ND	ND	ND	ND	ND
	1/28/2020	ND	3.8	**11.4**	ND	**2.5**
	4/21/2020	ND	0.81 J	0.83 J	ND	**8.2**
	7/7/2020	ND	ND	2.3	ND	**10.4**
	10/23/2020	ND	ND	ND	ND	ND
	3/17/2021	ND	ND	ND	ND	ND
	5/26/2021	ND	ND	ND	ND	ND
	9/29/2021	ND	ND	ND	ND	ND
	7/26/2022	ND	ND	1.3	0.63 J	**2.2**
	12/6/2023	1.5	0.57 J	2.2	ND	1.8
	3/7/2025	< 0.56	< 0.53	1.4	< 0.54	< 0.52
MW-9						
	11/20/2002	**110**	**46.3**	**174**	1.3	ND
	7/31/2003	**103**	**42.4**	**111**	0.95	1
	10/16/2003	**159**	**51.4**	**174**	1.3	1.9
	1/20/2004	**151**	**49.2**	**135**	0.95	1.7
	4/26/2004	**181**	**58.1**	**130**	ND	ND
	7/21/2004	**163**	**54**	**132**	1.1	1.8
	4/7/2008	**344**	**70.7**	**141**	1.1	**3.6**
	9/30/2009	**261**	**38.5**	**84.3**	1	1.3
	8/4/2011	**131**	**21.7**	**40.1**	ND	0.82 J
	1/29/2013	**219**	**26.1**	**47.8**	0.29 J	ND
	1/21/2015	**148**	**17.2**	**27.5**	ND	ND
	4/6/2015	**53.5**	**16.3**	**36.3**	ND	1.1
	6/29/2015	**14.6**	3.6	**6.6**	ND	1.5
	10/6/2015	4.5	1.8	**5.4**	ND	0.47 J
	10/3/2016	NS	NS	NS	NS	NS
MW-10						
	4/7/2008	0.56 J	ND	0.79 J	ND	ND
	9/30/2009	ND	ND	0.76 J	ND	ND
	8/3/2011	ND	ND	1.1	ND	ND
	1/31/2013	ND	ND	0.36 J	ND	ND
	10/8/2015	ND	ND	0.60 J	ND	ND
	10/5/2016	ND	ND	0.53 J	ND	ND
	7/18/2017	ND	ND	0.53 J	ND	ND
	1/9/2019	ND	ND	ND	ND	ND
	4/19/2019	ND	ND	ND	ND	ND
	7/18/2019	ND	ND	ND	ND	ND
	10/25/2019	ND	ND	ND	ND	ND
	1/29/2020	ND	ND	ND	ND	ND
	4/22/2020	ND	ND	ND	ND	ND
	7/8/2020	ND	ND	ND	ND	ND
	10/21/2020	ND	ND	ND	ND	ND
	3/17/2021	ND	ND	ND	ND	ND
	5/24/2021	ND	ND	ND	ND	ND
	9/30/2021	ND	ND	ND	ND	ND
	12/7/2023	ND	ND	ND	ND	ND
	3/7/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52
NYSDEC Groundwater Standards		**5**	**5**	**5**	**5**	**2**

Notes:

[1] Feet below top of casing.

[2] Feet above mean sea level.

[3] All concentrations are presented in units of micrograms per liter. Bold values indicate the concentrations exceed the respective NYSDEC Groundwater Standards.

[4] ND - Compound not detected at laboratory detection limits.

[5] J - Estimated value.

[6] NS - Not Sampled. Wells damaged by street paving and properly abandoned.

TABLE 2

CAROL CLEANERS -THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Historical Groundwater Sampling Results for Select CVOCs

Well ID	Sample Date	Concentration (ug/L)[3] Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
MW-11						
	4/7/2008	**1,380**	**109**	**191**	2.3 J	**3.4 J**
	9/29/2009	**931**	**91**	**129**	0.95 J	1.3 J
	8/4/2011	**560**	**84**	**117**	0.92 J	ND
	1/29/2013	**318**	**50.3**	**87.7**	0.61 J	ND
	1/21/2015	**291**	**41.5**	**95.1**	ND	0.53 J
	4/6/2015	**144**	**19.8**	**160**	0.67 J	**2.3**
	6/29/2015	**90.2**	**12.8**	**48.7**	0.77 J	0.57 J
	10/6/2015	**55.4**	**13.9**	**16.8**	0.90 J	0.91 J
	10/10/2016	**10.2**	**8.7**	**8.5**	1.1	**2**
	7/28/2017	**9.6**	4.8	**18.6**	0.59 J	**4.5**
MW-12						
	4/7/2008	**534**	**136**	**205**	1.3 J	**2.9**
	9/30/2009	**283**	**159**	**235**	1.3	**3.6**
	8/4/2011	**145**	**124**	**156**	0.89 J	**3**
	1/29/2013	**125**	**109**	**148**	0.54 J	1.3
	5/20/2014	**89**	**103**	**166**	0.61 J	**2.8**
	11/18/2014	**113**	**119**	**137**	0.8 J	**2**
	1/19/2015	**59.4**	**74.5**	**145**	ND	1.2
	4/6/2015	**38.7**	**47.7**	**156**	ND	1.8
	6/29/2015	**41.7**	**97.6**	**195**	0.88 J	**6**
	10/6/2015	**11.7**	**38.1**	**208**	0.97 J	**7.7**
	10/10/2016	**7.4**	**21.6**	**114**	1.1	**9**
	7/28/2017	0.99 J	**10.1**	**85.7**	0.79 J	**7.8**
	4/17/2019	ND	**7.8**	**127**	1.5	**10**
	7/23/2019	ND	2.6	**83.8**	0.92 J	**5.5**
	10/28/2019	ND	**7.9 J**	**39.9**	ND	ND
	1/29/2020	ND	1.1	**37.1**	0.57 J	**4.1**
	4/22/2020	ND	1	2.5	ND	1
	7/9/2020	ND	ND	0.84	ND	ND
	10/20/2020	ND	ND	1.3	ND	ND
MW-13						
	4/7/2008	**7.9**	3.4	**9.1**	ND	ND
	9/30/2009	**193**	**48.1**	**73.4**	0.34 J	1.4
	8/4/2011	**487**	**90.8**	**126**	0.71 J	**3.7**
	1/29/2013	**857**	**130**	**171**	0.77 J	1.5
	5/19/2014	**66**	**12.9**	**21**	ND	ND
	11/18/2014	**1,470**	**182**	**435**	ND	ND
	1/19/2015	**954**	**111**	**250**	ND	ND
	4/6/2015	**90.5**	**10.6**	**25.2**	ND	0.30 J
	6/29/2015	**77.7**	**63.6**	**99.3**	ND	**11.3**
	10/6/2015	**24.4**	**60.4**	**492**	4.6	**493**
	10/3/2016	NS	NS	NS	NS	NS
	7/28/2017	3.7	**22.9**	**37.1**	ND	**4.2**
	4/17/2019	ND	ND	1.5	ND	**2.5**
	7/23/2019	1	ND	0.76 J	ND	ND
	10/28/2019	ND	ND	0.99 J	ND	ND
	1/29/2020	ND	ND	ND	ND	ND
	4/22/2020	ND	ND	0.88 J	ND	ND
	7/9/2020	ND	ND	0.91 J	ND	ND
	10/20/2020	ND	ND	1.3	ND	ND
MW-14						
	4/7/2008	ND	ND	ND	ND	ND
	9/30/2009	ND	ND	ND	ND	ND
	8/2/2011	NS	NS	NS	NS	NS
	1/31/2013	0.29 J	ND	ND	ND	ND
	5/19/2014	ND	ND	ND	ND	ND
	10/8/2015	ND	ND	ND	ND	ND
	10/4/2016	ND	ND	ND	ND	ND
	7/18/2017	ND	ND	ND	ND	ND
MW-15						
	4/7/2008	ND	ND	ND	ND	ND
	9/30/2009	ND	ND	ND	ND	ND
	8/2/2011	ND	ND	ND	ND	ND
	1/28/2013	ND	ND	ND	ND	ND
	10/8/2015	ND	ND	ND	ND	ND
	10/4/2016	ND	ND	ND	ND	ND
	7/18/2017	ND	ND	ND	ND	ND
NYSDEC Groundwater Standards		**5**	**5**	**5**	**5**	**2**

Notes:

[1] Feet below top of casing.

[2] Feet above mean sea level.

[3] All concentrations are presented in units of micrograms per liter. Bold values indicate the concentrations exceed the respective NYSDEC Groundwater Standards.

[4] ND - Compound not detected at laboratory detection limits.

[5] J - Estimated value.

[6] NS - Not Sampled. Wells damaged by street paving and properly abandoned.

TABLE 2

CAROL CLEANERS -THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Historical Groundwater Sampling Results for Select CVOCs

Well ID	Sample Date	Concentration (ug/L)[3] Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
MW-16						
	8/4/2011	**171**	**25.6**	**58.7**	0.53 J	1.8
	1/31/2013	**72.6**	**9.6**	**12.3**	ND	ND
	1/19/2015	**110**	**14.2**	**12.8**	ND	ND
	4/6/2015	**166**	**21.7**	**30.6**	ND	0.72 J
	7/1/2015	**194**	**27.7**	**57.9**	ND	**2.4**
	10/8/2015	**124**	**16.3**	**23.2**	ND	0.43 J
	10/7/2016	**47.6**	**6.2**	**8.6**	ND	ND
	7/20/2017	**72.2**	**12.5**	**28.6**	ND	**ND**
	1/10/2019	ND	ND	**238**	ND	ND
	4/17/2019	**6.5**	4.9 J	**14.9**	ND	**39.7**
	7/23/2019	ND	ND	ND	ND	**5.8**
	10/28/2019	ND	ND	ND	ND	ND
	1/30/2020	ND	ND	ND	ND	ND
	4/22/2020	ND	1.5 J	ND	ND	ND
	7/9/2020	ND	ND	ND	ND	ND
	10/22/2020	ND	ND	0.61 J	ND	ND
	3/16/2021	ND	ND	ND	ND	ND
	5/25/2021	ND	ND	ND	ND	ND
	9/30/2021	ND	ND	ND	ND	ND
	12/7/2023	ND	ND	0.56 J	ND	ND
	3/4/2025	< 0.56	< 0.53	0.80 J	< 0.54	< 0.52
MW-17						
	8/4/2011	**1,650**	**88.7**	**275**	1.8 J	**3.7**
	1/31/2013	**1,050**	**50.7**	**139**	ND	1.8 J
	1/19/2015	**1,330**	**49.2**	**69.8**	ND	ND
	4/7/2015	**1,190**	**37**	**254**	ND	**15.5**
	7/1/2015	**1,280**	**34.5**	**153**	ND	**5.3**
	10/8/2015	**868**	**66**	**158**	ND	**8.1**
	10/7/2016	**852**	**36.2**	**54.1**	0.84 J	**2.1**
	7/21/2017	**983**	**31.1**	**44.7**	ND	**7.2**
	1/10/2019	ND	ND	**444**	ND	ND
	4/18/2019	2.1	3	**373**	2.6	**13.7**
	7/23/2019	ND	ND	**33**	ND	**18.6**
	10/28/2019	ND	ND	**96.2**	ND	**49.1**
	1/30/2020	ND	ND	**21.9**	ND	**18.5**
	4/23/2020	ND	ND	**13.2**	ND	**9.5**
	7/9/2020	ND	ND	**5.9**	ND	**2.4 J**
	10/22/2020	ND	0.75 J	0.74 J	1.6	**5.7**
	3/16/2021	ND	ND	ND	ND	ND
	5/25/2021	ND	ND	0.99	1.1	ND
	9/30/2021	ND	ND	ND	ND	ND
	7/27/2022	ND	ND	2.7	1.3	1.7
	12/7/2023	ND	ND	**5.6**	ND	**4.5**
	3/4/2025	< 0.56	1.5	**71.9**	1.9	**24.8**
MW-18						
	8/3/2011	**418**	**69.9**	**97.5**	0.83 J	1.4
	1/31/2013	**315**	**54.5**	**97.5**	0.5 J	1.3
	1/19/2015	**217**	**44.5**	**68.3**	ND	1.3
	4/7/2015	**139**	**22.2**	**38.5**	ND	ND
	7/1/2015	**203**	**46.5**	**100**	0.82 J	1.9
	10/8/2015	**75.6**	**24**	**43.7**	ND	0.89 J
	10/7/2016	**111**	**36.1**	**43.2**	0.54 J	**2.6**
	7/21/2017	**55.6**	**30.3**	**129**	1.2	**9.3**
	1/10/2019	ND	ND	**110**	ND	ND
	4/18/2019	ND	1	**7.5**	ND	**2.2**
	7/23/2019	ND	0.59 J	0.78 J	ND	ND
	10/28/2019	ND	ND	ND	ND	ND
	1/30/2020	ND	ND	ND	ND	ND
	4/23/2020	ND	ND	0.55 J	ND	ND
	7/9/2020	ND	ND	0.65 J	ND	ND
	10/22/2020	ND	0.94 J	2.6	0.61 J	1.3
	3/16/2021	ND	ND	1.7	ND	ND
	5/25/2021	ND	0.78	3.3	ND	ND
	9/30/2021	ND	ND	0.83	ND	0.8
	7/27/2022	ND	ND	0.89 J	ND	0.98 J
	12/8/2023	ND	0.61 J	2	ND	1.1
	3/4/2025	1.5	1.4	2.5	< 0.54	1.5
NYSDEC Groundwater Standards		**5**	**5**	**5**	**5**	**2**

Notes:

[1] Feet below top of casing.

[2] Feet above mean sea level.

[3] All concentrations are presented in units of micrograms per liter. Bold values indicate the concentrations exceed the respective NYSDEC Groundwater Standards.

[4] ND - Compound not detected at laboratory detection limits.

[5] J - Estimated value.

[6] NS - Not Sampled. Wells damaged by street paving and properly abandoned.

TABLE 2

CAROL CLEANERS -THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Historical Groundwater Sampling Results for Select CVOCs

Well ID	Sample Date	Concentration (ug/L)[3] Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
MW-19						
	8/3/2011	**287**	**25.4**	**30.3**	ND	ND
	1/31/2013	**313**	**20.7**	**22.9**	ND	ND
	1/19/2015	**179**	**32.1**	**56.4**	ND	**2.1**
	4/7/2015	**280**	**46.5**	**87**	ND	1.7
	7/1/2015	**189**	**22.9**	**30.3**	ND	0.63 J
	10/8/2015	**124**	**23.9**	**82.6**	ND	**13**
	10/7/2016	**99.8**	**84.7**	**389**	2.2	**31.1**
	7/20/2017	**52.2**	**10.7**	**14.8**	ND	1.6
	1/10/2019	ND	ND	**52.8**	ND	ND
	4/18/2019	ND	0.70 J	1.5	ND	**14.2**
	7/23/2019	ND	0.66 J	ND	ND	0.99 J
	10/28/2019	ND	ND	ND	ND	ND
	1/30/2020	ND	ND	ND	ND	ND
	4/23/2020	ND	ND	ND	ND	ND
	7/9/2020	ND	0.57 J	2.4	ND	1.2
	10/22/2020	ND	ND	1.8	1.2	1.3
	3/16/2021	ND	ND	1.6	ND	ND
	5/25/2021	ND	ND	1.7	ND	ND
	10/1/2021	ND	ND	0.59	ND	ND
	7/27/2022	ND	1.2	**27.8**	ND	**16.1**
	12/8/2023	1.3	0.68 J	2.9	0.63 J	**2.2**
	3/4/2025	1.7	2.3	1.4	< 0.54	0.54 J
MW-20						
	10/4/2016	**32.8**	2.5	1.3	ND	ND
	7/20/2017	**25.1**	3.3	4.5	ND	ND
	1/8/2019	**7.6**	**23.2**	4.3 J	ND	ND
	4/17/2019	ND	1.3	**27.1**	**6.1**	ND
	7/23/2019	ND	ND	ND	**5.3**	**5.5**
	10/29/2019	ND	ND	ND	ND	ND
	1/28/2020	ND	ND	ND	ND	ND
	4/21/2020	ND	ND	ND	ND	ND
	7/8/2020	ND	ND	ND	ND	ND
	10/20/2020	ND	ND	ND	1.1	ND
	3/16/2021	ND	ND	ND	ND	ND
	5/26/2021	ND	ND	ND	1.6	ND
	9/30/2021	ND	ND	ND	ND	ND
	12/7/2023	ND	ND	ND	ND	ND
	3/5/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52
MW-21						
	10/6/2016	0.68 J	ND	0.59 J	ND	ND
	7/19/2017	ND	ND	ND	ND	ND
	1/9/2019	ND	ND	ND	ND	ND
	4/17/2019	ND	ND	ND	ND	ND
	7/23/2019	ND	ND	ND	ND	ND
	10/29/2019	ND	ND	ND	ND	ND
	1/28/2020	ND	ND	ND	ND	ND
	4/21/2020	ND	ND	ND	ND	ND
	7/8/2020	ND	ND	ND	ND	ND
	10/20/2020	ND	ND	ND	ND	ND
	3/16/2021	ND	ND	ND	ND	ND
	5/26/2021	ND	ND	ND	ND	ND
	9/29/2021	ND	ND	ND	ND	ND
	12/6/2023	ND	ND	0.60 J	ND	ND
	3/5/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52
MW-22						
	10/6/2016	4.8	ND	0.46 J	ND	ND
	7/19/2017	2.4	ND	0.63 J	ND	ND
	1/9/2019	ND	ND	ND	ND	ND
	3/16/2021	ND	ND	0.73 J	ND	ND
	5/26/2021	ND	ND	1.2	ND	ND
	9/29/2021	1.1	ND	1.1	ND	ND
	12/7/2023	0.96 J	ND	1.1	ND	0.93 J
	3/4/2025	3.3	< 0.53	0.64 J	< 0.54	< 0.52
NYSDEC Groundwater Standards		**5**	**5**	**5**	**5**	**2**

Notes:

[1] Feet below top of casing.

[2] Feet above mean sea level.

[3] All concentrations are presented in units of micrograms per liter. Bold values indicate the concentrations exceed the respective NYSDEC Groundwater Standards.

[4] ND - Compound not detected at laboratory detection limits.

[5] J - Estimated value.

[6] NS - Not Sampled. Wells damaged by street paving and properly abandoned.

TABLE 2

CAROL CLEANERS -THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Historical Groundwater Sampling Results for Select CVOCs

Well ID	Sample Date	Concentration (ug/L)[3] Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl Chloride
MW-23						
	10/5/2016	0.41 J	ND	ND	ND	ND
	7/18/2017	0.50 J	ND	ND	ND	ND
	1/8/2019	ND	ND	ND	ND	ND
	3/18/2021	ND	ND	ND	ND	ND
	5/28/2021	ND	ND	0.91	ND	ND
	9/28/2021	ND	ND	0.87	ND	ND
	7/26/2022	ND	ND	0.85 J	ND	ND
	12/6/2023	0.90 J	ND	1.0	ND	ND
	3/5/2025	1.1	0.54 J	0.85 J	< 0.54	< 0.52
MW-24						
	10/5/2016	ND	ND	ND	ND	ND
	7/17/2017	ND	ND	0.65 J	ND	ND
	1/8/2019	ND	ND	ND	ND	ND
	4/17/2019	ND	ND	ND	ND	ND
	7/18/2019	ND	ND	ND	ND	ND
	10/25/2019	ND	ND	ND	ND	ND
	1/29/2020	ND	ND	ND	ND	ND
	4/21/2020	ND	ND	ND	ND	ND
	7/7/2020	ND	ND	ND	ND	ND
	10/20/2020	ND	ND	ND	ND	ND
	3/18/2021	ND	ND	ND	ND	ND
	5/28/2021	ND	ND	ND	ND	ND
	9/29/2021	ND	ND	ND	ND	ND
	12/6/2023	ND	ND	ND	ND	ND
	3/7/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52
MW-25						
	7/17/2017	ND	ND	ND	ND	ND
MW-26						
	7/17/2017	ND	ND	ND	ND	ND
MW-27						
	7/17/2017	ND	ND	ND	ND	ND
MW-28						
	7/20/2017	0.96 J	1.3	**6.7**	ND	ND
MW-29						
	7/20/2017	ND	ND	ND	ND	ND
NYSDEC Groundwater Standards		**5**	**5**	**5**	**5**	**2**

Notes:

[1] Feet below top of casing.

[2] Feet above mean sea level.

[3] All concentrations are presented in units of micrograms per liter. Bold values indicate the concentrations exceed the respective NYSDEC Groundwater Standards.

[4] ND - Compound not detected at laboratory detection limits.

[5] J - Estimated value.

[6] NS - Not Sampled. Wells damaged by street paving and properly abandoned.

TABLE 3.1

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	B-1		B-2		B-3		B-4		NYSDEC Residential SCO[7]	NYSDEC Commercial SCO[7]	NYSDEC Protection of Groundwater SCO[7]
Approximate Depth to Water (ft bg)[2]	6.8		7.9		13.5		10.4				
Approximate Depth to Bedrock (ft bg)	12		18.5		18		14				
Approximate Bedrock Elevation (ft msl)[3]	18.6		11.9		12.3		16.2				
Sample Depth (ft bg)	6	11.5	7.5	18	13	17	10	14			
Tetrachloroethene	**2.05**[4]	0.0082	0.0096	0.0022	0.0027	0.0038	0.0061	0.0023	**5.5**	**150**	**1.3**
Trichloroethene	0.109	ND[5]	ND	ND	ND	ND	ND	ND	**10**	**200**	**0.47**
Total Organic Carbon	<1,200	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	ND[6]	ND[6]	ND[6]

Notes: (1) See Figure 5A for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (fl msl), and projected from grade elevations surveyed for nearby monitor wells.
(4) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(5) Compound not detected.
(6) Not applicable.
(7) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).

TABLE 3.1

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	**B-5**			**B-6**		**B-7**			**NYSDEC Residential SCO**[7]	**NYSDEC Commercial SCO**[7]	**NYSDEC Protection of Groundwater SCO**[7]
Approximate Depth to Water (ft bg)[2]	7.2			7.7		9.2					
Approximate Depth to Bedrock (ft bg)	11.5			12		12.5					
Approximate Bedrock Elevation (ft msl)[3]	18.9			18.2		17.5					
Sample Depth (ft bg)	5	6.5	11	7	12	7	9	12			
Tetrachloroethene	0.41	0.0397	0.0138	0.044	0.0322	ND[4]	.0054[5]	0.109	**5.5**	**150**	**1.3**
Trichloroethene	0.0542	0.0033	ND	0.005	0.0085	ND	ND	0.0217	**10**	**200**	**0.47**
Total Organic Carbon	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	ND[6]	ND[6]	ND[6]

Notes: (1) See Figure 5A for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (fl msl), and projected from grade elevations surveyed for nearby monitor wells.
(4) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(5) Compound not detected.
(6) Not applicable.
(7) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).

TABLE 3.1

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	**B-8**		**B-9**		**B-10**		**B-11**		**NYSDEC Residential SCO**[1]	**NYSDEC Commercial SCO**[1]	**NYSDEC Protection of Groundwater SCO**[1]
Approximate Depth to Water (ft bg)[2]	8.7		8.3		7.8		7.8				
Approximate Depth to Bedrock (ft bg)	11.0		11.0		14.5		12.5				
Approximate Bedrock Elevation (ft msl)[3]	18.9		18.8		15.5		17.4				
Sample Depth (ft bg)	8	11	8	11	7	14	7	12			
Tetrachloroethene	ND	0.0049	0.0049	ND	0.0054	0.0073	0.0018	ND	**5.5**	**150**	**1.3**
Trichloroethene	ND	ND	0.0015	ND	ND	ND	ND	ND	**10**	**200**	**0.47**
Total Organic Carbon	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,200	<1,100	ND[6]	ND[6]	ND[6]

Notes: (1) See Figure 5A for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (fl msl), and projected from grade elevations surveyed for nearby monitor wells.
(4) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(5) Compound not detected.
(6) Not applicable.
(7) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).

TABLE 3.1

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	**B-12**		**B-13**			**B-14**			**B-15**		**NYSDEC Residential SCO**[7]	**NYSDEC Commercial SCO**[7]	**NYSDEC Protection of Groundwater SCO**[7]
Approximate Depth to Water (ft bg)[2]	7.5		12.5			9.5			7.7				
Approximate Depth to Bedrock (ft bg)	12.5		13.5			13.5			19.5				
Approximate Bedrock Elevation (ft msl)[3]	17.7		16.5			16.1			10.7				
Sample Depth (ft bg)	7	12	6	12	13	9	11	13	7	19			
Tetrachloroethene	0.126	ND	0.0047	ND	ND	ND[4]	.0021[5]	ND	ND	0.012	**5.5**	**150**	**1.3**
Trichloroethene	0.0026	ND	0.0024	ND	ND	ND	ND	ND	ND	ND	**10**	**200**	**0.47**
Total Organic Carbon	2320	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	ND[6]	ND[6]	ND[6]

Notes: (1) See Figure 5A for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (fl msl), and projected from grade elevations.surveyed for nearby monitor wells.
(4) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(5) Compound not detected.
(6) Not applicable.
(7) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).

TABLE 3.1

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	**B-16**		**B-17**		**B-18**		**B-19**		**B-20**		**NYSDEC Residential SCO**[7]	**NYSDEC Commercial SCO**[7]	**NYSDEC Protection of Groundwater SCO**[7]
Approximate Depth to Water (ft bg)[2]	8.4		8.6		9.5		NOT ENCOUNTERED		NOT ENCOUNTERED				
Approximate Depth to Bedrock (ft bg)	13.5		15.5		9.5		8.5		8.5				
Approximate Bedrock Elevation (ft msl)[3]	16.5		14		31.5		32		31				
Sample Depth (ft bg)	8	13	8	15	5	9	7	8	7	8			
Tetrachloroethene	ND	ND	ND	0.0051	0.0204	ND	ND	0.0027	ND	ND	**5.5**	**150**	**1.3**
Trichloroethene	ND	ND	ND	0.0016	0.002	ND	ND	ND	ND	ND	**10**	**200**	**0.47**
Total Organic Carbon	<1,100	<1,100	<1,100	<1,200	2,860	<1,100	<1,100	<1,100	<1,100	<1,100	ND[6]	ND[6]	ND[6]

Notes: (1) See Figure 5A for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (fl msl), and projected from grade elevations.surveyed for nearby monitor wells.
(4) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(5) Compound not detected.
(6) Not applicable.
(7) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).

TABLE 3.1

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	B-21		B-22		B-23		B-24		B-25		NYSDEC Residential SCO[7]	NYSDEC Commercial SCO[7]	NYSDEC Protection of Groundwater SCO[7]
Approximate Depth to Water (ft bg)[2]	8.5		7.8		10.5		10.5		7.4				
Approximate Depth to Bedrock (ft bg)	12.5		12.5		16.5		17.5		15.5				
Approximate Bedrock Elevation (ft msl)[3]	17.5		18.2		22		17.5		15.3				
Sample Depth (ft bg)	8	12	7	12	10	16	10	17	7	15			
Tetrachloroethene	ND[4]	ND	ND	ND	ND	ND	ND	ND	.0198[5]	ND	**5.5**	**150**	**1.3**
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	0.0036	ND	**10**	**200**	**0.47**
Total Organic Carbon	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	ND[6]	ND[6]	ND[6]

Notes: (1) See Figure 5A for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (fl msl), and projected from grade elevations.surveyed for nearby monitor wells.
(4) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(5) Compound not detected.
(6) Not applicable.
(7) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).

TABLE 3.2

CAROL CLEANERS, STATEN ISLAND MALL SITE
STATEN ISLAND, NEW YORK

Geoprobe Soil Sampling[(1)] Summary
May 11 - 12, 2006

Compound (mg/kg)	B-26 (6.5-7)	B-26 (11.5-12)	B-27 (7.5-8)	B-27 (14.3-14.8)	NYSDEC Residential SCO[(1)]	NYSDEC Commercial SCO[(1)]	NYSDEC Protection of Groundwater SCO[(1)]
Tetrachloroethene (PCE)	ND[(2)]	ND	ND	ND	**5.5**	**150**	**1.3**
Trichloroethene (TCE)	ND	ND	ND	ND	**10**	**200**	**0.47**
cis-1,2-Dichloroethene (cis-1,2-DCE)	0.0023 J	0.0221	ND	ND	**59**	**500**	**0.25**
Carbon Disulfide	ND	ND	ND	ND	**100**	**-**	**2.7**
Ethylbenzene	ND	ND	ND	ND	**30**	**390**	**1**
Xylene (Total)	ND	ND	ND	ND	**total = 100**	**total = 500**	**total = 1.6**
2-Butanone (MEK)	ND	ND	ND	ND	**100**	**500**	**0.12**
Volatile Organic Chemicals (VOC) TIC's	ND	ND	ND	ND	**-**	**-**	**-**
TOC[(5)]	<1100	<1200	<1100	<1100	**-**	**-**	**-**

NOTES:
(1) See Figure 5B for sample locations. All soil cleanup objectives (SCOs) are in mg/kg or parts per million (ppm).
(2) ND-Not Detected.
(3) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).
(4) Concentrations for TOC are in mg/kg or parts per million (ppm).
(5) J-Estimated concentration.
(6) Bold and highlighted in yellow exceed the NYSDEC Protection of Groundwater SCO.

TABLE 3.2

CAROL CLEANERS, STATEN ISLAND MALL SITE
STATEN ISLAND, NEW YORK

Geoprobe Soil Sampling[(1)] Summary
May 11 - 12, 2006

Compound (mg/kg)	B-28 (7.5-8)	B-28 (12.5-13)	B-29 (8.8-9.3)	B-29 (12.5-13)	B-30 (7.7-8.3)	NYSDEC Residential SCO[(1)]	NYSDEC Commercial SCO[(1)]	NYSDEC Protection of Groundwater SCO[(1)]
Tetrachloroethene (PCE)	ND	ND	0.0031 J[(3)]	ND	ND	**5.5**	**150**	**1.3**
Trichloroethene (TCE)	ND	ND	ND	ND	ND	**10**	**200**	**0.47**
cis-1,2-Dichloroethene (cis-1,2-DCE)	ND	ND	ND	ND	ND	**59**	**500**	**0.25**
Carbon Disulfide	ND	ND	ND	ND	ND	**100**	**-**	**2.7**
Ethylbenzene	ND	ND	ND	ND	ND	**30**	**390**	**1**
Xylene (Total)	ND	ND	ND	ND	ND	**total = 100**	**total = 500**	**total = 1.6**
2-Butanone (MEK)	ND	ND	ND	ND	ND	**100**	**500**	**0.12**
Volatile Organic Chemicals (VOC) TIC's	ND	ND	ND	ND	ND	**-**	**-**	**-**
TOC[(5)]	<1100	<1100	<1200	<1100	<1100	**-**	**-**	**-**

NOTES:
(1) See Figure 5B for sample locations. All soil cleanup objectives (SCOs) are in mg/kg or parts per million (ppm).
(2) ND-Not Detected.
(3) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).
(4) Concentrations for TOC are in mg/kg or parts per million (ppm).
(5) J-Estimated concentration.
(6) Bold and highlighted in yellow exceed the NYSDEC Protection of Groundwater SCO.

TABLE 3.2

CAROL CLEANERS, STATEN ISLAND MALL SITE
STATEN ISLAND, NEW YORK

Geoprobe Soil Sampling[(1)] Summary
May 11 - 12, 2006

Compound (mg/kg)	B-30 (14.5-15)	B-31 (4.5-5)	B-31 (15.5-16)	B-32 (5.3-5.8)	NYSDEC Residential SCO[(1)]	NYSDEC Commercial SCO[(1)]	NYSDEC Protection of Groundwater SCO[(1)]
Tetrachloroethene (PCE)	ND	0.0183	ND	ND	**5.5**	**150**	**1.3**
Trichloroethene (TCE)	ND	0.0192	ND	ND	**10**	**200**	**0.47**
cis-1,2-Dichloroethene (cis-1,2-DCE)	ND	0.0198	ND	ND	**59**	**500**	**0.25**
Carbon Disulfide	ND	0.0029 J	ND	ND	**100**	**-**	**2.7**
Ethylbenzene	ND	ND	0.00069 J	ND	**30**	**390**	**1**
Xylene (Total)	ND	ND	0.0013 J	ND	**total = 100**	**total = 500**	**total = 1.6**
2-Butanone (MEK)	ND	ND	0.0073 J	ND	**100**	**500**	**0.12**
Volatile Organic Chemicals (VOC) TIC's	ND	0.0133	ND	ND	**-**	**-**	**-**
TOC[(5)]	<1200	2410	<1100	<1200	**-**	**-**	**-**

NOTES:
(1) See Figure 5B for sample locations. All soil cleanup objectives (SCOs) are in mg/kg or parts per million (ppm).
(2) ND-Not Detected.
(3) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).
(4) Concentrations for TOC are in mg/kg or parts per million (ppm).
(5) J-Estimated concentration.
(6) Bold and highlighted in yellow exceed the NYSDEC Protection of Groundwater SCO.

TABLE 3.2

CAROL CLEANERS, STATEN ISLAND MALL SITE
STATEN ISLAND, NEW YORK

Geoprobe Soil Sampling[(1)] Summary
May 11 - 12, 2006

Compound (mg/kg)	B-32 (11.5-12)	B-33 (6.2-6.7)	B-33 (12.5-13)	NYSDEC Residential SCO[(1)]	NYSDEC Commercial SCO[(1)]	NYSDEC Protection of Groundwater SCO[(1)]
Tetrachloroethene (PCE)	ND	0.0053 J	0.0305	**5.5**	**150**	**1.3**
Trichloroethene (TCE)	ND	ND	0.0046 J	**10**	**200**	**0.47**
cis-1,2-Dichloroethene (cis-1,2-DCE)	ND	ND	0.0044 J	**59**	**500**	**0.25**
Carbon Disulfide	ND	ND	ND	**100**	**-**	**2.7**
Ethylbenzene	ND	ND	ND	**30**	**390**	**1**
Xylene (Total)	ND	ND	ND	**total = 100**	**total = 500**	**total = 1.6**
2-Butanone (MEK)	0.0058 J	ND	ND	**100**	**500**	**0.12**
Volatile Organic Chemicals (VOC) TIC's	ND	ND	ND	**-**	**-**	**-**
TOC[(5)]	<1100	<1100	<1100	**-**	**-**	**-**

NOTES:
(1) See Figure 5B for sample locations. All soil cleanup objectives (SCOs) are in mg/kg or parts per million (ppm).
(2) ND-Not Detected.
(3) Bold and red values exceed the NYSDEC Residential Soil Cleanup Objectives (SCO).
(4) Concentrations for TOC are in mg/kg or parts per million (ppm).
(5) J-Estimated concentration.
(6) Bold and highlighted in yellow exceed the NYSDEC Protection of Groundwater SCO.

TABLE 3.3
THE CROSSINGS
GGP STATEN ISLAND MALL, LLC. STATEN ISLAND, NEW YORK
Summary of Soil Boring Sampling Results - May 2011

Boring ID	**SB-1**	**SB-2**	**SB-4**	**SB-5**			**SB-6**			**SB-7**		**NYSDEC Residential SCO[3]**	**NYSDEC Commercial SCO[3]**	**NYSDEC Protection of Groundwater SCO[3]**
Sample Depth (ft bg)	**6**	**4.5**	**5.5**	**4.5**	**5.5**	**8**	**1.5**	**4.5**	**7**	**7**	**16**			
Date Sampled	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**5/12/2011**	**7/20/2011**	**7/20/2011**			
Constituent/Compound	**Constituent Concentration (mg/kg)[2]**													
Acetone	ND[5]	ND	ND	ND	ND	ND	0.0623	ND	ND	ND	ND	**100**	**500**	**0.05**
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.9**	**44**	**0.06**
Bromobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
2-Butanone (MEK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.12**
n-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	-	**2.7**
sec-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
tert-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**1.4**	**22**	**0.76**
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**1.9**
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**10**	**350**	**0.37**
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
o-Chorotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
p-Chlorotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dibromo-3-chloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**17**	**280**	**2.4**
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**9.8**	**130**	**1.8**
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**19**	**240**	**0.27**
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.3**	**30**	**0.02**
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.33**
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	0.00041 J	ND	ND	ND	**59**	**500**	**0.25**
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.19**
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,3-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
2,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Ethylbenzene	ND	ND	ND	ND	ND	ND	0.00051 J[6]	0.00057 J	ND	ND	ND	**30**	**390**	**1**
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**3.9**
p-Isopropyltoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND			
Methyl tert butyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**62**	**500**	**0.93**
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**1**
Methylene bromide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Methylene chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**51**	**500**	**0.05**

TABLE 3.3
THE CROSSINGS
GGP STATEN ISLAND MALL, LLC. STATEN ISLAND, NEW YORK
Summary of Soil Boring Sampling Results - May 2011

Boring ID	**SB-1**	**SB-2**	**SB-4**	**SB-5**			**SB-6**			**SB-7**		**NYSDEC Residential SCO[3]**	**NYSDEC Commercial SCO[3]**	**NYSDEC Protection of Groundwater SCO[3]**
Sample Depth (ft bg)	**6**	**4.5**	**5.5**	**4.5**	**5.5**	**8**	**1.5**	**4.5**	**7**	**7**	**16**			
Date Sampled	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**05/12/11**	**5/12/2011**	**7/20/2011**	**7/20/2011**			
Constituent/Compound	**Constituent Concentration (mg/kg)[2]**													
Naphthalene(4)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
n-Propylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Styrene	ND	ND	ND	0.00039 J	ND	ND	0.00038 J	0.00068 J	0.00028 J	ND	ND	-	-	-
1,1,1,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**35**	-	**0.6**
Tetrachloroethene	ND	ND	ND	ND	ND	0.0054 J	ND	0.0103	ND	0.00058 J	0.0022 J	**5.5**	**150**	**1.3**
Toluene	ND	ND	ND	ND	ND	ND	ND	0.00052 J	ND	ND	ND	**100**	**500**	**0.7**
1,2,3-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**3.4**
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.68**
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	0.0008 J	ND	ND	ND	**10**	**200**	**0.47**
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2,3-Trichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2,4-Trimethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,3,5-Trimethylbenzene	0.00037 J	ND	0.00031 J	0.00024 J	0.00032 J	ND	0.00041 J	0.0004 J	ND	ND	ND	-	-	-
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.21**	**13**	**0.02**
Xylenes (total)	0.00061 J	ND	0.00061 J	0.00098 J	0.0013	0.00088 J	0.0029	0.0031	0.00054 J	ND	ND	**total = 100**	**total = 500**	**total = 1.6**

Notes:
(1) See Figure 5C.
(2) All concentrations presented in milligrams per kilogram; bold numbers represent exceedance of NYSDEC SCOs.
(3) New York State Department of Environmental Protection (NYSDEC) Soil Cleanup Objectives (SCOs).
(4) Napthalene SCOs are from the semi-volatile organic compound list.
(5) ND - Compound not detected at laboratory detection limits.
(6) J - Estimated value.

TABLE 3.3
THE CROSSINGS
GGP STATEN ISLAND MALL, LLC. STATEN ISLAND, NEW YORK
Summary of Soil Boring Sampling Results - May 2011

Boring ID	**SB-8**		**SB-9**		**SB-10**		**SB-11**		**NYSDEC Residential SCO[3]**	**NYSDEC Commercial SCO[3]**	**NYSDEC Protection of Groundwater SCO[3]**
Sample Depth (ft bg)	**7**	**18**	**9**	**13**	**9**	**15**	**9**	**14**			
Date Sampled	**7/21/2011**	**7/21/2011**	**7/20/2011**	**7/20/2011**	**7/21/2011**	**7/21/2011**	**7/21/2011**	**7/21/2011**			
Constituent/Compound	**Constituent Concentration (mg/kg)[2]**										
Acetone	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.05**
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	**2.9**	**44**	**0.06**
Bromobenzene	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
2-Butanone (MEK)	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.12**
n-Butylbenzene	ND	ND	ND	ND	ND	ND	0.00049 J	ND	**100**	**-**	**2.7**
sec-Butylbenzene	ND	ND	ND	ND	ND	0.00027 J	0.00067 J	ND	**-**	**-**	**-**
tert-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	**1.4**	**22**	**0.76**
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**1.9**
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	**10**	**350**	**0.37**
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
o-Chorotoluene	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
p-Chlorotoluene	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,2-Dibromo-3-chloropropane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	**17**	**280**	**2.4**
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	**9.8**	**130**	**1.8**
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	**19**	**240**	**0.27**
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	**2.3**	**30**	**0.02**
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.33**
cis-1,2-Dichloroethene	ND	0.0045 J	ND	ND	ND	ND	ND	ND	**59**	**500**	**0.25**
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.19**
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,3-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
2,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,1-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	**30**	**390**	**1**
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**3.9**
p-Isopropyltoluene	ND	ND	ND	ND	ND	ND	0.00052 J	ND			
Methyl tert butyl ether	ND	ND	ND	ND	ND	ND	ND	ND	**62**	**500**	**0.93**
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**1**
Methylene bromide	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Methylene chloride	ND	ND	ND	ND	ND	ND	ND	ND	**51**	**500**	**0.05**

TABLE 3.3
THE CROSSINGS
GGP STATEN ISLAND MALL, LLC. STATEN ISLAND, NEW YORK
Summary of Soil Boring Sampling Results - May 2011

Boring ID	**SB-8**		**SB-9**		**SB-10**		**SB-11**		**NYSDEC Residential SCO[3]**	**NYSDEC Commercial SCO[3]**	**NYSDEC Protection of Groundwater SCO[3]**
Sample Depth (ft bg)	**7**	**18**	**9**	**13**	**9**	**15**	**9**	**14**			
Date Sampled	**7/21/2011**	**7/21/2011**	**7/20/2011**	**7/20/2011**	**7/21/2011**	**7/21/2011**	**7/21/2011**	**7/21/2011**			
Constituent/Compound	**Constituent Concentration (mg/kg)[2]**										
Naphthalene(4)	ND	ND	ND	ND	ND	ND	0.0034 J	ND	-	-	-
n-Propylbenzene	ND	ND	ND	ND	ND	ND	0.00048 J	ND	-	-	-
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1,1,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	**35**	-	**0.6**
Tetrachloroethene	ND	0.0286	ND	0.00039 J	ND	ND	ND	ND	**5.5**	**150**	**1.3**
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.7**
1,2,3-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**3.4**
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.68**
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Trichloroethene	ND	0.003 J	ND	ND	ND	ND	ND	ND	**10**	**200**	**0.47**
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2,3-Trichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2,4-Trimethylbenzene	ND	ND	ND	ND	ND	ND	0.0023 J	ND	-	-	-
1,3,5-Trimethylbenzene	ND	ND	ND	ND	ND	ND	0.00066 J	ND	-	-	-
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	**0.21**	**13**	**0.02**
Xylenes (total)	ND	ND	ND	ND	ND	ND	ND	ND	**total = 100**	**total = 500**	**total = 1.6**

Notes:
(1) See Figure 5C.
(2) All concentrations presented in milligrams per kilogram; bold numbers represent exceedance of NYSDEC SCOs.
(3) New York State Department of Environmental Protection (NYSDEC) Soil Cleanup Objectives (SCOs).
(4) Napthalene SCOs are from the semi-volatile organic compound list.
(5) ND - Compound not detected at laboratory detection limits.
(6) J - Estimated value.

TABLE 3.4
CAROL CLEANERS - THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK
Summary of Soil boring Sampling Results - May and June 2017

Sample ID	SWB-1(5')	SWB-1(12')	SWB-2(7')	SWB-2(11.5')	SWB-3(3')	SWB-3(9')	SWB-4(5')	SWB-4(7')	SWB-5(4')	SWB-6(3')	SWB-7(5')	SWB-7(7')	NYSDEC Residential SCO[1]	NYSDEC Commercial SCO[1]	NYSDEC Protection of Groundwater SCO[1]
Laboratory ID	**JC44543-6**	**JC44543-7**	**JC44543-3**	**JC44543-13**	**JC44543-8**	**JC44543-4**	**JC44543-1**	**JC44543-5**	**JC44543-2**	**JC44408-11**	**JC44543-9**	**JC44543-10**			
Date Sampled	**06/01/17**	**06/01/17**	**06/01/17**	**06/01/17**	**06/01/17**	**06/01/17**	**06/01/17**	**06/01/17**	**06/01/17**	**05/31/17**	**06/01/17**	**06/01/17**			
Constituent/Compound	**Constituent Concentration (mg/kg)[1]**														
Acetone	ND[2]	0.0066 J[3]	0.0068 J	ND	ND	0.0071 J	0.0084 J	0.0113	0.0379	ND	ND	ND	**100**	**500**	**0.05**
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.9**	**44**	**0.06**
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
2-Butanone (MEK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.12**
Carbon disulfide	ND	ND	ND	ND	ND	ND	ND	ND	0.0021 J	ND	ND	ND	**100**	**-**	**2.7**
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**1.4**	**22**	**0.76**
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**1.9**
Chloroform	ND	0.0016 J	ND	0.0012 J	0.0013 J	ND	ND	ND	ND	0.00078 J	0.0011 J	0.00096 J	**10**	**350**	**0.37**
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Cyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,2-Dibromo-3-chloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**17**	**280**	**2.4**
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**9.8**	**130**	**1.8**
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**19**	**240**	**0.27**
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.3**	**30**	**0.02**
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.33**
cis-1,2-Dichloroethene	ND	ND	0.00050 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	**59**	**500**	**0.25**
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.19**
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Ethylbenzene	ND	ND	ND	ND	ND	ND	0.00025 J	ND	ND	ND	ND	ND	**30**	**390**	**1**
Freon 113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**-**	**6**
2-Hexanone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**3.9**
Methyl Acetate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Methylcyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Methyl Tert Butyl Ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**62**	**500**	**0.93**
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**1**
Methylene chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0032 J	ND	ND	**51**	**500**	**0.05**
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**35**	**-**	**0.6**
Tetrachloroethene	ND	ND	0.0222	0.0024	0.0013 J	ND	0.0029	0.0041	ND	0.0014 J	ND	ND	**5.5**	**150**	**1.3**
Toluene	0.00018 J	ND	ND	0.00024 J	ND	0.00027 J	ND	0.00021 J	ND	ND	ND	0.00035 J	**100**	**500**	**0.7**
1,2,3-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**3.4**
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.68**
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Trichloroethene	ND	ND	0.00045 J	ND	0.00081 J	ND	ND	ND	ND	ND	ND	ND	**10**	**200**	**0.47**
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**-**	**-**	**-**
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.21**	**13**	**0.02**
Xylene (total)	ND	ND	ND	ND	ND	ND	0.00079 J	ND	0.00029 J	ND	ND	ND	**total = 100**	**total = 500**	**total = 1.6**

NOTES:
(1) All concentrations presented in milligrams per kilogram; bold numbers represent an exceedance of the NYSDEC Soil Cleanup Objectives (SCO).
(2) ND - Compound not detected at laboratory detection limits.
(3) J - Estimated value.

TABLE 3.4
CAROL CLEANERS - THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK
Summary of Soil boring Sampling Results - May and June 2017

Sample ID	SWB-8(4')	SWB-8(9')	SWB-9(6')	SWB-10(4')	SWB-10(11')	SWB-11(7')	SWB-11(11')	SWB-12(4')	SWB-12(13')	SWB-13(7')	SWB-13(15')	SWB-14(5')	NYSDEC Residential SCO[1]	NYSDEC Commercial SCO[1]	NYSDEC Protection of Groundwater $SCO_{(1)}$
Laboratory ID	JC44543-12	JC44543-11	JC44408-10	JC44543-15	JC44543-17	JC44408-9	JC44408-8	JC44543-20	JC44543-21	JC44408-6	JC44408-7	JC44408-1			
Date Sampled	06/01/17	06/01/17	05/31/17	06/02/17	06/02/17	05/31/17	05/31/17	06/02/17	06/02/17	05/31/17	05/31/17	05/31/17			
Constituent/Compound	Constituent Concentration (mg/kg)[1]														
Acetone	ND	ND	0.0054 J	ND	ND	0.02	ND	ND	ND	0.0064 J	ND	ND	**100**	**500**	**0.05**
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.9**	**44**	**0.06**
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
2-Butanone (MEK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.12**
Carbon disulfide	ND	ND	ND	ND	ND	0.0016 J	ND	ND	ND	ND	ND	ND	**100**	-	**2.7**
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**1.4**	**22**	**0.76**
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**1.9**
Chloroform	0.0014 J	0.0020 J	0.00031 J	0.00087 J	0.00071 J	ND	0.00089 J	0.0011 J	0.00094 J	0.00081 J	0.0014 J	0.0014 J	**10**	**350**	**0.37**
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Cyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dibromo-3-chloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**17**	**280**	**2.4**
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**9.8**	**130**	**1.8**
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**19**	**240**	**0.27**
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.3**	**30**	**0.02**
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.33**
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0323	ND	0.0013	**59**	**500**	**0.25**
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00040 J	ND	ND	**100**	**500**	**0.19**
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**30**	**390**	**1**
Freon 113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	-	**6**
2-Hexanone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**3.9**
Methyl Acetate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Methylcyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Methyl Tert Butyl Ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**62**	**500**	**0.93**
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**1**
Methylene chloride	ND	ND	0.0020 J	ND	ND	0.0018 J	0.0014 J	ND	ND	0.0018 J	0.0016 J	0.0016 J	**51**	**500**	**0.05**
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**35**	-	**0.6**
Tetrachloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0048	0.00040 J	0.0058	**5.5**	**150**	**1.3**
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.7**
1,2,3-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**3.4**
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.68**
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0051	ND	0.00039 J	**10**	**200**	**0.47**
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00089 J	ND	ND	**0.21**	**13**	**0.02**
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00029 J	ND	ND	**total = 100**	**total = 500**	**total = 1.6**

NOTES:
(1) All concentrations presented in milligrams per kilogram; bold numbers represent an exceedance of the NYSDEC Soil Cleanup Objectives (SCO).
(2) ND - Compound not detected at laboratory detection limits.
(3) J - Estimated value.

TABLE 3.4
CAROL CLEANERS - THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK
Summary of Soil boring Sampling Results - May and June 2017

Sample ID	SWB-14(10')	SWB-14(16')	SWB-15(8')	SWB-15(13.5')	SWB-16(8')	SWB-16(12')	SWB-17(5')	SWB-17(13')	SWB-17(17')	SWB-18(5')	SWB-18(11')	SWB-18(18')	NYSDEC Residential SCO[1]	NYSDEC Commercial SCO[1]	NYSDEC Protection of Groundwater $SCO_{(1)}$
Laboratory ID	**JC44408-2**	**JC44408-3**	**JC44543-18**	**JC44543-22**	**JC44543-24**	**JC44543-27**	**JC44543-19**	**JC44543-14**	**JC44543-26**	**JC44543-16**	**JC44543-23**	**JC44543-25**			
Date Sampled	**05/31/17**	**05/31/17**	**06/02/17**	**06/02/17**	**06/02/17**	**06/02/17**	**06/02/17**	**06/02/17**	**06/02/17**	**06/02/17**	**06/02/17**	**06/02/17**			
Constituent/Compound	**Constituent Concentration (mg/kg)[1]**														
Acetone	0.0128	0.0097	ND	0.0059 J	0.0152	0.0092 J	0.0121 J	ND	0.0088 J	0.0159	ND	ND	**100**	**500**	**0.05**
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.9**	**44**	**0.06**
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
2-Butanone (MEK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.12**
Carbon disulfide	0.0046	0.0024	ND	0.00027 J	0.00088 J	ND	0.00051 J	ND	ND	0.00052 J	ND	ND	**100**	-	**2.7**
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**1.4**	**22**	**0.76**
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**1.9**
Chloroform	0.00035 J	ND	0.00087 J	0.00076 J	0.00098 J	ND	0.0018 J	0.0015 J	0.00095 J	0.00079 J	0.00071 J	0.0011 J	**10**	**350**	**0.37**
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Cyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dibromo-3-chloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**1.1**
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**17**	**280**	**2.4**
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**9.8**	**130**	**1.8**
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**19**	**240**	**0.27**
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**2.3**	**30**	**0.02**
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.33**
cis-1,2-Dichloroethene	0.0014	0.137	0.0024	ND	0.0054	ND	ND	0.0011	ND	ND	ND	ND	**59**	**500**	**0.25**
trans-1,2-Dichloroethene	ND	0.00036 J	ND	ND	0.00017 J	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.19**
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**30**	**390**	**1**
Freon 113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	-	**6**
2-Hexanone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**3.9**
Methyl Acetate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Methylcyclohexane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Methyl Tert Butyl Ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**62**	**500**	**0.93**
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**1**
Methylene chloride	0.0017 J	0.0016 J	ND	ND	ND	0.0015 J	ND	ND	ND	ND	ND	ND	**51**	**500**	**0.05**
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**35**	-	**0.6**
Tetrachloroethene	0.0029	0.0214	0.0093	0.003	0.0087	0.00050 J	0.0017 J	0.0068	0.0014 J	ND	0.00031 J	0.00088 J	**5.5**	**150**	**1.3**
Toluene	ND	ND	0.00019 J	0.00025 J	0.00017 J	ND	ND	ND	ND	0.00025 J	ND	ND	**100**	**500**	**0.7**
1,2,3-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	**3.4**
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**100**	**500**	**0.68**
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Trichloroethene	0.001	0.0224	0.0021	ND	0.0034	ND	ND	0.0011	ND	ND	0.00020 J	ND	**10**	**200**	**0.47**
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-
Vinyl chloride	ND	0.00038 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.21**	**13**	**0.02**
Xylene (total)	0.00034 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**total = 100**	**total = 500**	**total = 1.6**

NOTES:
(1) All concentrations presented in milligrams per kilogram; bold numbers represent an exceedance of the NYSDEC Soil Cleanup Objectives (SCO).
(2) ND - Compound not detected at laboratory detection limits.
(3) J - Estimated value.

TABLE 3.5

CAROL CLEANERS - THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Summary of Reductive Dechlorination Indicator Parameters
January 2013 Pre-Injection through March 2025 Post-Injection

Well ID[1]	Date	Methane	Ethane	Ethene	Acetone	MEK[11]	Sulfate	Carbon Dioxide	BOD[2]	COD[3]	TOC[4]	Alkalinity
		Concentration (ug/L)[5]					Concentration (mg/L)[6]					
Injection Wells - Zone 1												
MW-3	1/30/2013	0.15	ND	ND	ND	ND	31.3	291	<4.5	<20	1.3	228
	1/20/2015	20.7	0.13	1	ND	ND	28	1.72	15	47.6	13.5	227
	4/7/2015	38.8	0.22	1.5	ND	ND	<10	3,700	201	279	92.7	492
	6/30/2015	5.1	ND	0.93	5.0 J	ND	10.9	3,630	26.8	71.3	19.9	433
	10/7/2015	ND	ND	ND	ND	ND	26.4	933	<3.4	<20	2.5	227
	10/6/2016	9	ND	0.43	ND	ND	33.6	980	<3.4	<20	1.3	245
	1/10/2019	66.1	ND	ND	ND	ND	323	147,000	>7,030 [10]	57,600	<500 [10]	7,460 [10]
	4/18/2019	9,010	ND	ND	278	776	<2.0	37,800	2,460	2,020	774	704
	7/18/2019	4,450	ND	ND	ND	ND	11.7	37,900	<270	13,000	86.1	NA
	10/25/2019	3,040	ND	ND	ND	ND	2.3	22,700	ND	475	71.6	ND
	1/29/2020	3,380	ND	ND	ND	ND	ND	11,400	168	381	137	ND
	4/21/2020	2,640	ND	ND	ND	ND	5.5	8,330	120	359	84.1	590
	7/7/2020	3,340	0.67	ND	ND	ND	3.5	6,350	353	269	97.3	600
	10/20/2020	2,630	0.8	ND	ND	ND	ND	6,340	31.1	179	95.5	523
	3/18/2021	3,800	ND	ND	ND	ND	6.3	3,960	49.8	134	44.9	273
	5/27/2021	2,090	6.25	42.2	ND	ND	21.1	1,440	66.2	27.9	12.2	205
	9/29/2021	1,330	66	1.2	ND	ND	ND	1,610	ND	83.5	ND	233
	7/26/2022	1,020	15.7	0.97	ND	ND	8	1,270	1.9	27	12	140
	12/6/2023	75	1.9	3.79	ND	ND	31.4		1.7	27	3.3	177
	3/4/2025	44	0.29	2.7	ND	ND	24.6	1,620	2.2	<20	2.8	191 [c]
MW-5	1/30/2013	ND	ND	ND	ND	ND	35.4	3,090	<3.4	<20	3.4	141
	1/20/2015	77.3	ND	ND	7.9 J	ND	ND	16.5	<43	181	68.3	830
	4/7/2015	5.9	ND	ND	ND	ND	ND	7,200	<5.0	<20	8.6	178
	6/30/2015	0.32	ND	ND	ND	ND	39.9	10,600	<3.4	75.9	20	360
	10/7/2015	ND	ND	ND	ND	ND	50.2	8,400	<5.0	82.5	27.9	406
	10/6/2016	22.4	ND	ND	ND	ND	25.5	9,680	<3.4	36	11.9	299
	1/9/2019	12.4	ND	ND	7.1 J	7.4 J	4.1	17,900	89.7	237	76.5	564
	4/18/2019	9880	ND	1.1	8.4 J	9.7 J	9.2	15,700	50.6	73	19.6	351
	7/18/2019	6210	ND	0.61	ND	ND	17	25,300	<200	50.2	13.6	NA
	10/29/2019	4820	ND	0.72	30	171	5.4	44,700	222	863	181	ND
	1/28/2020	8580	ND	ND	ND	ND	13.7	12,900	158	63.5	18.5	ND
	4/21/2020	608	ND	ND	ND	ND	19.4	8,240	167	43.6	7.8	265
	7/7/2020	656	ND	ND	ND	ND	22	8,230	263	ND	5	136
	10/23/2020	685	ND	ND	ND	554		139,000	1550	7760	5460	3500
	3/19/2021	5910	ND	ND	358	1,470	5.8	37,100	334	1240	408	3750
	5/27/2021	4730	0.33	ND	266	767	7.8	10,100	141	521	228	1970
	9/29/2021	6820	0.8	ND	15.2	ND	ND	8,020	ND	86	ND	505
	7/27/2022	4,620	1.8	2.5	6.0 J	ND	10.2	4,970	13.9	97.2	64.2	275
	12/5/2023	599	ND	ND	ND	ND	24.9		6.6	35.1	4.8	177
	3/5/2025	43	ND	ND	ND	ND	54.6	4,050	2.6	36	8.1	120 [c]
Injection Area - Zone 2												
MW-7	1/30/2013	0.39	ND	ND	4.8 J	ND	37	182	<3.4	<20	1.5	238
	10/7/2015	ND	ND	ND	ND	ND	32.2	454	<2.0	<20	1.6	197
	10/6/2016	ND	ND	ND	ND	ND	33	865	<3.4	<20	1.1	223
	1/9/2019	0.26	ND	ND	39.3 J	501	419	152,000	>6,600 [10]	56,800	13,100	10,200
	4/17/2019	5,470	ND	0.54	144	1,590	2.9	91,300	>6,860	17,600	4,180	2,590
	7/18/2019	6,050	ND	ND	329	2,800	<2.0	63,000	<2,700	14,600	1,170	NA
	10/25/2019	5,850	ND	ND	ND	ND	3.9	34,600	ND	1,430	259	ND
	1/28/2020	4,140	ND	ND	ND	ND	6	17,100	362	809	260	ND
	4/21/2020	2,590	ND	ND	ND	ND	3.4	9,440	191	256	101	563
	7/7/2020	2,540	ND	1.6	ND	ND	7.3	4,010	338	114	43.9	312
	10/23/2020	1,170	ND	1.2	59	103	ND	118,000	1,560	7,530	1,020	918
	3/17/2021	7,610	ND	ND	797	3,250	4	37,200	232	2,930	771	5,100
	5/26/2021	4,890	ND	ND	1,100	4,320	91.5	13,800	140	1,670	737	5,060
	9/28/2021	5,200	ND	ND	ND	ND	ND	22,700	3.6	627	215	5,290
	7/26/2022	3,790	0.38	ND	8.0 J	ND	<2.0	5,900	17.6	116	232	1,350
	12/7/2023	ND	ND	ND	15.6 J	ND	ND		10.5	431	69.5	622
	3/5/2025	470	0.62	0	ND	ND	14	2,790	4.4	61	7.6	255 [c]
MW-20	10/4/2016	7.5	0.43	ND	ND	ND	36.4	4,110	<2.0	<20	2.6	327
	1/8/2019	2,270	ND	ND	232	243	10.1	97,700	4,160	5,700	1,830	1,870
	4/17/2019	11,000	ND	ND	390	735	<2.0	68,700	917	1,930	619	1,750
	7/23/2019	8,890	ND	ND	ND	ND	8.5	48,500	<330	511	177	1,890
	10/29/2019	473	ND	ND	70.9	145	246	140,000	15,100	28,600	11,000	ND
	1/28/2020	7,070	ND	ND	1,380	3,140	2.2	33,900	2,410	2,670	1,210	ND
	4/21/2020	3,050	ND	ND	ND	ND	2.7	24,200	373	1,330	500	3,960
	7/8/2020	1,840	ND	ND	ND	ND	ND	27,400	128	829	235	2,050
	10/20/2020	5,300	ND	0.68	ND	ND	5.9	20,800	36.1	308	120	1,400
	3/16/2021	5,580	ND	1.4	13.8	ND	6.6	13,600	121	142	39.7	178
	5/26/2021	1,240	ND	3.99	ND	ND	36.3	2,000	3	78.4	26.6	392
	9/30/2021	72.9	ND	ND	6.6	ND	27	4,240	1	27.8	15.3	342
	12/7/2023	ND	ND	ND	ND	ND	30.5		1	21.6	3	297
	3/5/2025	18	ND	ND	ND	ND	25.1	1,850	1	44.5	4	278 [c]
MW-21	10/6/2016	2.3	ND	ND	ND	ND	40.8	1,400	<3.4	<20	1.4	252
	1/9/2019	296	ND	ND	21.7	20.9	13.5	7,710	81.7	131	13.2	130 [10]
	4/17/2019	3,500	ND	ND	7.4 J	11.5	12.3	10,800	18.4	70.3	14.9	118
	7/23/2019	2,550	ND	ND	9.1 J	ND	8.5	20,700	<330	97.5	23.7	138
	10/29/2019	937	ND	ND	36.3	194	114	89,900	15200	28200	12100	ND
	1/28/2020	4,980	ND	ND	592	3,480	ND	31,800	2770	2570	1520	ND
	4/21/2020	3,520	ND	ND	368	728	3.9	6,540	373	1230	358	2500
	7/8/2020	6,520	ND	ND	ND	ND	ND	33,800	123	878	276	2050
	10/20/2020	6,400	ND	ND	7.7	ND	18.7	24,500	19.8	308	96.5	373
	3/17/2021	4,220	ND	ND	ND	ND	8.9	19,400	396	179	30.5	823
	5/26/2021	1,110	ND	ND	ND	ND	24.3	7,140	1.4	38	16.5	62
	9/29/2021	1,270	ND	ND	ND	ND	17.1	5,990	ND	50.6	15	286
	12/6/2023	639	ND	ND	ND	ND	29.6		11.3	29.7	5.6	219
	3/5/2025	11	ND	ND	ND	ND	32.7	1,160	5.3	114.0	9.6	116 [c]
MW-22	10/6/2016	2.8	ND	ND	ND	ND	39.7	1,210	<3.4	24	1.1	256
	1/9/2019	15	ND	ND	ND	805 J	59	126,000	>6,610 [10]	24500	21400	9,300 [10]
	3/17/2021	8,590	ND	ND	ND	ND	13.1	14,200	146	147	43	413
	5/26/2021	3,020	ND	ND	ND	ND	28.3	9,550	34.8	53.1	14.4	269
	9/29/2021	2,050	ND	ND	4.5	ND	11.1	6,430	13.3	50.6	16	234
	12/7/2023	ND	ND	ND	3.7 J	ND	23		8.8	37.8	4.7	297
	3/4/2025	1,000	ND	ND	15.1	5.0 J	30.1	2,950	2.3	<20	3.6	262 [c]
MW-23	10/5/2016	4	ND	ND	ND	ND	27.3	3,080	<3.4	<20	<1.0	241
	1/8/2019	5,980	ND	ND	518	970	7.2	75,900	>2,210 [10]	4410	1450	1,860 [10]
	3/18/2021	437	ND	ND	ND	ND	27	2,040	227	31.6	1.8	119
	5/28/2021	189	ND	ND	ND	ND	27.4	1,310	76	28	3.4	215
	9/28/2021	277	ND	ND	ND	ND	ND	1,170	ND	ND	3.8	204
	7/26/2022	300	ND	ND	3.7 J	ND	21.8	1,720	8.1	<20	42.9	201
	12/6/2023	5.5	ND	ND	ND	ND	25.3		2.6	ND	1.2	216
	3/5/2025	0.3	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 [c]

TABLE 3.5

CAROL CLEANERS - THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Summary of Reductive Dechlorination Indicator Parameters
January 2013 Pre-Injection through March 2025 Post-Injection

Well ID[1]	Date	Methane	Ethane	Ethene	Acetone	MEK[11]	Sulfate	Carbon Dioxide	BOD[2]	COD[3]	TOC[4]	Alkalinity
		Concentration (ug/L)[5]					Concentration (mg/L)[6]					
MW-24	10/5/2016	0.27	ND	ND	ND	ND	23.2	1120	<1.0	<20	<1.0	230 c
	1/8/2019	0	ND	ND	ND	ND	23	1,120	<1.0	<20	<1.0	230 c
	4/17/2019	0.27	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 c
	7/18/2019	0.27	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 c
	10/25/2019	0.27	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 c
	1/29/2020	0.27	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 c
	4/21/2020	0.27	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 c
	7/7/2020	0.27	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 c
	10/20/2020	0.27	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 c
	3/18/2021	0.27	ND	ND	ND	ND	23.2	1,120	<1.0	<20	<1.0	230 c
	5/28/2021	ND	ND	ND	ND	ND	22.3	1,180	146	33	5.1	269
	9/29/2021	0.84	ND	ND	ND	ND	ND	1,170	ND	144	ND	238
	12/6/2021	0.32	ND	ND	3.7 J	ND	20.3		4.4	27	3.7	219
	3/7/2025	ND	ND	ND	ND	ND	17.9	1390	2.3	61.2	4.9	104 a
Injection Area - Zone 3												
MW-9	1/29/2013	3.6	ND	ND	ND	ND	39.5	319	<5.0	<20	3.4	243
	10/6/2015	ND	ND	ND	ND	ND	<10	1,770	<3.4	<20	5.1	61.7
	10/4/2016	NS[7]	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	WELL MW-9 ABANDONED											
MW-11	1/29/2013	1.8	ND	ND	ND	ND	36.6	526	<5.0	<20	2	253
	10/6/2015	2.7	ND	ND	ND	ND	<10	4,790	<2.0	<20	2.5	315
	10/10/2016	451	0.28	ND	ND	ND	27.3	329	<3.4	<20	2	307
MW-12	1/29/2013	62.1	ND	ND	ND	ND	40	1,290	<5.0	<20	4.9	426
	10/6/2015	0.92	ND	ND	ND	ND	20.1	14,500	<3.4	<20	5.8	316
	10/10/2016	415	1	ND	ND	ND	22.2	10,000	<3.4	45.6	5.7	321
	4/17/2019	744	0.31	ND	ND	ND	25.5	10,100	917	40.5	5.4	377
	7/23/2019	1320	0.54	ND	ND	ND	22.2	13,300	24	30	6.8	456
	10/28/2019	2.8	ND	ND	229	199	202	150,000	14000	29500	8720	ND
	1/30/2020	3990	ND	ND	376	538	ND	50,200	2210	3690	1310	ND
	4/22/2020	2860	ND	ND	595	701	ND	53,000	1430	2100	394	2,300
	7/9/2020	3960	ND	ND	140	210	ND	50,200	203	561	140	2,150
	10/20/2020	1470	ND	ND	ND	ND	ND	48,700	15.4	308	99.3	1,870
MW-13	1/29/2013	2.9	ND	ND	ND	ND	43	759	<5.0	<20	3.2	342
	10/6/2015	2.4	ND	ND	ND	ND	12.6	1,870	<2.0	<20	3.7	299
	10/4/2016	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4/17/2019	8,300	ND	1.2	8.3 J	8.4 J	13.6	16,600	57.6	122	40.2	482
	7/23/2019	10,800	0.92	ND	11	13	10.7	18,300	<330	25	14.8	444
	10/28/2019	4,740	0.51	ND	ND	ND	18.9	17,300	54.2	90.9	19.3	ND
	1/29/2020	3,890	ND	ND	ND	ND	11.3	8,890	15.7	147	46.9	ND
	4/22/2020	3,720	1.1	ND	ND	ND	28.9	7,170	4.5	59	11.4	445
	7/9/2020	4,820	1.1	ND	7	ND	6.6	3,720	7.8	ND	12.8	369
	10/20/2020	2,690	0.83	ND	ND	ND	26.7	5,240	9.3	68.6	13.9	325
Monitor Wells within Treatment Area												
MW-3D	2/1/2013	0.96	ND	ND	ND	ND	10.4	ND	<3.4	<20	<1.0	229
	1/20/2015	40.5	ND	0.25	ND	ND	ND	ND	46	76.2	21.1	249
	4/7/2015	11.4	ND	0.29	ND	ND	10.7	ND	8.6	27.8	8.7	181
	6/30/2015	0.21	ND	ND	ND	ND	<10	ND	<3.4	<20	1.8	203
	10/7/2015	ND	ND	ND	ND	ND	<10	ND	<2.0	<20	1.5	211
	10/5/2016	0.98	ND	ND	ND	ND	10.4	ND	<3.4	<20	<1.0	268
	1/10/2019	3.7	ND	ND	ND	ND	8.3	ND	<3.4	<20	4.2	257
	4/18/2019	0.33	ND	ND	ND	ND	13.4	ND	16.3	29.7	1.6	143
	7/18/2019	6.7	ND	ND	ND	ND	10.8	ND	<3.4	<20	1	NA
	10/25/2019	6.7	ND	ND	ND	ND	11.5	ND	ND	ND	ND	ND
	1/29/2020	4.7	ND	ND	ND	ND	6.7	ND	2.7	ND	1.5	ND
	4/21/2020	2.2	ND	ND	ND	ND	8.3	ND	1.5	ND	1.2	116
	7/7/2020	3.6	ND	ND	ND	ND	10.4	ND	ND	ND	1.2	224
	10/20/2020	4.1	ND	ND	ND	ND	11.2	ND	ND	ND	1.7	174
	3/18/2021	0.18	ND	ND	ND	ND	9.2	ND	3	31.6	1.2	105
	5/27/2021	ND	ND	ND	ND	ND	15.2	ND	ND	ND	3.1	170
	7/26/2022	0.3	ND	ND	ND	ND	14.6	ND	<1	<20	2.4	114
MW-4	1/30/2013	2	0.26	ND	ND	ND	35.6	1,730	<3.4	<20	1.3	241
	1/20/2015	40.8	2.9	7.3	ND	ND	ND	4.66	108	143	61.6	380
	4/7/2015	48.8	1.2	4	ND	ND	<10	4,840	273	354	94	426
	6/30/2015	21.2	ND	2.3	ND	ND	<10	8,350	>227	1,490	158	578
	10/7/2015	12.1	ND	ND	26	41.9	16.5	13,000	16	52.5	18.1	521
	10/5/2016	1,340	0.28	14.4	ND	ND	30.8	7,940	4.7	<20	3.4	332
	1/8/2019	957	ND	ND	ND	356 J	298	157,000	7,520	57,600	23,500	13,400
	4/18/2019	5,250	ND	ND	430	1,190	<2.0	108,000	6,530	2,280	2,480	2,370
	7/18/2019	4970	ND	ND	435	1,390	16.6	71,900	2,720	14,300	1,210	NA
	10/29/2019	560	ND	ND	71.5	272	318	136,000	15,100	28,200	16,400	ND
	1/28/2020	4830	ND	ND	1,720	10,300	3.3	64,000	17,000	10,700	11,900	ND
	4/21/2020	3890	ND	ND	1,910	8,140	ND	57,800	14,800	47,500	9,740	10,300
	7/7/2020	6470	ND	ND	1,810	8,300	ND	14,800	15,700	19,500	6,320	9,350
	10/23/2020	1700	ND	ND	39.1	462	ND	104,000	4,910	7,530	2,650	2,130
	3/19/2021	7270	ND	ND	913	5,840	ND	54,700	6,370	8,440	5,270	8,080
	5/27/2021	5,230	ND	ND	947	4250	ND	16,400	4,060	10,500	5,880	11,200
	9/29/2021	2,360	ND	ND	1510	8120	ND	34,400	14,400	12,300	6,300	11,600
	12/6/2023	3020	ND	0.28 J	56.7 J	171	ND		93.6	3920	751	7150
	3/7/2025	4560	ND	0.26 J	16.1 J	ND	<40	12500	95.7 d	1180	481	3600 f
MW-8	1/30/2013	4.9	ND	ND	ND	ND	41.3	1,340	<3.4	<20	1.1	227
	10/7/2015	ND	ND	ND	ND	ND	33.2	3,690	<3.4	<20	4	192
	10/6/2016	22.7	ND	ND	ND	ND	39.2	4,940	<3.4	26.4	1	224
	1/9/2019	16.8	ND	ND	ND	ND	29	2,250	<5.0	30.6	3.5	202
	4/17/2019	9.8	ND	ND	ND	ND	31.7	5,740	<5.0	37.8	6.7	192
	7/18/2019	19	ND	ND	ND	ND	31.8	8,960	ND	23.8	3.8	ND
	10/29/2019	0.45	ND	ND	171	84.1	262	33,000	15100	29500	8090	ND
	1/28/2020	6340	ND	ND	252	718	ND	25,800	657	904	313	ND
	4/21/2020	4500	ND	ND	23.2	38.8	3.3	10,200	312	210	91.9	705
	7/7/2020	5860	ND	ND	ND	ND	3.7	6,100	68	107	38	528
	10/23/2020	200	ND	ND	30.7	21.5	ND	14,700	257	1060	521	453
	3/17/2021	9520	ND	ND	21.9	ND	3.2	11,100	632	189	43.4	1200
	5/26/2021	5900	ND	ND	9.9	ND	17.7	5,730	24.8	309	103	1200
	9/29/2021	2980	ND	ND	ND	ND	ND	6,290	33.5	434	102	1000
	7/26/2022	1,180	ND	3.68	ND	ND	25.7	12,000	2.0	48.6	35.1	320
	12/6/2023	163	0.16 J	2.70	ND	ND	31.3		1.3	29.7	3.2	230
	3/7/2025	2.17	ND	0.27 J	3.2 J	ND	29.6	726	2.3	44.5	7.7	169 a
Monitor Wells Outside Treatment Area												
MW-1	2/1/2013	5.7	ND	ND	ND	ND	49.7	1,890	<3.4	40.9	4.3	305
	10/8/2015	ND[8]	ND	ND	ND	ND	44.1	6,350	<2.0	<20	2	263
	10/4/2016	ND	ND	ND	ND	ND	52.1	6,700	116	182	45.4	256

TABLE 3.5

CAROL CLEANERS - THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Summary of Reductive Dechlorination Indicator Parameters
January 2013 Pre-Injection through March 2025 Post-Injection

Well ID[1]	Date	Methane	Ethane	Ethene	Acetone	MEK[11]	Sulfate	Carbon Dioxide	BOD[2]	COD[3]	TOC[4]	Alkalinity
		Concentration (ug/L)[5]					Concentration (mg/L)[6]					
MW-2[9]	2/1/2013	8.2	ND	ND	48.3	ND	60.8	259	117	904	74.8	29.2
	10/8/2015	17.6	ND	ND	4.1 J	ND	11.4	6,200	25.3	74.2	32	408
	10/4/2016	4370	ND	ND	ND	ND	<10	4,290	8.4	67.2	58.6	210
	1/9/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/19/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/29/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/22/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/8/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/21/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3/17/2021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/24/2021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/29/2021	1670	0.32	ND	13.8	ND	ND	5,999	ND	48.1	676	485
	12/8/2023	419	ND	ND	24.1	10.4	37.9		17.8	823	6	402
	3/7/2025	78.2	ND	ND	10.5	ND	45.6	4,820	15.1 d	147	9.5	300 a
MW-6R	2/1/2013	ND	ND	ND	ND	ND	35.4	156	<3.4	<20	2.1	270
	10/7/2015	ND	ND	ND	ND	ND	32.8	567	<2.0	<20	1.9	194
	10/5/2016	ND	ND	ND	ND	ND	30.3	749	<3.4	<20	3.3	166
	1/9/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/19/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/25/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/29/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/22/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/8/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/21/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3/18/2021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/24/2021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/29/2021	0.16	ND	ND	ND	ND	ND	362	ND	ND	2.7	172
	12/6/2023	0.13	ND	ND	ND	ND	20		ND	ND	1.9	212
	3/5/2025	ND	ND	ND	ND	ND	3.8	153	<1.0	<20	<1.0	70.4 c
MW-10	1/31/2013	0.89	ND	ND	ND	ND	48.2	611	<3.4	<20	2.4	294
	10/8/2015	ND	ND	ND	ND	ND	44.2	1200	<2.0	<20	1.5	258
	10/5/2016	1.2	ND	ND	ND	ND	44.8	1730	<2.0	<20	1.2	280
	1/9/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/19/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/18/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/25/2019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/29/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/22/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/8/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/21/2020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3/17/2021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/24/2021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	9/29/2021	0.6	ND	ND	5.1	ND	31.6	2550	ND	ND	9.9	240
	12/7/2023	ND	ND	ND	ND	ND	30.8		ND	ND	1.7	224
	3/7/2025	0.10 J	ND	ND	ND	ND	31.5	3030	2.3	58.4	3.6	216 a
MW-14	1/31/2013	27.9	ND	ND	ND	ND	48.4	3,950	<3.4	<20	3.5	261
	10/8/2015	ND	ND	ND	ND	ND	43.3	8,330	<3.4	<20	2.9	290
	10/4/2016	4.3	ND	ND	ND	ND	38.2	15,000	<3.4	<20	59.4	301
MW-15	1/28/2013	0.39	ND	ND	ND	ND	50	701	<5.0	<20	2.1	364
	10/8/2015	ND	ND	ND	ND	ND	43.1	2,670	<2.0	<20	1.8	302
	10/4/2016	1.8	ND	ND	ND	ND	39.1	2,990	<2.0	<20	2.3	308
MW-16	1/31/2013	0.17	ND	ND	ND	ND	40.5	1,580	<3.4	<20	2.4	265
	10/8/2015	ND	ND	ND	ND	ND	35.7	4,510	<2.0	<20	1.7	218
	10/7/2016	ND	ND	ND	ND	ND	37.9	4,870	<3.4	<20	1.5	253
	1/9/2019	1,670	ND	ND	ND	882 J	<20 [10]	181,000	>7,000 [10]	645	<200 [10]	3,900 [10]
	4/17/2019	8,660	ND	0.34	325	473	3.1	69,700	2,910	4,390	928	2,150
	7/23/2019	8,840	ND	ND	204	365	7.2	64,500	<410	1,090	154	3,750
	10/28/2019	2,420	ND	0.5	108	491	211	122,000	14,200	28,200	9940	ND
	1/30/2020	3,930	ND	ND	1,020	3,790	ND	38,900	10,700	25,600	5760	ND
	4/22/2020	3,780	ND	ND	669	1,790	ND	33,200	2,340	6,360	1790	853
	7/9/2020	4,750	ND	ND	ND	ND	ND	37,200	225	1,390	550	3,950
	10/22/2020	5,810	ND	ND	ND	ND	2.7	20,900	33.8	894	263	2,520
	3/16/2021	9,120	ND	ND	ND	ND	5.3	25,400	289	667	23.4	2,870
	5/25/2021	1,590	0.43	ND	7.4	ND	6.8	8,970	48	690	193	2,140
	9/30/2021	6,220	0.82	ND	ND	ND	9.4	16,600	7	98.7	101	453
	12/7/2023	ND	ND	ND	ND	ND	4.6		3.1	51.3	8.9	167
	3/4/2025	1,150	0.29	ND	ND	ND	12.4	1,340	6.2 d	26.7	5.6	217 c
MW-17	1/31/2013	1.1	ND	ND	ND	ND	38.9	607	<3.4	<20	1.1	237
	10/8/2015	1.4	ND	ND	ND	ND	28.6	1,650	<2.0	<20	1.6	240
	10/7/2016	8.6	ND	ND	ND	ND	35.7	2,380	<3.4	<20	1.3	268
	1/10/2019	979	ND	ND	ND	85.9	<10 [10]	34,200	856	1,460	518	4,460 [10]
	4/18/2019	5,390	ND	ND	213	492	23.6	28,500	2,380	1,300	773	1,990
	7/23/2019	7,640	ND	2.8	53.6	402	12.3	47,900	<410	724	105	1,930
	10/28/2019	1,950	ND	2.4	ND	141	258.0	148,000	14,100	29,100	7610	ND
	1/30/2020	5,900	ND	20.2	1,470	9,450	ND	49,600	17,200	46,400	7260	ND
	4/23/2020	4,690	4	8.1	1,100	4,910	3.2	33,200	3,690	8,690	2690	2,910
	7/9/2020	6,340	9.8	2.9	440	1,460	6.7	25,900	380	1,190	284	ND
	10/22/2020	6,590	3.7	5.5	79	968	ND	59,300	1,560	7,760	2050	1,990
	3/16/2021	8,390	12.3	ND	ND	28.2	5.6	26,000	89.1	1,090	38.1	3,100
	5/25/2021	6,460	24.5	2	5.7	ND	8.6	5,670	40	809	189	2,210
	9/30/2021	6,840	19.7	3.09	ND	ND	8.6	9,360	2.2	91.1	27.8	499
	7/27/2022	3,040	12.2	0.51	8.2 J	113	18.9	5,770	12.8	113	98.3	724
	12/7/2023	ND	ND	ND	ND	ND	ND		13.3	372	70.2	931
	3/4/2025	4,790	7.35	0.45	ND	ND	25.4	3,750	8.5	117	29.8	371 c
MW-18	1/31/2013	68.5	ND	ND	ND	ND	38.7	3,500	<3.4	<20	2.4	262
	10/8/2015	0.27	ND	ND	ND	ND	38.9	8,810	<2.0	25.6	6.6	356
	10/7/2016	18.7	ND	ND	ND	ND	29.8	9,000	<3.4	33.6	2.1	254
	1/10/2019	467	0.26	1.8	ND	641	<10 [10]	183,000	>2,340 [10]	13,100	<100 [10]	2,940 [10]
	4/18/2019	6,810	2.4	1.7	241	754	8.1	98,800	2,330	1,380	544	2,120
	7/23/2019	9,350	3.6	ND	ND	6.9 J	12.0	51,500	<330	100	25.9	613
	10/28/2019	2,000	0.24	ND	468	3,630	22.6	82,600	9,900	18,200	5120	ND
	1/30/2020	4,870	ND	ND	485	2,530	ND	30,600	1,540	1,760	426	ND
	4/23/2020	4,230	1.2	ND	20.6	88.7	ND	29,500	363	126	254	2,450
	7/9/2020	6,210	1.6	ND	ND	ND	9.6	17,300	59.9	119	64.5	915
	10/22/2020	2,150	1.9	0.74	ND	ND	26.1	4,600	4.8	27.9	7.3	343
	3/16/2021	2,310	1.1	0.61	ND	ND	28.5	1,420	99.7	55.2	7.1	355
	5/25/2021	1,560	1.4	1.4	ND	ND	33.8	1,180	29	60.8	6.5	265
	9/30/2021	1,580	1.4	1.1	ND	ND	31	1,780	ND	25.3	6.1	263
	7/27/2022	420	0.54	ND	ND	ND	30	1,580	2.7	<20	3.4	240
	12/8/2023	49.4	0.17 J	ND	ND	ND	30.3		ND	ND	2.1	249
	3/4/2025	16.2	0.20 J	ND	ND	ND	30.1	1,300	1.8 e	<20	1.0	250 c

TABLE 3.5

CAROL CLEANERS - THE CROSSINGS AT STATEN ISLAND MALL
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Summary of Reductive Dechlorination Indicator Parameters
January 2013 Pre-Injection through March 2025 Post-Injection

Well ID[1]	Date	Methane	Ethane	Ethene	Acetone	MEK[11]	Sulfate	Carbon Dioxide	BOD[2]	COD[3]	TOC[4]	Alkalinity
		Concentration (ug/L)[5]					Concentration (mg/L)[6]					
MW-19	1/30/2013	ND	ND	ND	ND	ND	32.3	882	<3.4	<20	1.2	205
	10/8/2015	2.1	ND	ND	ND	ND	24.2	4,270	<2.0	<20	2.9	268
	10/7/2016	92.6	0.41	ND	ND	ND	30.6	2,950	<3.4	26.4	1.8	280
	1/10/2019	2,000	ND	ND	300	734	<20 [10]	189,000	>7,920 [10]	12,900	<200 [10]	4,460 [10]
	4/18/2019	11,000	ND	6.3	178	769	<2.0	53,900	1,920	1,160	408	1,670
	7/23/2019	8,820	ND	ND	12.8	26.1	7.2	39,500	<330	255	37.6	888
	10/28/2019	3,380	ND	0.32	ND	230	187	85,700	14,000	30,000	9850	ND
	1/30/2020	5,160	ND	ND	2,870	17,400	5.9	41,400	11,200	23,800	7880	ND
	4/23/2020	4,820	0.3	ND	1,180	6,790	13.9	27,000	1,340	2,830	1130	5,400
	7/9/2020	6,140	0.56	0.56	13.1	65.8	7.5	19,100	105	585	183	1,520
	10/22/2020	7,130	1.6	3	ND	14.2	48.8	8,430	26.9	198	88	893
	3/16/2021	9,690	1.5	ND	ND	ND	19.5	5,620	128	311	94.5	628
	5/25/2021	6,740	1	ND	ND	ND	21.7	2,200	18.5	104	30.2	360
	10/1/2021	1,970	0.69	ND	9.2	ND	18.1	2,310	8.6	86	17	337
	7/27/2022	1,840	0.31	0.55	6.3 J	ND	22	1,420	3.8	27	16	252
	12/8/2023	609	0.15 J	ND	ND	ND	20.6		ND	21.6	3.1	233
	3/4/2025	481	ND	ND	3.6 J	ND	22.1	504	2.4 e	<20	1.9	235 c

Notes:
[1] See Figure 2.
[2] BOD - Biological Oxygen Demand.
[3] COD - Chemical Oxygen Demand.
[4] TOC - Total Organic Carbon.
[5] Micrograms per liter.
[6] Milligrams per liter.
[7] NS - Not Sampled. MW-9 and MW-13 were not accessible due to street paving activities at the time of sampling.
[8] ND - Not Detected.
[9] Monitoring Well MW-2 is located within the perimeter zone upgradient of the source area. This monitoring well routinely exhibits microbiological activity.
[10] Elevated sample detection limit due to difficult sample matrix (sodium lactate content required 3 separate dilutions)
[11]MEK - 2-Butanone

TABLE 4

CAROL CLEANERS SITE
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 1 Injection Wells

Well ID[1]	MW-3																			NYSDEC Class GA Groundwater Standards
Date Sampled	**01/30/13**	**01/20/15**	**04/07/15**	**06/30/15**	**10/07/15**	**10/05/16**	**01/10/19**	**04/18/19**	**07/18/19**	**10/24/19**	**01/29/20**	**04/21/20**	**07/07/20**	**10/20/20**	**03/18/21**	**05/27/21**	**09/29/21**	**07/26/22**	**12/06/23**	**03/04/25**	
Constituent																				
Total Metals																				
Aluminum	<100	**167**	**129**	<200[4]	<200[4]	<200[4]	**10,800** [4]	**272**	**<400** [4]	**ND (2000) c**	<2000	<2000	**225**	<1000	<1000	<200	**691**	NA	**435**	<200	**100**
Barium	<200	<200	269	316	352	257	<2,000 [4]	<200	<400 [4]	ND (2000) c	<2000	<2000	<200	<1000	<1000	<200	<200	NA	<200	<200	**1,000**
Cobalt	<5.0	<5.0	<5.0	<50[4]	<50[4]	<50[4]	<500 [4]	<50	<100 [4]	ND (500) c	<500	<500	<50	<250	<250	<50	<50	NA	<50	<50	**5**
Iron	**307**	**1,710**	**2,260**	**2,780**	**1,530**	**540**	**135,000** [4]	**23,600**	**10,300** [4]	**12500 c**	**9,520**	**9,070**	**7,510**	**5,460**	**16,800**	**896**	**1,790**	NA	**2,740**	**777**	**300/500**[3]
Manganese	155	**1,600**	**7,940**	**3,660**	**1,190**	**429**	**9,070** [4]	**3,010**	**1,780** [4]	**2270 c**	**1,630**	**1,900**	**1,620**	**1,140**	**593**	88	**350**	NA	**691**	293	**300/500**[3]
Nickel	14	<10	<10	<10	<10	<10	**613** [4]	15	24.4 [4]	ND (100) c	<100	<100	34	<50	<50	<10	26	NA	<10	<10	**100**
Sodium	**133,000**	**150,000**	**217,000**	**169,000**	**210,000**	**191,000**	**7,570,000** [4]	**535,000**	**276,000** [4]	**454000 c**	**397,000**	**567,000**	**639,000**	**526,000**	**211,000**	**38,300**	**168,000**	NA	**148,000**	**166,000**	**20,000**
Dissolved Metals																					
Aluminum	<100	<100	<100	<200[4]	<200[4]	<200[4]	**9,410** [4]	<200	<200	ND (2000) c	<2000	<1000	<200	<200	<1000	<200	<200	NA	NA	<200	**100**
Barium	<200	<200	247	285	325	223	<2,000 [4]	<200	<200	ND (2000) c	<2000	<1000	<200	<200	<1000	<200	<200	NA	NA	<200	**1,000**
Cobalt	<5.0	<5.0	<5.0	<50[4]	<50[4]	<50[4]	<500 [4]	<50	<50	ND (500) c	<500	<250	<50	<50	<250	<50	<50	NA	NA	<50	**5**
Iron	<100	<100	<100	<100	<100	<100	**117,000** [4]	**14,700**	**6,480**	**7730 c**	**3,210**	**2,720**	**1,970**	**2,780**	**1,380**	120	**785**	NA	NA	<100	**300/500**[3]
Manganese	<15	**1,470**	**7,420**	**3,700**	**1,390**	**491**	**7,700** [4]	**3,450**	**1,680**	**2030 c**	**1,360**	**1,040**	**1,330**	**703**	283	18	**311**	NA	NA	239	**300/500**[3]
Nickel	<10	<10	<10	<10	<10	<10	**545** [4]	14	17	ND (100) c	<100	<50	26	25	<50	<10	21	NA	NA	<10	**100**
Sodium	**138,000**	**143,000**	**208,000**	**160,000**	**193,000**	**180,000**	**7,000,000** [4]	**615,000**	**359,000**	**443000 c**	**386,000**	**317,000**	**588,000**	**360,000**	**274,000**	**21,200**	**163,000**	NA	NA	160,000	**20,000**
Nitrates and Nitrites (mg/L)[5]																					
Nitrogen, Nitrate	2	<0.11	<0.11	<0.11	0	-	0	<0.15	<0.11	**290 h**	0	0	<0.15	<10	<0.11	0	<0.2	1.4	0.22	<0.11 b	**10 (total)**
Nitrogen, Nitrate + Nitrite	2	<0.10	<0.10	0	0	-	0	<0.10	<0.10	**290**	0	0	0	<0.1	<0.1	0	0	1.4	0.22	<0.10	
Nitrogen, Nitrite	<0.010	<0.010	<0.010	<0.010	<0.002	-	<0.010	<0.050	<0.010	ND (100)	<0.01	0	0	10	<0.01	0	<0.1	<0.010	<0.010	<0.010	
Field Parameters																					
pH (s.u.)[6]	8.18	8.37	6.94	7.71	8.39	8.37	6.68	6.63	7.8	7.18	7.29	7.32	7.44	6.84	**6.18**	8.37	7.84	7.68	7.41	6.94	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	1.27	1.35	2.1	1.67	1.91	1.5	19	2.52	1.76	2.39	2.36	1.56	2.17	1.63	1.36	1.5	0.721	0.692	0.932	9.31	--
Turbidity (NTU)[8]	**15.9**	**24**	**11.11**	**6.9**	2.5	**5.4**	**709**	**44**	**57.7**	**51.6**	**50.5**	**14.5**	**14.3**	**10.3**	3.1	**5.4**	**25.2**	**39.3**	1.9	1.9	**5**
Dissolved Oxygen (mg/L)	1.66	0.51	10.31	6.11	0.33	6.9	4.48	0.95	1.65	0	7.48	4.45	0	0.68	7.72	6.9	6	1.82	0.1	0	--
Temperature (°C)[9]	16.18	14.74	14.26	19.33	23.45	23.39	13.23	13.76	22.59	22.58	13.74	15.25	20.04	21.6	23.24	23.39	22.97	22.6	18.94	13.42	--
REDOX (mV)[10]	157	-42	-199	-231	-60	-37	-236	-53	-112	-62	-86	-101	-148	-114	-112	-37	-130	-161	-163	-64	--

NOTES:
[1] See Figure 2.
[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.
[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).
[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.
[4] The detection limit is raised due to dilution required for possible matrix interference.
[5] There is no Class A groundwater standard for this constituent.
[5] Milligrams per liter (mg/L).
[6] Standard units (s.u.).
[7] Microsiemens per centimeter (mS/cm).
[8] Nephelometric turbidity units (NTU).
[9] Degrees Celcius (°C).
[10] Millivolts (mV).
NR - Not recorded

TABLE 4

CAROL CLEANERS SITE
BROOKFIELD RETAIL PROPERTIES
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 1 Injection Wells

Well ID[1]	MW-5																			NYSDEC Class GA Groundwater Standards
Date Sampled	**01/30/13**	**01/20/15**	**04/09/15**	**06/30/15**	**10/07/15**	**10/06/16**	**01/09/19**	**04/18/19**	**07/18/19**	**10/29/19**	**01/28/20**	**04/21/20**	**07/07/20**	**10/23/20**	**03/19/21**	**05/27/21**	**09/29/21**	**07/27/22**	**12/05/23**	**03/04/25**	
Constituent																					
Total Metals																					
Aluminum	<100	**1,310**	--	**257**	**3,380**	**2,220**	**1,630**	<200	<200	**1,090**	**805**	**1,310**	**339**	<10000	<2000	<1000	**627**	NA	**1,400**	**512**	**100**
Barium	<200	<200	826	314	<200	<200	<200	<200	<200	<1000	<200	<200	<200	<10000	<2000	<1000	<200	NA	<200	<200	**1,000**
Cobalt	<5.0	**6**	**98**	<50[4]	<50[4]	<50[4]	<50	<50	<50	<250	<50	<50	<50	<2500	<500	<250	<50	NA	<50	<50	**5**
Iron	194	**8,190**	**12,000**	**4,410**	**2,530**	**3,210**	**6,010**	**25,500**	**13,200**	**7,040**	**12,000**	**7,860**	**14,400**	**39,500**	**33,900**	**41,300**	**6,820**	NA	**21,800**	**789**	**300/500[3]**
Manganese	<15	**11,800**	**35,700**	**13,500**	**2,480**	**865**	**813**	**5,110**	**4,020**	**719**	**1,800**	**958**	**3,000**	**3,340**	**4,100**	**7,200**	**1,370**	NA	**875**	**674**	**300/500[3]**
Nickel	<10	14	100	21	47	28	17	<10	<10	<50	<10	11.2	<10	<500	<100	<50	<10	NA	36.5	20.9	**100**
Sodium	**177,000**	**280,000**	**2,420,000**	**1,430,000**	**494,000**	**379,000**	**368,000**	**658,000**	**586,000**	**406,000**	**289,000**	**251,000**	**282,000**	**3,880,000**	**1,990,000**	**1,680,000**	**491,000**	NA	**168,000**	**492,000**	**20,000**
Dissolved Metals																					
Aluminum	<100	<100	<200[4]	<200[4]	**1,250**	**521**	**205**	<200	<200	<1000	<200	<200	<200	<1000	<2000	<2000	<200	NA	NA	<200	**100**
Barium	<200	<200	802	311	<200	<200	<200	<200	<200	<1000	<200	<200	<200	<1000	<2000	<2000	<200	NA	NA	<200	**1,000**
Cobalt	<5.0	**6**	**106**	<50[4]	<50[4]	<50[4]	<50	<50	<50	<250	<50	<50	<50	<250	<500	<500	<50	NA	NA	<50	**5**
Iron	<100	**1,350**	**4,290**	**229**	**1,050**	**978**	**3,490**	<100	**418**	**5,660**	**981**	**917**	**242**	**35,400**	**20,300**	**8,710**	**454**	NA	NA	106	**300/500[3]**
Manganese	<15	**13,600**	**35,000**	**13,500**	**2,350**	**662**	**796**	**4,810**	**3,970**	**653**	**1,580**	**815**	**2,360**	**2,990**	**3,330**	**6,820**	**1,210**	NA	NA	**717**	**300/500[3]**
Nickel	<10	14	**134**	19	59	18	12	<10	<10	<50	<10	<10	<10	89	<100	<100	<10	NA	NA	19	**100**
Sodium	**172,000**	**325,000**	**2,390,000**	**1,430,000**	**518,000**	**380,000**	**397,000**	**652,000**	**620,000**	**389,000**	**276,000**	**200,000**	**282,000**	**4,120,000**	**1,870,000**	**1,700,000**	**442,000**	NA	NA	**502,000**	**20,000**
Nitrates and Nitrites (mg/L)[5]																					
Nitrogen, Nitrate	1.3	<0.11	0	<0.11	1.5	-	<0.11	<0.11	<0.11	0	<0.11	<0.11	<0.11	<3	**26.9**	<0.11	<0.2	<0.11	<0.11	0.68 [b]	**10 (total)**
Nitrogen, Nitrate + Nitrite	1.3	<0.10	0	<0.10	1.5	-	<0.10	<0.10	<0.10	0	0	<0.1	<0.1	<2	**26.9**	<0.1	<0.1	<0.10	<0.10	1	
Nitrogen, Nitrite	<0.010	<0.010	0	<0.010	<0.002	-	<0.01	<0.010	<0.010	<0.05	0	<0.01	<0.01	<1	<1	<0.01	<0.1	<0.01	<0.010	<0.010	
Field Parameters																					
pH (s.u.)[6]	**6.38**	7.86	7.47	7.22	6.57	7.05	6.94	6.99	**8.95**	**6.4**	6.89	7.03	6.74	**6.43**	7.04	7.05	6.85	7.27	6.79	7.19	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	0.559	1.53	0.76	7.76	2.44	2.27	1.46	3.22	3.1	1.69	1.41	1.07	1.39	10.6	2.95	2.27	1.9	1.73	1.21	3.23	--
Turbidity (NTU)[8]	**28.4**	**10**	1	**16.9**	4.1	**36.7**	**19.8**	**20.7**	**10.15**	**83.2**	**51.5**	**30.8**	4.4	**428**	**320**	**367**	3.2	NR	0	7.1	**5**
Dissolved Oxygen (mg/L)	4.2	3.79	3.71	0.98	0.97	0	4.52	0.5	1.61	0	9.79	2.75	0	0.49	4.85	0	0	0.8	0	8.32	--
Temperature (°C)[9]	12.96	12.05	10.58	19.2	21.39	23.9	13.39	12.05	22.75	21.87	11.32	13.65	19.95	21.04	25.83	23.9	22.36	21.01	17.37	14.27	--
REDOX (mV)[10]	199	-9	-26	-130	105	168	-92	-80	-105	-35	-83	-82	-78	-122	-145	-168	-121	-103	-108	67	--

NOTES:
(1) See Figure 2.
(2) All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.
(3) The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).
(3) The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.
(4) The detection limit is raised due to dilution required for possible matrix interference.
(5) There is no Class A groundwater standard for this constituent.
(5) Milligrams per liter (mg/L).
(6) Standard units (s.u.).
(7) Microsiemens per centimeter (mS/cm).
(8) Nephelometric turbidity units (NTU).
(9) Degrees Celcius (°C).
(10) Millivolts (mV).
NR - Not recorded

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 2 Injection Wells

Well ID[1]	MW-7																	NYSDEC Class GA Groundwater Standards
Date Sampled	**01/30/13**	**10/07/15**	**10/06/16**	**01/09/19**	**04/17/19**	**07/18/19**	**10/25/19**	**01/28/20**	**04/21/20**	**07/07/20**	**10/23/20**	**03/17/21**	**05/26/21**	**09/28/21**	**07/26/22**	**12/07/23**	**03/05/25**	
Constituent																		
Total Metals																		
Aluminum	<100	<200[4]	<200	**16,800**[4]	**2,330**[4]	<2,000[4]	<10000	<2000	<2000	<200	<2000	<1000	<2000	<200	NA	**556**	<200	**100**
Barium	203	<200	<200	<2,000[4]	<1,000[4]	<2,000[4]	<10000	<2000	<2000	<200	<2000	<1000	<2000	<200	NA	<200	<200	**1,000**
Cobalt	<5.0	<50	<50	<500[4]	<250[4]	<500[4]	<2500	<500	<500	<50	<500	<250	<500	<50	NA	<50	<50	**5**
Iron	286	208	**264**	**215,000**[4]	**161,000**[4]	**54,100**[4]	**26,600**	**16,900**	**11,500**	**9,660**	**14,100**	**27,200**	**10,500**	**3,090**	NA	**2,670**	**1,220**	**300/500**[3]
Manganese	<15	<15	<15	**10,400**[4]	**14,100**[4]	**5,990**[4]	**3,320**	**2,270**	**1,180**	**1,720**	**712**	**825**	<150	50	NA	137	**310**	**300/500**[3]
Nickel	<10	<10	<10	**609**[4]	**913**[4]	**362**[4]	<500	**156**	<100	32	<100	**151**	**197**	**123**	NA	**161**	<10	**100**
Sodium	**167,000**	**164,000**	**186,000**	**10,900,000**	**4,840,000**	**1,890,000**[4]	**1,360,000**	**1,290,000**	**567,000**	**385,000**	**708,000**	**3,680,000**	**3,710,000**	**1,280,000**	NA	**494,000**	**372,000**	**20,000**
Dissolved Metals																		
Aluminum	<100	<200	<200	**15,500**[4]	<400[4]	<400[4]	<10000	<2000	<1000	<1000	<200	<1000	<2000	<200	NA	NA	<200	**100**
Barium	<200	<200	<200	<2,000[4]	<400[4]	<400[4]	<10000	<2000	<1000	<1000	<200	<1000	<2000	<200	NA	NA	<200	**1,000**
Cobalt	<5.0	<50	<50	<500[4]	<129[4]	<100[4]	<2500	<500	<250	<50	<50	<250	<500	<50	NA	NA	<50	**5**
Iron	<100	<100	<100	**215,000**[4]	**97,100**[4]	**25,600**[4]	**17,100**	**16,400**	**5,070**	**3,450**	**13,000**	**12,300**	**8,910**	**3,090**	NA	NA	205	**300/500**[3]
Manganese	<15	<15	<15	**10,600**[4]	**17,300**[4]	**4,300**[4]	**2,580**	**2,280**	**898**	**1,350**	**657**	**627**	<150	34	NA	NA	275	**300/500**[3]
Nickel	<10	<10	<10	**604**[4]	**563**[4]	**248**[4]	<500	**152**	74	27	59	**139**	**181**	**125**	NA	NA	<10	**100**
Sodium	**164,000**	**167,000**	**178,000**	**10,600,000**	**3,160,000**	**2,100,000**[4]	**1,220,000**	**1,350,000**	**486,000**	**355,000**	**810,000**	**3,880,000**	**3,580,000**	**1,310,000**	NA	NA	**351,000**	**20,000**
Nitrates and Nitrites (mg/L)[5]																		
Nitrogen, Nitrate	1.90	1.40	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.20	<0.11	<1.0	<0.11[b]	**10 (total)**
Nitrogen, Nitrite	<0.010	<0.0020	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.10	<0.10	<1.0	<0.010	
Nitrogen, Nitrate + Nitrite	1.90	1.40	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.10	<0.01	<0.010	<0.10	
Field Parameters																		
pH (s.u.)[6]		8.55	8.31	6.70	6.61	8.33	7.30	7.13	7.56	7.23	**5.74**	7.09	**6.31**	7.93	7.93	7.55	7.20	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	1.27	1.60	1.95	22.20	9.30	7.49	5.88	5.81	1.53	1.77	2.60	1.46	1.95	5.95	5.88	3.02	2.39	--
Turbidity (NTU)[8]	**15.90**	**6.00**	**18.40**	**830.00**	**142.00**	**241.00**	**156.00**	**106.00**	**330.00**	**30.10**	**114.00**	**114.00**	**181.00**	**6.70**	**8.00**	**28.10**	**9.80**	**5**
Dissolved Oxygen (mg/L)	1.66	0.78	0.00	3.87	1.83	2.29	0.00	7.89	4.98	0.00	0.25	5.63	0.00	0.50	1.71	0.00	0.00	--
Temperature (°C)[9]	16.18	23.10	23.00	14.41	13.74	22.97	23.19	12.34	14.90	20.96	21.84	27.95	23.00	23.55	22.31	18.27	12.28	--
REDOX (mV)[10]	157	40	243	-243	-88	-179	-143	-102	-125	-136	-21	-173	-24	-176	-240	-130	45	--

NOTES:

[1] See Figure 2.

[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.

[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).

[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.

[4] The detection limit is raised due to dilution required for possible matrix interference.

[5] There is no Class A groundwater standard for this constituent.

[5] Milligrams per liter (mg/L).

[6] Standard units (s.u.).

[7] Microsiemens per centimeter (mS/cm).

[8] Nephelometric turbidity units (NTU).

[9] Degrees Celcius (°C).

[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 2 Injection Wells

Well ID[1]	MW-20														NYSDEC Class GA Groundwater Standards
Date Sampled	**10/04/16**	**01/08/19**	**04/17/19**	**07/23/19**	**10/29/19**	**01/28/20**	**04/21/20**	**07/08/20**	**10/20/20**	**03/16/21**	**05/26/21**	**09/30/21**	**12/07/23**	**03/05/25**	
Constituent															
Total Metals															
Aluminum	<200	<2,000 [4]	**432** [4]	<400	<200	<10000	<2000	<2000	<2000	<200	<200	<200	<200	<200	**100**
Barium	551	<2,000 [4]	780 [4]	784	479	<10000	<2000	<2000	<2000	<200	479	544	4.5	456	**1,000**
Cobalt	<50	<500 [4]	<100 [4]	<100	<50	<2500	<500	<500	<500	<50	<50	<50	<50	<50	**5**
Iron	<100	**47,000** [4]	**52,900** [4]	**43,700**	**1,040**	**53,400**	**30,800**	**18,000**	**9,320**	**3,380**	**1,040**	**1,210**	**799**	**617**	**300/500**[3]
Manganese	204	**14,700** [4]	**10,600** [4]	**9,460**	262	**3,110**	**2,270**	**2,080**	**925**	**536**	262	**1,080**	**961**	**533**	**300/500**[3]
Nickel	<10	**280** [4]	**200** [4]	**113**	<10	<500	**183**	<100	<100	<10	<10	<10	<10	<10	**100**
Sodium	**238,000**	**1,320,000** [4]	**1,060,000**	**1,050,000**	**394,000**	**2,360,000**	**1,920,000**	**1,380,000**	**740,000**	**229,000**	**394,000**	**371,000**	**326,000**	**325,000**	**20,000**
Dissolved Metals															
Aluminum	<200	<2,000 [4]	<400 [4]	<200	<200	<2000	<1000	<2000	<1000	<200	<200	<200	NA	<200	**100**
Barium	536	<2,000 [4]	<400 [4]	347	453	<2000	<1000	<2000	<1000	<200	453	504	NA	446	**1,000**
Cobalt	<50	<500 [4]	<100 [4]	<50	<50	<500	<250	<500	<250	<50	<50	<50	NA	<50	**5**
Iron	<100	**40,000** [4]	**6,930** [4]	**10,600**	110	**20,400**	**7,680**	**7,000**	**1,780**	**2,450**	110	<100	NA	<100	**300/500**[3]
Manganese	204	**14,100** [4]	**10,800** [4]	**9,200**	256	**2,180**	**1,660**	**1,720**	**1,040**	**519**	256	**1,170**	NA	**575**	**300/500**[3]
Nickel	<10	**262** [4]	**196** [4]	83	<10	**135**	**122**	<100	54	<10	<10	<10	NA	<10	**100**
Sodium	**232,000**	**1,270,000** [4]	**1,180,000**	**995,000**	**375,000**	**1,630,000**	**1,630,000**	**1,240,000**	**907,000**	**229,000**	**375,000**	**373,000**	NA	**310,000**	**20,000**
Nitrates and Nitrites (mg/L)[5]															
Nitrogen, Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.11	0.12	<0.11 b	**10 (total)**
Nitrogen, Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.10	<0.010	<0.010	
Nitrogen, Nitrate + Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.010	0.12	<0.10	
Field Parameters															
pH (s.u.)[6]	**8.62**	**6.18**	7.09	**8.02**	6.73	7.26	7.26	7.40	6.98	**6.39**	6.62	7.62	7.33	7.36	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	3.12	5.15	5.75	5.62	19.00	7.95	6.71	4.90	3.94	3.10	3.12	3.05	4.27	3.24	--
Turbidity (NTU)[8]	4.40	**338.00**	**200.00**	**184.00**	**695.00**	**569.00**	**314.00**	**64.80**	**34.50**	**60.10**	4.40	0.00	0.00	3.70	**5**
Dissolved Oxygen (mg/L)	2.30	3.31	1.79	2.31	0.00	1.90	2.50	2.42	3.25	5.95	2.30	4.84	0.00	7.33	--
Temperature (°C)[9]	19.97	12.76	14.59	14.65	21.01	14.62	15.29	18.41	19.89	20.81	19.97	19.62	18.91	14.56	--
REDOX (mV)[10]	146	-26	-136	-152	-84	-190	-157	-171	-144	-115	-146	-137	-131	-12	--

NOTES:

[1] See Figure 2.

[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.

[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).

[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.

[4] The detection limit is raised due to dilution required for possible matrix interference.

[5] There is no Class A groundwater standard for this constituent.

[5] Milligrams per liter (mg/L).

[6] Standard units (s.u.).

[7] Microsiemens per centimeter (mS/cm).

[8] Nephelometric turbidity units (NTU).

[9] Degrees Celcius (°C).

[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 2 Injection Wells

Well ID[1]	MW-21														NYSDEC Class GA Groundwater Standards
Date Sampled	**10/06/16**	**01/09/19**	**04/17/19**	**07/23/19**	**10/29/19**	**01/28/20**	**04/21/20**	**07/08/20**	**10/20/20**	**03/17/21**	**05/26/21**	**09/29/21**	**12/06/23**	**03/05/25**	
Constituent															
Total Metals															
Aluminum	<200	**1,620**	**344**	**247**	**94,500**	**23,300**	**19,400**	**12,500**	**11,700**	**870**	**409**	**987**	**7,550**	**1,070**	**100**
Barium	320	<200	<200	<200	<10000	<10000	<2000	<2000	<1000	<200	<200	<200	216	<200	**1,000**
Cobalt	<50	<50	<50	<50	<2500	<2500	<500	<500	<250	<50	<50	<50	<50	<50	**5**
Iron	<100	**9,770**	**3,330**	**5,820**	**75,700**	**36,500**	**33,000**	**36,000**	**23,600**	**7,200**	**531**	**6,240**	**9,750**	**4,090**	**300/500[3]**
Manganese	288	**565**	**388**	**1,390**	**9,270**	**4,830**	**4,660**	**4,890**	**2,680**	**1,110**	35	**1,150**	**712**	135	**300/500[3]**
Nickel	<10	17	<10	<10	<500	<500	<100	<100	<50	11	<10	12	16	14	**100**
Sodium	**225,000**	**93,100**	**582,000**	**130,000**	**4,950,000**	**1,870,000**	**1,530,000**	**1,270,000**	**707,000**	**892,000**	**36,300**	**328,000**	**213,000**	**793,000**	**20,000**
Dissolved Metals															
Aluminum	<200	<200	<200	<200	<10000	<2000	<1000	<2000	<200	<200	<200	<200	NA	<200	**100**
Barium	311	<200	<200	<200	<10000	<2000	<1000	<2000	<200	<200	<200	<200	NA	<200	**1,000**
Cobalt	<50	<50	<50	<50	<2500	<500	<250	<500	<50	<50	<50	<50	NA	<50	**5**
Iron	<100	**1,310**	**451**	**1,600**	**59,600**	**14,200**	**13,100**	**22,600**	**7,770**	343	159	121	NA	199	**300/500[3]**
Manganese	268	**491**	**405**	**1,410**	**6,920**	**3,600**	**3,600**	**3,930**	**969**	**1,160**	32	**1,120**	NA	201	**300/500[3]**
Nickel	<10	<10	<10	<10	<500	<100	<50	<100	11	11	<10	<10	NA	<10	**100**
Sodium	**221,000**	**90,000**	**634,000**	**131,000**	**5,840,000**	**1,640,000**	**1,560,000**	**1,090,000**	**266,000**	**913,000**	**36,900**	**341,000**	NA	**1,130,000**	**20,000**
Nitrates and Nitrites (mg/L)[5]															
Nitrogen, Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.14	0.31	0.41 [b]	**10 (total)**
Nitrogen, Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.010	<0.010	<0.010	
Nitrogen, Nitrate + Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.14	0.31	0.42	
Field Parameters															
pH (s.u.)[6]	**9.31**	6.60	7.02	6.95	6.79	7.19	7.28	7.18	**6.29**	**6.11**	7.35	7.51	7.22	7.02	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	2.41	0.75	3.59	0.31	18.60	7.39	5.84	4.97	1.66	2.79	2.41	2.84	2.16	4.29	--
Turbidity (NTU)[8]	0.00	**142.00**	**34.50**	**12.80**	**>999**	**>999**	**>999**	**359.00**	**448.00**	**11.40**	0.00	**35.90**	**16.00**	109.00	**5**
Dissolved Oxygen (mg/L)	1.29	6.93	10.53	2.94	0.00	1.75	5.48	0.25	0.79	8.53	1.29	0.52	0.00	4.69	--
Temperature (°C)[9]	21.48	11.63	13.36	20.30	21.94	12.14	14.92	20.06	21.40	19.73	21.48	21.51	17.63	12.06	--
REDOX (mV)[10]	-78	-14	-65	24	-132	-130	-138	-172	-69	-10	-78	-121	-131	142	--

NOTES:

[1] See Figure 2.

[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.

[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).

[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.

[4] The detection limit is raised due to dilution required for possible matrix interference.

[5] There is no Class A groundwater standard for this constituent.

[5] Milligrams per liter (mg/L).

[6] Standard units (s.u.).

[7] Microsiemens per centimeter (mS/cm).

[8] Nephelometric turbidity units (NTU).

[9] Degrees Celcius (°C).

[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 2 Injection Wells

Well ID[1]	MW-22							MW-23								NYSDEC Class GA Groundwater Standards
Date Sampled	**10/06/16**	**01/09/19**	**03/17/21**	**05/26/21**	**09/29/21**	**12/07/23**	**03/04/25**	**10/05/16**	**01/08/19**	**03/18/21**	**05/28/21**	**09/28/21**	**07/26/22**	**12/06/23**	**03/05/25**	
Constituent																
Total Metals																
Aluminum	<200	**5,800** [4]	<1000	<200	<200	**3,220**	**3,580**	**1,090**	<2,000 [4]	<200	<200	<200	NA	**746**	<200	**100**
Barium	333	<2,000 [4]	<1000	722	573	**1,450**	479.0	246	<2,000 [4]	269	338	333	NA	528	<200	**1,000**
Cobalt	<50	<500 [4]	<250	<50	<50	<50	<50	<50	<500 [4]	<50	<50	<50	NA	<50	<50	**5**
Iron	179	**545,000** [4]	**24,800**	**27,500**	**16,300**	**103,000**	**31,100**	**1,460**	**41,800** [4]	**1,830**	**899**	**809**	NA	**12,800**	190	**300/500**[3]
Manganese	**635**	**56,100** [4]	**6,030**	**9,040**	**5,810**	**11,500**	**1,900**	238	**13,800** [4]	**1,180**	**1,120**	**1,060**	NA	**645**	**308**	**300/500**[3]
Nickel	<10	**907** [4]	<50	<10	<10	97.5	22	25	**921** [4]	<10	<10	<10	NA	41.1	<10	**100**
Sodium	**259,000**	**7,580,000**	**539,000**	**456,000**	**364,000**	**340,000**	**255,000**	**120,000**	**1,260,000**	**141,000**	**156,000**	**152,000**	NA	**135,000**	**111,000**	**20,000**
Dissolved Metals																
Aluminum	<200	4,380 [4]	<1000	<200	<200	NA	<200	<200	<2,000 [4]	<200	<200	<200	NA	NA	<200	**100**
Barium	327	<2,000 [4]	<1000	543	439	NA	355	231	<2,000 [4]	254	319	313	NA	NA	<200	**1,000**
Cobalt	<50	<500 [4]	<250	<50	<50	NA	<50	<50	<500 [4]	<50	<50	<50	NA	NA	<50	**5**
Iron	<100	**452,000** [4]	**1,030**	**1,300**	**1,520**	NA	188	<100	**35,300** [4]	<100	<100	<100	NA	NA	<100	**300/500**[3]
Manganese	**581**	**44,300** [4]	**5,410**	**8,770**	**5,610**	NA	**1,990**	172	**13,000** [4]	**1,260**	**1,110**	**1,050**	NA	NA	**302**	**300/500**[3]
Nickel	<10	**736** [4]	<50	<10	<10	NA	<10	<10	**857** [4]	<10	<10	<10	NA	NA	<10	**100**
Sodium	**258,000**	**6,230,000**	**498,000**	**452,000**	**359,000**	NA	**300,000**	**118,000**	**1,160,000**	**149,000**	**155,000**	**147,000**	NA	NA	**111,000**	**20,000**
Nitrates and Nitrites (mg/L)[5]																
Nitrogen, Nitrate	NA	NA	NA	NA	0.12	0.22	0.28 b	NA	NA	NA	NA	NA	0.19	0.51	0.17 b	
Nitrogen, Nitrite	NA	NA	NA	NA	0.026	<0.010	0.02	NA	NA	NA	NA	NA	0.20	0.01	<0.010	**10 (total)**
Nitrogen, Nitrate + Nitrite	NA	NA	NA	NA	0.15	0.22	0.30	NA	NA	NA	NA	NA	<0.01	0.52	0.18	
Field Parameters																
pH (s.u.)[6]	**8.86**	6.53	7.10	7.06	6.91	7.02	7.35	7.21	**5.47**	**6.30**	7.21	7.82	7.91	7.48	7.81	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	2.56	20.20	3.33	2.56	3.33	3.91	3.20	1.54	4.77	1.60	1.54	1.46	1.37	1.33	0.98	--
Turbidity (NTU)[8]	**11.20**	**372.00**	**32.40**	**11.20**	0.40	**6.80**	8.50	**49.60**	**168.00**	**10.50**	**49.60**	0.00	2.40	0.00	0.00	**5**
Dissolved Oxygen (mg/L)	0.83	1.95	5.64	0.83	0.70	0.03	1.00	0.00	12.36	1.29	0.00	0.07	0.02	0.00	0.01	--
Temperature (°C)[9]	23.89	12.57	27.30	23.89	23.17	18.52	14.81	25.22	13.05	24.70	25.22	26.26	25.11	18.36	13.91	--
REDOX (mV)[10]	85	-193	-133	-85	-111	-121	-100	251	-115	-116	-51	-147	-101	-57	35	--

NOTES:

[1] See Figure 2.

[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.

[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).

[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.

[4] The detection limit is raised due to dilution required for possible matrix interference.

[5] There is no Class A groundwater standard for this constituent.

[5] Milligrams per liter (mg/L).

[6] Standard units (s.u.).

[7] Microsiemens per centimeter (mS/cm).

[8] Nephelometric turbidity units (NTU).

[9] Degrees Celcius (°C).

[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 2 Injection Wells

Well ID[1]	**MW-24**														**NYSDEC Class GA Groundwater Standards**
Date Sampled	**10/05/16**	**01/08/19**	**04/17/19**	**07/18/19**	**10/25/19**	**01/29/20**	**04/21/20**	**07/07/20**	**10/20/20**	**03/18/21**	**05/28/21**	**09/28/21**	**12/06/23**	**03/07/25**	
Constituent															
Total Metals															
Aluminum	**1,580**	<200	**1,780**	**8,400**	**9,050**	**1,590**	**372**	**6,660**	**1,880**	**740**	**795**	**121,000**	**701**	**615**	**100**
Barium	275	<200	<200	<200	<400	<200	<200	<200	<200	<200	<200	606	<200	<200	**1,000**
Cobalt	<50	<50	<50	<50	<100	<50	<50	<50	<50	<50	<50	181	<50	<50	**5**
Iron	**6,030**	**548**	**2,440**	**4,930**	**5,560**	**1,250**	**394**	**5,090**	**1,390**	**922**	**699**	**109,000**	**1,320**	**1,070**	**300/500**[3]
Manganese	147	**518**	**330**	**147**	193	46	33	176	58	47	25	4,870	61.9	23.1	**300/500**[3]
Nickel	**258**	39	32	**32**	38	<10	<10	41	19	<10	11	1,300	14.4	<10	**100**
Sodium	**193,000**	**158,000**	**299,000**	**95,200**	**156,000**	**318,000**	**107,000**	**79,100**	**93,700**	**408,000**	**186,000**	**129,000**	**38,100**	**394,000**	**20,000**
Dissolved Metals															
Aluminum	<200	<200	<200	**<200**	<200	<200	<200	<200	<200	<200	<200	<400	NA	<200	**100**
Barium	252	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<400	NA	<200	**1,000**
Cobalt	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<100	NA	<50	**5**
Iron	<100	<100	<100	**<100**	<100	<100	<100	<100	<100	<100	<100	<200	NA	<100	**300/500**[3]
Manganese	<15	**495**	<15	**<15**	<15	<15	<15	<15	<15	<15	<15	<30	NA	<15	**300/500**[3]
Nickel	<10	32	<10	12	10	<10	<10	<10	<10	<10	<10	<20	NA	<10	**100**
Sodium	**186,000**	**151,000**	**343,000**	**106,000**	**156,000**	**322,000**	**103,000**	**73,400**	**93,400**	**424,000**	**179,000**	**127,000**	NA	**481,000**	**20,000**
Nitrates and Nitrites (mg/L)[5]															
Nitrogen, Nitrate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.56	<0.11	1.1 b	**10 (total)**
Nitrogen, Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	<0.010	<0.010	
Nitrogen, Nitrate + Nitrite	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.56	0.10	1.10	
Field Parameters															
pH (s.u.)[6]	**8.90**	7.69	7.78	8.39	7.66	7.69	NA	7.66	7.04	7.42	7.90	8.27	7.11	7.42	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	1.890	0.845	1.680	0.856	0.802	1.930	NA	0.802	0.684	1.940	1.890	0.613	0.627	3.82	--
Turbidity (NTU)[8]	**33.10**	**51.30**	**72.80**	**294.00**	**371.00**	**194.00**	NA	**371.00**	**247.00**	0.00	**33.10**	**30.10**	**>1000**	33.20	**5**
Dissolved Oxygen (mg/L)	4.45	11.01	10.69	4.66	7.50	6.85	NA	7.50	5.50	3.46	4.45	7.79	1.63	3.24	--
Temperature (°C)[9]	24.32	12.78	14.47	22.84	22.38	12.18	NA	22.38	21.79	26.55	24.32	23.66	16.54	10.37	--
REDOX (mV)[10]	116	-81	197	-43	239	-40	NA	239	97	-99	-116	119	-41	150	--

NOTES:

[1] See Figure 2.

[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.

[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).

[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.

[4] The detection limit is raised due to dilution required for possible matrix interference.

[5] There is no Class A groundwater standard for this constituent.

[5] Milligrams per liter (mg/L).

[6] Standard units (s.u.).

[7] Microsiemens per centimeter (mS/cm).

[8] Nephelometric turbidity units (NTU).

[9] Degrees Celcius (°C).

[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 3 Injection Wells

Well ID[1]	**MW-9**						**MW-11**						**NYSDEC Class GA Groundwater Standards**
Date Sampled	**01/29/13**	**01/21/15**	**04/07/15**	**06/29/15**	**10/06/15**	**10/04/16**	**01/29/13**	**01/21/15**	**04/06/15**	**06/29/15**	**10/06/15**	**10/10/2016**	
Constituent													
Total Metals													
Aluminum	**675**	**1,830**	**1,410**	**1,220**	**886**	NS	**1,310**	**371**	**3,520**	**219**	**487**	**869**	**100**
Barium	<200	311	207	<200	<200	NS	<200	201	231	238	284	233	**1000**
Cobalt	<5.0	<250	<5.0	<50	<50	NS	<5.0	<50	<5.0	<50	<50	<50	**5**
Iron	**6,910**	**18,600**	**7,240**	**5,740**	**4,500**	NS	**2,010**	**522**	**6,610**	**272**	**644**	**1,760**	**300/500[3]**
Manganese	**624**	**1,210**	**733**	**724**	**438**	NS	**928**	**139**	**1,770**	**542**	**579**	**872**	**300/500[3]**
Nickel	<10	<50	12	<10	<10	NS	62	11.4	100	23.8	28.9	40.7	**100**
Sodium	**398,000**	**2,210,000**	**587,000**	**118,000**	**85,900**	NS	**157,000**	**224,000**	**209,000**	**251,000**	**330,000**	**282,000**	**20,000**
Dissolved Metals													
Aluminum	<100	--	--	--	<200	NS	<100	--	--	--	<200	<200	**100**
Barium	<200	--	--	--	<200	NS	<200	--	--	--	267	238	**1000**
Cobalt	<5.0	--	--	--	<50	NS	<5.0	--	--	--	<50	<50	**5**
Iron	<100	--	--	--	241	NS	<100	--	--	--	<100	<100	**300/500[3]**
Manganese	419	--	--	--	475	NS	<15	--	--	--	377	271	**300/500[3]**
Nickel	<10	NA	NA	NA	<10	NS	<10	NA	NA	NA	17.2	16.8	**100**
Sodium	**423,000**	NA	NA	NA	**92,400**	NS	**180,000**	NA	NA	NA	**312,000**	**321,000**	**20000**
Field Parameters													
pH (s.u.)[6]	7.29	7.62	**9.72**	6.22	7.23	NS	7.29	8.15	8.15	7.28	6.7	**8.52**	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	3.38	14.8	5.65	0.77	0.301	NS	0.828	2.07	2.07	2.38	2.64	2.55	--
Turbidity (NTU)[8]	**74.4**	**77**	**41**	**199**	**145**	NS	**83.6**	4	4	**8.7**	4	**73.9**	**5**
Dissolved Oxygen (mg/L)	2.27	0	0	2.05	0.31	NS	9.26	1.9	1.9	8.13	1.83	4.22	--
Temperature (°C)[9]	13.25	11.88	13.21	19.26	25.67	NS	13.15	11.36	11.36	18.42	21.12	21.25	--
REDOX (mV)[10]	81	136	-94	3	-21	NS	156	87	87	145	186	132	--

NOTES:
[1] See Figure 2.
[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.
[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.
[4] The detection limit is raised due to dilution required for possible matrix interference.
[5] Milligrams per liter (mg/L).
[6] Standard units (s.u.).
[7] Microsiemens per centimeter (mS/cm).
[8] Nephelometric turbidity units (NTU).
[9] Degrees Celcius (°C).
[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 3 Injection Wells

Well ID[1]	**MW-12**													**NYSDEC Class GA Groundwater Standards**
Date Sampled	**01/29/13**	**01/20/15**	**04/06/15**	**06/29/15**	**10/06/15**	**10/10/2016**	**4/17/2019**	**7/23/2019**	**10/28/2019**	**1/30/2020**	**4/22/2020**	**7/9/2020**	**10/20/2020**	
Constituent														
Total Metals														
Aluminum	**899**	**593**	**435**	<200	**2,620**	**210**	<200	<200	<10000	<10000	<2000	<2000	<2000	**100**
Barium	<200	<200	212	365	263	254	294	281	<10000	<10000	<2000	<2000	<2000	**1000**
Cobalt	<5.0	<5.0	<5.0	<50	<50	<50	<50	<50	<2500	<2500	<500	<500	<500	**5**
Iron	**1,680**	**1,590**	**1,960**	**2,180**	**6,440**	**2,400**	**8,160**	**4,400**	**240,000**	**123,000**	**102,000**	**50,300**	**31,600**	**300/500**[3]
Manganese	**1,680**	**2,630**	**3,360**	**4,240**	**3,450**	**3,150**	**4,200**	**2,660**	**27,900**	**13,500**	**17,100**	**7,730**	**5,460**	**300/500**[3]
Nickel	15	10	23	<10	29	<10	<10	<10	540	<500	<100	<100	<100	**100**
Sodium	**248,000**	**261,000**	**314,000**	**394,000**	**355,000**	**328,000**	**440,000**	**462,000**	**5,490,000**	**1,700,000**	**1,380,000**	**1,150,000**	**1,270,000**	**20,000**
Dissolved Metals														
Aluminum	**140**	--	--	--	<200	<200	<200	<200	<10000	<2000	<1000	<200	<200	**100**
Barium	<200	--	--	--	266	247	249	256	<10000	<2000	<1000	237	<200	**1000**
Cobalt	<5.0	--	--	--	<50	<50	<50	<50	<2500	<500	<250	<50	<50	**5**
Iron	**158**	--	--	--	**122**	<100	157	<100	**224,000**	**96,400**	**59,900**	**32,200**	**1,560**	**300/500**[3]
Manganese	**1,540**	--	--	--	**3,470**	**3,150**	**3,700**	**2,470**	**26,200**	**13,400**	**15,000**	**7,010**	**4,780**	**300/500**[3]
Nickel	<10	NA	NA	NA	<10	<10	<10	<10	<500	**122**	84	46.9	35.9	**100**
Sodium	**269,000**	NA	NA	NA	**373,000**	**327,000**	**427,000**	**460,000**	**5,170,000**	**1,370,000**	**1,490,000**	**1,200,000**	**1,330,000**	**20000**
Field Parameters														
pH (s.u.)[6]	7	**8.72**	6.7	6.85	7.24	7.93	7.43	7.9	**6.49**	6.5	6.8	6.95	6.76	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	2.51	3.08	3.57	3.94	3.38	3.05	3.71	3.38	15.4	7.25	6.78	6.36	6.7	--
Turbidity (NTU)[8]	**72.9**	0	0.4	3.92	**65**	**9.7**	**64.4**	**49.6**	**503**	**172**	**167**	**41.1**	**41**	**5**
Dissolved Oxygen (mg/L)	0	4.54	4.49	3.48	0.13	1.34	1.06	2.7	0	9.55	3.63	0	1.44	--
Temperature (°C)[9]	12.57	11.64	11.66	17.94	22.29	23.04	13.07	21.41	21.35	10.82	13.81	20.65	21.38	--
REDOX (mV)[10]	11	45	-22	-71	-60	-13	-79	-109	-90	-78	-113	-148	-129	--

NOTES:
[1] See Figure 2.
[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.
[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.
[4] The detection limit is raised due to dilution required for possible matrix interference.
[5] Milligrams per liter (mg/L).
[6] Standard units (s.u.).
[7] Microsiemens per centimeter (mS/cm).
[8] Nephelometric turbidity units (NTU).
[9] Degrees Celcius (°C).
[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Zone 3 Injection Wells

Well ID[1]	**MW-13**													**NYSDEC Class GA Groundwater Standards**
Date Sampled	**01/29/13**	**01/19/15**	**04/06/15**	**06/29/15**	**10/06/15**	**10/04/16**	**04/17/19**	**07/23/19**	**10/28/19**	**01/29/20**	**04/22/20**	**07/09/20**	**10/20/20**	
Constituent														
Total Metals														
Aluminum	**528**	<100	**207**	<200	<200	NS	**213**	**8,760**					**409**	**100**
Barium	<200	<200	217	299	252	NS	<200	534					211	**1000**
Cobalt	<5.0	<5.0	<5.0	<50	<50	NS	<50	<50					<50	**5**
Iron	**1,270**	206	**677**	**889**	**1,930**	NS	**14,800**	**47,300**					**7,790**	**300/500[3]**
Manganese	**356**	116	**745**	**2,330**	**2,170**	NS	**10,400**	**12,600**					**2,360**	**300/500[3]**
Nickel	29.9	<10	20.1	12	19	NS	17.5	**345.0**					20.2	**100**
Sodium	**334,000**	**289,000**	**323,000**	**405,000**	**212,000**	NS	**516,000**	**553,000**					**267,000**	**20,000**
Dissolved Metals														
Aluminum	**146**	--	--	--	<200	NS	<200	<200					<200	**100**
Barium	<200	--	--	--	235	NS	<200	211					<200	**1000**
Cobalt	<5.0	--	--	--	<50	NS	<50	<50					<50	**5**
Iron	<100	--	--	--	<100	NS	**8,220**	212					<100	**300/500[3]**
Manganese	<15	--	--	--	**1,830**	NS	**11,600**	**10,000**					**1890**	**300/500[3]**
Nickel	<10	NA	NA	NA	<10	NS	13.2	10					<10	**100**
Sodium	**386,000**	NA	NA	NA	**216,000**	NS	**563,000**	**496,000**					**258,000**	**20000**
Field Parameters														
pH (s.u.)[6]	7.41	**9.11**	6.74	6.85	7.21	NS	7.22	7.95	7.1	7.28	7.14	7.52	7.18	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	3.01	2.47	3.15	3.73	2.1	NS	4.4	3.26	3.92	7.56	3.37	2.06	1.46	--
Turbidity (NTU)[8]	**26.1**	0	0	**5.5**	0.2	NS	**72.6**	**49.6**	**38.4**	**127**	**73.6**	**29.3**	**35**	**5**
Dissolved Oxygen (mg/L)	6.07	0.52	10.57	7.25	7.3	NS	1.13	2.7	6.34	0.53	2.78	4.87	3	--
Temperature (°C)[9]	11.91	11.96	10.97	18.41	20.74	NS	13.27	21.41	20.76	11.64	11.81	20.81	20.5	--
REDOX (mV)[10]	157	60	85	-15	-9	NS	-99	-109	-55	-25	-90	-96	-68	--

NOTES:
[1] See Figure 2.
[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.
[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.
[4] The detection limit is raised due to dilution required for possible matrix interference.
[5] Milligrams per liter (mg/L).
[6] Standard units (s.u.).
[7] Microsiemens per centimeter (mS/cm).
[8] Nephelometric turbidity units (NTU).
[9] Degrees Celcius (°C).
[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Monitor Wells within Treatment Area

Well ID[1]	**MW-3D**																	**NYSDEC Class GA Groundwater Standards**
Date Sampled	**02/01/13**	**01/20/15**	**04/07/15**	**06/30/15**	**10/07/15**	**10/05/16**	**01/10/19**	**04/18/19**	**07/18/19**	**10/25/19**	**01/29/20**	**04/21/20**	**07/07/20**	**10/20/20**	**03/18/21**	**05/27/21**	**07/26/22**	
Constituent																		
Total Metals																		
Aluminum	<100	<100	<100	<200[4]	<200[4]	<200	<200	<200	<200	<200	<200	<200	<200	<200	**384**	<200	NA	**100**
Barium	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	NA	**1,000**
Cobalt	<5.0	<5.0	<5.0	<50[4]	<50[4]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	NA	**5**
Iron	190	223	204	<100	<100	<100	<100	<100	**393**	250	124	**475**	221	**326**	**2380**	**486**	NA	**300/500**[3]
Manganese	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	51.9	15.3	NA	**300/500**[3]
Nickel	<10	<10	10.8	<10	<10	<10	<10	<10	15.1	<10	<10	13	<10	<10	11.8	<10	NA	**100**
Sodium	**97,800**	**125,000**	**371,000**	**184,000**	**139,000**	**121,000**	**143,000**	**343,000**	**134,000**	**143000**	**52300**	**67900**	**91200**	**89500**	**162000**	**166000**	NA	**20,000**
Dissolved Metals																		
Aluminum	<100	<100	<100	<200[4]	<200[4]	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	NA	**100**
Barium	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	NA	**1,000**
Cobalt	<5.0	<5.0	<5.0	<50[4]	<50[4]	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	NA	**5**
Iron	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	NA	**300/500**[3]
Manganese	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	<15	NA	**300/500**[3]
Nickel	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	**100**
Sodium	**98,300**	**125,000**	**417,000**	**192,000**	**138,000**	**114,000**	**132,000**	**339,000**	**133,000**	**140,000**	**53,000**	**66,700**	**108,000**	**101,000**	**166,000**	**153,000**	NA	**20,000**
Nitrates and Nitrites (mg/L)[5]																		
Nitrogen, Nitrate	0.26	<0.11	<0.11	<0.11	<0.10	--	<0.11	0.57	0.26	0.13	1.2	0.87	0.81	0.99	1.2	1.1	1.4	**10 (total)**
Nitrogen, Nitrate + Nitrite	0.28	<0.10	<0.10	<0.10	<0.10	--	<0.10	0.57	0.26	0.15	1.2	0.87	0.81	0.99	1.2	1.1	1.4	
Nitrogen, Nitrite	0.16	0.019	<0.010	0.013	0.0088	--	0.025	<0.010	<0.010	0.019	0.01	<0.01	<0.01	<0.01	<0.01	0.024	<0.010	
Field Parameters																		
pH (s.u.)[6]	**10.52**	**9.88**	**9.72**	**9.63**	**9.23**	**10.45**	**10.03**	**9.46**	**10.95**	**10.32**	**10.05**	**9.88**	**10.21**	**9.58**	**6.02**	**10.45**	**10.59**	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	0.556	0.615	3.18	1.33	0.701	0.607	0.589	1.93	0.98	0.531	0.581	0.575	0.561	0.537	0.8	0.607	0.651	--
Turbidity (NTU)[8]	**38.1**	2	0	2.7	0.3	3.7	1.5	**42.5**	**14.8**	1.7	**69.2**	**11.3**	4	**18.2**	2.6	3.7	3.0	**5**
Dissolved Oxygen (mg/L)	0	0	0.17	1.18	1.21	0	5.85	3.58	1.93	0	5.52	4.81	4.69	8.87	7.3	0	1.34	--
Temperature (°C)[9]	14.44	15.03	16.91	18.84	19.88	20.85	11.84	15.98	22.46	10.17	15.09	16.7	19	18.56	21.09	20.85	21.6	--
REDOX (mV)[10]	44	-278	-158	-156	85	68	-85	66	-69	64	-221	-94	-107	-34	-70	68	-95	--

NOTES:

[1] See Figure 2.

[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.

[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).

[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.

[4] The detection limit is raised due to dilution required for possible matrix interference.

[5] There is no Class A groundwater standard for this constituent.

[5] Milligrams per liter (mg/L).

[6] Standard units (s.u.).

[7] Microsiemens per centimeter (mS/cm).

[8] Nephelometric turbidity units (NTU).

[9] Degrees Celcius (°C).

[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Monitor Wells within Treatment Area

Well ID[1]	**MW-4**																		**NYSDEC Class GA Groundwater Standards**
Date Sampled	**01/30/13**	**01/20/15**	**04/07/15**	**06/30/15**	**10/07/15**	**10/05/16**	**01/08/19**	**04/18/19**	**07/18/19**	**10/29/19**	**01/28/20**	**04/21/20**	**07/07/20**	**10/23/20**	**03/19/21**	**05/27/21**	**09/29/21**	**12/06/23**	**03/07/25**	
Constituent																				
Total Metals																				
Aluminum	<100	**218**	**315**	<200[4]	<200[4]	<200	**8,160**	<400[4]	<1,000 (4)	**18,200**	<10000	<2000	<2000	<2000	<2000	<200	1,010	<200	569	**100**
Barium	<200	**1,910**	667	796	**1,090**	411	<2,000	595[4]	<1,000 (4)	<10000	<10000	**2,120**	<2000	<2000	<2000	<200	641	<200	<200	**1,000**
Cobalt	<5.0	**15.4**	**7**	<50[4]	<50[4]	<50	<500	<100[4]	<250 (4)	<2500	<2500	<500	<500	<500	<500	<50	<100	<50	80	**5**
Iron	**118**	**4,660**	**4,640**	**5,060**	**5,610**	**3,290**	**228,000**	**76000**[4]	**44,400 (4)**	**93,400**	**250,000**	**210,000**	**168,000**	**19,200**	**42,600**	**3,290**	**16,300**	**505**	**3,510**	**300/500**[3]
Manganese	**1,100**	**21,700**	**14,100**	**11,100**	**10,700**	**6,080**	**66,700**	**40600**[4]	**21,400 (4)**	**18,200**	**53,400**	**48,100**	**37,100**	**2,080**	**4,000**	246	825	<15	157	**300/500**[3]
Nickel	11.5	**130**	46.5	13.1	14.3	12.2	**2,220**	**390**[4]	**103,000 (4)**	**905**	**1,050**	**1,170**	**555**	**200**	**464**	69	2,840	**140**	**979**	**100**
Sodium	**146,000**	**262,000**	**325,000**	**360,000**	**540,000**	**266,000**	**10,700,000**	**1,730,000**	**2,130,000 (4)**	**9,640,000**	**9,560,000**	**7,550,000**	**7,020,000**	**1,770,000**	**5,490,000**	**644,000**	**6,820,000**	**330,000**	**1,330,000**	**20,000**
Dissolved Metals																				
Aluminum	<100	<100	**228**	<200[4]	<200[4]	<200	**7,550**	<400[4]	<400 (4)	<10000	<10000	<1000	<2000	<1000	<2000	<2000	<400	NA	<200	**100**
Barium	<200	**2,080**	588	757	998	387	<2,000	<400[4]	<400 (4)	<10000	<10000	**1800**	<2000	<1000	<2000	<2000	692	NA	<200	**1,000**
Cobalt	<5.0	**5.6**	<5.0	<50[4]	<50[4]	<50	<500	<100[4]	<100 (4)	<2500	<2500	<250	<500	<250	<500	<500	<100	NA	67	**5**
Iron	<100	**236**	**2,820**	**201**	**370**	**620**	**215,000**	**31100**[4]	**12,400 (4)**	**87,500**	**182,000**	**181,000**	**152,000**	**17,700**	**42,900**	**20,000**	**17,700**	NA	**3,450**	**300/500**[3]
Manganese	56.9	**18,600**	**9,910**	**9,750**	**8,500**	**4,200**	**62,600**	**35300**[4]	**19,100 (4)**	**16,500**	**38,900**	**46,900**	**34,700**	**1,960**	**3,980**	**1,730**	**874**	NA	34	**300/500**[3]
Nickel	<10	**114**	24.5	<10	11.2	<10	**2,050**	**345**[4]	**96 (4)**	**790**	**685**	**978**	**432**	**128**	**465**	**507**	**2200**	NA	**964**	**100**
Sodium	**148,000**	**310,000**	**323,000**	**384,000**	**544,000**	**258,000**	**10,100,000**	**1,600,000**	**2,120,000 (4)**	**9,200,000**	**7,100,000**	**6,570,000**	**6,400,000**	**1,760,000**	**5,870,000**	**4,790,000**	**6,640,000**	NA	**1,470,000**	**20,000**
Nitrates and Nitrites (mg/L)[5]																				
Nitrogen, Nitrate	1.2	<0.11	<0.11	<0.11	<0.10	--	0.39	<0.11	<0.11	0.96	<0.6	<0.15	0.26	<2	<11	<0.2	<0.6	<1.0	<0.11 b	**10 (total)**
Nitrogen, Nitrate + Nitrite	1.2	<0.10	<0.10	<0.10	<0.10	--	0.39	<0.10	<0.10	0.96	0.27	<0.1	0.26	<1	<10	0.13	0.49	<1.0	<0.010	
Nitrogen, Nitrite	<0.012	<0.010	<0.010	<0.010	<0.002	--	<0.010	<0.010	<0.010	<0.5	<0.5	<0.05	<0.1	<1	<1	<0.1	<0.5	<0.010	<0.10	
Field Parameters																				
pH (s.u.)[6]	6.96	**8.62**	7.35	6.98	7.66	8.15	6.78	6.66	8.21	6.86	**6.09**	6.79	7.03	**6.07**	7.29	8.15	7.67	8.02	7.72	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	0.71	3.35	3.13	4.17	4.54	1.4	23.2	9.11	8.12	20.6	20.2	16.9	17.2	5.5	2.61	1.4	33.9	15.9	8.24	--
Turbidity (NTU)[8]	1.9	**38.7**	**51.54**	**6.5**	3.6	1	**541**	**107**	**193**	**654**	**376**	**260**	**211**	**347**	**332**	1	546	**79.9**	**113**	**5**
Dissolved Oxygen (mg/L)	0.28	2.49	0.15	1.2	0.22	1	2.78	3.31	2.21	0	1.48	1.16	0	0.41	5.9	1	0.77	0	0	--
Temperature (°C)[9]	14.68	12.5	11.68	17.87	22.06	23	13.33	12.21	22.75	21.41	11.41	13.31	20.85	20.75	20.99	23	17.11	16.3	9.18	--
REDOX (mV)[10]	140	-89	-196	-153	-161	-60	-178	-83	-176	-139	-170	-140	-167	-68	-138	-60	-218	-74	-77	--

NOTES:

[1] See Figure 2.

[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.

[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).

[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.

[4] The detection limit is raised due to dilution required for possible matrix interference.

[5] There is no Class A groundwater standard for this constituent.

[5] Milligrams per liter (mg/L).

[6] Standard units (s.u.).

[7] Microsiemens per centimeter (mS/cm).

[8] Nephelometric turbidity units (NTU).

[9] Degrees Celcius (°C).

[10] Millivolts (mV).

TABLE 4

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Summary of Metals Exceedances and Field Parameters for Treatment Zone Monitor Wells - January 2013 Pre-Injection through 2025 - Monitor Wells within Treatment Area

Well ID[1]	**MW-8**																**NYSDEC Class GA Groundwater Standards**
Date Sampled	**01/30/13**	**10/07/15**	**10/06/16**	**01/08/19**	**04/17/19**	**07/18/19**	**10/29/19**	**01/28/20**	**04/21/20**	**07/07/20**	**10/23/20**	**03/17/21**	**05/26/21**	**09/29/21**	**09/29/21**	**03/07/25**	
Constituent																	
Total Metals																	
Aluminum	**139**	**473**	<200	<200	<200	<200	**36,100**	<2000	<2000	**516**	**265**	<1000	<2000	**8,730**	NA	**421**	**100**
Barium	340	350	427	345	335	526	<10000	<2000	<2000	271	<200	<1000	<2000	368	NA	226	**1,000**
Cobalt	<5.0	<50	<50	<50	<50	<50	<2500	<500	<500	<50	<50	<250	<500	<50	NA	<50	**5**
Iron	**285**	**441**	**273**	121	131	158	**58,300**	**21,300**	**13,800**	**11,900**	**3,850**	**9,930**	**9,800**	**20,900**	NA	**1,890**	**300/500**[3]
Manganese	**1,450**	**831**	**1,100**	**1,330**	**2,480**	**3,650**	**123,000**	**14,300**	**8,320**	**16,300**	**1,080**	**859**	**1,430**	**1,890**	NA	**2,370**	**300/500**[3]
Nickel	<10	<10	<10	<10	14	21	**2,500**	**171**	<100	19	22	<50	<100	**140**	NA	20	**100**
Sodium	**212,000**	**248,000**	**263,000**	**250,000**	**296,000**	**334,000**	**6,250,000**	**753,000**	**479,000**	**718,000**	**376,000**	**296,000**	**530,000**	**760,000**	NA	**200,000**	**20,000**
Dissolved Metals																	
Aluminum	<100	<200	<200	<200	<200	<200	<10000	<2000	<1000	<200	<200	<1000	<2000	<200	NA	<200	**100**
Barium	321	305	407	339	321	597	<10000	<2000	<1000	<200	<200	<1000	<2000	<200	NA	219	**1,000**
Cobalt	<5.0	<50	<50	<50	<50	<50	<2500	<500	<250	<50	<50	<250	<500	<50	NA	<50	**5**
Iron	<100	132	<100	<100	<100	<100	**49,500**	**8,980**	**2,330**	**710**	**3,500**	**3,090**	**<1000**	**3190**	NA	**367**	**300/500**[3]
Manganese	**543**	**533**	**557**	**1,050**	**2,220**	**5,920**	**107,000**	**12,600**	**7,020**	**15,600**	**1,060**	**753**	**1,500**	**1410**	NA	**2,500**	**300/500**[3]
Nickel	<10	<10	<10	<10	11.4	54.7	2140	114	<50	21.4	19.6	<50	<100	54.3	NA	17	**100**
Sodium	**211,000**	**253,000**	**269,000**	**256,000**	**317,000**	**328,000**	**5,400,000**	**701,000**	**424,000**	**738,000**	**408,000**	**316,000**	**664,000**	**845,000**	NA	**203,000**	**20,000**
Nitrates and Nitrites (mg/L)[5]																	
Nitrogen, Nitrate	<0.010	2.9	--	2.1	1.4	0.53	<25	<0.11	0.11	<0.15	<0.6	<0.11	<0.15	<0.2	<0.20	2.1	**10 (total)**
Nitrogen, Nitrate + Nitrite	1.5	<0.0020	--	2.1	1.4	0.54	0.42	<0.1	0.11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.1 b	
Nitrogen, Nitrite	1.5	2.9	--	<0.010	<0.010	<0.010	<25	<0.01	<0.01	<0.05	<0.5	<0.01	<0.05	<0.1	<0.1	<0.010	
Field Parameters																	
pH (s.u.)[6]	8.18	8.39	7.27	7.94	7.32	8.1	6.68	7.11	7.03	7.2	**6.2**	7.24	**6.27**	7.36	7.16	6.87	**6.5 - 8.5**
Specific Conductivity (mS/cm)[7]	1.27	1.91	2.93	1.95	2.57	2.81	15.9	3.71	3.31	3.54	1.73	2.4	2.93	2.03	4.97	1.59	--
Turbidity (NTU)[8]	**15.9**	2.5	**15.7**	4.7	**7.4**	**15.5**	**452**	**434**	**156**	**74.1**	**96.7**	**76.2**	**65.7**	**7.9**	2.1	**9.9**	**5**
Dissolved Oxygen (mg/L)	1.66	0.33	0	2.38	1.16	6.35	0	3.62	0.91	4.88	1.15	1.88	0	0.21	0.21	0.33	--
Temperature (°C)[9]	16.18	23.45	23.56	14.93	12.98	22.22	21.47	10.85	13.67	21.68	21.22	22.22	23.56	22.21	23.45	10.69	--
REDOX (mV)[10]	157	-60	259	15	-42	-20	-164	-101	-115	-124	-20	-136	-25	-151	-112	96	--

NOTES:

[1] See Figure 2.

[2] All concentrations are presented in micrograms per liter (ug/L) unless otherwise specified. Bold and red values indicate the concentrations which exceed the respective NYSDEC Groundwater Standards.

[3] The groundwater standard for beryllium is 11 ug/L when hardness is less than 75 ppm (mg/L) and 1,100 ug/L when hardness is greater than 75 ppm (mg/L).

[3] The individual groundwater standard for iron and manganese is 300 ug/L and the total groundwater standard for iron and manganese concentrations combined is 500 ug/L.

[4] The detection limit is raised due to dilution required for possible matrix interference.

[5] There is no Class A groundwater standard for this constituent.

[5] Milligrams per liter (mg/L).

[6] Standard units (s.u.).

[7] Microsiemens per centimeter (mS/cm).

[8] Nephelometric turbidity units (NTU).

[9] Degrees Celcius (°C).

[10] Millivolts (mV).

Table 5
Former Carol Cleaners
280-30 Marsh Ave. Staten Island, NY
Indoor Air and Sub Slab Volatile Organic Compounds - March 2025

Client Sample ID:		NYSDOH Air Matrics Trigger Values IA/SS	IA-1-25	IA-2-25	IA-3-25	IA-4-25	IA-5-25	SS-1-25	SS-2-25	SS-3-25	SS-4-25	SS-5-25	AA-1-25
Lab Sample ID:			JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932
Date Sampled:			3/7/2025 11:02 AM	3/7/2025 11:50 AM	3/7/2025 12:05 PM	3/7/2025 9:27 AM	3/7/2025 9:23 AM	3/7/2025 12:23 PM	3/7/2025 11:59 AM	3/7/2025 12:42 PM	3/7/2025 12:45 PM	3/7/2025 9:20 AM	3/7/2025 8:40 AM
Matrix:	Unit		Indoor Air Comp.	Indoor Air Comp.	Indoor Air Comp.	Indoor Air Comp.	Indoor Air Comp.	Soil Vapor Comp.	Soil Vapor Comp.	Soil Vapor Comp.	Soil Vapor Comp.	Soil Vapor Comp.	Ambient Air Comp.
MS Voilatiles (TO-15) - ug/m3													
Acetone (2-Propanone)	ug/m3		50.6	20	26.8	29.7	27.1	64.6	24.9	167	31.8	71.5	9.3
1,3-Butadiene	ug/m3		< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.19
Benzene	ug/m3	<2/>60	0.38 J	0.38 J	0.45 J	0.45 J	0.45 J	< 0.61	< 0.61	1.4 J	< 0.61	< 0.61	0.35 J
Bromodichloromethane	ug/m3		< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80	< 0.20
Bromoform	ug/m3		< 0.73	< 0.73	< 0.73	< 0.73	< 0.73	< 2.9	< 2.9	< 2.9	< 2.9	< 2.9	< 0.73
Bromomethane	ug/m3		< 0.27	< 0.27	< 0.27	< 0.27	< 0.27	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 0.27
Bromoethene	ug/m3		< 0.27	< 0.27	< 0.27	< 0.27	< 0.27	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.27
Benzyl Chloride	ug/m3		< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 2.6	< 2.6	< 2.6	< 2.6	< 2.6	< 0.67
Carbon disulfide	ug/m3		< 0.34	< 0.34	< 0.34	< 0.34	< 0.34	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 0.34
Chlorobenzene	ug/m3		< 0.34	< 0.34	< 0.34	< 0.34	< 0.34	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	< 0.34
Chloroethane	ug/m3		< 0.18	< 0.18	< 0.18	< 0.18	< 0.18	< 0.71	< 0.71	1.6 J	< 0.71	1.3 J	< 0.18
Chloroform	ug/m3		2	< 0.18	< 0.18	< 0.18	< 0.18	9.8	18	< 0.73	< 0.73	15	< 0.18
Chloromethane	ug/m3		1.1	1.2	1.2	1.2	1.2	< 0.74	< 0.74	1.0 J	1.1 J	< 0.74	1.1
3-Chloropropene	ug/m3		< 0.26	< 0.26	< 0.26	< 0.26	< 0.26	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.26
2-Chlorotoluene	ug/m3		< 0.37	< 0.37	< 0.37	< 0.37	< 0.37	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 0.37
Carbon tetrachloride	ug/m3	<0.2/>60	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.25
Cyclohexane	ug/m3	<2/>60	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.62	< 0.62	< 0.62	< 0.62	< 0.62	< 0.15
1,1-Dichloroethane	ug/m3		< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.93	< 0.93	< 0.93	< 0.93	< 0.93	< 0.23
1,1-Dichloroethylene	ug/m3	<0.2/>60	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.95	< 0.95	< 0.95	< 0.95	< 0.95	< 0.23
1,2-Dibromoethane (EDB)	ug/m3		< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.92	< 0.92	< 0.92	< 0.92	< 0.92	< 0.23
1,2-Dichloroethane	ug/m3		< 0.28	0.65 J	1.1	1.6	1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 0.28
1,2-Dichloropropane	ug/m3		< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 0.29
1,4-Dioxane	ug/m3		< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68	< 0.17
Dichlorodifluoromethane	ug/m3		2.3	2.3	2.3	2.3	2.3	2.4 J	2.4 J	3.2 J	2.2 J	4.9	2.2
Dibromochloromethane	ug/m3		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 4.2	< 4.2	< 4.2	< 4.2	< 4.2	< 1.0
trans-1,2-Dichloroethylene	ug/m3		< 0.27	< 0.27	< 0.27	< 0.27	< 0.27	< 1.1	2.1 J	< 1.1	< 1.1	< 1.1	< 0.27
cis-1,2-Dichloroethylene	ug/m3	<0.2/>60	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.48	2.4	< 0.48	< 0.48	< 0.48	< 0.12
cis-1,3-Dichloropropene	ug/m3		< 0.28	< 0.28	< 0.28	< 0.28	< 0.28	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 0.28
m-Dichlorobenzene	ug/m3		< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.66	< 0.66	< 0.66	< 0.66	< 0.66	< 0.17
o-Dichlorobenzene	ug/m3		< 0.41	< 0.41	< 0.41	< 0.41	< 0.41	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 0.41
p-Dichlorobenzene	ug/m3		< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 1.9	< 1.9	< 1.9	< 1.9	< 1.9	< 0.47
trans-1,3-Dichloropropene	ug/m3		< 0.45	< 0.45	< 0.45	< 0.45	< 0.45	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8	< 0.45
Ethanol	ug/m3		68.6	72.9	25.8	20.5	20.2	7.2	102	169	31.5	172	3.2
Ethylbenzene	ug/m3	<2/>60	< 0.26	0.56 J	1	1.3	1.2	2.3 J	2.0 J	2.0 J	< 1.0	2.3 J	< 0.26
Ethyl Acetate	ug/m3		13	9	13	9.7	10	11	9.7	14	9	19	3.6
4-Ethyltoluene	ug/m3		< 0.47	< 0.47	< 0.47	< 0.47	< 0.47	< 1.9	< 1.9	< 1.9	< 1.9	< 1.9	< 0.47
Freon 113	ug/m3		< 0.24	< 0.24	< 0.24	< 0.24	< 0.24	< 0.92	< 0.92	< 0.92	< 0.92	< 0.92	< 0.24
Freon 114	ug/m3		< 0.35	< 0.35	< 0.35	< 0.35	< 0.35	3.4	< 1.4	< 1.4	< 1.4	< 1.4	< 0.35
Heptane	ug/m3	<6/>200	< 0.37	0.41 J	0.74 J	0.74 J	0.70 J	1.9 J	1.6 J	2.3 J	< 1.5	2.4 J	< 0.37
Hexachlorobutadiene	ug/m3		< 0.66	< 0.66	< 0.66	< 0.66	< 0.66	< 2.7	< 2.7	< 2.7	< 2.7	< 2.7	< 0.66
Hexane	ug/m3	<6/>200	0.99	0.95	1.1	1.4	1.1	1.4 J	2.6 J	4.9	< 0.74	3.5	0.85

Table 5
Former Carol Cleaners
280-30 Marsh Ave. Staten Island, NY
Indoor Air and Sub Slab Volatile Organic Compounds - March 2025

Client Sample ID:		NYSDOH Air Matrics Trigger Values IA/SS	IA-1-25	IA-2-25	IA-3-25	IA-4-25	IA-5-25	SS-1-25	SS-2-25	SS-3-25	SS-4-25	SS-5-25	AA-1-25
Lab Sample ID:			JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932	JE6932
Date Sampled:			3/7/2025 11:02 AM	3/7/2025 11:50 AM	3/7/2025 12:05 PM	3/7/2025 9:27 AM	3/7/2025 9:23 AM	3/7/2025 12:23 PM	3/7/2025 11:59 AM	3/7/2025 12:42 PM	3/7/2025 12:45 PM	3/7/2025 9:20 AM	3/7/2025 8:40 AM
Matrix:	Unit		Indoor Air Comp.	Indoor Air Comp.	Indoor Air Comp.	Indoor Air Comp.	Indoor Air Comp.	Soil Vapor Comp.	Soil Vapor Comp.	Soil Vapor Comp.	Soil Vapor Comp.	Soil Vapor Comp.	Ambient Air Comp.
MS Voilatiles (TO-15) - ug/m3													
2-Hexanone	ug/m3		< 0.61	< 0.61	< 0.61	< 0.61	< 0.61	4.5	< 2.4	< 2.4	< 2.4	< 2.4	< 0.61
Isopropyl Alcohol	ug/m3		4.4	1.8	2.4	2.5	2.4	4.4	6.9	115	3.9	35.9	0.84
Methylene chloride	ug/m3	<3/>1000	1.6	1.8	2.2	3.1	2.3	< 1.8	3.3	3.5	< 1.8	< 1.8	1.5
Methyl ethyl ketone	ug/m3		0.62	1.1	1.8	1.6	2.2	321	10	28	5	14	0.32 J
Methyl Isobutyl Ketone	ug/m3		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	11	< 1.2	3.2 J	< 1.2	< 1.2	< 0.30
Methyl Tert Butyl Ether	ug/m3		< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 0.29
Methylmethacrylate	ug/m3		< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 1.1	< 1.1	< 1.1	< 1.1	< 1.1	< 0.29
Propylene	ug/m3		< 0.082	< 0.082	< 0.082	< 0.082	< 0.082	< 0.33	< 0.33	< 0.33	< 0.33	4.3	< 0.082
Styrene	ug/m3		< 0.23	< 0.23	0.64 J	0.72 J	0.60 J	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89	< 0.23
1,1,1-Trichloroethane	ug/m3	<3/>1000	< 0.43	< 0.43	< 0.43	< 0.43	< 0.43	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7	< 0.43
1,1,2,2-Tetrachloroethane	ug/m3		< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 1.3	< 1.3	< 1.3	< 1.3	< 1.3	< 0.33
1,1,2-Trichloroethane	ug/m3		< 0.21	< 0.21	< 0.21	< 0.21	< 0.21	< 0.82	< 0.82	< 0.82	< 0.82	< 0.82	< 0.21
1,2,4-Trichlorobenzene	ug/m3	<2/>60	< 0.89	< 0.89	< 0.89	< 0.89	< 0.89	< 3.6	< 3.6	< 3.6	< 3.6	< 3.6	< 0.89
1,2,4-Trimethylbenzene	ug/m3		< 0.43	< 0.43	< 0.43	< 0.43	< 0.43	12	8.4	5.4	< 1.7	12	< 0.43
1,3,5-Trimethylbenzene	ug/m3	<2/>60	< 0.39	< 0.39	< 0.39	< 0.39	< 0.39	2.9 J	2.3 J	< 1.6	< 1.6	2.9 J	< 0.39
2,2,4-Trimethylpentane	ug/m3	<2/>60	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.75	< 0.75	< 0.75	< 0.75	< 0.75	< 0.19
Tertiary Butyl Alcohol	ug/m3		< 0.28	0.39 J	0.64	0.67	0.55 J	1.5 J	1.6 J	24	< 1.1	12	< 0.28
Tetrachloroethylene(PCE)	ug/m3	<3/>1000	< 0.20	0.62	0.75	1.2	0.88	24	936	4.3	< 0.81	12	0.3
Tetrahydrofuran	ug/m3		< 0.27	< 0.27	< 0.27	< 0.27	< 0.27	162	< 1.1	< 1.1	< 1.1	< 1.1	< 0.27
Toluene	ug/m3	<10/>300	0.64 J	2.9	5.3	5.3	4.9	3.7	3.7	5.3	4.5	4.9	< 0.21
Trichloroethylene(TCE)	ug/m3	<0.2/>60	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	3.2	**374**	0.75 J	< 0.41	0.86	< 0.10
Trichlorofluoromethane	ug/m3		3.1	1.6	1.6	1.5	1.5	2.6	< 1.3	6.7	< 1.3	14	1.6
Vinyl chloride	ug/m3	<0.2/>60	< 0.18	< 0.18	< 0.18	< 0.18	< 0.18	< 0.72	< 0.72	< 0.72	< 0.72	< 0.72	< 0.18
Vinyl Acetate	ug/m3		< 0.39	< 0.39	0.7	< 0.39	< 0.39	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	< 0.39
m,p-Xylene	ug/m3	<6/>200	< 0.61	1.7	2.9	3.3	3.2	9.1	7.4	6.5	< 2.4	8.7	< 0.61
o-Xylene	ug/m3	<2/>60	< 0.33	0.87	1.7	1.9	1.8	6.1	5.2	4.3	1.8 J	5.6	< 0.33
Xylenes (total)	ug/m3		< 0.33	2.5	4.3	5.2	4.8	15	13	11	1.8 J	14	< 0.33

Legend:

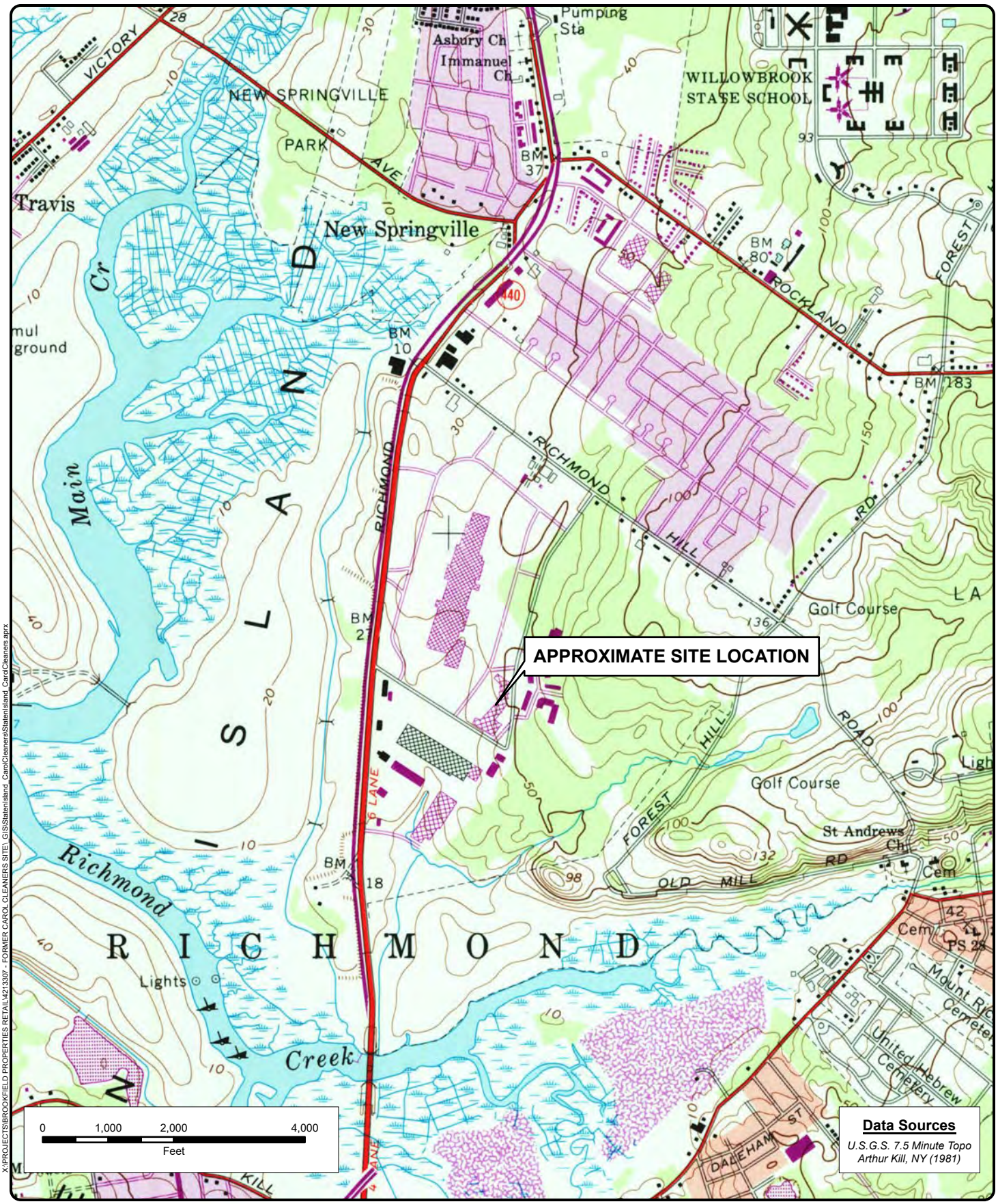
374	Number in bold and yellow background indicates an exceedance of NYSDOH Indoor/Outdoor Air Guidelines INDOOR AIR CONCENTRATION of COMPOUND (mcg/m3)/SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m3)
1.7	Number with blue background indicates the consituent was detected, but does not exceed the NYSDOH Indoor/ Outdoor Air Guidelines
< 0.18	Indicates the consituent was non-detect with the corresponding laboratory method detection limit (MDL).
J	J Indicates an estimated value.

Table 6
Former Carol Cleaners
280-30 Marsh Ave. Staten Island, NY

Sub-Slab Vapor Pressure Testing Pressure Readings - January 2024

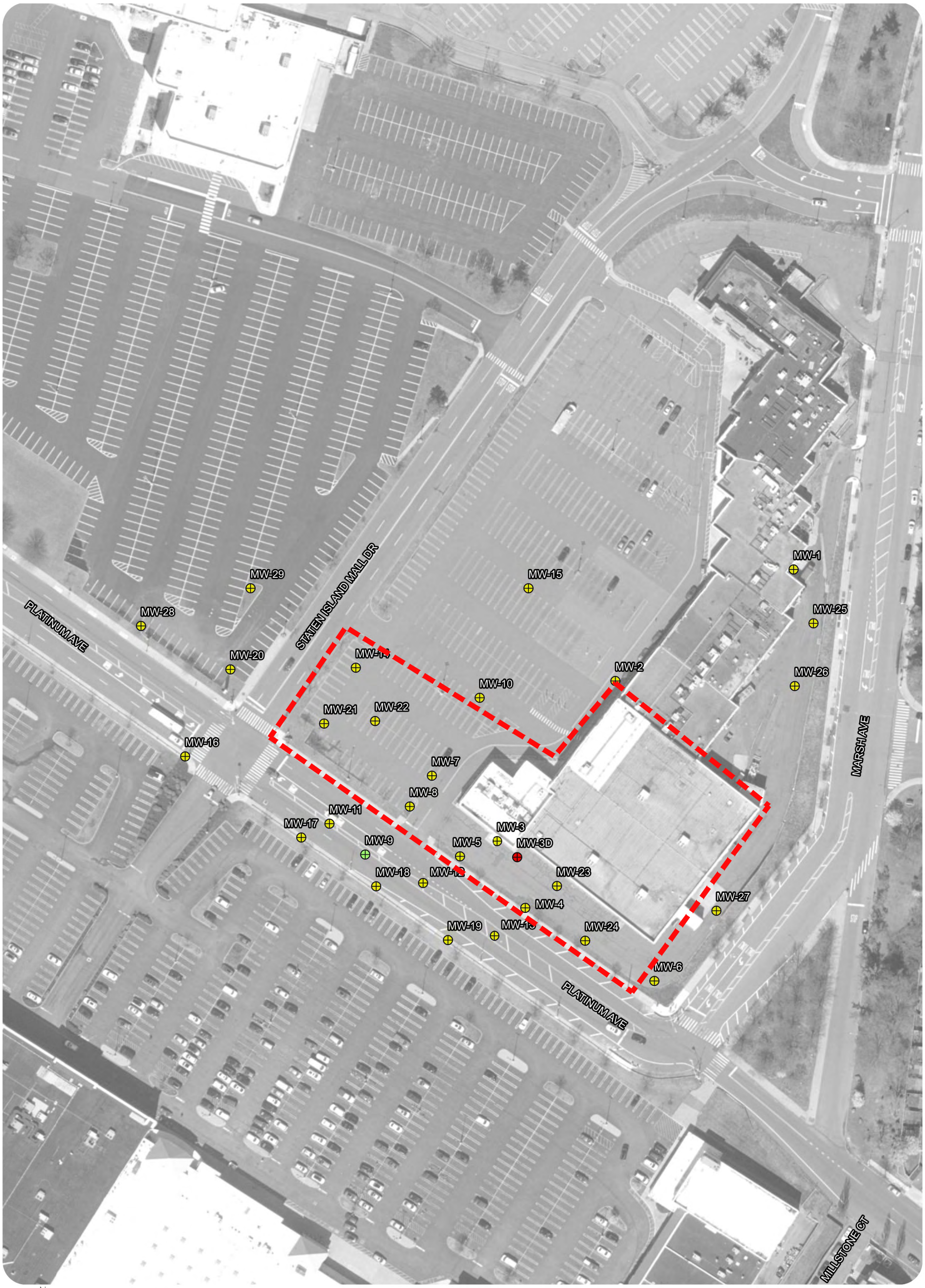
Vacuum Testing Location	Pressure Reading (inches of water)
SI Mall-VT-1	-0.032
SI Mall-VT-2	-0.102
SI Mall-VT-3	-0.651
SI Mall-VT-4	-0.158
SI Mall-VT-5	-0.085
SI Mall-VT-6	-2.275
SI Mall-VT-7	-0.04

FIGURES



X:\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_GIS\StatenIsland_CarolCleanersStatenIsland_CarolCleaners.aprx

PREPARED BY: AGB APPROVED BY: MGA DATE CREATED: 7/14/2021	TETRA TECH PREPARED BY: TETRATECH This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.	GGP STATEN ISLAND MALL, LLC CARL CLEANERS - THE CROSSINGS STATEN ISLAND, NEW YORK **SITE LOCATION**	FIGURE NO. **1** PROJECT NO. 4201222



This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

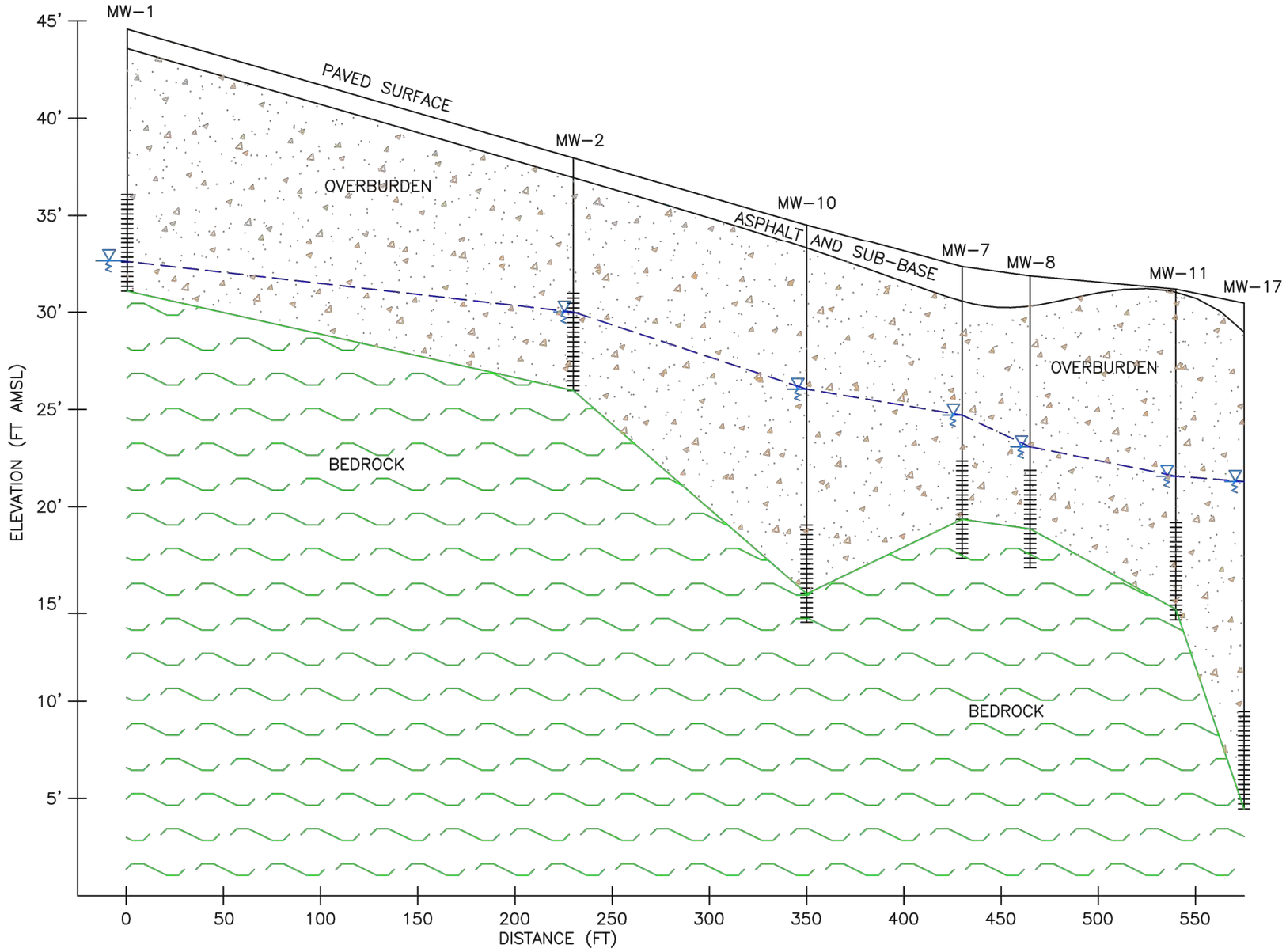
DATE OF ISSUE _____ DRAWN BY _____ CHECKED BY _____
DESIGNED BY _____ APPROVED BY _____

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

SITE PLAN

FIGURE NO.
2
PROJECT NO.
4201222



LEGEND

SCREENED INTERVAL

GROUNDWATER ELEVATION

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE

DRAWN BY

DESIGNED BY

CHECKED BY

APPROVED BY

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

GEOLOGIC CROSS SECTION

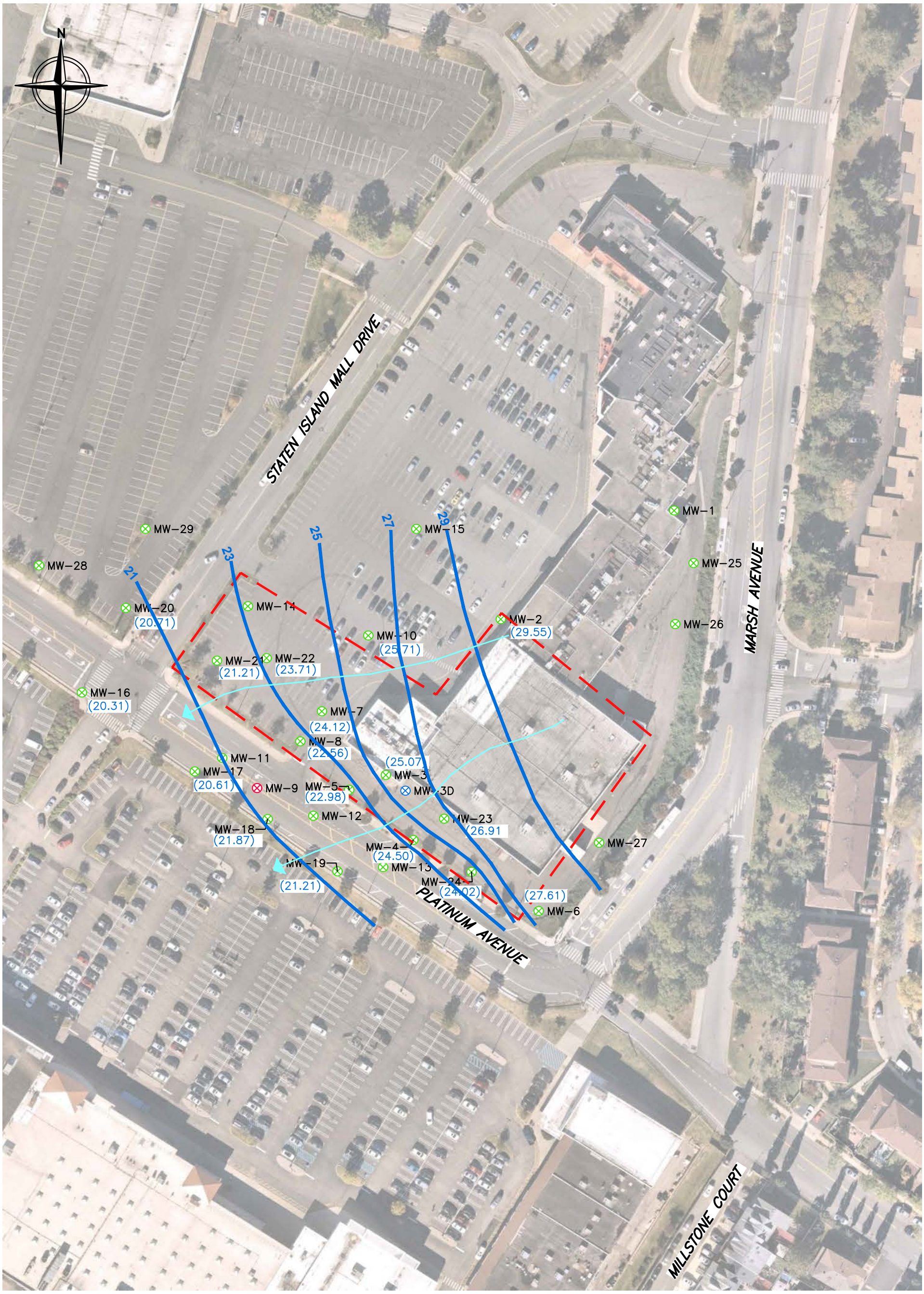
SHEET NO.

3

PROJECT NO.
4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\Border.dwg Layout: ANSI-B-L User: JISS.PHILIP May 30, 2023 - 11:59am

1" 1/2" 0" 1"



LEGEND:

- MW-9 — ABANDONED WELL
- MW-3D — BEDROCK WELL
- MW-13 — OVERBURDEN WELL
- SITE BOUNDARY
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION

0 100 200

SCALE IN FEET

SOURCE:

BACKGROUND AERIAL DOWNLOADED FROM NEAR MAP PROGRAM, DATED 2021-10-19.

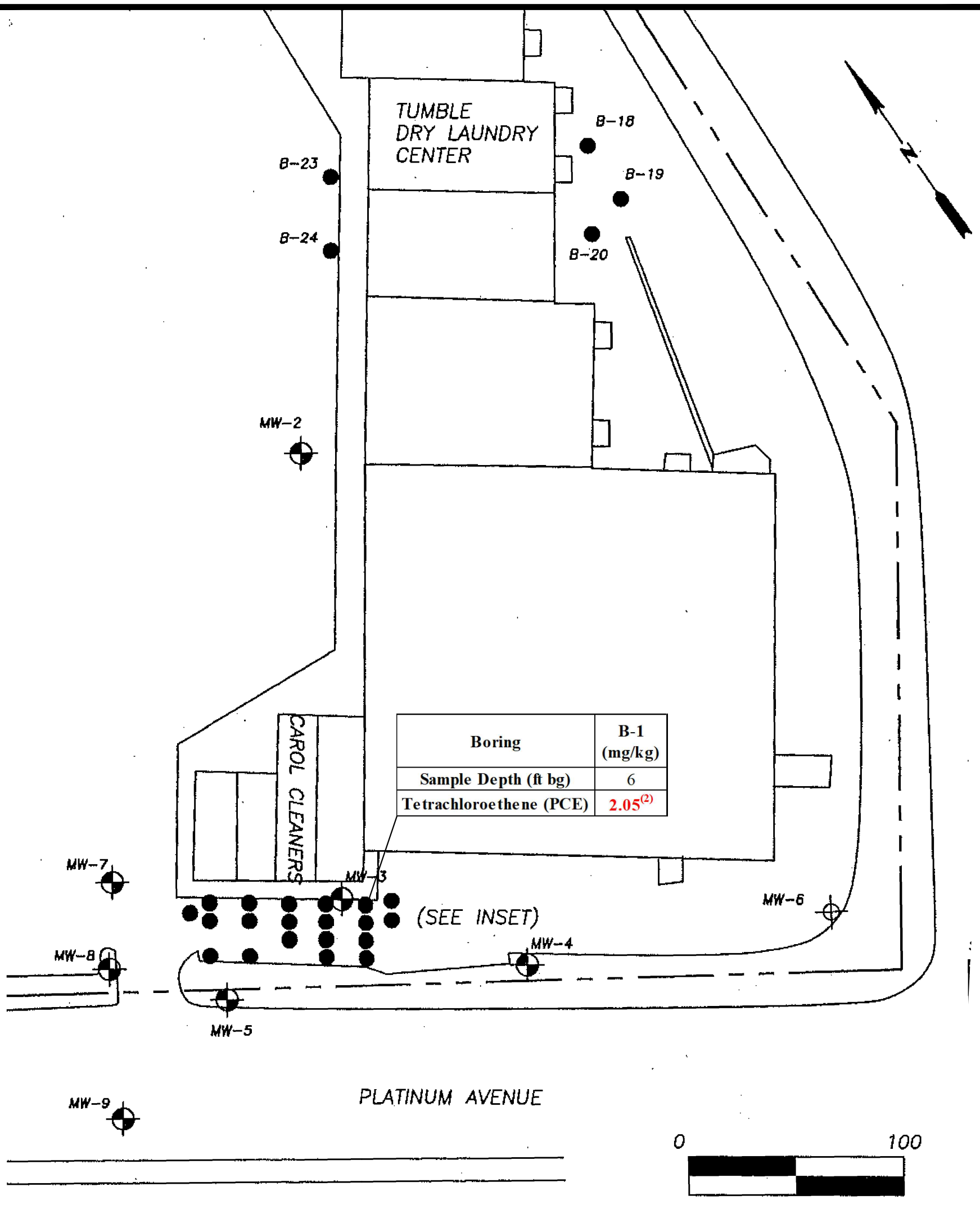
cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
CAROL CLEANERS – THE CROSSINGS
STATEN ISLAND, NEW YORK
GROUNDWATER CONTOURS AND FLOW DIRECTION MARCH 3, 2025

FIGURE NO. **4**

PROJECT NO. 4213307

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\213307-F-0X-GW CONTOURS MARCH25.DWG Layout: FIGURE 04 User: JISS.PHILIP Apr 08, 2025 – 1:45pm



	Tetrachloroethene (mg/kg)
NYSDEC Residential SCO	5.5
NYSDEC Commercial SCO	150
NYSDEC Protection of Groundwater SCO	1.3

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM FIGURE 3 PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 06/26/2022, AND INCLUDED WITHIN REMEDIAL INVESTIGATION REPORT JULY 2003.
2. CONCENTRATIONS EXPRESSED IN MILLIGRAMS PER KILOGRAM [MG/KG, EQUIVALENT TO PARTS PER MILLION (PPM)].
3. FROM TABLE 11-2. FINAL RESTRICTED USE SOIL CLEANUP OBJECTIVES (SCOS) AS PRESENTED IN 6 NYCRR PART 375-6.8(B).

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

DATE OF ISSUE _____ DRAWN BY _____ CHECKED BY _____
DESIGNED BY _____ APPROVED BY _____

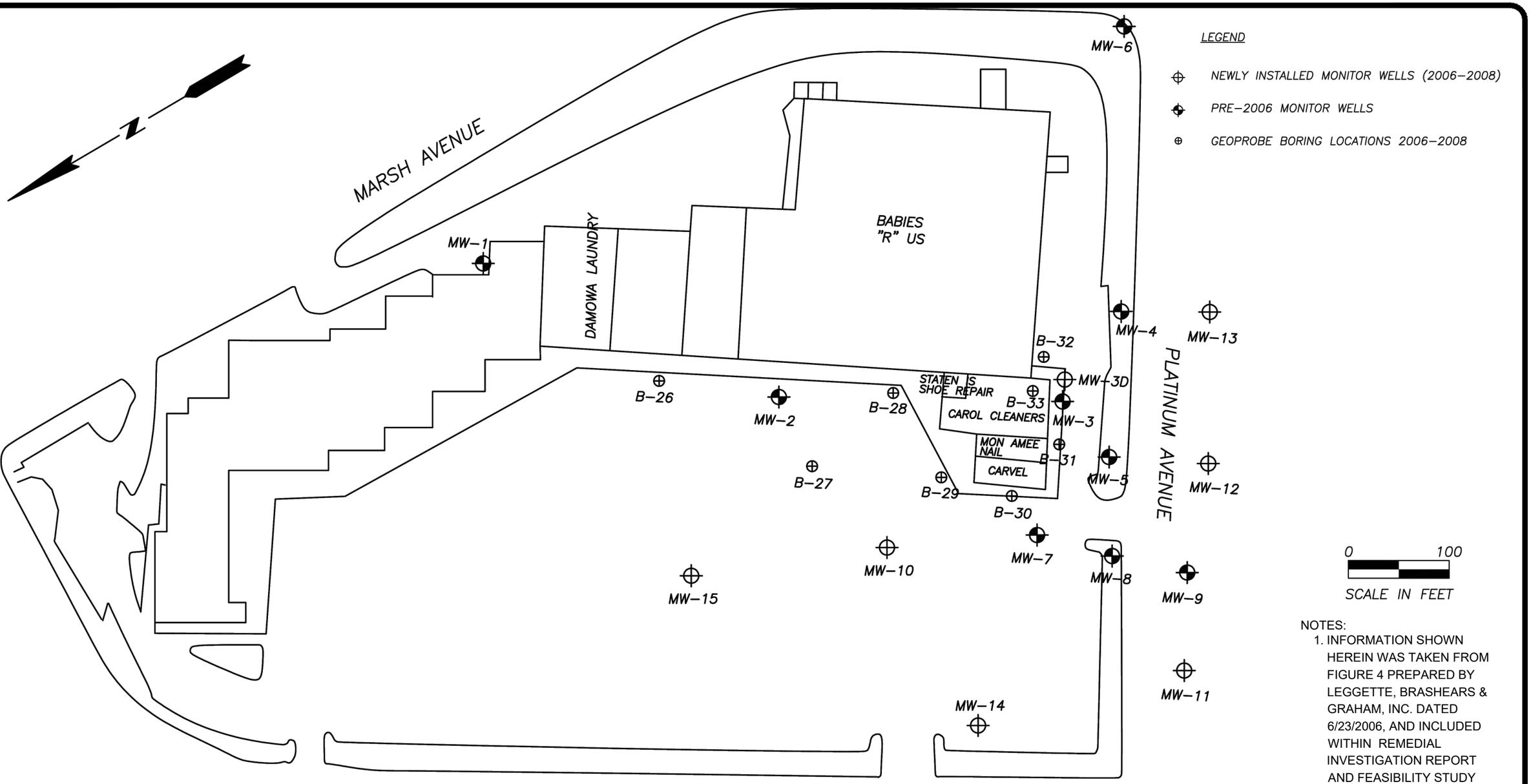
cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

HISTORICAL 2002 SOIL BORING LOCATIONS

FIGURE NO. **5A**
PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\Figures for SMP_recover.dwg Layout: Figure 5A User: JISS.PHILIP Jun 05, 2025 - 12:53pm



NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM FIGURE 4 PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 6/23/2006, AND INCLUDED WITHIN REMEDIAL INVESTIGATION REPORT AND FEASIBILITY STUDY SUBMITTED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED JUNE 2009.

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE _____

DRAWN BY _____ CHECKED BY _____

DESIGNED BY _____ APPROVED BY _____

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

HISTORICAL 2006 SOIL BORING LOCATIONS

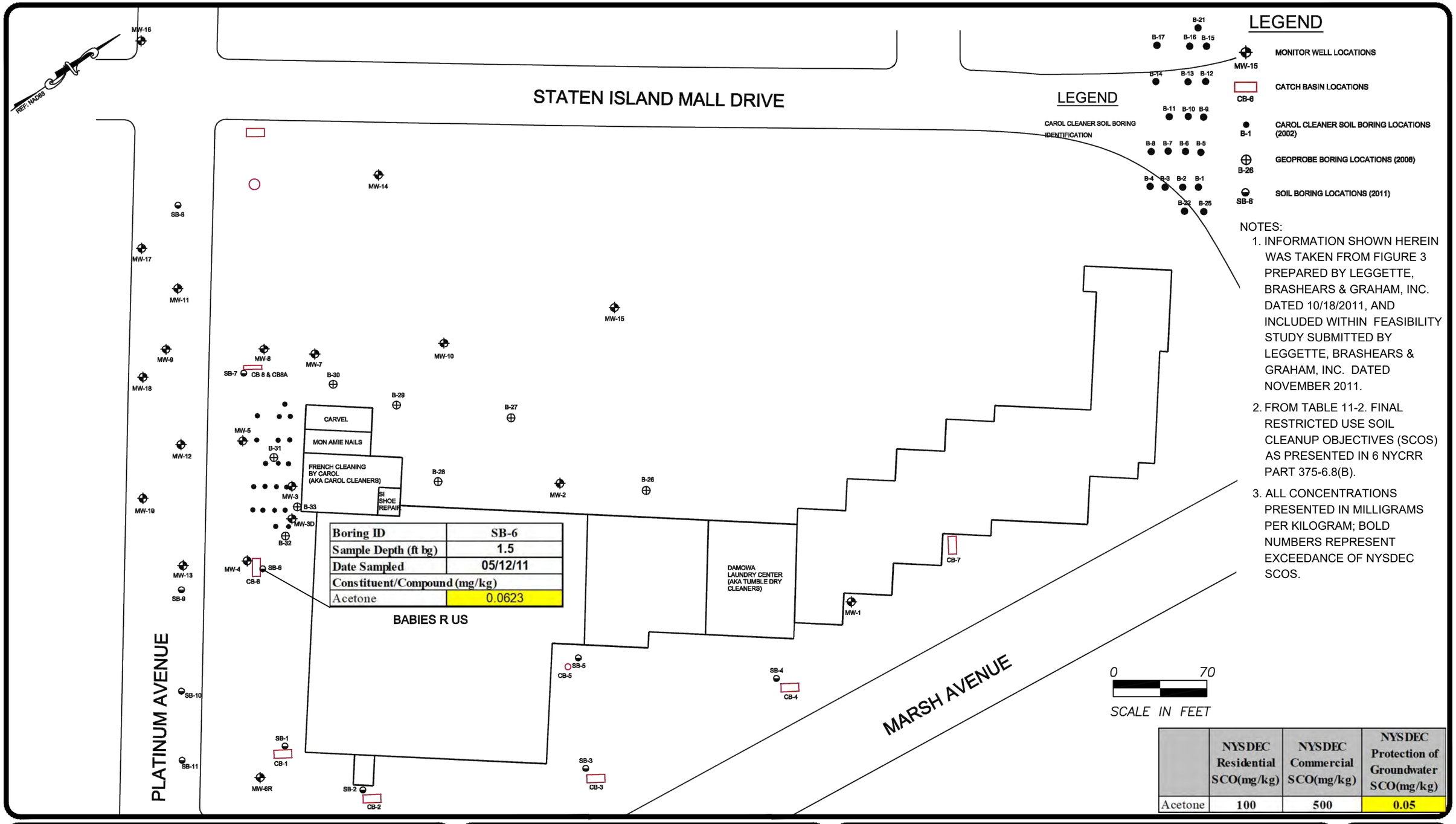
SHEET NO.

5B

PROJECT NO.
4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\Figures for SMP_recover.dwg Layout: Figure 5B User: JISS.PHILIP May 15, 2025 - 1:

1" 1/2" 0" 1"



NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM FIGURE 3 PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 10/18/2011, AND INCLUDED WITHIN FEASIBILITY STUDY SUBMITTED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED NOVEMBER 2011.
2. FROM TABLE 11-2. FINAL RESTRICTED USE SOIL CLEANUP OBJECTIVES (SCOS) AS PRESENTED IN 6 NYCRR PART 375-6.8(B).
3. ALL CONCENTRATIONS PRESENTED IN MILLIGRAMS PER KILOGRAM; BOLD NUMBERS REPRESENT EXCEEDANCE OF NYSDEC SCOS.

	NYSDEC Residential SCO(mg/kg)	NYSDEC Commercial SCO(mg/kg)	NYSDEC Protection of Groundwater SCO(mg/kg)
Acetone	100	500	**0.05**

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE

DRAWN BY
DESIGNED BY
CHECKED BY
APPROVED BY

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

HISTORICAL 2011 SOIL BORING LOCATIONS

SHEET NO.
5C
PROJECT NO.
4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\Figures for SMP_recover.dwg Layout: Figure 5C User: JISS.PHILIP Jun 05, 2025 - 1

1" 1/2" 0" 1"



Legend

- Monitor Well with ID
- Soil Boring with ID
- Temporary Well Point with ID
- Site Boundary

100 50 0 100 Feet

New York Quadrangle Location

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

DATE OF ISSUE _____ DRAWN BY _____ CHECKED BY _____ DESIGNED BY _____ APPROVED BY _____

cornerstone PLLC

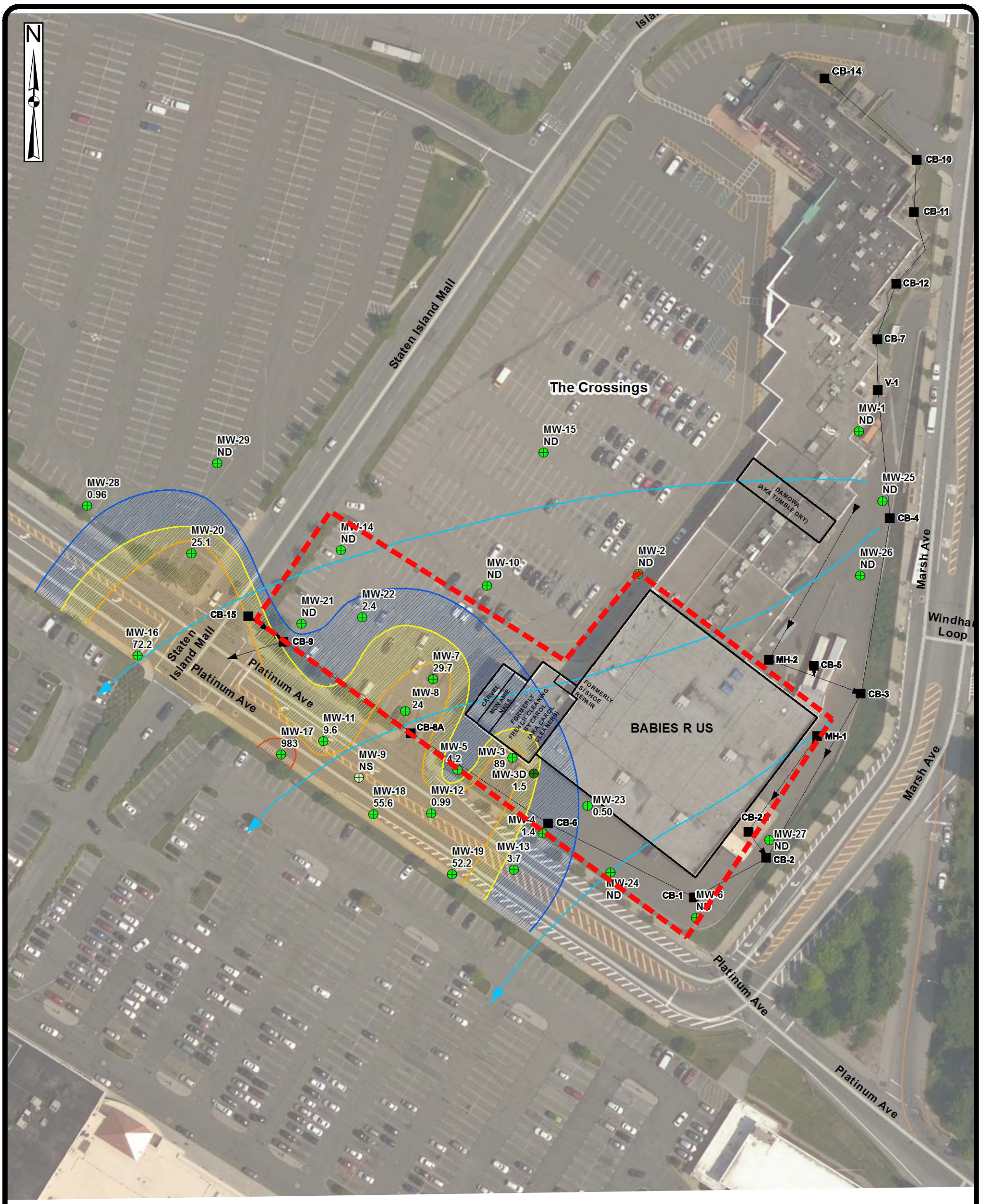
GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

HISTORICAL 2017 SOIL BORING LOCATIONS ASSOCIATED WITH CATCH BASIN INVESTIGATION

FIGURE NO. **5D**

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\Figures for SMP.dwg Layout: Figure 5D User: JISS.PHILIP Apr 25, 2025 – 4:37pm



Legend

MW-1 ND = Monitor Well with ID and Concentration in ppb

MW-3D 1.5 = Bedrock Monitor Well with ID and Concentration in ppb

MW-9 = Abandoned Monitor Well

CB-4 = Stormwater System Component with Arrow Indicating Direction of Flow

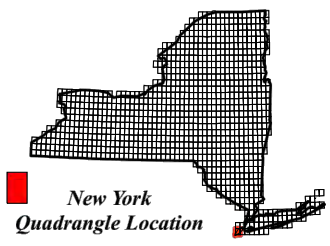
PCE Concentration Contour (ppb)

- ≥1
- ≥5
- ≥10
- ≥100

= Approximate Groundwater Flow Direction

— — Site Boundary

100 50 0 100 Feet



Notes: ND = Non-detect; NS = Not Sampled; J = Estimated Value; MW-3D is completed in bedrock and was not used for contours.

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

DATE OF ISSUE _____ DRAWN BY _____ CHECKED BY _____

DESIGNED BY _____ APPROVED BY _____

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

PCE ISOPLETH MAP
JULY 2017

FIGURE NO. **6**

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\Border.dwg Layout: Figure 6 User: JISS.PHILIP May 31, 2023 – 12:40pm



LEGEND:

MW-9	ABANDONED WELL
MW-3D	BEDROCK WELL
MW-13	OVERBURDEN WELL
	PCE ISOPLETH (ug/L)
	SITE BOUNDARY

NOTES:

1. PARAMETERS SAMPLE RESULTS FOR TETRACHLOROETHENE (PCE).
2. CONCENTRATIONS MEASURED IN UG/L.
3. NYSDEC GROUNDWATER STANDARDS (PCE) – 5 UG/L.

SOURCE:

BACKGROUND AERIAL DOWNLOADED FROM NEAR MAP PROGRAM, DATED 2021-10-19.

0 100 200

SCALE IN FEET

cornerstone PLLC

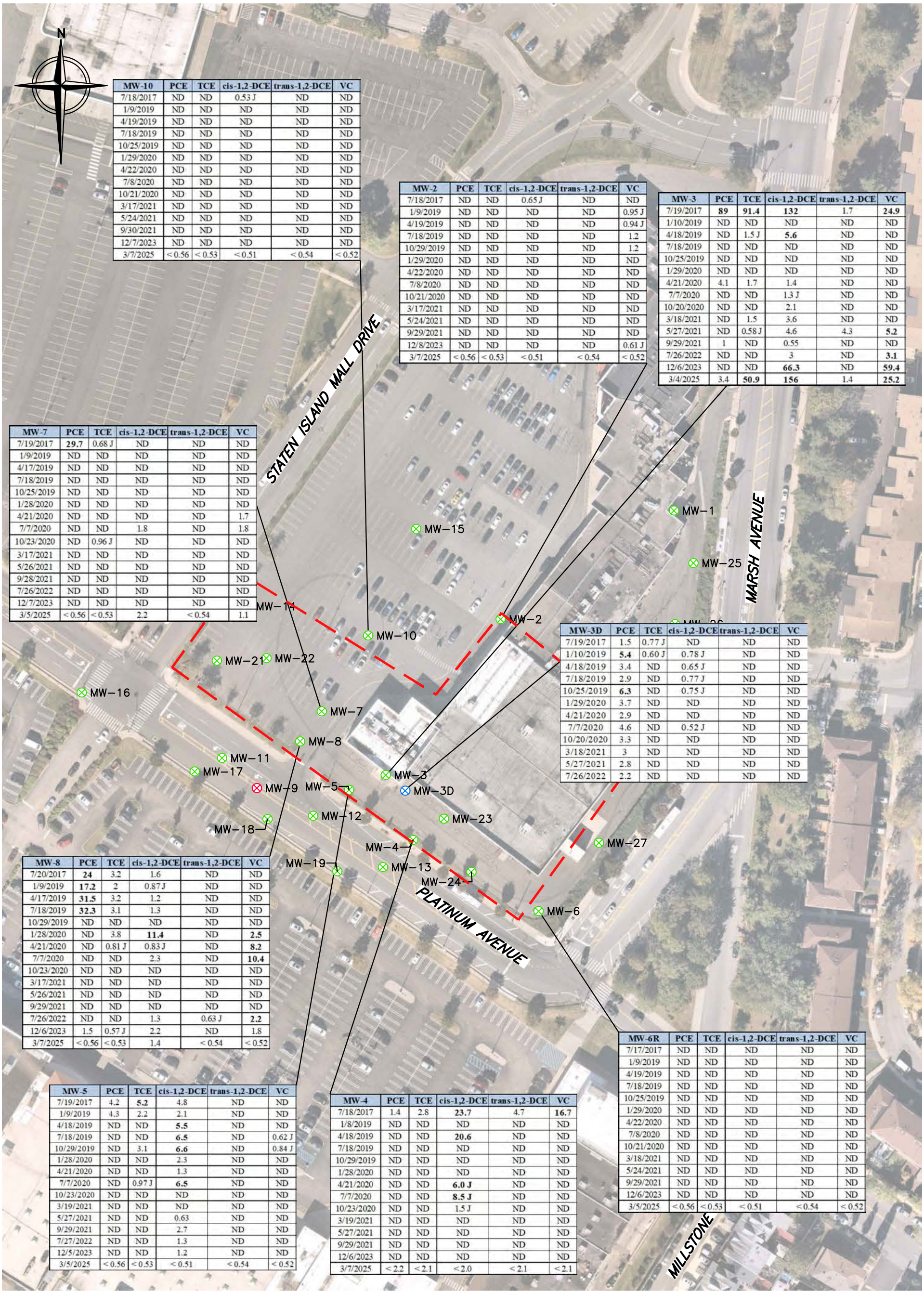
GGP STATEN ISLAND MALL, LLC
CAROL CLEANERS – THE CROSSINGS
STATEN ISLAND, NEW YORK

PCE ISOPLETH - MARCH 2025

FIGURE NO. **7**

PROJECT NO. 4213307

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\213307-F-05A-PCE ISO MARCH25.DWG Layout: FIGURE 05A User: JISS.PHILIP Apr 08, 2025 – 11:46am



MW-10	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/18/2017	ND	ND	0.53 J	ND	ND
1/9/2019	ND	ND	ND	ND	ND
4/19/2019	ND	ND	ND	ND	ND
7/18/2019	ND	ND	ND	ND	ND
10/25/2019	ND	ND	ND	ND	ND
1/29/2020	ND	ND	ND	ND	ND
4/22/2020	ND	ND	ND	ND	ND
7/8/2020	ND	ND	ND	ND	ND
10/21/2020	ND	ND	ND	ND	ND
3/17/2021	ND	ND	ND	ND	ND
5/24/2021	ND	ND	ND	ND	ND
9/30/2021	ND	ND	ND	ND	ND
12/7/2023	ND	ND	ND	ND	ND
3/7/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52

MW-2	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/18/2017	ND	ND	0.65 J	ND	ND
1/9/2019	ND	ND	ND	ND	0.95 J
4/19/2019	ND	ND	ND	ND	0.94 J
7/18/2019	ND	ND	ND	ND	1.2
10/29/2019	ND	ND	ND	ND	1.2
1/29/2020	ND	ND	ND	ND	ND
4/22/2020	ND	ND	ND	ND	ND
7/8/2020	ND	ND	ND	ND	ND
10/21/2020	ND	ND	ND	ND	ND
3/17/2021	ND	ND	ND	ND	ND
5/24/2021	ND	ND	ND	ND	ND
9/29/2021	ND	ND	ND	ND	ND
12/8/2023	ND	ND	ND	ND	0.61 J
3/7/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52

MW-3	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/19/2017	**89**	**91.4**	**132**	1.7	**24.9**
1/10/2019	ND	ND	ND	ND	ND
4/18/2019	ND	1.5 J	**5.6**	ND	ND
7/18/2019	ND	ND	ND	ND	ND
10/25/2019	ND	ND	ND	ND	ND
1/29/2020	ND	ND	ND	ND	ND
4/21/2020	4.1	1.7	1.4	ND	ND
7/7/2020	ND	ND	1.3 J	ND	ND
10/20/2020	ND	ND	2.1	ND	ND
3/18/2021	ND	1.5	3.6	ND	ND
5/27/2021	ND	0.58 J	4.6	4.3	**5.2**
9/29/2021	1	ND	0.55	ND	ND
7/26/2022	ND	ND	3	ND	**3.1**
12/6/2023	ND	ND	**66.3**	ND	**59.4**
3/4/2025	3.4	**50.9**	**156**	1.4	**25.2**

MW-7	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/19/2017	**29.7**	0.68 J	ND	ND	ND
1/9/2019	ND	ND	ND	ND	ND
4/17/2019	ND	ND	ND	ND	ND
7/18/2019	ND	ND	ND	ND	ND
10/25/2019	ND	ND	ND	ND	ND
1/28/2020	ND	ND	ND	ND	ND
4/21/2020	ND	ND	ND	ND	1.7
7/7/2020	ND	ND	1.8	ND	1.8
10/23/2020	ND	0.96 J	ND	ND	ND
3/17/2021	ND	ND	ND	ND	ND
5/26/2021	ND	ND	ND	ND	ND
9/28/2021	ND	ND	ND	ND	ND
7/26/2022	ND	ND	ND	ND	ND
12/7/2023	ND	ND	ND	ND	ND
3/5/2025	< 0.56	< 0.53	2.2	< 0.54	1.1

MW-3D	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/19/2017	1.5	0.77 J	ND	ND	ND
1/10/2019	**5.4**	0.60 J	0.78 J	ND	ND
4/18/2019	3.4	ND	0.65 J	ND	ND
7/18/2019	2.9	ND	0.77 J	ND	ND
10/25/2019	**6.3**	ND	0.75 J	ND	ND
1/29/2020	3.7	ND	ND	ND	ND
4/21/2020	2.9	ND	ND	ND	ND
7/7/2020	4.6	ND	0.52 J	ND	ND
10/20/2020	3.3	ND	ND	ND	ND
3/18/2021	3	ND	ND	ND	ND
5/27/2021	2.8	ND	ND	ND	ND
7/26/2022	2.2	ND	ND	ND	ND

MW-8	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/20/2017	**24**	3.2	1.6	ND	ND
1/9/2019	**17.2**	2	0.87 J	ND	ND
4/17/2019	**31.5**	3.2	1.2	ND	ND
7/18/2019	**32.3**	3.1	1.3	ND	ND
10/29/2019	ND	ND	ND	ND	ND
1/28/2020	ND	3.8	**11.4**	ND	**2.5**
4/21/2020	ND	0.81 J	0.83 J	ND	**8.2**
7/7/2020	ND	ND	2.3	ND	**10.4**
10/23/2020	ND	ND	ND	ND	ND
3/17/2021	ND	ND	ND	ND	ND
5/26/2021	ND	ND	ND	ND	ND
9/29/2021	ND	ND	ND	ND	ND
7/26/2022	ND	ND	1.3	0.63 J	**2.2**
12/6/2023	1.5	0.57 J	2.2	ND	1.8
3/7/2025	< 0.56	< 0.53	1.4	< 0.54	< 0.52

MW-6R	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/17/2017	ND	ND	ND	ND	ND
1/9/2019	ND	ND	ND	ND	ND
4/19/2019	ND	ND	ND	ND	ND
7/18/2019	ND	ND	ND	ND	ND
10/25/2019	ND	ND	ND	ND	ND
1/29/2020	ND	ND	ND	ND	ND
4/22/2020	ND	ND	ND	ND	ND
7/8/2020	ND	ND	ND	ND	ND
10/21/2020	ND	ND	ND	ND	ND
3/18/2021	ND	ND	ND	ND	ND
5/24/2021	ND	ND	ND	ND	ND
9/29/2021	ND	ND	ND	ND	ND
12/6/2023	ND	ND	ND	ND	ND
3/5/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52

MW-5	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/19/2017	4.2	**5.2**	4.8	ND	ND
1/9/2019	4.3	2.2	2.1	ND	ND
4/18/2019	ND	ND	**5.5**	ND	ND
7/18/2019	ND	ND	**6.5**	ND	0.62 J
10/29/2019	ND	3.1	**6.6**	ND	0.84 J
1/28/2020	ND	ND	2.3	ND	ND
4/21/2020	ND	ND	1.3	ND	ND
7/7/2020	ND	0.97 J	**6.5**	ND	ND
10/23/2020	ND	ND	ND	ND	ND
3/19/2021	ND	ND	ND	ND	ND
5/27/2021	ND	ND	0.63	ND	ND
9/29/2021	ND	ND	2.7	ND	ND
7/27/2022	ND	ND	1.3	ND	ND
12/5/2023	ND	ND	1.2	ND	ND
3/5/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52

MW-4	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/18/2017	1.4	2.8	**23.7**	4.7	**16.7**
1/8/2019	ND	ND	ND	ND	ND
4/18/2019	ND	ND	**20.6**	ND	ND
7/18/2019	ND	ND	ND	ND	ND
10/29/2019	ND	ND	ND	ND	ND
1/28/2020	ND	ND	ND	ND	ND
4/21/2020	ND	ND	**6.0 J**	ND	ND
7/7/2020	ND	ND	**8.5 J**	ND	ND
10/23/2020	ND	ND	1.5 J	ND	ND
3/19/2021	ND	ND	ND	ND	ND
5/27/2021	ND	ND	ND	ND	ND
9/29/2021	ND	ND	ND	ND	ND
12/6/2023	ND	ND	ND	ND	ND
3/7/2025	< 2.2	< 2.1	< 2.0	< 2.1	< 2.1

LEGEND:

- ABANDONED WELL
- BEDROCK WELL
- OVERBURDEN WELL
- SITE BOUNDARY

0 100 200

SCALE IN FEET

NOTES:

1. PARAMETERS SAMPLED INCLUDE TETRACHLOROETHENE (PCE), TRICHLOROETHENE (TCE), CIS-1,2-DICHLOROETHENE (cis-1,2-DCE), TRANS-1,2-DICHLOROETHENE (trans-1,2-DCE), AND VINYL CHLORIDE (VC).
2. CONCENTRATIONS MEASURED IN ug/L.
3. BOLDED VALUES INDICATED EXCEEDANCES.

NYSDEC Groundwater Standards				
PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
5	5	5	5	2

SOURCE:

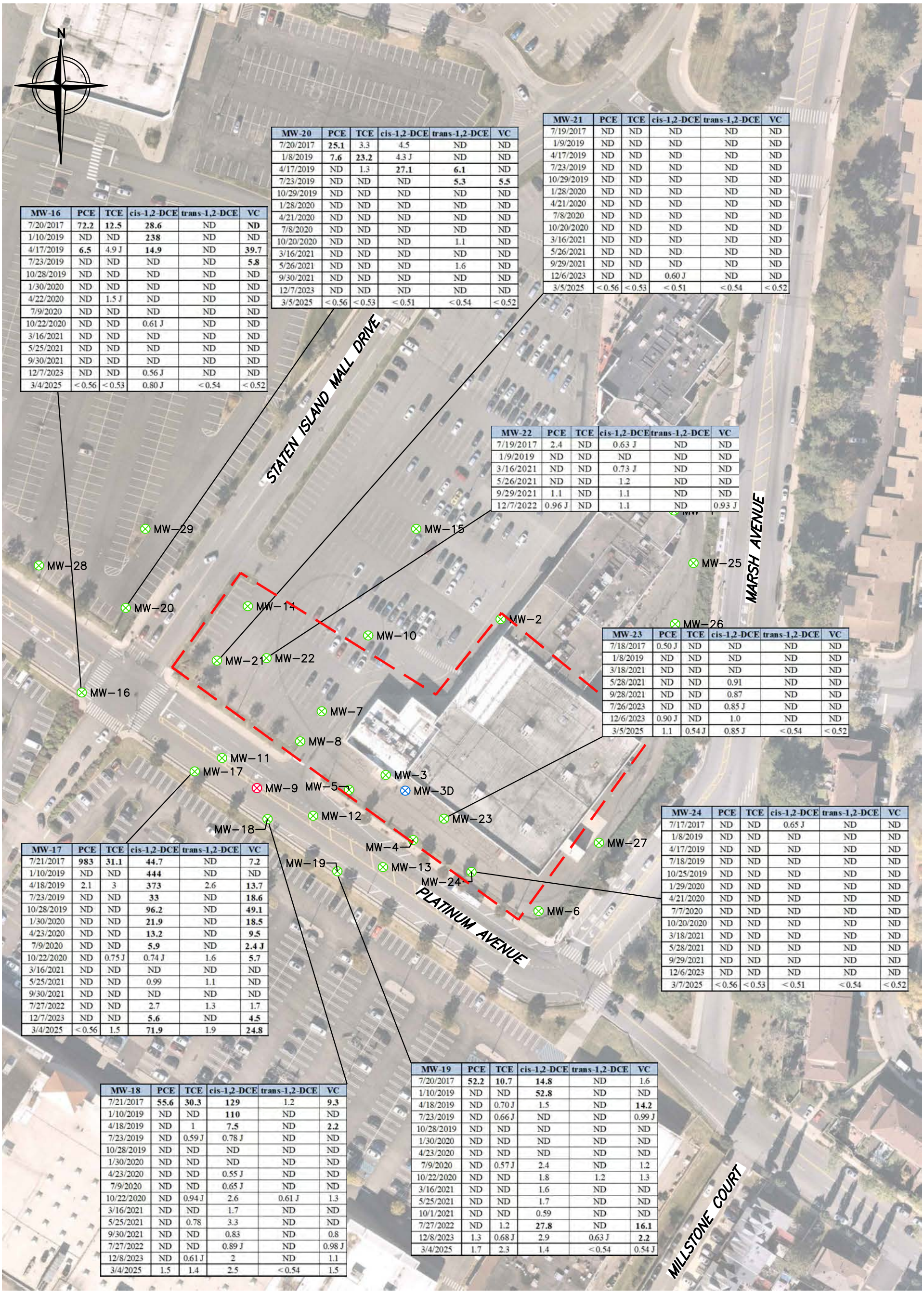
BACKGROUND AERIAL DOWNLOADED FROM NEAR MAP PROGRAM, DATED 2021-10-19.

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
CAROL CLEANERS – THE CROSSINGS
STATEN ISLAND, NEW YORK
GROUNDWATER SAMPLING RESULTS
JULY 2017 THROUGH MARCH 2025

FIGURE NO.
8A
PROJECT NO.
4213307

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\213307-F-4A-RESULTS MARCH25.dwg Layout: FIGURE 04 User: JISS.PHILIP Jul 28, 2025 – 9:57am



MW-16	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/20/2017	**72.2**	**12.5**	**28.6**	ND	**ND**
1/10/2019	ND	ND	**238**	ND	ND
4/17/2019	**6.5**	4.9 J	**14.9**	ND	**39.7**
7/23/2019	ND	ND	ND	ND	**5.8**
10/28/2019	ND	ND	ND	ND	ND
1/30/2020	ND	ND	ND	ND	ND
4/22/2020	ND	1.5 J	ND	ND	ND
7/9/2020	ND	ND	ND	ND	ND
10/22/2020	ND	ND	0.61 J	ND	ND
3/16/2021	ND	ND	ND	ND	ND
5/25/2021	ND	ND	ND	ND	ND
9/30/2021	ND	ND	ND	ND	ND
12/7/2023	ND	ND	0.56 J	ND	ND
3/4/2025	< 0.56	< 0.53	0.80 J	< 0.54	< 0.52

MW-20	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/20/2017	**25.1**	3.3	4.5	ND	ND
1/8/2019	**7.6**	**23.2**	4.3 J	ND	ND
4/17/2019	ND	1.3	**27.1**	**6.1**	ND
7/23/2019	ND	ND	ND	**5.3**	**5.5**
10/29/2019	ND	ND	ND	ND	ND
1/28/2020	ND	ND	ND	ND	ND
4/21/2020	ND	ND	ND	ND	ND
7/8/2020	ND	ND	ND	ND	ND
10/20/2020	ND	ND	ND	1.1	ND
3/16/2021	ND	ND	ND	ND	ND
5/26/2021	ND	ND	ND	1.6	ND
9/30/2021	ND	ND	ND	ND	ND
12/7/2023	ND	ND	ND	ND	ND
3/5/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52

MW-21	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/19/2017	ND	ND	ND	ND	ND
1/9/2019	ND	ND	ND	ND	ND
4/17/2019	ND	ND	ND	ND	ND
7/23/2019	ND	ND	ND	ND	ND
10/29/2019	ND	ND	ND	ND	ND
1/28/2020	ND	ND	ND	ND	ND
4/21/2020	ND	ND	ND	ND	ND
7/8/2020	ND	ND	ND	ND	ND
10/20/2020	ND	ND	ND	ND	ND
3/16/2021	ND	ND	ND	ND	ND
5/26/2021	ND	ND	ND	ND	ND
9/29/2021	ND	ND	ND	ND	ND
12/6/2023	ND	ND	0.60 J	ND	ND
3/5/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52

MW-22	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/19/2017	2.4	ND	0.63 J	ND	ND
1/9/2019	ND	ND	ND	ND	ND
3/16/2021	ND	ND	0.73 J	ND	ND
5/26/2021	ND	ND	1.2	ND	ND
9/29/2021	1.1	ND	1.1	ND	ND
12/7/2022	0.96 J	ND	1.1	ND	0.93 J

MW-23	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/18/2017	0.50 J	ND	ND	ND	ND
1/8/2019	ND	ND	ND	ND	ND
3/18/2021	ND	ND	ND	ND	ND
5/28/2021	ND	ND	0.91	ND	ND
9/28/2021	ND	ND	0.87	ND	ND
7/26/2023	ND	ND	0.85 J	ND	ND
12/6/2023	0.90 J	ND	1.0	ND	ND
3/5/2025	1.1	0.54 J	0.85 J	< 0.54	< 0.52

MW-24	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/17/2017	ND	ND	0.65 J	ND	ND
1/8/2019	ND	ND	ND	ND	ND
4/17/2019	ND	ND	ND	ND	ND
7/18/2019	ND	ND	ND	ND	ND
10/25/2019	ND	ND	ND	ND	ND
1/29/2020	ND	ND	ND	ND	ND
4/21/2020	ND	ND	ND	ND	ND
7/7/2020	ND	ND	ND	ND	ND
10/20/2020	ND	ND	ND	ND	ND
3/18/2021	ND	ND	ND	ND	ND
5/28/2021	ND	ND	ND	ND	ND
9/29/2021	ND	ND	ND	ND	ND
12/6/2023	ND	ND	ND	ND	ND
3/7/2025	< 0.56	< 0.53	< 0.51	< 0.54	< 0.52

MW-17	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/21/2017	**983**	**31.1**	**44.7**	ND	7.2
1/10/2019	ND	ND	**444**	ND	ND
4/18/2019	2.1	3	**373**	2.6	**13.7**
7/23/2019	ND	ND	**33**	ND	**18.6**
10/28/2019	ND	ND	**96.2**	ND	**49.1**
1/30/2020	ND	ND	**21.9**	ND	**18.5**
4/23/2020	ND	ND	**13.2**	ND	**9.5**
7/9/2020	ND	ND	**5.9**	ND	**2.4 J**
10/22/2020	ND	0.75 J	0.74 J	1.6	**5.7**
3/16/2021	ND	ND	ND	ND	ND
5/25/2021	ND	ND	0.99	1.1	ND
9/30/2021	ND	ND	ND	ND	ND
7/27/2022	ND	ND	2.7	1.3	1.7
12/7/2023	ND	ND	**5.6**	ND	**4.5**
3/4/2025	< 0.56	1.5	**71.9**	1.9	**24.8**

MW-18	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/21/2017	**55.6**	**30.3**	**129**	1.2	**9.3**
1/10/2019	ND	ND	**110**	ND	ND
4/18/2019	ND	1	**7.5**	ND	**2.2**
7/23/2019	ND	0.59 J	0.78 J	ND	ND
10/28/2019	ND	ND	ND	ND	ND
1/30/2020	ND	ND	ND	ND	ND
4/23/2020	ND	ND	0.55 J	ND	ND
7/9/2020	ND	ND	0.65 J	ND	ND
10/22/2020	ND	0.94 J	2.6	0.61 J	1.3
3/16/2021	ND	ND	1.7	ND	ND
5/25/2021	ND	0.78	3.3	ND	ND
9/30/2021	ND	ND	0.83	ND	0.8
7/27/2022	ND	ND	0.89 J	ND	0.98 J
12/8/2023	ND	0.61 J	2	ND	1.1
3/4/2025	1.5	1.4	2.5	< 0.54	1.5

MW-19	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
7/20/2017	**52.2**	**10.7**	**14.8**	ND	1.6
1/10/2019	ND	ND	**52.8**	ND	ND
4/18/2019	ND	0.70 J	1.5	ND	**14.2**
7/23/2019	ND	0.66 J	ND	ND	0.99 J
10/28/2019	ND	ND	ND	ND	ND
1/30/2020	ND	ND	ND	ND	ND
4/23/2020	ND	ND	ND	ND	ND
7/9/2020	ND	0.57 J	2.4	ND	1.2
10/22/2020	ND	ND	1.8	1.2	1.3
3/16/2021	ND	ND	1.6	ND	ND
5/25/2021	ND	ND	1.7	ND	ND
10/1/2021	ND	ND	0.59	ND	ND
7/27/2022	ND	1.2	**27.8**	ND	**16.1**
12/8/2023	1.3	0.68 J	2.9	0.63 J	**2.2**
3/4/2025	1.7	2.3	1.4	< 0.54	0.54 J

LEGEND:

- ABANDONED WELL
- BEDROCK WELL
- OVERBURDEN WELL
- SITE BOUNDARY

0 100 200

SCALE IN FEET

NOTES:

1. PARAMETERS SAMPLED INCLUDE TETRACHLOROETHENE (PCE), TRICHLOROETHENE (TCE), CIS–1,2–DICHLOROETHENE (cis–1,2–DCE), TRANS–1,2–DICHLOROETHENE (trans–1,2–DCE), AND VINYL CHLORIDE (VC).
2. CONCENTRATIONS MEASURED IN ug/L.
3. BOLDED VALUES INDICATED EXCEEDANCES.

NYSDEC Groundwater Standards				
PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
5	5	5	5	2

SOURCE:

BACKGROUND AERIAL DOWNLOADED FROM NEAR MAP PROGRAM, DATED 2021–10–19.

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
CAROL CLEANERS – THE CROSSINGS
STATEN ISLAND, NEW YORK
GROUNDWATER SAMPLING RESULTS
JULY 2017 THROUGH MARCH 2025

FIGURE NO.
8B
PROJECT NO.
4213307

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\213307-F-4B-RESULTSMARCH25.dwg Layout: FIGURE 04 User: JISS.PHILIP Jul 28, 2025 – 9:45am



Legend

- Monitor Well with ID
- SSD System Blower Location (on roof)
- SSD System Suction Point (in slab)
- SSD System Magnahelic Gage
- Catch Basin
- General Layout
- Environmental Easement Area
- Unpaved Areas within Environmental Easement Area

100 50 0 100 Feet

New York Quadrangle Location

1, 2, 3, 4, 5, 6 Points of Bearing from Schedule A

ENGINEERING CONTROL - CAP/COVER (ASPHALT AND BUILDINGS)

ENGINEERING CONTROL - SUB-SLAB DEPRESSURIZATION (SSD) SYSTEM

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 10/07/2016, AND INCLUDED WITHIN CAROL CLEANERS EASEMENT WITH RECORDED DATED OF JUNE 6, 2016 AND SIGNED BY ROBERT W. SCHICK, DIRECTOR OF DIVISION OF ENVIRONMENTAL REMEDIATION, ON PAGE 6 PRESENTS SCHEDULE A.

ERICH ZIMMERMAN, P.E.

N.Y.P.E. Lic. No. 081831-01

Date 01/21/2026

cornerstone PLLC

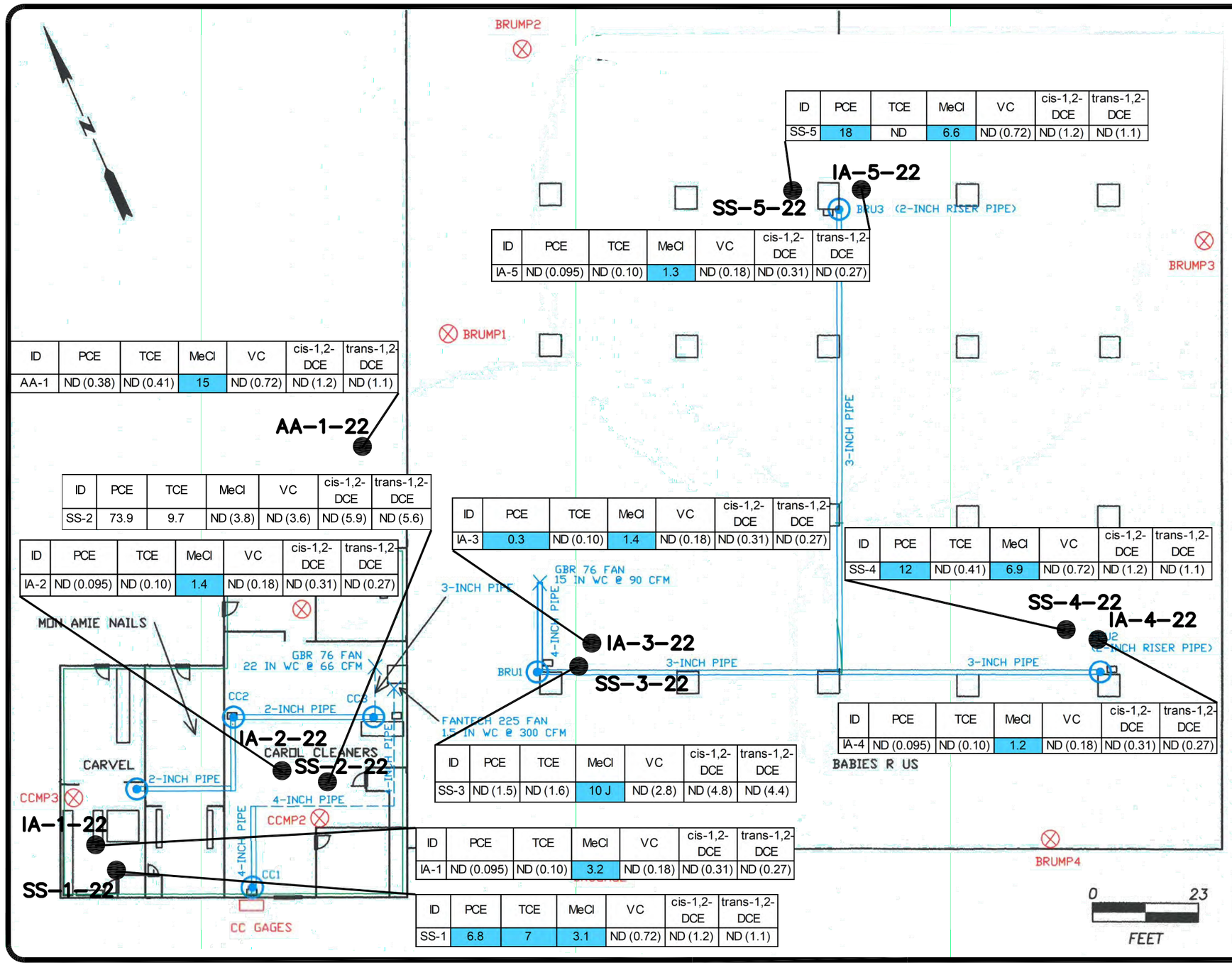
GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

INSTITUTIONAL AND ENGINEERING CONTROL BOUNDARIES

FIGURE NO. 9

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\Border – 2026.dwg Layout: Figure 9 User: JISS.PHILIP Jan 22, 2026 – 12:07pm



ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
SS-5	18	ND	6.6	ND (0.72)	ND (1.2)	ND (1.1)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
IA-5	ND (0.095)	ND (0.10)	1.3	ND (0.18)	ND (0.31)	ND (0.27)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
AA-1	ND (0.38)	ND (0.41)	15	ND (0.72)	ND (1.2)	ND (1.1)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
SS-2	73.9	9.7	ND (3.8)	ND (3.6)	ND (5.9)	ND (5.6)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
IA-2	ND (0.095)	ND (0.10)	1.4	ND (0.18)	ND (0.31)	ND (0.27)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
IA-3	0.3	ND (0.10)	1.4	ND (0.18)	ND (0.31)	ND (0.27)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
SS-4	12	ND (0.41)	6.9	ND (0.72)	ND (1.2)	ND (1.1)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
IA-4	ND (0.095)	ND (0.10)	1.2	ND (0.18)	ND (0.31)	ND (0.27)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
SS-3	ND (1.5)	ND (1.6)	10 J	ND (2.8)	ND (4.8)	ND (4.4)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
IA-1	ND (0.095)	ND (0.10)	3.2	ND (0.18)	ND (0.31)	ND (0.27)

ID	PCE	TCE	MeCl	VC	cis-1,2-DCE	trans-1,2-DCE
SS-1	6.8	7	3.1	ND (0.72)	ND (1.2)	ND (1.1)

LEGEND

- CC1 — SUCTION POINT LOCATION WITH DESIGNATION
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- GBR 76 FAN — LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE
- IA-5-22 / SS-5-22 — JUNE 2022 INDOOR AIR AND SUB-SLAB SAMPLING LOCATION
- MAGNAHELIC GAGE LOCATION

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 2/18/2015, AND INCLUDED WITHIN A FINAL ENGINEERING DESIGN REPORT SUBMITTED BY WSP DATED 6/26/2018 AND STAMPED BY WILLIAM K. BECKMAN, P.E., NYS PE #063219-1
2. ALL RESULTS IN MICROGRAMS PER CUBIC METER AIR (UG/M3).

PCE - TETRACHLOROETHYLENE
TCE - TRICHLOROETHYLENE
MECL - METHYLENE CHLORIDE
VC - VINYL CHLORIDE
CIS- 1,2-DCE - CIS-1,2-DICHLOROETHYLENE
TRANS-1,2-DCE - TRANS-1,2-DICHLOROETHYLENE

24 — NUMBER WITH BLUE BACKGROUND INDICATES THE CONSITUENT WAS DETECTED, BUT DOES NOT EXCEED THE NYSDOH INDOOR/ OUTDOOR AIR GUIDELINES

ERICH ZIMMERMAN, P.E.

N.Y.P.E. Lic. No. 081831-01 Date 05/18/2023

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

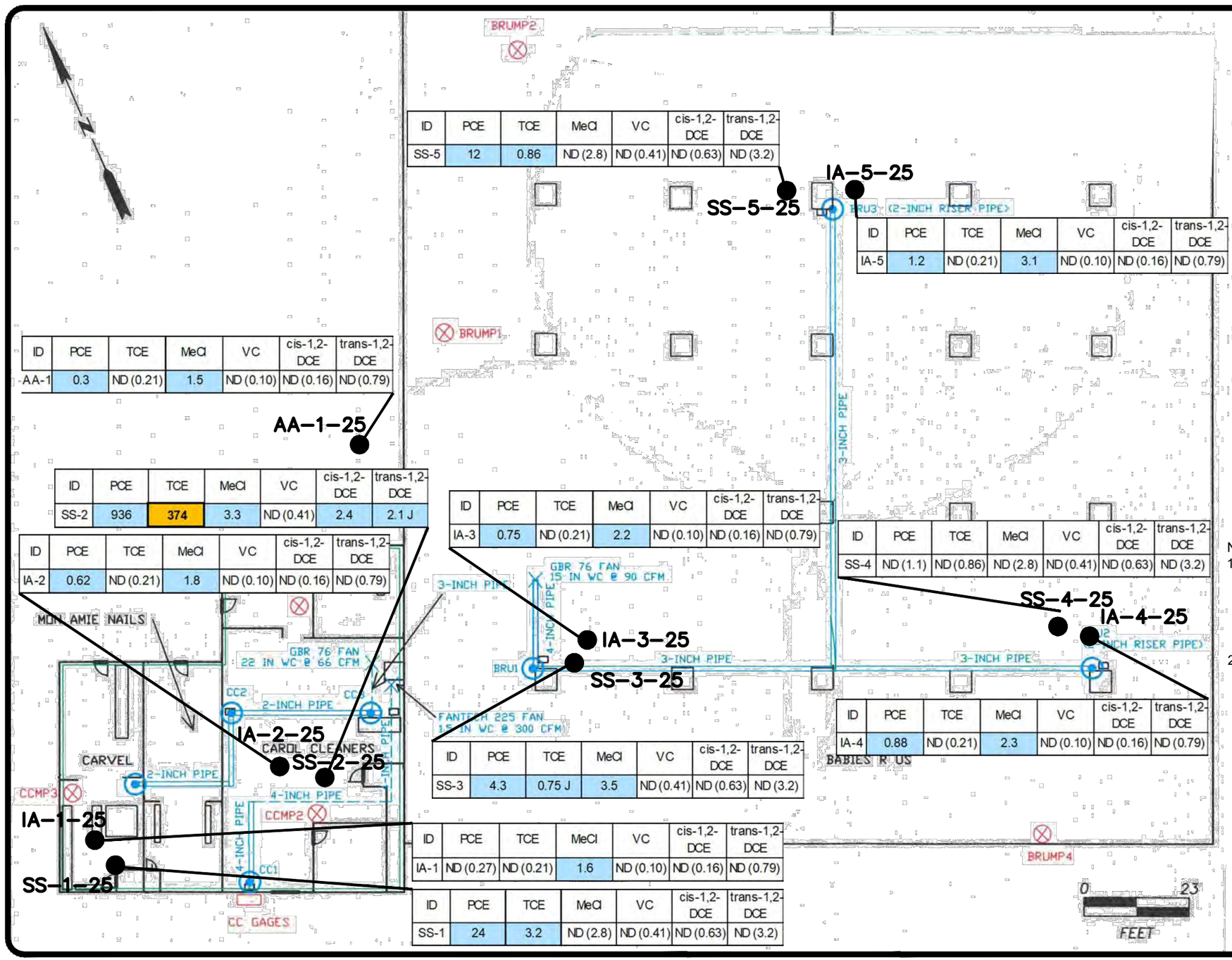
JUNE 2022 SAMPLING RESULTS

BASE DRAWING PREPARED BY: LBG ENGINEERING SERVICES, PC

SHEET NO. **10**

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\March 2025 Indoor Air and Sub-Slab.dwg Layout: June 2022 User: JISS.PHILIP Jul 2
1" 1/2" 0" 1"



LEGEND

- SUCTION POINT LOCATION WITH DESIGNATION (CC1)
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE (GBR 76 FAN)

IA-5-25
SS-5-25
MARCH 2025 INDOOR AIR AND SUB-SLAB SAMPLING LOCATION

MAGNAHELIC GAGE LOCATION

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 2/18/2015, AND INCLUDED WITHIN A FINAL ENGINEERING DESIGN REPORT SUBMITTED BY WSP DATED 6/26/2018 AND STAMPED BY WILLIAM K. BECKMAN, P.E., NYS PE #063219-1
2. ALL RESULTS IN MICROGRAMS PER CUBIC METER AIR (UG/M3).

PCE - TETRACHLOROETHYLENE
TCE - TRICHLOROETHYLENE
MECL - METHYLENE CHLORIDE
VC - VINYL CHLORIDE
CIS- 1,2-DCE - CIS-1,2-DICHLOROETHYLENE
TRANS-1,2-DCE - TRANS-1,2-DICHLOROETHYLENE

374 — NUMBER IN BOLD AND YELLOW BACKGROUND INDICATES AN EXCEEDANCE OF NYSDOH INDOOR/OUTDOOR AIR GUIDELINES

24 — NUMBER WITH BLUE BACKGROUND INDICATES THE CONSITUENT WAS DETECTED, BUT DOES NOT EXCEED THE NYSDOH INDOOR/ OUTDOOR AIR GUIDELINES

ERICH ZIMMERMAN, P.E.

N.Y.P.E. Lic. No. 081831-01 Date :

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

INDOOR AIR AND SUB-SLAB SAMPLE RESULTS

BASE DRAWING PREPARED BY: LBG ENGINEERING SERVICES, PC

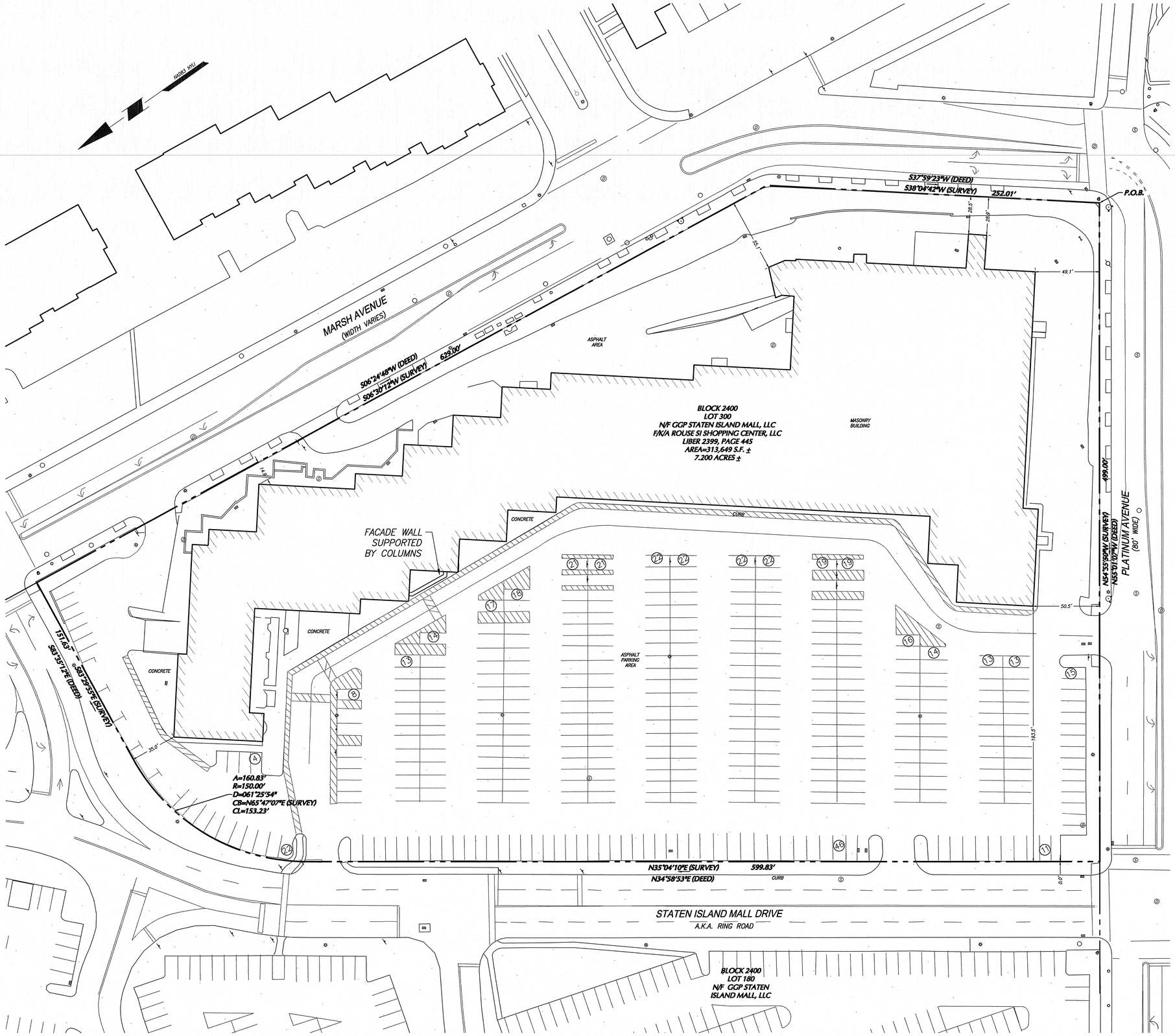
SHEET NO. 11

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\March 2025 Indoor Air and Sub-Slab.dwg Layout: ANSI-B-L User: JISS.PHILIP Apr 2
1" 1/2" 0" 1"

APPENDICES

APPENDIX A - ENVIRONMENTAL EASEMENT



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 NEW YORK ENVIRONMENTAL CONSERVATION LAW. THE ENGINEERING AND INSTITUTIONAL CONTROLS FOR THIS EASEMENT ARE SET FORTH IN THE SITE MANAGEMENT PLAN (SMP). A COPY OF THE SMP MUST BE OBTAINED BY ANY PARTY WITH AN INTEREST IN THE PROPERTY. THE SMP CAN BE OBTAINED FROM THE NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION, DIVISION OF ENVIRONMENTAL REMEDIATION, SITE CONTROL SECTION, 625 BROADWAY, ALBANY, NY 12233 OR AT "derweb@dec.ny.gov".

0 5 10 METERS

30 0 15 30
SCALE IN FEET

NOTES

1. THIS SURVEY IS BASED UPON EXISTING PHYSICAL CONDITIONS FOUND AT THE SUBJECT SITE, DEED INFORMATION AND THE FOLLOWING REFERENCES:
   - A. TITLE REPORT:
     BY: FIDELITY NATIONAL TITLE INSURANCE COMPANY
     DATE: 04/02/2015
     TITLE NO. 15-7406-35840-SI
   - B. MAP TITLED "ALTA/ACSM LAND TITLE SURVEY PREPARED FOR: GGP, GENERAL GROWTH PROPERTIES, INC., STATEN ISLAND MALL, 2655 RICHMOND AVENUE, BOROUGH OF STATEN ISLAND, COUNTY OF RICHMOND, STATE OF NEW YORK" DATED 7/28/2011 AND LAST REVISED 8/31/11 PREPARED BY MILLMAN SURVEY, INC.
   - C. AERIAL PHOTOGRAMMETRY PREPARED BY PROMAPS, JOB NO. 366912 DATE OF PHOTOGRAPHY 11-06-12.
   - D. MAP ENTITLED "BOUNDARY AND TOPOGRAPHIC SURVEY, STATEN ISLAND MALL, BLOCK NO. 2400, LOTS 7, 180 & 300, BOROUGH OF STATEN ISLAND, CITY OF NEW YORK, RICHMOND COUNTY, NEW YORK" PREPARED BY LANGAN AND DATED JANUARY 30, 2013.
   - E. THE DIGITAL TAX MAP OF THE CITY OF NEW YORK. http://gis.nyc.gov/taxmap/map.htm
2. THE SURVEYED PROPERTY IS SUBJECT TO BUT NOT LIMITED TO THE FOLLOWING FACTS AS REVEALED BY THE HEREON REFERENCED INFORMATION. THE INFORMATION SHOWN HEREON DOES NOT CONSTITUTE A TITLE SEARCH BY THE SURVEYOR. ALL INFORMATION THAT MAY AFFECT THE QUALITY OF TITLE TO BOTH THE SUBJECT AND ADJOINING PARCELS SHOULD BE VERIFIED BY AN ACCURATE AND CURRENT TITLE REPORT.

   SURVEY RELATED SCHEDULE B EXCEPTIONS:

   5 EASEMENT CONTAINED IN THE INSTRUMENTS RECORDED IN LIBER 2100 CP1 – EASEMENT AFFECTS LANDS EAST OF MARSH AVENUE, DOES NOT AFFECT SURVEYED PROPERTY;

   6 AMENDED AND RESTATED CONSTRUCTION, OPERATION AND RECIPROCAL AGREEMENT RECORDED IN REEL 3638 PAGE 84, AS AMENDED IN REEL 13853 PAGE 24 – BLANKET, AFFECTS SURVEYED PROPERTY;

   7 EASEMENT IN FAVOR OF NEW YORK TELEPHONE COMPANY IN REEL 4933 PAGE 277 – CANNOT PLOT;

   8 AGREEMENT RECORDED IN LIBER 2399 CP 466 – CANNOT PLOT;

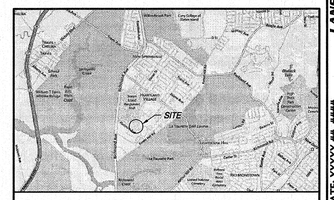
   9 NOTICE OF ORDER OF AGREEMENT IN REEL 14176 PAGE 334 – BLANKET, AFFECTS SURVEYED PROPERTY;
3. THE MERIDIAN OF THIS SURVEY IS REFERENCED TO NEW YORK STATE PLANE COORDINATE SYSTEM NAD 1983, NY LONG ISLAND. MERIDIAN ESTABLISHED USING GPS METHODS.
4. STREET NAMES AND R.O.W WIDTHS, BLOCK AND LOT NUMBERS AS PER MAPS REFERENCED IN NOTE 1.
5. PLANIMETRIC AND TOPOGRAPHIC INFORMATION SHOWN HEREON HAS BEEN OBTAINED FROM GROUND SURVEYS BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING AND LANDSCAPE ARCHITECTURE, D.P.C. FIELD WORK COMPLETED DURING THE MONTH OF DECEMBER 2012 AND APRIL 2015.
6. OFFSETS (IF SHOWN) ARE FOR SURVEY REFERENCES ONLY AND ARE NOT TO BE USED IN CONSTRUCTION OF ANY TYPE.
7. AS PER THE "NATIONAL FLOOD INSURANCE PROGRAM FIRM MAP ENTITLED FLOOD INSURANCE RATE MAP CITY OF NEW YORK, PANEL 308 OF 457, COMMUNITY PANEL NUMBER 3604970308F REVISED DATE SEPTEMBER 5, 2007" THE ENTIRE SUBJECT PROPERTY LIES WITHIN ZONE X, AREA DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN.
8. UNLESS SPECIFICALLY NOTED HEREON, STORM AND SANITARY SEWER INFORMATION (INCLUDING PIPE INVERT, PIPE MATERIAL, AND PIPE SIZE) WAS OBSERVED AND MEASURED AT FIELD LOCATED STRUCTURES MANHOLES / CATCH BASINS, ETC). CONDITIONS CAN VARY FROM THOSE ENCOUNTERED AT THE TIMES WHEN AND LOCATIONS WHERE DATA IS OBTAINED. DESPITE MEETING THE REQUIRED STANDARD OF CARE, THE SURVEYOR CANNOT, AND DOES NOT WARRANT THAT PIPE MATERIAL AND/OR PIPE SIZE THROUGHOUT THE PIPE RUN ARE THE SAME AS THOSE OBSERVED AT EACH STRUCTURE, OR THAT THE PIPE RUN IS STRAIGHT BETWEEN THE LOCATED STRUCTURES.

   ADDITIONAL UTILITY (WATER, GAS, ELECTRIC ETC.) DATA MAY BE SHOWN FROM FIELD LOCATED SURFACE MARKINGS (BY OTHERS), EXISTING STRUCTURES, AND/OR FROM EXISTING DRAWINGS,

   UNLESS SPECIFICALLY NOTED HEREON, THE SURVEYOR HAS NOT EXCAVATED TO PHYSICALLY LOCATE THE UNDERGROUND UTILITIES. THE SURVEYOR MAKES NO GUARANTEES THAT THE SHOWN UNDERGROUND UTILITIES ARE EITHER IN SERVICE, ABANDONED OR SUITABLE FOR USE, NOR ARE IN THE EXACT LOCATION OR CONFIGURATION INDICATED HEREON.

   PRIOR TO ANY DESIGN OR CONSTRUCTION, THE PROPER UTILITY AGENCIES MUST BE CONTACTED FOR VERIFICATION OF UTILITY TYPE AND FOR FIELD LOCATIONS.

   UNLESS NOTED BELOW SUPPLEMENTAL DOCUMENTS WERE NOT USED TO COMPILE THE SUBSURFACE UTILITY INFORMATION SHOWN HEREON.
9. THIS IS TO CERTIFY THAT THERE ARE NO STREAMS NOR NATURAL WATERCOURSES ON THE PROPERTY AS SHOWN ON THIS SURVEY.
10. UNAUTHORIZED ALTERATION OR ADDITION TO A SURVEY MAP BEARING A LICENSED LAND SURVEYOR'S SEAL IS A VIOLATION OF SECTION 7209, SUB-DIVISION 2, OF THE NEW YORK STATE EDUCATION LAW.
11. THIS SURVEY IS NOT VALID WITHOUT THE INKED SEAL OF THE PROFESSIONAL.



PROJECT LOCATION MAP
SCALE: 1" = 2,000'

LEGEND (NOT SHOWN TO SCALE)

- HYDRANT
- STREET LIGHT
- AREA LIGHT
- SIGNAL POLE
- POLE
- ANCHOR POLE
- MANHOLE (TYPE AS LABELED)
- WATER VALVE
- GAS VALVE
- UNKNOWN VALVE
- CATCH BASIN
- SPOT ELEVATION
- CLEAN OUT
- TREE
- SIGN
- BOLLARD
- TRANSFORMER
- MONITOR WELL
- EP — EDGE OF PAVEMENT
- SWS — SINGLE WHITE STRIPE
- DYS — DOUBLE YELLOW STRIPE
- BC — BITUMINOUS CURB
- SC — STONE CURB
- CC — CONCRETE CURB
- GC — GRANITE CURB
- DW — DETECTABLE WARNING
- EW — EDGE OF WALK
- BIT — BITUMINOUS
- CNC — CONCRETE
- ENC — ENCROACHES
- CLR — CLEARS
- WD — WOOD
- CP — CONCRETE PAD
- OVERHEAD WIRE
- GUIDE RAIL WOOD
- GUIDE RAIL METAL
- TREE LINE
- CHAINLINK FENCE
- STOCKADE FENCE
- IRON FENCE
- EASEMENT LINE
- PROPERTY LINE
- RIGHT-OF-WAY LINE
- 177 — CONTOUR LINE
- G — GAS MARK OUT LINE
- W — WATER MARK OUT LINE
- E — ELECTRIC MARK OUT LINE
- T — COMMUNICATION MARK OUT LINE
- S — SANITARY MARK OUT LINE
- D — DRAINAGE MARK OUT LINE
- RE — REFERENCE UTILITY LINE (TYPE AS NOTED) – PLOTTED FROM EXISTING MAPPING

WRITTEN DESCRIPTION
BLOCK 2400 LOT 300
BOROUGH OF STATEN ISLAND
CITY OF NEW YORK
COUNTY OF RICHMOND
NEW YORK

BEGINNING at a point being the intersection of the northerly line of Platinum Avenue (80 feet wide) and the westerly line of Marsh Avenue (various widths) and running, thence

1. Along said northerly line of Platinum Avenue, North 54°55'50" West, a distance of 499.00 feet to a point; thence
2. North 35°04'10" East, a distance of 599.83 feet to a point of curvature; thence
3. Northeasterly along a curve to the right, having an arc distance of 160.83 feet, a radius of 150.00 feet and a central angle of 61°25'54" and being subtended by a chord which bears North 65°47'07" East 153.23 feet to a point; thence
4. South 83°29'55" East, a distance of 151.63 feet to a point on the aforementioned westerly line of Marsh Avenue; thence
5. Along said westerly line of Marsh Avenue, South 06°30'12" West, a distance of 629.00 feet to a point; thence
6. Still along said westerly line of Marsh Avenue, South 38°04'42" West, a distance of 252.01 feet to the point or place of BEGINNING.

Encompassing an area of 7.200 acres, more or less.

TO:

1. GGP STATEN ISLAND MALL, LLC F/K/A ROUSE SI SHOPPING CENTER, LLC, SUCCESSOR BY MERGER TO ROUSE SI SHOPPING CENTER
2. FIDELITY NATIONAL TITLE INSURANCE COMPANY

"I HEREBY STATE THAT THIS PLAN IS BASED ON A FIELD SURVEY MADE BY ME OR UNDER MY IMMEDIATE SUPERVISION IN ACCORDANCE WITH NYSPLS CODE OF PRACTICE FOR LAND SURVEYS, AND TO THE BEST OF MY PROFESSIONAL KNOWLEDGE, INFORMATION AND BELIEF, AND IN MY PROFESSIONAL OPINION, CORRECTLY REPRESENTS THE CONDITIONS FOUND ON THE DATE OF THE FIELD SURVEY AT THE SUBJECT PROPERTY" AND

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2011 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/ACSM LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 2, 3, 4, 8, 9, 11(a), 14, AND 15, OF TABLE A THEREOF. THE FIELD WORK WAS COMPLETED ON 11-06-12 AND FIELD VERIFIED DURING APRIL 2015.

Date:

Signature:

STATE OF NEW YORK — PAUL D. FISHER — LICENSED LAND SURVEYOR

PAUL D. FISHER
PROFESSIONAL LAND SURVEYOR
NY LIC. No. 050784-1

05/09/15	REVISE PER NEW TITLE REPORT	1
Date	Description	No.
REVISIONS		

LANGAN
River Drive Center 1, 618 River Drive, Elmwood Park, NJ 07407
T: 201.794.6900 F: 201.794.0366 www.langan.com
NEW JERSEY NEW YORK VIRGINIA CALIFORNIA
PENNSYLVANIA CONNECTICUT FLORIDA
ABU DHABI ATHENS DOHA
DUBAI ISTANBUL
Langan Engineering and Environmental Services, Inc.
Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C.
Langan International LLC
Collectively known as Langan

Project	STATEN ISLAND MALL 280 PLATINUM AVENUE BLOCK No. 2400, LOT No. 300 BOROUGH OF STATEN ISLAND CITY OF NEW YORK RICHMOND COUNTY NEW YORK
Drawing Title	ALTA/ACSM LAND TITLE SURVEY
Project No.	100320901
Date	03/14/2013
Scale	1" = 30'
Drawn By	BP
Submission Date	X
Drawing No.	VL-101
Sheet	1 of 1

LANGAN
SUBMISSION DATE: XXXX ##, ####
PROJECT No. 100320901

© 2011 Langan

Filename: \\Langan.com\data\EP\data5\100320901\Civil 3D\100320901-V-EX0101 - Lot 300 Outbound.dwg Date: 5/11/2015 Time: 09:04 User: whoggeteen Style Table: Langan.stb Layout: ARCH-ISL

Office of the
Richmond County Clerk
130 Stuyvesant Place
Staten Island, NY 10301

Hon. Stephen J. Fiala, County Clerk

ACS-000000000515495-000000000686140-010

Recording and Endorsement Cover Page

Document Type: EASEMENT COMMERCIAL
Document Page Count: 10

PRESENTER:	RETURN TO:
FIDELITY NATIONAL TITLE INSURANCE	FIDELITY NATIONAL TITLE INSURANCE
485 LEXINGTON AVENUE	485 LEXINGTON AVENUE
18TH FLOOR	18TH FLOOR- 35840-SI
NEW YORK,NY 10017	NEW YORK,NY 10017

PROPERTY DATA # OF BLOCKS 1 # OF LOTS 1

Block	Lot	Unit
2400	300	Entire Lot

PARTIES

GRANTOR	GRANTEE
GGP STATEN ISLAND MALL, LLC	THE PEOPLE OF THE STATE OF NEW YORK THROUGH
110 NORTH WACKER DRIVE	COMMISSIONER OF THE DEC
	625 BROADWAY
CHICAGO,IL 60606	NEW YORK,NY 12233

SUPPORTING DOCUMENTS

RPT
TP-584

PAYMENT DETAIL

Make Checks Payable to:

Richmond County Clerk:	55.00 Recording Fees
Total Payments For This Document:	55.00

FEES PAID

AG JUN 29 2016

EXAM _____ DATE _____

RECORDED IN RICHMOND COUNTY

JUN 30 2016

COUNTY CLERK

LAND DOC# 610219
23Z-EASEMENT
RETT: 7669 $.00
RPT: 7669 $.00
06/30/2016 11:16:03 A.M.
RECEIPT: 29655 FEE: $55.00
RICHMOND COUNTY CLERK

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

THIS INDENTURE made this 13th day of June, 2016, between Owner(s) GGP Staten Island Mall, LLC f/k/a Rouse SI Shopping Center, LLC, having an office at 2655 Richmond Avenue, Staten Island, New York 10314, County of Richmond, 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 280 Platinum Avenue in the City of New York, County of Richmond and State of New York, known and designated on the tax map of the New York City Department of Finance as tax map parcel number: Block 2400 Lot 300, being a portion of the property conveyed to Grantor by deed dated November 1, 1980 and recorded in the Richmond County Clerk's Office in Liber and Page 2399/445. The property subject to this Environmental Easement (the "Controlled Property") comprises approximately 1.821 +/- acres, and is hereinafter more fully described in the Land Title Survey dated October 14, 2015 prepared by Paul D. Fisher, PLS of Langan Engineering and Environmental Services, Inc., 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 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 Order on Consent Index Number: R2-20111017-719, 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:

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 New York City Department of Health and Mental Hygiene 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 or Restricted Residential purposes as defined in 6NYCRR 375-1.8(g)(2)(i) and (ii), 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 b 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: 243020
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.

GGP Staten Island Mall, LLC:

By: _____

Print Name: Marvin J. Levine

Title: Authorized Signatory Date: 6-7-2016

Grantor's Acknowledgment

STATE OF ~~NEW YORK~~ Illinois)
) ss:
COUNTY OF Cook)

On the 7th day of June, in the year 20 16, before me, the undersigned, personally appeared Marvin J Levine, 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.

_____
Notary Public - State of ~~New York~~ Illinois, County of Cook

OFFICIAL SEAL
KATYA R LEWANDOWSKA
NOTARY PUBLIC - STATE OF ILLINOIS
MY COMMISSION EXPIRES:10/30/16

OFFICIAL SEAL
KATYA R LEWANDOWSKA
NOTARY PUBLIC - STATE OF ILLINOIS
MY COMMISSION EXPIRES:10/30/16

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 13th day of June, in the year 2016, 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

Beginning at the intersection of the southerly line of Staten Island Mall Drive (a.k.a. Ring Road), and the northerly line of Platinum Avenue (80' wide) and running, thence:

1. Along said southerly line of Staten Island Mall Drive, North 35°04'10" East, a distance of 141.65 feet to a point; thence
2. Leaving said southerly line, South 52°02'15" East, a distance of 261.99 feet to a point on the interior corner of a masonry building; thence
3. Along the westerly face of said masonry building North 38°02'56" East, a distance of 111.16 feet, to a point; thence
4. South 51°57'58" East, a distance of 189.16 feet to a point on the easterly face of said masonry building; thence
5. Along the said easterly face of masonry building and crossing a paved parking area, South 38°03'01" West, a distance of 229.96 feet to a point on the northerly line of Platinum Avenue; thence
6. Along said northerly line of Platinum Avenue, North 54°55'50" West, a distance of 444.38 feet the Point of Beginning.

Encompassing an area of 79,329 square feet or 1.821 acres.



Legend

- Monitor Well with ID
- SSD System Blower Location (on roof)
- SSD System Suction Point (in slab)
- SSD System Magnahelic Gage
- Catch Basin
- General Layout
- Environmental Easement Area
- Unpaved Areas within Environmental Easement Area

100 50 0 100
Feet

New York Quadrangle Location

BASE SOURCE: 2015 BING MAPS AERIAL

THE CROSSINGS
GGP STATEN ISLAND MALL, LLC
STATEN ISLAND, NEW YORK

INSTITUTIONAL AND ENGINEERING CONTROLS

Source:
LBG ENGINEERING SERVICES, PC
Professional Groundwater and Environmental Services
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
(201) 818-0700 www.lbgweb.com

DATE: 10/07/16

FILE: B:\Carol Cleaners\GIS\maps | *DRAWN BY: ZT* | *CHECKED BY: CS* | *FIGURE: 6*



Legend

- Monitor Well with ID
- SSD System Blower Location (on roof)
- SSD System Suction Point (in slab)
- SSD System Magnahelic Gage
- Catch Basin
- General Layout
- Environmental Easement Area
- Unpaved Areas within Environmental Easement Area

100 50 0 100 Feet



NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 10/07/2016, AND INCLUDED WITHIN CAROL CLEANERS EASEMENT WITH RECORDED DATED OF JUNE 6, 2016 AND SIGNED BY ROBERT W. SCHICK, DIRECTOR OF DIVISION OF ENVIRONMENTAL REMEDIATION, ON PAGE 6 PRESENTS SCHEDULE A.

1, 2, 3, 4, 5, 6 Points of Bearing from Schedule A

ERICH ZIMMERMAN, P.E.

05/18/2023

NY PE License No. 081831-01 Date

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

PREPARED BY: LBG ENGINEERING SERVICES, PC
INSTITUTIONAL AND ENGINEERING CONTROLS

FIGURE NO.

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\Brookfiled AS BUILT.dwg Layout: ANSI-B-P (2) User: JISS.PHILIP May 18, 2023 - 2:54pm

APPENDIX B - CONTACTS

Contacts*

Name	**Contact Information**
NYSDEC Project Manager – Yildiz Palumbo	(718) 482-4891 yildiz.palumbo@dec.ny.gov
NYSDEC Project Manager's Supervisor – Andre Obligado	(718) 482-6412 andre.obligado@dec.ny.gov
NYSDEC Site Control – Kelly Lewandowski	(518) 402-9553 Kelly.lewandowski@dec.ny.gov
NYSDOH Project Manager – Sarita Wagh	(518) 402-7817 sarita.wagh@health.ny.gov
Tetratech Project Manager – Erich Zimmerman	(315) 461-2849 Erich.zimmerman@tetratech.com
Brookfield Properties – Josh Ryals	(312) 960-2852 joshua.ryals@bpretail.com

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

**Note: Numbers in this column reference the numbered bullets in the notification list in this section.

APPENDIX C - MONITORING WELL LOGS

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-25

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC	**DIAMETER:** 4”
	SLOT NO.: 20	**SETTING:** 8’-13’
DATE COMPLETED: 6/29/2017	**SAND PACK SIZE:** #2	
DRILLING COMPANY: AmeriDrill	**SETTING:** 7’-13’	
	CASING TYPE: PVC	**DIAMETER:** 4”
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-13’	
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite	
OBSERVER: SS, MK	**SETTING**: 7’-8’	
REFERENCE POINT (RP): Grade	**BACKFILL TYPE**: Cement Grout	
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**	
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD**: Submersible Pump	
	DURATION: 1 Hour **ESTIMATED YIELD:** 1 gpm	
COMMENTS:		
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings		

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	C	N/A		First 5’ was soft dig, not representative of
					overburden.
5	7	SS	5-6-7-10	1.1	Red Brown f SAND; with silt; some subangular
					to angular f m c gravel; few weathered bedrock
					at 1.1’; moist. PID=4.4 at 5.7’
7	10	C	N/A		Brown Red f Sand and Silt; with f m c
					subrounded gravel.
10	12	SS	17-18	1.1	Red Brown Silt and f m c Sand; some f m
					subrounded-subangular gravel; little weathered
					bedrock at 11.9’; moist.
12	15	C	N/A		Red Brown Silt and f m c Sand; some f m c

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					subrounded-subangular gravel; moist.
					-EOB, Bedrock at 13'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-26

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC	**DIAMETER:** 4”
	SLOT NO.: 20	**SETTING:** 9-14’
DATE COMPLETED: 6/28/2017	**SAND PACK SIZE:** #2	
DRILLING COMPANY: AmeriDrill	**SETTING:** 8-14’	
	CASING TYPE: PVC	**DIAMETER:** 4”
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-14’	
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite	
OBSERVER: SS, MK	**SETTING**: 8-9’	
REFERENCE POINT (RP): Grade	**BACKFILL TYPE**: Cement Grout	
ELEVATION OF RP:	**STATIC WATER LEVEL:**	**DATE:**
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD**: Submersible Pump	
	DURATION: 1 Hour	**ESTIMATED YIELD:** 1 gpm
COMMENTS:		
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings		

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	C	N/A		Soft dig, fill.
5	7	SS	9-9-22-22	2.0	5-6’ Red Brown Silt and f Sand; with f m c
					subangular gravel; tight; dry.
					6-7’ Weathered Bedrock; at 6.6’ bedrock
					cobble.
7	10	C	N/A		Light Brown Silt and f Sand; some f m c
					subrounded gravel.
10	12	SS	11-12-20-39	2.0	10-12’ Red Brown Silt and f m c Sand; with
					m c subangular-angular gravel; cobble at 10.9’;
					bedrock cobble at 11.6’; slightly moist. PID=0.3
					at 10’; PID= 1.2 at 12’

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
12	15	C	N/A		12-13.5’ Red Brown Silt and f Sand; with f m c
					subrounded-rounded gravel. Trace green
					bedrock sand.
					13.5-14’ Weathered Bedrock; very moist.
					-EOB Bedrock at 14’-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-27

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC	**DIAMETER:** 4”
	SLOT NO.: 20	**SETTING:** 5-10’
DATE COMPLETED: 6/28/2017	**SAND PACK SIZE:** #2	
DRILLING COMPANY: AmeriDrill	**SETTING:** 4-10’	
	CASING TYPE: PVC	**DIAMETER:** 4”
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-10’	
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite	
OBSERVER: SS, MK	**SETTING**: 3-4’	
REFERENCE POINT (RP): Grade	**BACKFILL TYPE**: Cement Grout	
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**	
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD**: Submersible Pump	
	DURATION: 1 Hour **ESTIMATED YIELD:** 1 gpm	
COMMENTS:		
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings		

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					Did not collect samples. The soil is not
					representative of the areas geology. It is backfill
					from SWB-8.
					-EOB Bedrock at 10’-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-28

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 4”
	SLOT NO.: 20 **SETTING:** 17.5-22.5’
DATE COMPLETED: 6/29/2017	**SAND PACK SIZE:** #2
DRILLING COMPANY: AmeriDrill	**SETTING:** 16.5-22.5’
	CASING TYPE: PVC **DIAMETER:** 4”
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-22.5’
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite
OBSERVER: SS, MK	**SETTING**: 16.5-17.5’
REFERENCE POINT (RP): Grade	**BACKFILL TYPE**: Cement Grout
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD**: Submersible Pump
	DURATION: ~1 Hour **ESTIMATED YIELD:** 1 gpm
COMMENTS:	
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	C	N/A		Soft dig, fill material.
5	7	SS	10-12-17-10	0.3	Red Brown Clay and Silt; with f subrounded
					to subangular gravel; saturated.
7	10	C	N/A		7-9’ Red Brown Clay and Silt; with f
					subrounded to subangular gravel; moist
					9-10’ Dark Brown Clay and Silt; with organic
					material
10	12	SS	4-5-7-9	1.6	10-11’ Grey Brown Silt and f m c Sand; little
					f m c subrounded gravel.
					11-11.3’ Grey Brown Silt and f m c Sand; little
					f m c subrounded gravel; little organic matter;

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					clay pockets.
					11.3-12’ Red Brown f m c Sand and Silt; with
					f m c subangular to subround gravel; moist.
12	15	C	N/A		Brown Red Clay and Silt; some f m c sand;
					moist.
15	17	SS	2-11	1.2	15-17’ Fill material; Brown Red f m c SAND;
					little cobble; saturated.
17	20	C	N/A		Brown Red Clay and Silt; little f m c sand;
					moist.
20	22	SS	4-9-11-13	0.8	Red Brown Silt and Clay; with f m c subangular
					gravel.
22	25	C	N/A		Brown Red SILT; with f m c sand.
					-EOB Bedrock at 22.5’-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-29

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC	**DIAMETER:** 4”
	SLOT NO.: 20	**SETTING:** 19-24’
DATE COMPLETED: 6/29/2017	**SAND PACK SIZE:** #2	
DRILLING COMPANY: AmeriDrill	**SETTING:** 18-24’	
	CASING TYPE: PVC	**DIAMETER:** 4”
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-24’	
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite	
OBSERVER: SS, MK	**SETTING**: 18-19’	
REFERENCE POINT (RP): Grade	**BACKFILL TYPE**: Cement Grout	
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**	
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD**: Submersible Pump	
	DURATION: 1 Hour **ESTIMATED YIELD:** 1 gpm	
COMMENTS:		
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings		

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	C	N/A		Soft dig, fill material.
5	7	SS	6-7-6-8	2.0	5-6.2’ Brown Red Silt and f Sand; with f m c
					subangular gravel; little clay; little weathered
					bedrock.
					6.2-7’ Dark Brown f Sand and Silt; some f m
					angular gravel; some organic material; slightly
					moist; tight.
7	10	C	N/A		Red Brown Clay and Silt; with f sand; some
					f m c subangular gravel; moist.
10	12	SS	3-12-17-11	1.5	10-10.8’ Brown Red Clay and Silt; with f sand;
					some f m angular gravel; slightly moist; tight.

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					10.8-11.0’ Dark Brown f Sand and Silt; some
					f m angular gravel; some organic material;
					slightly moist; tight.
					11-12’ Red Brown f m c SAND; with silt and
					f m c angular gravel; moist; little weathered
					bedrock.
12	15	C	N/A		Red Brown Clay and Silt; with f sand; some
					f m c subangular gravel; moist.
15	17	SS	3-4-15-15	1.8	15-15.2’ Dark Brown f Sand and Silt; some
					f m angular gravel; some organic material;
					slightly moist; tight.
					15.2-16.0’ Red Brown CLAY; with silt some
					f m c subangular to subround gravel; very tight;
					moist.
					16-17’ Red Brown f m c Sand and f m c
					subround to subangular Gravel; saturated.
17	20	C	N/A		Red Brown Silt; with clay; little organic material;
					some f rounded gravel; slightly moist.
20	22	SS	7-7-9-50/40	1.55	Red Brown Clay and Silt; with f m c angular to
					subangular gravel; little f m c sand; moist; tight.
					SS came up saturated; drillers were sending
					down water.
22	25	C	N/A		Red Brown Clay and Silt; with f m c sand;
					moist.
					-EOB Bedrock at 24’-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-25

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 4"
	SLOT NO.: 20 **SETTING:** 8'-13'
DATE COMPLETED: 6/29/2017	**SAND PACK SIZE:** #2
DRILLING COMPANY: AmeriDrill	**SETTING:** 7'-13'
	CASING TYPE: PVC **DIAMETER:** 4"
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-13'
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite
OBSERVER: SS, MK	**SETTING:** 7'-8'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cement Grout
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD:** Submersible Pump
	DURATION: 1 Hour **ESTIMATED YIELD:** 1 gpm
COMMENTS:	
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings	

DEPTH (FEET) FROM	DEPTH (FEET) TO	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	5	C	N/A		First 5' was soft dig, not representative of
					overburden.
5	7	SS	5-6-7-10	1.1	Red Brown f SAND; with silt; some subangular
					to angular f m c gravel; few weathered bedrock
					at 1.1'; moist. PID=4.4 at 5.7'
7	10	C	N/A		Brown Red f Sand and Silt; with f m c
					subrounded gravel.
10	12	SS	17-18	1.1	Red Brown Silt and f m c Sand; some f m
					subrounded-subangular gravel; little weathered
					bedrock at 11.9'; moist.
12	15	C	N/A		Red Brown Silt and f m c Sand; some f m c

OWNER: GGP Staten Island Mall

WELL NO.: MW-25 **PAGE:** 2 **OF** 2 **PAGES**

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					subrounded-subangular gravel; moist.
					-EOB, Bedrock at 13'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-26

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 4"
	SLOT NO.: 20 **SETTING:** 9-14'
DATE COMPLETED: 6/28/2017	**SAND PACK SIZE:** #2
DRILLING COMPANY: AmeriDrill	**SETTING:** 8-14'
	CASING TYPE: PVC **DIAMETER:** 4"
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-14'
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite
OBSERVER: SS, MK	**SETTING:** 8-9'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cement Grout
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD:** Submersible Pump
	DURATION: 1 Hour **ESTIMATED YIELD:** 1 gpm
COMMENTS:	
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	C	N/A		Soft dig, fill.
5	7	SS	9-9-22-22	2.0	5-6' Red Brown Silt and f Sand; with f m c
					subangular gravel; tight; dry.
					6-7' Weathered Bedrock; at 6.6' bedrock
					cobble.
7	10	C	N/A		Light Brown Silt and f Sand; some f m c
					subrounded gravel.
10	12	SS	11-12-20-39	2.0	10-12' Red Brown Silt and f m c Sand; with
					m c subangular-angular gravel; cobble at 10.9';
					bedrock cobble at 11.6'; slightly moist. PID=0.3
					at 10'; PID= 1.2 at 12'

OWNER: GGP Staten Island Mall

WELL NO.: MW-26 **PAGE:** 2 **OF** 2 **PAGES**

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
12	15	C	N/A		12-13.5' Red Brown Silt and f Sand; with f m c
					subrounded-rounded gravel. Trace green
					bedrock sand.
					13.5-14' Weathered Bedrock; very moist.
					-EOB Bedrock at 14'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-27

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 4"
	SLOT NO.: 20 **SETTING:** 5-10'
DATE COMPLETED: 6/28/2017	**SAND PACK SIZE:** #2
DRILLING COMPANY: AmeriDrill	**SETTING:** 4-10'
	CASING TYPE: PVC **DIAMETER:** 4"
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-10'
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite
OBSERVER: SS, MK	**SETTING:** 3-4'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cement Grout
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD:** Submersible Pump
	DURATION: 1 Hour **ESTIMATED YIELD:** 1 gpm
COMMENTS:	
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					Did not collect samples. The soil is not
					representative of the areas geology. It is backfill
					from SWB-8.
					-EOB Bedrock at 10'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-28

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 4"
	SLOT NO.: 20 **SETTING:** 17.5-22.5'
DATE COMPLETED: 6/29/2017	**SAND PACK SIZE:** #2
DRILLING COMPANY: AmeriDrill	**SETTING:** 16.5-22.5'
	CASING TYPE: PVC **DIAMETER:** 4"
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-22.5'
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite
OBSERVER: SS, MK	**SETTING:** 16.5-17.5'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cement Grout
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD:** Submersible Pump
	DURATION: ~1 Hour **ESTIMATED YIELD:** 1 gpm
COMMENTS:	
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	C	N/A		Soft dig, fill material.
5	7	SS	10-12-17-10	0.3	Red Brown Clay and Silt; with f subrounded
					to subangular gravel; saturated.
7	10	C	N/A		7-9' Red Brown Clay and Silt; with f
					subrounded to subangular gravel; moist
					9-10' Dark Brown Clay and Silt; with organic
					material
10	12	SS	4-5-7-9	1.6	10-11' Grey Brown Silt and f m c Sand; little
					f m c subrounded gravel.
					11-11.3' Grey Brown Silt and f m c Sand; little
					f m c subrounded gravel; little organic matter;

OWNER: GGP Staten Island Mall

WELL NO.: MW-28 **PAGE:** 2 **OF** 2 **PAGES**

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					clay pockets.
					11.3-12' Red Brown f m c Sand and Silt; with
					f m c subangular to subround gravel; moist.
12	15	C	N/A		Brown Red Clay and Silt; some f m c sand;
					moist.
15	17	SS	2-11	1.2	15-17' Fill material; Brown Red f m c SAND;
					little cobble; saturated.
17	20	C	N/A		Brown Red Clay and Silt; little f m c sand;
					moist.
20	22	SS	4-9-11-13	0.8	Red Brown Silt and Clay; with f m c subangular
					gravel.
22	25	C	N/A		Brown Red SILT; with f m c sand.
					-EOB Bedrock at 22.5'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

WELL NO.: MW-29

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 4"
	SLOT NO.: 20 **SETTING:** 19-24'
DATE COMPLETED: 6/29/2017	**SAND PACK SIZE:** #2
DRILLING COMPANY: AmeriDrill	**SETTING:** 18-24'
	CASING TYPE: PVC **DIAMETER:** 4"
DRILLING METHOD: Hollow Stem Auger	**SETTING:** 0-24'
SAMPLING METHOD: Split Spoon, 140 lb hammer	**SEAL TYPE:** Bentonite
OBSERVER: SS, MK	**SETTING:** 18-19'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cement Grout
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION: Flush Mount	**DEVELOPMENT METHOD:** Submersible Pump
	DURATION: 1 Hour **ESTIMATED YIELD:** 1 gpm
COMMENTS:	
ABBREVIATIONS: c = Coarse, m = Medium, f = Fine, SS = Split Spoon, C = Cuttings	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	C	N/A		Soft dig, fill material.
5	7	SS	6-7-6-8	2.0	5-6.2' Brown Red Silt and f Sand; with f m c
					subangular gravel; little clay; little weathered
					bedrock.
					6.2-7' Dark Brown f Sand and Silt; some f m
					angular gravel; some organic material; slightly
					moist; tight.
7	10	C	N/A		Red Brown Clay and Silt; with f sand; some
					f m c subangular gravel; moist.
10	12	SS	3-12-17-11	1.5	10-10.8' Brown Red Clay and Silt; with f sand;
					some f m angular gravel; slightly moist; tight.

OWNER: GGP Staten Island Mall

WELL NO.: MW-29 **PAGE:** 2 **OF** 2 **PAGES**

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					10.8-11.0' Dark Brown f Sand and Silt; some
					f m angular gravel; some organic material;
					slightly moist; tight.
					11-12' Red Brown f m c SAND; with silt and
					f m c angular gravel; moist; little weathered
					bedrock.
12	15	C	N/A		Red Brown Clay and Silt; with f sand; some
					f m c subangular gravel; moist.
15	17	SS	3-4-15-15	1.8	15-15.2' Dark Brown f Sand and Silt; some
					f m angular gravel; some organic material;
					slightly moist; tight.
					15.2-16.0' Red Brown CLAY; with silt some
					f m c subangular to subround gravel; very tight;
					moist.
					16-17' Red Brown f m c Sand and f m c
					subround to subangular Gravel; saturated.
17	20	C	N/A		Red Brown Silt; with clay; little organic material;
					some f rounded gravel; slightly moist.
20	22	SS	7-7-9-50/40	1.55	Red Brown Clay and Silt; with f m c angular to
					subangular gravel; little f m c sand; moist; tight.
					SS came up saturated; drillers were sending
					down water.
22	25	C	N/A		Red Brown Clay and Silt; with f m c sand;
					moist.
					-EOB Bedrock at 24'-

MW-28
N 635659.99
E 584766.67
GRADE EL. 29.06
PVC EL. 28.69

REF: NAD83

MW-29
N 635698.25
E 584883.72
GRADE EL. 31.57
PVC EL. 31.28

MW-16
N 635523.920
E 584811.789
GRADE EL. 29.72
PVC EL 29.46

MW-20
N 635611.877
E 584862.831
GRADE EL. 29.79
PVC EL. 29.53

CB
EL. 29.44

MW-14
N 635612.138
E 584996.270
GRADE EL. 32.23
PVC EL. 31.67

SB 8
N 635475.929
E 584928.623
GRADE EL. 30.87

CB
EL. 29.91

MW-21
N 635552.252
E 584958.476
GRADE EL. 30.48
PVC EL. 30.19

MW-17
N 635435.119
E 584939.484
GRADE EL. 30.47
PVC EL. 30.05

MW-22
N 635556.833
E 585017.991
GRADE EL. 31.65
PVC EL. 31.31

MW-11
N 635439.976
E 584979.639
GRADE EL. 31.19
PVC EL. 30.71

MW-15
N 635699.984
E 585179.178
GRADE EL. 36.97
PVC EL. 36.51

MW-8
N 635466.785
E 585054.151
GRADE EL. 31.86
PVC EL. 31.31

MW-9
N 635406.552
E 585012.175
GRADE EL. 31.30
PVC EL. 31.06

MW-10
N 635579.947
E 585127.788
GRADE EL. 34.53
PVC EL. 34.21

MW-7
N 635495.781
E 585079.136
GRADE EL. 32.35
PVC EL. 32.05

CB 8
EL. 30.47

MW-18
N 635380.194
E 585019.466
GRADE EL. 31.05
PVC EL. 30.67

SB 6
N 635443.864
E 585060.348
GRADE EL. 30.38

CB 8A
EL. 30.59

MW-12
N 635374.608
E 585077.204
GRADE EL. 32.13
PVC EL. 31.77

MW-2
N 635590.694
E 585263.954
GRADE EL. 37.97
PVC EL. 37.74

MW-5
N 635414.101
E 585101.476
GRADE EL. 31.98
PVC EL. 31.60

MW-3
N 635424.863
E 585150.454
GRADE EL. 32.59
PVC EL. 32.12

MW-19
N 635328.223
E 585093.432
GRADE EL. 32.37
PVC EL. 31.82

MW-3D
N 635410.928
E 585170.391
GRADE EL. 32.85
PVC EL. 32.46

MW-13
N 635323.911
E 585152.318
GRADE EL. 33.81
PVC EL. 33.38

CB 6
EL. 32.61

MW-23
N 635383.273
E 585211.324
GRADE EL. 33.43
PVC EL. 33.05

STATEN ISLAND MALL

SB 9
N 635312.536
E 585166.447
GRADE EL. 34.09

MW-4
GRID N:635365.373
GRID E:585177.033
GRADE EL. 33.02
PVC EL. 32.68

SB 6
N 635371.445
E 585188.570
GRADE EL. 32.71

MW-24
N 635325.771
E 585242.689
GRADE EL. 33.90
PVC EL. 33.28

MW-1
N 635718.820
E 585461.919
GRADE EL. 44.58
PVC EL. 44.28

SB 4
N 635641.675
E 585484.932
GRADE EL. 41.04

MW-25
N 635664.48
E 585482.28
GRADE EL. 41.87
PVC EL. 41.41

SB 5
N 635527.077
E 585378.914
GRADE EL. 37.49

MW-26
N 635597.34
E 585462.59
GRADE EL. 39.18
PVC EL. 38.77

CB 4
EL. 40.88

SB 10
N 635269.014
E 585228.645
GRADE EL. 35.47

SB 1
N 635307.952
E 585308.150
GRADE EL. 34.80

SB 3
N 635483.329
E 585456.225
GRADE EL. 34.48

SB 11
N 635239.736
E 585271.341
GRADE EL. 36.34

MW-6R
N 635280.268
E 585315.573
GRADE EL. 35.16
PVC EL. 34.85

CB 1
EL. 34.73

SB 2
N 635338.015
E 585367.294
GRADE EL. 34.60

MW-27
N 635358.68
E 585380.63
GRADE EL. 34.47
PVC EL. 34.10

CB 2
EL. 34.21

CB 3
EL. 34.17

GRAPHIC SCALE
40 0 20 40 80
1" = 40'

HORIZONTAL DATUM IS BASED ON NAD 83.
VERTICAL DATUM IS NAVD88.

MONITORING WELL & SOIL BORING LOCATIONS FOR

STATEN ISLAND MALL
STATEN ISLAND , NY

C:\Land Projects 3\11-55 LBG Staten Island Mall\dwg\11-55 LBG Staten Island Mall.dwg 8/9/2017 6:18:18 AM EDT

REF: NAD83

CB
GRATE EL. 29.44

CB-1
N 635531.87
E 584948.67
GRATE EL. 29.95
INV IN EL. 23.91
INV OUT EL. 23.28
BOTTOM EL. 23.12

174'

CB-3
N 635455.35
E 585061.61
GRATE EL. 30.68
INV IN EL. 25.96
INV OUT EL. NOT VISIBLE
BOTTOM EL. 23.46

CB-2
N 635446.57
E 585058.53
GRATE EL. 30.46
INV IN EL. 25.96
INV OUT EL. NOT VISIBLE
BOTTOM EL. 23.46

146'

CB-19
N 636042.46
E 585432.53
GRATE EL. 44.77
INV OUT EL. 41.77
BOTTOM EL. 39.60

108'

CB-18
N 635967.39
E 585514.08
GRATE EL. 48.60
INV IN NOT VISIBLE
INV OUT EL. 40.43
BOTTOM EL. 40.35

45'

CB-17
N 635921.69
E 585513.31
GRATE EL. 44.98
INV IN NOT VISIBLE
INV OUT EL. 40.19
BOTTOM EL. 37.90

52'

CB-15
N 635856.48
E 585497.45
GRATE EL. 45.44
INV IN NOT VISIBLE
INV OUT EL. 39.43
BOTTOM EL. 37.11

CB-16
NOT FOUND

CB-14
N 635805.13
E 585474.41
GRATE EL. 45.08
INV IN NOT VISIBLE
INV OUT EL. 38.96
BOTTOM EL. 36.08

42'

CB-13
N 635761.25
E 585480.56
GRATE EL. 45.30
INV IN NOT VISIBLE
INV OUT EL. 38.05
BOTTOM EL. 35.72

113'

CB-4
N 635366.36
E 585185.82
GRATE EL. 32.61
INV IN EL. 28.69
INV OUT EL. 28.69
BOTTOM EL. 26.44

138'

MH-11
N 635517.15
E 585380.74
RIM EL. 37.17
INV OUT EL. 31.50
BOTTOM EL. 31.21

CB-10
N 635513.37
E 585421.85
GRATE EL. 34.22
INV OUT EL. 31.89
BOTTOM EL. 31.64

84'

156'

CB-12
N 635644.65
E 585488.42
GRATE EL. 40.93
INV IN EL. 35.93
INV OUT EL. 35.85
BOTTOM EL. 33.51

CB-5
N 635302.63
E 585312.46
GRATE EL. 34.74
INV IN EL. 30.24
INV OUT EL. 30.24
BOTTOM EL. 27.74

71'

24'

105'

165'

CB-6
N 635338.15
E 585376.56
GRATE EL. 34.21
INV IN EL. 30.46
INV OUT EL. 30.46
BOTTOM EL. 28.63

CB-7
N 635361.18
E 585363.01
GRATE EL. 34.16
INV IN EL. 30.66
INV OUT EL. 30.60
BOTTOM EL. 28.95

MH-8
N 635448.40
E 585423.27
RIM EL. 34.96
INV OUT EL. 30.96
BOTTOM EL. 29.88

CB-9
N 635485.58
E 585461.98
GRATE EL. 34.16
INV IN EL. 30.91
INV OUT EL. 30.83
BOTTOM EL. 30.16

STATEN ISLAND MALL

GRAPHIC SCALE

40 0 20 40 80

1" = 40'

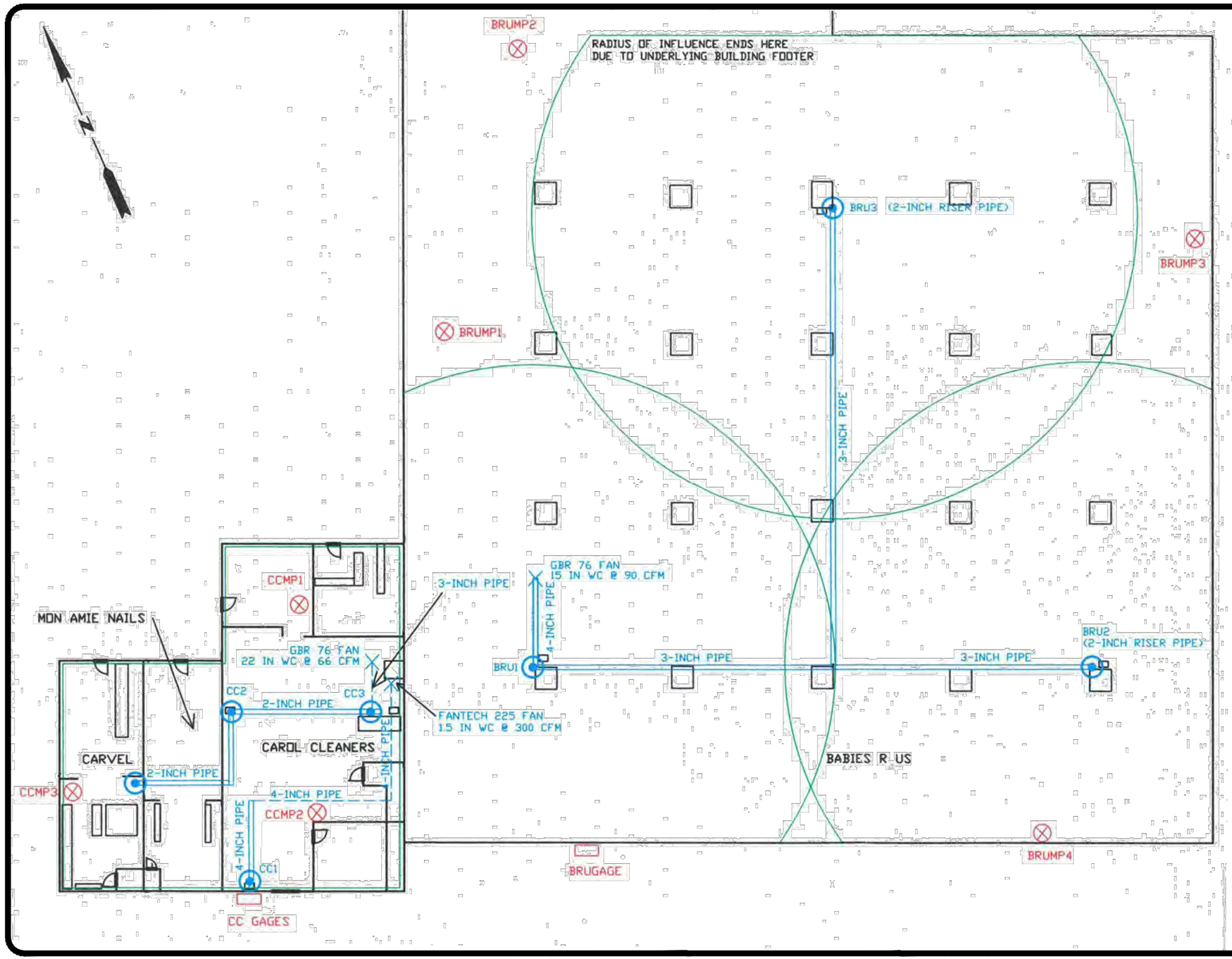
HORIZONTAL DATUM IS BASED ON NAD 83.
VERTICAL DATUM IS NAVD88.

CATCH BASIN LOCATIONS
FOR

STATEN ISLAND MALL
STATEN ISLAND , NY

C:\Land Projects 3\16-87 LBG Staten Island Mall CB\dwg\16-87 LBG Staten Island Mall CB.dwg 12/22/2016 1:41:28 PM EST

APPENDIX D - SSDS - AS-BUILD



LEGEND

- CC1 — SUCTION POINT LOCATION WITH DESIGNATION
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- GBR 76 FAN — LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE
- PROPOSED EFFECTIVE RADIUS OF INFLUENCE EXERTED BY BLOWER FAN
- MAGNAHELIC GAGE LOCATION

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 2/18/2015, AND INCLUDED WITHIN A FINAL ENGINEERING DESIGN REPORT SUBMITTED BY WSP DATED 6/26/2018 AND STAMPED BY WILLIAM K. BECKMAN, P.E., NYS PE #063219-1

0 23
FEET

ERICH ZIMMERMAN, P.E.

STATE OF NEW YORK — ERICH ZIMMERMAN — 081831 — LICENSED PROFESSIONAL ENGINEER

N.Y.P.E. Lic. No. 081831-01 Date 05/18/2023

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

SUB SLAB DEPRESSURIZATION SYSTEM AS-BUILT

PREPARED BY: LBG ENGINEERING SERVICES, PC

SHEET NO.

PROJECT NO.
4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\Brookfiled AS BUILT.dwg Layout: ANSI-B-L User: JISS.PHILIP May 18, 2023 - 4:04pm
1" 1/2" 0" 1"

APPENDIX E - SOIL BORING LOGS

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-1

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/17/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**S`EAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	4.4	1-2-1-1	0.8	Red Brown MF SAND, and Silt, little cmf Gravel (wet)
4	6	6.8	2-2-2-3	0.9	Red Brown MF SAND, some Silt, trace f Gravel (wet)
6	8	6.6	2-1-4-1	1.4	Red Brown SILT, and f Sand, little cmf Gravel (wet, ndcc)
8	10		17-21-25-30	0.0	No Recovery
10	12	1.2	12-20-30-45	2.0	Red Brown SILT, some mf Sand, little cmf Gravel (piece of weathered bedrock at bottom of spoon) (moist)
12	11.5	0.4	100/4"	1.7	Red Brown SILT, some mf Sand, little cmf Gravel (very dense, wet, ndcc) - drill refusal
					EOB bedrock at 11.5'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-2

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/17/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**
COMMENTS:	

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	3.1	8-11-13-15	1.7	Red Brown MF SAND, and Silt, some cmf Gravel (dense)
4	6	4.5	22-27-24-22	0.8	Red Brown SILT, some f Sand, trace f Gravel (moist, ndcc)
6	8	4.7	25-29-20-18	0.2	Red Brown F SAND, and Silt, trace cmf Gravel (moist)
8	10	5.0	13-11-8-9	1.3	Red Brown SILT, some cmf Gravel, some mf Sand (wet)
10	12	4.2	5-10-11-25	1.2	Red Brown SILT, some cmf Gravel, some mf Sand (moist, dense, pieces of weathered bedrock)
12	14	1.7	35-45-42-58	1.6	Red Brown MF SAND, and cmf Gravel, little Silt (moist, very dense, pieces of weathered bedrock)
14	16	0.1	36-27-22-29	1.5	Red Brown SILT, and cmf Gravel, some mf Sand--grading to CMF SAND (wet)

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-3

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/18/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**S`EAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	1.0	40-24-42-31	1.1	CMF GRAVEL, and Red Brown Sand, trace Silt
4	6	1.7	26-40-22-21	0.7	Red Brown F SAND, and cmf Gravel, some Silt (dry)
6	8	1.1	23-100/1"	0.2	CMF GRAVEL, and Red Brown mf Sand, trace Silt (dry)
8	10	0.7	7-11-14-13	1.8	Red Brown Silt, and mf Sand, little mf Gravel (wet)
10	12	4.2	15-18-30-30	1.8	Red Brown Silt, and mf Sand, little mf Gravel (moist, dense)
12	14	6.1	48-52-28-42	2.0	Red Brown F SAND, and cmf Gravel, little Silt (ndcc, wet)
14	16	0.3	8-10-11-14	2.0	Red Brown Clayey Silt (1st 8"), 6" of cmf SAND, 5" of dense SILT, 2" of weathered bedrock
16	18	1.3	47-61-54-100/2"	2.0	Red Brown CMF SAND, trace Silt, last 4" is bedrock (ndcc, moist)
					EOB @ 18'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-4

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/18/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**S`EAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**
COMMENTS:	

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.1	17-33-35-35	1.2	Red Brown MF SAND, and cmf Gravel, some Silt (dry)
4	6	0.0	19-24-15-18	1.6	Red Brown F SAND, and Silt, some cmf Gravel (dry, dense)
6	8	0.0	25-31-20-22	1.2	Red Brown SILT, and f SAND, trace f Gravel (moist)
8	10	0.0	25-55-23-40	1.4	Red Brown SILT, and f SAND, trace f Gravel (moist)
10	12	3.2	100/2"	0.1	Red Brown SILT, and f Sand, somr mf Gravel (moist, dense, ndcc)
12	14	0.0	35-69-100/3"	1.1	Red Brown MF SAND, and mf Gravel, some Silt (loose, wet)
14	14.1	1.1	100/2"	0.1	Red Brown SILT, and mf Sand, and weathered Bedrock (very dense, ndcc)
					EOB @ 14' —Drill Refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-5

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/17/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**S`EAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**
COMMENTS:	

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	2.4	1-4-7-13	0.75	Red Brown MF SAND, some Silt, trace Gravel (wet, ndcc)
4	6	19.0	10-10-13-8	2.0	Red Brown SILT, and mf Sand, some Gravel (wet)
6	8	55.6	10-18-7-5	2.0	Red Brown SILT, and mf Sand, some Gravel (wet, ndcc)
8	10	36.6	17-19-16-11	1.0	Red Brown Silty CLAY, some cmf Gravel, little Sand (moist)
10	11.5	63.0	33-45-100/3"	1.2	Red Brown SILT, little cmf Sand, little Gravel
					EOB - bedrock @ 11.5' - drill refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-6

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/17/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**
COMMENTS:	

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	1.6	5-7-16-20	1.2	Red Brown SILT, some mf Sand, trace f Gravel (moist)
4	6	1.5	9-45-54-60	0.6	Red Brown Clayey SILT, some cmf Sand, some cmf Gravel (moist)
6	8	3.3	45-41-44-38	1.2	Red Brown mf SAND, and cmf Gravel, some Silt (moist to wet last 1", ndcc)
8	10	1.8	20-16-18-15	0.7	Red Brown SILT, some cmf Gravel, some mf Sand (very moist)
10	12	1.5	24-24-15-20	1.2	Red Brown SILT, some cmf Gravel, some mf Sand (moist, pieces of weathered bedrock))
					EOB - bedrock @ 12 ft.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-7

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/18/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**
COMMENTS:	

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.6	4-2-3-2	0.2	Red Brown SILT, little f Sand, trace f Gravel
4	6	0.4	12-7-14-10	1.0	Red Brown F SAND, and Silt, trace f Gravel (moist)
6	8	62	8-10-31-42	1.3	Red Brown SILT, little f Sand, trace f Gravel (moist, ndcc)
8	10	1.4	30-25-31-29	0.1	Red Brown F SAND, and Silt, trace f Gravel (moist)
10	12	5.1	10-20-24-41	1.8	Red Brown Clayey SILT, little mf Gravel, little mf Sand (weathered pieces of bedrock in last 3", wet, ndcc)
12	12.5	3.3	100/1"	0.1	Red Brown SILT, some mf Gravel, little f Sand (ndcc)
					EOB - bedrock @ 12.5' - - - Drill Refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-8

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/18/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.1	19-19-45-100/4"	1.5	Red Brown F SAND, and cmf Gravel, some Silt (dry)
4	6	0.0	100/5"	0.5	Red Brown SILT, some cmf Gravel, little f Sand (very moist, dense, last 2" = Gravel)
6	8	0.0	22-11-6-9	1.6	Red Brown F SAND, and Silt, little mf Gravel (moist)
8	10	0.3	24-15-17-9	1.8	Red Brown SILT, and f Sand, little f Gravel (moist)
10	11	9.8	17-36-100/4"	1.5	Red Brown Clayey SILT, and f Sand, little mf Gravel (moist, ndcc)
					EOB - bedrock @ 11' —Drill Refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-9

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/19/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**S`EAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	11.5	12-17-14-20	1.5	Red Brown SILT, and mf Sand, trace mf Gravel (moist)
4	6	20.2	7-7-14-20	1.8	Red Brown F SAND, and Silt, little cmf Gravel (moist)
6	8	38.7	10-7-10-20	1.2	Red Brown F SAND, and Silt, little cmf Gravel (moist, ndcc)
8	10	0.4	12-17-15-21	1.3	Red Brown F SAND, and Silt, little cmf Gravel (moist)
10	11.5	1.2	22-35-100/5"	1.8	Red Brown F SAND, and Silt, trace mf Gravel (very dense, ndcc)
					Drill refusal @ 11.5 ft. - Bedrock - EOB

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-10

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/18/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	8.7	8-10-17-20	1.7	Red Brown F SAND, and Silt, trace f Gravel (dry, dense, ndcc)
4	6	2.8	16-20-15-15	1.4	Red Brown SILT, and f Sand, some cmf Gravel (very moist)
6	8	2.6	19-24-55-60	1.4	Red Brown F SAND, and Silt, little cmf Gravel (dry to very moist, dense, ndcc)
8	10	0.1	9-18-30-22	1.9	Red Brown F SAND, and Silt, trace mf Gravel (moist)
10	12	0.0	23-20-25-29	2.0	Red Brown SILT, and mf Sand, trace cmf Gravel (dense, moist)
12	14	0.1	21-33-55-35	2.0	Red Brown (very dense) SILT grading to CMF (loose) SAND (wet)
14	14.5	1.3	100/5"	0.4	Red Brown SILT, and f Sand, little mf Gravel (dense, moist, ndcc)
					EOB @ 14.5' - - - Bedrock

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-11

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/18/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.2	9-23-24-24	1.7	Red Brown CMF SAND, some cmf Gravel, little Silt (dry)
4	6	0.3	28-25-22-20	1.1	Red Brown F SAND, and cmf Gravel, some Silt (dry, very dense)
6	8	17.9	23-21-33-35	1.0	Red Brown F SAND, and Silt, little cmf Gravel (moist to wet, ndcc)
8	10	0.9	41-37-33-40	2.0	Red Brown F SAND, and Silt, trace f Gravel (moist, dense)
10	12	1.1	27-26-37-41	1.8	Red Brown SILT, and f Sand, some mf Gravel (very dense, ndcc)
12	12.5	0.4	45-100/2"	0.3	Red Brown SILT, and f Sand, some mf Gravel (very dense, moist, ndcc)
					EOB - bedrock @ 12.5' - - - Drill Refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-12

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/19/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	2.3	15-13-12-12	1.8	Red Brown SILT, and F Sand, trace f Gravel (moist)
4	6	4.7	8-16-22-15	2.0	Red Brown SILT, and F Sand, trace f Gravel (moist)
6	8	5.8	17-35-28-22	1.0	Red Brown F SAND, and Silt, trace fine Gravel (moist to wet, ndcc)
8	10	0.5	20-22-34-45	1.5	Red Brown F SAND, some cmf Gravel, little Silt (very dense, wet)
10	12	0.2	20-25-27-34	2.0	Red Brown F SAND, some cmf Gravel, little Silt (very dense, wet)
12	12.5	0.0	29-73-100/3"	1.0	CMF GRAVEL, and cmf Sand, some Silt (wet, weathered bedrock, ndcc)
					Drill refusal @ 12.5 ft. - Bedrock - EOB

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-13

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/20/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	7.3	12-14-25-38	1.7	Red Brown MF SAND, and Silt, little mf Gravel (dry, dense, ndcc)
4	6	4.1	18-26-32-28	2.0	Red Brown MF SAND, and mf Gravel, some Silt (dry)
6	8	0.4	20-30-25-20	1.2	Red Brown F SAND, and Silt, trace mf Gravel (very moist, dense, ndcc)
8	10	0.2	29-40-61-55	1.5	Red Brown F SAND, and Silt, little mf Gravel (very dense)
10	12	0.3	28-30-22-30	2.0	Red Brown F SAND, and Silt, little mf Gravel (very dense)
12	13.5	1.4	74-78-100/2"	1.2	Red Brown F SAND, and cmf Gravel (weathered bedrock), little Silt (very dense, ndcc)
					EOB @ 13.5- - - Bedrock @ 13.5 ft.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-14

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/20/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** 9' **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.0	10-12-9-20	2.0	Red Brown F SAND, some Silt, trace cmf Gravel (dry)
4	6	0.1	19-20-23-18	2.0	Red Brown CM(+)F, trace Silt (dry)
6	8	0.3	15-20-21-23	1.8	Red Brown MF(+) SAND, little Silt, trace f Gravel (very moist)
8	10	0.7	15-16-12-22	1.8	Red Brown Silt, some F Sand, trace f Gravel (moist)
10	12	4.3	16-14-20-25	1.9	Red Brown MF(+) Sand, some Silt, little mf Gravel (wet, ndcc)
12	13.5	0.0	35-27-100/1"	1.5	Red Brown CM(+)F SAND, and cmf Gravel, little Silt (wet, ndcc)
					EOB @ 13.5'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-15

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/19/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.3	3-7-10-17	2.0	Red Brown SILT, and F Sand, little f Gravel (dense, dry)
4	6	0.7	7-10-62-45	0.8	Same (moist)
6	8	1.3	47-18-16-11	0.7	Same (wet, ndcc)
8	10	0.2	25-43-65-100/1"	1.3	Red Brown MF SAND, some cmf Gravel, little Silt (dense, wet)
10	12	0.0	29-33-61-32	1.0	1st 18" = Silt (loose, mucky), last 6" = F SAND, and Silt, little mf Gravel
12	14	0.0	38-60-100/2"	1.0	Red Brown F SAND, and Silt, some mf Gravel (very dense, moist)
14	16	0.0	33-65-29-24	2.0	Red Brown MF Sand, some MF Gravel, little Silt (very dense)
16	18	0.1	18-36-51-35	2.0	Red Brown loose CMF SAND, grading to very dense Silt with pieces of bedrock
18	19.5	0.5	12-29-32-100/3"	1.1	Red Brown MF SAND, and cmf Gravel, some Silt (dense, ndcc)
					Split Spoon refusal @ 19.5 ft. - Bedrock - EOB

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-16

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/19/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.3	15-13-18-29	1.7	Red Brown Silt, and f Sand, trace f Gravel (very dense, dry)
4	6	0.5	22-15-18-25	0.8	Red Brown MF SAND, little mf Gravel, little Silt (dry)
6	8	1.2	30-35-18-24	1.5	Red Brown MF SAND, trace f Gravel & Silt (loose, moist, ndcc)
8	10	0.1	13-30-43-47	1.4	Red Brown SILT, and mf Sand, little mf Gravel (wet, dense)
10	12	0.0	50-53-67-100/5"	2.0	Red Brown CMF SAND (loose) grading to F SAND (very dense), and cmf Gravel
12	13.5	0.3	75-100/4"	1.2	Red Brown F SAND, some Silt, little f Gravel (dry, very dense, ndcc)
					EOB - bedrock @ 13.5- - - Drill Refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-17

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/18/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.1	5-20-8-11	1.8	Red Brown F SAND, some cm Gravel, little Silt (dry)
4	6	0.0	13-14-13-15	2.0	Red Brown CMF SAND (moist)
6	8	0.0	8-12-11-15	1.8	Red Brown F SAND, and Silt, trace f Gravel (very moist)
8	10	0.0	6-14-12-27	1.5	Red Brown CMF SAND, little Silt (loose, wet)
10	12	0.3	24-27-30-24	1.6	Red Brown F SAND, and Silt, trace f Gravel (ndcc, wet)
12	14	0.0	100/1"	0.1	Red Brown SILT, some mf Gravel, some f Sand (wet, dense)
14	15.5	0.9	36-34-22-31	1.5	Red Brown CMF SAND (loose, wet, ndcc)
					EOB - bedrock @ 15.5'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-18

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/20/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.0	4-6-6-25	1.8	Red Brown F SAND, some cmf Gravel, little Silt (dry)
4	6	0.4	100/5"	0.2	Red Brown F SAND, and cmf Gravel, trace Silt (moist, ndcc)
6	8	0.0	40-35-26-28	1.5	Red Brown MF SAND, and cmf Gravel (some weathered Bedrock), trace Silt, (dry, ndcc)
8	9.5	0.0	44-45-51-100/5"	1.6	Red Brown MF SAND, some cmf Gravel (some weathered Bedrock), trace Silt, (moist, ndcc)
					EOB - bedrock @ 9.5' - drill refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-19

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/20/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**
COMMENTS:	

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.0	8-8-11-12	1.8	Red Brown MF SAND, some mf Gravel, little Silt (dry)
4	6	0.0	13-33-29-27	0.9	Red Brown MF SAND, and cmf Gravel (some weathered Bedrock), little Silt, (dry)
6	8	0.0	8-29-21-55	1.5	Red Brown MF SAND, and cmf Gravel (some weathered Bedrock), little Silt, (dry, ndcc)
8	8.5	0.0	46-100/5"	1.0	Red Brown MF SAND, and cmf Gravel (some weathered Bedrock), little Silt, (dry, very dense, ndcc)
					EOB - bedrock @ 8.5'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-20

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/20/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**
COMMENTS:	

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.0	12-17-14-8	1.6	Red Brown F SAND, some cmf Gravel, little Silt (dry)
4	6	0.0	7-9-71-47	2.0	Red Brown F SAND, and cmf Gravel, trace Silt (moist)
6	8	0.2	22-24-35-31	1.8	Red Brown MF SAND, and cmf Gravel (some weathered Bedrock), trace Silt, (dry, ndcc)
8	8.5	0.0	25-100/5"	1.4	Red Brown MF SAND, some cmf Gravel (some weathered Bedrock), trace Silt, (moist, ndcc)
					EOB - bedrock @ 8.5'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-21

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/23/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.7	20-20-33-36	1.1	Red Brown F SAND, and cmf Gravel, some Silt (dense, dry, ndcc)
4	6	0.1	34-37-51-51	1.2	Red Brown MF SAND, some Silt, little cmf Gravel (dense, moist)
6	8	0.0	29-24-11-22	1.0	Red Brown F SAND, and Silt, trace f Gravel (moist, ndcc)
8	10	0.0	30-28-69-52	1.2	Red Brown F SAND, and cmf Gravel, some Silt (moist)
10	12	0.0	25-45-54-43	1.5	Red Brown MF SAND, some Silt, little cmf Gravel (moist)
12	12.5	0.0	47-41-76-100/5"	1.6	Red Brown F SAND, and Silt, some mf Gravel (very dense, moist, ndcc)
					EOB - bedrock @ 12.5 ft

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-22

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/23/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.9	10-18-18-12	1.3	Red Brown SILT, and f Sand, trace cmf Gravel (dry, ndcc)
4	6	0.4	13-14-19-12	0.9	Red Brown SILT, and f Sand, trace cmf Gravel (dry)
6	8	0.5	18-7-8-12	1.2	Red Brown SILT, and f Sand, trace cmf Gravel (very moist)
8	10	0.4	15-12-19-28	1.5	Red Brown MF SAND, and Silt, little cmf Gravel (moist)
10	12	1.2	19-32-100/5"	1.4	Red Brown MF SAND, and Silt, little mf Gravel (moist, very dense, ndcc)
12	12.5	0.0	77-103/5"	1.0	Red Brown SILT, and mf Sand, little mf Gravel (very dense, wet, ndcc)
					EOB @ 12.5' - Drill Refusal - Bedrock

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-23

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY

DATE COMPLETED: 9/23/02

DRILLING COMPANY: Summit

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Split Spoon

OBSERVER: R. Wade Watkins

REFERENCE POINT (RP): Ground Surface

ELEVATION OF RP:

SURFACE COMPLETION:

SCREEN TYPE: **DIAMETER:**

SLOT NO.: **SETTING:**

SAND PACK SIZE:

SETTING:

CASING TYPE: **DIAMETER:**

SETTING:

SEAL TYPE:

SETTING:

BACKFILL TYPE:

STATIC WATER LEVEL: **DATE:**

DEVELOPMENT METHOD:

DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.0	11-12-28-35	[illegible]	Red Brown MF SAND, and Silt, little cmf Gravel (dry)
4	6	0.0	20-18-21-21	[illegible]	Red Brown MF SAND, and Silt, little cmf Gravel (dry)
6	8	0.0	19-8-10-16	[illegible]	Red Brown SILT, some cmf Gravel, little f Sand (very moist)
8	10	0.0	9-5-8-10	[illegible]	Red Brown Silty CLAY, grading to F SAND, some mf Gravel, little Silt (moist, ndcc)
10	12	0.0	5-16-8-12	2.0	Red Brown MF SAND, some cmf Gravel (weathered bedrock), some Silt (very moist)
12	14	0.0	11-9-30-34	1.7	Red Brown MF SAND, some cmf Gravel (weathered bedrock), some Silt (wet)
14	16	0.0	100/2"	0.2	Red Brown MF SAND, some cmf Gravel (weathered bedrock), some Silt (wet, ndcc)
16	16.5	0.0	30-100/5"	0.7	Red Brown CMF SAND, and cmf Gravel (wet, ndcc)
					EOB - bedrock @ 16.5' - Drill Refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-24

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 9/23/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**SEAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.6	17-9-21-18	0.6	Brown SILT with grey and red mottling, little cmf Sand, trace cmf Gravel (dry, elastic in some places, ndcc)
4	6	0.1	27-25-28-27	1.8	Red Brown with grey mottles F Sand, and Silt, little mf Gravel (moist, ndcc)
6	8	0.0	23-21-16-11	2.0	Red Brown Silt, and mf Sand, trace mf Gravel (moist)
8	10	0.0	24-18-13-14	1.5	Red Brown Silt, and mf Sand, trace mf Gravel (moist)
10	12	0.0	10-9-11-15	1.0	Red Brown F SAND, and cmf Gravel, some Silt (moist)
12	14	0.0	28-2-2-2	0.5	Red Brown Silt, and cmf Gravel, some mf Sand (wet)
14	16	0.0	10-12-1-3	0.5	CMF GRAVEL, and Silt, some cmf Sand (wet)
16	17.5	0.0	2-1-13-42	0.7	Red Brown CM(+)F SAND, and cmf Gravel (wet, ndcc)
					EOB - bedrock @ 17.5' - Spoon Refusal

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse

BORING NO.: B-25

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, NY	**SCREEN TYPE:** **DIAMETER:**
	SLOT NO.: **SETTING:**
DATE COMPLETED: 10/31/02	**SAND PACK SIZE:**
DRILLING COMPANY: Summit	**SETTING:**
	CASING TYPE: **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:**
SAMPLING METHOD: Split Spoon	**S`EAL TYPE:**
OBSERVER: R. Wade Watkins	**SETTING:**
REFERENCE POINT (RP): Ground Surface	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** **DATE:**
SURFACE COMPLETION:	**DEVELOPMENT METHOD:**
	DURATION: **ESTIMATED YIELD:**

COMMENTS:

ABBREVIATIONS: SS = split spoon C(c) = coarse M(m) = medium F(f) = fine GS = ground surface EOB = end of boring NDCC = no dye (Sudan IV) color change to indicate DNAPL

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID VALUE (ppm)	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	2				Augured through asphalt and sub-base
2	4	0.4	10-9-15-20	1.5	Red Brown MF SAND, some Silt, little mf Gravel (moist, ndcc)
4	6	0.3	13-17-20-18	1.2	Red Brown MF SAND, some Silt, little mf Gravel (moist, ndcc)
6	8	3.8	15-21-29-100/3"	1.0	Red Brown F SAND, and Silt, some cmf Gravel (very moist, ndcc))
8	10	0.4	16-13-7-7	1.0	Red Brown Clayey SILT, little f Sand, little cmf Gravel (wet)
10	12	0.4	16-17-23-20	1.7	Red Brown MF SAND, and Silt, some cmf Gravel (wet)
12	14	0.2	91-100/1"	1.7	Red Brown CMF SAND, and Silt (dense), some mf Gravel (wet)
14	15.5	0.4	45-63-87-89	1.0	CM GRAVEL, and cmf Sand, some Silt (weathered bedrock, wet, ndcc)
					EOB @ 15.5' - Bedrock

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: General Growth Properties

WELL NO.: B-26

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 1"
	SLOT NO.: #10 **SETTING:** 7 – 12'
DATE COMPLETED: 5/11/06	**SAND PACK SIZE:** N/A
DRILLING COMPANY: S_2C_2, Inc.	**SETTING:** N/A
	CASING TYPE: PVC **DIAMETER:** 1"
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** 0 – 7'
SAMPLING METHOD: Macro-Core w/ Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Jonas Holliss	**SETTING:** N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE:** Bentonite
ELEVATION OF RP:	**STATIC WATER LEVEL:** 10.69' **DATE:** 5/11/06
SURFACE COMPLETION: PVC removed, boring filled with bentonite, asphalt on top.	**DEVELOPMENT METHOD:** Purge
	DURATION: 20 min **ESTIMATED YIELD:** < 1 gal
COMMENTS: Temporary Well point installed for single round of ground-water sampling	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	0.4	0		Black asphalt, dry
0.4	0.75	0		Gray GRAVEL sub-grade
0.75	2.1	0		Red brown f SAND and silt; dry
2.1	3.2	0		Gray brown SILT; little clay; moist; mottled near 3'
3.2	4.2	0		Light red brown f SAND and silt; little clay; moist
4.2	4.4	0		Gray cm SAND; dry
4.4	8.9	0		Red brown mf SAND; some silt; little clay; little gravel; wet at 7'
8.9	9.3	0		Dark gray brown SILTY CLAY; moist
9.3	9.5	0		Dark gray brown c SAND and gravel; dry
9.5	11	0		Red brown f SAND; some silt; little clay; trace gravel; wet
11	12	0		Red brown CLAY; moist; (non-reactive with Sudan IV) – refusal at 12'
				E.O.B. at 12'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: General Growth Properties

WELL NO.: B-27

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 1"
	SLOT NO.: #10 **SETTING:** 9.8 – 14.8'
DATE COMPLETED: 5/11/06	**SAND PACK SIZE:** N/A
DRILLING COMPANY: S_2C_2, Inc.	**SETTING:** N/A
	CASING TYPE: PVC **DIAMETER:** 1"
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** 0 – 9.8'
SAMPLING METHOD: Macro-Core w/ Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Jonas Holliss	**SETTING:** N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE:** Bentonite
ELEVATION OF RP:	**STATIC WATER LEVEL:** 10.42' **DATE:** 5/11/06
SURFACE COMPLETION: PVC removed, boring filled with Bentonite, asphalt on top.	**DEVELOPMENT METHOD:** Purge
	DURATION: 20 min **ESTIMATED YIELD:** < 1 gal
COMMENTS: Temporary Well point installed for single round of ground-water sampling	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	0.4	0		Black asphalt; dry
0.4	1.5	0		Light gray GRAVEL sub-grade; dry
1.5	1.8	0		Black GRAVEL sub-grade; moist
1.8	3.0	0		Brown mf SAND; some silt; little gravel; moist
3.0	3.1	0		Red crushed brick; dry
3.1	4.5	0		Red brown mf SAND and silt; some clay; little gravel; moist
4.5	4.7	0		Gray brown GRAVEL sluff
4.7	5.2	0		Brown f SAND; clean; moist
5.2	5.9	0		Orange brown f SAND; moist
5.9	8.0	0		Red brown mf SAND and silt; some clay; little gravel; moist
8.0	9.4	0		Red brown SILTY CLAY; wet at 8'

OWNER: General Growth Properties

WELL NO.: B-27 **PAGE:** 2 **OF** 2 **PAGES**

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
9.4	9.5	0		Red brown cm SAND; clean; wet
9.5	9.7	0		Red brown SILTY CLAY; wet
9.7	9.8	0		Red brown cm SAND; clean; wet
9.8	10.0	0		Red brown SILTY CLAY; wet
10.0	10.2	0		Red brown cm SAND; some silt; wet
10.2	12.0	0		Red brown mf SAND; some silt; little clay; little gravel; wet
12.0	14.8	0		Red brown mf SAND; some silt; little clay; little gravel; trace cobbles; wet (non-reactive with Sudan IV); hit refusal (bedrock) at 14.8'
				E.O.B. at 14.8'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: General Growth Properties.

WELL NO.: B-28

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 1"
	SLOT NO.: #10 **SETTING:** 8 – 13'
DATE COMPLETED: 5/11/06	**SAND PACK SIZE:** N/A
DRILLING COMPANY: S_2C_2, Inc.	**SETTING:** N/A
	CASING TYPE: PVC **DIAMETER:** 1"
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** 0 – 8'
SAMPLING METHOD: Macro-Core w/ Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Jonas Holliss	**SETTING:** N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE:** Bentonite
ELEVATION OF RP:	**STATIC WATER LEVEL:** 11.62' **DATE:** 5/11/06
SURFACE COMPLETION: PVC removed, boring filled with Bentonite, asphalt on top.	**DEVELOPMENT METHOD:** Purge
	DURATION: 20 min **ESTIMATED YIELD:** < 1 gal
COMMENTS: Temporary Well point installed for single round of ground-water sampling	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	0.4	0		Black asphalt; dry
0.4	1.1	0		Gray GRAVEL sub-base; dry
1.1	2.8	0		Red brown f SAND; some silt; little gravel; dry
2.8	3.3	0		Dark gray CLAYEY SILT; moist
3.3	5.3	0		Gray brown CLAYEY SILT; moist
5.3	6.0	0		Brown f SAND; little gravel; moist
6.0	9.5	0		Red brown mf SAND and silt; some gravel; little clay; moist; wet at 9.3'
9.5	9.9	0		Red brown cm SAND; clean; wet
9.9	13.0	0		Red brown f SAND and silt; some clay; trace gravel; wet (non reactive to Sudan IV) – refusal (bedrock) at 13'
				E.O.B. at 13'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: General Growth Properties

WELL NO.: B-29

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 1"
	SLOT NO.: #10 **SETTING:** 8 – 13'
DATE COMPLETED: 5/11/06	**SAND PACK SIZE:** N/A
DRILLING COMPANY: S_2C_2, Inc.	**SETTING:** N/A
	CASING TYPE: PVC **DIAMETER:** 1"
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** 0 – 8'
SAMPLING METHOD: Macro-Core w/ Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Jonas Holliss	**SETTING:** N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE:** Bentonite
ELEVATION OF RP:	**STATIC WATER LEVEL:** 12.10' **DATE:** 5/11/06
SURFACE COMPLETION: PVC removed, boring filled with Bentonite, asphalt on top.	**DEVELOPMENT METHOD:** Purge
	DURATION: 20 min **ESTIMATED YIELD:** < 1 gal
COMMENTS: Temporary Well point installed for single round of ground-water sampling	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	0.8	0		Black asphalt; dry
0.8	1.1	0		Light gray GRAVEL sub-base; dry
1.1	1.6	0		Dark gray brown SILT; some f sand; moist
1.6	2.3	0		Brown f SAND and silt; dry
2.3	2.5	0		Dark gray brown SILT and f sand; moist
2.5	2.8	0		Light gray brown SILTY CLAY; moist
2.8	3.6	0		Red brown CLAY; some silt; moist
3.6	4.4	0		Red brown SILT and f sand; moist
4.4	5.7	0		Red brown f SAND and silt; some clay; trace gravel; moist
5.7	5.9	0		Gray brown SILTY CLAY; moist
5.9	7.3	0		Red brown f SAND and silt; some clay; trace gravel; moist

OWNER:	General Growth Properties
WELL NO.:	B-29

DEPTH (FEET)		PID (ppm)	RECOVERY (feet)	DESCRIPTION
FROM	TO			
7.3	8.0	0		Red brown siltstone BOULDER; dry
8.0	8.8	0		Light gray GRAVEL sluff
8.8	9.3	0		Red brown CLAY; some silt; moist
9.3	10.3	0		Red brown mf SAND and silt; some clay; wet at 9.3'
10.3	10.6	0		Red siltstone COBBLE
10.6	12.0	0		Red brown SILT; some f sand; some clay; wet
12.0	13.0	0		Red brown SILT and f sand; some clay; little gravel; wet (non-reactive to Sudan IV) – refusal (bedrock) at 13'
				E.O.B. at 13'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: General Growth Properties

WELL NO.: B-30

PAGE: 1 of 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 1"
	SLOT NO.: #10 **SETTING:** 10 – 15'
DATE COMPLETED: 5/11/06	**SAND PACK SIZE:** N/A
DRILLING COMPANY: S_2C_2, Inc.	**SETTING:** N/A
	CASING TYPE: PVC **DIAMETER:** 1"
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** 0 – 10'
SAMPLING METHOD: Macro-Core w/ Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Jonas Holliss	**SETTING:** N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE:** Bentonite
ELEVATION OF RP:	**STATIC WATER LEVEL:** 14.11' **DATE:** 5/11/06
SURFACE COMPLETION: PVC removed, boring filled with Bentonite, asphalt on top.	**DEVELOPMENT METHOD:** Purge
	DURATION: 20 min **ESTIMATED YIELD:** < 1 gal

COMMENTS: This boring was done on a 15 degree (from vertical) angle to get under Carvel. Temporary Well point installed for single round of ground-water sampling

ABBREVIATIONS: C = Coarse, M = Medium, F = Fine

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.2	0		Black asphalt; dry
1.2	1.9	0		Light gray GRAVEL sub-grade and wood fill; dry
1.9	4.4	0		Red brown mf SAND and silt; some clay; dry
4.4	11.3	0		Red brown mf SAND and silt; some clay; little gravel; moist; wet at 8.3'
11.3	12.0	0		Red brown mf SAND and silt; trace gravel; moist
12.0	15.0	0		Red brown mf SAND; little gravel; little silt; wet (non-reactive to Sudan IV) – refusal (bedrock) at 15'
				E.O.B. at 15'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: General Growth Properties

WELL NO.: B-31

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 1"
	SLOT NO.: #10 **SETTING:** 11 – 16'
DATE COMPLETED: 5/11/06	**SAND PACK SIZE:** N/A
DRILLING COMPANY: S_2C_2, Inc.	**SETTING:** N/A
	CASING TYPE: PVC **DIAMETER:** 1"
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** 0 – 11'
SAMPLING METHOD: Macro-Core w/ Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Jonas Holliss	**SETTING:** N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE:** Bentonite
ELEVATION OF RP:	**STATIC WATER LEVEL:** 11.12' **DATE:** 5/11/06
SURFACE COMPLETION: PVC removed, boring filled with Bentonite, asphalt on top.	**DEVELOPMENT METHOD:** Purge
	DURATION: 20 min **ESTIMATED YIELD:** < 1 gal

COMMENTS: This boring was done on a 30 degree (from vertical) angle to get under Mon Amiee Nails. Temporary Well point installed for single round of ground-water sampling

ABBREVIATIONS: C = Coarse, M = Medium, F = Fine

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.2	0		Black asphalt; dry
1.2	1.6	0		Brown mf SAND; moist
1.6	1.8	0		Wood fill
1.8	2.0	0		Gray COBBLES; dry
2.0	5.0	0		Brown mf SAND and silt; moist
5.0	5.4	0		Green and brown SILT and f sand; some clay; wet at 5'
5.4	6.4	0		Red brown f SAND and silt; some clay; little gravel; siltstone cobble at 5.8'; wet
6.4	6.5	0		Light orange brown SILT; dry
6.5	8.0	0		Red brown f SAND and silt; wet
8.0	12.0	0		Red brown f SAND and silt; little gravel; wet

OWNER:	General Growth Properties
WELL NO.:	B-31

DEPTH (FEET)		PID (ppm)	RECOVERY (feet)	DESCRIPTION
FROM	TO			
12.0	16.0	0		Red brown f SAND and silt; little gravel; wet (non-reactive with Sudan IV) – refusal (bedrock) at 16'
				E.O.B. at 16'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: General Growth Properties

WELL NO.: B-32

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** PVC **DIAMETER:** 1"
	SLOT NO.: #10 **SETTING:** 7 – 12'
DATE COMPLETED: 5/11/06	**SAND PACK SIZE:** N/A
DRILLING COMPANY: S_2C_2, Inc.	**SETTING:** N/A
	CASING TYPE: PVC **DIAMETER:** 1"
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** 0 – 7'
SAMPLING METHOD: Macro-Core w/ Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Jonas Holliss	**SETTING:** N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE:** Bentonite
ELEVATION OF RP:	**STATIC WATER LEVEL:** 7.86' **DATE:** 5/12/06
SURFACE COMPLETION: PVC removed, boring filled with Bentonite, asphalt on top.	**DEVELOPMENT METHOD:** Purge
	DURATION: 20 min **ESTIMATED YIELD:** < 1 gal
COMMENTS: Temporary Well point installed for single round of ground-water sampling	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET)		PID (ppm)	RECOVERY (feet)	DESCRIPTION
FROM	TO			
0.0	0.8	0		Black asphalt; dry
0.8	1.7	0		Black GRAVEL sub-grade; dry
1.7	2.1	0		Light gray GRAVEL sub-grade; wet
2.1	5.5	0		Red brown f SAND and silt; little clay; moist
5.5	5.8	0		Red brown mf SAND; clean; moist
5.8	6.0	0		Red brown f SAND; clean; wet at 5.8'
6.0	6.9	0		Red brown f SAND and silt; some clay; wet
6.9	7.0	0		Orange brown GRAVEL and c sand; wet
7.0	8.8	0.2		Red brown f SAND and silt; some clay; wet
8.8	9.2	0		Red brown GRAVEL and silt; wet
9.2	10.7	0		Red brown f SAND and silt; some clay; wet

OWNER:	General Growth Properties	
WELL NO.:	B-32	PAGE: 2 OF 2 PAGES

DEPTH (FEET)		PID (ppm)	RECOVERY (feet)	DESCRIPTION
FROM	TO			
10.7	10.9	0		Dark brown cm SAND and silt; wet
10.9	12.0	0		Red brown f SAND and silt; some clay; wet (non-reactive to Sudan IV) – refusal (bedrock) at 12'
				E.O.B. at 12'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: General Growth Properties

WELL NO.: B-33

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: N/A **SETTING:** N/A
DATE COMPLETED: 5/12/06	**SAND PACK SIZE:** N/A
DRILLING COMPANY: S_2C_2, Inc.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push – Hand-held	**SETTING:** N/A
SAMPLING METHOD: Macro-Core w/ Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Jonas Holliss	**SETTING:** N/A
REFERENCE POINT (RP): Dry Cleaner Floor	**BACKFILL TYPE:** Bentonite
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Borehole backfilled with bentonite and top covered with concrete	**DEVELOPMENT METHOD:** N/A
	DURATION: **ESTIMATED YIELD:**

COMMENTS: Borehole drilled through floor in Dry Cleaners. Bedrock not reached due to equipment limitations. The floor is approximately 4.8' above the asphalt directly outside of the building.

ABBREVIATIONS: C = Coarse, M = Medium, F = Fine

DEPTH (FEET) FROM	TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0		Concrete and sub-grade
1.0	1.8	0		Orange brown m SAND; clean; dry
1.8	4.3	0		Red brown f SAND and silt; some clay; little gravel; moist
4.3	4.4	0		Dark gray GRAVEL (quartz and basalt); dry
4.4	4.7	0		Brown f SAND and silt; little clay; dry
4.7	5.0	0		Light brown SILT and f sand; little clay; dry
5.0	7.0	0		Light brown SILT and f sand; orange iron-staining and mottling at 6.3-6.7'; dry (non-reactive to Sudan IV)
7.0	7.5	0		Red brown mf SAND; little silt; dry
7.5	8.0	0		Red brown mf SAND; some clay; moist

OWNER:	General Growth Properties
WELL NO.:	B-33

DEPTH (FEET)		PID (ppm)	RECOVERY (feet)	DESCRIPTION
FROM	TO			
8.0	9.2	0		Red brown CLAY; little f sand; trace gravel; moist
9.2	10.0	0		Red brown SILT and clay; little f sand; moist
10.0	13.0	0		Red brown SILT and clay; some f sand; moist (non-reactive to Sudan IV) – Driller could not get deeper due to physical limitations of hand equipment.
				E.O.B. at 13'

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

BORING ID: SB-1

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: NA **SETTING:** N/A
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** NA
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**:
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	2.6	3.5	Black Asphalt and Subbase; dry
1.0	3.0	2.2		Red/brown F-M SAND; little silt; dry to moist
3.0	4.0	0.7		Red/brown F-M SAND; little silt; very moist
4.0	5.0	0.3		Red/brown F-M SAND; some silt; very moist at 4.5’
5.0	6.0	0.3	2.1	Red/brown F-M SAND; some silt; very moist
6.0	6.5	0.3		Red/brown F-M SAND; some silt; little clay; very moist
6.5	8.0	0.3		Red/brown F SAND and M-C rounded gravel; some silt; saturated
				Refusal at 8.0’, E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

BORING ID: SB-2

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: NA **SETTING:** N/A
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** NA
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**:
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	2.9	4.6	Black and gray Gravel and Asphalt; dry
1.0	2.0	1.4		Fill; Red/brown F SAND and SILT; dry
2.0	3.0	0.0		Red/brown F SAND; little F-M-C subrounded gravel; dry
3.0	5.0	0.0		Red/brown SAND; some F-M-C subrounded gravel; dry
5.0	6.0	0.0		Red/brown SAND; with gray cobble; moist
				Refusal at 6.0', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

BORING ID: SB-3

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: NA **SETTING:** N/A
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** NA
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**:
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0.5		Black Asphalt and Subbase; dry
1.0	3.0	0.0		Red/brown F SAND and SILT; with gray sub angular pebbles; dry
				Refusal at 3.0', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-4

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: N/A **SETTING:** N/A
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** N/A
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0.0	1.2	Black Asphalt and Subbase; dry
1.0	5.0	40.0		Red/brown F SAND and SILT; with F-M-C subangular gravel; dry * Cobble lodged in macro core at 1.2’
5.0	5.5	2.8	2.8	Red/brown F SAND and SILT; very moist
5.5	6.0	1.0		Red/brown F SAND and SILT; saturated
6.0	7.0	0.2		Red/brown F SAND and SILT; trace clay with brown mottling; saturated
7.0	8.5	0.3		Red/brown F SAND and SILT; trace clay; very tight; saturated
8.5	9.0	0.1		Red/brown F SAND and SILT; very tight; some F-M-C gravel; saturated
				Refusal at 9.0’, E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-5

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: N/A **SETTING:** N/A'
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** N/A
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0.5	3.3	Black Asphalt and Subbase; dry
1.0	3.5	2.0		Red/brown F SAND and SILT; with F-M-C subrounded gravel; dry
3.5	5.0	5.3		Red/brown F SAND; with F-M-C subrounded gravel; moist
5.0	6.0	16.0	3.2	Red/brown F SAND and SILT; F-M-C gravel; moist
6.0	7.5	4.8		Red/brown F SAND and SILT; F-M-C gravel; very moist
7.5	8.5	4.2		Red/brown F SAND and SILT; M-C gravel; very tight; moist
				Refusal at 8.5', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-6

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: N/A **SETTING:** N/A'
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** N/A
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0.3	4.3	Black Asphalt and Subbase; dry
1.0	4.0	16.7		Brown F-M SAND and SILT; F-M-C subangular gravel; little gray clay seams; tight; dry
4.0	5.0	9.1		Red/brown F SAND and SILT; some M-C subrounded gravel; some grey brown clay pockets (possibly varved); tight; moist
5.0	6.5	2.9	2.4	Red/brown F SAND and SILT; with F-M rounded gravel; trace cobbles; very moist
6.5	7.5	3.7		Red/brown F SAND and SILT; with F-M rounded gravel; trace cobbles; very tight; slightly moist
7.5	9.0	--		*Cobble in shoe at 7.5
				Refusal at 9.0', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-7

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/20/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 0.5’ Asphalt; PID= 0.0 0.5 – 2’ Subbase (large angular gravel w/ fines); PID= 0.6 2 – 5’ Light brown F SILT; some F sand; w/ subangular F-M-C rounded gravel; dry; PID= 3.0 @ 5 ft.
5	7	SS	11-16-16-15	0.8	Red/brown SILT and F SAND; with F-M-C rounded gravel; some clay; moist at 7’; PID= 0.0
7	9	SS	18-15-11-28	1.1	7 – 8’ Red/brown SILT and F-M SAND; with F-M-C rounded gravel; saturated; PID= 0.0 8 – 9’ Red/brown F-M-C SAND; with F-M-C rounded gravel; some silt; saturated; PID= 0.0
9	11	SS	4-5-8-12	1.2	Red/brown SILT; some F-M-C sand; some F-M-C gravel; some clay; very moist; PID= 0.2 @ 9’ and 0.0 from 9.5’ – 11’

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-7 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
11	13	SS	27-20-32-50/5	1.2	11 - 12' Red/brown SILT and CLAY; with F rounded gravel; very tight; moist; PID= 0.0 12 - 12.5' Red/brown SILT and CLAY; with F-M rounded gravel; some F-M Sand; tight; moist; PID=0.0 12.5 – 13' Red/brown SILT and F-M SAND; with F-M-C rounded gravel; some clay; saturated; PID= 0.0
13	15	SS	5-19-24-48	1.0	M-C SAND; w/ F-M-C gravel; some cobbles; little fines; saturated; PID= 0.0
15	16	SS	28-15/4	0.5	Red/brown SILT and F SAND; with F rounded gravel; tight; moist; PID= 0.0
16	17	SS	50-50/1	0.2	Rock fragments (boulder or bedrock)
					AUGER REFUSAL @ 17', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-8

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/21/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 1’ Asphalt; PID= 0.0 1 – 3’ Subbase; PID= 0.0 3 – 5’ Light brown SILT and F SAND; some F-M-C rounded gravel; dry; PID= 0.0
5	7	SS	18-19-28-32	0.7	Red/brown SILT and F SAND; some F subrounded gravel; moist; PID= 0.0
7	9	SS	17-13-11-14	0.3	Red/brown SILT and F SAND; some F subrounded gravel; saturated; PID= 0.0
9	11	SS	50/2	0.0	No Recovery
11	13	SS	8-15-20-22	1.3	Red/brown C SAND and F-M-C GRAVEL; with red/brown fines; saturated; PID= 0.0
13	15	SS	22-29-20-15	1.3	F-M SAND; saturated; PID= 0.0

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-8 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET) FROM	DEPTH (FEET) TO	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
15	17	SS	3-6-5-30	1.3	15 – 16.5' F-M SAND; with fines; some F-M-C rounded gravel; saturated; PID= 0.0 ½" wood fiber layer (construction debris) @ 16'. 16.5 – 17' Weathered Rock in SILT with CLAY; PID= 0.0
17	18	SS	25-100/4	0.3	17 – 18' F-M SAND; with wood fibers; saturated; PID= 0.0 18' Bedrock
					AUGER REFUSAL @ 18', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-9

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/20/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 1’ Asphalt; PID= 0.0 1 – 3’ Subbase (large stone); PID= 0.0 3 – 5’ Light brown SILT and F SAND; some F-M-C subrounded gravel; dry; PID= 0.0
5	7	SS	10-17-12-8	1.0	Red/brown SILT; some F-M-C subangular to subrounded gravel; slightly moist; PID= 0.0
7	9	SS	5-7-5-8	0.9	Red/brown SILT and F-M-C subangular to subrounded GRAVEL; some cobbles; moist; PID= 0.0
9	11	SS	10-19-5-5	0.5	Red/brown SILT and F-M Sand; trace F rounded gravel; saturated; PID= 0.0
11	13	SS	11-28-20-50/4	0.4	Red/brown SILT; some F rounded gravel; very tight; barely moist; PID= 0.0

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-9 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
13	15	SS	50/3	0	No Recovery
15	17	SS	50/4	0.3	No Recovery; Weathered Rock
					AUGER REFUSAL @ 16', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-10

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/21/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 1’ Asphalt; PID= 0.0 1 – 3’ Subbase (large stone); PID= 0.0 3 – 5’ Light brown SILT and F SAND; some F-M-C subrounded gravel; dry; PID= 0.0
5	7	SS	7-17-32-19	0	No Recovery, lost split spoon nose in hole.
7	9	SS	23-27-12-8	0.5	Red/brown SILT and F SAND; some F-M-C subrounded gravel; very moist; PID= 0.0
9	11	SS	19-9-5-9	0.9	Red/brown SILT and F SAND; some F-M subrounded gravel; little cobbles; saturated; PID= 0.0
11	13	SS	15-24-31-50/4	0.6	Red/brown SILT and F-M SAND; some F rounded gravel; some C subrounded gravel and cobbles; saturated; PID= 0.0

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-10 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
13	15	SS	100/3	0.1	13 – 13.5' Cobble in nose of spoon; smear of clayey SILT and F SAND Weathered Rock
15	17	SS	100/0	0	No Recovery; Bedrock
					AUGER REFUSAL @ 15.25', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall	
WELL NO.: SB-11	
PAGE: 1 **of** 2 **PAGES**	
SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/21/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 1’ Asphalt; PID= 0.0 1 – 3’ Subbase (large stone); PID= 0.0 3 – 5’ Light brown SILT and F SAND; some F-M-C subrounded gravel; dry; PID= 0.0
5	7	SS	31-28-30-33	0.9	Red/brown SILT and F SAND; some F-M-C subangular to subrounded gravel and cobbles; slightly moist; PID= 3.5 @ 5’
7	9	SS	10-12-7-7	1.3	Red/brown SILT and F SAND; some F-M-C subrounded gravel and cobbles; moist; PID= 1.5 @ 7’ and 0.0 @ 9’
9	11	SS	15-50/4	0.2	Red/brown SILT and F SAND; some F-M subrounded gravel; little cobbles; very moist; PID= 0.0
11	13	SS	50/4	0.1	Red/brown SILT; some F rounded gravel; very tight; barely moist; PID= 0.0

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-11 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
13	15	SS	75-85-109-122	1.0	13 – 14.5' Red/brown SILT and F-M-C SAND; some F rounded gravel; saturated; PID= 0.0 14.5 – 15' Weathered bedrock; some Red/brown SILT and F SAND
					AUGER REFUSAL @ 15', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

BORING ID: SB-1

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: NA **SETTING:** N/A
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** NA
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**:
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	2.6	3.5	Black Asphalt and Subbase; dry
1.0	3.0	2.2		Red/brown F-M SAND; little silt; dry to moist
3.0	4.0	0.7		Red/brown F-M SAND; little silt; very moist
4.0	5.0	0.3		Red/brown F-M SAND; some silt; very moist at 4.5’
5.0	6.0	0.3	2.1	Red/brown F-M SAND; some silt; very moist
6.0	6.5	0.3		Red/brown F-M SAND; some silt; little clay; very moist
6.5	8.0	0.3		Red/brown F SAND and M-C rounded gravel; some silt; saturated
				Refusal at 8.0’, E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

BORING ID: SB-2

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: NA **SETTING:** N/A
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** NA
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**:
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	2.9	4.6	Black and gray Gravel and Asphalt; dry
1.0	2.0	1.4		Fill; Red/brown F SAND and SILT; dry
2.0	3.0	0.0		Red/brown F SAND; little F-M-C subrounded gravel; dry
3.0	5.0	0.0		Red/brown SAND; some F-M-C subrounded gravel; dry
5.0	6.0	0.0		Red/brown SAND; with gray cobble; moist
				Refusal at 6.0', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

BORING ID: SB-3

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: NA **SETTING:** N/A
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** NA
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**:
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0.5		Black Asphalt and Subbase; dry
1.0	3.0	0.0		Red/brown F SAND and SILT; with gray sub angular pebbles; dry
				Refusal at 3.0', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-4

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: N/A **SETTING:** N/A
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** N/A
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0.0	1.2	Black Asphalt and Subbase; dry
1.0	5.0	40.0		Red/brown F SAND and SILT; with F-M-C subangular gravel; dry * Cobble lodged in macro core at 1.2’
5.0	5.5	2.8	2.8	Red/brown F SAND and SILT; very moist
5.5	6.0	1.0		Red/brown F SAND and SILT; saturated
6.0	7.0	0.2		Red/brown F SAND and SILT; trace clay with brown mottling; saturated
7.0	8.5	0.3		Red/brown F SAND and SILT; trace clay; very tight; saturated
8.5	9.0	0.1		Red/brown F SAND and SILT; very tight; some F-M-C gravel; saturated
				Refusal at 9.0’, E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-5

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: N/A **SETTING:** N/A'
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** N/A
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0.5	3.3	Black Asphalt and Subbase; dry
1.0	3.5	2.0		Red/brown F SAND and SILT; with F-M-C subrounded gravel; dry
3.5	5.0	5.3		Red/brown F SAND; with F-M-C subrounded gravel; moist
5.0	6.0	16.0	3.2	Red/brown F SAND and SILT; F-M-C gravel; moist
6.0	7.5	4.8		Red/brown F SAND and SILT; F-M-C gravel; very moist
7.5	8.5	4.2		Red/brown F SAND and SILT; M-C gravel; very tight; moist
				Refusal at 8.5', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-6

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: Staten Island, New York	**SCREEN TYPE:** N/A **DIAMETER:** N/A
	SLOT NO.: N/A **SETTING:** N/A'
DATE COMPLETED: 5/12/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:** N/A
DRILLING METHOD: Geoprobe Direct Push	**SETTING:** N/A
SAMPLING METHOD: Acetate Sleeve	**SEAL TYPE:** N/A
OBSERVER: Eric S Ricci	**SETTING**: N/A
REFERENCE POINT (RP): Ground Level	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:** N/A
SURFACE COMPLETION: Asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:** N/A
COMMENTS:	
ABBREVIATIONS: C = Coarse, M = Medium, F = Fine	

DEPTH (FEET) FROM	DEPTH (FEET) TO	PID (ppm)	RECOVERY (feet)	DESCRIPTION
0.0	1.0	0.3	4.3	Black Asphalt and Subbase; dry
1.0	4.0	16.7		Brown F-M SAND and SILT; F-M-C subangular gravel; little gray clay seams; tight; dry
4.0	5.0	9.1		Red/brown F SAND and SILT; some M-C subrounded gravel; some grey brown clay pockets (possibly varved); tight; moist
5.0	6.5	2.9	2.4	Red/brown F SAND and SILT; with F-M rounded gravel; trace cobbles; very moist
6.5	7.5	3.7		Red/brown F SAND and SILT; with F-M rounded gravel; trace cobbles; very tight; slightly moist
7.5	9.0	--		*Cobble in shoe at 7.5
				Refusal at 9.0', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-7

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/20/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 0.5’ Asphalt; PID= 0.0 0.5 – 2’ Subbase (large angular gravel w/ fines); PID= 0.6 2 – 5’ Light brown F SILT; some F sand; w/ subangular F-M-C rounded gravel; dry; PID= 3.0 @ 5 ft.
5	7	SS	11-16-16-15	0.8	Red/brown SILT and F SAND; with F-M-C rounded gravel; some clay; moist at 7’; PID= 0.0
7	9	SS	18-15-11-28	1.1	7 – 8’ Red/brown SILT and F-M SAND; with F-M-C rounded gravel; saturated; PID= 0.0 8 – 9’ Red/brown F-M-C SAND; with F-M-C rounded gravel; some silt; saturated; PID= 0.0
9	11	SS	4-5-8-12	1.2	Red/brown SILT; some F-M-C sand; some F-M-C gravel; some clay; very moist; PID= 0.2 @ 9’ and 0.0 from 9.5’ – 11’

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-7 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
11	13	SS	27-20-32-50/5	1.2	11 - 12' Red/brown SILT and CLAY; with F rounded gravel; very tight; moist; PID= 0.0 12 - 12.5' Red/brown SILT and CLAY; with F-M rounded gravel; some F-M Sand; tight; moist; PID=0.0 12.5 – 13' Red/brown SILT and F-M SAND; with F-M-C rounded gravel; some clay; saturated; PID= 0.0
13	15	SS	5-19-24-48	1.0	M-C SAND; w/ F-M-C gravel; some cobbles; little fines; saturated; PID= 0.0
15	16	SS	28-15/4	0.5	Red/brown SILT and F SAND; with F rounded gravel; tight; moist; PID= 0.0
16	17	SS	50-50/1	0.2	Rock fragments (boulder or bedrock)
					AUGER REFUSAL @ 17', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-8

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/21/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 1’ Asphalt; PID= 0.0 1 – 3’ Subbase; PID= 0.0 3 – 5’ Light brown SILT and F SAND; some F-M-C rounded gravel; dry; PID= 0.0
5	7	SS	18-19-28-32	0.7	Red/brown SILT and F SAND; some F subrounded gravel; moist; PID= 0.0
7	9	SS	17-13-11-14	0.3	Red/brown SILT and F SAND; some F subrounded gravel; saturated; PID= 0.0
9	11	SS	50/2	0.0	No Recovery
11	13	SS	8-15-20-22	1.3	Red/brown C SAND and F-M-C GRAVEL; with red/brown fines; saturated; PID= 0.0
13	15	SS	22-29-20-15	1.3	F-M SAND; saturated; PID= 0.0

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-8 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET) FROM	DEPTH (FEET) TO	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
15	17	SS	3-6-5-30	1.3	15 – 16.5' F-M SAND; with fines; some F-M-C rounded gravel; saturated; PID= 0.0 ½" wood fiber layer (construction debris) @ 16'. 16.5 – 17' Weathered Rock in SILT with CLAY; PID= 0.0
17	18	SS	25-100/4	0.3	17 – 18' F-M SAND; with wood fibers; saturated; PID= 0.0 18' Bedrock
					AUGER REFUSAL @ 18', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-9

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/20/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 1’ Asphalt; PID= 0.0 1 – 3’ Subbase (large stone); PID= 0.0 3 – 5’ Light brown SILT and F SAND; some F-M-C subrounded gravel; dry; PID= 0.0
5	7	SS	10-17-12-8	1.0	Red/brown SILT; some F-M-C subangular to subrounded gravel; slightly moist; PID= 0.0
7	9	SS	5-7-5-8	0.9	Red/brown SILT and F-M-C subangular to subrounded GRAVEL; some cobbles; moist; PID= 0.0
9	11	SS	10-19-5-5	0.5	Red/brown SILT and F-M Sand; trace F rounded gravel; saturated; PID= 0.0
11	13	SS	11-28-20-50/4	0.4	Red/brown SILT; some F rounded gravel; very tight; barely moist; PID= 0.0

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-9 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
13	15	SS	50/3	0	No Recovery
15	17	SS	50/4	0.3	No Recovery; Weathered Rock
					AUGER REFUSAL @ 16', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall

WELL NO.: SB-10

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/21/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 1’ Asphalt; PID= 0.0 1 – 3’ Subbase (large stone); PID= 0.0 3 – 5’ Light brown SILT and F SAND; some F-M-C subrounded gravel; dry; PID= 0.0
5	7	SS	7-17-32-19	0	No Recovery, lost split spoon nose in hole.
7	9	SS	23-27-12-8	0.5	Red/brown SILT and F SAND; some F-M-C subrounded gravel; very moist; PID= 0.0
9	11	SS	19-9-5-9	0.9	Red/brown SILT and F SAND; some F-M subrounded gravel; little cobbles; saturated; PID= 0.0
11	13	SS	15-24-31-50/4	0.6	Red/brown SILT and F-M SAND; some F rounded gravel; some C subrounded gravel and cobbles; saturated; PID= 0.0

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-10 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
13	15	SS	100/3	0.1	13 – 13.5' Cobble in nose of spoon; smear of clayey SILT and F SAND Weathered Rock
15	17	SS	100/0	0	No Recovery; Bedrock
					AUGER REFUSAL @ 15.25', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
6 Arrow Road, Suite 103
Ramsey, New Jersey 07446
www.lbgweb.com

OWNER: Rouse Staten Island Mall	
WELL NO.: SB-11	
PAGE: 1 **of** 2 **PAGES**	
SITE LOCATION: Platinum Ave, Staten Island NY	**SCREEN TYPE:** N/A **DIAMETER:**
	SLOT NO.: N/A **SETTING:**
DATE COMPLETED: 7/21/11	**SAND PACK SIZE:** N/A
DRILLING COMPANY: Summit Drilling Co.	**SETTING:** N/A
	CASING TYPE: N/A **DIAMETER:**
DRILLING METHOD: Hollow Stem Auger	**SETTING:** N/A
SAMPLING METHOD: Split spoon	**SEAL TYPE:** N/A
OBSERVER: Spiros Zois	**SETTING**: N/A
REFERENCE POINT (RP): grade	**BACKFILL TYPE**: N/A
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: asphalt patch	**DEVELOPMENT METHOD**: N/A
	DURATION: N/A **ESTIMATED YIELD:**
COMMENTS:	
ABBREVIATIONS: SS = split spoon C = cuttings F-M-C = Fine, Medium, Coarse	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	Airknife	-	-	0 – 1’ Asphalt; PID= 0.0 1 – 3’ Subbase (large stone); PID= 0.0 3 – 5’ Light brown SILT and F SAND; some F-M-C subrounded gravel; dry; PID= 0.0
5	7	SS	31-28-30-33	0.9	Red/brown SILT and F SAND; some F-M-C subangular to subrounded gravel and cobbles; slightly moist; PID= 3.5 @ 5’
7	9	SS	10-12-7-7	1.3	Red/brown SILT and F SAND; some F-M-C subrounded gravel and cobbles; moist; PID= 1.5 @ 7’ and 0.0 @ 9’
9	11	SS	15-50/4	0.2	Red/brown SILT and F SAND; some F-M subrounded gravel; little cobbles; very moist; PID= 0.0
11	13	SS	50/4	0.1	Red/brown SILT; some F rounded gravel; very tight; barely moist; PID= 0.0

OWNER:	Rouse Staten Island Mall
WELL NO.:	SB-11 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
13	15	SS	75-85-109-122	1.0	13 – 14.5' Red/brown SILT and F-M-C SAND; some F rounded gravel; saturated; PID= 0.0 14.5 – 15' Weathered bedrock; some Red/brown SILT and F SAND
					AUGER REFUSAL @ 15', E.O.B.

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-1

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 6/1/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 14'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:**9.46 ftbtopvc **DATE:** 6/1/2017
SURFACE COMPLETION: Temporary Well	

COMMENTS: Stick up: 1' ag

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million ftbtopvc = Feet below top of PVC, ag= Above Grade

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	1.1	0-5'Asphalt and Subbase, no recovery after.
5	10	MC	N/A	1.4	5-10'Red Brown Silt and f Sand; f m c
					subround gravel; some cobbles; very moist.
10	15	MC	N/A	3.15	10-12' Highly weathered rock; red brown Silt
					and f Sand; with f m rounded gravel; some f m
					gravel and cobbles (weathered bedrock);
					moist.
					12-14' Weathered Bedrock; Red Brown SILT
					with f m gravel and cobble (weathered
					bedrock); moist; tight.
					-EOB Refusal at 14'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-2

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 6/1/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 13'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE**: Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET) FROM	DEPTH (FEET) TO	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	5	MC	N/A	2.0	0-1' Asphalt and Subbase.
					1-5' Red Brown Silt and f Sand; with f m c
					subangular gravel; barley moist.
5	10	MC	N/A	2.3	5-6' Red Brown Silt and f Sand; with f m c
					subangular gravel; little cobble; barley moist;
					tight.
					6-6.5' Weathered Bedrock Cobble.
					6.5-10' Red Brown Silt and f Sand; with f m c
					subangular gravel and weathered bedrock;
					some cobbles; dry; at 10' weathered bedrock
					cobble.

OWNER: GGP Staten Island Mall

BORING NO.: SWB-2 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
10	15	MC	N/A	2.3	10-10.5' Weather Bedrock Cobble.
					10.5-13' Red Brown Silt and f Sand; with f m c
					subangular gravel and weathered bedrock;
					some cobbles; dry; at 13' weathered bedrock
					cobble.
					-EOB Refusal at 15'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-3

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 6/1/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 13'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	3.4	0-1' Asphalt and Subbase.
					1-3' Red Brown f m c Sand and Silt; with
					subangular f m c gravel; very tight; slightly
					moist.
					3-5' Weathered Bedrock; cobble at 5'.
5	10	MC	N/A	4.0	5-10' Red Brown f Sand and Silt; f m c
					subangular gravel and weathered bedrock;
					tight; moist; bedrock cobble at 7.5'.
10	15	MC	N/A	1.8	10-12.5' Red Brown f Sand and Silt; f m c
					subangular f m c gravel; very tight; slightly
					moist.

OWNER: GGP Staten Island Mall

BORING NO.: SWB-3 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					12.5-13' Weathered Bedrock.
					-EOB Refusal at 15'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-4

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 6/1/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 8'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	2.3	0-1' Asphalt and Subbase.
					1-5' Red Brown Silt and f Sand; with f m c
					gravel and cobbles; subround weathered
					bedrock; tight; moist; cobble at 2'.
5	10	MC	N/A	2.4	5-7' Red Brown Silt and f Sand; with f m c
					gravel and cobbles; subround weathered
					bedrock; tight; moist.
					7-8' Weathered Bedrock; c gravel and cobbles.
					-EOB Refusal at 8'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-5

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 6/1/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 5'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET) FROM	DEPTH (FEET) TO	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	5	MC	N/A	4.1	0-0.8' Asphalt and Subbase.
					0.8-4.2' Red Brown f m Sand and Silt; with
					f m c subrounded gravel; little f m c cobbles;
					tight; barley moist.
					4.2-5' Weathered Bedrock; green f Sand
					and Silt; with f m c gravel and cobbles; barely
					moist.
					-EOB Refusal at 5'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-6

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 5/31/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 3'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	
COMMENTS:	
ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	2.5	0-0.8' Asphalt and Subbase.
					0.8-1.5' Red Brown Silt and f Sand; some
					f subround gravel; little clay; moist.
					1.5'-3.0' Light Brown Silt and f Sand; with
					f m c subangular gravel; weathered bedrock
					cobbles; tight; dry.
					-EOB Refusal at 3'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-7

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 6/1/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 10'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:** 7.39 ftbtopvc **DATE:** 6/1/2017
SURFACE COMPLETION: Temporary Well	

COMMENTS: Stickup height: 3.25' ag

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million ftbtopvc = Feet below top of PVC, ag= Above Grade

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	3.5	0-1' Asphalt and Subbase.
					1-1.5' Red Brown f m c Sand and Silt; with
					f m c subangular gravel; dry.
					1.5-5' Red Brown f m c Sand and Silt; with
					f m c subangular gravel; cobble at 1.5';
					little weathered bedrock; tight; moist.
5	10	MC	N/A	4.1	5-6.5' f m c GRAVEL; with f m c sand and silt;
					saturated; cobble at 6.5'.
					6.5-10' Red Brown Silt and Clay; with
					f m c sand; little subround f m c gravel; little
					weathered bedrock.
					-EOB Refusal at 10'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-8

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 6/1/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 10'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	
COMMENTS:	
ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	3.7	0-1' Asphalt and Subbase.
					1-5' Red Brown Silt and f Sand; some f m c
					subangular gravel; some weathered bedrock;
					weathered bedrock cobble at 2.5' and 5'.
					At 1.2' PID=1.2
5	10	MC	N/A	3.2	Red Brown Silt and f Sand; some f m c
					subangular gravel; some weathered bedrock;
					tight; from 5-8' moist; from 8-10' dry. At 5'
					bedrock cobble.
					-EOB Refusal at 10'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-9

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 5/31/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 6'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	4.5	0-1' Asphalt and Subbase. At 0' PID=0.8
					1-5' Red Brown Silt and f Sand; with f m c
					subround-subangular gravel; little cobbles;
					some weathered bedrock; tight; moist.
5	10	MC	N/A	1	5-6' Red Brown Silt and f Sand; with f m c
					subround-subangular gravel; little cobbles;
					weathered bedrock; tight; dry.
					-EOB Refusal at 6'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-10

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Back of building, parallel to Marsh Ave.
DATE COMPLETED: 6/2/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 12'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	4.1	0-2' Asphalt and Subbase. At 0' PID=4.1; At 1'
					PID=0.3; At 3' PID=1.5
					2-3' Red Brown f m c Sand and Silt; with f m c
					angular gravel; tight; slightly moist.
					3-5' Red Brown f m c Sand and Silt; with f m c
					angular gravel; tight; slightly moist.
5	10	MC	N/A	4.8	5-7' Red Brown f m c Sand and Silt; with f m c
					angular gravel; little weathered bedrock; tight;
					slightly moist.
					7-10' Red Brown f m c Sand and Silt; with
					f m c angular gravel; with weathered bedrock;

OWNER: GGP Staten Island Mall

BORING NO.: SWB-10 **PAGE: 2 OF 2 PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					tight; slightly moist.
10	15	MC	N/A	1.2	10-11' Red Brown f m c Sand and Silt; with
					f m c angular gravel; with weathered bedrock;
					some clay; tight; slightly moist.
					11-12' Light Brown Silt and Clay; some f m c
					rounded gravel; some gravel and cobbles
					(weathered bedrock); little f sand; from
					11.5-12' saturated.
					-EOB Refusal at 12'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-11

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Parallel to Platinum Ave
DATE COMPLETED: 5/31/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 12'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	
COMMENTS:	
ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million	

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	2.7	0-1.0' Asphalt and Subbase.
					1.0-2.5' Red Brown f SAND; some silt; little
					f rounded gravel; dry.
					2.5-5.0' Red Brown f Sand and Silt; with f m c
					subround gravel; some cobbles; tight; moist.
5	10	MC	N/A	4.4	5-6' Red Brown f Sand and Silt; with f m c
					subround gravel; some cobbles; tight; very
					moist.
					6-7' Red Brown f Sand and Silt; with f m c
					subangular gravel and cobble; very tight;
					moist.

OWNER: GGP Staten Island Mall

BORING.: SWB-11 **PAGE: 2 OF 2 PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					7-10' Red Brown f m Sand and Silt; with
					f m c subangular gravel; weathered bedrock;
					tight; dry; cobble at 7'.
10	15	MC	N/A	1.2	10-12' Red Brown f m Sand and Silt; with
					f m c subangular gravel; weathered bedrock;
					tight; dry.
					-EOB Refusal at 12'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-12

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Parallel to Platinum Ave
DATE COMPLETED: 6/2/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 14'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	4.2	0-1' Asphalt and Subbase; At 0' PID= 0.3
					1-2' Red Brown f m c Sand and Silt; with
					m c subangular gravel.
					2-4' Red Brown f m c SAND; with little silt;
					tight.
					4-5' Red Brown f m c Sand and Silt; tight;
					slightly moist.
5	10	MC	N/A	1.0	5-10' Red Brown f m c Sand and Silt; tight;
					slightly moist; cobble at 7.5'.
10	15	MC	N/A	2.0	10-12' Reddish Brown SILT; with some f m c
					sand and subrounded-subangular f m c gravel;

OWNER: GGP Staten Island Mall

BORING NO.: SWB-12 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					very tight; slightly moist.
					12-14' Reddish Brown f m c Sand and Silt;
					with weathered bedrock.
					-EOB Refusal at 14'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-13

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Parallel to Platinum Ave
DATE COMPLETED: 5/31/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 18'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	3.3	0-0.5' Asphalt and Subbase. At 0' PID=0.5
					0.5-3.5' Light Brown SILT; some f sand; little
					f rounded gravel; tight; moist.
					3.5-5.0' Red Brown SILT; with f sand; some
					f m rounded gravel; tight; moist.
5	10	MC	N/A	3.1	5-10' Red Brown SILT; with f sand; with; f m
					round-subround gravel; moist; tight; cobble at
					9'. At 8' PID= 0.4
10	15	MC	N/A	4.9	10-15' Red Brown SILT; with f sand; with; f m c
					round-subround gravel; tight; moist; cobble at
					13'; weathered bedrock at 14'.

OWNER: GGP Staten Island Mall

BORING NO.: SWB-13 **PAGE: 2 OF 2 PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
15	20	MC	N/A	1.5	15-18' Red Brown SILT; with f sand; with;
					f m c round-subround gravel; tight; dry;
					weathered bedrock; slight sulfur smell.
					-EOB Refusal at 18'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-14

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Parallel to Platinum Ave
DATE COMPLETED: 5/31/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 19'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE**: Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	5.0	0-0.5' Asphalt and Subbase.
					0.5-4.0' Fill material. Red Brown SILT; with
					f m sand; some f m rounded gravel; tight;
					moist.
					4-5' Red Brown f m Sand and Silt; very
					wet.
5	10	MC	N/A	4.4	5-6' Fill material; Red Brown Silt and f m Sand;
					with f m subround gravel; little clay; very moist.
					6-9' Red Brown Silt and f Sand; f m round
					gravel; tight; saturated to 7.5'; moist from
					7.5-9'. At 5' PID=1.2; At 6' PID=0.1;

OWNER: GGP Staten Island Mall

BORING NO.: SWB-14 **PAGE: 2 OF 2 PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					At 8' PID=0.2
					9-10' f m c Sand and Silt; some f m rounded
					gravel; little clay; very moist. At 9' PID=0.1'; At
					10' PID=10.6
10	15	MC	N/A	4.1	10-11' Red Brown f m c SAND; some silt;
					saturated. At 10' PID=23.8
					11.0-13.8' Red Brown Silt and Clay; with
					f m c subround gravel; little f sand; very tight;
					moist. At 11' PID=0.5; At 12' PID=0.2
					13.8-15' Red Brown Silt and f m Sand; with
					m rounded gravel; moist; cobble at 14.8-15.0
15	20	MC	N/A	4.8	15-17' Red Brown f m c SAND; some silt;
					some f m gravel; saturated.
					17-19' Red Brown SILT; with f m
					subrounded gravel; some clay; tight ; moist.
					-EOB Refusal at 19'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-15

PAGE: 1 of 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Parallel to Platinum Ave
DATE COMPLETED: 6/2/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 14.5'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:**
ELEVATION OF RP:	**STATIC WATER LEVEL:**8.35ftbtopvc **DATE:** 6/2/2017
SURFACE COMPLETION: Temporary Well	

COMMENTS: Stickup height: 1' ag

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million ftbtopvc= Feet Below Top of PVC, ag= Above Grade

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	3.0	0-2' Asphalt and Subbase.
					2-5' Fill material; Brown Silt and f m c
					Sand; with some f m subrounded gravel.
5	10	MC	N/A	2.9	5-10' Red Brown f m c Sand and Silt; some
					f m c subrounded gravel; tight; moist.
10	15	MC	N/A	3.5	10.0-12.5' Red Brown Clay and Silt; with f m
					rounded gravel; tight; moist.
					12.5-14.5' Red Brown Silt and f m Sand; with
					f m c gravel and cobbles (weathered bedrock);
					At 14.3-14.5' f m c sand and gravel seem;
					saturated at 14' (could be water from top)

OWNER: GGP Staten Island Mall

BORING NO.: SWB-15 **PAGE: 2 OF 2 PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					At 13.0-13.5' Cobbles.
					-EOB Refusal at 14.5'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-16

PAGE: 1 **of** 1 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Parallel to Platinum Ave
DATE COMPLETED: 6/2/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 13'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	2.3	0-2.5' Asphalt and Subbase.
					2.5-5.0' Brown SILT; some f m c subangular
					cobbles and gravel; some clay; tight; moist.
5	10	MC	N/A	1.0	5-10' Red Brown Silt and f Sand; with f m c
					subrounded gravel; moist.
10	15	MC	N/A	0.9	10-10.5' f m c SAND; with silt; with f m
					rounded gravel; (could be sluff from higher
					material).
					10.5-13' Silt and Clay; with subangular to
					subround f m c gravel and cobbles; saturated
					(might be water from top).
					-EOB Refusal at 13'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-17

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Parallel to Platinum Ave
DATE COMPLETED: 6/2/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 18'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET) FROM	DEPTH (FEET) TO	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
0	5	MC	N/A	2.3	0-1' Asphalt and Subbase.
					1-5' Fill material; Brown Silt and f Sand; some
					brick; concrete; wood.
5	10	MC	N/A	2.5	5-10' Red Brown f m c Sand and Silt; with
					subround-subangular f m c gravel; with
					little pockets of grey clay; tight; moist.
10	15	MC	N/A	4.0	10-14' Red Brown f m c Sand and Silt with
					pockets of grey clay; little subrounded f m
					gravel.
					14-15' Red Brown Silt and f m c Sand with
					pockets of grey clay; little subrounded f m c

OWNER: GGP Staten Island Mall

BORING NO.: SWB-17 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					gravel.
15	20	MC	N/A	2.2	15-18' Red Brown f m c Sand and Silt; with
					some f m c rounded to subrounded gravel and
					cobbles; tight; moist.
					-EOB Refusal at 18'-

GEOLOGIC LOG

Leggette, Brashears & Graham, Inc.
600 E. Crescent Ave., Suite 200
Upper Saddle River, New Jersey 07458
www.lbgweb.com

OWNER: GGP Staten Island Mall

SOIL BORING NO.: SWB-18

PAGE: 1 **of** 2 **PAGES**

SITE LOCATION: 280 Marsh Avenue, Staten Island Mall, New York	**BORING LOCATION:** Parallel to Platinum Ave
DATE COMPLETED: 6/2/2017	
DRILLING COMPANY: Cascade	
DRILLING METHOD: Geoprobe	
SAMPLING METHOD: 5' Macro Cores	
OBSERVER: M.Karban, S. Zois	**TOTAL DEPTH OF BORING:** 14'
REFERENCE POINT (RP): Grade	**BACKFILL TYPE:** Cuttings
ELEVATION OF RP:	**STATIC WATER LEVEL:** N/A **DATE:**
SURFACE COMPLETION: Asphalt Patch	

COMMENTS:

ABBREVIATIONS: MC = Macro Core, c = Coarse, m = Medium, f = fine, EOB = End of Boring, ppm = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
0	5	MC	N/A	2.6	0-1' Asphalt and Subbase.
					1-4.8' Fill material; Grey f Sand and Silt; small
					organics.
					4.8-5.0' Brown f SAND fill.
5	10	MC	N/A	3.4	5-9' Red Brown f Sand and Silt; with f m c
					subangular gravel; little subangular cobble.
					9-10' Red Brown Clay and Silt; with f m c
					subangular gravel; tight; slightly moist.
10	15	MC	N/A	3.4	10-12' Red Brown Clay and Silt; with f m c
					subangular gravel; tight; slightly moist.
					12-15' f m c SAND; little f subround gravel;

OWNER: GGP Staten Island Mall

BORING NO.: SWB-18 **PAGE:** 2 **OF** 2 **PAGES**

Leggette, Brashears & Graham, Inc. www.lbgweb.com

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DESCRIPTION
FROM	TO				
					little silt.
15	20	MC	N/A	3.9	15-16' f m c SAND; little f subround gravel;
					little silt.
					16-17.5' Red Brown f Sand and Silt; with f m c
					subangular gravel.
					17.5-17.8' Weathered Bedrock.
					17.8-19' Red Brown f Sand and Silt; with f m c
					subangular gravel; with weathered bedrock;
					moist.
					-EOB Refusal at 19'-

APPENDIX F - HISTORICAL SOIL SAMPLING RESULTS

TABLE 1

STATEN ISLAND MALL - CONVENIENCE CENTER
PLATINUM AVENUE
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, aud October 31, 2002

Boring[1]	B-1		B-2		B-3		B-4		B-5			B-6		
Approximate Depth to Water (ft bg)[2]	6.8		7.9		13.5		10.4		7.2			7.7		NYSDEC TAGMS#4046 Rec. Soil Cleanup Objective
Approximate Depth to Bedrock (ft bg)	12.0		18.5		18.0		14.0		11.5			12.0		
Approximate Bedrock Elevation (ft msl)[3]	18.6		11.9		12.3		16.2		18.9			18.2		
Sample Depth (ft bg)	6	11.5	7.5	18	13	17	10	14	5	6.5	11	7	12	
Tetrachloroethene	2.05[4]	.0082	.0096	.0022	.0027	.0038	.0061	.0023	.410	.0397	.0138	.044	.0322	1.40
Trichloroethene	.109	ND[5]	ND	ND	ND	ND	ND	ND	.0542	.0033	ND	.005	.0085	0.70
Total Organic Carbon	<1,200	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,200	<1,100	<1,100	<1,100	<1,100	NA[6]

Notes:
(1) See Figure 3 for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (ft msl), and projected from grade elevations surveyed for nearby monitor wells.
(4) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(5) Compound not detected.
(6) Not applicable.

TABLE 1 (CONTINUED)

STATEN ISLAND MALL - CONVENIENCE CENTER
PLATINUM AVENUE
STATEN ISLAND, NEW YORK
Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	B-7			B-8		B-9		B-10		B-11		B-12		B-13			
Approximate Depth to Water (ft bg)[2]	9.2			8.7		8.3		7.8		7.8		7.5		12.5			NYSDEC TAGMS #4046 Rec. Soil Cleanup Objective
Approximate Depth to Bedrock (ft bg)	12.5			11.0		11.5		14.5		12.5		12.5		13.5			
Approximate Bedrock Elevation (ft msl)[3]	17.5			18.9		18.8		15.5		17.4		17.7		16.5			
Sample Depth (ft bg)	7	9	12	8	11	8	11	7	14	7	12	7	12	6	12	13	
Tetrachloroethene	ND[4]	.0054[5]	.109	ND	.0049	.0049	ND	.0054	.0073	.0018	ND	.126	ND	.0047	ND	ND	1.40
Trichloroethene	ND	ND	.0217	ND	ND	.0015	ND	ND	ND	ND	ND	.0026	ND	.0024	ND	ND	0.70
Total Organic Carbon	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,100	<1,200	<1,100	2,320	<1,100	<1,100	<1,100	<1,100	NA[6]

Notes:
(1) See Figure 3 for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (ft msl), and projected from grade elevations surveyed for nearby monitor wells.
(4) Compound not detected.
(5) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(6) Not applicable.

TABLE 1 (CONTINUED)

STATEN ISLAND MALL - CONVENIENCE CENTER
PLATINUM AVENUE
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	B-14			B-15		B-16		B-17		B-18		B-19		B-20		
Approximate Depth to Water (ft bg)[2]	9.5			7.7		8.4		8.6		9.5		NOT ENCOUNTERED		NOT ENCOUNTERED		NYSDEC TAGMS #4046 Rec. Soil Cleanup Objective
Approximate Depth to Bedrock (ft bg)	13.5			19.5		13.5		15.5		9.5		8.5		8.5		
Approximate Bedrock Elevation (ft msl)[3]	16.1			10.7		16.5		14.0		31.5		32.0		31.0		
Sample Depth (ft bg)	9	11	13	7	19	8	13	8	15	5	9	7	8	7	8	
Tetrachloroethene	ND[4]	.0021[5]	ND	ND	.0120	ND	ND	ND	.0051	.0204	ND	ND	.0027	ND	ND	1.40
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	.0016	.0020	ND	ND	ND	ND	ND	0.70
Total Organic Carbon	<1,100	<1,100	<1,100	<1,200	<1,100	<1,100	<1,100	<1,100	<1,200	2,860	<1,100	<1,100	<1,100	<1,100	<1,100	NA[6]

Notes:
(1) See Figure 3 for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (ft msl), and projected from grade elevations surveyed for nearby monitor wells.
(4) Compound not detected.
(5) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(6) Not applicable.

TABLE 1 (CONTINUED)

STATEN ISLAND MALL - CONVENIENCE CENTER
PLATINUM AVENUE
STATEN ISLAND, NEW YORK

Summary of Soil Sampling Results
For September 17-20, and October 31, 2002

Boring[1]	B-21		B-22		B-23		B-24		B-25		
Approximate Depth to Water (ft bg)[2]	8.5		7.8		10.5		10.5		7.4		NYSDEC TAGMS #4046 Rec. Soil Cleanup Objective
Approximate Depth to Bedrock (ft bg)	12.5		12.5		16.5		17.5		15.5		
Approximate Bedrock Elevation (ft msl)[3]	17.5		18.2		22.0		20.0		15.3		
Sample Depth (ft bg)	8	12	7	12	10	16	10	17	7	15	
Tetrachloroethene	ND[4]	ND	ND	ND	ND	ND	ND	ND	.0198[5]	ND	1.40
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	.0036	ND	0.70
Total Organic Carbon	<1,100	<1,100	<1,100	<1,100	<1,100	<1,200	<1,100	<1,100	<1,100	<1,100	NA[6]

Notes: (1) See Figure 3 for sample location.
(2) Depth presented in feet below grade (ft bg). Ground-water level determined from soil sample saturation observed in field, or projected from nearby monitor-well data.
(3) Elevation in feet above mean sea level (ft msl), and projected from grade elevations surveyed for nearby monitor wells.
(4) Compound not detected.
(5) Concentrations expressed in milligrams per kilogram [mg/kg, equivalent to parts per million (ppm)].
(6) Not applicable.

TABLE 5
CAROL CLEANERS
Staten Island Mall Convenience Center
Geoprobe Soil Sampling [1] Summary
May 11 - 12, 2006

Compound	B-26 (6.5-7)	B-26 (11.5-12)	B-27 (7.5-8)	B-27 (14.3-14.8)	B-28 (7.5-8)	B-28 (12.5-13)	B-29 (8.8-9.3)	B-29 (12.5-13)	NYSDEC RSCO[2]
PCE	ND[3]	ND	ND	ND	ND	ND	3.1 J[6]	ND	1400
TCE	ND	ND	ND	ND	ND	ND	ND	ND	700
cis-1,2-DCE	2.3 J	22.1	ND	ND	ND	ND	ND	ND	-
Carbon Disulfide	ND	ND	ND	ND	ND	ND	ND	ND	2700
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	5500
Xylene (Total)	ND	ND	ND	ND	ND	ND	ND	ND	1200
2-Butanone (MEK)	ND	ND	ND	ND	ND	ND	ND	ND	300
VOC TIC's	ND	ND	ND	ND	ND	ND	ND	ND	-
TOC [5]	<1100	<1200	<1100	<1100	<1100	<1100	<1200	<1100	

Compound	B-30 (7.7-8.3)	B-30 (14.5-15)	B-31 (4.5-5)	B-31 (15.5-16)	B-32 (5.3-5.8)	B-32 (11.5-12)	B-33 (6.2-6.7)	B-33 (12.5-13)	NYSDEC RSCO[2]
PCE	ND	ND	18.3	ND	ND	ND	5.3 J	30.5	1400
TCE	ND	ND	19.2	ND	ND	ND	ND	4.6 J	700
cis-1,2-DCE	ND	ND	19.8	ND	ND	ND	ND	4.4 J	-
Carbon Disulfide	ND	ND	2.9 J	ND	ND	ND	ND	ND	2700
Ethylbenzene	ND	ND	ND	0.69 J	ND	ND	ND	ND	5500
Xylene (Total)	ND	ND	ND	1.3 J	ND	ND	ND	ND	1200
2-Butanone (MEK)	ND	ND	ND	7.3 J	ND	5.8 J	ND	ND	300
VOC TIC's	ND	ND	13.3	ND	ND	ND	ND	ND	-
TOC [5]	<1100	<1200	2410	<1100	<1200	<1100	<1100	<1100	

NOTES:

(1) See Figure 3 for sample locations. All concentrations are in ug/kg or parts per billion (ppb).

(2) NYSDEC Recommended Soil Cleanup Objectives (ppb).

(3) ND-Not Detected.

(4) **Bold** values exceed the NYSDEC Standards.

(5) Concentrations for TOC are in mg/kg or parts per million (ppm).

(6) J-Estimated concentration

TABLE 2

GGP STATEN ISLAND MALL, LLC.
STATEN ISLAND, NEW YORK

Soil Boring Sampling Results

Boring ID	SB-1	SB-2	SB-4	SB-5			SB-6			SB-7		SB-8		SB-9		SB-10		SB-11		NYSDEC Restricted Use Commercial SCO[3]
Sample Depth (ft bg)	6	4.5	5.5	4.5	5.5	8	1.5	4.5	7	7	16	7	18	9	13	9	15	9	14	
Date Sampled	05/12/11	05/12/11	05/12/11	05/12/11	05/12/11	05/12/11	05/12/11	05/12/11	05/12/11	07/20/11	07/20/11	07/21/11	07/21/11	07/20/11	07/20/11	07/21/11	07/21/11	07/21/11	07/21/11	
Constituent/Compound	Constituent Concentration (mg/kg)[2]																			
Acetone	ND[5]	ND	ND	ND	ND	ND	0.0623	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**44**
Bromobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
2-Butanone (MEK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
n-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00049 J	ND	**500**
sec-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00027 J	0.00067 J	ND	**500**
tert-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**22**
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**350**
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
o-Chorotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
p-Chlorotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,2-Dibromo-3-chloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**280**
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**130**
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**240**
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**30**
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	0.00041 J	ND	ND	ND	ND	0.0045 J	ND	ND	ND	ND	ND	ND	**500**
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,3-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
2,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,1-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Ethylbenzene	ND	ND	ND	ND	ND	ND	0.00051 J[6]	0.00057 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**390**
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
p-Isopropyltoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00052 J	ND	-
Methyl tert butyl ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
4-Methyl-2-pentanone (MIBK)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Methylene bromide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Methylene chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
Naphthalene[4]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0034 J	ND	**500**
n-Propylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00048 J	ND	**500**
Styrene	ND	ND	ND	0.00039 J	ND	ND	0.00038 J	0.00068 J	0.00028 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,1,1,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Tetrachloroethene	ND	ND	ND	ND	ND	0.0054 J	ND	0.0103	ND	0.00058 J	0.0022 J	ND	0.0286	ND	0.00039 J	ND	ND	ND	ND	**150**
Toluene	ND	ND	ND	ND	ND	ND	ND	0.00052 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
1,2,3-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	0.0008 J	ND	ND	ND	ND	0.003 J	ND	ND	ND	ND	ND	ND	**200**
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,2,3-Trichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-
1,2,4-Trimethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0023 J	ND	**190**
1,3,5-Trimethylbenzene	0.00037 J	ND	0.00031 J	0.00024 J	0.00032 J	ND	0.00041 J	0.0004 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00066 J	ND	**190**
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**13**
Xylenes (total)	0.00061 J	ND	0.00061 J	0.00098 J	0.0013	0.00088 J	0.0029	0.0031	0.00054 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**500**

Notes:
(1) See Figure 3.
(2) All concentrations presented in milligrams per kilogram; bold numbers represent exceedance of NYSDEC SCOs.
(3) New York State Department of Environmental Protection (NYSDEC) Soil Cleanup Objectives (SCOs).
(4) Napthalene SCOs are from the semi-volatile organic compound list.
(5) ND - Compound not detected at laboratory detection limits.
(6) J - Estimated value.

Report of Analysis

Client Sample ID:	SB-1 (7FT)		
Lab Sample ID:	JA81768-1	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	91.8
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117692.D	1	07/27/11	AVM	n/a	n/a	VV5013
Run #2							

	Initial Weight
Run #1	4.6 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	7.8	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	5.9	0.23	ug/kg	
74-97-5	Bromochloromethane	ND	5.9	0.61	ug/kg	
75-27-4	Bromodichloromethane	ND	5.9	0.27	ug/kg	
75-25-2	Bromoform	ND	5.9	0.89	ug/kg	
74-83-9	Bromomethane	ND	5.9	0.47	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.1	ug/kg	
104-51-8	n-Butylbenzene	ND	5.9	0.28	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.9	0.19	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.9	0.16	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.9	0.41	ug/kg	
108-90-7	Chlorobenzene	ND	5.9	0.38	ug/kg	
75-00-3	Chloroethane	ND	5.9	0.48	ug/kg	
67-66-3	Chloroform	ND	5.9	0.57	ug/kg	
74-87-3	Chloromethane	ND	5.9	0.74	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.9	0.45	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.9	0.25	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	5.9	0.20	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.28	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.9	0.33	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.9	0.23	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.9	0.20	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.9	0.38	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.9	0.26	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.22	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.9	0.73	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.9	0.38	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.9	0.50	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.9	0.31	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.9	0.44	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-1 (7FT)		
Lab Sample ID:	JA81768-1	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	91.8
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.9	0.20	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.9	0.25	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.9	0.18	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.9	0.40	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.18	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.9	0.62	ug/kg	
98-82-8	Isopropylbenzene	ND	5.9	0.16	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.9	0.35	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.21	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.9	3.1	ug/kg	
74-95-3	Methylene bromide	ND	5.9	0.67	ug/kg	
75-09-2	Methylene chloride	ND	5.9	0.27	ug/kg	
91-20-3	Naphthalene	ND	5.9	1.3	ug/kg	
103-65-1	n-Propylbenzene	ND	5.9	0.41	ug/kg	
100-42-5	Styrene	ND	5.9	0.22	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.9	0.22	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.9	0.21	ug/kg	
127-18-4	Tetrachloroethene	0.58	5.9	0.23	ug/kg	J
108-88-3	Toluene	ND	1.2	0.45	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.9	0.52	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.9	0.40	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.9	0.29	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.9	0.51	ug/kg	
79-01-6	Trichloroethene	ND	5.9	0.29	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.9	0.57	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.9	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.9	1.3	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	5.9	0.15	ug/kg	
75-01-4	Vinyl chloride	ND	5.9	0.55	ug/kg	
	m,p-Xylene	ND	1.2	0.37	ug/kg	
95-47-6	o-Xylene	ND	1.2	0.22	ug/kg	
1330-20-7	Xylene (total)	ND	1.2	0.22	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	111%		67-131%
17060-07-0	1,2-Dichloroethane-D4	105%		66-130%
2037-26-5	Toluene-D8	106%		76-125%
460-00-4	4-Bromofluorobenzene	98%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-1 (7FT)		
Lab Sample ID:	JA81768-1	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	91.8
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	91.8		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	08/03/11 10:57	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-1 (16FT)		
Lab Sample ID:	JA81768-2	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	89.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117693.D	1	07/27/11	AVM	n/a	n/a	VV5013
Run #2							

	Initial Weight
Run #1	4.6 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	8.1	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	6.1	0.24	ug/kg	
74-97-5	Bromochloromethane	ND	6.1	0.63	ug/kg	
75-27-4	Bromodichloromethane	ND	6.1	0.27	ug/kg	
75-25-2	Bromoform	ND	6.1	0.92	ug/kg	
74-83-9	Bromomethane	ND	6.1	0.48	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.3	ug/kg	
104-51-8	n-Butylbenzene	ND	6.1	0.29	ug/kg	
135-98-8	sec-Butylbenzene	ND	6.1	0.19	ug/kg	
98-06-6	tert-Butylbenzene	ND	6.1	0.17	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.1	0.42	ug/kg	
108-90-7	Chlorobenzene	ND	6.1	0.39	ug/kg	
75-00-3	Chloroethane	ND	6.1	0.50	ug/kg	
67-66-3	Chloroform	ND	6.1	0.59	ug/kg	
74-87-3	Chloromethane	ND	6.1	0.76	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.1	0.46	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.1	0.25	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	6.1	0.20	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.29	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.1	0.34	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.1	0.23	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.1	0.21	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.1	0.39	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.1	0.27	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.22	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.1	0.75	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	6.1	0.39	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	6.1	0.52	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.1	0.32	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.1	0.45	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-1 (16FT)		
Lab Sample ID:	JA81768-2	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	89.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.1	0.21	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.1	0.25	ug/kg	
10061-01-5	cis-1,3-Dicbloropropene	ND	6.1	0.19	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.1	0.41	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.18	ug/kg	
87-68-3	Hexachlorobutadiene	ND	6.1	0.63	ug/kg	
98-82-8	Isopropylbenzene	ND	6.1	0.17	ug/kg	
99-87-6	p-Isopropyltoluene	ND	6.1	0.36	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.22	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.1	3.2	ug/kg	
74-95-3	Methylene bromide	ND	6.1	0.69	ug/kg	
75-09-2	Methylene chloride	ND	6.1	0.28	ug/kg	
91-20-3	Napbthalene	ND	6.1	1.3	ug/kg	
103-65-1	n-Propylbenzene	ND	6.1	0.42	ug/kg	
100-42-5	Styrene	ND	6.1	0.23	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.1	0.22	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.1	0.22	ug/kg	
127-18-4	Tetrachloroethene	2.2	6.1	0.23	ug/kg	J
108-88-3	Toluene	ND	1.2	0.46	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	6.1	0.53	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.1	0.42	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.1	0.29	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.1	0.53	ug/kg	
79-01-6	Trichloroethene	ND	6.1	0.30	ug/kg	
75-69-4	Trichlorofluoromethane	ND	6.1	0.59	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.1	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	6.1	1.4	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	6.1	0.15	ug/kg	
75-01-4	Vinyl chloride	ND	6.1	0.56	ug/kg	
	m,p-Xylene	ND	1.2	0.38	ug/kg	
95-47-6	o-Xylene	ND	1.2	0.22	ug/kg	
1330-20-7	Xylene (total)	ND	1.2	0.22	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	112%		67-131%
17060-07-0	1,2-Dichloroethane-D4	107%		66-130%
2037-26-5	Toluene-D8	106%		76-125%
460-00-4	4-Bromofluorobenzene	97%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-1 (16FT)		
Lab Sample ID:	JA81768-2	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	89.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	89.2		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	08/03/11 11:14	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-2 (7FT)		
Lab Sample ID:	JA81768-3	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.0
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117694.D	1	07/27/11	AVM	n/a	n/a	VV5013
Run #2							

	Initial Weight
Run #1	4.5 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	13	8.4	ug/kg	
71-43-2	Benzene	ND	1.3	0.17	ug/kg	
108-86-1	Bromobenzene	ND	6.3	0.25	ug/kg	
74-97-5	Bromochloromethane	ND	6.3	0.66	ug/kg	
75-27-4	Bromodichloromethane	ND	6.3	0.28	ug/kg	
75-25-2	Bromoform	ND	6.3	0.95	ug/kg	
74-83-9	Bromomethane	ND	6.3	0.50	ug/kg	
78-93-3	2-Butanone (MEK)	ND	13	5.5	ug/kg	
104-51-8	n-Butylbenzene	ND	6.3	0.30	ug/kg	
135-98-8	sec-Butylbenzene	ND	6.3	0.20	ug/kg	
98-06-6	tert-Butylbenzene	ND	6.3	0.17	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.3	0.44	ug/kg	
108-90-7	Chlorobenzene	ND	6.3	0.41	ug/kg	
75-00-3	Chloroethane	ND	6.3	0.52	ug/kg	
67-66-3	Chloroform	ND	6.3	0.61	ug/kg	
74-87-3	Chloromethane	ND	6.3	0.79	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.3	0.47	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.3	0.26	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	13	1.9	ug/kg	
124-48-1	Dibromochloromethane	ND	6.3	0.21	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.3	0.30	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.3	0.35	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.3	0.24	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.3	0.21	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.3	0.41	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.3	0.28	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.3	0.23	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.3	0.77	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	6.3	0.41	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	6.3	0.54	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.3	0.34	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.3	0.47	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-2 (7FT)		
Lab Sample ID:	JA81768-3	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.0
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.3	0.22	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.3	0.26	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.3	0.19	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.3	0.42	ug/kg	
100-41-4	Ethylbenzene	ND	1.3	0.19	ug/kg	
87-68-3	Hexachlorobutadiene	ND	6.3	0.66	ug/kg	
98-82-8	Isopropylbenzene	ND	6.3	0.17	ug/kg	
99-87-6	p-Isopropyltoluene	ND	6.3	0.37	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.3	0.23	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.3	3.3	ug/kg	
74-95-3	Methylene bromide	ND	6.3	0.72	ug/kg	
75-09-2	Methylene chloride	ND	6.3	0.29	ug/kg	
91-20-3	Naphthalene	ND	6.3	1.3	ug/kg	
103-65-1	n-Propylbenzene	ND	6.3	0.44	ug/kg	
100-42-5	Styrene	ND	6.3	0.23	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.3	0.23	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.3	0.23	ug/kg	
127-18-4	Tetrachloroethene	ND	6.3	0.24	ug/kg	
108-88-3	Toluene	ND	1.3	0.48	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	6.3	0.55	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.3	0.43	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.3	0.30	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.3	0.55	ug/kg	
79-01-6	Trichloroethene	ND	6.3	0.31	ug/kg	
75-69-4	Trichlorofluoromethane	ND	6.3	0.61	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.3	1.4	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	6.3	1.4	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	6.3	0.16	ug/kg	
75-01-4	Vinyl chloride	ND	6.3	0.58	ug/kg	
	m,p-Xylene	ND	1.3	0.40	ug/kg	
95-47-6	o-Xylene	ND	1.3	0.23	ug/kg	
1330-20-7	Xylene (total)	ND	1.3	0.23	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	115%		67-131%
17060-07-0	1,2-Dichloroethane-D4	110%		66-130%
2037-26-5	Toluene-D8	107%		76-125%
460-00-4	4-Bromofluorobenzene	97%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-2 (7FT)		
Lab Sample ID:	JA81768-3	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	88.0
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	88		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon	3520	1100	mg/kg	1	08/03/11 11:23	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-2 (18FT)		
Lab Sample ID:	JA81768-4	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	81.6
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117695.D	1	07/27/11	AVM	n/a	n/a	VV5013
Run #2							

	Initial Weight
Run #1	4.8 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	13	8.5	ug/kg	
71-43-2	Benzene	ND	1.3	0.17	ug/kg	
108-86-1	Bromobenzene	ND	6.4	0.25	ug/kg	
74-97-5	Bromochloromethane	ND	6.4	0.66	ug/kg	
75-27-4	Bromodichloromethane	ND	6.4	0.29	ug/kg	
75-25-2	Bromoform	ND	6.4	0.96	ug/kg	
74-83-9	Bromomethane	ND	6.4	0.50	ug/kg	
78-93-3	2-Butanone (MEK)	ND	13	5.5	ug/kg	
104-51-8	n-Butylbenzene	ND	6.4	0.30	ug/kg	
135-98-8	sec-Butylbenzene	ND	6.4	0.20	ug/kg	
98-06-6	tert-Butylbenzene	ND	6.4	0.18	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.4	0.44	ug/kg	
108-90-7	Chlorobenzene	ND	6.4	0.41	ug/kg	
75-00-3	Chloroethane	ND	6.4	0.52	ug/kg	
67-66-3	Chloroform	ND	6.4	0.62	ug/kg	
74-87-3	Chloromethane	ND	6.4	0.80	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.4	0.48	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.4	0.27	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	13	1.9	ug/kg	
124-48-1	Dibromochloromethane	ND	6.4	0.21	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.3	0.30	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.4	0.35	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.4	0.25	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.4	0.22	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.4	0.41	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.4	0.28	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.3	0.23	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.4	0.78	ug/kg	
156-59-2	cis-1,2-Dichloroethene	4.5	6.4	0.41	ug/kg	J
156-60-5	trans-1,2-Dichloroethene	ND	6.4	0.54	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.4	0.34	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.4	0.48	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-2 (18FT)		
Lab Sample ID:	JA81768-4	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	81.6
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.4	0.22	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.4	0.27	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.4	0.19	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.4	0.43	ug/kg	
100-41-4	Ethylbenzene	ND	1.3	0.19	ug/kg	
87-68-3	Hexachlorobutadiene	ND	6.4	0.67	ug/kg	
98-82-8	Isopropylbenzene	ND	6.4	0.17	ug/kg	
99-87-6	p-Isopropyltoluene	ND	6.4	0.38	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.3	0.23	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.4	3.4	ug/kg	
74-95-3	Methylene bromide	ND	6.4	0.73	ug/kg	
75-09-2	Methylene chloride	ND	6.4	0.29	ug/kg	
91-20-3	Naphthalene	ND	6.4	1.4	ug/kg	
103-65-1	n-Propylbenzene	ND	6.4	0.44	ug/kg	
100-42-5	Styrene	ND	6.4	0.24	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.4	0.23	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.4	0.23	ug/kg	
127-18-4	Tetrachloroethene	28.6	6.4	0.24	ug/kg	
108-88-3	Toluene	ND	1.3	0.48	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	6.4	0.56	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.4	0.44	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.4	0.31	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.4	0.55	ug/kg	
79-01-6	Trichloroethene	3.0	6.4	0.32	ug/kg	J
75-69-4	Trichlorofluoromethane	ND	6.4	0.62	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.4	1.4	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	6.4	1.4	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	6.4	0.16	ug/kg	
75-01-4	Vinyl chloride	ND	6.4	0.59	ug/kg	
	m,p-Xylene	ND	1.3	0.40	ug/kg	
95-47-6	o-Xylene	ND	1.3	0.23	ug/kg	
1330-20-7	Xylene (total)	ND	1.3	0.23	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	112%		67-131%
17060-07-0	1,2-Dichloroethane-D4	107%		66-130%
2037-26-5	Toluene-D8	107%		76-125%
460-00-4	4-Bromofluorobenzene	97%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-2 (18FT)		
Lab Sample ID:	JA81768-4	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	81.6
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	81.6		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon	< 1200	1200	mg/kg	1	08/03/11 11:38	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-3 (9FT)		
Lab Sample ID:	JA81768-5	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.0
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117696.D	1	07/27/11	AVM	n/a	n/a	VV5013
Run #2							

	Initial Weight
Run #1	4.7 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	8.0	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	6.0	0.24	ug/kg	
74-97-5	Bromochloromethane	ND	6.0	0.63	ug/kg	
75-27-4	Bromodichloromethane	ND	6.0	0.27	ug/kg	
75-25-2	Bromoform	ND	6.0	0.91	ug/kg	
74-83-9	Bromomethane	ND	6.0	0.48	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.2	ug/kg	
104-51-8	n-Butylbenzene	ND	6.0	0.28	ug/kg	
135-98-8	sec-Butylbenzene	ND	6.0	0.19	ug/kg	
98-06-6	tert-Butylbenzene	ND	6.0	0.17	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.0	0.42	ug/kg	
108-90-7	Chlorobenzene	ND	6.0	0.39	ug/kg	
75-00-3	Chloroethane	ND	6.0	0.49	ug/kg	
67-66-3	Chloroform	ND	6.0	0.58	ug/kg	
74-87-3	Chloromethane	ND	6.0	0.75	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.0	0.45	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.0	0.25	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	6.0	0.20	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.29	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.0	0.33	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.0	0.23	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.0	0.21	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.0	0.39	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.0	0.26	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.22	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.0	0.74	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	6.0	0.39	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	6.0	0.51	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.0	0.32	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.0	0.45	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-3 (9FT)		
Lab Sample ID:	JA81768-5	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.0
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.0	0.21	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.0	0.25	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.0	0.18	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.0	0.41	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.18	ug/kg	
87-68-3	Hexachlorobutadiene	ND	6.0	0.63	ug/kg	
98-82-8	Isopropylbenzene	ND	6.0	0.17	ug/kg	
99-87-6	p-Isopropyltoluene	ND	6.0	0.36	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.22	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.0	3.2	ug/kg	
74-95-3	Methylene bromide	ND	6.0	0.69	ug/kg	
75-09-2	Methylene chloride	ND	6.0	0.28	ug/kg	
91-20-3	Naphthalene	ND	6.0	1.3	ug/kg	
103-65-1	n-Propylbenzene	ND	6.0	0.42	ug/kg	
100-42-5	Styrene	ND	6.0	0.22	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.0	0.22	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.0	0.22	ug/kg	
127-18-4	Tetrachloroethene	ND	6.0	0.23	ug/kg	
108-88-3	Toluene	ND	1.2	0.46	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	6.0	0.53	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.0	0.41	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.0	0.29	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.0	0.52	ug/kg	
79-01-6	Trichloroethene	ND	6.0	0.30	ug/kg	
75-69-4	Trichlorofluoromethane	ND	6.0	0.58	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.0	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	6.0	1.4	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	6.0	0.15	ug/kg	
75-01-4	Vinyl chloride	ND	6.0	0.56	ug/kg	
	m,p-Xylene	ND	1.2	0.38	ug/kg	
95-47-6	o-Xylene	ND	1.2	0.22	ug/kg	
1330-20-7	Xylene (total)	ND	1.2	0.22	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	112%		67-131%
17060-07-0	1,2-Dichloroethane-D4	109%		66-130%
2037-26-5	Toluene-D8	110%		76-125%
460-00-4	4-Bromofluorobenzene	97%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-3 (9FT)		
Lab Sample ID:	JA81768-5	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	88.0
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	88		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	08/03/11 12:08	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-3 (13FT)		
Lab Sample ID:	JA81768-6	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	90.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117735.D	1	07/28/11	AVM	n/a	n/a	VV5015
Run #2							

	Initial Weight
Run #1	4.7 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	7.7	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	5.9	0.23	ug/kg	
74-97-5	Bromochloromethane	ND	5.9	0.61	ug/kg	
75-27-4	Bromodichloromethane	ND	5.9	0.26	ug/kg	
75-25-2	Bromoform	ND	5.9	0.88	ug/kg	
74-83-9	Bromomethane	ND	5.9	0.46	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.1	ug/kg	
104-51-8	n-Butylbenzene	ND	5.9	0.28	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.9	0.19	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.9	0.16	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.9	0.40	ug/kg	
108-90-7	Chlorobenzene	ND	5.9	0.38	ug/kg	
75-00-3	Chloroethane	ND	5.9	0.48	ug/kg	
67-66-3	Chloroform	ND	5.9	0.57	ug/kg	
74-87-3	Chloromethane	ND	5.9	0.73	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.9	0.44	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.9	0.24	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	5.9	0.20	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.28	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.9	0.32	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.9	0.22	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.9	0.20	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.9	0.38	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.9	0.26	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.21	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.9	0.72	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.9	0.38	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.9	0.50	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.9	0.31	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.9	0.44	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-3 (13FT)		
Lab Sample ID:	JA81768-6	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	90.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.9	0.20	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.9	0.24	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.9	0.18	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.9	0.39	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.17	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.9	0.61	ug/kg	
98-82-8	Isopropylbenzene	ND	5.9	0.16	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.9	0.35	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.21	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.9	3.1	ug/kg	
74-95-3	Methylene bromide	ND	5.9	0.66	ug/kg	
75-09-2	Methylene chloride	ND	5.9	0.27	ug/kg	
91-20-3	Naphthalene	ND	5.9	1.2	ug/kg	
103-65-1	n-Propylbenzene	ND	5.9	0.40	ug/kg	
100-42-5	Styrene	ND	5.9	0.22	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.9	0.22	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.9	0.21	ug/kg	
127-18-4	Tetrachloroethene	0.39	5.9	0.22	ug/kg	J
108-88-3	Toluene	ND	1.2	0.44	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.9	0.51	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.9	0.40	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.9	0.28	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.9	0.51	ug/kg	
79-01-6	Trichloroethene	ND	5.9	0.29	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.9	0.56	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.9	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.9	1.3	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	5.9	0.15	ug/kg	
75-01-4	Vinyl chloride	ND	5.9	0.54	ug/kg	
	m,p-Xylene	ND	1.2	0.37	ug/kg	
95-47-6	o-Xylene	ND	1.2	0.22	ug/kg	
1330-20-7	Xylene (total)	ND	1.2	0.22	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	111%		67-131%
17060-07-0	1,2-Dichloroethane-D4	104%		66-130%
2037-26-5	Toluene-D8	107%		76-125%
460-00-4	4-Bromofluorobenzene	97%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-3 (13FT)		
Lab Sample ID:	JA81768-6	**Date Sampled:**	07/20/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	90.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	90.9		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	08/03/11 10:21	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-4 (9FT)		
Lab Sample ID:	JA81768-7	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.7
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117736.D	1	07/28/11	AVM	n/a	n/a	VV5015
Run #2							

	Initial Weight
Run #1	4.8 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	7.8	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	5.9	0.23	ug/kg	
74-97-5	Bromochloromethane	ND	5.9	0.61	ug/kg	
75-27-4	Bromodichloromethane	ND	5.9	0.26	ug/kg	
75-25-2	Bromoform	ND	5.9	0.89	ug/kg	
74-83-9	Bromomethane	ND	5.9	0.46	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.1	ug/kg	
104-51-8	n-Butylbenzene	ND	5.9	0.28	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.9	0.19	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.9	0.16	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.9	0.41	ug/kg	
108-90-7	Chlorobenzene	ND	5.9	0.38	ug/kg	
75-00-3	Chloroethane	ND	5.9	0.48	ug/kg	
67-66-3	Chloroform	ND	5.9	0.57	ug/kg	
74-87-3	Chloromethane	ND	5.9	0.73	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.9	0.44	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.9	0.25	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	5.9	0.20	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.28	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.9	0.33	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.9	0.23	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.9	0.20	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.9	0.38	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.9	0.26	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.21	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.9	0.72	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.9	0.38	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.9	0.50	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.9	0.31	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.9	0.44	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-4 (9FT)		
Lab Sample ID:	JA81768-7	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.7
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.9	0.20	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.9	0.25	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.9	0.18	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.9	0.39	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.17	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.9	0.61	ug/kg	
98-82-8	Isopropylbenzene	ND	5.9	0.16	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.9	0.35	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.21	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.9	3.1	ug/kg	
74-95-3	Methylene bromide	ND	5.9	0.67	ug/kg	
75-09-2	Methylene chloride	ND	5.9	0.27	ug/kg	
91-20-3	Naphthalene	ND	5.9	1.2	ug/kg	
103-65-1	n-Propylbenzene	ND	5.9	0.41	ug/kg	
100-42-5	Styrene	ND	5.9	0.22	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.9	0.22	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.9	0.21	ug/kg	
127-18-4	Tetrachloroethene	ND	5.9	0.22	ug/kg	
108-88-3	Toluene	ND	1.2	0.44	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.9	0.51	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.9	0.40	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.9	0.28	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.9	0.51	ug/kg	
79-01-6	Trichloroethene	ND	5.9	0.29	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.9	0.57	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.9	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.9	1.3	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	5.9	0.15	ug/kg	
75-01-4	Vinyl chloride	ND	5.9	0.54	ug/kg	
	m,p-Xylene	ND	1.2	0.37	ug/kg	
95-47-6	o-Xylene	ND	1.2	0.22	ug/kg	
1330-20-7	Xylene (total)	ND	1.2	0.22	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	112%		67-131%
17060-07-0	1,2-Dichloroethane-D4	108%		66-130%
2037-26-5	Toluene-D8	107%		76-125%
460-00-4	4-Bromofluorobenzene	97%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-4 (9FT)		
Lab Sample ID:	JA81768-7	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	88.7
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	88.7		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	08/03/11 12:32	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-4 (15FT)		
Lab Sample ID:	JA81768-8	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	80.4
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117737.D	1	07/28/11	AVM	n/a	n/a	VV5015
Run #2							

	Initial Weight
Run #1	5.1 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	8.1	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	6.1	0.24	ug/kg	
74-97-5	Bromochloromethane	ND	6.1	0.63	ug/kg	
75-27-4	Bromodichloromethane	ND	6.1	0.27	ug/kg	
75-25-2	Bromoform	ND	6.1	0.92	ug/kg	
74-83-9	Bromomethane	ND	6.1	0.48	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.3	ug/kg	
104-51-8	n-Butylbenzene	ND	6.1	0.29	ug/kg	
135-98-8	sec-Butylbenzene	0.27	6.1	0.19	ug/kg	J
98-06-6	tert-Butylbenzene	ND	6.1	0.17	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.1	0.42	ug/kg	
108-90-7	Chlorobenzene	ND	6.1	0.39	ug/kg	
75-00-3	Chloroethane	ND	6.1	0.50	ug/kg	
67-66-3	Chloroform	ND	6.1	0.59	ug/kg	
74-87-3	Chloromethane	ND	6.1	0.76	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.1	0.46	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.1	0.25	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	6.1	0.20	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.29	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.1	0.34	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.1	0.23	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.1	0.21	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.1	0.39	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.1	0.27	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.22	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.1	0.75	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	6.1	0.39	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	6.1	0.52	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.1	0.32	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.1	0.45	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-4 (15FT)		
Lab Sample ID:	JA81768-8	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	80.4
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.1	0.21	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.1	0.25	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.1	0.19	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.1	0.41	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.18	ug/kg	
87-68-3	Hexachlorobutadiene	ND	6.1	0.64	ug/kg	
98-82-8	Isopropylbenzene	ND	6.1	0.17	ug/kg	
99-87-6	p-Isopropyltoluene	ND	6.1	0.36	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.22	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.1	3.2	ug/kg	
74-95-3	Methylene bromide	ND	6.1	0.69	ug/kg	
75-09-2	Methylene chloride	ND	6.1	0.28	ug/kg	
91-20-3	Naphthalene	ND	6.1	1.3	ug/kg	
103-65-1	n-Propylbenzene	ND	6.1	0.42	ug/kg	
100-42-5	Styrene	ND	6.1	0.23	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.1	0.22	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.1	0.22	ug/kg	
127-18-4	Tetrachloroethene	ND	6.1	0.23	ug/kg	
108-88-3	Toluene	ND	1.2	0.46	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	6.1	0.53	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.1	0.42	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.1	0.29	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.1	0.53	ug/kg	
79-01-6	Trichloroethene	ND	6.1	0.30	ug/kg	
75-69-4	Trichlorofluoromethane	ND	6.1	0.59	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.1	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	6.1	1.4	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	6.1	0.15	ug/kg	
75-01-4	Vinyl chloride	ND	6.1	0.56	ug/kg	
	m,p-Xylene	ND	1.2	0.38	ug/kg	
95-47-6	o-Xylene	ND	1.2	0.22	ug/kg	
1330-20-7	Xylene (total)	ND	1.2	0.22	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	113%		67-131%
17060-07-0	1,2-Dichloroethane-D4	104%		66-130%
2037-26-5	Toluene-D8	108%		76-125%
460-00-4	4-Bromofluorobenzene	99%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-4 (15FT)		
Lab Sample ID:	JA81768-8	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	80.4
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	80.4		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon	< 1200	1200	mg/kg	1	08/03/11 15:59	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-5 (9FT)		
Lab Sample ID:	JA81768-9	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117690.D	1	07/27/11	AVM	n/a	n/a	VV5013
Run #2							

	Initial Weight
Run #1	4.6 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	8.1	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	6.1	0.24	ug/kg	
74-97-5	Bromochloromethane	ND	6.1	0.63	ug/kg	
75-27-4	Bromodichloromethane	ND	6.1	0.27	ug/kg	
75-25-2	Bromoform	ND	6.1	0.92	ug/kg	
74-83-9	Bromomethane	ND	6.1	0.48	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.3	ug/kg	
104-51-8	n-Butylbenzene	0.49	6.1	0.29	ug/kg	J
135-98-8	sec-Butylbenzene	0.67	6.1	0.19	ug/kg	J
98-06-6	tert-Butylbenzene	ND	6.1	0.17	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.1	0.42	ug/kg	
108-90-7	Chlorobenzene	ND	6.1	0.39	ug/kg	
75-00-3	Chloroethane	ND	6.1	0.50	ug/kg	
67-66-3	Chloroform	ND	6.1	0.59	ug/kg	
74-87-3	Chloromethane	ND	6.1	0.76	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.1	0.46	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.1	0.26	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	6.1	0.21	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.29	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.1	0.34	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.1	0.23	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.1	0.21	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.1	0.39	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.1	0.27	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.22	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.1	0.75	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	6.1	0.39	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	6.1	0.52	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.1	0.33	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.1	0.46	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5 (9FT)		
Lab Sample ID:	JA81768-9	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.1	0.21	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.1	0.26	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.1	0.19	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.1	0.41	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.18	ug/kg	
87-68-3	Hexachlorobutadiene	ND	6.1	0.64	ug/kg	
98-82-8	Isopropylbenzene	ND	6.1	0.17	ug/kg	
99-87-6	p-Isopropyltoluene	0.52	6.1	0.36	ug/kg	J
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.22	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.1	3.2	ug/kg	
74-95-3	Methylene bromide	ND	6.1	0.69	ug/kg	
75-09-2	Methylene chloride	ND	6.1	0.28	ug/kg	
91-20-3	Naphthalene	3.4	6.1	1.3	ug/kg	J
103-65-1	n-Propylbenzene	0.48	6.1	0.42	ug/kg	J
100-42-5	Styrene	ND	6.1	0.23	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.1	0.22	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.1	0.22	ug/kg	
127-18-4	Tetrachloroethene	ND	6.1	0.23	ug/kg	
108-88-3	Toluene	ND	1.2	0.46	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	6.1	0.54	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.1	0.42	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.1	0.29	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.1	0.53	ug/kg	
79-01-6	Trichloroethene	ND	6.1	0.30	ug/kg	
75-69-4	Trichlorofluoromethane	ND	6.1	0.59	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.1	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	2.3	6.1	1.4	ug/kg	J
108-67-8	1,3,5-Trimethylbenzene	0.66	6.1	0.16	ug/kg	J
75-01-4	Vinyl chloride	ND	6.1	0.56	ug/kg	
	m,p-Xylene	ND	1.2	0.38	ug/kg	
95-47-6	o-Xylene	ND	1.2	0.22	ug/kg	
1330-20-7	Xylene (total)	ND	1.2	0.22	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	112%		67-131%
17060-07-0	1,2-Dichloroethane-D4	106%		66-130%
2037-26-5	Toluene-D8	108%		76-125%
460-00-4	4-Bromofluorobenzene	97%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5 (9FT)		
Lab Sample ID:	JA81768-9	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	88.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	88.9		%	1	07/29/11	DK	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	08/03/11 15:37	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-5 (14FT)		
Lab Sample ID:	JA81768-10	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.3
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	V117691.D	1	07/27/11	AVM	n/a	n/a	VV5013
Run #2							

	Initial Weight
Run #1	5.1 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	11	7.4	ug/kg	
71-43-2	Benzene	ND	1.1	0.15	ug/kg	
108-86-1	Bromobenzene	ND	5.6	0.22	ug/kg	
74-97-5	Bromochloromethane	ND	5.6	0.58	ug/kg	
75-27-4	Bromodichloromethane	ND	5.6	0.25	ug/kg	
75-25-2	Bromoform	ND	5.6	0.84	ug/kg	
74-83-9	Bromomethane	ND	5.6	0.44	ug/kg	
78-93-3	2-Butanone (MEK)	ND	11	4.8	ug/kg	
104-51-8	n-Butylbenzene	ND	5.6	0.26	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.6	0.18	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.6	0.15	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.6	0.38	ug/kg	
108-90-7	Chlorobenzene	ND	5.6	0.36	ug/kg	
75-00-3	Chloroethane	ND	5.6	0.45	ug/kg	
67-66-3	Chloroform	ND	5.6	0.54	ug/kg	
74-87-3	Chloromethane	ND	5.6	0.69	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.6	0.42	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.6	0.23	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	11	1.7	ug/kg	
124-48-1	Dibromochloromethane	ND	5.6	0.19	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.1	0.26	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.6	0.31	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.6	0.21	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.6	0.19	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.6	0.36	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.6	0.24	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.1	0.20	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.6	0.68	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.6	0.36	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.6	0.47	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.6	0.30	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.6	0.41	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5 (14FT)		
Lab Sample ID:	JA81768-10	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	88.3
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.6	0.19	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.6	0.23	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.6	0.17	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.6	0.37	ug/kg	
100-41-4	Ethylbenzene	ND	1.1	0.16	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.6	0.58	ug/kg	
98-82-8	Isopropylbenzene	ND	5.6	0.15	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.6	0.33	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.1	0.20	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.6	2.9	ug/kg	
74-95-3	Methylene bromide	ND	5.6	0.63	ug/kg	
75-09-2	Methylene chloride	ND	5.6	0.26	ug/kg	
91-20-3	Naphthalene	ND	5.6	1.2	ug/kg	
103-65-1	n-Propylbenzene	ND	5.6	0.38	ug/kg	
100-42-5	Styrene	ND	5.6	0.21	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.6	0.20	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.6	0.20	ug/kg	
127-18-4	Tetrachloroethene	ND	5.6	0.21	ug/kg	
108-88-3	Toluene	ND	1.1	0.42	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.6	0.49	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.6	0.38	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.6	0.27	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.6	0.48	ug/kg	
79-01-6	Trichloroethene	ND	5.6	0.27	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.6	0.54	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.6	1.2	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.6	1.2	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	5.6	0.14	ug/kg	
75-01-4	Vinyl chloride	ND	5.6	0.51	ug/kg	
	m,p-Xylene	ND	1.1	0.35	ug/kg	
95-47-6	o-Xylene	ND	1.1	0.20	ug/kg	
1330-20-7	Xylene (total)	ND	1.1	0.20	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	113%		67-131%
17060-07-0	1,2-Dichloroethane-D4	108%		66-130%
2037-26-5	Toluene-D8	108%		76-125%
460-00-4	4-Bromofluorobenzene	97%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5 (14FT)		
Lab Sample ID:	JA81768-10	**Date Sampled:**	07/21/11
Matrix:	SO - Soil	**Date Received:**	07/22/11
		Percent Solids:	88.3
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	88.3		%	1	08/03/11	DD	SM18 2540G
Total Organic Carbon [a]	< 1100	1100	mg/kg	1	08/03/11 16:28	SJG	CORP ENG 81M/SW9060M

(a) Multiple injections indicate possible sample non-homogeneity.

RL = Reporting Limit

Report of Analysis

Client Sample ID:	FB072011		
Lab Sample ID:	JA81768-11	**Date Sampled:**	07/20/11
Matrix:	AQ - Field Blank Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	4D13353.D	1	07/29/11	TYG	n/a	n/a	V4D590
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	7.6	ug/l	
71-43-2	Benzene	ND	1.0	0.22	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.18	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.40	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.23	ug/l	
75-25-2	Bromoform	ND	4.0	0.24	ug/l	
74-83-9	Bromomethane	ND	2.0	0.31	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	2.9	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.33	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.20	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.24	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.19	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.22	ug/l	
75-00-3	Chloroethane	ND	1.0	0.37	ug/l	
67-66-3	Chloroform	ND	1.0	0.21	ug/l	
74-87-3	Chloromethane	ND	1.0	0.22	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.19	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.19	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.3	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.20	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.21	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.18	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.29	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.26	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.31	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.19	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.18	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.28	ug/l	
156-59-2	cis-1,2-Dichloroethene	ND	1.0	0.22	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.31	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.22	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.19	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	FB072011		
Lab Sample ID:	JA81768-11	**Date Sampled:**	07/20/11
Matrix:	AQ - Field Blank Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.26	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.36	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.19	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.21	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.19	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.19	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.18	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	1.2	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.46	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.68	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.17	ug/l	
100-42-5	Styrene	ND	5.0	0.23	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.24	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.20	ug/l	
127-18-4	Tetrachloroethene	ND	1.0	0.32	ug/l	
108-88-3	Toluene	ND	1.0	0.15	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.69	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.15	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.24	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.23	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.21	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.35	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.54	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.18	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.23	ug/l	
75-01-4	Vinyl chloride	ND	1.0	0.27	ug/l	
	m,p-Xylene	ND	1.0	0.32	ug/l	
95-47-6	o-Xylene	ND	1.0	0.17	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.17	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	93%		77-120%
17060-07-0	1,2-Dichloroethane-D4	102%		70-127%
2037-26-5	Toluene-D8	93%		79-120%
460-00-4	4-Bromofluorobenzene	94%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	FB072011		
Lab Sample ID:	JA81768-11	**Date Sampled:**	07/20/11
Matrix:	AQ - Field Blank Soil	**Date Received:**	07/22/11
		Percent Solids:	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Total Organic Carbon	< 1.0	1.0	mg/l	1	07/31/11 02:48	SJG	SM20 5310B, 9060 M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	FB072111		
Lab Sample ID:	JA81768-12	**Date Sampled:**	07/21/11
Matrix:	AQ - Field Blank Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	4D13354.D	1	07/29/11	TYG	n/a	n/a	V4D590
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	7.6	ug/l	
71-43-2	Benzene	ND	1.0	0.22	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.18	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.40	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.23	ug/l	
75-25-2	Bromoform	ND	4.0	0.24	ug/l	
74-83-9	Bromomethane	ND	2.0	0.31	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	2.9	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.33	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.20	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.24	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.19	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.22	ug/l	
75-00-3	Chloroethane	ND	1.0	0.37	ug/l	
67-66-3	Chloroform	ND	1.0	0.21	ug/l	
74-87-3	Chloromethane	ND	1.0	0.22	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.19	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.19	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.3	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.20	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.21	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.18	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.29	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.26	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.31	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.19	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.18	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.28	ug/l	
156-59-2	cis-1,2-Dichloroethene	ND	1.0	0.22	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.31	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.22	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.19	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	FB072111		
Lab Sample ID:	JA81768-12	**Date Sampled:**	07/21/11
Matrix:	AQ - Field Blank Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.26	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.36	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.19	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.21	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.19	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.19	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.18	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	1.2	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.46	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.68	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.17	ug/l	
100-42-5	Styrene	ND	5.0	0.23	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.24	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.20	ug/l	
127-18-4	Tetrachloroethene	ND	1.0	0.32	ug/l	
108-88-3	Toluene	ND	1.0	0.15	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.69	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.15	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.24	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.23	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.21	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.35	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.54	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.18	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.23	ug/l	
75-01-4	Vinyl chloride	ND	1.0	0.27	ug/l	
	m,p-Xylene	ND	1.0	0.32	ug/l	
95-47-6	o-Xylene	ND	1.0	0.17	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.17	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	94%		77-120%
17060-07-0	1,2-Dichloroethane-D4	104%		70-127%
2037-26-5	Toluene-D8	90%		79-120%
460-00-4	4-Bromofluorobenzene	94%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	FB072111		
Lab Sample ID:	JA81768-12	**Date Sampled:**	07/21/11
Matrix:	AQ - Field Blank Soil	**Date Received:**	07/22/11
		Percent Solids:	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Total Organic Carbon	< 1.0	1.0	mg/l	1	07/31/11 03:04	SJG	SM20 5310B, 9060 M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	JA81768-13	**Date Sampled:**	07/21/11
Matrix:	AQ - Trip Blank Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	4D13355.D	1	07/29/11	TYG	n/a	n/a	V4D590
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	7.6	ug/l	
71-43-2	Benzene	ND	1.0	0.22	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.18	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.40	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.23	ug/l	
75-25-2	Bromoform	ND	4.0	0.24	ug/l	
74-83-9	Bromomethane	ND	2.0	0.31	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	2.9	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.33	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.20	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.24	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.19	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.22	ug/l	
75-00-3	Chloroethane	ND	1.0	0.37	ug/l	
67-66-3	Chloroform	ND	1.0	0.21	ug/l	
74-87-3	Chloromethane	ND	1.0	0.22	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.19	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.19	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.3	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.20	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.21	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.18	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.29	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.26	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.31	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.19	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.18	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.28	ug/l	
156-59-2	cis-1,2-Dichloroethene	ND	1.0	0.22	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.31	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.22	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.19	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	JA81768-13	**Date Sampled:**	07/21/11
Matrix:	AQ - Trip Blank Soil	**Date Received:**	07/22/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.26	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.36	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.19	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.21	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.19	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.19	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.18	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	1.2	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.46	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.68	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.17	ug/l	
100-42-5	Styrene	ND	5.0	0.23	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.24	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.20	ug/l	
127-18-4	Tetrachloroethene	ND	1.0	0.32	ug/l	
108-88-3	Toluene	ND	1.0	0.15	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.69	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.15	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.24	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.23	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.21	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.35	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.54	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.18	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.23	ug/l	
75-01-4	Vinyl chloride	ND	1.0	0.27	ug/l	
	m,p-Xylene	ND	1.0	0.32	ug/l	
95-47-6	o-Xylene	ND	1.0	0.17	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.17	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	95%		77-120%
17060-07-0	1,2-Dichloroethane-D4	104%		70-127%
2037-26-5	Toluene-D8	91%		79-120%
460-00-4	4-Bromofluorobenzene	93%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-1-6		
Lab Sample ID:	JA75840-1	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	85.5
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115050.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	4.5 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	13	8.6	ug/kg	
71-43-2	Benzene	ND	1.3	0.17	ug/kg	
108-86-1	Bromobenzene	ND	6.5	0.25	ug/kg	
74-97-5	Bromochloromethane	ND	6.5	0.67	ug/kg	
75-27-4	Bromodichloromethane	ND	6.5	0.29	ug/kg	
75-25-2	Bromoform	ND	6.5	0.98	ug/kg	
74-83-9	Bromomethane	ND	6.5	0.51	ug/kg	
78-93-3	2-Butanone (MEK)	ND	13	5.6	ug/kg	
104-51-8	n-Butylbenzene	ND	6.5	0.31	ug/kg	
135-98-8	sec-Butylbenzene	ND	6.5	0.21	ug/kg	
98-06-6	tert-Butylbenzene	ND	6.5	0.18	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.5	0.45	ug/kg	
108-90-7	Chlorobenzene	ND	6.5	0.42	ug/kg	
75-00-3	Chloroethane	ND	6.5	0.53	ug/kg	
67-66-3	Chloroform	ND	6.5	0.63	ug/kg	
74-87-3	Chloromethane	ND	6.5	0.81	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.5	0.49	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.5	0.27	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	13	2.0	ug/kg	
124-48-1	Dibromochloromethane	ND	6.5	0.22	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.3	0.31	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.5	0.36	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.5	0.25	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.5	0.22	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.5	0.42	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.5	0.28	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.3	0.24	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.5	0.80	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	6.5	0.42	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	6.5	0.55	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.5	0.35	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.5	0.48	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-1-6		
Lab Sample ID:	JA75840-1	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	85.5
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.5	0.22	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.5	0.27	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.5	0.20	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.5	0.44	ug/kg	
100-41-4	Ethylbenzene	ND	1.3	0.19	ug/kg	
87-68-3	Hexachlorobutadiene	ND	6.5	0.68	ug/kg	
98-82-8	Isopropylbenzene	ND	6.5	0.18	ug/kg	
99-87-6	p-Isopropyltoluene	ND	6.5	0.38	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.3	0.23	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.5	3.4	ug/kg	
74-95-3	Methylene bromide	ND	6.5	0.74	ug/kg	
75-09-2	Methylene chloride	ND	6.5	0.30	ug/kg	
91-20-3	Naphthalene	ND	6.5	1.4	ug/kg	
103-65-1	n-Propylbenzene	ND	6.5	0.45	ug/kg	
100-42-5	Styrene	ND	6.5	0.24	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.5	0.24	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.5	0.23	ug/kg	
127-18-4	Tetrachloroethene	ND	6.5	0.25	ug/kg	
108-88-3	Toluene	ND	1.3	0.49	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	6.5	0.57	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.5	0.44	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.5	0.31	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.5	0.56	ug/kg	
79-01-6	Trichloroethene	ND	6.5	0.32	ug/kg	
75-69-4	Trichlorofluoromethane	ND	6.5	0.63	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.5	1.4	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	6.5	1.5	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	0.37	6.5	0.17	ug/kg	J
75-01-4	Vinyl chloride	ND	6.5	0.60	ug/kg	
	m,p-Xylene	ND	1.3	0.41	ug/kg	
95-47-6	o-Xylene	0.61	1.3	0.24	ug/kg	J
1330-20-7	Xylene (total)	0.61	1.3	0.24	ug/kg	J

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	92%		67-131%
17060-07-0	1,2-Dichloroethane-D4	88%		66-130%
2037-26-5	Toluene-D8	99%		76-125%
460-00-4	4-Bromofluorobenzene	92%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-1-6		
Lab Sample ID:	JA75840-1	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	85.5
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	85.5		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	< 1200	1200	mg/kg	1	05/25/11 10:02	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-2-4.5		
Lab Sample ID:	JA75840-2	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	91.1
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115051.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	4.7 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	7.7	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	5.8	0.23	ug/kg	
74-97-5	Bromochloromethane	ND	5.8	0.61	ug/kg	
75-27-4	Bromodichloromethane	ND	5.8	0.26	ug/kg	
75-25-2	Bromoform	ND	5.8	0.88	ug/kg	
74-83-9	Bromomethane	ND	5.8	0.46	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.1	ug/kg	
104-51-8	n-Butylbenzene	ND	5.8	0.27	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.8	0.19	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.8	0.16	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.8	0.40	ug/kg	
108-90-7	Chlorobenzene	ND	5.8	0.38	ug/kg	
75-00-3	Chloroethane	ND	5.8	0.48	ug/kg	
67-66-3	Chloroform	ND	5.8	0.56	ug/kg	
74-87-3	Chloromethane	ND	5.8	0.73	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.8	0.44	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.8	0.24	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	5.8	0.20	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.28	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.8	0.32	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.8	0.22	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.8	0.20	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.8	0.37	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.8	0.25	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.21	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.8	0.72	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.8	0.38	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.8	0.50	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.8	0.31	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.8	0.44	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-2-4.5		
Lab Sample ID:	JA75840-2	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	91.1
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.8	0.20	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.8	0.24	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.8	0.18	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.8	0.39	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.17	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.8	0.61	ug/kg	
98-82-8	Isopropylbenzene	ND	5.8	0.16	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.8	0.35	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.21	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.8	3.1	ug/kg	
74-95-3	Methylene bromide	ND	5.8	0.66	ug/kg	
75-09-2	Methylene chloride	ND	5.8	0.27	ug/kg	
91-20-3	Naphthalene	ND	5.8	1.2	ug/kg	
103-65-1	n-Propylbenzene	ND	5.8	0.40	ug/kg	
100-42-5	Styrene	ND	5.8	0.22	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.8	0.21	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.8	0.21	ug/kg	
127-18-4	Tetrachloroethene	ND	5.8	0.22	ug/kg	
108-88-3	Toluene	ND	1.2	0.44	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.8	0.51	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.8	0.40	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.8	0.28	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.8	0.51	ug/kg	
79-01-6	Trichloroethene	ND	5.8	0.29	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.8	0.56	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.8	1.2	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.8	1.3	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	5.8	0.15	ug/kg	
75-01-4	Vinyl chloride	ND	5.8	0.54	ug/kg	
	m,p-Xylene	ND	1.2	0.37	ug/kg	
95-47-6	o-Xylene	ND	1.2	0.21	ug/kg	
1330-20-7	Xylene (total)	ND	1.2	0.21	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	93%		67-131%
17060-07-0	1,2-Dichloroethane-D4	91%		66-130%
2037-26-5	Toluene-D8	99%		76-125%
460-00-4	4-Bromofluorobenzene	92%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-2-4.5		
Lab Sample ID:	JA75840-2	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	91.1
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	91.1		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	05/25/11 10:22	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-4-5.5		
Lab Sample ID:	JA75840-3	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	89.8
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115055.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	4.8 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	7.7	ug/kg	
71-43-2	Benzene	ND	1.2	0.15	ug/kg	
108-86-1	Bromobenzene	ND	5.8	0.23	ug/kg	
74-97-5	Bromochloromethane	ND	5.8	0.60	ug/kg	
75-27-4	Bromodichloromethane	ND	5.8	0.26	ug/kg	
75-25-2	Bromoform	ND	5.8	0.88	ug/kg	
74-83-9	Bromomethane	ND	5.8	0.46	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.0	ug/kg	
104-51-8	n-Butylbenzene	ND	5.8	0.27	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.8	0.18	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.8	0.16	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.8	0.40	ug/kg	
108-90-7	Chlorobenzene	ND	5.8	0.37	ug/kg	
75-00-3	Chloroethane	ND	5.8	0.47	ug/kg	
67-66-3	Chloroform	ND	5.8	0.56	ug/kg	
74-87-3	Chloromethane	ND	5.8	0.72	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.8	0.44	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.8	0.24	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.8	ug/kg	
124-48-1	Dibromochloromethane	ND	5.8	0.19	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.28	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.8	0.32	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.8	0.22	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.8	0.20	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.8	0.37	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.8	0.25	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.21	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.8	0.71	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.8	0.37	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.8	0.49	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.8	0.31	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.8	0.43	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-4-5.5		
Lab Sample ID:	JA75840-3	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	89.8
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.8	0.20	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.8	0.24	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.8	0.18	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.8	0.39	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.17	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.8	0.60	ug/kg	
98-82-8	Isopropylbenzene	ND	5.8	0.16	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.8	0.34	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.21	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.8	3.1	ug/kg	
74-95-3	Methylene bromide	ND	5.8	0.66	ug/kg	
75-09-2	Methylene chloride	ND	5.8	0.27	ug/kg	
91-20-3	Naphthalene	ND	5.8	1.2	ug/kg	
103-65-1	n-Propylbenzene	ND	5.8	0.40	ug/kg	
100-42-5	Styrene	ND	5.8	0.21	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.8	0.21	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.8	0.21	ug/kg	
127-18-4	Tetrachloroethene	ND	5.8	0.22	ug/kg	
108-88-3	Toluene	ND	1.2	0.44	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.8	0.51	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.8	0.40	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.8	0.28	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.8	0.50	ug/kg	
79-01-6	Trichloroethene	ND	5.8	0.29	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.8	0.56	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.8	1.2	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.8	1.3	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	0.31	5.8	0.15	ug/kg	J
75-01-4	Vinyl chloride	ND	5.8	0.53	ug/kg	
	m,p-Xylene	ND	1.2	0.36	ug/kg	
95-47-6	o-Xylene	0.61	1.2	0.21	ug/kg	J
1330-20-7	Xylene (total)	0.61	1.2	0.21	ug/kg	J

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	91%		67-131%
17060-07-0	1,2-Dichloroethane-D4	87%		66-130%
2037-26-5	Toluene-D8	98%		76-125%
460-00-4	4-Bromofluorobenzene	92%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-4-5.5		
Lab Sample ID:	JA75840-3	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	89.8
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	89.8		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	05/25/11 10:31	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-5-4.5		
Lab Sample ID:	JA75840-4	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	90.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115056.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	5.0 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	11	7.3	ug/kg	
71-43-2	Benzene	ND	1.1	0.15	ug/kg	
108-86-1	Bromobenzene	ND	5.5	0.21	ug/kg	
74-97-5	Bromochloromethane	ND	5.5	0.57	ug/kg	
75-27-4	Bromodichloromethane	ND	5.5	0.25	ug/kg	
75-25-2	Bromoform	ND	5.5	0.83	ug/kg	
74-83-9	Bromomethane	ND	5.5	0.43	ug/kg	
78-93-3	2-Butanone (MEK)	ND	11	4.8	ug/kg	
104-51-8	n-Butylbenzene	ND	5.5	0.26	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.5	0.17	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.5	0.15	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.5	0.38	ug/kg	
108-90-7	Chlorobenzene	ND	5.5	0.35	ug/kg	
75-00-3	Chloroethane	ND	5.5	0.45	ug/kg	
67-66-3	Chloroform	ND	5.5	0.53	ug/kg	
74-87-3	Chloromethane	ND	5.5	0.69	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.5	0.41	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.5	0.23	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	11	1.7	ug/kg	
124-48-1	Dibromochloromethane	ND	5.5	0.18	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.1	0.26	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.5	0.30	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.5	0.21	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.5	0.19	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.5	0.35	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.5	0.24	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.1	0.20	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.5	0.67	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.5	0.35	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.5	0.47	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.5	0.29	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.5	0.41	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5-4.5		
Lab Sample ID:	JA75840-4	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	90.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.5	0.19	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.5	0.23	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.5	0.17	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.5	0.37	ug/kg	
100-41-4	Ethylbenzene	ND	1.1	0.16	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.5	0.57	ug/kg	
98-82-8	Isopropylbenzene	ND	5.5	0.15	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.5	0.33	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.1	0.20	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.5	2.9	ug/kg	
74-95-3	Methylene bromide	ND	5.5	0.62	ug/kg	
75-09-2	Methylene chloride	ND	5.5	0.25	ug/kg	
91-20-3	Naphthalene	ND	5.5	1.2	ug/kg	
103-65-1	n-Propylbenzene	ND	5.5	0.38	ug/kg	
100-42-5	Styrene	0.39	5.5	0.20	ug/kg	J
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.5	0.20	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.5	0.20	ug/kg	
127-18-4	Tetrachloroethene	ND	5.5	0.21	ug/kg	
108-88-3	Toluene	ND	1.1	0.42	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.5	0.48	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.5	0.38	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.5	0.27	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.5	0.48	ug/kg	
79-01-6	Trichloroethene	ND	5.5	0.27	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.5	0.53	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.5	1.2	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.5	1.2	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	0.24	5.5	0.14	ug/kg	J
75-01-4	Vinyl chloride	ND	5.5	0.51	ug/kg	
	m,p-Xylene	0.65	1.1	0.35	ug/kg	J
95-47-6	o-Xylene	0.33	1.1	0.20	ug/kg	J
1330-20-7	Xylene (total)	0.98	1.1	0.20	ug/kg	J

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	93%		67-131%
17060-07-0	1,2-Dichloroethane-D4	87%		66-130%
2037-26-5	Toluene-D8	99%		76-125%
460-00-4	4-Bromofluorobenzene	92%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5-4.5		
Lab Sample ID:	JA75840-4	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	90.9
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	90.9		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	05/25/11 16:06	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-5-5.5		
Lab Sample ID:	JA75840-5	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	90.5
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115057.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	4.5 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	8.1	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	6.1	0.24	ug/kg	
74-97-5	Bromochloromethane	ND	6.1	0.64	ug/kg	
75-27-4	Bromodichloromethane	ND	6.1	0.28	ug/kg	
75-25-2	Bromoform	ND	6.1	0.93	ug/kg	
74-83-9	Bromomethane	ND	6.1	0.48	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.3	ug/kg	
104-51-8	n-Butylbenzene	ND	6.1	0.29	ug/kg	
135-98-8	sec-Butylbenzene	ND	6.1	0.20	ug/kg	
98-06-6	tert-Butylbenzene	ND	6.1	0.17	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.1	0.42	ug/kg	
108-90-7	Chlorobenzene	ND	6.1	0.40	ug/kg	
75-00-3	Chloroethane	ND	6.1	0.50	ug/kg	
67-66-3	Chloroform	ND	6.1	0.59	ug/kg	
74-87-3	Chloromethane	ND	6.1	0.77	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.1	0.46	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.1	0.26	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.9	ug/kg	
124-48-1	Dibromochloromethane	ND	6.1	0.21	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.29	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.1	0.34	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.1	0.24	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.1	0.21	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.1	0.39	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.1	0.27	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.22	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.1	0.75	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	6.1	0.40	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	6.1	0.52	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.1	0.33	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.1	0.46	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5-5.5		
Lab Sample ID:	JA75840-5	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	90.5
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.1	0.21	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.1	0.26	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.1	0.19	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.1	0.41	ug/kg	
100-41-4	Ethylbenzene	ND	1.2	0.18	ug/kg	
87-68-3	Hexachlorobutadiene	ND	6.1	0.64	ug/kg	
98-82-8	Isopropylbenzene	ND	6.1	0.17	ug/kg	
99-87-6	p-Isopropyltoluene	ND	6.1	0.36	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.22	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.1	3.2	ug/kg	
74-95-3	Methylene bromide	ND	6.1	0.70	ug/kg	
75-09-2	Methylene chloride	ND	6.1	0.28	ug/kg	
91-20-3	Naphthalene	ND	6.1	1.3	ug/kg	
103-65-1	n-Propylbenzene	ND	6.1	0.42	ug/kg	
100-42-5	Styrene	ND	6.1	0.23	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.1	0.23	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.1	0.22	ug/kg	
127-18-4	Tetrachloroethene	ND	6.1	0.23	ug/kg	
108-88-3	Toluene	ND	1.2	0.46	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	6.1	0.54	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.1	0.42	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.1	0.30	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.1	0.53	ug/kg	
79-01-6	Trichloroethene	ND	6.1	0.30	ug/kg	
75-69-4	Trichlorofluoromethane	ND	6.1	0.59	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.1	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	6.1	1.4	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	0.32	6.1	0.16	ug/kg	J
75-01-4	Vinyl chloride	ND	6.1	0.57	ug/kg	
	m,p-Xylene	0.78	1.2	0.39	ug/kg	J
95-47-6	o-Xylene	0.53	1.2	0.23	ug/kg	J
1330-20-7	Xylene (total)	1.3	1.2	0.23	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	93%		67-131%
17060-07-0	1,2-Dichloroethane-D4	90%		66-130%
2037-26-5	Toluene-D8	99%		76-125%
460-00-4	4-Bromofluorobenzene	92%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5-5.5		
Lab Sample ID:	JA75840-5	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	90.5
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	90.5		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	4530	1100	mg/kg	1	05/25/11 11:16	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-5-8		
Lab Sample ID:	JA75840-6	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	90.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115058.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	5.0 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	11	7.3	ug/kg	
71-43-2	Benzene	ND	1.1	0.15	ug/kg	
108-86-1	Bromobenzene	ND	5.5	0.22	ug/kg	
74-97-5	Bromochloromethane	ND	5.5	0.58	ug/kg	
75-27-4	Bromodichloromethane	ND	5.5	0.25	ug/kg	
75-25-2	Bromoform	ND	5.5	0.84	ug/kg	
74-83-9	Bromomethane	ND	5.5	0.44	ug/kg	
78-93-3	2-Butanone (MEK)	ND	11	4.8	ug/kg	
104-51-8	n-Butylbenzene	ND	5.5	0.26	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.5	0.18	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.5	0.15	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.5	0.38	ug/kg	
108-90-7	Chlorobenzene	ND	5.5	0.36	ug/kg	
75-00-3	Chloroethane	ND	5.5	0.45	ug/kg	
67-66-3	Chloroform	ND	5.5	0.54	ug/kg	
74-87-3	Chloromethane	ND	5.5	0.69	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.5	0.42	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.5	0.23	ug/kg	
96-12-8	1,2-Dihromo-3-chloropropane	ND	11	1.7	ug/kg	
124-48-1	Dibromochloromethane	ND	5.5	0.19	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.1	0.26	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.5	0.31	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.5	0.21	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.5	0.19	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.5	0.36	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.5	0.24	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.1	0.20	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.5	0.68	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.5	0.36	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.5	0.47	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.5	0.29	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.5	0.41	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-5-8		
Lab Sample ID:	JA75840-6	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	90.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.5	0.19	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.5	0.23	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.5	0.17	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.5	0.37	ug/kg	
100-41-4	Ethylbenzene	ND	1.1	0.16	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.5	0.58	ug/kg	
98-82-8	Isopropylbenzene	ND	5.5	0.15	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.5	0.33	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.1	0.20	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.5	2.9	ug/kg	
74-95-3	Methylene bromide	ND	5.5	0.63	ug/kg	
75-09-2	Methylene chloride	ND	5.5	0.25	ug/kg	
91-20-3	Naphthalene	ND	5.5	1.2	ug/kg	
103-65-1	n-Propylbenzene	ND	5.5	0.38	ug/kg	
100-42-5	Styrene	ND	5.5	0.21	ug/kg	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.5	0.20	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.5	0.20	ug/kg	
127-18-4	Tetrachloroethene	5.4	5.5	0.21	ug/kg	J
108-88-3	Toluene	ND	1.1	0.42	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.5	0.49	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.5	0.38	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.5	0.27	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.5	0.48	ug/kg	
79-01-6	Trichloroethene	ND	5.5	0.27	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.5	0.53	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.5	1.2	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.5	1.2	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	5.5	0.14	ug/kg	
75-01-4	Vinyl chloride	ND	5.5	0.51	ug/kg	
	m,p-Xylene	0.60	1.1	0.35	ug/kg	J
95-47-6	o-Xylene	0.28	1.1	0.20	ug/kg	J
1330-20-7	Xylene (total)	0.88	1.1	0.20	ug/kg	J

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	99%		67-131%
17060-07-0	1,2-Dichloroethane-D4	100%		66-130%
2037-26-5	Toluene-D8	99%		76-125%
460-00-4	4-Bromofluorobenzene	91%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	SB-5-8		
Lab Sample ID:	JA75840-6	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	90.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	90.2		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	05/25/11 11:27	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-6-1.5		
Lab Sample ID:	JA75840-7	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	92.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115059.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	5.0 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	62.3	11	7.2	ug/kg	
71-43-2	Benzene	ND	1.1	0.14	ug/kg	
108-86-1	Bromobenzene	ND	5.4	0.21	ug/kg	
74-97-5	Bromochloromethane	ND	5.4	0.56	ug/kg	
75-27-4	Bromodichloromethane	ND	5.4	0.24	ug/kg	
75-25-2	Bromoform	ND	5.4	0.82	ug/kg	
74-83-9	Bromomethane	ND	5.4	0.43	ug/kg	
78-93-3	2-Butanone (MEK)	ND	11	4.7	ug/kg	
104-51-8	n-Butylbenzene	ND	5.4	0.25	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.4	0.17	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.4	0.15	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.4	0.38	ug/kg	
108-90-7	Chlorobenzene	ND	5.4	0.35	ug/kg	
75-00-3	Chloroethane	ND	5.4	0.44	ug/kg	
67-66-3	Chloroform	ND	5.4	0.52	ug/kg	
74-87-3	Chloromethane	ND	5.4	0.68	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.4	0.41	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.4	0.23	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	11	1.6	ug/kg	
124-48-1	Dibromochloromethane	ND	5.4	0.18	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.1	0.26	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.4	0.30	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.4	0.21	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.4	0.18	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.4	0.35	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.4	0.24	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.1	0.20	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.4	0.66	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.4	0.35	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.4	0.46	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.4	0.29	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.4	0.40	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-6-1.5		
Lab Sample ID:	JA75840-7	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	92.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.4	0.19	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.4	0.23	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.4	0.16	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.4	0.36	ug/kg	
100-41-4	Ethylbenzene	0.51	1.1	0.16	ug/kg	J
87-68-3	Hexachlorobutadiene	ND	5.4	0.57	ug/kg	
98-82-8	Isopropylbenzene	ND	5.4	0.15	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.4	0.32	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.1	0.19	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.4	2.9	ug/kg	
74-95-3	Methylene bromide	ND	5.4	0.62	ug/kg	
75-09-2	Methylene chloride	ND	5.4	0.25	ug/kg	
91-20-3	Naphthalene	ND	5.4	1.1	ug/kg	
103-65-1	n-Propylbenzene	ND	5.4	0.38	ug/kg	
100-42-5	Styrene	0.38	5.4	0.20	ug/kg	J
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.4	0.20	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.4	0.19	ug/kg	
127-18-4	Tetrachloroethene	ND	5.4	0.21	ug/kg	
108-88-3	Toluene	ND	1.1	0.41	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.4	0.48	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.4	0.37	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.4	0.26	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.4	0.47	ug/kg	
79-01-6	Trichloroethene	ND	5.4	0.27	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.4	0.52	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.4	1.2	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.4	1.2	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	0.41	5.4	0.14	ug/kg	J
75-01-4	Vinyl chloride	ND	5.4	0.50	ug/kg	
	m,p-Xylene	1.9	1.1	0.34	ug/kg	
95-47-6	o-Xylene	1.0	1.1	0.20	ug/kg	J
1330-20-7	Xylene (total)	2.9	1.1	0.20	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	95%		67-131%
17060-07-0	1,2-Dichloroethane-D4	91%		66-130%
2037-26-5	Toluene-D8	100%		76-125%
460-00-4	4-Bromofluorobenzene	92%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-6-1.5		
Lab Sample ID:	JA75840-7	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	92.2
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	92.2		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	2550	1100	mg/kg	1	05/25/11 12:21	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-6-4.5		
Lab Sample ID:	JA75840-8	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	88.3
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115060.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	4.6 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	12	8.1	ug/kg	
71-43-2	Benzene	ND	1.2	0.16	ug/kg	
108-86-1	Bromobenzene	ND	6.2	0.24	ug/kg	
74-97-5	Bromochloromethane	ND	6.2	0.64	ug/kg	
75-27-4	Bromodichloromethane	ND	6.2	0.28	ug/kg	
75-25-2	Bromoform	ND	6.2	0.93	ug/kg	
74-83-9	Bromomethane	ND	6.2	0.49	ug/kg	
78-93-3	2-Butanone (MEK)	ND	12	5.3	ug/kg	
104-51-8	n-Butylbenzene	ND	6.2	0.29	ug/kg	
135-98-8	sec-Butylbenzene	ND	6.2	0.20	ug/kg	
98-06-6	tert-Butylbenzene	ND	6.2	0.17	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.2	0.43	ug/kg	
108-90-7	Chlorobenzene	ND	6.2	0.40	ug/kg	
75-00-3	Chloroethane	ND	6.2	0.50	ug/kg	
67-66-3	Chloroform	ND	6.2	0.59	ug/kg	
74-87-3	Chloromethane	ND	6.2	0.77	ug/kg	
95-49-8	o-Chlorotoluene	ND	6.2	0.46	ug/kg	
106-43-4	p-Chlorotoluene	ND	6.2	0.26	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	12	1.9	ug/kg	
124-48-1	Dibromochloromethane	ND	6.2	0.21	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.2	0.29	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	6.2	0.34	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	6.2	0.24	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	6.2	0.21	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	6.2	0.40	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.2	0.27	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.2	0.22	ug/kg	
75-35-4	1,1-Dichloroethene	ND	6.2	0.75	ug/kg	
156-59-2	cis-1,2-Dichloroethene	0.41	6.2	0.40	ug/kg	J
156-60-5	trans-1,2-Dichloroethene	ND	6.2	0.52	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.2	0.33	ug/kg	
142-28-9	1,3-Dichloropropane	ND	6.2	0.46	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-6-4.5		
Lab Sample ID:	JA75840-8	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	88.3
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	6.2	0.21	ug/kg	
563-58-6	1,1-Dichloropropene	ND	6.2	0.26	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.2	0.19	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.2	0.41	ug/kg	
100-41-4	Ethylbenzene	0.57	1.2	0.18	ug/kg	J
87-68-3	Hexachlorobutadiene	ND	6.2	0.64	ug/kg	
98-82-8	Isopropylbenzene	ND	6.2	0.17	ug/kg	
99-87-6	p-Isopropyltoluene	ND	6.2	0.36	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.2	0.22	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	6.2	3.2	ug/kg	
74-95-3	Methylene bromide	ND	6.2	0.70	ug/kg	
75-09-2	Methylene chloride	ND	6.2	0.28	ug/kg	
91-20-3	Naphthalene	ND	6.2	1.3	ug/kg	
103-65-1	n-Propylbenzene	ND	6.2	0.43	ug/kg	
100-42-5	Styrene	0.68	6.2	0.23	ug/kg	J
630-20-6	1,1,1,2-Tetrachloroethane	ND	6.2	0.23	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.2	0.22	ug/kg	
127-18-4	Tetrachloroethene	10.3	6.2	0.24	ug/kg	
108-88-3	Toluene	0.52	1.2	0.47	ug/kg	J
87-61-6	1,2,3-Trichlorobenzene	ND	6.2	0.54	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	6.2	0.42	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.2	0.30	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.2	0.53	ug/kg	
79-01-6	Trichloroethene	0.80	6.2	0.30	ug/kg	J
75-69-4	Trichlorofluoromethane	ND	6.2	0.59	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	6.2	1.3	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	6.2	1.4	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	0.40	6.2	0.16	ug/kg	J
75-01-4	Vinyl chloride	ND	6.2	0.57	ug/kg	
	m,p-Xylene	2.0	1.2	0.39	ug/kg	
95-47-6	o-Xylene	1.1	1.2	0.23	ug/kg	J
1330-20-7	Xylene (total)	3.1	1.2	0.23	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	94%		67-131%
17060-07-0	1,2-Dichloroethane-D4	93%		66-130%
2037-26-5	Toluene-D8	99%		76-125%
460-00-4	4-Bromofluorobenzene	91%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-6-4.5		
Lab Sample ID:	JA75840-8	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	88.3
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	88.3		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	2420	1100	mg/kg	1	05/25/11 12:33	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	SB-6-7		
Lab Sample ID:	JA75840-9	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	91.3
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	X115061.D	1	05/25/11	JTP	n/a	n/a	VX4882
Run #2							

	Initial Weight
Run #1	5.1 g
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	11	7.1	ug/kg	
71-43-2	Benzene	ND	1.1	0.14	ug/kg	
108-86-1	Bromobenzene	ND	5.4	0.21	ug/kg	
74-97-5	Bromochloromethane	ND	5.4	0.56	ug/kg	
75-27-4	Bromodichloromethane	ND	5.4	0.24	ug/kg	
75-25-2	Bromoform	ND	5.4	0.81	ug/kg	
74-83-9	Bromomethane	ND	5.4	0.42	ug/kg	
78-93-3	2-Butanone (MEK)	ND	11	4.6	ug/kg	
104-51-8	n-Butylbenzene	ND	5.4	0.25	ug/kg	
135-98-8	sec-Butylbenzene	ND	5.4	0.17	ug/kg	
98-06-6	tert-Butylbenzene	ND	5.4	0.15	ug/kg	
56-23-5	Carbon tetrachloride	ND	5.4	0.37	ug/kg	
108-90-7	Chlorobenzene	ND	5.4	0.35	ug/kg	
75-00-3	Chloroethane	ND	5.4	0.44	ug/kg	
67-66-3	Chloroform	ND	5.4	0.52	ug/kg	
74-87-3	Chloromethane	ND	5.4	0.67	ug/kg	
95-49-8	o-Chlorotoluene	ND	5.4	0.40	ug/kg	
106-43-4	p-Chlorotoluene	ND	5.4	0.22	ug/kg	
96-12-8	1,2-Dibromo-3-chloropropane	ND	11	1.6	ug/kg	
124-48-1	Dibromochloromethane	ND	5.4	0.18	ug/kg	
106-93-4	1,2-Dibromoethane	ND	1.1	0.26	ug/kg	
95-50-1	1,2-Dichlorobenzene	ND	5.4	0.30	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	5.4	0.21	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	5.4	0.18	ug/kg	
75-71-8	Dichlorodifluoromethane	ND	5.4	0.34	ug/kg	
75-34-3	1,1-Dichloroethane	ND	5.4	0.23	ug/kg	
107-06-2	1,2-Dichloroethane	ND	1.1	0.20	ug/kg	
75-35-4	1,1-Dichloroethene	ND	5.4	0.66	ug/kg	
156-59-2	cis-1,2-Dichloroethene	ND	5.4	0.35	ug/kg	
156-60-5	trans-1,2-Dichloroethene	ND	5.4	0.46	ug/kg	
78-87-5	1,2-Dichloropropane	ND	5.4	0.29	ug/kg	
142-28-9	1,3-Dichloropropane	ND	5.4	0.40	ug/kg	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-6-7		
Lab Sample ID:	JA75840-9	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	91.3
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.4	0.18	ug/kg	
563-58-6	1,1-Dichloropropene	ND	5.4	0.22	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	5.4	0.16	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	5.4	0.36	ug/kg	
100-41-4	Ethylbenzene	ND	1.1	0.16	ug/kg	
87-68-3	Hexachlorobutadiene	ND	5.4	0.56	ug/kg	
98-82-8	Isopropylbenzene	ND	5.4	0.15	ug/kg	
99-87-6	p-Isopropyltoluene	ND	5.4	0.32	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	1.1	0.19	ug/kg	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.4	2.8	ug/kg	
74-95-3	Methylene bromide	ND	5.4	0.61	ug/kg	
75-09-2	Methylene chloride	ND	5.4	0.25	ug/kg	
91-20-3	Naphthalene	ND	5.4	1.1	ug/kg	
103-65-1	n-Propylbenzene	ND	5.4	0.37	ug/kg	
100-42-5	Styrene	0.28	5.4	0.20	ug/kg	J
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.4	0.20	ug/kg	
79-34-5	1,1,2,2-Tetrachloroethane	ND	5.4	0.19	ug/kg	
127-18-4	Tetrachloroethene	ND	5.4	0.21	ug/kg	
108-88-3	Toluene	ND	1.1	0.41	ug/kg	
87-61-6	1,2,3-Trichlorobenzene	ND	5.4	0.47	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	5.4	0.37	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	5.4	0.26	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	5.4	0.46	ug/kg	
79-01-6	Trichloroethene	ND	5.4	0.27	ug/kg	
75-69-4	Trichlorofluoromethane	ND	5.4	0.52	ug/kg	
96-18-4	1,2,3-Trichloropropane	ND	5.4	1.1	ug/kg	
95-63-6	1,2,4-Trimethylbenzene	ND	5.4	1.2	ug/kg	
108-67-8	1,3,5-Trimethylbenzene	ND	5.4	0.14	ug/kg	
75-01-4	Vinyl chloride	ND	5.4	0.50	ug/kg	
	m,p-Xylene	ND	1.1	0.34	ug/kg	
95-47-6	o-Xylene	0.22	1.1	0.20	ug/kg	J
1330-20-7	Xylene (total)	0.54	1.1	0.20	ug/kg	J

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	92%		67-131%
17060-07-0	1,2-Dichloroethane-D4	87%		66-130%
2037-26-5	Toluene-D8	99%		76-125%
460-00-4	4-Bromofluorobenzene	93%		53-142%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	SB-6-7		
Lab Sample ID:	JA75840-9	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	91.3
Project:	Sl Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	91.3		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	05/25/11 13:01	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	STORM DRAIN 1		
Lab Sample ID:	JA75840-10	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	2D96808.D	1	05/27/11	MAH	n/a	n/a	V2D3947
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	4.4	ug/l	
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	1.7	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.26	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	ND	1.0	0.14	ug/l	
74-87-3	Chloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	17.8	1.0	0.24	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	STORM DRAIN 1		
Lab Sample ID:	JA75840-10	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.13	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	39.6	1.0	0.24	ug/l	
108-88-3	Toluene	ND	1.0	0.27	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	6.5	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.27	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.31	ug/l	
75-01-4	Vinyl chloride	0.76	1.0	0.22	ug/l	J
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	95%		77-120%
17060-07-0	1,2-Dichloroethane-D4	100%		70-127%
2037-26-5	Toluene-D8	93%		79-120%
460-00-4	4-Bromofluorobenzene	92%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	STORM DRAIN 2		
Lab Sample ID:	JA75840-11	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	2E65283.D	1	05/25/11	MH	n/a	n/a	V2E2925
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	4.4	ug/l	
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	1.7	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.26	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	ND	1.0	0.14	ug/l	
74-87-3	Chloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	23.1	1.0	0.24	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	STORM DRAIN 2		
Lab Sample ID:	JA75840-11	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.13	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	59.9	1.0	0.24	ug/l	
108-88-3	Toluene	0.29	1.0	0.27	ug/l	J
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	9.0	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.27	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.31	ug/l	
75-01-4	Vinyl chloride	0.86	1.0	0.22	ug/l	J
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	106%		77-120%
17060-07-0	1,2-Dichloroethane-D4	106%		70-127%
2037-26-5	Toluene-D8	100%		79-120%
460-00-4	4-Bromofluorobenzene	95%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	STORM DRAIN 3		
Lab Sample ID:	JA75840-12	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3B70773.D	1	05/26/11	TLR	n/a	n/a	V3B3301
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	5.1	10	4.4	ug/l	J
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	1.7	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.26	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	ND	1.0	0.14	ug/l	
74-87-3	Chloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	10.7	1.0	0.24	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	STORM DRAIN 3		
Lab Sample ID:	JA75840-12	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.13	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	0.27	1.0	0.24	ug/l	J
108-88-3	Toluene	0.30	1.0	0.27	ug/l	J
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	2.5	5.0	0.27	ug/l	J
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.31	ug/l	
75-01-4	Vinyl chloride	1.6	1.0	0.22	ug/l	
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	99%		77-120%
17060-07-0	1,2-Dichloroethane-D4	89%		70-127%
2037-26-5	Toluene-D8	105%		79-120%
460-00-4	4-Bromofluorobenzene	99%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	STORM DRAIN 4		
Lab Sample ID:	JA75840-13	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	2E65285.D	1	05/25/11	MH	n/a	n/a	V2E2925
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	117	10	4.4	ug/l	
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	114	10	1.7	ug/l	
104-51-8	n-Butylbenzene	1.0	5.0	0.26	ug/l	J
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	0.46	1.0	0.14	ug/l	J
74-87-3	Chloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	0.31	1.0	0.24	ug/l	J
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	STORM DRAIN 4		
Lab Sample ID:	JA75840-13	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	1.8	5.0	0.13	ug/l	J
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	1.5	2.0	0.20	ug/l	J
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	ND	1.0	0.24	ug/l	
108-88-3	Toluene	7.6	1.0	0.27	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	1.9	5.0	0.27	ug/l	J
108-67-8	1,3,5-Trimethylbenzene	0.49	5.0	0.31	ug/l	J
75-01-4	Vinyl chloride	0.58	1.0	0.22	ug/l	J
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	105%		77-120%
17060-07-0	1,2-Dichloroethane-D4	105%		70-127%
2037-26-5	Toluene-D8	100%		79-120%
460-00-4	4-Bromofluorobenzene	102%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	STORM DRAIN 6		
Lab Sample ID:	JA75840-14	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3B70774.D	1	05/26/11	TLR	n/a	n/a	V3B3301
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	4.4	ug/l	
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	1.7	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.26	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	ND	1.0	0.14	ug/l	
74-87-3	Chloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	12.5	1.0	0.24	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	STORM DRAIN 6		
Lab Sample ID:	JA75840-14	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.13	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	30.5	1.0	0.24	ug/l	
108-88-3	Toluene	ND	1.0	0.27	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	4.8	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.27	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.31	ug/l	
75-01-4	Vinyl chloride	0.47	1.0	0.22	ug/l	J
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	99%		77-120%
17060-07-0	1,2-Dichloroethane-D4	91%		70-127%
2037-26-5	Toluene-D8	106%		79-120%
460-00-4	4-Bromofluorobenzene	98%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	STORM DRAIN 7		
Lab Sample ID:	JA75840-15	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3B70775.D	1	05/26/11	TLR	n/a	n/a	V3B3301
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	87.2	10	4.4	ug/l	
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	21.0	10	1.7	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.26	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	0.63	1.0	0.14	ug/l	J
74-87-3	Chloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	ND	1.0	0.24	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	STORM DRAIN 7		
Lab Sample ID:	JA75840-15	**Date Sampled:**	05/13/11
Matrix:	AQ - Surface Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	0.96	5.0	0.13	ug/l	J
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	ND	1.0	0.24	ug/l	
108-88-3	Toluene	0.87	1.0	0.27	ug/l	J
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.27	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.31	ug/l	
75-01-4	Vinyl chloride	ND	1.0	0.22	ug/l	
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	100%		77-120%
17060-07-0	1,2-Dichloroethane-D4	95%		70-127%
2037-26-5	Toluene-D8	107%		79-120%
460-00-4	4-Bromofluorohenzene	99%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	FB051211		
Lab Sample ID:	JA75840-16	**Date Sampled:**	05/12/11
Matrix:	AQ - Field Blank Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	2E65284.D	1	05/25/11	MH	n/a	n/a	V2E2925
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	4.4	ug/l	
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	1.7	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.26	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	ND	1.0	0.14	ug/l	
74-87-3	Cbloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	ND	1.0	0.24	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	FB051211		
Lab Sample ID:	JA75840-16	**Date Sampled:**	05/12/11
Matrix:	AQ - Field Blank Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.13	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	ND	1.0	0.24	ug/l	
108-88-3	Toluene	ND	1.0	0.27	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.27	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.31	ug/l	
75-01-4	Vinyl chloride	ND	1.0	0.22	ug/l	
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	107%		77-120%
17060-07-0	1,2-Dichloroethane-D4	108%		70-127%
2037-26-5	Toluene-D8	99%		79-120%
460-00-4	4-Bromofluorobenzene	97%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	FB051311		
Lab Sample ID:	JA75840-17	**Date Sampled:**	05/13/11
Matrix:	AQ - Field Blank Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3B70778.D	1	05/26/11	TLR	n/a	n/a	V3B3301
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	4.4	ug/l	
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	1.7	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.26	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	ND	1.0	0.14	ug/l	
74-87-3	Chloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	ND	1.0	0.24	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	FB051311		
Lab Sample ID:	JA75840-17	**Date Sampled:**	05/13/11
Matrix:	AQ - Field Blank Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.13	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	ND	1.0	0.24	ug/l	
108-88-3	Toluene	ND	1.0	0.27	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.27	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.31	ug/l	
75-01-4	Vinyl chloride	ND	1.0	0.22	ug/l	
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	101%		77-120%
17060-07-0	1,2-Dichloroethane-D4	99%		70-127%
2037-26-5	Toluene-D8	108%		79-120%
460-00-4	4-Bromofluorobenzene	100%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	JA75840-18	**Date Sampled:**	05/13/11
Matrix:	AQ - Trip Blank Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3B70777.D	1	05/26/11	TLR	n/a	n/a	V3B3301
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
67-64-1	Acetone	ND	10	4.4	ug/l	
71-43-2	Benzene	ND	1.0	0.26	ug/l	
108-86-1	Bromobenzene	ND	5.0	0.13	ug/l	
74-97-5	Bromochloromethane	ND	5.0	0.79	ug/l	
75-27-4	Bromodichloromethane	ND	1.0	0.18	ug/l	
75-25-2	Bromoform	ND	4.0	0.42	ug/l	
74-83-9	Bromomethane	ND	2.0	0.24	ug/l	
78-93-3	2-Butanone (MEK)	ND	10	1.7	ug/l	
104-51-8	n-Butylbenzene	ND	5.0	0.26	ug/l	
135-98-8	sec-Butylbenzene	ND	5.0	0.40	ug/l	
98-06-6	tert-Butylbenzene	ND	5.0	0.34	ug/l	
56-23-5	Carbon tetrachloride	ND	1.0	0.35	ug/l	
108-90-7	Chlorobenzene	ND	1.0	0.15	ug/l	
75-00-3	Chloroethane	ND	1.0	0.25	ug/l	
67-66-3	Chloroform	ND	1.0	0.14	ug/l	
74-87-3	Chloromethane	ND	1.0	0.34	ug/l	
95-49-8	o-Chlorotoluene	ND	5.0	0.17	ug/l	
106-43-4	p-Chlorotoluene	ND	5.0	0.29	ug/l	
96-12-8	1,2-Dibromo-3-chloropropane	ND	10	1.2	ug/l	
124-48-1	Dibromochloromethane	ND	1.0	0.16	ug/l	
106-93-4	1,2-Dibromoethane	ND	2.0	0.39	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.15	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.19	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.22	ug/l	
75-71-8	Dichlorodifluoromethane	ND	5.0	0.39	ug/l	
75-34-3	1,1-Dichloroethane	ND	1.0	0.16	ug/l	
107-06-2	1,2-Dichloroethane	ND	1.0	0.31	ug/l	
75-35-4	1,1-Dichloroethene	ND	1.0	0.24	ug/l	
156-59-2	cis-1,2-Dichloroethene	ND	1.0	0.24	ug/l	
156-60-5	trans-1,2-Dichloroethene	ND	1.0	0.30	ug/l	
78-87-5	1,2-Dichloropropane	ND	1.0	0.23	ug/l	
142-28-9	1,3-Dichloropropane	ND	5.0	0.22	ug/l	

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	TRIP BLANK		
Lab Sample ID:	JA75840-18	**Date Sampled:**	05/13/11
Matrix:	AQ - Trip Blank Water	**Date Received:**	05/13/11
Method:	SW846 8260B	**Percent Solids:**	n/a
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

VOA 8260 List

CAS No.	Compound	Result	RL	MDL	Units	Q
594-20-7	2,2-Dichloropropane	ND	5.0	0.21	ug/l	
563-58-6	1,1-Dichloropropene	ND	5.0	0.16	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.16	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.22	ug/l	
100-41-4	Ethylbenzene	ND	1.0	0.31	ug/l	
87-68-3	Hexachlorobutadiene	ND	5.0	0.23	ug/l	
98-82-8	Isopropylbenzene	ND	2.0	0.31	ug/l	
99-87-6	p-Isopropyltoluene	ND	5.0	0.13	ug/l	
1634-04-4	Methyl Tert Butyl Ether	ND	1.0	0.20	ug/l	
108-10-1	4-Methyl-2-pentanone(MIBK)	ND	5.0	0.74	ug/l	
74-95-3	Methylene bromide	ND	5.0	0.35	ug/l	
75-09-2	Methylene chloride	ND	2.0	0.20	ug/l	
91-20-3	Naphthalene	ND	5.0	0.78	ug/l	
103-65-1	n-Propylbenzene	ND	5.0	0.33	ug/l	
100-42-5	Styrene	ND	5.0	0.48	ug/l	
630-20-6	1,1,1,2-Tetrachloroethane	ND	5.0	0.18	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.12	ug/l	
127-18-4	Tetrachloroethene	ND	1.0	0.24	ug/l	
108-88-3	Toluene	ND	1.0	0.27	ug/l	
87-61-6	1,2,3-Trichlorobenzene	ND	5.0	0.29	ug/l	
120-82-1	1,2,4-Trichlorobenzene	ND	5.0	0.16	ug/l	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.20	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.13	ug/l	
79-01-6	Trichloroethene	ND	1.0	0.22	ug/l	
75-69-4	Trichlorofluoromethane	ND	5.0	0.23	ug/l	
96-18-4	1,2,3-Trichloropropane	ND	5.0	0.52	ug/l	
95-63-6	1,2,4-Trimethylbenzene	ND	5.0	0.27	ug/l	
108-67-8	1,3,5-Trimethylbenzene	ND	5.0	0.31	ug/l	
75-01-4	Vinyl chloride	ND	1.0	0.22	ug/l	
	m,p-Xylene	ND	1.0	0.39	ug/l	
95-47-6	o-Xylene	ND	1.0	0.28	ug/l	
1330-20-7	Xylene (total)	ND	1.0	0.28	ug/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	101%		77-120%
17060-07-0	1,2-Dichloroethane-D4	96%		70-127%
2037-26-5	Toluene-D8	108%		79-120%
460-00-4	4-Bromofluorobenzene	100%		76-118%

ND = Not detected MDL - Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

Client Sample ID:	SB-1-1.5		
Lab Sample ID:	JA75840-19	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	91.7
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	91.7		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	05/25/11 13:13	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

Accutest LabLink@641505 17:26 31-Oct-2011

Report of Analysis

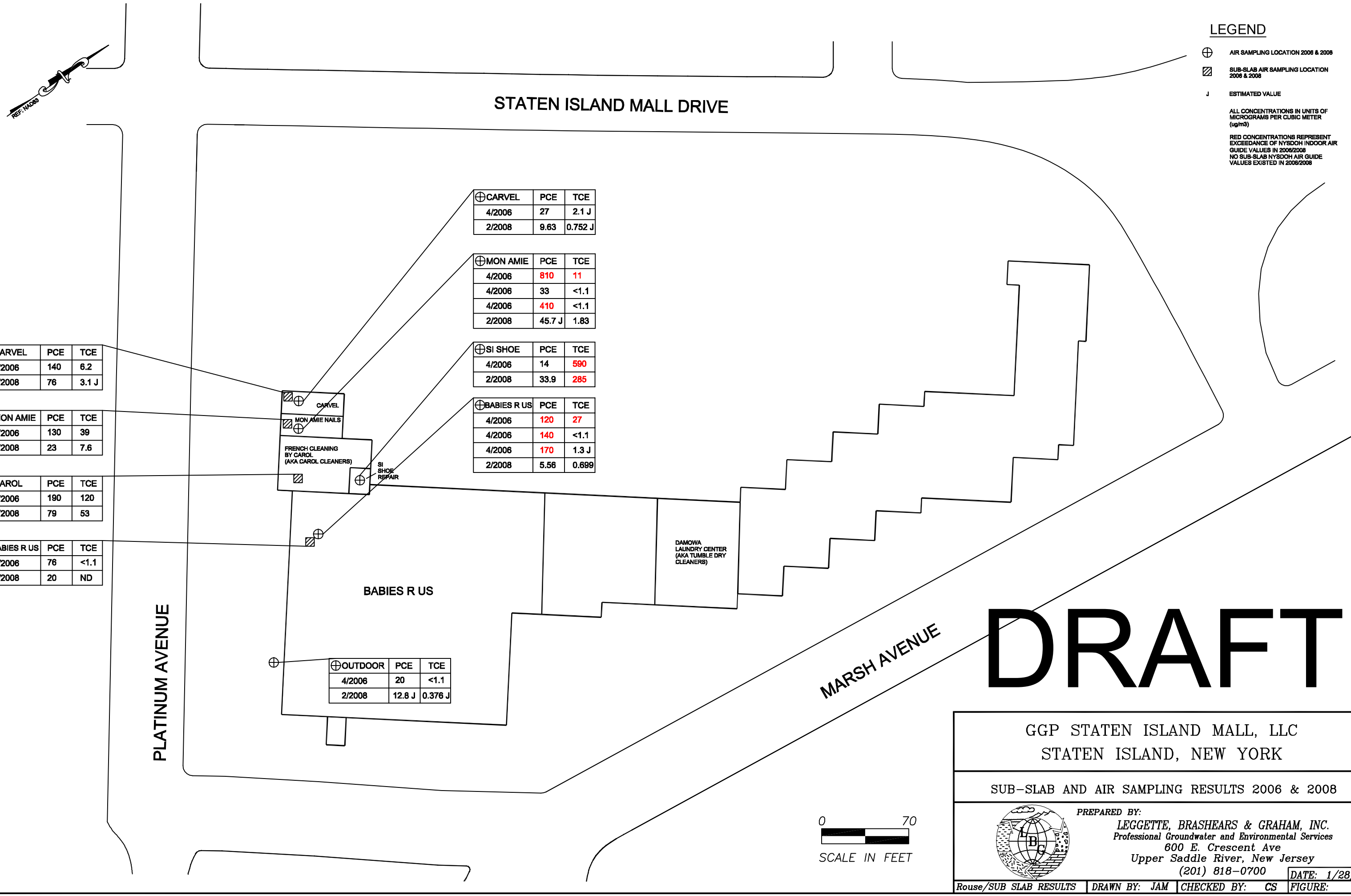
Client Sample ID:	SB-5-2.5		
Lab Sample ID:	JA75840-20	**Date Sampled:**	05/12/11
Matrix:	SO - Soil	**Date Received:**	05/13/11
		Percent Solids:	90.7
Project:	SI Mall, Platinum Avenue, Staten Island, NY		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Percent	90.7		%	1	05/25/11	CS	SM18 2540G
Total Organic Carbon	< 1100	1100	mg/kg	1	05/25/11 13:26	SJG	CORP ENG 81M/SW9060M

RL = Reporting Limit

APPENDIX G - INDOOR AIR/SUB-SLAB SAMPLING RESULTS



CARVEL	PCE	TCE
4/2006	140	6.2
2/2008	76	3.1 J

MON AMIE	PCE	TCE
4/2006	130	39
2/2008	23	7.6

CAROL	PCE	TCE
4/2006	190	120
2/2008	79	53

BABIES R US	PCE	TCE
4/2006	76	<1.1
2/2008	20	ND

CARVEL	PCE	TCE
4/2006	27	2.1 J
2/2008	9.63	0.752 J

MON AMIE	PCE	TCE
4/2006	810	11
4/2006	33	<1.1
4/2006	410	<1.1
2/2008	45.7 J	1.83

SI SHOE	PCE	TCE
4/2006	14	590
2/2008	33.9	285

BABIES R US	PCE	TCE
4/2006	120	27
4/2006	140	<1.1
4/2006	170	1.3 J
2/2008	5.56	0.699

OUTDOOR	PCE	TCE
4/2006	20	<1.1
2/2008	12.8 J	0.376 J

DRAFT

GGP STATEN ISLAND MALL, LLC
STATEN ISLAND, NEW YORK

SUB-SLAB AND AIR SAMPLING RESULTS 2006 & 2008

PREPARED BY:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Groundwater and Environmental Services
600 E. Crescent Ave
Upper Saddle River, New Jersey
(201) 818-0700

DATE: 1/28/12

Rouse/SUB SLAB RESULTS | DRAWN BY: JAM | CHECKED BY: CS | FIGURE:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Region 2
47-40 21st Street, Long Island City, NY 11101
P: (718) 482-4995
www.dec.ny.gov

July 24, 2024

Josh Ryals
Senior Manager, Corporate Environmental Services | National Operations –Retail
General Growth Properties
350 North Orleans Street, Suite 300
Chicago, IL 60654
joshua.ryals@bpretail.com

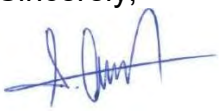
Re: Carol Cleaners, Staten Island Mall
280 Platinum Avenue, Staten Island, Richmond County
Site No. 243020
Indoor Air/Sub-Slab Vapor and Vacuum Radius of Influence Testing Report

Dear Josh Ryals:

The New York State Department of Environmental Conservation (NYSDEC), in consultation with the New York State Department of Health (NYSDOH) has reviewed the Indoor Air/Sub-Slab Vapor and Vacuum Radius of Influence Testing Report (the "Report") was submitted by Tetra Tech, dated June 13, 2024, regarding the above referenced site. The Report demonstrates the effectiveness of the sub-slab depressurization system (SSDS) engineering control at preventing exposures from soil vapor intrusion, and the Department hereby accepts the Report.

If you would like to discuss this letter, please contact me at (718)-482-4891 or e-mail: yildiz.palumbo@dec.ny.gov.

Sincerely,



Yildiz Palumbo
Project Manager

ec: J. O'Connell, A. Obligado – NYSDEC
McLaughlin, S. Bogardus, A. Ghosh – NYSDOH
E. Zimmerman – Tetra Tech
J. Ryals- Brookfield Properties

100 Crystal Run Road, Suite 101, Middletown, NY 10941
T 877.294.9070 | F 877.845.1456 | W www.cornerstoneeg.com

June 13, 2024

Yildiz Palumbo, P.E.
Project Manager
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway, 12th Floor
Albany, NY 12233-7012

Re: Former Carol Cleaners Site, Staten Island, New York
NYSDEC Site Number 243020
Results of Indoor Air/Sub-Slab Vapor Sampling and Radius of Influence Testing - Revised

Dear Ms. Palumbo,

On behalf of Brookfield Retail Properties (Brookfield), Cornerstone Engineering and Geology, PLLC (Cornerstone) performed sub slab vapor and indoor air sampling in December 2023 and sub-slab vacuum radius of influence testing in January 2024 at the Former Carol Cleaners Site (the site), located at 280-30 Marsh Avenue, Staten Island, New York. This letter provides a summary of the field work and analytical results from these investigations.

Scope of Work December 2023 Sub-Slab and Indoor Air Sampling

Cornerstone mobilized to the site on December 4, 2023 to perform sub slab vapor and indoor air sampling. Sub slab vapor samples were collected from a total of five (5) sampling ports installed on December 4, 2023. Indoor air samples were collected from a total of five (5) locations near each sub slab vapor sample. One (1) ambient air sample was collected at a location outside and generally upwind of the former Carol Cleaners building. All samples were submitted to SGS Laboratory (SGS) in Dayton, New Jersey and analyzed for Volatile Organic Compounds (VOCs) by USEPA Method TO-15. The site location is shown on Figure 1, and sampling locations for the December 2023 Sub-Slab and Indoor Air Sampling are shown on Figure 2.

Prior to sampling, the existing sub-slab depressurization system (SSDS) was shut down for a period of 30 days to allow system pressures to equilibrate. A New York State Department of Health (NYSDOH) pre-sampling building survey and product inventory were also conducted prior to collecting samples to confirm that cleaning solvents or other materials present within the building did not impact sampling results. The field notes are documented in Appendix A.

Sampling was conducted over a 24-hour period from December 4 to December 5, 2023. Sub-slab vapor samples were collected from Vapor Pin® flush-mount sample ports. Photos of a typical Vapor Pin® installation are included in Appendix A. Prior to sampling, a water dam leak test method was performed in accordance with the procedures outlined in the NYSDOH Guidance (2006). Indoor air samples were collected from locations adjacent to the sub-slab soil vapor samples at a height above the ground representative of the breathing zone (approximately 3-5 feet).

All samples were collected in laboratory pre-cleaned 6-liter Summa canisters with regulators calibrated to collect samples over a 24-hour period. Sampling was stopped after 24 hours elapsed time or once the vacuum level dropped to a total pressure of approximately 5 inches of mercury. The Summa canisters were closed, packed in secure boxes, and transported via courier to SGS in Dayton, NJ.

Indoor Air/Sub-Slab Vapor Sampling Results

Sub-slab and indoor air sampling results are summarized in Table 1, and VOC results are summarized on Figure 3. Laboratory data packages are provided in Appendix B. Results of sampling were compared to the NYSDOH Air Matrices A, B and C guidance values. The air matrices provide an assessment of the need for no further action, potential monitoring or remedial action based on a combination of sub-slab concentrations and indoor air concentrations. A copy of Air Matrices A, B and C is provided within Appendix C.

Results of sampling indicated that none of the compounds regulated within Air Matrices A, B or C were detected within indoor air samples at concentrations above their respective method detection limits except for methylene chloride. Methylene chloride was detected at low concentrations, ranging from the detection limit of 0.76 µg/m^3 to a maximum concentration of 2.6 µg/m^3. Methylene chloride was also identified within ambient/outdoor air sample AA-1-23 at a concentration of 1.8 µg/m^3.

For sub-slab samples, cis-1,2-dichloroethene (DCE), trichloroethene (TCE), methylene chloride (MC), tetrachloroethene (PCE) and vinyl chloride (VC) were each identified within sub-slab vapor samples. These compounds were identified at the following frequency:

Cis-1,2-DCE was identified within SS-2-23 at a concentration of 15 µg/m^3. Based on Air Matrix A no further action is necessary associated with this compound;

TCE was identified in four of five samples, at concentrations ranging from 2.6 µg/m^3 within sample SS-3-23 to a concentration of 181 µg/m^3 within sample SS-2-23. Based on Air Matrix A the sub-slab concentration of 181 ug/m3 in sub-slab sample SS-2-23 requires mitigation. No further action is necessary at the other locations;

MC was identified within sub-slab sample SS-4-23 at a concentration of 9 µg/m^3. Based on Air Matrix B no further action is necessary associated with this compound;

PCE was identified within five of five sub-slab samples, at concentrations ranging from 4.5 µg/m^3 within sample SS-3-23 to 489 µg/m^3 within sample SS-2-23. Based on Air Matrix B no further action is necessary associated with this compound; and

VC was identified within sample SS-4-23 at a concentration of 3.1 µg/m^3. Based on Air Matrix C no further action is necessary associated with this compound.

Based on a comparison of the indoor air and sub-slab vapor samples obtained, mitigation is required due solely to the concentration of TCE identified within sub-slab vapor sample SS-2-23; however, as indicated above, no site-related constituents (including TCE) were detected within any of the indoor air samples obtained after the SSDS had been shut down for at least 30 days.

Data Usability

The NYSDEC requested via letter dated April 16, 2024 that Cornerstone provide a DUSR for the indoor air/sub-slab vapor sampling data. As data validation had not previously been requested by the NYSDEC for this site Cornerstone had not originally requested a Category B data deliverable package from SGS Laboratories for this work. A Category B data deliverables package was requested by Cornerstone on May 28, 2024 and SGS provided the requested data package on June 5, 2024.

Cornerstone staff reviewed the revised data package in accordance with the requirements of the Technical Requirements for Site Investigation and Remediation (DER-10) and prepared a DUSR outlining the results of the data review. The DUSR is included within Appendix B along with the modified laboratory data package.

As indicated within the attached DUSR, the data were usable for their intended purpose, with minor data qualifications included where appropriate.

Scope of Work January 2024 Sub-Slab Vacuum Radius Testing

Subsequent to the completion of indoor air/sub-slab vapor testing, Brookfield reactivated the SSDS on or about December 7, 2023, and system pressures were again allowed to equilibrate under operating conditions for at least 30 days. Cornerstone subsequently mobilized to the site on January 15, 2024 to install additional Vapor Pin® vapor sampling points and obtain vacuum readings from these locations and/or existing Vapor Pin® locations installed during indoor air/sub-slab vapor sampling conducted on December 4, 2023. The goal of this work was to confirm the vacuum radius of influence of the existing SSDS. To that end, six (6) new vapor sampling points were installed, and readings were obtained from each of these locations, plus two previously installed sampling points (for a total of eight sampling locations).

Sub-Slab Vacuum Radius Testing Results

The sampling locations are identified as VT-1 through VT-8, as shown on Figure 4, and readings obtained are shown in Table 2. Photos documenting the readings obtained from each location are provided in Appendix D.

As indicated within Table 2 and as shown on Figure 4, negative pressure (vacuum) readings were obtained from each location tested, and the values obtained were generally consistent with readings obtained during initial system installation and performance confirmation work. Induced vacuums ranged from - 0.032 inches of water adjacent to the exterior building wall at sample location VT-1 to -2.274 inches of water at sample location VT-6. Based on these readings, Cornerstone has confirmed that vacuum induced by the SSDS extends beneath the entire Hobby Lobby and Carvel buildings. The results of vacuum testing further confirm that the SSDS is operating effectively and as intended.

As requested by the NYSDEC, Cornerstone has included a Record Drawing showing the layout of the existing SSDS. The drawing has been stamped by a Professional Engineer licensed within New York State. This Record Drawing is included as Figure 5.

Please do not hesitate to contact me with any questions or comments.

Sincerely,
Cornerstone Engineering and Geology, PLLC.

Erich Zimmerman, P.E.
Client Manager

Cc: J. Ryals – Brookfield
File

Enclosures

TABLES

Table 1
Former Carol Cleaners
280-30 Marsh Ave. Staten Island, NY
Indoor Air and Sub Slab Volatile Organic Compounds - December 2023

Client Sample ID:		NYSDOH Air Matrics Trigger Values IA/SS	IA-1-23	SS-1-23	IA-2-23	SS-2-23	IA-3-23	SS-3-23	IA-4-23	SS-4-23	IA-5-23	SS-5-23	AA-1-23
Lab Sample ID:			JD78191-1	JD78191-6	JD78191-2	JD78191-7	JD78191-3	JD78191-8	JD78191-4	JD78191-9	JD78191-5	JD78191-10	JD78191-11
Date Sampled:			12/5/2023	12/5/2023	12/5/2023	12/5/2023	12/5/2023	12/5/2023	12/5/2023	12/5/2023	12/5/2023	12/5/2023	12/5/2023
Matrix:			Indoor Air Comp.	Soil Vapor Comp.	Indoor Air Comp.	Soil Vapor Comp.	Indoor Air Comp.	Soil Vapor Comp.	Indoor Air Comp.	Soil Vapor Comp.	Indoor Air Comp.	Soil Vapor Comp.	Ambient Air Comp.
MS Voilatiles (TO-15) - ug/m3													
Acetone (2-Propanone)	ug/m3		150	46.8	16	404	20	135	18	1500	20	501	6.4
1,3-Butadiene	ug/m3		ND (0.19)	ND (0.75)	ND (0.19)	ND (0.75)	ND (0.19)	ND (0.75)	ND (0.19)	ND (0.75)	ND (0.19)	ND (0.75)	ND (0.19)
Benzene	ug/m3		0.7	ND (1.9)	0.58 J	2.0 J	0.54 J	2.8	0.54 J	41.5	0.64	8.9	0.64
Bromodichloromethane	ug/m3		ND (0.20)	2.7	ND (0.20)	ND (0.80)	ND (0.20)	ND (0.80)	ND (0.20)	ND (0.80)	ND (0.20)	4.6	ND (0.20)
Bromoform	ug/m3		ND (0.73)	ND (2.9) [a]	ND (0.73)	ND (2.9) [a]	ND (0.73)	ND (2.9) [a]	ND (0.73)	ND (2.9) [a]	ND (0.73) [a]	ND (2.9) [b]	ND (0.73) [a]
Bromomethane	ug/m3		ND (0.27)	ND (1.1)	ND (0.27)	ND (1.1)	ND (0.27)	ND (1.1)	ND (0.27)	ND (1.1)	ND (0.27)	ND (1.1)	ND (0.27)
Bromoethene	ug/m3		ND (0.27)	ND (1.0)	ND (0.27)	ND (1.0)	ND (0.27)	ND (1.0)	ND (0.27)	ND (1.0)	ND (0.27)	ND (1.0)	ND (0.27)
Benzyl Chloride	ug/m3		ND (0.67)	ND (2.6)	ND (0.67)	ND (2.6)	ND (0.67)	ND (2.6)	ND (0.67)	ND (2.6)	ND (0.67)	ND (2.6)	ND (0.67)
Carbon disulfide	ug/m3		ND (0.14)	1.4 J	ND (0.14)	1.4 J	ND (0.14)	ND (0.56)	ND (0.14)	3.1	ND (0.14)	12	ND (0.14)
Chlorobenzene	ug/m3		ND (0.34)	ND (1.4)	ND (0.34)	ND (1.4)	ND (0.34)	ND (1.4)	ND (0.34)	ND (1.4)	ND (0.34)	ND (1.4)	ND (0.34)
Chloroethane	ug/m3		ND (0.18)	ND (0.71)	ND (0.18)	ND (0.71)	ND (0.18)	ND (0.71)	ND (0.18)	7.9	ND (0.18)	3.2	ND (0.18)
Chloroform	ug/m3		1.2	47	ND (0.18)	ND (0.73)	ND (0.18)	ND (0.73)	ND (0.18)	2.3 J	ND (0.18)	53.7	ND (0.18)
Chloromethane	ug/m3		1.1	ND (0.74)	1	ND (0.74)	1.1	1.5 J	1.2	1.8	1.4	1.4 J	1.3
3-Chloropropene	ug/m3		ND (0.26)	ND (1.0)	ND (0.26)	ND (1.0)	ND (0.26)	ND (1.0)	ND (0.26)	ND (1.0)	ND (0.26)	ND (1.0)	ND (0.26)
2-Chlorotoluene	ug/m3		ND (0.37)	ND (1.5)	ND (0.37)	ND (1.5)	ND (0.37)	ND (1.5)	ND (0.37)	ND (1.5)	ND (0.37)	ND (1.5)	ND (0.37)
Carbon tetrachloride	ug/m3	<0.2/>60	ND (0.25)	ND (1.0)	ND (0.25)	ND (1.0)	ND (0.25)	ND (1.0)	ND (0.25)	ND (1.0)	ND (0.25)	ND (1.0)	ND (0.25)
Cyclohexane	ug/m3		ND (0.15)	ND (0.62)	ND (0.15)	1.8 J	ND (0.15)	4.1	ND (0.15)	12	ND (0.15)	3.4	ND (0.15)
1,1-Dichloroethane	ug/m3		ND (0.23)	ND (0.93)	ND (0.23)	ND (0.93)	ND (0.23)	ND (0.93)	ND (0.23)	ND (0.93)	ND (0.23)	ND (0.93)	ND (0.23)
1,1-Dichloroethylene	ug/m3	<0.2/>60	ND (0.23)	ND (0.95)	ND (0.23)	ND (0.95)	ND (0.23)	ND (0.95)	ND (0.23)	ND (0.95)	ND (0.23)	ND (0.95)	ND (0.23)
1,2-Dibromoethane (EDB)	ug/m3		ND (0.23)	ND (0.92)	ND (0.23)	ND (0.92)	ND (0.23)	ND (0.92)	ND (0.23)	ND (0.92)	ND (0.23)	ND (0.92)	ND (0.23)
1,2-Dichloroethane	ug/m3		ND (0.28)	ND (1.1)	ND (0.28)	2.0 J	ND (0.28)	ND (1.1)	ND (0.28)	6.1	ND (0.28)	3.0 J	ND (0.28)
1,2-Dichloropropane	ug/m3		ND (0.29)	ND (1.2)	ND (0.29)	ND (1.2)	ND (0.29)	ND (1.2)	ND (0.29)	ND (1.2)	ND (0.29)	ND (1.2)	ND (0.29)
1,4-Dioxane	ug/m3		ND (0.43)	ND (1.7)	ND (0.43)	ND (1.7)	ND (0.43)	ND (1.7)	ND (0.43)	5.4	ND (0.43)	ND (1.7)	ND (0.43)
Dichlorodifluoromethane	ug/m3		2.3	2.4 J	1.8	2.4 J	1.7	2.6 J	1.9	2.8 J	2.3	4.9	2.3
Dibromochloromethane	ug/m3		ND (0.44)	ND (1.8)	ND (0.44)	ND (1.8)	ND (0.44)	ND (1.8)	ND (0.44)	ND (1.8)	ND (0.44)	ND (1.8)	ND (0.44)
trans-1,2-Dichloroethylene	ug/m3		ND (0.11)	ND (0.44)	ND (0.11)	2.0 J	ND (0.11)	ND (0.44)	ND (0.11)	ND (0.44)	ND (0.11)	ND (0.44)	ND (0.11)
cis-1,2-Dichloroethylene	ug/m3	<0.2/>60	ND (0.12)	ND (0.48)	ND (0.12)	15	ND (0.12)	ND (0.48)	ND (0.12)	ND (0.48)	ND (0.12)	ND (0.48)	ND (0.12)
cis-1,3-Dichloropropene	ug/m3		ND (0.28)	ND (1.1)	ND (0.28)	ND (1.1)	ND (0.28)	ND (1.1)	ND (0.28)	ND (1.1)	ND (0.28)	ND (1.1)	ND (0.28)
m-Dichlorobenzene	ug/m3		ND (0.24)	ND (0.96)	ND (0.24)	ND (0.96)	ND (0.24)	ND (0.96)	ND (0.24)	ND (0.96)	ND (0.24)	ND (0.96)	ND (0.24)
o-Dichlorobenzene	ug/m3		ND (0.41)	ND (1.7)	ND (0.41)	ND (1.7)	ND (0.41)	ND (1.7)	ND (0.41)	ND (1.7)	ND (0.41)	ND (1.7)	ND (0.41)
p-Dichlorobenzene	ug/m3		ND (0.47)	ND (1.9)	ND (0.47)	ND (1.9)	ND (0.47)	ND (1.9)	ND (0.47)	ND (1.9)	ND (0.47)	ND (1.9)	ND (0.47)
trans-1,3-Dichloropropene	ug/m3		ND (0.45)	ND (1.8)	ND (0.45)	ND (1.8)	ND (0.45)	ND (1.8)	ND (0.45)	ND (1.8)	ND (0.45)	ND (1.8)	ND (0.45)
Ethanol	ug/m3		168	6.8	6.4	80.3	6.8	57.5	7.7	360	11	103	4.3
Ethylbenzene	ug/m3		0.78 J	ND (1.0)	ND (0.26)	2.0 J	ND (0.26)	3.1 J	ND (0.26)	106	ND (0.26)	10	ND (0.26)
Ethyl Acetate	ug/m3		24	14	8.3	15	15	14	3.6	56.1	15	6.8	7.6
4-Ethyltoluene	ug/m3		ND (0.47)	ND (1.9)	ND (0.47)	ND (1.9)	ND (0.47)	ND (1.9)	ND (0.47)	ND (1.9)	ND (0.47)	6.9	ND (0.47)
Freon 113	ug/m3		ND (0.24)	ND (0.92)	ND (0.24)	ND (0.92)	ND (0.24)	ND (0.92)	0.57 J	ND (0.92)	ND (0.24)	ND (0.92)	ND (0.24)
Freon 114	ug/m3		ND (0.35)	ND (1.4)	ND (0.35)	ND (1.4)	ND (0.35)	ND (1.4)	ND (0.35)	ND (1.4)	ND (0.35)	ND (1.4)	ND (0.35)
Heptane	ug/m3		1.1	ND (0.74)	ND (0.18)	ND (0.74)	ND (0.18)	1.8 J	ND (0.18)	7.8	0.45 J	2.5 J	ND (0.18)
Hexachlorobutadiene	ug/m3		ND (0.66)	ND (2.7)	ND (0.66)	ND (2.7)	ND (0.66)	ND (2.7)	ND (0.66)	ND (2.7)	ND (0.66)	ND (2.7)	ND (0.66)
Hexane	ug/m3		0.88	ND (0.74)	0.74	2.6 J	1	3.3	1.4	19	1.6	4.2	1.3
2-Hexanone	ug/m3		ND (0.61)	ND (2.4)	ND (0.61)	ND (2.4)	ND (0.61)	ND (2.4)	ND (0.61)	ND (2.4)	ND (0.61)	6.1	ND (0.61)
Isopropyl Alcohol	ug/m3		10	4.4	1	14	1.2	13	1.3	85	1.5	28	0.69
Methylene chloride	ug/m3	<3/>1000	ND (0.19)	ND (0.76)	0.76	ND (0.76)	1.5	ND (0.76)	2.6	9	2.1	ND (0.76)	1.8
Methyl ethyl ketone	ug/m3		0.91	274	0.8	14	0.74	10	0.8	55.2	0.94	61.6	0.71
Methyl Isobutyl Ketone	ug/m3		0.57 J	27	ND (0.30)	ND (1.2)	ND (0.30)	3.0 J	ND (0.30)	17	ND (0.30)	18	ND (0.30)
Methyl Tert Butyl Ether	ug/m3		ND (0.29)	ND (1.2)	ND (0.29)	ND (1.2)	ND (0.29)	ND (1.2)	ND (0.29)	ND (1.2)	ND (0.29)	ND (1.2)	ND (0.29)
Methylmethacrylate	ug/m3		ND (0.29)	ND (1.1)	ND (0.29)	ND (1.1)	ND (0.29)	ND (1.1)	ND (0.29)	1.6 J	ND (0.29)	ND (1.1)	ND (0.29)
Propylene	ug/m3		ND (0.24)	ND (0.98)	ND (0.24)	ND (0.98)	ND (0.24)	ND (0.98)	ND (0.24)	ND (0.98)	ND (0.24)	ND (0.98)	ND (0.24)
Styrene	ug/m3		0.68 J	ND (0.89)	ND (0.23)	2.3 J	ND (0.23)	ND (0.89)	ND (0.23)	ND (0.89)	ND (0.23)	11	ND (0.23)
1,1,1-Trichloroethane	ug/m3	<3/>1000	ND (0.20)	ND (0.82)	ND (0.20)	ND (0.82)	ND (0.20)	ND (0.82)	ND (0.20)	ND (0.82)	ND (0.20)	ND (0.82)	ND (0.20)
1,1,2,2-Tetrachloroethane	ug/m3		ND (0.33)	ND (1.3)	ND (0.33)	ND (1.3)	ND (0.33)	ND (1.3)	ND (0.33)	3.5	ND (0.33)	ND (1.3)	ND (0.33)
1,1,2-Trichloroethane	ug/m3		ND (0.21)	ND (0.82)	ND (0.21)	ND (0.82)	ND (0.21)	ND (0.82)	ND (0.21)	ND (0.82)	ND (0.21)	ND (0.82)	ND (0.21)
1,2,4-Trichlorobenzene	ug/m3		ND (0.89)	ND (3.6)	ND (0.89)	ND (3.6)	ND (0.89)	ND (3.6)	ND (0.89)	ND (3.6)	ND (0.89)	ND (3.6)	ND (0.89)
1,2,4-Trimethylbenzene	ug/m3		ND (0.43)	ND (1.7)	ND (0.43)	4.4	ND (0.43)	3.5 J	ND (0.43)	3.6 J	ND (0.43)	17	ND (0.43)
1,3,5-Trimethylbenzene	ug/m3		ND (0.39)	ND (1.6)	ND (0.39)	2.8 J	ND (0.39)	ND (1.6)	ND (0.39)	ND (1.6)	ND (0.39)	11	ND (0.39)
2,2,4-Trimethylpentane	ug/m3		0.84 J	ND (0.75)	ND (0.19)	ND (0.75)	ND (0.19)	ND (0.75)	ND (0.19)	5.1	0.46 J	ND (0.75)	ND (0.19)
Tertiary Butyl Alcohol	ug/m3		ND (0.28)	2.9	ND (0.28)	11	ND (0.28)	14	ND (0.28)	64.9	ND (0.28)	45.2	ND (0.28)
Tetrachloroethylene (PCE)	ug/m3	<3/>1000	ND (0.095)	13	ND (0.095)	489	ND (0.095)	4.5	ND (0.095)	14	ND (0.095)	28	ND (0.095)
Tetrahydrofuran	ug/m3		ND (0.27)	186	ND (0.27)	38.9	ND (0.27)	17	ND (0.27)	94.4	ND (0.27)	59	ND (0.27)
Toluene	ug/m3		4.1	4.1	2.7	22	1.3	19	1.2	102	1.7	35	0.94
Trichloroethylene (TCE)	ug/m3	<0.2/>60	ND (0.10)	ND (0.41)	ND (0.10)	**181**	ND (0.10)	2.6	ND (0.10)	21	ND (0.10)	32	ND (0.10)
Trichlorofluoromethane	ug/m3		3.1	ND (3.5)	1.3	ND (3.5)	1.3	3.8	1.3	3.9	1.5	13	1.5
Vinyl chloride	ug/m3	<0.2/>60	ND (0.18)	ND (0.72)	ND (0.18)	ND (0.72)	ND (0.18)	ND (0.72)	ND (0.18)	3.1	ND (0.18)	ND (0.72)	ND (0.18)
Vinyl Acetate	ug/m3		ND (0.39)	ND (1.6)	ND (0.39)	1.8 J	ND (0.39)	ND (1.6)	ND (0.39)	ND (1.6)	1.3	3.5	ND (0.39)
m,p-Xylene	ug/m3		2.3	3.1 J	1.2	6.5	0.87	10	0.69 J	267	1.2	36	0.78 J
o-Xylene	ug/m3		0.74 J	ND (1.3)	0.43 J	4.3	ND (0.33)	3.2 J	ND (0.33)	87.3	0.43 J	18	ND (0.33)
Xylenes (total)	ug/m3		3	3.1 J	1.6	11	0.87	13	0.69 J	354	1.6	54	0.78 J

Legend:

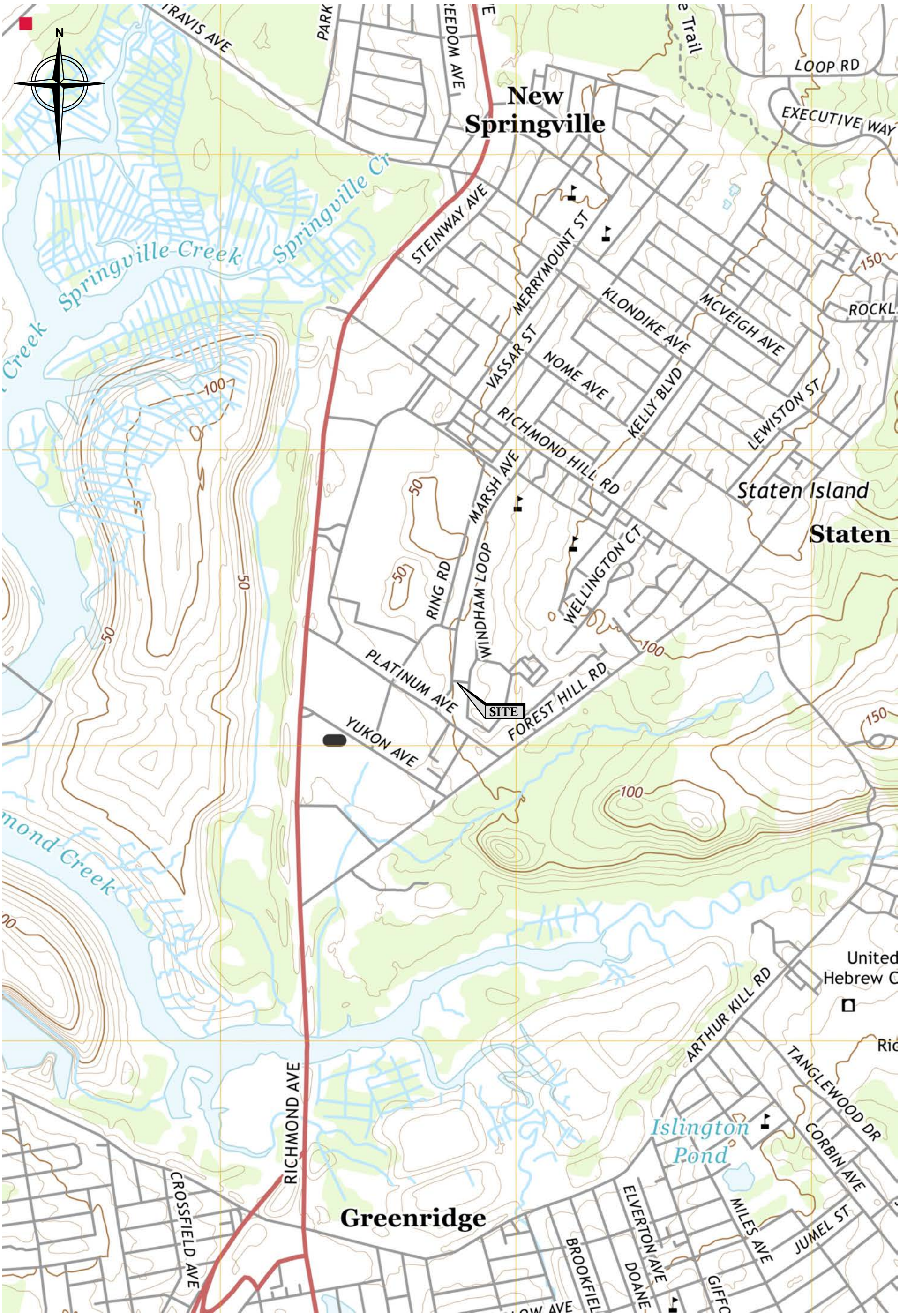
181	Number in bold and yellow background indicates an exceedance of NYSDOH Indoor/Outdoor Air Guidelines INDOOR AIR CONCENTRATION of COMPOUND (mcg/m3)/SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m3)
4.9	Number with blue background indicates the consituent was detected, but does not exceed the NYSDOH Indoor/ Outdoor Air Guidelines
ND(0.10)	Indicates the consituent was non-detect with the corresponding laboratory reporting limit.
J	J Indicates an estimated value.

Table 2
Former Carol Cleaners
280-30 Marsh Ave. Staten Island, NY

Sub-Slab Vapor Pressure Testing Pressure Readings - January 2024

Vacuum Testing Location	Pressure Reading (inches of water)
SI Mall-VT-1	-0.032
SI Mall-VT-2	-0.102
SI Mall-VT-3	-0.651
SI Mall-VT-4	-0.158
SI Mall-VT-5	-0.085
SI Mall-VT-6	-2.275
SI Mall-VT-7	-0.04

FIGURES



0 1000 2000

SCALE IN FEET

SOURCE:
7.5 MIN USGS QUADRANGLE, ARTHUR KILL NY/NJ, DATED 2019.

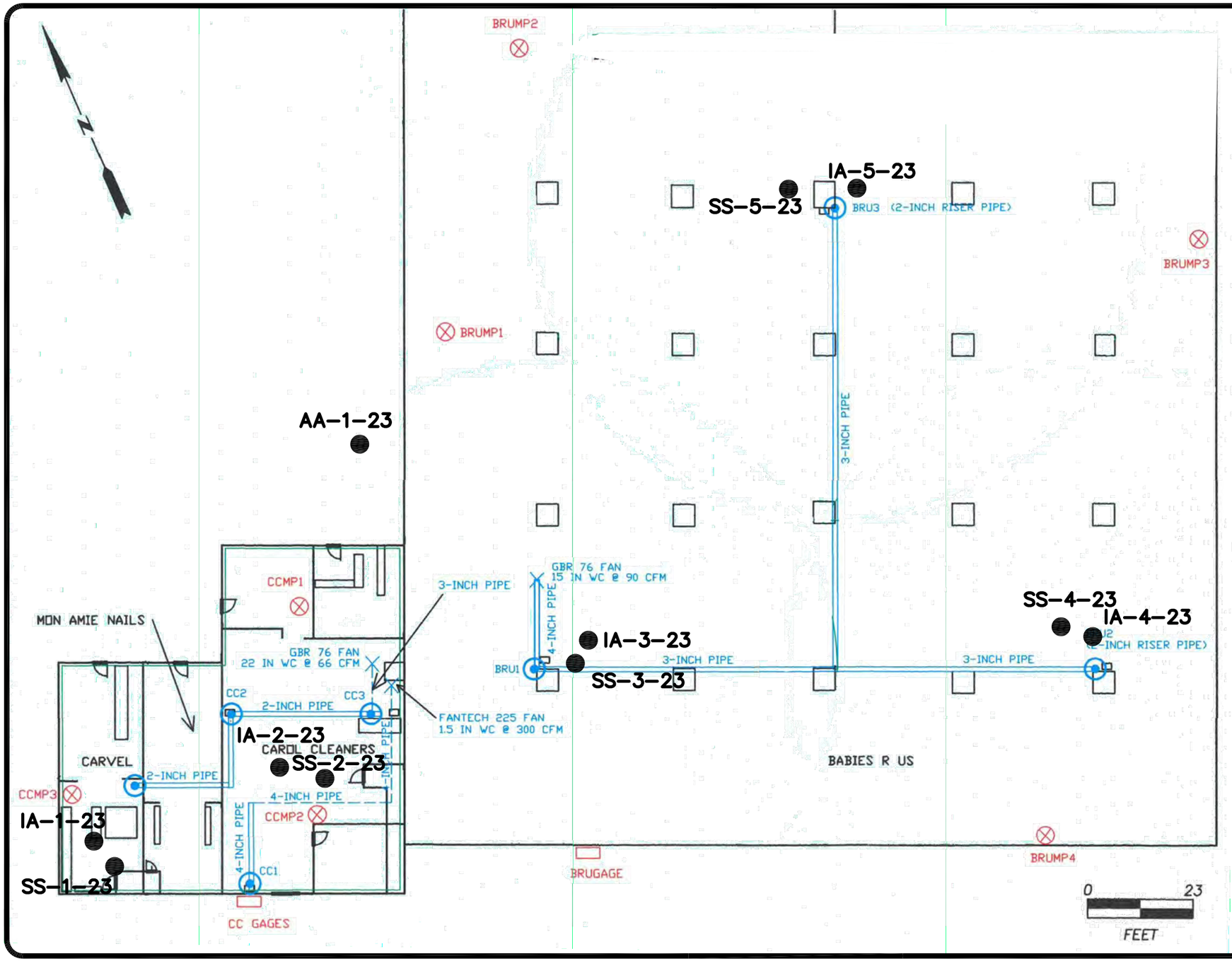
cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
CAROL CLEANERS – THE CROSSINGS
STATEN ISLAND, NEW YORK

SITE LOCATION MAP

FIGURE NO.
1
PROJECT NO.
4213307

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\213307-F-01-SITE LOCATION MAP.DWG Layout: FIGURE 01 User: JISS.PHILIP Feb 20, 2024 – 3:31pm



LEGEND

- SUCTION POINT LOCATION WITH DESIGNATION (CC1)
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE (GBR 76 FAN)
- IA–5–23 / SS–5–23: DECEMBER 2023 INDOOR AIR AND SUB-SLAB SAMPLING LOCATION
- MAGNAHELIC GAGE LOCATION

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 2/18/2015, AND INCLUDED WITHIN A FINAL ENGINEERING DESIGN REPORT SUBMITTED BY WSP DATED 6/26/2018 AND STAMPED BY WILLIAM K. BECKMAN, P.E., NYS PE #063219-1

ERICH ZIMMERMAN, P.E.

STATE OF NEW YORK · ERICH ZIMMERMAN · 081031 · LICENSED PROFESSIONAL ENGINEER

N.Y.P.E. Lic. No. 081031 Date 05/18/2023

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

INDOOR AIR AND SUB-SLAB SAMPLE LOCATIONS

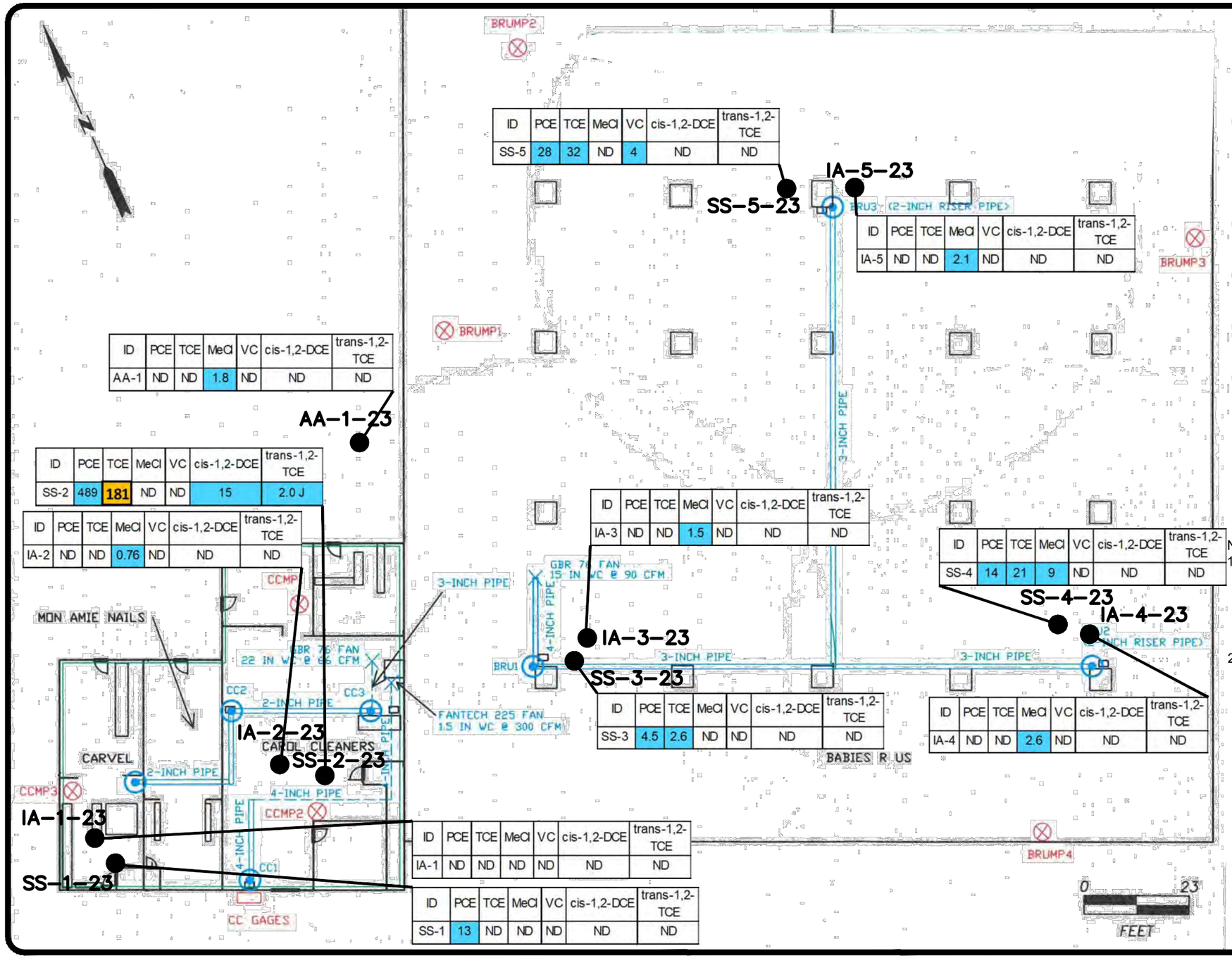
BASE DRAWING PREPARED BY: LBG ENGINEERING SERVICES, PC

SHEET NO. **2**

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\December 2023 Indoor Air and Sub-Slab.dwg Layout: Figure 2 User: JISS.PHILIP May

1" 1/2" 0" 1"



LEGEND

- SUCTION POINT LOCATION WITH DESIGNATION (CC1)
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE (GBR 76 FAN)

IA-5-23
SS-5-23
DECEMBER 2023 INDOOR AIR AND SUB-SLAB SAMPLING LOCATION

MAGNAHELIC GAGE LOCATION

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 2/18/2015, AND INCLUDED WITHIN A FINAL ENGINEERING DESIGN REPORT SUBMITTED BY WSP DATED 6/26/2018 AND STAMPED BY WILLIAM K. BECKMAN, P.E., NYS PE #063219-1
2. ALL RESULTS IN MICROGRAMS PER CUBIC METER AIR (UG/M3).

PCE -TETRACHLOROETHYLENE
TCE -TRICHLOROETHYLENE
MECL -METHYLENE CHLORIDE
VC -VINYL CHLORIDE
CIS-1,2-DCE -CIS-1,2-DICHLOROETHYLENE
TRANS-1,2-TCE -TRANS-1,2-DICHLOROETHYLENE

181 NUMBER IN BOLD AND YELLOW BACKGROUND INDICATES AN EXCEEDANCE OF NYSDOH INDOOR/OUTDOOR AIR GUIDELINES

15 NUMBER WITH BLUE BACKGROUND INDICATES THE CONSITUENT WAS DETECTED, BUT DOES NOT EXCEED THE NYSDOH INDOOR/ OUTDOOR AIR GUIDELINES

ERICH ZIMMERMAN P.E.

STATE OF NEW YORK ERICH ZIMMERMAN 081831 LICENSED PROFESSIONAL ENGINEER

N.Y.P.E. Lic. No. 081831-01 Date 05/18/2023

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

INDOOR AIR AND SUB-SLAB SAMPLE RESULTS

BASE DRAWING PREPARED BY: LBG ENGINEERING SERVICES, PC

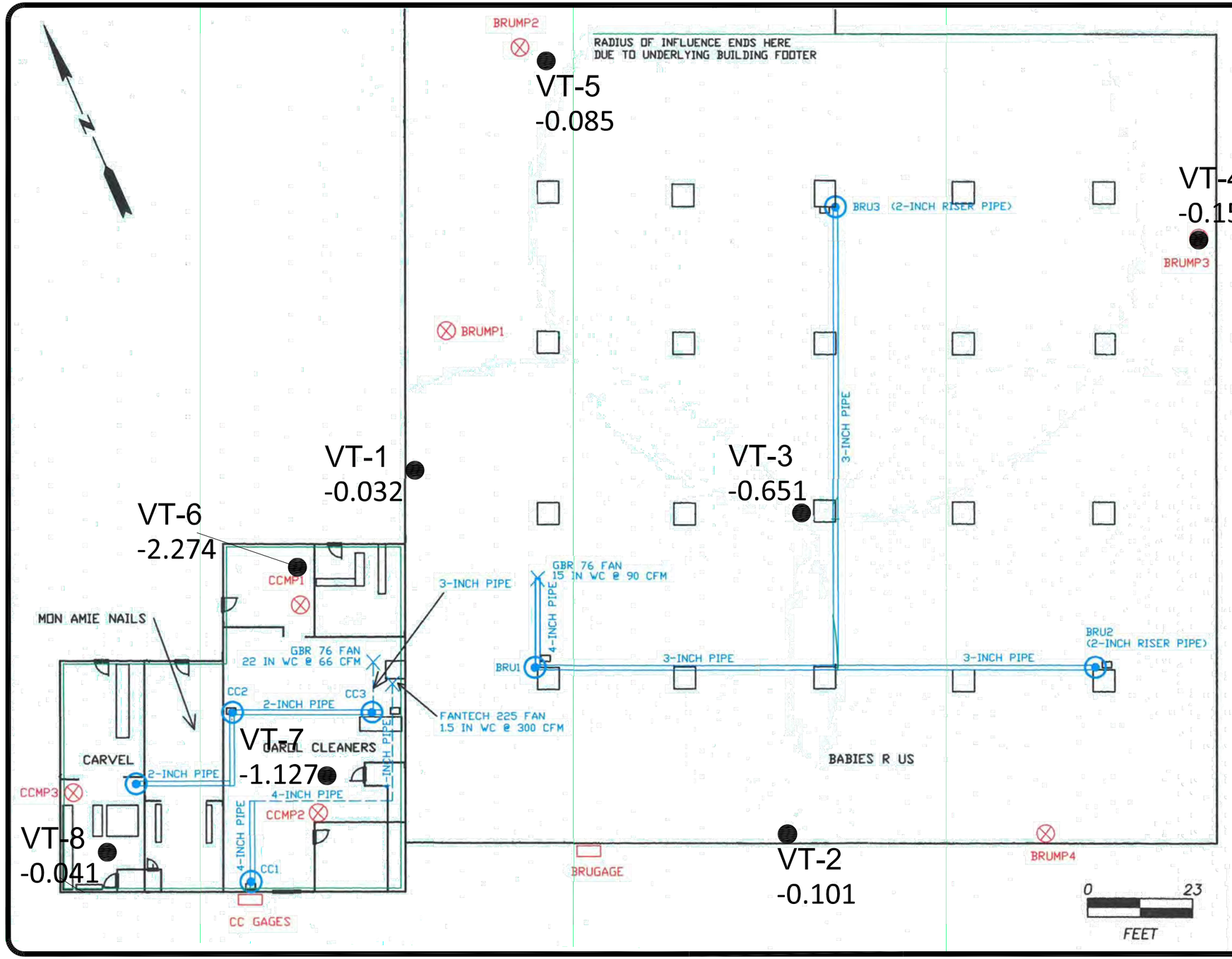
SHEET NO. **3**

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\December 2023 Indoor Air and Sub-Slab.dwg Layout: ANSI-B-L User: JISS.PHILIP

1" 1/2" 0" 1"

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\January 2024 Sub-Slab Vapor.dwg Layout: ANSI-B-L User: JISS.PHILIP Apr 29, 2024



LEGEND

- SUCTION POINT LOCATION WITH DESIGNATION (CC1)
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE (GBR 76 FAN)
- VT-3 -0.651 — VACUUM TESTING LOCATIONS & PRESSURE READING
- MAGNAHELIC GAGE LOCATION

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 2/18/2015, AND INCLUDED WITHIN A FINAL ENGINEERING DESIGN REPORT SUBMITTED BY WSP DATED 6/26/2018 AND STAMPED BY WILLIAM K. BECKMAN, P.E., NYS PE #063219-1

ERICH ZIMMERMAN, P.E.

STATE OF NEW YORK · ERICH ZIMMERMAN · 081831 · LICENSED PROFESSIONAL ENGINEER

N.Y.P.E. No. 081831-01 Date 04/29/2023

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

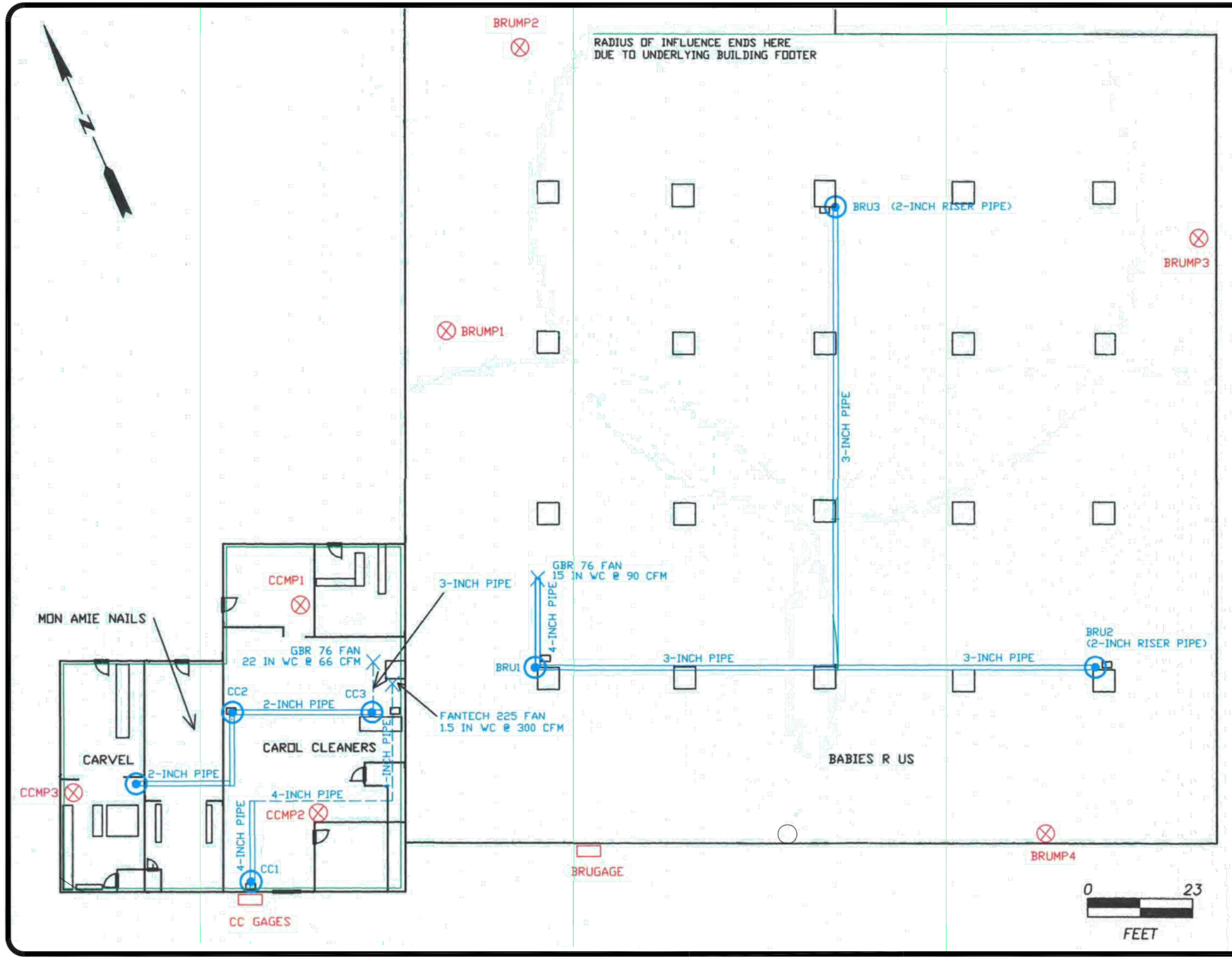
VACUUM TESTING LOCATIONS & PRESSURE READING

BASE DRAWING PREPARED BY: LBG ENGINEERING SERVICES, PC

SHEET NO. **4**

PROJECT NO. 4201222

1" 1/2" 0" 1"



LEGEND

- CC1 — SUCTION POINT LOCATION WITH DESIGNATION
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- GBR 76 FAN — LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE
- MAGNAHELIC GAGE LOCATION

NOTES:

1. INFORMATION SHOWN HEREIN WAS TAKEN FROM A DRAWING PREPARED BY LEGGETTE, BRASHEARS & GRAHAM, INC. DATED 2/18/2015, AND INCLUDED WITHIN A FINAL ENGINEERING DESIGN REPORT SUBMITTED BY WSP DATED 6/26/2018 AND STAMPED BY WILLIAM K. BECKMAN, P.E., NYS PE #063219-1

ERICH ZIMMERMAN, P.E.

N.Y.P.E. LIC. NO. 081831-01 Date 04/29/2023

cornerstone PLLC

GGP STATEN ISLAND MALL, LLC
FORMER CAROL CLEANERS SITE
STATEN ISLAND, NEW YORK

SSDS RECORD DRAWING

BASE DRAWING PREPARED BY: LBG ENGINEERING SERVICES, PC

SHEET NO. **5**

PROJECT NO. 4201222

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_Project Drawings\SSDS 2024.dwg Layout: ANSI-B-L User: JISS.PHILIP May 10, 2024 - 11:55am

APPENDIX A

FIELD DOCUMENTS

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name Reagan O'Donnell Date/Time Prepared 12/5/2023

Preparer's Affiliation CEG/Tetra Tech Phone No. _____

Purpose of Investigation _____

1. OCCUPANT:

Interviewed: Y / (N)

~~Last Name:~~ Soon to be Hobby Lobby First Name: _____

Address: 280-30 Marsh Ave, Staten Island NY 10314

County: Richmond

Home Phone: _____ Office Phone: _____

Number of Occupants/persons at this location _____ Age of Occupants _____

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

~~Last Name~~: Brookfield Properties First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) Soon to be Hobby Lobby

Does it include residences (i.e., multi-use)? Y / (N) If yes, how many? _____

Other characteristics:

Number of floors 1 Building age_____

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

_____

_____

_____

Airflow near source

_____

_____

_____

Outdoor air infiltration

_____

_____

_____

Infiltration into air ducts

_____

_____

_____

5. **BASEMENT AND CONSTRUCTION CHARACTERISTICS** (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other _____
c. Basement floor:	concrete	dirt	stone	other _____
d. Basement floor:	uncovered	covered	covered with _____	
e. Concrete floor:	unsealed	sealed	sealed with _____	
f. Foundation walls:	poured	block	stone	other _____
g. Foundation walls:	unsealed	sealed	sealed with _____	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			
k. Water in sump?	Y / N / not applicable			

Basement/Lowest level depth below grade: _____(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

_____

_____

6. **HEATING, VENTING and AIR CONDITIONING** (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other _____

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other_____
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

_____

_____

_____

_____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	_____
1st Floor	_____
2nd Floor	_____
3rd Floor	_____
4th Floor	_____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / (N)

b. Does the garage have a separate heating unit? Y / N / (NA)

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / (NA) Please specify_____

d. Has the building ever had a fire? Y / N When?_____

e. Is a kerosene or unvented gas space heater present? Y / N Where?_____

f. Is there a workshop or hobby/craft area? Y / N Where & Type? _____

g. Is there smoking in the building? Y / N How frequently? _____

h. Have cleaning products been used recently? Y / N When & Type? _____

i. Have cosmetic products been used recently? Y / N When & Type? _____

j. Has painting/staining been done in the last 6 months? Y / N Where & When? _____

k. Is there new carpet, drapes or other textiles? Y / N Where & When? _____

l. Have air fresheners been used recently? Y / N When & Type? _____

m. Is there a kitchen exhaust fan? Y / N If yes, where vented? _____

n. Is there a bathroom exhaust fan? Y / N If yes, where vented? _____

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type? _____

Are there odors in the building? Y / N
If yes, please describe: _____

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No
Yes, use dry-cleaning infrequently (monthly or less) Unknown
Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: _____
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _____
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: _____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

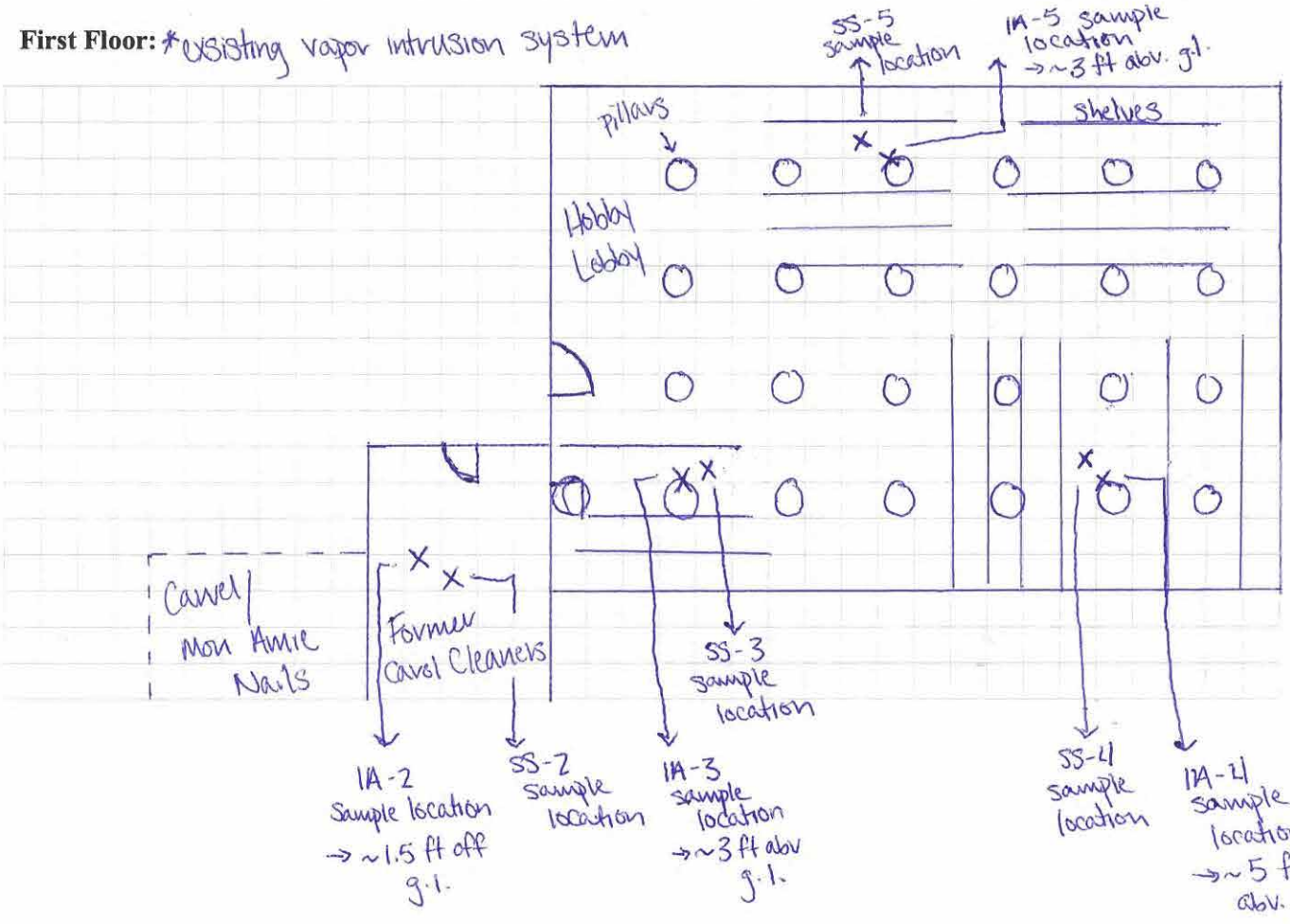
d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement: N/A

First Floor: *existing vapor intrusion system



12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.



13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: _____

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y / N

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name Reagan O'Donnell Date/Time Prepared 12/5/2023

Preparer's Affiliation CEG/Tetra Tech Phone No. _____

Purpose of Investigation _____

1. OCCUPANT:

Interviewed: Y / (N)

~~Last Name:~~ Carvelve First Name: _____

Address: 280-30 Marsh Ave, Staten Island NY 10314

County: Richmond

Home Phone: Bz Office Phone: _____

Number of Occupants/persons at this location _____ Age of Occupants _____

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

Last Name: Brookfield Properties First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	~~Other:~~ _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) Multi-Strip Mall; Carvel

Does it include residences (i.e., multi-use)? Y / (N) If yes, how many? _____

Other characteristics:

Number of floors 1 Building age_____

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

_____

_____

_____

Airflow near source

_____

_____

_____

Outdoor air infiltration

_____

_____

_____

Infiltration into air ducts

_____

_____

_____

5. **BASEMENT AND CONSTRUCTION CHARACTERISTICS** (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other _____
c. Basement floor:	concrete	dirt	stone	other _____
d. Basement floor:	uncovered	covered	covered with _____	
e. Concrete floor:	unsealed	sealed	sealed with _____	
f. Foundation walls:	poured	block	stone	other _____
g. Foundation walls:	unsealed	sealed	sealed with _____	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			
k. Water in sump?	Y / N / not applicable			

Basement/Lowest level depth below grade: _____(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

_____

_____

6. **HEATING, VENTING and AIR CONDITIONING** (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other _____

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other_____
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

_____

_____

_____

_____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	_____
1st Floor	_____
2nd Floor	_____
3rd Floor	_____
4th Floor	_____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / (N)

b. Does the garage have a separate heating unit? Y / N / (NA)

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / (NA) Please specify_____

d. Has the building ever had a fire? Y / N When?_____

e. Is a kerosene or unvented gas space heater present? Y / N Where? _____

f. Is there a workshop or hobby/craft area? Y / N Where & Type? _____

g. Is there smoking in the building? Y / N How frequently? _____

h. Have cleaning products been used recently? Y / N When & Type? _____

i. Have cosmetic products been used recently? Y / N When & Type? _____

j. Has painting/staining been done in the last 6 months? Y / N Where & When? _____

k. Is there new carpet, drapes or other textiles? Y / N Where & When? _____

l. Have air fresheners been used recently? Y / N When & Type? _____

m. Is there a kitchen exhaust fan? Y / N If yes, where vented?_____

n. Is there a bathroom exhaust fan? Y / N If yes, where vented?_____

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?_____

Are there odors in the building? Y / N
If yes, please describe: _____

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No
Yes, use dry-cleaning infrequently (monthly or less) Unknown
Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: _____
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _____
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: _____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

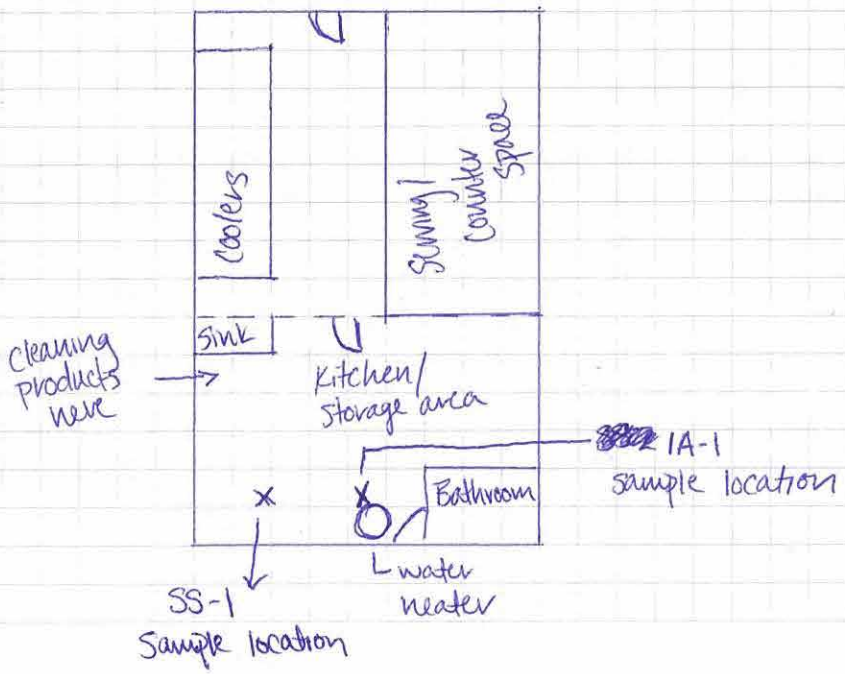
d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement: N/A

First Floor:



12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

* See previous drawing from July, 2022

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: _____

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo** Y / N
Rear	Lysol Disinfectant	19oz	U		N/A	Y
Rear	Purell Surface Sanitizer	32oz	U		N/A	Y
Rear	Raid Ant + Roach	17.5oz	U		N/A	Y
Rear	Windex Original	32oz	U		N/A	Y
Rear (multi (2))	Clorox	3.8 QT	U/UO		N/A	Y
Rear (multi (7))	Dawn	2.66L	U/UO		N/A	Y
Rear	Renuzit	7oz	UO		N/A	Y
Rear	Blaster Lithium Grease	11oz	U		N/A	Y

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Location SI Mall - Vapor Date 12/4/23

Project / Client Brookfield Prop.

9am - AK + RO on site, discussing scope, site walk; bldg forms

10:00 - AK + RO begin drilling SS points. Pins installed + capped before moving to next.

11:00 - SGS on site w/ air + gw supplies

12:15 - All vapor pins installed. Beginning leak tests. Photos of pins taken.

13:00 - Beginning summa can set up.

SS-5-23: FC998, can A1055, start 13:05 29.6"

IA-5-23 FC1212, can A188, start 13:15 28.3"

SS-4-23: FC812, can A1482, start 13:25 30.0"

IA-4-23 FC1125, can A049, start 13:30 30+"

SS-3-23 FC1181, can A627, start 13:35 30+"

IA-3-23 FC870, can A222, start 13:40 29.0"

SS-2-23 FC743, can A486, start 13:45 27.5"

IA-2-23 FC721, can A1694, start 13:50 27.3"

Location SI Mall - Vapor Date 12/4/23

Project / Client Brookfield prop

SS-1-23 FC653, can A1465, start 14:10 29.8"

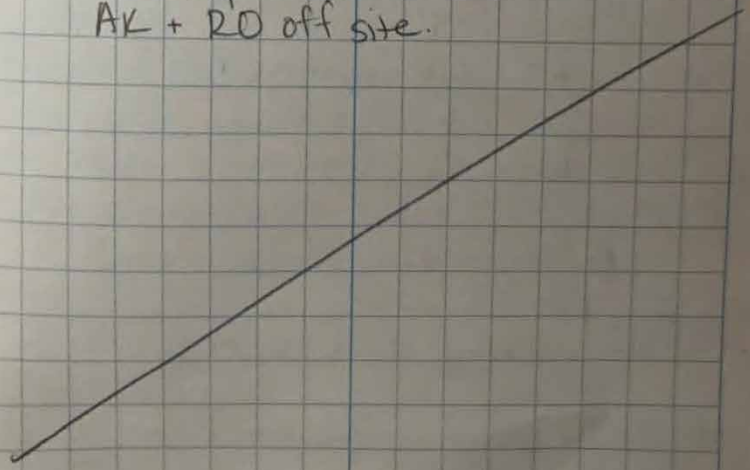
IA-1-23 FC864, can A1479, start 14:15 30+"

AA-1-23 FC1198, can A1599, start 14:20 28.8"

14:30 - All samples set + started. AK + RO packing.

15:00 - AK + RO - checking samples to ensure no lg loss of vac / all functioning.

15:30 - All samples ok. AK + RO off site.



Location SI Mall Date 12/5/23

Project / Client Brookfield Prop.

8:30 - AK on site to begin checking SS + IA samples.

9:00 - RO on site.

can checks

AA-01:	7.2	Stop - 10:15	5.4"
SS-5:	8.1	7.5	stop 11:45 5.5"
IA-5:	9	8.5	stop 12:45 5.0"
*SS-4:	26	25.5	stop @ 13:25 24.2"*
IA-4:	10	9.5	stop 13:30 5.8"
SS-3:	9	9	stop 12:50 5"
IA-3:	8.8	8	stop 12:45 5"
SS-2:	7.9	6.2	
IA-2:	5.6	stop - 9:35	5.1"
SS-1:	6	5.9 - stop 13:05	
IA-1:	7	5.5 stop - 13:00	

10:00 - AK + RO checking bottle sets, equipment etc for gw sampling.

11:00 - 14:00 AK + RO checking cans + taking WL's for gw sampling.

14:00 - Air sampling completed.

14:30 - Begin gw sampling.

Location SI Mall Date 12/5/23

Project / Client Brookfield Prop

WL's

Well	Time	WL btoc	Notes
MW-2	11:09	8.25	
MW-3	12:08	6.95	
MW-4	12:11	8.55	
MW-5	12:04	8.99	
MW-6R	12:26	7.15	
MW-7	11:37	8.44	
MW-8	11:40	8.60	
MW-10	11:16	8.22	
MW-16	12:56	8.91	
MW-17	13:00	9.35	
MW-18	13:03	9.58	
MW-19	13:07	10.46	
MW-20	12:53	8.71	
MW-21	11:31	8.72	o.c damaged
MW-22	11:25	8.12	
MW-23	12:15	6.11	
MW-24	12:20	*1.10	no cover; damaged?

16:45 - SGS on site for air samples.

17:00 - AK + RO cleaning up / offsite.

dk

Photographic Record

December 2023
Project No: 209-4213307-002

Client: Brookfield Properties Retail
Site Name: Former Carol Cleaners
Site Location: Staten Island Mall



Photograph No.: 001
Comments: Drilling of flush mount Vapor Pin® through drilling guide.



Photograph No.: 002
Comments: Installed Vapor Pin®



Photograph No.: 003
Comments: Leak testing of Vapor Pin® prior to sampling.



Photograph No.: 004
Comments: Flush mount cover

APPENDIX B

DATA USABILITY SUMMARY REPORT AND LABORATORY DATA PACKAGE

cornerstone PLLC

MEMO

To:	
Cc:	
From:	Diane Conroy
Date:	6/6/2024
Subject:	Data Validation – Brookfield Staten Island Mall

Review has been completed for the data package generated by SGS North America, Inc – Dayton, New Jersey that pertain to indoor air quality samples collected at the Staten Island Mall on December 5, 2023. The data package was reviewed for required constituents, duplicates, field blanks, trip blanks, matrix spikes, laboratory control samples, and method blanks.

Data validation was performed on two data packages with guidance from the USEPA CLP National Functional Guidelines for Organic Data Review Standard Operating Procedure (SOP). The following items were reviewed:

- Data completeness
- Custody Documentation
- Holding Times
- Surrogate and Internal Standard Recoveries
- Blank Spike (BS) and Blank Spike Duplicate (BSD) Recovery Correlations
- Preparation/Calibration Blanks
- Method Compliance

Those items showing deficiencies are discussed in the following sections of the report. Items not mentioned in the following discussion were found to be acceptable as outlined in the above-mentioned validation procedures and as applicable for the methodology. Unless specifically noted in the following text, reported results of the validated samples are substantiated by the raw data, and generated in compliance with the protocol requirements.

The case narrative, annotated quality control (QC) results, and annotated sample results are attached to this text and should be reviewed in conjunction with this report.

LABORATORY REPORT: JD78191

The samples were analyzed within their holding times. Internal standard areas, retention times, and surrogate results fell within acceptable ranges. Generally, continuing calibration results, with the most recent calibrations performed on on December 7, 8, 9, and 12, 2023, indicated results within acceptable ranges.

<u>Blank Spike (BS) and Blank Spike Duplicate (BSD) Recovery Correlations</u>

Bromoform recovered high in the QC processes associated with sample locations 5 through 11. As outlined in the SOP, the detected laboratory results should be qualified with a “J”. Despite the elevated percent

recovery indicated in the QC analyses, the associated results in the laboratory report were not detected, therefore no changes were made to the laboratory report.

Benzyl chloride recovered high in the QC processes associated with sample location 11. As outlined in the SOP, the detected laboratory results should be qualified with a “J”. Despite the elevated percent recovery indicated in the QC analysis, the associated results in the laboratory report were not detected, therefore no changes were made to the laboratory report.

Hexachlorobutadiene and 1,2,4-trichlorobenzene recovered high in the QC processes associated with sample location 9. As outlined in the SOP, the detected laboratory results should be qualified with a “J”. Despite the elevated percent recovery indicated in the QC analysis, the associated results in the laboratory report were not detected, therefore no changes were made to the laboratory report.

Carbon disulfide recovered high in the QC processes associated with sample locations 3 and 8. As outlined in the SOP, the detected laboratory results should be qualified with a “J”. Despite the elevated percent recovery indicated in the QC analyses, the associated results in the laboratory report were not detected, therefore no changes were made to the laboratory report.

Hexachlorobutadiene, 1,2,4-trichlorobenzene, and 1,2,4-trimethylbenzene recovered high in the QC processes associated with sample location 7. As outlined in the SOP, the detected laboratory results should be qualified with a “J”. The appropriate changes to the results for 1,2,4-trimethylbenzene have been made in the laboratory report.

There were no constituents in this laboratory report that were detected in both the laboratory method blank as well as the sample results.

SUMMARY

During the Data Validation procedures, the required constituents, duplicates, field blanks, trip blanks, blank spikes, and method blanks were reviewed. It was determined that the sample results were reported within compliance to protocol requirements and with adherence to quality criteria. The laboratory results are usable as reported, or usable as qualified.

APPENDIX C

NYSDOH AIR MATRICES

Soil Vapor / Indoor Air Matrix A

May 2017

Analytes Assigned:
Trichloroethene (TCE), *cis*-1,2-Dichloroethene (*c*12-DCE), 1,1-Dichloroethene (11-DCE), Carbon Tetrachloride

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m³)		
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m³)	< 0.2	0.2 to < 1	1 and above
< 6	1. No further action	2. No Further Action	3. IDENTIFY SOURCE(S) and RESAMPLE or MITIGATE
6 to < 60	4. No further action	5. MONITOR	6. MITIGATE
60 and above	7. MITIGATE	8. MITIGATE	9. MITIGATE

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) and Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX A

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.20 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

Soil Vapor / Indoor Air Matrix B

May 2017

Analytes Assigned:
Tetrachloroethene (PCE), 1,1,1-Trichloroethane (111-TCA), Methylene Chloride

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m³)		
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m³)	< 3	3 to < 10	10 and above
< 100	1. No further action	2. No Further Action	3. IDENTIFY SOURCE(S) and RESAMPLE or MITIGATE
100 to < 1,000	4. No further action	5. MONITOR	6. MITIGATE
1,000 and above	7. MITIGATE	8. MITIGATE	9. MITIGATE

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) and Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX B

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 1 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

Soil Vapor/Indoor Air Matrix C

May 2017

Analytes Assigned:
Vinyl Chloride

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)	
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 0.2	0.2 and above
< 6	1. No further action	2. IDENTIFY SOURCE(S) and RESAMPLE or MITIGATE
6 to < 60	3. MONITOR	4. MITIGATE
60 and above	5. MITIGATE	6. MITIGATE

No further action: No additional actions are recommended to address human exposures.

Identify Source(s) and Resample or Mitigate: We recommend that reasonable and practical actions be taken to identify the source(s) affecting the indoor air quality and that actions be implemented to reduce indoor air concentrations to within background ranges. For example, if an indoor or outdoor air source is identified, we recommend the appropriate party implement actions to reduce the levels. In the event that indoor or outdoor sources are not readily identified or confirmed, resampling (which might include additional sub-slab vapor and indoor air sampling locations) is recommended to demonstrate that SVI mitigation actions are not needed. Based on the information available, mitigation might also be recommended when soil vapor intrusion cannot be ruled out.

Monitor: We recommend monitoring (sampling on a recurring basis), including but not necessarily limited to sub-slab vapor, basement air and outdoor air sampling, to determine whether concentrations in the indoor air or sub-slab vapor have changed and/or to evaluate temporal influences. Monitoring might also be recommended to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined based on site-, building- and analyte-specific information, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: We recommend mitigation to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

These general recommendations are made with consideration being given to the additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX C

This matrix summarizes actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate analyte-specific, building-specific conditions (e.g., dirt floor in basement, crawl spaces, thick slabs, current occupancy, etc.), and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, collection of additional samples may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Mitigation might be recommended when the results of multiple contaminants indicate monitoring is recommended. Proactive actions may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action might be undertaken for reasons other than public health (e.g., seeking community acceptance, reducing costs, etc.). However, actions implemented *in lieu* of sampling will typically be expected to be captured in the final engineering report and site management plan, and might not rule out the need for post-implementation sampling (e.g., to document effectiveness or to support terminating the action).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of soil vapor contamination, nor does it preclude remediating contaminated soil vapor or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.20 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples and dirt floor soil vapor samples, a minimum reporting limit of 1 microgram per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions might be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including but not limited to the following: the identified source of the volatile chemicals, the environmental remediation program, and analyte-specific, site-specific and building-specific factors.

APPENDIX D

VACUUM TESTING LOCATION PICTURES

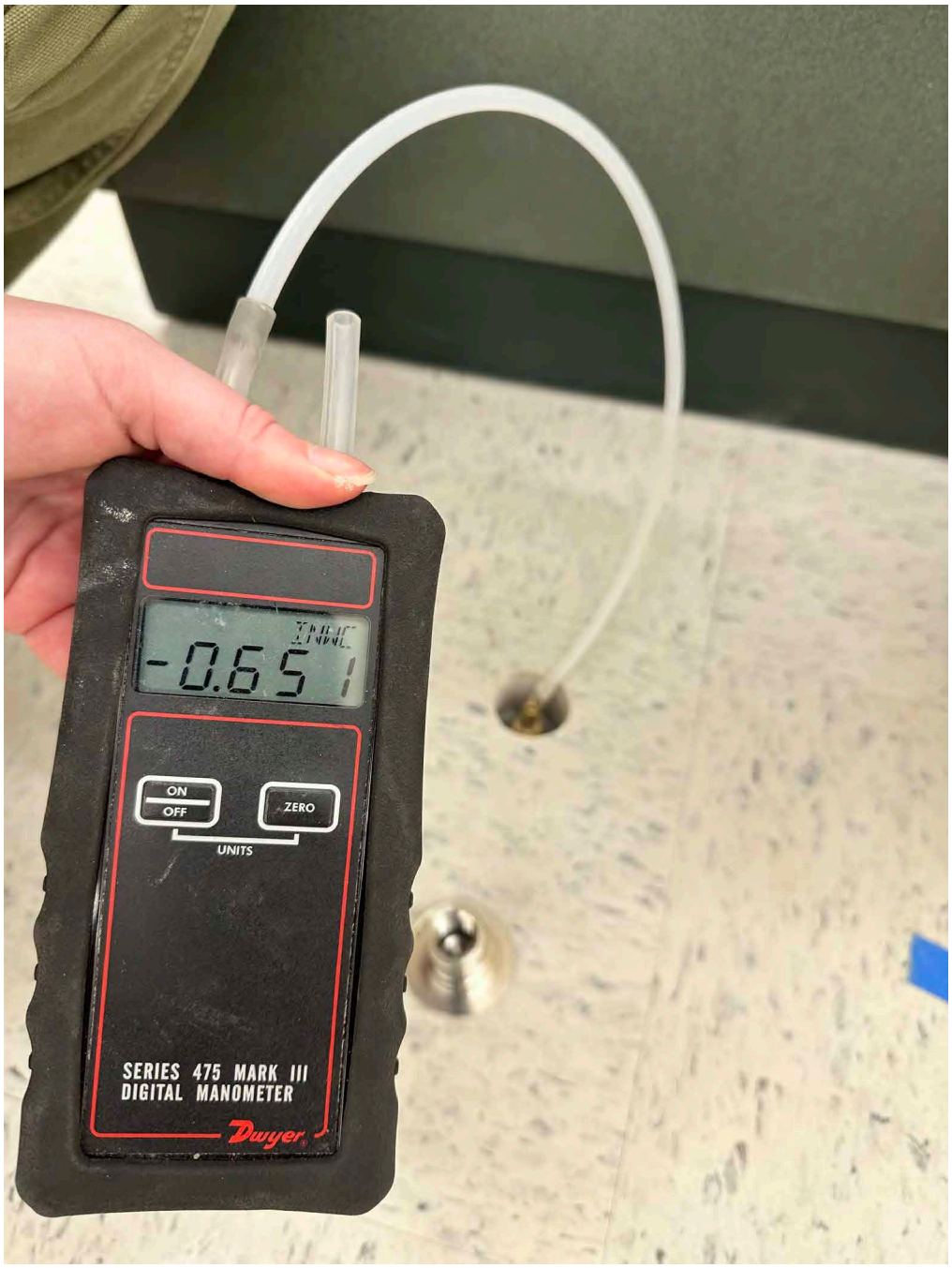


SI Mall-VT-1

Tetra Tech
100 Crystal Run Road, Suite 101, Middletown, NY 10941
Tel 877.294.9070 **Fax** 877.845.1456 | tetratech.com


-0.101
ON
OFF
ZERO
UNITS
SERIES 475 MARK III
DIGITAL MANOMETER
Dwyer

SI Mall-VT-2


-0.651
ON
OFF
ZERO
UNITS
SERIES 475 MARK III
DIGITAL MANOMETER
Dwyer

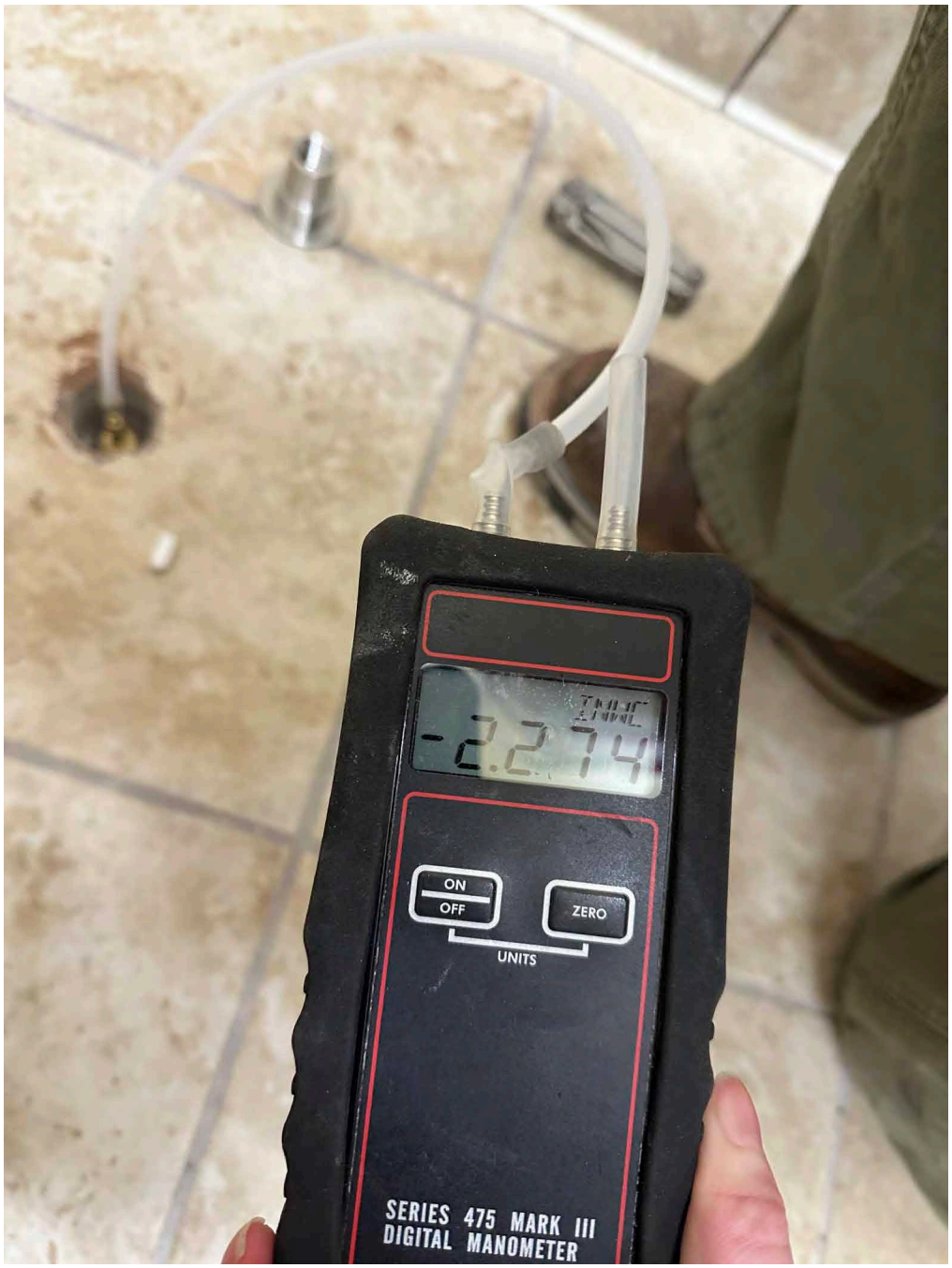
SI Mall-VT-3


-0.158
ON
OFF
ZERO
UNITS
SERIES 475 MARK III
DIGITAL MANOMETER
Dwyer

SI Mall-VT-4


-0.085
ON
OFF
ZERO
UNITS
SERIES 475 MARK III
DIGITAL MANOMETER
Dwyer

SI Mall-VT-5


-2.274
ON
OFF
ZERO
UNITS
SERIES 475 MARK III
DIGITAL MANOMETER

SI Mall-VT-6


-1.127
ON
OFF
ZERO
UNITS
SERIES 475 MARK III
DIGITAL MANOMETER
Dwyer

SI Mall-VT-7


-0.040
ON
OFF
ZERO
UNITS
SERIES 475 MARK III
DIGITAL MANOMETER
Dwyer

SI Mall-VT-8

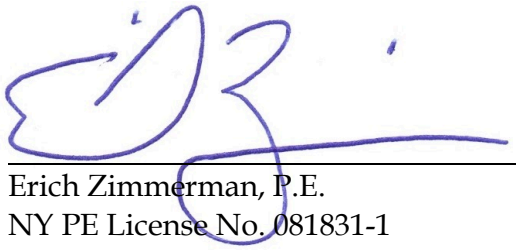
APPENDIX H - EXCAVATION WORKPLAN

Attachment H – Excavation Work Plan

Former Carol Cleaners Site
Staten Island, Richmond County, NY

The material and data in this Excavation Work Plan were prepared under the supervision and direction of the undersigned.

Cornerstone Engineering and Geology, PLLC



01/21/2026

Erich Zimmerman, P.E. Date
NY PE License No. 081831-1

It is a violation of Article 145 of the New York State Education Law; unless acting under the direction of a licensed Professional Engineer who affixes signature, date, seal and the words "altered by"; for any person to alter this document in any way.

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 GENERAL 1
1.2 NOTIFICATION 1

2 EXCAVATION PLAN 3

2.1 SITE PREPARATION AND STORMWATER POLLUTION PREVENTION 3
2.2 HEALTH AND SAFETY AND COMMUNITY AIR MONITORING PLAN 3
2.3 ODOR CONTROL PLAN 4
2.4 DUST CONTROL 4
2.5 EXCAVATION 4
2.6 FLUIDS MANAGEMENT 5
2.7 IMPORTED FILL 6

1 INTRODUCTION

1.1 General

Soil remediation at the Former Carol Cleaners Site (the Site) was completed in June 2017, and as a result of the completion of remediation. The extent and degree of PCE-impacted soil at the site is minimal, localized, and does not appear to be acting as a continuing source of groundwater impacts. The soil in the corresponding area is effectively capped, as the entire property is covered by asphalt, concrete, and the footprint of the mall building. As such, the SMP assumed the use of this cap to address the impacted soil is an appropriate Institutional Control (IC) for the Site. Consequently, while Site-disturbance activities are not planned, if future disturbance of soils were to occur, it should be performed in accordance with this Excavation Work Plan (EWP) so that soils and groundwater are handled properly.

1.2 Notification

If soil disturbance is planned at the Site, at least 15 days prior to the start of any such activity, the Site owner or their representative will notify the NYSDEC and the NYSDOH as follows:

Yildiz Palumbo, NYSDEC Project Manager
Phone: (718) 482-4891
E-mail address: yildiz.palumbo@dec.ny.gov

Sarita Wagh, NYSDOH Project Manager
Phone: (518) 402-7817
E-mail address: sarita.wagh@health.ny.gov

The Site owner or their representative will coordinate with the NYSDEC and the NYSDOH regarding other notifications, if any, that may be necessary prior to soil disturbance activity.

The notification will include the following:

- A description of the work to be performed, including the location and areal extent of excavation, and drawings showing site grading, if regrading is proposed;
- A summary of environmental conditions anticipated to be encountered in the work areas, such as whether groundwater will be encountered;
- A schedule for the 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) and Community Air Monitoring Plan (CAMP);
- Identification of disposal facilities, or destinations for reuse, if any, and the basis for the final destination of materials; and
- Identification of sources of off-site backfill, if any is proposed to be used, along with chemical testing results.

2 EXCAVATION PLAN

2.1 Site Preparation and Stormwater Pollution Prevention

Prior to the start of soil disturbance activities, the contractor will be responsible for notifying Dig Safely New York (811), and also verifying if there are any utilities on Site that may be disturbed and require protection or removal.

Also prior to the start of soil disturbance activities, a sediment barrier such as silt fencing or hay bales will be installed around the perimeter of the disturbance area. If the soil disturbance is more than one acre, the contractor responsible for the work will prepare a Stormwater Pollution Prevention Plan in accordance with the NYSDEC Division of Water guidance and regulations, and obtain coverage under a construction general stormwater management permit or an individual stormwater management permit, as may be applicable depending on the scope of the work. Additional soil erosion and sediment control measures may be necessary depending on the scope of the soil disturbance activity.

Manufacturer's recommendations will be followed for installation, maintenance and repair of silt fencing used as a sediment barrier for the soil disturbance work.

Sediment barriers will be inspected once a week and after storm events. Results of inspections will be recorded in a logbook and maintained at the Site and be available for inspection by regulatory authorities. Repairs to sediment barriers will be made immediately.

Accumulated sediments will be removed as required to keep the sediment barriers functional.

Stormwater discharge locations will be inspected once per week and after storm events to ascertain whether erosion control measures are effective in preventing potential impacts to receiving waters.

A stabilized construction entrance will be used to control potential sediment transport onto public roadways. Public roadways will be cleaned of sediment as necessary on a continuing basis.

2.2 Health and Safety and Community Air Monitoring Plan

Prior to the start of soil disturbance activities, the Contractor responsible for the work will prepare a Site-specific Health and Safety Plan and a Community Air Monitoring Plan.

Each entity on the Site during any soil disturbance activities is solely responsible for the health and safety of its employees.

2.3 Odor Control Plan

Site-related COCs have the potential to be odorous even if below applicable cleanup levels. Therefore, before the start of soil disturbance activities, the contractor will prepare an Odor Control Plan, and have odor control facilities as defined in the plan in place prior to the start of the work. Odor control methods to be used on a routine basis may include limiting the area of open excavations and size of soil stockpiles, use of suppressant foam cover or soil, other means of covering excavations or stockpiles (e.g., tarps) or other means approved by the NYSDEC prior to the start of work.

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 nuisance odors have been abated. The NYSDEC will be notified of odor complaints.

2.4 Dust Control

Before the start of soil disturbance activities, the contractor will prepare a Dust Control Plan, and have dust control facilities as defined in the plan in place prior to the start of the work.

A dust suppression plan that addresses dust management during invasive on-Site work will include the following, as applicable:

- The equipment that will be available for wetting with water to suppress dust on access roads, and other open areas.
- Minimizing clearing and grubbing of larger areas to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Use of gravel on roadways, as applicable, to provide a "dust-free" road surface.

2.5 Excavation

As excavation commences, soil screening will be used to assess the potential for encountering contaminated materials not otherwise anticipated based on Site conditions following the completion of the soil remediation. Visual, olfactory and instrument-based (e.g. photoionization detector) soil screening will be performed at active soil disturbance areas. If screening indicates soils that may be differentiated based on potential for contamination, the materials will be segregated as appropriate.

Temporarily stockpiled soils, if not within the confines of an overall sediment barrier, will be encircled with a sediment barrier to control potential sediment transport. If temporarily

stockpiled soils are encountered, which may be contaminated, then these soils will be separately stockpiled on plastic sheeting and covered with plastic sheeting to control potential transport of contaminated material.

Excavated materials, depending on the nature of the soil disturbance activity, may be handled as follows:

- For a small, temporary disturbance, the soil may be reused in the excavation, unless there are indications of contamination that require separate management; or
- For soil disturbance for the purpose of regrading that would result in excess soil at the conclusion of the work, such material will be loaded into trucks for transport to an off-site location for disposal or reuse.

If materials are to leave the site, the following procedures will be used:

- Materials will be chemically characterized in accordance with the NYSDEC DER-10 sampling frequency requirements and per the analytical testing requirements of the Remedial Action Work Plan, Quality Assurance Project Plan.
- The chemical characterization data will be compared to the Site-specific cleanup levels, and the 6 CRR-NY Part 375 cleanup objectives.
- Off-site destinations of excavated material will be based on the chemical characterization data comparison to cleanup objectives. Excavated material will only be shipped off Site to locations acceptable based on chemical characterization.
- Any material meeting the classification of waste will be transported off-site by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 CRR-NY Part 364. Haulers will be appropriately licensed and trucks properly placarded. Wastes shipped off-Site will be documented with manifests.
- Material transported by trucks exiting the Site will be secured with tight-fitting covers. If loads contain wet material capable of producing free liquid, truck liners will be used.
- Trucks exiting the Site must turn right onto Maybrook Road and proceed to their destination from that point. Queuing or idling on public roads is not permitted.

2.6 Fluids Management

If the soil disturbance activity intersects the groundwater table and groundwater must be managed, or stormwater comes in contact with excavated material or groundwater, such

liquids are to be properly managed and are not permitted to be directly discharged to any surface water body. Management of liquids may be as follows:

- Liquids may be containerized, chemically characterized, transported and disposed of in accordance with applicable local, State, and Federal regulations.

- Liquids may be discharged to surface waters per a SPDES permit, and will be subject to treatment to meet the SPDES discharge limits. If discharge will be under a SPDES permit the contractor responsible for the fluids management will obtain the permit from the NYSDEC.

2.7 Imported Fill

If the soil disturbance activities involve the importation of backfill materials, the following procedures will apply:

- The sources of the proposed backfill material imported from off-site must be identified in advance to the property owner for acceptance.

- All imported soils will meet the backfill and cover soil quality standards established in 6CRR-NY 375-6.7(d).

- Only imported backfill meeting the 6 CRR-NY 375-6.8(a) and (b) criteria for unrestricted or residential use will be acceptable. Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the site.

APPENDIX I - HASP

HEALTH AND SAFETY REQUIREMENTS

GENERAL

This appendix to the Site Management Plan (SMP) includes health and safety requirements for activities undertaken at the Former Carol Cleaners Site (the Site). Requirements include training, personal protective equipment, and specific information to be included in a Health and Safety Plan. Any contractor, organization, governmental body, or any other entity is solely responsible for the health and safety of its employees while/if working at the Site. Any entity working at the Site is responsible for preparing a health and safety plan covering its employees.

SITE CONDITIONS

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 Richmond County Clerk, requires compliance with this SMP and all ECs and ICs placed on the site. In addition, Site-related COCs remain in groundwater at concentrations above New York State Groundwater Quality Standards at 6 CRR-NY 703.5 and above New York State Technical and Operational Guidance Series (TOGS) 1.1.1 Guidance Values. Brookfield Properties (Brookfield; formerly The Rouse Company) entered into an Order on Consent on October 4, 2002 (last amended on November 4, 2011) with the NYSDEC to remediate the site.

Any entity working on the Site which may involve intrusive contact with soils or groundwater should review a copy of the Full-Scale Remedial Design Work Plan, the SMP for information on COCs at the Site. The property owner takes no responsibility for the completeness of the information provided herein. Any entity working at the Site is solely responsible for making its own determinations regarding site conditions and the health and safety of its employees. The attached Table 1 and 2 provides a summary of Site COCs and concentrations above Site-related soil and groundwater cleanup levels per the Record of Decision for the Site.

RESPONSIBILITIES, TRAINING, AND MINIMUM PPE REQUIREMENTS

Any entity working working on Site is responsible for managing the Site, controlling access, and checking credentials for visitors, per a site-specific health and safety plan.

While on Site personnel are required to at a minimum to don:

- General work clothes
- Hard hat
- Safety glasses
- Steel toe boots
- Hi-visibility safety vests

Other personal protective equipment (PPE) will be as defined in a site-specific health and safety plan.

Personnel working on Site must be Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-hour trained, and be current with 8-hour HAZWOPER refresher training, and have a current OSHA required medical clearance from a qualified health care provider, as applicable.

Supervisory personnel must have completed the 8-hour HAZWOPER Supervisor Training.

Requirements for 40-hour training may be modified per the provisions of OSHA 1910-120 for non-intrusive activities.

SITE-SPECIFIC HEALTH AND SAFETY PLAN

A Site-specific Health and Safety Plan (HASP) must establish policies and procedures to protect workers and the public from the potential hazards posed by the work. The HASP must be prepared and submitted to the USEPA before intrusive Site activities proceed.

A Site-specific Health and Safety Plan must conform to requirements under 29 CFR 1910.120, and 29 CFR 1926. At a minimum the plan must:

- Name key personnel and alternates responsible for site safety.
- Describe risks associated with each operation conducted.
- Confirm that personnel are adequately trained to perform their job responsibilities and to handle the specific situations they may encounter.
- Include provisions for daily safety meetings.
- Describe the protective clothing and equipment to be worn by personnel during site activities.
- Describe any site-specific medical surveillance requirements.
- Describe the program for periodic air monitoring, personnel monitoring, and environmental sampling (if needed).
- Describe the actions to be taken to mitigate hazards.
- Define site control measures, visitor logs, exclusion zones, etc., and include a site map.
- Define means to monitor and protect the surrounding community, including both an encompassing workspace and community air monitoring program (CAMP) meeting the minium requirements of the CAMP attached. Air monitoning program should include thresholds for respirator requirements and stopwork conditions.
- Establish decontamination procedures for personnel and equipment.
- Set forth Standard Operating Procedures for Health and Safety.
- Include a site-specific contingency plan in the event of site emergencies.
    - Provide documentation of medical monitoring, if applicable.
    - Provide documentation of personnel training.
    - Provide documentation of personnel respirator qualification and fit testing, if respirators are in use or are planned for use.

RESPONSIBILITIES DURING SITE ACTIVITIES

Maintain required forms and OSHA records on Site as applicable.

Maintain a Site chemical inventory and index of Safety Data Sheets for the chemicals or products present on Site.

Implement health and safety procedures in accordance with the Site-specific Health and Safety Plan and relevant regulations.

Control site access at all times, including access through open gates during working hours.

Implement health and safety monitoring in accordance with the HASP and CAMP, and maintain records on Site for review by governing authorities.

Update the HASP as needed as the work progresses, and advise the USEPA and Site owner of any changes.

Prepare Job Safety Analyses (JSAs) for activities to be performed for the completion of the Work. Maintain JSAs on site.

Update JSAs as necessary during the course of the work.

Coordinate with the USEPA, Site owner, or any other governing authority in the event of questions regarding protection of the community or if an emergency situation occurs.

In the event of an emergency or release execute reporting responsibilities in accordance with the requirements of the HASP.

Prepare incident reports for any occurrences resulting in injury or property damage and for any occurrences deemed to be near misses, and provide such reports to governing authorities, as applicable

TABLES

TABLE 1

Potential Inhalation and Explosive Hazards of the Contaminants of Concern

Constituent	Permissible Exposure Limit (PEL)	Immediately Dangerous to Life and Health (IDHL)	Lower Explosive Limit (LEL)	Upper Explosive Limit (UEL)
Tetrachloroethylene	TWA - 100 ppm C - 200 ppm* (*300 ppm [5 minute max peak in 3 hours])	150 ppm	NA	NA
Trichloroethylene	TWA - 100 ppm C – 200 ppm* (*300 ppm [5-minute max peak in 2 hours])	1,000 ppm	8% (77°F)	10.5% (77°F)
cis-1,2-Dichloroethylene	TWA - 200 ppm (790 mg/m^3)	1,000 ppm	5.6%	12.8%
trans-1,2-Dichloroethylene	TWA - 200 ppm (790 mg/m^3)	1,000 ppm	5.6%	12.8%
Vinyl Chloride	TWA - 1 ppm (C - 5 ppm [15-minute])	ND	3.6%	33%
Methylene Chloride	TWA – 25 ppm (ST – 125 ppm)	2,300 ppm	13%	23%

C - Ceiling
mg/m^3 – milligrams per cubic meter.
NA - Not Applicable.
ND - Not Determined.
ppm - parts per million.
ST - Short-term
TWA - Time-weighted average.

TABLE 2

Health Effects of the Contaminants of Concern

Constituent	Symptoms	First Aid	Target Organs
Tetrachloroethylene	**Potential Symptoms:** Irritation of eyes, skin, nose, throat, and respiratory system; nausea; flushing of face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	**Eyes**: Irrigate immediately **Skin**: Soap wash promptly **Breath**: Respiratory support **Swallow**: Immediate medical attention	Eyes, skin, respiratory system, liver, kidneys, central nervous system (CNS)
Trichloroethylene	**Potential Symptoms:** Irritation of eyes, skin; headache; visual disturbance; lassitude (weakness, exhaustion), dizziness; tremor; drowsiness, nausea; vomiting; dermatitis; cardiac arrhythmia, paresthesia; liver injury; potential male reproductive toxin; [potential occupational carcinogen]	**Eyes**: Irrigate immediately **Skin**: Soap wash promptly **Breath**: Respiratory support **Swallow**: Immediate medical attention	Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system (CNS)
cis-1,2-Dichloroethylene	**Potential Symptoms:** Irritation of eyes, respiratory system irritation; central nervous system (CNS) depression, light-headedness, dizziness, euphoria, nausea, vomiting, weakness, tremor, epigastric cramps; dermatitis	**Eyes**: Irrigate immediately **Skin**: Soap wash promptly **Breath**: Respiratory support **Swallow**: Immediate medical attention	Eyes, respiratory system, central nervous system (CNS)
trans-1,2-Dichloroethylene	**Potential Symptoms:** Irritation of eyes, respiratory system irritation; central nervous system (CNS) depression, light-headedness, dizziness, euphoria, nausea, vomiting, weakness, tremor, epigastric cramps; dermatitis	**Eyes**: Irrigate immediately **Skin**: Soap wash promptly **Breath**: Respiratory support **Swallow**: Immediate medical attention	Eyes, respiratory system, central nervous system (CNS)
Vinyl Chloride	**Potential Symptoms:** Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]	**Eyes**: Frostbite **Skin**: Frostbite **Breath**: Respiratory support	Liver, central nervous system (CNS), blood, respiratory system, lymphatic system
Methylene Chloride	**Potential Symptoms:** Irritation of eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numb, tingle limbs; nausea; [potential occupational carcinogen]	**Eyes**: Irrigate immediately **Skin**: Soap wash promptly **Breath**: Respiratory support **Swallow**: Immediate medical attention	Eyes, skin, cardiovascular system, central nervous system (CNS)

ATTACHMENT A
COMMUNITY AIR MONITORING PROGRAM

APPENDIX A

Former Carol Cleaners Site
Community Air Monitoring Plan

General

This Community Air Monitoring Plan (CAMP) includes real-time monitoring for the potential presence of volatile organic compounds (VOCs) and particulates (i.e., dust) at the Former Nepera Chemical Company Superfund Site (the Site) when activities are being performed that may disturb the soils in the area. The intent of this CAMP is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers) from potential airborne releases as a result of the historical use of the Site and known presence of constituents of concern (COCs) in the soil and groundwater. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown.

Continuous, real-time monitoring will be required whenever activities are being performed that may disturb soils at the Site. Monitoring is to commence at the beginning of each work day and will continue until intrusive activities have ceased. If the air quality action levels are exceeded at the perimeter, the site supervisor and engineer will be promptly notified of the results and the need for the implementation of additional measures to further control emissions from the Site will be reviewed.

A wind speed and direction measurement device will be furnished and placed at a location on Site 10-feet above ground level in an area unobstructed by above grade structures/objects and with unobstructed line of sight to Site personnel. This device will provide information regarding localized air flow patterns that the on-site safety personnel will utilize to supplement real time air monitoring and to validate Site conditions.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) will be monitored at the downwind perimeter of the former lagoon remediation area on a continuous basis, unless otherwise indicated by Site conditions and subject to the approval of the USEPA or other governing authority. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work will be performed using equipment as described below. VOCs are not expected to be present in the soil, and therefore, the action levels are based on a generic range of potential VOCs, and are as follows:

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area 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 persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will 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 an additional 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 will be shutdown until the source of the VOCs is identified and corrective actions are implemented.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of soil disturbance areas, at temporary particulate monitoring stations. The particulate monitoring will 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 will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during disturbance activities. Action Levels are as follows:

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 will 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 placement 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 the USEPA, State (DEC and DOH) and County Health personnel, as applicable, to review.

4. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort, activities may need to be suspended.

Dust Suppression Action Plan

Dust suppression will be initiated to protect Site personnel and reduce the potential for off-Site migration. Some or all of the following techniques may be implemented based on Site conditions and approved by the on-Site safety personnel:

- Apply water on Site Access roads;
- Wet equipment and excavation faces;
- Spray water on buckets during excavation and dumping;
- Haul materials in properly covered containers;
- Restrict vehicle speed to 5 mph;
- Apply stone or mulch to ground surface;
- Cover material piles once excavation activity ceases;
- Backfill or close excavations as soon as practical;
- Wash construction vehicles.

Equipment

VOC air monitoring equipment will be performed with real-time photoionization detectors (PID) with a 10.6 eV lamp with a resolution of 0.1 to 1.0 ppm. The PIDs will be continuously logged during the course of daily operations, and each instrument will have an audible alarm to indicate if an action level has been exceeded. The PIDs will be capable of calculating 15-minute running average concentrations for comparison to the previously noted action levels. At the end of each work day, the PID data will be downloaded and saved electronically. The PIDs will be pedestal or tripod mounted in various locations to vary location according to downwind and upwind directions. The PIDs will be calibrated daily with a 100 parts per million isobutylene standard in accordance with manufacturer's instructions.

Particulate monitoring will be performed using real-time particulate monitors that 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/m^3 (1 to 400,000 ug/m^3);
(c) Precision (2-sigma) at constant temperature: +/- 10 g/m^3 for one second averaging; and +/- 1.5 g/m^3 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 $1g/m^3$, 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;

(1) Operating Temperature: -10 to 50˚ C (14 to 122˚ 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.

APPENDIX J - UIC

Type or print all information. See reverse for instructions. OMB No. 2040-0042 Approval Expires 4/30/07

INVENTORY OF INJECTION WELLS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF GROUND WATER AND DRINKING WATER

(This information is collected under the authority of the Safe Drinking Water Act)

1. DATE PREPARED *(Year, Month, Day)*: 13-05-21

2. FACILITY ID NUMBER: S24-3-020

PAPERWORK REDUCTION ACT NOTICE

The public reporting burden for this collection of information is estimated at about 0.5 hour per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Chief, Information Policy Branch, 2136, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460, and to the Office of Management and Budget, Paperwork Reduction Project, Washington, DC 20503.

3. TRANSACTION TYPE *(Please mark one of the following)*

- ☐ Deletion
- ☐ First Time Entry
- ☐ Entry Change
- ☐ Replacement

4. FACILITY NAME AND LOCATION

A. NAME *(last, first, and middle initial)*: Carol Cleaners, Staten Island Mall

B. STREET ADDRESS/ROUTE NUMBER: 280 Marsh Avenue

C. LATITUDE

DEG	MIN	SEC
40	34	41.4

D. LONGITUDE

DEG	MIN	SEC
74	09	52.4

E. TOWNSHIP/RANGE

TOWNSHIP	RANGE	SECT	1/4 SECT
NA*	NA	NA	NA

F. CITY/TOWN: Staten Island

G. STATE: New York

H. ZIP CODE: 10314

I. NUMERIC COUNTY CODE: 085

J. INDIAN LAND *(mark "x")*: ☐ Yes ☐ No

5. LEGAL CONTACT:

A. TYPE *(mark "x")*: ☒ Owner ☐ Operator

B. NAME *(last, first, and middle initial)*: Kelly Webb

C. PHONE *(area code and number)*: (410) 992-6581

D. ORGANIZATION: General Growth Properties, Inc.

E. STREET/P.O. BOX: 10440 Little Patuxent Parkway, Suite 1000

F. CITY/TOWN: Columbia

G. STATE: Maryland

H. ZIP CODE: 21044

I. OWNERSHIP *(mark "x")*

- ☒ PRIVATE
- ☐ PUBLIC
- ☐ SPECIFY OTHER
- ☐ STATE
- ☐ FEDERAL

6. WELL INFORMATION:

A. CLASS AND TYPE		B. NUMBER OF WELLS		C. TOTAL NUMBER OF WELLS	D. WELL OPERATION STATUS				
		COMM	NON-COMM		UC	AC	TA	PA	AN
5	G		10	10	10				
				0					
				0					
				0					
				0					
				0					
				0					

COMMENTS *(Optional)*:

"Injection Wells" will actually be temporary well points (IP-1 through IP-10) advanced via direct push Geoprobe.

* Non-Applicable - New York State is "Not Part of the National Public Land Surveys System (PLSS)".

KEY:

DEG = Degree
MIN = Minute
SEC = Second
SECT = Section
1/4 SECT = Quarter Section

COMM = Commercial
NON-COMM = Non-Commercial
AC = Active
UC = Under Construction
TA = Temporarily Abandoned
PA = Permanently Abandoned and Approved by State
AN = Permanently Abandoned and not Approved by State

SECTION 1. DATE PREPARED: Enter date in order of year, month, and day.

SECTION 2. FACILITY ID NUMBER: In the first two spaces, insert the appropriate U.S. Postal Service State Code. In the third space, insert one of the following one letter alphabetic identifiers:

D - DUNS Number,
G - GSA Number, or
S - State Facility Number.

In the remaining spaces, insert the appropriate nine digit DUNS, GSA, or State Facility Number. For example, A Federal facility (GSA - 123456789) located in Virginia would be entered as : VAG123456789.

SECTION 3. TRANSACTION TYPE: Place an "x" in the applicable box. See below for further instructions.

Deletion. Fill in the Facility ID Number.
First Time Entry. Fill in all the appropriate information.
Entry Change. Fill in the Facility ID Number and the information that has changed.
Replacement.

SECTION 4. FACILITY NAME AND LOCATION:

A. Name. Fill in the facility's official or legal name.
B. Street Address. Self Explanatory.
C. Latitude. Enter the facility's latitude (all latitudes assume North Except for American Samoa).
D. Longitude. Enter the facility's longitude (all longitudes assume West except Guam).
E. Township/Range. Fill in the complete township and range. The first 3 spaces are numerical and the fourth is a letter (N,S,E,W) specifying a compass direction. A township is North or South of the baseline, and a range is East or West of the principal meridian (e.g., 132N, 343W).
F. City/Town. Self Explanatory.
G. State. Insert the U.S. Postal Service State abbreviation.
H. Zip Code. Insert the five digit zip code plus any extension.

SECTION 4. FACILITY NAME & LOCATION (CONT'D.):

I. Numeric County Code. Insert the numeric county code from the Federal Information Processing Standards Publication (FIPS Pub 6-1) June 15, 1970, U.S. Department of Commerce, National Bureau of Standards. For Alaska, use the Census Division Code developed by the U.S. Census Bureau.
J. Indian Land. Mark an "x" in the appropriate box (Yes or No) to indicate if the facility is located on Indian land.

SECTION 5. LEGAL CONTACT:

A. Type. Mark an "x" in the appropriate box to indicate the type of legal contact (Owner or Operator). For wells operated by lease, the operator is the legal contact.
B. Name. Self Explanatory.
C. Phone. Self Explanatory.
D. Organization. If the legal contact is an individual, give the name of the business organization to expedite mail distribution.
E. Street/P.O. Box. Self Explanatory.
F. City/Town. Self Explanatory.
G. State. Insert the U.S. Postal Service State abbreviation.
H. Zip Code. Insert the five digit zip code plus any extension.
I. Ownership. Place an "x" in the appropriate box to indicate ownership status.

SECTION 6. WELL INFORMATION:

A. Class and Type. Fill in the Class and Type of injection wells located at the listed facility. Use the most pertinent code (specified below) to accurately describe each type of injection well. For example, 2R for a Class II Enhanced Recovery Well, or 3M for a Class III Solution Mining Well, etc.
B. Number of Commercial and Non-Commercial Wells. Enter the total number of commercial and non-commercial wells for each Class/Type, as applicable.
C. Total Number of Wells. Enter the total number of injection wells for each specified Class/Type.
D. Well Operation Status. Enter the number of wells for each Class/Type under each operation status (see key on other side).

CLASS I Industrial, Municipal, and Radioactive Waste Disposal Wells used to inject waste below the lowermost Underground Source of Drinking Water (USDW).

TYPE	**1I**	Non-Hazardous Industrial Disposal Well.
	1M	Non-Hazardous Municipal Disposal Well.
	1H	Hazardous Waste Disposal Well injecting below the lowermost USDW.
	1R	Radioactive Waste Disposal Well.
	1X	Other Class I Wells.

CLASS II Oil and Gas Production and Storage Related Injection Wells.

TYPE	**2A**	Annular Disposal Well.
	2D	Produced Fluid Disposal Well.
	2H	Hydrocarbon Storage Well.
	2R	Enhanced Recovery Well.
	2X	Other Class II Wells.

CLASS III Special Process Injection Wells.

TYPE	**3G**	*In Situ* Gassification Well
	3M	Solution Mining Well.

CLASS III (CONT'D.)

TYPE	**3S**	Sulfur Mining Well by Frasch Process.
	3T	Geothermal Well.
	3U	Uranium Mining Well.
	3X	Other Class III Wells.

CLASS IV Wells that inject hazardous waste into/above USDWs.

TYPE	**4H**	Hazardous Facility Injection Well.
	4R	Remediation Well at RCRA or CERCLA site.

CLASS V Any Underground Injection Well not included in Classes I through IV.

TYPE	**5A**	Industrial Well.
	5B	Beneficial Use Well.
	5C	Fluid Return Well.
	5D	Sewage Treatment Effluent Well.
	5E	Cesspools (non-domestic).
	5F	Septic Systems.
	5G	Experimental Technology Well.
	5H	Drainage Well.
	5I	Mine Backfill Well.
	5J	Waste Discharge Well.

PAPERWORK REDUCTION ACT The public reporting and record keeping burden for this collection of information is estimated to average 0.5 hours per response. Burden means the total time, effort, or financial resource expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822), 1200 Pennsylvania Ave., NW., Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed forms to this address.

Type or print all information. See reverse for instructions. OMB No. 2040-0042 Approval Expires 4/30/07

INVENTORY OF INJECTION WELLS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF GROUND WATER AND DRINKING WATER

(This information is collected under the authority of the Safe Drinking Water Act)

1. DATE PREPARED *(Year, Month, Day)*: 13-05-21

2. FACILITY ID NUMBER: S24-3-020

PAPERWORK REDUCTION ACT NOTICE

The public reporting burden for this collection of information is estimated at about 0.5 hour per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Chief, Information Policy Branch, 2136, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460, and to the Office of Management and Budget, Paperwork Reduction Project, Washington, DC 20503.

3. TRANSACTION TYPE *(Please mark one of the following)*

- ☐ Deletion
- ☐ First Time Entry
- ☐ Entry Change
- ☐ Replacement

4. FACILITY NAME AND LOCATION

A. NAME *(last, first, and middle initial)*: Carol Cleaners, Staten Island Mall

B. STREET ADDRESS/ROUTE NUMBER: 280 Marsh Avenue

C. LATITUDE

DEG	MIN	SEC
40	34	41.4

D. LONGITUDE

DEG	MIN	SEC
74	09	52.4

E. TOWNSHIP/RANGE

TOWNSHIP	RANGE	SECT	1/4 SECT
NA*	NA	NA	NA

F. CITY/TOWN: Staten Island

G. STATE: New York

H. ZIP CODE: 10314

I. NUMERIC COUNTY CODE: 085

J. INDIAN LAND *(mark "x")*: ☐ Yes ☒ No

5. LEGAL CONTACT:

A. TYPE *(mark "x")*: ☒ Owner ☐ Operator

B. NAME *(last, first, and middle initial)*: Kelly Webb

C. PHONE *(area code and number)*: (410) 992-6581

D. ORGANIZATION: General Growth Properties, Inc.

E. STREET/P.O. BOX: 10440 Little Patuxent Parkway, Suite 1000

F. CITY/TOWN: Columbia

G. STATE: Maryland

H. ZIP CODE: 21044

I. OWNERSHIP *(mark "x")*

- ☒ PRIVATE
- ☐ PUBLIC
- ☐ SPECIFY OTHER
- ☐ STATE
- ☐ FEDERAL

6. WELL INFORMATION:

A. CLASS AND TYPE		B. NUMBER OF WELLS		C. TOTAL NUMBER OF WELLS	D. WELL OPERATION STATUS				
		COMM	NON-COMM		UC	AC	TA	PA	AN
5	G		10	10	10				
				0					
				0					
				0					
				0					
				0					
				0					

COMMENTS *(Optional)*:

"Injection Wells" will actually be temporary well points (IP-1 through IP-10) advanced via direct push Geoprobe.

* Non-Applicable - New York State is "Not Part of the National Public Land Surveys System (PLSS)".

KEY:

DEG = Degree
MIN = Minute
SEC = Second
SECT = Section
1/4 SECT = Quarter Section
COMM = Commercial
NON-COMM = Non-Commercial
AC = Active
UC = Under Construction
TA = Temporarily Abandoned
PA = Permanently Abandoned and Approved by State
AN = Permanently Abandoned and not Approved by State

SECTION 1. DATE PREPARED: Enter date in order of year, month, and day.

SECTION 2. FACILITY ID NUMBER: In the first two spaces, insert the appropriate U.S. Postal Service State Code. In the third space, insert one of the following one letter alphabetic identifiers:

D - DUNS Number,
G - GSA Number, or
S - State Facility Number.

In the remaining spaces, insert the appropriate nine digit DUNS, GSA, or State Facility Number. For example, A Federal facility (GSA - 123456789) located in Virginia would be entered as : VAG123456789.

SECTION 3. TRANSACTION TYPE: Place an "x" in the applicable box. See below for further instructions.

Deletion. Fill in the Facility ID Number.
First Time Entry. Fill in all the appropriate information.
Entry Change. Fill in the Facility ID Number and the information that has changed.
Replacement.

SECTION 4. FACILITY NAME AND LOCATION:

A. Name. Fill in the facility's official or legal name.
B. Street Address. Self Explanatory.
C. Latitude. Enter the facility's latitude (all latitudes assume North Except for American Samoa).
D. Longitude. Enter the facility's longitude (all longitudes assume West except Guam).
E. Township/Range. Fill in the complete township and range. The first 3 spaces are numerical and the fourth is a letter (N,S,E,W) specifying a compass direction. A township is North or South of the baseline, and a range is East or West of the principal meridian (e.g., 132N, 343W).
F. City/Town. Self Explanatory.
G. State. Insert the U.S. Postal Service State abbreviation.
H. Zip Code. Insert the five digit zip code plus any extension.

SECTION 4. FACILITY NAME & LOCATION (CONT'D.):

I. Numeric County Code. Insert the numeric county code from the Federal Information Processing Standards Publication (FIPS Pub 6-1) June 15, 1970, U.S. Department of Commerce, National Bureau of Standards. For Alaska, use the Census Division Code developed by the U.S. Census Bureau.
J. Indian Land. Mark an "x" in the appropriate box (Yes or No) to indicate if the facility is located on Indian land.

SECTION 5. LEGAL CONTACT:

A. Type. Mark an "x" in the appropriate box to indicate the type of legal contact (Owner or Operator). For wells operated by lease, the operator is the legal contact.
B. Name. Self Explanatory.
C. Phone. Self Explanatory.
D. Organization. If the legal contact is an individual, give the name of the business organization to expedite mail distribution.
E. Street/P.O. Box. Self Explanatory.
F. City/Town. Self Explanatory.
G. State. Insert the U.S. Postal Service State abbreviation.
H. Zip Code. Insert the five digit zip code plus any extension.
I. Ownership. Place an "x" in the appropriate box to indicate ownership status.

SECTION 6. WELL INFORMATION:

A. Class and Type. Fill in the Class and Type of injection wells located at the listed facility. Use the most pertinent code (specified below) to accurately describe each type of injection well. For example, 2R for a Class II Enhanced Recovery Well, or 3M for a Class III Solution Mining Well, etc.
B. Number of Commercial and Non-Commercial Wells. Enter the total number of commercial and non-commercial wells for each Class/Type, as applicable.
C. Total Number of Wells. Enter the total number of injection wells for each specified Class/Type.
D. Well Operation Status. Enter the number of wells for each Class/Type under each operation status (see key on other side).

CLASS I Industrial, Municipal, and Radioactive Waste Disposal Wells used to inject waste below the lowermost Underground Source of Drinking Water (USDW).

TYPE	**1I**	Non-Hazardous Industrial Disposal Well.
	1M	Non-Hazardous Municipal Disposal Well.
	1H	Hazardous Waste Disposal Well injecting below the lowermost USDW.
	1R	Radioactive Waste Disposal Well.
	1X	Other Class I Wells.

CLASS II Oil and Gas Production and Storage Related Injection Wells.

TYPE	**2A**	Annular Disposal Well.
	2D	Produced Fluid Disposal Well.
	2H	Hydrocarbon Storage Well.
	2R	Enhanced Recovery Well.
	2X	Other Class II Wells.

CLASS III Special Process Injection Wells.

TYPE	**3G**	*In Situ* Gassification Well
	3M	Solution Mining Well.

CLASS III (CONT'D.)

TYPE	**3S**	Sulfur Mining Well by Frasch Process.
	3T	Geothermal Well.
	3U	Uranium Mining Well.
	3X	Other Class III Wells.

CLASS IV Wells that inject hazardous waste into/above USDWs.

TYPE	**4H**	Hazardous Facility Injection Well.
	4R	Remediation Well at RCRA or CERCLA site.

CLASS V Any Underground Injection Well not included in Classes I through IV.

TYPE	**5A**	Industrial Well.
	5B	Beneficial Use Well.
	5C	Fluid Return Well.
	5D	Sewage Treatment Effluent Well.
	5E	Cesspools (non-domestic).
	5F	Septic Systems.
	5G	Experimental Technology Well.
	5H	Drainage Well.
	5I	Mine Backfill Well.
	5J	Waste Discharge Well.

PAPERWORK REDUCTION ACT The public reporting and record keeping burden for this collection of information is estimated to average 0.5 hours per response. Burden means the total time, effort, or financial resource expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal Agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to the collection of information; search data sources; complete and review the collection of information; and, transmit or otherwise disclose the information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including the use of automated collection techniques to Director, Collection Strategies Division, U.S. Environmental Protection Agency (2822), 1200 Pennsylvania Ave., NW., Washington, D.C. 20460. Include the OMB control number in any correspondence. Do not send the completed forms to this address.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

JUL 1 1 2013

RECEIVED
JUL 15 2013
LBG - NJ

Kelly Webb
General Growth Properties, Inc.
10440 Little Patuxent Parkway, Suite 1000
Columbia, MD 21044

Re: Underground Injection Control (UIC) Program Regulation
Carol Cleaners, Staten Island Mall (**Reference UICID: 13NY08534013**)
280 Marsh Avenue
Staten Island, NY 10314
Richmond County
Authorization to Inject

Dear Ms. Webb:

This letter serves to inform you that the U.S. Environmental Protection Agency ("EPA") is in receipt of inventory information addressing wells authorized by rule located at the above-referenced facility in accordance with 40 Code of Federal Regulations ("CFR") §144.26. The operation of the following Underground Injection Control wells are authorized by rule, pursuant to 40 CFR §144.24:

Injection of sodium lactate (a blend of non-toxic fatty acids and fermentables) into ten (10) temporary well points (IP-1 through IP-10) advanced via direct push Geoprobe. The New York State Department of Environmental Conservation ("NYSDEC") Class 2 Inactive Hazardous Waste Disposal Site ("IHWDS") Number is 24-3-020.

Should any conditions change in the operation of any of the wells listed above (such as injectate composition, closure of the well, injection of cooling water greater than 150 degrees Fahrenheit, construction of additional wells, etc.) you are required to notify this office within five (5) days. Any accidental spills into a well should be reported within twenty-four (24) hours after the event. Change in operation information should be addressed to:

Nicole Foley Kraft, Chief
Ground Water Compliance Section
United States Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007-1866
Re: 13NY08534013
Attn: Lisa Kim Pelcyger

Should you own or operate **other** facilities using underground injection wells, please use the enclosed inventory form (EPA Form 7520-16) and instructions, copy for multiple facilities, and submit them to the address listed above. These documents can also be found on the internet at:

http://www.epa.gov/safewater/uic/pdfs/7520-16.pdf
http://www.epa.gov/region02/water/compliance/supplemental_instructions_inventory.pdf
http://www.epa.gov/region02/water/compliance/wellclasstypetable_inventoryc_form

Failure to respond to this letter truthfully and accurately within the time provided may subject you to sanctions authorized by federal law. Please also note that all information submitted by you may be used in an administrative, civil judicial or criminal action. In addition, making a knowing submission of materially false information to the U.S. Government may be a criminal offense.

Should you have any questions, please contact Lisa Kim Pelcyger of my staff at (212) 637-4225 or **kim.lisa@epa.gov**.

Sincerely,

Nicole Foley Kraft, Chief
Ground Water Compliance Section

Enclosure

cc: Robert Elburn
NYSDEC, Region 2
1 Hunter's Point Plaza
Long Island City, NY 11101

Christine Stokes, Senior Engineer
Leggette, Brashears & Graham, Inc.
600 East Crescent Avenue, Suite 200
Upper Saddle River, NJ 07458

APPENDIX K - QAPP

Carol Cleaners, Staten Island Mall Site

Quality Assurance Project Plan for Carol Cleaners Site, Staten Island, New York

JUNE 5, 2025
209-4213307

PRESENTED TO

Brookfield Properties Retail
350 N Orleans Street, Suite 300
Chicago, IL 60654

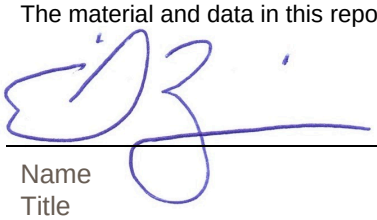
SUBMITTED BY

Tetra Tech
100 Crystal Run Road, Suite 101
Middletown, New York 10941

P +1.877.294.9070
F +1.877.845.1456
tetratech.com

REPORT CERTIFICATION

The material and data in this report were prepared under the supervision and direction of the undersigned.



06/05/2025

Name
Title
Date

Name
Title
Date

TABLE OF CONTENTS

INTRODUCTION **1**

PROJECT SCOPE AND PROJECT GOALS **2**

PROJECT CONTACT INFORMATION **3**

SAMPLING PRODEDURES **4**

Groundwater Monitoring 4
Groundwater Sampling 4
Indoor Air and Sub-slab Vapor Sampling 4
Indoor Air Sampling / Sub-Slab Vapor Sampling 5

LABORATORY DATA DELIVERABLE FORMATS **7**

DECONTAMINATION PROCEDURES **5**

Worksheet	Title
QAPP Worksheet #11	Project Quality Objectives/Systematic Planning Process Statements
QAPP Worksheet #15	Reference Limits and Evaluation Table, Site-Specific Compounds
QAPP Worksheet #19	Analytical SOP Requirements Table
QAPP Worksheet #20	Field Quality Control Sample Summary Table
QAPP Worksheet #22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table
QAPP Worksheet #23	Analytical SOP Reference Table
QAPP Worksheet #28	QC Samples Table
QAPP Worksheet #32	Assessment Findings and Response Actions

Sampling and Analysis Plan attached separately.

LIST OF TABLES

No table entries found.

LIST OF FIGURES

Figure 1 Site Map
Figure 2 Sample Locations – Indoor Air and Sub-Slab Sampling
Figure 3 Groundwater Monitoring Wells

APPENDIX SECTIONS

Appendix A FIELD INSTRUMENTS STANDARD OPERATING PROCEDURES
Appendix B RESUMES
Appendix C SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) UNDER NYSDEC'S PART 375 REMEDIAL PROGRAMS

INTRODUCTION

This project-specific Quality Assurance Project Plan (QAPP) was prepared in accordance with Section 2.2 of the New York State Department of Environmental Conservation (NYSDEC) DER-10 document for NYSDEC Carol Cleaners Site ID 2-43-020 (Site). The QAPP provides quality assurance/quality control (QA/QC) protocols and guidance that are to be followed when implementing the Site Management Plan (SMP) for the Site to ensure that data of a known and acceptable precision and accuracy are generated. The QAPP also provides a summary of the remedial project, identifies personnel responsibilities, and provides procedures to be used during sampling of environmental media, other field activities, and the analytical laboratory testing of samples. The components of the QAPP are provided herein.

PROJECT SCOPE AND PROJECT GOALS

The QAPP applies to the aspects of the project associated with the collection of field data, the collection and analytical laboratory testing of field samples and QA/QC samples, and the evaluation of the quality of the data that is generated. Groundwater monitoring will be conducted that involves analytical laboratory testing of groundwater samples and the collection of groundwater quality measurements.

PROJECT CONTACT INFORMATION

The key individuals involved with the QAPP are as follows:

Project Manager: Erich Zimmerman, P.E.
Cornerstone Environmental
Telephone: +1 (845) 695-0214 (Office); +1 (716) 864-0093 (Cell)
Email: Erich.zimmerman@tetratech.com

Field Sampling, QA/QC, Health and Safety:

Jiss Philip
Cornerstone Environmental
Telephone: 1 (845) 695-0216
Email: Jiss.Philip@tetratech.com

Field Sampling Staff

Nicole Scalla
Cornerstone Environmental
Telephone: (845) 415-2478
Email: nicole.scalla@tetratech.com

QA/QC Supervisor
Diane Conroy
Cornerstone Environmental
Telephone: 1 (845) 695-0255
Email: diane.conroy@tetratech.com

List of NYSDOH ELAP-certified laboratory

- SGS NORTH AMERICA INC. - DAYTON (ELAP #10983)
- PACE ANALYTICAL SERVICES, LLC - MELVILLE, NY (ELAP #10478)

Resumes are attached in Appendix B. Should personnel change, this plan will be updated accordingly.

SAMPLING PRODEDURES

Groundwater Monitoring

Groundwater sampling and monitoring has been conducted at the former Carol Cleaners Site to assess groundwater conditions and monitor the effectiveness of the remedial action at reducing chlorinated volatile organic compounds (CVOCs) to concentrations below groundwater quality standards. Groundwater monitoring is currently conducted on an annual basis. Figure 3 shows the locations of all the groundwater monitoring wells.

Groundwater Sampling

Prior to sampling, the wells will be opened, and head-space VOC readings will be collected using a photoionization detector (PID). Water level measurements will be taken prior to sampling. The groundwater samples will then be collected from the wells by a bladder or peristaltic pump, taking care to cause minimal agitation or turbulence. The groundwater will be passed through a flow-through cell and water quality will be recorded. The wells will be purged and sampled using the low-flow or minimal draw-down technique which monitors groundwater quality parameters until three consecutive rounds of readings stabilize to within an established range indicating no significant change. Low-flow sampling will be in accordance with Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling (USEPA, March 1998). After purging, the samples will be transferred immediately to the appropriate laboratory-supplied containers. Once filled, the containers will be placed immediately in ice-filled coolers for shipment to the laboratory. No filtered groundwater samples will be collected.

The samples will be submitted to a NYSDOH ELAP-certified laboratory under standard chain of custody procedures along with a blind field duplicate, trip blank and a field blank; as well as sufficient sample quantity for site-specific matrix spike/matrix spike duplicate analyses. The samples will be analyzed for site-specific VOCs and SVOCs, 1,4 Dioxane using MS Volatiles (SW846 8260D BY SIM), PFAS using EPA method 1633 and additional parameters as shown in Table 1. Additionally, PFAS must be collected in accordance with the NYSDEC, Division of Environmental Remediation, Sampling, Analysis and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) under NYSDEC Part 375 Remedial Program, April 2023 shown in Appendix C. Based on the analytical results, the frequency of sampling may be reduced, or monitoring may be discontinued with approval from the NYSDEC and the NYSDOH.

Table 1 - Analytical Parameters, Groundwater Sampling

Sampling Location	Analytical Parameters	Schedule
MW-2, MW-3, MW-3D, MW-5, MW-8, MW-16, MW-17, MW-18, MW-19, MW-20, MW-21, MW-22, and MW-24	VOCs (EPA Method 8260)	Annually
MW-2, MW-3, MW-16, MW-17, MW-19, and MW-22	1,4 Dioxane using MS Volatiles (SW846 8260D BY SIM), PFAS using EPA method 1633	Annually

Indoor Air and Sub-slab Vapor Sampling

Indoor air and sub-slab vapor sampling have been performed previously at the site to confirm the efficacy of the existing sub-slab depressurization system. Based on the lack of CVOC-impacted soil and the observed decrease in CVOC concentrations in groundwater proximal to the on-site buildings because of groundwater injection/bioremediation activities, testing of sub-slab vapor and indoor air will be conducted to evaluate

whether it is necessary to continue operation of the SSD system. This includes shutting down the system for a period of three weeks subsequent to authorization from the NYSDEC and then conducting the testing by having one sub-slab and one indoor air sample collected from the Carvel, Mon Amie Nails, former Carol Cleaners, and former Babies R Us tenant spaces. A total of two separate heating season sampling events will be conducted, one during the fall (November to December) and one in the winter (January to March). Sampling would also be conducted in the event the system requires recommissioning.

Indoor Air Sampling / Sub-Slab Vapor Sampling

As discussed previously with the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH), two separate heating season sampling events will be conducted, one during the fall (November to December) and one in the winter (January to March). The existing sub-slab depressurization system (SSDS) will be shut down for a minimum of 30 days prior to each event to allow indoor air and sub-slab vapor pressures to stabilize. At the end of the 30-day period, two staff will mobilize to the site and install a total five sub-slab vapor sampling points through the concrete slab within the former Carol Cleaners and Babies-R-Us buildings. Proposed sampling locations are identified on Figure 2.

Each sampling point will be installed by drilling a 5/8-inch hole through the concrete, perforating the sub-slab vapor barrier (if present) and inserting a brass Vapor Pin® sampling port within the hole using a hammer drill. The sampling port will remain within the concrete hole as shown on the attached photos. The contractor proposed to use flush-mount sampling points to minimize the impact on surrounding building operations. To that end, the sampling points will be completed with a 2-inch diameter stainless steel cover mounted flush with the concrete floor. Per the manufacturer's specifications for leak testing, the contractor will perform a water dam leak test prior to sample collection. This method involves installing a 2" diameter pvc pipe approximately 2" long over the hole. VOC-free modeling clay is used to create a seal between the floor and the pvc pipe. Distilled water is then poured into the hole and added to approximately halfway up on the pvc pipe. The sample port is then purged. If the water level remains constant, no leaks are present, and sampling can commence. Another option recommended by the manufacturer is to use a 4-gas meter to purge the sample location. If no leaks are present, the oxygen levels will decrease and remain well below atmospheric levels, confirming an airtight seal has been established.

Prior to sampling, the contractor staff will photograph and survey the building interior for cleaning agents, gasoline cans or other containers potentially containing volatile organics. If identified, the contractor will inventory these materials and inform building management so that these materials may be removed from the building prior to sampling as the presence of these materials may influence the results of indoor air and/or sub-slab vapor testing.

After the interior materials assessment, the contractor will position two Suma® canisters at each of the five sub-slab sampling locations within the building and collect indoor air and sub-slab vapor samples over a 24-hour period. The indoor air samples will be collected from the breathing zone at 3-5 feet above the floor. The contractor will return the next day to collect the canisters, and they will be submitted to an ELAP-certified laboratory for volatile organics analysis by USEPA Method TO-15. All sampling will be performed in accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006).

Prior to the performance of sampling, the contractor will visually inspect the building floors for cracks, drains, holes or other potential preferential pathways. They will also document the current facility heating/cooling system status to confirm whether the system is operational, assess whether the indoor pressure is positive or negative, and confirm the location of air intake and exhaust vents.

Upon the receipt of laboratory results, the contractor will prepare a draft letter report, inclusive of tables and figures, summarizing the work performed and the results of laboratory analysis. The letter report will be

submitted to the NYSDEC and the NYSDOH for review and comment. Upon receipt of comments, the contractor will incorporate the comments into a revised letter report for submittal to the NYSDEC and the NYSDOH.

LABORATORY DATA DELIVERABLE FORMATS

Data Quality Objectives

Measurement variability: This project will require QC standards, blanks, and duplicate samples be analyzed in the laboratory environment. QC sample results will be evaluated against established precision and accuracy criteria established in approved analytical methods to assess the reliability of the analytical measurements New York State Public Health Law (PHL) § 502 requires environmental laboratory analyses of samples originating from New York State, “for the purposes of public or personal health protection or the protection of the environment or natural resources” be performed by a laboratory certified by the New York State Department of Health’s Environmental Laboratory Approval Program (NYSDOH ELAP) for which the Commissioner of Health issues certificates. The NYSDOH administers ELAP pursuant to PHL § 502 and regulates laboratories through 10 NYCRR Part 55, Subpart 55-2. By utilizing a NYSDOH ELAP certified laboratory, (state laboratory and NYSDOH ELAP certificate # 10983 and #10478) this project will follow PHL§ 502 and help ensure consistency and comparability of environmental measurements and demonstrate laboratory capability.

Data Usability Summary Report

Data usability summary reports (DUSRs) will be completed on some of the analytical laboratory data that is generated as part of the scope of work in SMP, to the extent required by the NYSDEC (e.g., analytical laboratory results for one or more groundwater monitoring events). The DUSR will be conducted in accordance with the provisions set forth in Appendix 2B of the DER-10 Technical Guidance for Site Investigation and Remediation dated May 2010. The findings of the DUSR will be incorporated in the corresponding Periodic Review Report (PRR). DUSRs will be completed by a qualified entity or individual that is approved by the NYSDEC.

Reporting

Analytical and QC data will be included in the PRR. The PRR will summarize the remedial work and provide evaluation of the data that is generated, including the validity of the results in the context of QA/QC procedures.

QAPP Worksheet #11

Project Quality Objectives/Systematic Planning Process

WHO WILL USE THE DATA?

Data will be used by NYSDEC/NYSDOH, and the Brookfield Properties post-remediation Site Management.

WHAT WILL THE DATA BE USED FOR?

Groundwater data will be used to verify that off-site constituent of concern (COC) migration is not occurring, to evaluate COC concentration trends, and to evaluate the need for a supplemental oxygen source in the groundwater.

WHAT TYPE OF DATA ARE NEEDED

Groundwater data will be obtained for site-specific VOCs and SVOCs, as well as for field parameters and groundwater elevation.

HOW "GOOD" DO THE DATA NEED TO BE IN ORDER TO SUPPORT THE ENVIRONMENTAL DECISION?

Laboratory data will be reviewed based on lab-reported QC forms, and also qualitatively assessed for reasonableness based on site history and previous data. If initial review suggests potential oversight laboratory QA problems, the project/CQA manager will recommend corrective action, which may include formal data validation. The laboratory completeness goal is 100 percent; failure to meet this goal may require re-sampling.

HOW MUCH DATA ARE NEEDED?

Groundwater Monitoring Data – wells to be monitored and the associated frequency are discussed in Section 4.3 (Groundwater Monitoring) and 4.4 (Private Water Supply Well Monitoring) of the Site Management Plan.

WHERE, WHEN, AND HOW SHOULD THE DATA BE COLLECTED/GENERATED?

Groundwater Monitoring – locations, parameters, and frequency are described in Sections 4.3 and 4.4 of the Site Management Plan.

Procedure – See Sampling and Analysis Plan.

WHO WILL COLLECT AND GENERATE THE DATA?

Groundwater samples will be collected by sampling personnel (TBD), who will ship the samples to the analytical laboratory (TBD on a contract basis), who will analyze the samples and generate the data.

Private water supply well samples will typically be collected by the analytical laboratory (TBD).

HOW WILL THE DATA BE REPORTED?

The analytical laboratory will tabulate and compile analytical results and associated QA/QC information and provide a complete laboratory report.

Private water supply well data will be provided by the laboratory directly to the NYSDOH for reporting to the residents.

Data will be reported to the NYSDEC in annual Site Management reports.

HOW WILL THE DATA BE ARCHIVED?

Generated data (field- and/or laboratory-related) will be stored in the project files when not undergoing processing/review.

EDDs will be prepared and submitted to the NYSDEC upon request.

QAPP Worksheet #19
Analytical SOP Requirements Table

[For each matrix, analytical group, and concentration level, list the analytical and preparation method/SOP and associated sample volume, container specifications, preservation requirements, and maximum holding time.]

Matrix	No. of Samples	Analytical Group	Concen-tration Level	Analytical and Preparation Method/ SOP Reference[1]	Minimum Sample Volume	Containers (number, size, and type) [3]	Preservation Requirements	Maximum Holding Time (preparation/ analysis) [2]
Soil	TBD	Volatile Organic Compounds	Low	SW 846 8260B	15 g	3 x 5 g EnCore or 4-oz glass jar, teflon lined cap, minimal headspace	cool to 4°C	14 days
Soil	TBD	Semi-volatile Organic Compounds (incl. 1,4-Dioxane) (modified)[4]	Low	SW 846 3550C followed by SW 846 8270D	30 g	8 oz glass jar	cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Soil	TBD	TCLP organics (VOCs and SVOCs)	Low	SW-846 1311 followed by 8260B and 8270D	100 g	8 oz glass jar	cool to 4°C	14 days to TCLP extract; 14 days for VOC analysis; 14 days for SVOC extract, then 40 for SVOC analysis
Aqueous	TBD	Volatile Organic Compounds	Low	SW846 8260B	3 x 40-mL	(3) 40 mL VOA vials w/Teflon lined septum	HCl to pH<2; cool to 4°C	14 days preserved (7 days unpreserved)
Aqueous	TBD	SVOCs(incl. 1,4-Dioxane)	Low	SW846 3510C followed by 8260SIM	1 L	2 x 1-L amber glass; 3x40ml Vial - HCL	cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Aqueous	TBD	Metals	Low	USEPA 200.7 / 245.1 or SW846 6010	100 mL	250 mL plastic	HNO_3 to pH<2; cool	6 months (28 days for Hg)
Aqueous	TBD	PFAS	Low	EPA 1663	250 mL; 60 mL	2 x 250 mL polyethylene bottles; 60 mL HDPE	Cool, 0-6ºC	14 days for extraction, 28 days to analysis
Soil	TBD	PFAS	Low	EPA 1663	250 mL	One 4 oz polyethylene bottle	Cool, 0-6ºC	28 days for extraction, 28 days to analysis

The number in parentheses in the "Sample Container" column denotes the number of containers needed. Laboratory Fortified Matrix analysis conducted at a frequency of 1 per 20 samples.

[1]Published Standard Operating Procedures Shown that may vary by laboratory.

[2]Holding time is technical holding time and is calculated from time of sample collection.

[3]Container types and quantities as listed in "US EPA Region 2 Laboratory – Volume, Container & Preservation Requirements," April, 2005. Subject to change.

[4]Modification is additional (non-standard) SVOCs added to target SVOC list.

QAPP Worksheet #20
Field Quality Control Sample Summary Table

[Summarize by matrix, analytical group, and concentration level the number of field QC samples that will be collected and sent to the laboratory.]

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Sampling Locations[2]	No. of Field Duplicate Pairs	No. of Extra Volume Laboratory QC (e.g., MS/MSD) Samples [3]	No. of Field Blanks	No. of Trip Blanks	No. of PE Samples
Wastewater	Volatile Organics	Low	EPA 8260B	TBD	0	1 set per 20	0	1 per shipment	0
Wastewater	SVOCs[4](incl. 1,4-Dioxane), metals	Low	EPA 8270D; EPA 200.7 (245.1 for Hg if required)	TBD	0	1 set per 20	0	0	0
Groundwater	Volatile Organics	Low	EPA 8260B	Event-specific (9 to 29)	1 per 20	1 set per 20	1 per 20	1 per shipment	0
Groundwater, private wells	Volatile Organics	Low	EPA 524.2	Event-specific (3-4)	0	1 set per 20	0	1 per shipment	0
Groundwater	SVOCs[4](incl. 1,4-Dioxane)	Low	EPA 8270D; 8260SIM	Event-specific (9 to 29)	1 per 20	1 set per 20	1 per 20	0	0
Soil – confirmation	VOCs, SVOCs[4]	Low	SW846 8260B and 3550C/8270D	TBD	1 per 20	1 set per 20	1/week	0	0
Soil – Waste classification	TCLP VOCs, SVOCs	Low	SW846 1311 then 8260B and 8270D	TBD	0	1 set per 20	0	0	0
Soil – TIC study	Expanded list SVOCs plus TICs [4]	Low	NYSDOH ELAP Certified Laboratory SOP SW-846 8270D, revision 7 (modified)	30	2	1 set per 20	0	0	0
Soil	PFAS	Low	EPA 1663	TBD	N/A	N/A	0	0	0
Groundwater	PFAS	Low	EPA 1663	TBD	N/A	N/A	0	0	0

[1]Published Standard Operating Procedures shown that may vary by laboratory.

[2]Number of samples for each event to be determined in the field.

[3]Each QC sample for VOCs requires additional volume (i.e., three additional VOA vials per QC sample). Soil SVOC QC does not require additional volume.

[4]SVOC list for soil confirmation and effluent discharge expanded to include ROD-required compounds.

QAPP Worksheet #22
Field Equipment Calibration, Maintenance, Testing, and Inspection Table[1]

[Identify all field equipment and instruments (other than analytical instrumentation) that require calibration, maintenance, or testing/inspection and provide the SOP reference number for each type of equipment. In addition, document the frequency of activity, acceptance criteria, and corrective action requirements on the worksheet.]

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
pH meter[2]	Two buffers (pH 4 and 7)	Clean probe, charge battery.	Check calibration against pH 7 buffer	Twice Daily	± 0.1 unit	recalibrate	FOL	NA
ORP meter[1]	Calibrate	Clean probe, charge battery	Check calibration	Twice Daily	± 0.1 unit	recalibrate	FOL	NA
Turbidimeter[1]	Calibration check at 50 NTU	Clean cell, charge battery	Verify factory calibration	Weekly	± 10 % of known value	recalibrate	FOL	NA
Dissolved Oxigen[1]	Calibrate	Clean probe, charge battery	Calibrate	Daily	± 0.2 % O_2	recalibrate	FOL	NA
Conductivity meter	Calibrate	Clean probe, charge battery	Calibrate	Daily	Per manufacturer recommendations	recalibrate	FOL	NA
Thermometer	None	Clean; prevent breakage	Annual check against NIST – traceable instrument	Annually	± 0.1 °	replace	Field team; FOL	NA
Organic vapor meter	Check against certified calibration gas	Clean instrument; charge battery.	Check against benzene equivalent or other gas as recommended by manufacturer.	Daily	± 0.1 ppm	recalibrate	Field team; FOL/SHSO	NA
Particulate monitoring equipment (PM-10)	Calibrate	Clean probe, charge battery	Calibrate	Daily	Per manufacturer recommendations	recalibrate	FOL	NA

[1]Specific equipment to be used has not yet been established. Calibration and maintenance of equipment to be conducted in accordance with instrument manual and manufacturer's recommendations.

[2]pH is not a required field monitoring parameter but is measured to determine well stabilization for groundwater sampling.

QAPP Worksheet #23
Analytical SOP References Table

[List all SOPs that will be used to perform on-site or off-site analysis. Indicate whether the procedure produces screening or definitive data. Include copies of the SOPs as attachments or reference in the QAPP (if required).]

EPA Reference Number	Laboratory SOP Reference Number[1]	Laboratory Title, Revision Date, and/or Number [1]	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N) [3]
SW846 8260	Laboratory Specific	Analysis of Volatile Organic Compounds by GC/MS	Definitive	VOCs	GC/MS	NYSDOH ELAP Certified Laboratory	N
EPA Method 524.2	Laboratory Specific	Purgeable Organic Compounds by Capillary Column GC/MS	Definitive	VOC	GC/MS	NYSDOH ELAP Certified Laboratory	N
EPA method 200.7	Laboratory Specific	Determination of Metals by ICP-Thermo ICP Metals by ICP-SS ICP	Definitive	Inorganics (metals)	ICP	NYSDOH ELAP Certified Laboratory	N
EPA method 245.1	Laboratory Specific	Cold Vapor Analysis of Mercury	Definitive	Mercury	Cold Vapor	NYSDOH ELAP Certified Laboratory	N
EPA method 8270 (modified) [2] EPA 8260SIM	Laboratory Specific	Semivolatle Organic Compounds by Gas Chromatography/ Mass Spectroscopy	Definitive	SVOCs (expanded with TIC)	GC/MS	NYSDOH ELAP Certified Laboratory	Y (project specific analyte list)
PFAS Method 1633	Laboratory Specific	Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS (821-D-21-001, August 2021)	Definitive	PFAS	LC-MS/MS	NYSDOH ELAP Certified Laboratory	N

[1]Copies of analytical SOPs are specific to contracted laboratory

[2]Methods may require modification (e.g., additional low calibration standards) to meet project quantitation limits.

QAPP Worksheet #28-1
QC Samples Table

[Complete a separate worksheet for analytical method (e.g., OLM04.3 vs. OLC03.2), matrix (e.g., soil vs. groundwater), analytical group (e.g., VOCs vs. metals), and concentration level (if applicable).]

Matrix	Aqueous
Analytical Group	Volatile Organic Compounds
Concentration Level	Low
Sampling SOP(s)	See Site Management Plan Sections 4.3 and 4.4
Analytical Method/SOP Reference	Laboratory Specific
Sampler's Name	TBD
Field Sampling Organization	TBD
Analytical Organization	NYSDOH ELAP Certified Laboratory
No. of Sample Locations	TBD

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits [1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria [1]
Tuning (Mass calibration check)	At beginning of run and every 12 hours	Meet all PBFB criteria	Check instrument, reanalyze, re-tune	lab personnel	Sensitivity	Meet all PBFB criteria
Method Blank (Lab Reagent Blank)	Prior to each analytical run	< MDL except for Methylene Chloride & Acetone	Identify source and correct prior to continuing analysis	lab personnel	Sensitivity/ Contamination	< MDL except for Methylene Chloride & Acetone
Trip Blank	One per shipment including aqueous VOCs	< RL	Identify source and correct	Field and/or laboratory personnel	Sensitivity/ Contamination	< RL
Initial Calibration	Prior to sample analysis	RSD ≤ 30% for CCCs, ≤ 15% for all target compounds, Minimum RRF for SPCCs (SOP Table 6)	Check instrument, recalibrate; qualify data	lab personnel	Accuracy/ Precision	RSD ≤ 30% for CCCs, ≤ 15% for all target compounds, Minimum RRF for SPCCs (SOP Table 6)
Continuing calibration check standard	Every 12 hours	Max %D ≤ 20% for CCCs; Minimum RRF ≥for SPCCs (See SOP table 6)	Recalibrate, qualify data	lab personnel	Accuracy	Max %D ≤ 20% for CCCs; Minimum RRF ≥for SPCCs (See SOP table 6
Matrix Spike/ Matrix Spike (Duplicate)	1 per ≤ 20 samples	See attached typical Compound List Report	Assume matrix bias; qualify data; note in case narrative	lab personnel	Accuracy	See Attachment 3 – Compound List Report

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits [1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria [1]
Blank Spike	2 per batch of ≤ 20 samples	See attached typical Compound List Report	Qualify data unless high recovery and/or not detected	lab personnel	Accuracy/ Precision	See Attachment 3 – Compound List Report
Surrogate Compounds	all samples, standards, and blanks	See attached typical Compound List Report	Reinject; qualify data	lab personnel	Extraction efficiency, Accuracy	See Attachment 3 – Compound List Report
Internal Standards	all samples, standards, and blanks	Factor of two (-50% to +100%)	Check instruments, reanalyze affected samples if possible. If reanalysis not possible qualify data	lab personnel	Accuracy	Factor of two (-50% to +100%)

QAPP Worksheet #28-2
QC Samples Table

[Complete a separate worksheet for analytical method (e.g., OLM04.3 vs. OLC03.2), matrix (e.g., soil vs. groundwater), analytical group (e.g., VOCs vs. metals), and concentration level (if applicable).]

Matrix	Aqueous
Analytical Group	Semivolatile Organic Compounds
Concentration Level	Low
Sampling SOP(s)	See Site Management Plan Sections 4.3 and 4.4
Analytical Method/SOP Reference	Laboratory Specific
Sampler's Name	TBD
Field Sampling Organization	WRScompass
Analytical Organization	NYSDOH ELAP Certified Laboratory
No. of Sample Locations	TBD

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits [1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria [1]
Tuning (Mass calibration check)	At beginning of run and every 12 hours	Meet all DFTPP criteria	Check instrument, reanalyze, re-tune	lab personnel	Sensitivity	Meet all PBFB criteria
Method Blank (Lab Reagent Blank)	1 per extraction batch of ≤ 20 samples	< MDL	Reanalyze/ retract entire batch	lab personnel	Sensitivity/ Contamination	< MDL
Initial Calibration	Prior to sample analysis	≤ 20% RSD Minimum RF's (see SOP 10.1.7.3)	Check instrument, recalibrate	lab personnel	Accuracy/ Precision	≤ 20% RSD Minimum RF's (see SOP 10.1.7.3)
Continuing calibration check standard	Every 12 hours	Max %D ≤ 20% Minimum RF's (see SOP 10.1.7.3)	Recalibrate	lab personnel	Accuracy	Max %D ≤ 20% Minimum RF's (see SOP 10.1.7.3)
Matrix Spike/Matrix Spike Duplicate	1 pair per ≤ 20 samples	In house limits, see attachments	Assume matrix bias; qualify data; note in case narrative	lab personnel	Accuracy	See Attachment 3 – Compound List Report

Blank Spike	1 per batch of ≤ 20 samples	In house limits, see attachments	Qualify data unless high recovery and not detected	lab personnel	Accuracy/ Precision	See Attachment 3 – Compound List Report

Lab QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits [1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria [1]
Surrogate Compounds	all samples, standards, and blanks	See attached typical – Compound List Report	Reinject; qualify data	lab personnel	Extraction efficiency, Accuracy	See Attachment 3 – Compound List Report
Internal Standards	all samples, standards, and blanks	Factor of two (-50% to +100%)	Check instruments, reanalyze affected samples if possible. If reanalysis not possible qualify data	lab personnel	Accuracy	Factor of two (-50% to +100%)

[1] See attached typical Compound List Report.

QAPP Worksheet #32
Assessment Findings and Corrective Action Responses

[For each type of assessment, describe procedures for deficiencies/deviations encountered.]

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Performance Evaluation Samples[1]	Recovery outside warning or control limits	Project Manager and/or QAO	Immediately to within 24 hours of review	Investigate and correct	Laboratory Manager; QA Manager; Section/ group Manager	Unknown
Split sample data	Poor agreement between data sets	EPA and Trust QA personnel and chemists	After both data sets completed and reviewed	Investigate and correct	EPA and Trust Laboratory Manager; QA Managers; Section / group Managers; sampling personnel; others as appropriate.	TBD
Laboratory Technical Systems/ Performance Audit [2]	Unknown	Laboratory Manager	Unknown	Unknown	Laboratory Manager or QA manager	Unknown
On-Site Field Inspection	Field Activities or equipment not as specified in project plans	PM or project representative; management personnel of affected organization	Immediately to within 24 hours of review	Corrective Action Memorandum	Trust Project Manager; USEPA PM and affected organization	Varies, based on nature and severity of problems noted.

1. PE samples not currently planned.
2. May include periodic audits in conjunction with maintaining NELAC certification.

Compound List Report

Product: V8260STD Volatile
Matrix: Organics AQ Aqueous

May 23, 2011 10:25

Method List:	VAIX8260 AQ	Method Ref: SW846 8260B	LJ35396
Report List:	V8260 ALL	VOA 8260 List	LJ16165
RL/MDL Factor:	1		

					Control Limits (%) Rev: 2/11			
Compound	CAS No.	RL	MDL	Units	MS/MSD	RPD	BS	DUP
Acetone	67-64-1	10	4.4	ug/l	39-150	20	49-142	16
Benzene	71-43-2	1.0	0.26	ug/l	40-139	12	76-119	10
Bromobenzene	108-86-1	5.0	0.13	ug/l	67-131	12	77-123	10
Bromochloromethane	74-97-5	5.0	0.79	ug/l	67-134	12	77-129	10
Bromodichloromethane	75-27-4	1.0	0.18	ug/l	68-135	12	81-133	12
Bromoform	75-25-2	4.0	0.42	ug/l	55-141	14	72-139	10
Bromomethane	74-83-9	2.0	0.24	ug/l	49-145	16	55-140	10
2-Butanone (MEK)	78-93-3	10	1.7	ug/l	55-141	15	64-132	10
n-Butylbenzene	104-51-8	5.0	0.26	ug/l	55-139	15	74-130	10
sec-Butylbenzene	135-98-8	5.0	0.40	ug/l	55-137	14	75-125	10
tert-Butylbenzene	98-06-6	5.0	0.34	ug/l	58-137	15	76-127	10
Carbon tetrachloride	56-23-5	1.0	0.35	ug/l	52-155	16	74-146	10
Chlorobenzene	108-90-7	1.0	0.15	ug/l	66-129	11	79-120	10
Chloroethane	75-00-3	1.0	0.25	ug/l	50-140	16	60-134	10
Chloroform	67-66-3	1.0	0.14	ug/l	63-133	13	77-127	11
Chloromethane	74-87-3	1.0	0.34	ug/l	43-138	17	50-128	10
o-Chlorotoluene	95-49-8	5.0	0.17	ug/l	62-132	13	78-124	10
p-Chlorotoluene	106-43-4	5.0	0.29	ug/l	62-129	13	75-120	10
1,2-Dibromo-3-chloropropane	96-12-8	10	1.2	ug/l	57-142	14	64-137	10
Dibromochloromethane	124-48-1	1.0	0.16	ug/l	64-136	12	77-131	10
1,2-Dibromoethane	106-93-4	2.0	0.39	ug/l	69-132	11	76-127	10
1,2-Dichlorobenzene	95-50-1	1.0	0.15	ug/l	69-129	11	78-123	10
1,3-Dichlorobenzene	541-73-1	1.0	0.19	ug/l	66-130	12	77-124	10
1,4-Dichlorobenzene	106-46-7	1.0	0.22	ug/l	66-127	12	76-121	10
Dichlorodifluoromethane	75-71-8	5.0	0.39	ug/l	31-166	20	41-138	10
1,1-Dichloroethane	75-34-3	1.0	0.16	ug/l	58-132	13	74-124	10
1,2-Dichloroethane	107-06-2	1.0	0.31	ug/l	62-145	12	71-138	10
1,1-Dichloroethene	75-35-4	1.0	0.24	ug/l	43-142	17	68-126	10
cis-1,2-Dichloroethene	156-59-2	1.0	0.24	ug/l	55-132	12	78-131	10
trans-1,2-Dichloroethene	156-60-5	1.0	0.30	ug/l	53-132	14	64-119	10
1,2-Dichloropropane	78-87-5	1.0	0.23	ug/l	65-128	12	76-121	10
1,3-Dichloropropane	142-28-9	5.0	0.22	ug/l	68-127	11	77-120	10
2,2-Dichloropropane	594-20-7	5.0	0.21	ug/l	41-146	16	53-143	10
1,1-Dichloropropene	563-58-6	5.0	0.16	ug/l	54-139	15	77-125	10
cis-1,3-Dichloropropene	10061-01-5	1.0	0.16	ug/l	66-130	12	76-123	10
trans-1,3-Dichloropropene	10061-02-6	1.0	0.22	ug/l	64-135	13	74-129	10
Ethylbenzene	100-41-4	1.0	0.31	ug/l	40-140	12	77-119	12
Hexachlorobutadiene	87-68-3	5.0	0.23	ug/l	51-141	16	66-137	10
Isopropylbenzene	98-82-8	2.0	0.31	ug/l	56-138	13	74-125	10
p-Isopropyltoluene	99-87-6	5.0	0.13	ug/l	58-136	14	78-128	10
Methyl Tert Butyl Ether	1634-04-4	1.0	0.20	ug/l	54-136	12	72-125	16
4-Methyl-2-pentanone(MIBK)	108-10-1	5.0	0.74	ug/l	61-138	14	68-131	10
Methylene bromide	74-95-3	5.0	0.35	ug/l	70-134	12	79-129	10
Methylene chloride	75-09-2	2.0	0.20	ug/l	60-130	13	73-122	10

Compound List Report

Product: V8260STD Volatile
Matrix: Organics AQ Aqueous

May 23, 2011 10:25

Method List:	VAIX8260 AQ	Method Ref: SW846 8260B	LJ35396
Report List:	V8260 ALL	VOA 8260 List	LJ16165
RL/MDL Factor:	1		

Compound	CAS No.	RL	MDL	Units	Control Limits (%) Rev: 2/11 MS/MSD	RPD	BS	DUP
Naphthalene	91-20-3	5.0	0.78	ug/l	51-149	14	61-136	14
n-Propylbenzene	103-65-1	5.0	0.33	ug/l	51-138	14	73-121	10
Styrene	100-42-5	5.0	0.48	ug/l	59-132	13	77-121	10
1,1,1,2-Tetrachloroethane	630-20-6	5.0	0.18	ug/l	69-134	12	80-128	10
1,1,2,2-Tetrachloroethane	79-34-5	1.0	0.12	ug/l	65-128	12	70-121	10
Tetrachloroethene	127-18-4	1.0	0.24	ug/l	52-143	15	64-148	13
Toluene	108-88-3	1.0	0.27	ug/l	47-140	12	77-122	10
1,2,3-Trichlorobenzene	87-61-6	5.0	0.29	ug/l	62-137	14	69-136	10
1,2,4-Trichlorobenzene	120-82-1	5.0	0.16	ug/l	64-136	14	73-133	10
1,1,1-Trichloroethane	71-55-6	1.0	0.20	ug/l	55-146	15	76-135	10
1,1,2-Trichloroethane	79-00-5	1.0	0.13	ug/l	70-129	12	79-125	10
Trichloroethene	79-01-6	1.0	0.22	ug/l	54-142	14	80-129	12
Trichlorofluoromethane	75-69-4	5.0	0.23	ug/l	45-159	19	66-145	10
1,2,3-Trichloropropane	96-18-4	5.0	0.52	ug/l	64-137	13	72-130	10
1,2,4-Trimethylbenzene	95-63-6	5.0	0.27	ug/l	40-147	12	77-123	10
1,3,5-Trimethylbenzene	108-67-8	5.0	0.31	ug/l	50-142	13	76-123	10
Vinyl chloride	75-01-4	1.0	0.22	ug/l	42-145	18	56-133	10
m,p-Xylene		1.0	0.39	ug/l	39-141	12	77-121	12
o-Xylene	95-47-6	1.0	0.28	ug/l	51-138	12	80-124	12
Xylene (total)	1330-20-7	1.0	0.28	ug/l	42-140	12	78-121	13
Dibromofluoromethane	1868-53-7				Surrogate Limits:		77-120	
1,2-Dichloroethane-D4	17060-07-0				Surrogate Limits:		70-127	
Toluene-D8	2037-26-5				Surrogate Limits:		79-120	
4-Bromofluorobenzene	460-00-4				Surrogate Limits:		76-118	

64 compounds and 4 surrogates reported in list V8260

Product: AB8270AP9 Acid and Base Neutrals, Appendix IX

Matrix: AQ Aqueous May 23, 2011 10:50 am

Method List:	AB8270 AQ	**Method Ref:** SW846 8270C	LJ35368
Report List:	ABAIX ALL	ABN Appendix IX List	LJ344
RL/MDL Factor:	1		

					Control Limits (%) Rev: 2/11			
Compound	**CAS No.**	**RL**	**MDL**	**Units**	**MS/MSD**	**RPD**	**BS**	**DUP**
2-Chlorophenol	95-57-8	5.0	1.1	ug/l	32-117	29	47-107	10
4-Chloro-3-methyl phenol	59-50-7	5.0	1.1	ug/l	48-134	21	55-126	10
2,4-Dichlorophenol	120-83-2	5.0	1.2	ug/l	34-129	28	51-124	10
2,4-Dimethylphenol	105-67-9	5.0	1.7	ug/l	50-140	20	54-132	10
2,4-Dinitrophenol	51-28-5	20	0.74	ug/l	10-156	41	16-156	10
2,6-Dichlorophenol	87-65-0	5.0	1.1	ug/l	29-129	32	53-122	10
4,6-Dinitro-o-cresol	534-52-1	20	0.51	ug/l	10-139	36	30-138	10
Dinoseb	88-85-7	5.0	0.51	ug/l	63-153	30	41-153	10
2-Methylphenol	95-48-7	2.0	1.1	ug/l	34-120	25	34-109	10
3&4-Methylphenol		2.0	1.0	ug/l	31-121	28	26-106	10
2-Nitrophenol	88-75-5	5.0	1.2	ug/l	30-130	29	49-126	10
4-Nitrophenol	100-02-7	10	0.83	ug/l	10-115	43	10-86	10
Pentachlorophenol	87-86-5	10	0.80	ug/l	10-136	36	27-127	10
Phenol	108-95-2	2.0	0.58	ug/l	10-91	36	10-78	10
2,3,4,6-Tetrachlorophenol	58-90-2	5.0	0.81	ug/l	24-129	32	48-120	10
2,4,5-Trichlorophenol	95-95-4	5.0	1.3	ug/l	33-136	29	55-128	10
2,4,6-Trichlorophenol	88-06-2	5.0	1.2	ug/l	29-133	30	55-124	10
2-Acetylaminofluorene	53-96-3	5.0	0.63	ug/l	63-175	30	48-144	10
4-Aminobiphenyl	92-67-1	5.0	0.65	ug/l	6-86	30	60-115	10
Acenaphthene	83-32-9	1.0	0.37	ug/l	55-119	21	57-118	10
Acenaphthylene	208-96-8	1.0	0.27	ug/l	47-110	20	49-110	10
Acetophenone	98-86-2	2.0	0.40	ug/l	48-145	23	60-132	10
Aniline	62-53-3	2.0	0.23	ug/l	10-111	34	20-104	10
Anthracene	120-12-7	1.0	0.16	ug/l	59-128	21	63-128	10
Aramite	140-57-8	5.0	1.9	ug/l	50-150	30	29-171	10
Atrazine [a]	1912-24-9	5.0	0.39	ug/l	48-159	22	64-150	10
A,A-Dimethylphenethylamine	122-09-8	5.0	0.87	ug/l	1-84	30	50-150	10
Benzaldehyde [b]	100-52-7	5.0	0.40	ug/l	25-152	25	39-146	10
Benzo(a)anthracene	56-55-3	1.0	0.12	ug/l	54-124	21	59-124	10
Benzo(a)pyrene	50-32-8	1.0	0.095	ug/l	57-129	21	63-129	10
Benzo(b)fluoranthene	205-99-2	1.0	0.25	ug/l	46-138	28	50-139	10
Benzo(g,h,i)perylene	191-24-2	1.0	0.12	ug/l	52-135	23	61-132	10
Benzo(k)fluoranthene	207-08-9	1.0	0.38	ug/l	45-141	30	53-140	10
4-Bromophenyl phenyl ether	101-55-3	2.0	0.35	ug/l	56-128	21	61-127	10
Butyl benzyl phthalate	85-68-7	2.0	0.25	ug/l	50-142	23	55-139	10
Benzyl Alcohol	100-51-6	2.0	0.31	ug/l	33-117	26	24-102	10
1,1'-Biphenyl [c]	92-52-4	1.0	0.42	ug/l	51-125	23	57-120	10
2-Chloronaphthalene	91-58-7	2.0	0.42	ug/l	50-115	22	51-115	10
4-Chloroaniline	106-47-8	5.0	0.25	ug/l	20-116	31	35-114	10
Carbazole [d]	86-74-8	1.0	0.17	ug/l	59-131	20	65-129	10
Caprolactam [e]	105-60-2	2.0	0.20	ug/l	10-85	43	1-78	10
Chlorobenzilate	510-15-6	5.0	0.48	ug/l	79-110	30	59-142	10
Chrysene	218-01-9	1.0	0.11	ug/l	55-127	20	59-128	10
bis(2-Chloroethoxy)methane	111-91-1	2.0	0.25	ug/l	52-127	22	56-127	10

Product: AB8270AP9 Acid and Base Neutrals, Appendix IX

Matrix: AQ Aqueous May 23, 2011 10:50 am

Method List:	AB8270 AQ	**Method Ref:** SW846 8270C	LJ35368
Report List:	ABAIX ALL	ABN Appendix IX List	LJ344
RL/MDL Factor:	1		

					Control Limits (%) Rev: 2/11			
Compound	**CAS No.**	**RL**	**MDL**	**Units**	**MS/MSD**	**RPD**	**BS**	**DUP**
bis(2-Chloroethyl)ether	111-44-4	2.0	0.31	ug/l	44-122	25	51-120	10
bis(2-Chloroisopropyl)ether	108-60-1	2.0	0.39	ug/l	37-124	22	38-125	10
4-Chlorophenyl phenyl ether	7005-72-3	2.0	0.35	ug/l	54-122	20	58-122	10
1,2-Dichlorobenzene	95-50-1	1.0	0.42	ug/l	34-105	25	34-102	10
1,3-Dichlorobenzene	541-73-1	1.0	0.36	ug/l	30-101	26	28-99	10
1,4-Dichlorobenzene	106-46-7	1.0	0.39	ug/l	32-103	25	31-101	10
2,4-Dinitrotoluene	121-14-2	2.0	0.22	ug/l	55-130	22	63-127	10
2,6-Dinitrotoluene	606-20-2	2.0	0.33	ug/l	55-142	20	59-140	10
3,3'-Dichlorobenzidine	91-94-1	5.0	0.30	ug/l	10-143	35	26-139	10
3,3'-Dimethylbenzidine	119-93-7	5.0	0.37	ug/l	70-130	30	12-58	10
7,12-Dimethylbenz(a)anthracene	57-97-6	5.0	0.30	ug/l	37-168	23	53-164	10
Diallate	2303-16-4	5.0	0.79	ug/l	66-112	30	29-154	10
Dibenzo(a,h)anthracene	53-70-3	1.0	0.15	ug/l	54-136	23	61-135	10
Dibenzofuran	132-64-9	5.0	0.30	ug/l	57-118	21	60-116	10
Dimethoate	60-51-5	5.0	0.52	ug/l	55-123	30	52-138	10
Diphenylamine	122-39-4	5.0	0.65	ug/l	1-107	30	27-140	10
Disulfoton	298-04-4	5.0	1.1	ug/l	56-104	30	61-148	10
m-Dinitrobenzene	99-65-0	5.0	0.70	ug/l	75-121	30	61-118	10
p-(Dimethylamine)azobenzene	60-11-7	5.0	0.65	ug/l	65-126	30	54-148	10
Di-n-butyl phthalate	84-74-2	2.0	0.19	ug/l	57-137	21	62-136	10
Di-n-octyl phthalate	117-84-0	2.0	0.40	ug/l	52-145	22	59-142	10
Diethyl phthalate	84-66-2	2.0	0.17	ug/l	49-132	22	53-131	10
Dimethyl phthalate	131-11-3	2.0	0.23	ug/l	36-135	26	37-137	10
bis(2-Ethylhexyl)phthalate	117-81-7	2.0	0.33	ug/l	51-146	24	59-141	10
Ethyl methanesulfonate	62-50-0	5.0	0.40	ug/l	68-97	30	46-114	10
Famphur	52-85-7	30	4.1	ug/l	1-109	30	28-174	10
Fluoranthene	206-44-0	1.0	0.17	ug/l	55-129	20	61-129	10
Fluorene	86-73-7	1.0	0.27	ug/l	57-125	21	62-124	10
Hexachlorobenzene	118-74-1	1.0	0.27	ug/l	53-128	21	58-127	10
Hexachlorobutadiene	87-68-3	1.0	0.13	ug/l	27-122	27	17-120	10
Hexachlorocyclopentadiene	77-47-4	20	0.24	ug/l	10-165	30	13-160	10
Hexachloroethane	67-72-1	2.0	0.21	ug/l	24-108	28	18-106	10
Hexachlorophene	70-30-4	50	14	ug/l	53-125	30	14-194	10
Hexachloropropene	1888-71-7	5.0	0.24	ug/l	48-102	30	13-122	10
Indeno(1,2,3-cd)pyrene	193-39-5	1.0	0.13	ug/l	53-138	23	59-138	10
Isodrin	465-73-6	5.0	0.90	ug/l	49-121	30	62-129	10
Isophorone	78-59-1	2.0	0.25	ug/l	42-139	20	44-141	10
Isosafrole	120-58-1	5.0	0.25	ug/l	75-109	30	44-135	10
Kepone	143-50-0	30	4.1	ug/l	1-110	30	10-157	10
2-Methylnaphthalene	91-57-6	1.0	0.66	ug/l	41-118	22	45-110	10
3-Methylcholanthrene	56-49-5	5.0	0.59	ug/l	70-111	30	68-120	10
Methapyrilene	91-80-5	5.0	1.1	ug/l	70-130	30	24-95	10
Methyl methanesulfonate	66-27-3	5.0	0.35	ug/l	26-77	30	10-98	10
Methyl parathion	298-00-0	5.0	0.77	ug/l	73-129	30	61-142	10

Product: AB8270AP9 Acid and Base Neutrals, Appendix IX

Matrix: AQ Aqueous May 23, 2011 10:50 am

Method List:	AB8270 AQ	**Method Ref:** SW846 8270C	LJ35368
Report List:	ABAIX ALL	ABN Appendix IX List	LJ344
RL/MDL Factor:	1		

					Control Limits (%) Rev: 2/11			
Compound	**CAS No.**	**RL**	**MDL**	**Units**	**MS/MSD**	**RPD**	**BS**	**DUP**
1,4-Naphthoquinone	130-15-4	5.0	0.43	ug/l	59-103	30	57-137	10
1-Naphthylamine	134-32-7	5.0	0.76	ug/l	1-65	30	45-106	10
2-Naphthylamine	91-59-8	5.0	0.51	ug/l	1-41	30	55-122	10
2-Nitroaniline	88-74-4	5.0	0.24	ug/l	45-151	25	50-147	10
3-Nitroaniline	99-09-2	5.0	0.29	ug/l	28-120	28	44-116	10
4-Nitroaniline	100-01-6	5.0	0.18	ug/l	32-131	28	50-125	10
5-Nitro-o-toluidine	99-55-8	5.0	0.90	ug/l	7-155	30	58-137	10
Naphthalene	91-20-3	1.0	0.43	ug/l	40-116	24	47-107	10
Nitrobenzene	98-95-3	2.0	0.25	ug/l	48-122	22	53-118	10
n-Nitrosodimethylamine	62-75-9	2.0	0.73	ug/l	10-101	31	10-78	10
4-Nitroquinoline 1-Oxide	56-57-5	10	1.1	ug/l	13-179	30	28-171	10
N-Nitroso-di-n-propylamine	621-64-7	2.0	0.44	ug/l	44-136	22	50-134	10
N-Nitrosodi-n-butylamine	924-16-3	5.0	1.3	ug/l	32-137	30	57-134	10
N-Nitrosodiethylamine	55-18-5	5.0	0.33	ug/l	69-105	30	55-112	10
N-Nitrosodiphenylamine	86-30-6	5.0	0.22	ug/l	52-130	23	61-121	10
N-Nitrosomethylethylamine	10595-95-6	5.0	0.80	ug/l	62-114	30	10-146	10
N-Nitrosomorpholine	59-89-2	5.0	0.43	ug/l	41-114	30	10-140	10
N-Nitrosopiperidine	100-75-4	5.0	0.40	ug/l	49-119	30	55-142	10
N-Nitrosopyrrolidine	930-55-2	5.0	0.49	ug/l	59-124	30	26-152	10
O,O,O-Triethyl phosphorothioat	126-68-1	5.0	0.38	ug/l	45-109	30	50-115	10
2-Picoline	109-06-8	5.0	0.28	ug/l	70-130	30	24-79	10
Parathion	56-38-2	5.0	0.78	ug/l	71-137	30	59-159	10
Pentachlorobenzene	608-93-5	5.0	0.43	ug/l	60-113	30	48-132	10
Pentachloronitrobenzene	82-68-8	5.0	1.8	ug/l	50-150	30	12-200	10
Phenacetin	62-44-2	5.0	1.1	ug/l	59-141	30	55-130	10
Phenanthrene	85-01-8	1.0	0.21	ug/l	57-126	21	62-124	10
Phorate	298-02-2	5.0	0.70	ug/l	9-147	30	33-179	10
Pronamide	23950-58-5	5.0	0.89	ug/l	62-115	30	45-163	10
Pyrene	129-00-0	1.0	0.16	ug/l	50-128	21	56-126	10
Pyridine	110-86-1	2.0	0.27	ug/l	10-91	40	10-73	10
p-Phenylenediamine	106-50-3	5.0	0.25	ug/l	33-145	30	50-150	10
Safrole	94-59-7	5.0	0.34	ug/l	48-103	30	48-124	10
1,2,4,5-Tetrachlorobenzene	95-94-3	2.0	0.48	ug/l	39-129	22	35-129	10
1,2,4-Trichlorobenzene	120-82-1	1.0	0.44	ug/l	38-111	24	33-110	10
Thionazin	297-97-2	5.0	0.79	ug/l	1-56	30	57-136	10
o-Toluidine	95-53-4	5.0	0.38	ug/l	70-130	30	30-113	10
sym-Trinitrobenzene	99-35-4	5.0	0.69	ug/l	88-122	30	34-158	10
Tetraethyl dithiopyrophosphate	3689-24-5	5.0	0.80	ug/l	72-120	30	58-142	10

2-Fluorophenol	367-12-4	Surrogate Limits:	10-83
Phenol-d5	4165-62-2	Surrogate Limits:	10-74
2-Chlorophenol-D4		Surrogate Limits:	70-130
2,4,6-Tribromophenol	118-79-6	Surrogate Limits:	24-148
1,2-Dichlorobenzene-d4	2199-69-1	Surrogate Limits:	70-130

Product: AB8270AP9 Acid and Base Neutrals, Appendix IX

Matrix: AQ Aqueous May 23, 2011 10:50 am

Method List:	AB8270 AQ	**Method Ref:**	SW846 8270C	LJ35368
Report List:	ABAIX ALL		ABN Appendix IX List	LJ344
RL/MDL Factor:	1			

					Control Limits (%) Rev: 2/11		
Compound	**CAS No.**	**RL**	**MDL**	**Units**	**MS/MSD RPD**	**BS**	**DUP**
Nitrobenzene-d5	4165-60-0				Surrogate Limits:	38-129	
2-Fluorobiphenyl	321-60-8				Surrogate Limits:	42-117	
Terphenyl-d14	1718-51-0				Surrogate Limits:	14-132	

126 compounds and 8 surrogates reported in list ABAIX

(a) Addon product code: BMS+ ATRZ
(b) Addon product code: BMS+ BAH
(c) Addon product code: BMS+ BIPHNYL
(d) Addon product code: BMS+ CZ
(e) Addon product code: BMS+ CAPR

DECONTAMINATION PROCEDURES

In order to reduce the potential for cross-contamination of samples collected during this project, the following procedures will be implemented to ensure that the data collected (primarily the laboratory data and groundwater quality measurement) is acceptable. It is anticipated that most of the materials used to assist in obtaining samples will be disposable one-use materials (e.g., sampling containers, bailers, rope, pump tubing, latex gloves, etc.). When equipment must be re-used (e.g., static water level indicator, oil/water interface meter, drilling equipment, etc.), it will be decontaminated by the following methods:

- Rough wash in tap water; wash in mixture of tap water and alconox-type soap; double rinse with deionized or distilled water; and air dry and/or dry with clean paper towel. When deemed necessary, a temporary decontamination pad will be constructed for decontamination of equipment. Any decontamination pad will be removed following completion of associated activities. Decontamination liquids and disposable equipment and personal protective equipment will be containerized in NYSDOT-approved 55-gallon drums and left on-site until the disposal method is determined.

Operation and Calibration of On-Site Monitoring Equipment

The field personnel will be familiar with the equipment being used. Volatile vapor monitoring will be conducted using a PID. It is anticipated that a RAE Systems MiniRAE 2000 PID equipped with a 10.6 eV lamp, or equivalent, will be used during this project. The PID will be calibrated in accordance with the manufacturer's specifications using an isobutylene gas standard prior to use and as necessary during fieldwork. Measurements will be collected in accordance with the protocols outlined in the Health and Safety Plan (HASP).

Other miscellaneous field instruments that may be used during this project include:

- An electronic static water level indicator;

- A low-flow bladder pump system;

- A global positioning system (GPS);

- Survey equipment;

- An oil/water interface meter; and

- A Horiba U-22 water quality meter, or similar.

These meters will be calibrated, operated, and maintained in accordance with the manufacturer's recommendations.

DATA REVIEW AND EVALUATION

DATA REVIEW, VERIFICATION AND VALIDATION

The Project Manager and the Quality Assurance Officer are responsible for determining that data are of adequate quality to support this project. The project will be modified as directed by the Project Manager. The Project Manager shall be responsible for the implementation of changes to the project and shall document the effective date of all changes made.

The Project Manager shall authorize all changes or deviations in the operation of the project. Any significant changes will require an amendment to the QAPP. All verification and validation methods will be noted in the analysis provided in the final project report (DUAR).

The Quality Assurance Officer will perform monthly quality checks of data packages to identify any systemic errors. Field data will be reviewed to ensure information is complete and note any deviations from this QAPP. Deviations will be brought to the attention of the Project Manager.

All laboratory data are to be reported in NYSDEC ASP Category B deliverables and will be delivered to NYSDEC in electronic data deliverable (EDD) format as described on NYSDEC's website (http://www.dec.ny.gov/chemical/62440.html).

VERIFICATION AND VALIDATION METHODS

The Project Quality Assurance Officer will review the laboratory data packages and data quality indicators monthly to ensure acceptance criteria are being met.

The cause for failure of data quality indicators to meet acceptance criteria will be evaluated to determine what if any project procedures need to be revised.

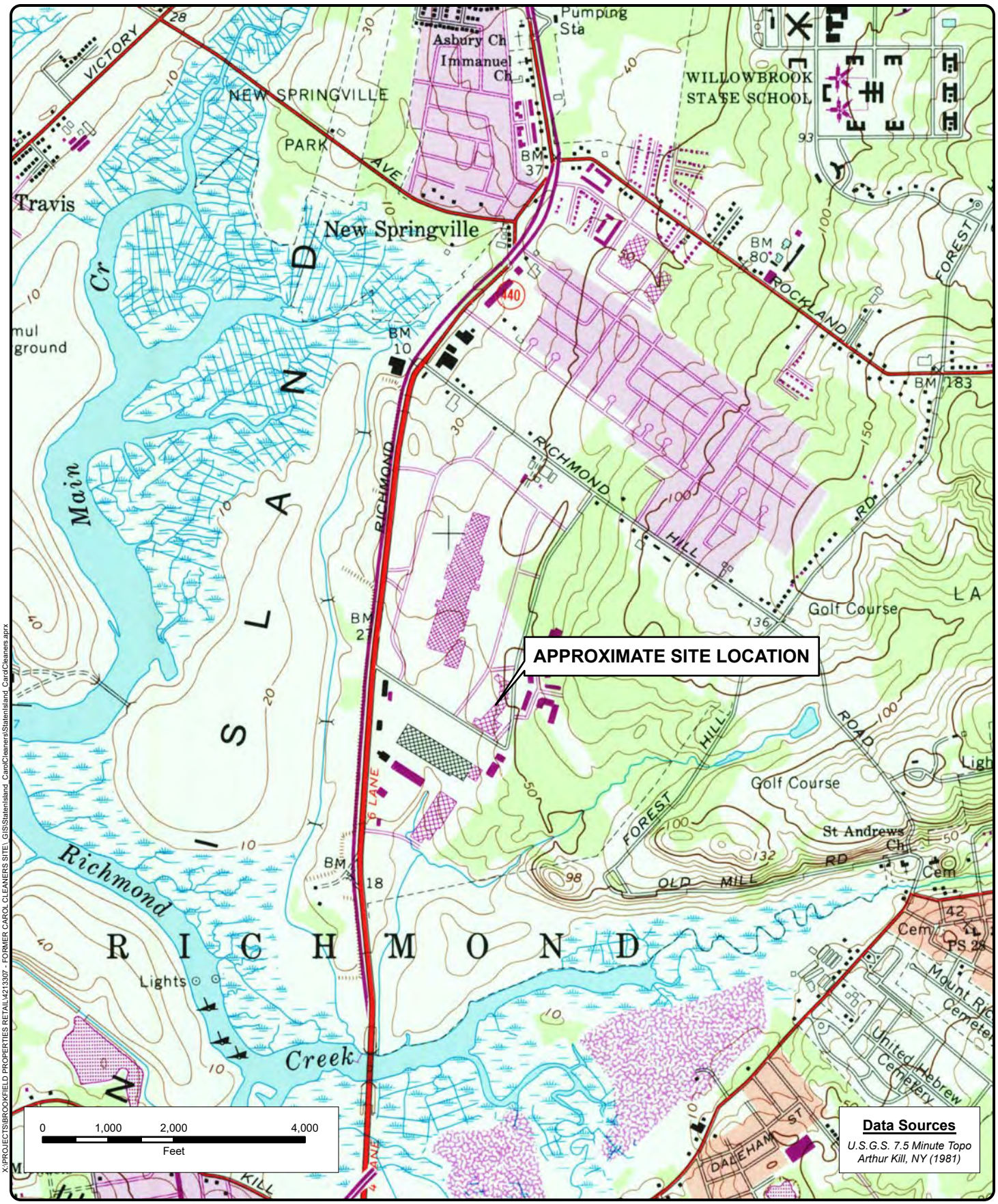
The Project Manager and project staff will be notified any issues and the required corrective action. All changes will be documented in an amended QAPP and distributed.

EVALUATING DATA IN TERMS OF USER NEEDS

The data quality objectives and validation procedures for this project are designed to ensure that the Project Manager and Project Quality Assurance Officer will be able to identify and correct any systematic errors found in the procedures for sample collection and reporting.

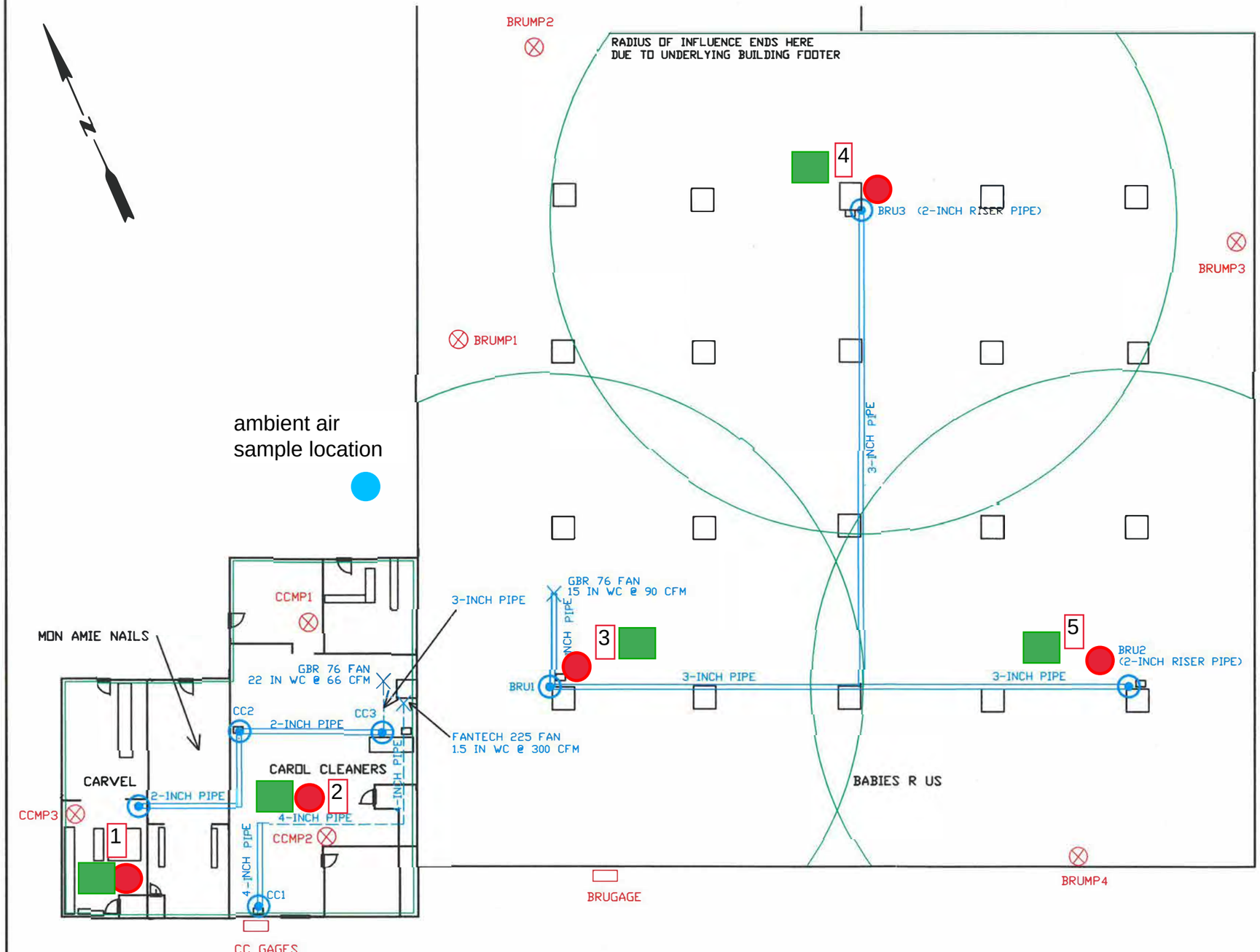
It is the Project Manager's responsibility to ensure that data not meeting the data quality objectives as defined in this QAPP are qualified as not valid and do not bias project outcomes. The Project manager has the authority and responsibility to implement and ensure corrective actions are followed.

FIGURES



X:\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 - FORMER CAROL CLEANERS SITE_GIS\StatenIsland_CarolCleanersStatenIsland_CarolCleaners.aprx

PREPARED BY: AGB APPROVED BY: MGA DATE CREATED: 7/14/2021	TETRA TECH PREPARED BY: TETRATECH This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.	GGP STATEN ISLAND MALL, LLC CARL CLEANERS - THE CROSSINGS STATEN ISLAND, NEW YORK **SITE LOCATION**	FIGURE NO. **1** PROJECT NO. 4201222



LEGEND

- SUCTION POINT LOCATION WITH DESIGNATION (CC1)
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE (GBR 76 FAN)
- PROPOSED EFFECTIVE RADIUS OF INFLUENCE EXERTED BY BLOWER FAN
- MAGNAHELIC GAGE LOCATION
- PROPOSED INDOOR AIR SAMPLING LOCATION
- PROPOSED SUB-SLAB VAPOR SAMPLING LOCATION
- 1 SAMPLE LOCATION NUMBER

GGP STATEN ISLAND MALL, LLC
STATEN ISLAND, NEW YORK

SUB-SLAB DEPRESSURIZATION SYSTEM AS-BUILT

PREPARED BY:
LEGGETTE, BRASHEARS & GRAHAM, INC.
Professional Groundwater and Environmental Services
600 E. Crescent Ave; Suite 200
Upper Saddle River, New Jersey
(201) 818-0700

FILE: ROUSE/2016-9asbuilt	DRAWN BY: JM	CHECKED BY: CS	FIGURE: 1

DATE: 2/18/15



LEGEND:

MW–9	ABANDONED WELL
MW–3D	BEDROCK WELL
MW–13	OVERBURDEN WELL

SOURCE:
BACKGROUND AERIAL DOWNLOADED FROM NEAR MAP PROGRAM, DATED 2021–10–19.

0 100 200
SCALE IN FEET

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

TETRA TECH

ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

GGP STATEN ISLAND MALL, LLC
CAROL CLEANERS – THE CROSSINGS
STATEN ISLAND, NEW YORK

GROUNDWATER MONITORING WELLS

FIGURE NO. 3

PROJECT NO. 4213307

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\213307–F–02–SITE PLAN.DWG Layout: FIGURE 02 User: JISS.PHILIP Feb 02, 2024 – 9:30am

APPENDIX A

FIELD INSTRUMENTS STANDARD OPERATING PROCEDURES

SOP No.: NJFP0001

STANDARD OPERATING PROCEDURE AND QUALITY ASSURANCE/QUALITY CONTROL MANUAL FOR THE MEASUREMENT OF FIELD WATER QUALITY PARAMETERS

Prepared by

CORNERSTONE
Engineering Group, LLC
90 Crystal Run Road, Suite 201
Middletown, New York 10941

Project (insert #)

SOP No.: NJFP0001

STANDARD OPERATING PROCEDURE AND QUALITY ASSURANCE/QUALITY CONTROL MANUAL FOR THE MEASUREMENT OF FIELD WATER QUALITY PARAMETERS

This document has been prepared under the supervision and direction of the undersigned

Cornerstone Environmental Group, LLC

Timothy R. Roeper, P.G. Manager/Technical Leader

Leslie A. Sparrow, P.G. QA/QC officer

TABLE OF CONTENTS

1 SCOPE AND APPLICATION 1-2

2 METHOD SUMMARY 2-1

3 SAMPLE COLLECTION 3-1

3.1 REQUIRED EQUIPMENT 3-1
3.2 FIELD PREPARATION FOR SAMPLING 3-1
3.3 PURGING AND SAMPLING 3-2
3.4 RECORD MAINTENANCE 3-3

4 SAMPLE PRESERVATION, STORAGE, HANDLING AND DOCUMENTATION 4-1

5 DECONTAMINATION 5-1

6 HORIBA U-50 WATER QUALITY METER CALIBRATION 6-1

6.1 RECORD MAINTENANCE 6-1
6.2 CALIBRATION REAGENTS 6-1
6.3 CALIBRATION RECORDS AND HANDLING 6-2
6.4 CALIBRATION 6-2
6.4.1 Temperature 6-2
6.4.2 pH Calibration 6-2
6.4.3 ORP Calibration 6-3
6.4.4 Conductivity (COND) Calibration 6-4
6.4.5 Turbidity 6-5
6.4.6 Dissolved Oxygen 6-6

7 QUALITY ASSURANCE/QUALITY CONTROL 7-1

7.1 QUALITY ASSURANCE (QA) 7-1
7.2 QUALITY CONTROL (QC) 7-1
7.2.1 Trip Blanks 7-1
7.2.2 Field Blanks 7-1
7.2.3 Equipment Blanks 7-2
7.2.4 Field Duplicates 7-2
7.2.5 MS/MSD Samples 7-2

8 HEALTH AND SAFETY 8-1

ATTACHMENT A HORIBA U-50 USERS MANUAL
ATTACHMENT B LAMOTT DISSOLVED OXYGEN MANUAL

1 SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the collection and handling of groundwater samples, collected in accordance with the Low Flow Purging and Sampling (LFPS) methodology, for analysis of field parameters consisting of pH, specific conductivity, Redox Potential (ORP) Dissolved Oxygen (DO) Turbidity, and Temperature. These field parameters are identified as "Analyze Immediately" parameters under NJDEP Analytical Testing Parameter codes WPP02 and WPP03.

All groundwater sampling conducted in New Jersey in accordance with the LFPS methodology will be conducted in accordance with this SOP. The sample collection, handling, shipping and analysis of other parameters (i.e., volatile organics, semi-volatile organics, metals, etc.) will be based upon site specific requirements documented in the Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP) or similar document specific to each site.

The objective of this SOP is to establish consistent procedures for equipment calibration and documentation, sample collection and handling, and parameter analysis and recording so that the results are representative and repeatable.

2 METHOD SUMMARY

The LFPS methodology requires the use of a positive displacement pump (variable speed electrical submersible pump or bladder pump) to evacuate and sample water from the well at a pumping rate between 100 and 500 ml/minute. The discharge tubing from the pump is connected directly to a flow through cell equipped with a "multi-parameter meter" that has been calibrated and documented in accordance with the manufacturer's recommendations and the procedures contained in this SOP. The multi-parameter meter used by Cornerstone is the Horiba U-50 Series multi sensor probe equipped with individual sensors to measure various water quality parameters. The field measurements will be read from the meter and recorded on field data sheets maintained for each sampling location (monitoring well). Measurements for each parameter will be recorded every five to six minutes until three consecutive readings fall within the range stated below.

Water Level	<0.3 feet
pH	+/- 0.1 standard pH unit
Specific Conductance	+/- 3%
Temperature	+/- 3%
Dissolved Oxygen	+/- 10%
Turbidity	+/-10%
ORP	+/- 10 millivolts

Once the parameters stabilize to within the above ranges the field parameter measurements are complete and the collection of samples for analysis of other parameter may be completed in accordance with the site specific requirements.

The analytical methods used by the Horiba U-50 Series multi-sensor probe to report the field parameters include the following:

- pH – SM 4500-HB (electronic method)
- Turbidity - EPA 180.1
- Conductivity – EPA 120.1
- Dissolved Oxygen – SM 4500-OG
- ORP – Ag/AgCL with 3.33 mol/L KCl reference standard

3 SAMPLE COLLECTION

Groundwater samples will be collected in accordance with LFPS methodology using a calibrated Horiba U-50 series multi parameter meter as described below. The Horiba U-50 series meter must be calibrated as described in Section 6.0. When known, samples will be collected first from the least impacted locations and then progressively to the most impacted locations.

3.1 Required Equipment

- Positive displacement pump and control box (electrical submersible, bladder pump, etc. (may be dedicated to the sampling location or moved between locations during sampling)
- Generator or other power source as needed
- Water- level indicator
- Horiba U-50 series Multi Water Quality Checker, fitted with flow-through-cell (THE U-50 METER MUST BE CALIBRATED AS DESCRIBED IN SECTION 6.0)
- Container(s) for evacuation liquids (as required by site specific protocols)
- Field data sheets and log book
- Calculator
- Stop watch or other time keeping device
- Decontamination solutions and containers (See Section 5.0)
- Distilled or deionized water
- Protective gloves and site specific health and safety gear
- Calibration solutions/equipment (See Section 6.2)
- Sample bottles and chain of custody forms obtained from analytical laboratory (for laboratory analyzed parameters)
- Ice (for samples shipped to analytical laboratory)
- Miscellaneous tools (screwdrivers, pliers, clamps, adjustable wrench, etc.)
- Site keys

3.2 Field Preparation for Sampling

- Start at the least contaminated well, if known.
- Wash the sensor probe on the U-50 Water Quality Meter 2 to 3 times with deionized water and secure the probe in the flow through cell

- Turn the power on and allow the meter to warm up while preparing to sample. Check that the DO readout has stabilized before starting measurements (typically about 20 minutes).
- Remove locking well cap, note location, time of day, and date in the site logbook.
- Remove well-casing cap.
- Lower water level measuring device into well until water surface is encountered. Measure the depth to water from the reference measuring point on the well casing. Absent a marked reference point, measurements are to be taken from the highest point on the inner casing (if present) or, if an inner well casing is not present, from the highest point on the protective casing. Record the depth to water in the log book.
- Connect the required length of sample tubing (as specified in the site specific sampling plan) to the pump (variable speed submersible pump or bladder pump).
- Slowly lower the pump into the well to the depth specified in the site specific sampling plan. Avoid hitting the bottom of the well with the pump as this may suspend sediment and significantly prolong the time required for field stabilization and sampling.

3.3 Purging and Sampling

- Start the pump at a speed that results in a flow rate between 100 and 500 ml/min (measured with a graduated cylinder).
- After the flow rate has stabilized, connect the tubing to the flow through cell.
- If drawdown in the well exceeds 0.3 feet, reduce the pumping rate until the drawdown is stabilized but DO NOT reduce the flow below 100 ml/min.
- If the drawdown will not stabilize at 100 ml/min, continue purging until the water level drops to within approximately 1.0 foot of the top of the screen (do not expose the screen to air). Stop purging and allow the water level to recover sufficiently to allow for the collection of sufficient sample volume. Re-start the pump, record the field parameters and collect the sample.
- If the drawdown stabilizes at 100 ml/min continue purging until the field parameters stabilize as described below.
- Record the drawdown and water quality parameters every 5 minutes on the field data sheet until three consecutive readings stabilize within the following criteria:

Water Level	<0.3 feet
pH	+/- 0.1 standard pH unit
Specific Conductance	+/- 3%
Temperature	+/- 3%
Dissolved Oxygen	+/- 10%
Turbidity	+/-10%
ORP	+/- 10 millivolts

- Once the field parameters have stabilized and are recorded on the field data sheet, prepare to collect the required samples, as specified in the site specific sampling plan, for laboratory analysis.
- Disconnect the pump tubing from the flow through cell.
- Samples are collected directly from the pump tubing into the laboratory provided sample containers.
- Note the collection of any quality assurance/quality control (QA/QC) samples (See Section 7.0) on the field data sheet.

3.4 Record Maintenance

Measurement records are to be recorded in the field book or on field data sheets and will be maintained with the project files for five years after the date of analysis. Measurement records will include: Sample/location ID, date and time of analysis, name and signature of person conducting the sampling and/or analysis, chain of custody records, analytical parameter and results.

4 SAMPLE PRESERVATION, STORAGE, HANDLING AND DOCUMENTATION

Field parameters are to be analyzed immediately (within 15 minutes) using a flow through cell and Horiba U-50 meter. No preservation is required.

Samples collected for laboratory analysis will be stored on ice and preserved in accordance with the site specific sampling plan. Sample bottles will be obtained from the laboratory and labeled with the well ID, samplers initials, date and time of sample collection and preservative (as required). All samples will be handled under chain-of-custody documentation and delivered to the lab within the sample holding times identified in the site specific sampling plan.

The following rules apply to Chain-of-Custody Records:

- All information must be supplied in the indicated spaces to complete the field Chain-of-Custody Record.
- All samplers and sampling team leaders (if applicable) must sign in the designated signature block.
- One sample should be entered on each line and not be split among multiple lines.
- The total number of sample containers for each sample must be listed in the appropriate column. Required analyses should be circled or entered in the appropriate location as indicated on the Chain-of-Custody Record.
- The sample custodian and subsequent transferee(s) should document the transfer of the samples listed on the Chain-of-Custody Record. The person who originally relinquishes custody should be the sample custodian. Both the person relinquishing the samples and the person receiving them must sign the form. The date and time that this occurs should be documented in the proper space on the Chain-of-Custody Record.
- Usually, the last person receiving the samples should be the laboratory sample custodian or their designee(s).

The Chain-of-Custody Record is a serialized document. Once the Record is completed, it becomes an accountability document and will be maintained in the project file.

5 DECONTAMINATION

The purpose of decontamination is: (1) to eliminate the transfer of contaminants from one groundwater monitor well to another, and (2) to protect the health and safety of personnel who may come in contact with contaminated equipment. Decontamination procedures described in this section will be performed at the beginning of each day of field work, between each boring and monitor point, at the end of each day of field work, and whenever the equipment is suspected of having been contaminated.

A triple rinse system is utilized to decontaminate the pump and electrical lead between wells. The triple rinse system involves running the pump in cleaning tubs that contain three progressively cleaner grades of potable water. The following steps will be followed:

1. Remove the pump, electrical lead and dedicated tubing from the well.
2. Disconnect the dedicated tubing from the pump (tubing will not be re-used or decontaminated).
4. Place the pump into the first cleaning tub or bucket containing Alconox/potable water solution. Run the pump within the solution for 2 minutes.
5. Place the pump into the second cleaning tub or bucket containing approximately 5 gallons of potable water. Run the pump within the water for 2 minutes.
6. Place the pump into the third cleaning tub or bucket containing approximately 5 gallons of potable water. Run the pump within the water for 2 minutes.
8. Replace the potable water and water solutions daily or as needed.

6 HORIBA U-50 WATER QUALITY METER CALIBRATION

Calibration will be completed before starting the sampling program and then at the frequency noted below for each respective parameter:

Turbidity, ORP – Once per day

pH – Once per day plus calibration check with pH 7 calibration solution every three hours of use. If the measured value is greater than +/- 0.20 pH units, recalibrate for pH before continuing.

Dissolved Oxygen – Once per day against air and weekly using Winkler Titration

Conductivity – Initial (one time) calibration curve and then a daily (once per day) calibration check. If the measured conductivity is within +/- 1% of the standard, calibration is complete. If the value is outside the +/- 1% range, then calibrate as called for below.

Temperature – Quarterly against a NIST calibrated thermometer

Record all calibration data in the dedicated log book associated with each instrument.

6.1 Record Maintenance

The calibration logbook shall be kept with the meter and a record of each calibration will include the date, calibration results, and name of the individual conducting the calibration. Records will be maintained in an accessible location in the office for five years after the date of analysis.

6.2 Calibration Reagents

The following standards and reagents are used for calibration:

- DI-Water
- ORP Standard Solution (200 – 275 mv)
- zero oxygen solution
- Conductivity solution standard (84 uS/cm) or approximate equivalent
- Conductivity solution standard (1,413 uS/cm) or approximate equivalent
- Conductivity solution standard (12,880 uS/cm) or approximate equivalent
- Turbidity calibration solution 0 NTU
- Turbidity calibration solution 5 NTU
- Turbidity calibration solution 10 NTU

- Turbidity calibration solution 100 NTU
- pH 4.00 Calibration solution standard
- pH 7.00 Calibration solution standard
- pH 10.00 Calibration solution standard
- NIST calibrated thermometer
- LaMotte Dissolved Oxygen Test Kit 5856

6.3 Calibration Records and Handling

All calibration reagents will be purchased commercially and will have a lot specific certificate. Upon receipt, the date at which the bottle was opened and the expiration date will be marked on the bottle. Any reagent that has passed its expiration date will not be used.

6.4 Calibration

Calibration is completed manually following the procedures in Section 3.3 of the attached user's manual and summarized below. Auto-Calibration can NOT be used.

A record of the calibration measurements must be maintained with each instrument as described above.

6.4.1 Temperature

- Insert probe into container with water of known temperature (determined with NIST certified thermometer).
- Allow 5 minutes for probe temperature to stabilize.
- Press CAL and select "Manual Calibration."
- Select "Temp" and press ENTER key.
- Use arrow keys to set calibration value (known temperature).
- Check that "measurement value" has stabilized and then press ENTER to start calibration.
- Calibration is complete when the message "Cal complete. CNT to measure" appears.

6.4.2 pH Calibration

The two point calibration method is required.

- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with pH 4 standard solution.
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup.
- Press CAL and select "Manual Calibration
- Select "pH" and press ENTER key
- Select number of calibration points (2)
- Use arrow keys to set pH value of the pH standard solution at the measurement temperature (See chart in Section 3.3 of attached user's manual)
- Check that "measurement value" has stabilized and then press ENTER to start calibration
- When the message "Cal complete. Press ENT to Span cal."appears, press ENTER
- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with pH 10 standard solution.
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- Use arrow keys to set pH value of the pH standard solution at the measurement temperature (See chart in Section 3.3 of attached user's manual)
- Check that "measurement value" has stabilized and then press ENTER to start calibration
- When the message "Cal complete. ENT to manual cal menu."appears, press ENTER

Calibration Check

- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with pH 7 standard solution.
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- If the measured pH is within +/- 0.2 pH units of the standard value (i.e., pH 7) calibration is complete. If the measured value is outside this range, recalibrate in accordance with the above.

6.4.3 ORP Calibration

- Fill the transparent calibration cup to the reference line with the commercially prepared standard solution.
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup.

- Press CAL and select “Manual Calibration”
- Select “ORP” and press ENTER key
- Use arrow keys to set ORP value of the standard solution at the measurement temperature (See chart in Section 3.3 of attached user’s manual)
- Check that “measurement value” has stabilized and then press ENTER to start calibration
- When the message “Cal complete. ENT to manual cal menu.”appears, press ENTER
- Calibration is complete.

6.4.4 Conductivity (COND) Calibration

- Calibrate the zero point by washing the sensor probe 2 to 3 times with deionized water and remove all moisture from the sensor probe (calibration is done in air)
- Press CAL and select “Manual Calibration”
- Select “COND” and press ENTER key
- Select the number of calibration points (4).
- Use arrow keys to set COND value to 0.00
- Check that “measurement value” has stabilized and then press ENTER to start calibration
- When the message “Cal complete. Press ENT to Span cal.”appears, press ENTER
- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with lowest Conductivity standard solution.
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- Use arrow keys to set COND value of the standard solution
- Check that “measurement value” has stabilized and then press ENTER to start calibration
- When the message “Cal complete. Press ENT to Span cal.”appears, press ENTER to start the next span calibration procedure.
- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with next highest Conductivity standard solution.
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- Use arrow keys to set COND value of the standard solution
- Check that “measurement value” has stabilized and then press ENTER to start calibration
- Repeat the above steps for each span calibration
- When the message “Cal complete. ENT to manual cal menu.” appears, press ENTER.
- Calibration is complete.

Calibration Curve (completed one time after initial calibration is complete):

- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with lowest Conductivity standard solution.
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- Record the measured conductivity value and the conductivity value of the standard solution
- Repeat above steps for each standard solution
- Plot measured conductivity versus standard solution conductivity to check linearity.

6.4.5 Turbidity

- Press CAL and select "Manual Calibration"
- Select "Turb" and press ENTER key
- Select the number of calibration points (4 - zero and three span calibration points)
- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with deionized water
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- Use arrow keys to set Turb value to 0.00
- Check that "measurement value" has stabilized and then press ENTER to start calibration
- When the message "Cal complete. Press ENT to Span cal." appears, press ENTER
- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with next lowest concentration turbidity standard solution
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- Use arrow keys to set Turb value of the standard solution
- Check that "measurement value" has stabilized and then press ENTER to start calibration
- When the message "Cal complete. Press ENT to Span cal." appears, press ENTER to start the next span calibration procedure
- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with next highest standard solution
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- Use arrow keys to set Turb value of the standard solution
- Check that "measurement value" has stabilized and then press ENTER to start calibration
- Repeat the above steps for each span calibration
- When the message "Cal complete. ENT to manual cal menu." appears, press ENTER
- Calibration is complete.

6.4.6 Dissolved Oxygen

A Two point calibration for dissolved oxygen (DO) is conducted using a zero oxygen standard solution and a calibration solution of known DO concentration determined using a dissolved oxygen test kit (LaMotte 5860 or equivalent) employing the Winkler Titration method. Instructions for using the dissolved oxygen test kit are attached and summarized below. The sample standard must be prepared before calibrating the meter.

Sample Standard Preparation

1. Fill the sample bottle provided with the test kit with potable water, making sure there are no visible air bubbles or air space trapped in the bottle.
2. Add 8 drops of manganese sulfate solution and 8 drops of alkaline potassium iodide azide solution
3. Cap bottle and mix solution
4. Allow precipitate to settle below shoulder of bottle
5. Add 8 drops sulfuric acid
6. Cap bottle and mix until precipitate and reagent have totally dissolved. Solution will be clear yellow to orange

Titration

1. Fill titration tube to the 20 ml line with the sample prepared above
2. Depress the plunger of the Titrator
3. Insert the Titrator into the plug of the Sodium Thiosulfate titrating solution
4. Invert the bottle and slowly withdraw the plunger until the large ring on the plunger is opposite the zero line on the scale. Push solution back into the bottle if required to remove bubbles from the sides of the Titrator. Repeat until there are no bubbles.
5. Turn the bottle upright and remove the Titrator. If the sample in the titration tube is very pale yellow go to step 9, else continue
6. Insert the tip of the Titrator into the titration tube cap
7. Slowly depress the plunger to dispense the titrating solution until the yellow brown color changes to a very pale yellow. Gently swirl the tube during the titration to mix the contents
8. Remove the Titrator and cap. Do not disturb the Titrator plunger
9. Add 8 drops of starch indicator solution. The sample should turn blue
10. Cap the titration tube. Insert the Titrator into the opening on the titrator cap
11. Continue titrating until the blue color disappears and the solution becomes clear
12. Read the results (in part per million) directly from the scale on the Titrator. Each minor division is 0.2 ppm.

Meter Calibration

- For a two point calibration, Press CAL and select “Manual Calibration”
- Select “DO” and press ENTER key

- Select “2” for the number of calibration points
- Wash the transparent calibration cup 2 or 3 times with deionized water and fill to reference line with zero oxygen solution
- Wash the sensor probe 2 to 3 times with deionized water and submerge in transparent calibration cup
- Use arrow keys to set DO value to 0.00 mg/L or 0.0%
- Check that “measurement value” has stabilized and then press ENTER to start calibration
- When the message “Cal complete. ENT to Span cal menu.”appears, press ENTER key
- Wash the sensor probe 2 or 3 times with deionized water to remove any dirt, then submerge the sensor probe in the container filled with the known DO concentration solution (sample) prepared above
- Use arrow keys to set the DO value to the oxygen value (mg/L) of the water sample prepared above
- Check that "Measurement value" has stabilized, then press the ENTER key to start calibration
- Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.

7 QUALITY ASSURANCE/QUALITY CONTROL

7.1 Quality Assurance (QA)

- All data must be documented within logbooks and/or field data sheets.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.
- Equipment checkout and calibration activities must occur prior to sampling/operation as described in this SOP.
- All equipment used between sampling locations must be decontaminated between sampling locations as described in this SOP.
- Calibration activities must be documented in the Calibration Lob Book associated with each instrument.
- Field parameters, also known as analyze immediately parameters, must be analyzed within 15 minutes of collection.
- Samples for laboratory analysis will be collected in laboratory provided sample bottles, preserved in accordance with the site specific sampling plan and stored on ice pending delivery to the lab.
- All samples will be maintained under chain of custody.

7.2 Quality Control (QC)

Field QC samples will be collected and analyzed to assess the consistency and performance of the groundwater sampling activities. Specific requirements for QC samples will be provided within the site specific sampling plan and may include the following:

7.2.1 Trip Blanks

Trip blanks will be prepared by the laboratory in 40-milliliter (mL) vials with analyte-free water. The trip blanks will be carried into the field, stored, and shipped to the laboratory along with the water samples. One trip blank will be shipped with each cooler that contains samples to be analyzed for VOCs. Trip blanks are evaluated to determine whether VOC cross-contamination between samples has occurred during storage and transportation. Trip blanks apply only to volatile organics and must be free of headspace.

7.2.2 Field Blanks

Collection and analysis of field blanks are provided as QC checks on the integrity of sample collection and handling procedures. Prepare field blank samples by using

deionized water and sample bottles randomly selected from the bottles prepared for environmental samples. Assign field blank samples unique sample numbers so they cannot be identified by the laboratory as blank samples.

Field blanks are analyzed using the same methods and procedures as those to be used for VOC environmental samples.

7.2.3 Equipment Blanks

Collection and analysis of field equipment blanks are provided as QC checks on the integrity of equipment decontamination procedures. Prepare equipment rinsate samples by using analyte free water (provided by the laboratory) and sample bottles randomly selected from the bottles prepared for environmental samples. Pour the analyte free water over the decontaminated equipment and collect it in the sample bottle.

Analyze these blanks for the same sample parameters as those analyzed for the collected environmental samples.

7.2.4 Field Duplicates

Field duplicates are two samples (an original and a duplicate) of the same matrix, to the extent practicable, collected at the same time and location and using the same sampling techniques. Field duplicate samples are used to evaluate the precision of the overall sample collection and analysis process. Field duplicates will be analyzed for the full set of analyses used for the regular sample collected. Exact locations of duplicate samples and sample identifications will be recorded in the field logbook and/or field data sheet.

7.2.5 MS/MSD Samples

The laboratory will analyze an MS/MSD for every twenty samples analyzed or for every analytical batch prepared, whichever is more frequent. Field personnel will collect triple the amount or the volume of the sample matrix for the designated MS/MSD sample. The MS/MSD sample will be used to determine the precision of the sample preparation, analytical methods and potential matrix interference.

8 HEALTH AND SAFETY

Prior to conducting work at any site, the site specific health and safety plan will be reviewed with specific emphasis placed on the protection program planned for the well-sampling tasks. Standard safe operating practices must be followed such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and disposable clothing, as required.

When working around volatile-organic contaminants:

- Avoid breathing constituents venting from the well.
- Survey the well headspace with a flame- ionization detector (FID) or photo-ionization detector (PID) prior to sampling.
- If monitoring results indicate organic constituents, sampling activities may be conducted in protective clothing. At a minimum, skin protection will be afforded by disposable protective gloves.

Physical hazards associated with well sampling:

- Lifting injuries associated with pump retrieval and moving equipment.
- Cuts associated with the use of knives for cutting discharge hose, etc.
- Heat/cold stress as a result of exposure to extreme temperatures and because of protective clothing.
- Situations conducive to slipping, tripping, or falling as a result of wet or icy conditions.
- Electrical shock associated with use of submersible pumps is possible. Use a ground fault circuit interrupter to avoid this problem.
- Acid burns may occur if acid preservatives are mishandled.

Multi Water Quality Checker
U-50 Series

Instruction Manual

CODE:GZ0000144342C

Preface

This manual describes the operation of the Multi Water Quality Checker, U-50 Series.
Be sure to read this manual before using the product to ensure proper and safe operation of the instrument. Also safely store the manual so it is readily available whenever necessary.

Product specifications and appearance, as well as the contents of this manual are subject to change without notice.

■ Warranty and Responsibility

HORIBA warrants that the Product shall be free from defects in material and workmanship and agrees to repair or replace free of charge, at HORIBA's option, any malfunctioned or damaged Product attributable to HORIBA's responsibility for a period of one (1) year from the delivery unless otherwise agreed with a written agreement. In any one of the following cases, none of the warranties set forth herein shall be extended;

- Any malfunction or damage attributable to improper operation
- Any malfunction attributable to repair or modification by any person not authorized by HORIBA
- Any malfunction or damage attributable to the use in an environment not specified in this manual
- Any malfunction or damage attributable to violation of the instructions in this manual or operations in the manner not specified in this manual
- Any malfunction or damage attributable to any cause or causes beyond the reasonable control of HORIBA such as natural disasters
- Any deterioration in appearance attributable to corrosion, rust, and so on
- Replacement of consumables

HORIBA SHALL NOT BE LIABLE FOR ANY DAMAGES RESULTING FROM ANY MALFUNCTIONS OF THE PRODUCT, ANY ERASURE OF DATA, OR ANY OTHER USES OF THE PRODUCT.

■ Trademarks

Generally, company names and brand names are either registered trademarks or trademarks of the respective companies.

 © 2008 – 2009 HORIBA, Ltd.

Conformable Directive

This equipment conforms to the following directives and standards:

CE

Directives: the EMC Directive 2004/108/EC

Standards: [the EMC Directive]

EN61326-1:2006 Class B, Portable test and measurement equipment

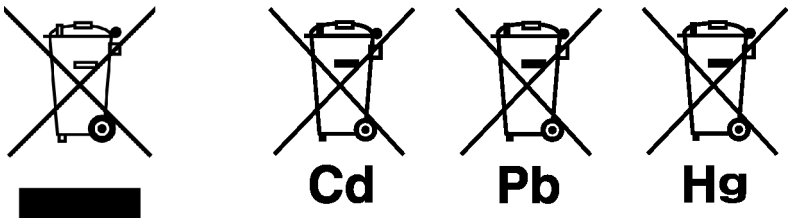
■ Information on Disposal of Electrical and Electronic Equipment and Disposal of Batteries and Accumulators

The crossed out wheeled bin symbol with underbar shown on the product or accompanying documents indicates the product requires appropriate treatment, collection and recycle for waste electrical and electronic equipment (WEEE) under the Directive 2002/96/EC, and/or waste batteries and accumulators under the Directive 2006/66/EC in the European Union.

The symbol might be put with one of the chemical symbols below. In this case, it satisfies the requirements of the Directive 2006/66/EC for the object chemical.

This product should not be disposed of as unsorted household waste.
Your correct disposal of WEEE, waste batteries and accumulators will contribute to reducing wasteful consumption of natural resources, and protecting human health and the environment from potential negative effects caused by hazardous substance in products.

Contact your supplier for information on applicable disposal methods.



FCC Rules

Any changes or modifications not expressly approved by the party responsible for compliance shall void the user's authority to operate the equipment.

■ WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

For your safety

Warning messages are described in the following manner. Read the messages and follow the instructions carefully.

● Meaning of warning messages

⚠DANGER	This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
⚠WARNING	This indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	This indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices. Without safety alert indication of hazardous situation which, if not avoided, could result in property damage.

● Symbols

	Description of what should be done, or what should be followed
	Description of what should never be done, or what is prohibited

■ Safety Precautions

This section provides precautions to enable you to use the product safely and correctly and to prevent injury and damage. The terms of DANGER, WARNING, and CAUTION indicate the degree of imminency and hazardous situation. Read the precautions carefully as it contains important safety messages.

⚠ WARNING
Do not disassemble or modify the meter. May cause overheating or fire, resulting in accidents.

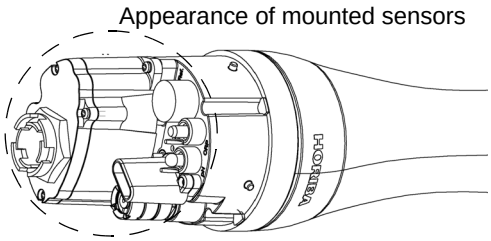
⚠ CAUTION
The pH and ORP sensors are made of glass. Handle them carefully to avoid breakage.
Do not ingest the DO, pH or ORP standard solutions. If it comes into contact with the eyes, rinse thoroughly with water. If swallowed, consult a physician.
Keep away from water when using USB communication. Improper use may result in fire or damage.

Points of concern

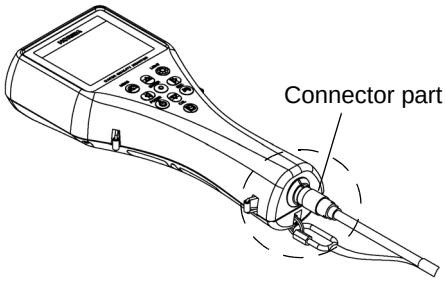
Use of the equipment in a manner not specified by the manufacturer may impair the protection provided by the equipment. It may also reduce equipment performance.

● Sensor probe

- Do not immerse the sensor probe in seawater or other samples with high salinity. Doing so may erode metallic parts. After use, promptly wash the sensor probe thoroughly in water.
- Do not immerse the sensor probe in alcohol, organic solvent, strong acid, strong alkaline, and other similar solutions.
- Do not subject to strong shocks.
- Do not perform measurement in environments of magnetic fields. Measurement errors may result.
- The sensor probe is no longer waterproof when the sensors are not mounted.

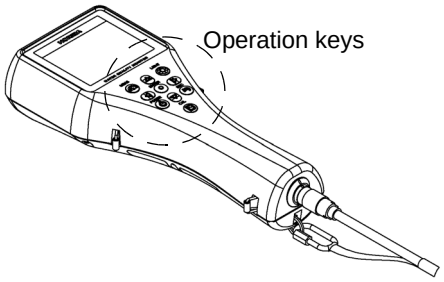


- Does not support measurement of samples containing fluorine.
- To disconnect the sensor cable or interface cable, pull them out with holding the connector part. Do not pull the cable part; it may cause breakage.



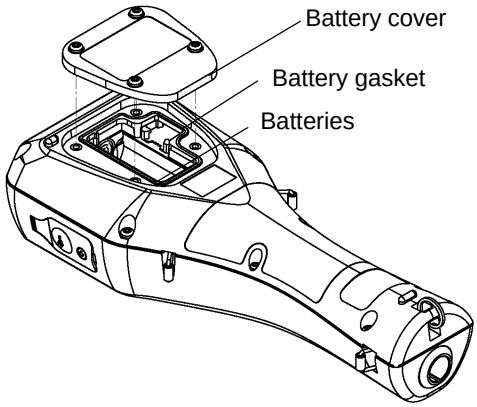
● Control unit

- Do not subject to strong shocks.
- The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.



- The control unit is no longer waterproof when the USB cable is connected.
- When operating the control unit only, protect the connector with the connector cap provided.

- Remove the batteries when not using the control unit for an extended period of time. Battery fluid leakage may cause equipment failure.
- Do not wipe the control unit with organic solvents or powder polish. The surface may deteriorate or its printing may disappear. If the display becomes dirty, wipe the dirt off with a soft cloth soaked in neutral detergent.
- Do not turn the power OFF or disconnect the cable during calibration or setting. Memory data may be erased.
- To perform measurement, connect the sensor probe cable before turning the power ON.
- Do not remove the battery gasket or twist it.
- When opening the battery case, make sure that no foreign matter is attached to the battery gasket.
- Do not use any unspecified batteries; it may cause breakage.



Measurement

- Do not pull the cable when lowering the sensor probe into the sample during measurement. Lower the sensor probe into the sample on a chain or string.
- Before lowering the sensor probe into the sample, do not connect the hook on the unit to a human body.
- The correct values are not displayed if the sensor is not mounted when the measurement display is activated.
- Perform DO measurement with no air bubbles in the internal solution.
- Do not reuse a membrane cap of DO sensor.
- Use the spanner for DO sensor provided to attach or remove the DO sensor.
- Avoid both U-53 and U-53G turbidity measurement in air, since the rubber wiper will quickly become damaged.
- Avoid turbidity measurement in direct sunlight, since the readout may be affected.

Calibration

During atmosphere calibration for the DO electrode with DO salinity compensation set to automatic, values are compensated based on electrical conductivity, but calibration is performed normally.

Location of use and storage

- Storage temperature: −10°C to 60°C
- Relative humidity: Under 80% and free from condensation

Store the meter in locations void of dust, strong vibrations, direct sunlight, corrosive gases, near air conditioners or windy areas.

Disposal of the product

When disposing of the product, follow the related laws and/or regulations of your country for disposal of the product.

Description in this manual

Note

This interprets the necessary points for correct operation and notifies the important points for handling the unit.

Reference

This indicates where to refer for information.

Tip

This indicates reference information.

Contents

1 About this Unit 1

2 Device Information. 2

2.1 Measurement parameters 2

2.2 Packing list 3

2.3 Parts name and functions 4

2.4 Setting menu items 7

2.5 Calibration menu items 7

2.6 Data operation menu items 7

3 Basic Operation 8

3.1 System setup 8

3.1.1 Inserting and replacing the batteries 8
3.1.2 Replacing the coin battery 10
3.1.3 Attaching sensors 11
3.1.4 Connecting the control unit and sensor probe 14
3.1.5 Conditioning 14
3.1.6 GPS (U-52G, U-53G) 15

3.2 Settings 18

3.2.1 Setting measurement methods 18
3.2.2 Setting sites 20
3.2.3 Unit for report 23
3.2.4 Sensor selection 25
3.2.5 Compensation 26
3.2.6 System settings 32

3.3 Calibration 39

3.3.1 Auto calibration 39
3.3.2 Manual calibration 42

3.4 Measurement 61

3.4.1 Storing data in memory manually 61
3.4.2 Automatic, continuous measurement 63

3.5 Data operations 64

3.5.1 Displaying data 64
3.5.2 Deleting data 68
3.5.3 Checking the data memory 69
3.5.4 Checking the calibration record 70
3.5.5 GPS data operations 71

3.6 Sensor information 72

3.7 USB communication 73

3.7.1 Communication settings 73

3.7.2 Commands 74

4 Maintenance 82

4.1 Routine care 82
4.2 Every 2 months maintenance 83
4.3 Storage 85
4.4 Replacing the turbidity sensor 86
4.5 Replacing the membrane cap 87
4.6 Troubleshooting 89
4.6.1 Error displays 89
4.6.2 Error displays in sensor information 94

5 Specifications 95

6 Reference 98

6.1 Consumable parts 98
6.2 Options sold separately 99
6.3 pH measurement 100
6.3.1 Principle of pH measurement 100
6.3.2 Temperature compensation 100
6.3.3 Standard solutions 100
6.4 DO measurement 101
6.4.1 Principle of DO measurement 101
6.4.2 Salinity calibration 102
6.5 Conductivity (COND) measurement 103
6.5.1 Four-AC-electrode method 103
6.5.2 SI units 104
6.5.3 Temperature coefficient 104
6.6 Salinity (SAL) conversion 106
6.7 TDS conversion 106
6.8 σt conversion 106
6.9 Turbidity (TURB) measurement 107
6.9.1 Principle of turbidity measurement 107
6.9.2 Standard solution 107
6.10 Depth (DEPTH) measurement 107
6.10.1 Principle of depth measurement 107
6.10.2 Influence of temperature and calibration 107

6.11 Oxidation reduction potential (ORP) measurement 108
6.11.1 Principle of ORP measurement 108
6.11.2 Standard electrode (reference electrode) types and ORP 108

1 About this Unit

The U-50 Series Multi Water Quality Checker features an integrated control unit and sensors. It is capable of making a maximum of eleven simultaneous measurements for various parameters, and is perfect for use in the field. The U-50 Series is designed with on-site ease-of-use in mind, provides a wide variety of functions, and can be used for water quality measurements and inspections of river water, groundwater, and waste water.

2 Device Information

2.1 Measurement parameters

Parameters	Model				
	U-51	U-52	U-52G	U-53	U-53G
pH (pH)	✓	✓	✓	✓	✓
pH (mV)	✓	✓	✓	✓	✓
Oxidation reduction potential (ORP)	✓	✓	✓	✓	✓
Dissolved oxygen (DO)	✓	✓	✓	✓	✓
Electrical conductivity (COND)	✓	✓	✓	✓	✓
Salinity (SAL) [expressed as electrical conductivity]	✓	✓	✓	✓	✓
Total dissolved solids (TDS) [expressed as electrical conductivity]	✓	✓	✓	✓	✓
Seawater specific gravity (SG) [expressed as electrical conductivity]	✓	✓	✓	✓	✓
Water temperature (TEMP)	✓	✓	✓	✓	✓
Turbidity (TURB) [LED transmission/front 30° scattering method]	–	✓	✓	–	–
Turbidity (TURB) [tungsten lamp 90° transmission/scattering method] with wiper	–	–	–	✓	✓
Water depth (DEP)	–	–	✓	✓	✓
GPS	–	–	✓	–	✓

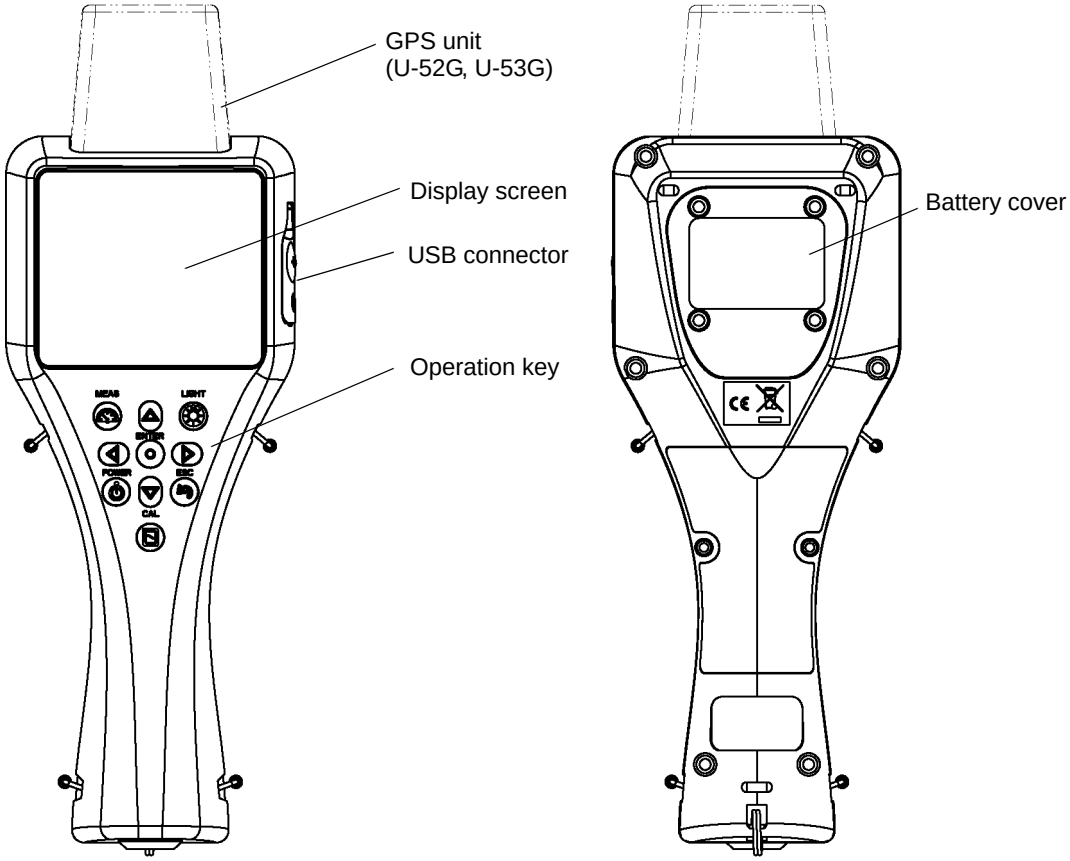
"✓" indicates a measurable parameter.

2.2 Packing list

Parts Name	Quantity	Note
Control unit	1	
Sensor probe	1	
pH sensor (#7112)	1	
ORP sensor (#7313)	1	
Reference electrode (#7210)	1	
DO sensor (#7543)	1	
Turbidity sensor (#7800)	1	With U-52/U-52G only. Attached to the sensor probe.
Turbidity sensor (#7801)	1	With U-53/U-53G only. Attached to the sensor probe.
pH 4 standard solution (#100-4)	1	500 mL
pH reference internal solution (#330)	1	250 mL
DO sensor internal solution set (#306)	1	Internal solution (50 mL), Sandpaper (#8000, #600), Syringe
DO Membrane spare parts set	1	
Spanner for DO sensor	1	
Cleaning brush	1	
calibration cup	1	transparent calibration cup, black calibration cup
Back pack	1	
Strap	1	
Alkaline batteries	4	LR14
Silicon grease	1	
Instruction manual	1	

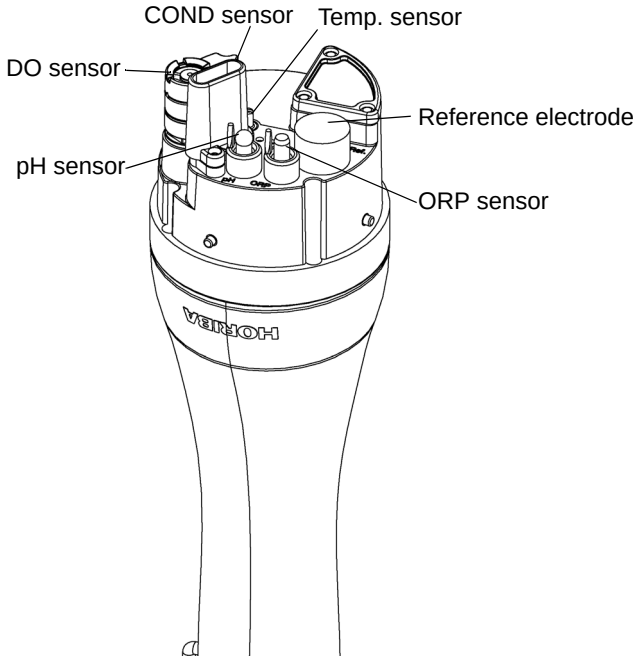
2.3 Parts name and functions

● Display

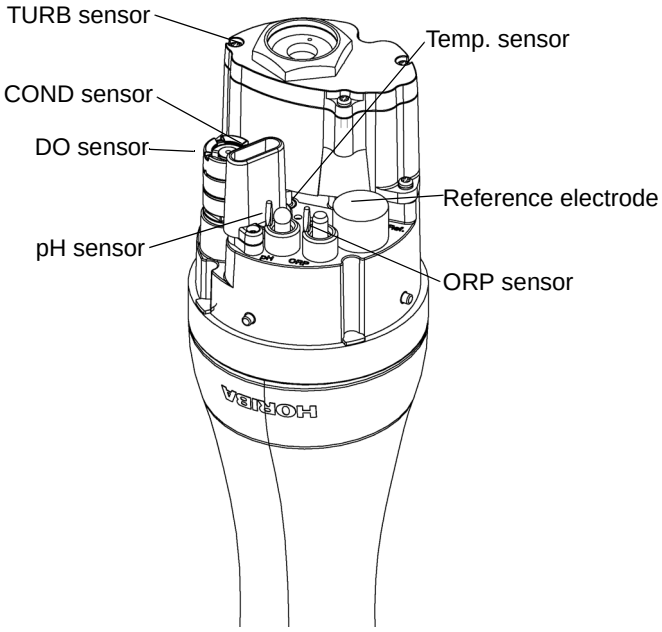


Front view　　Back view

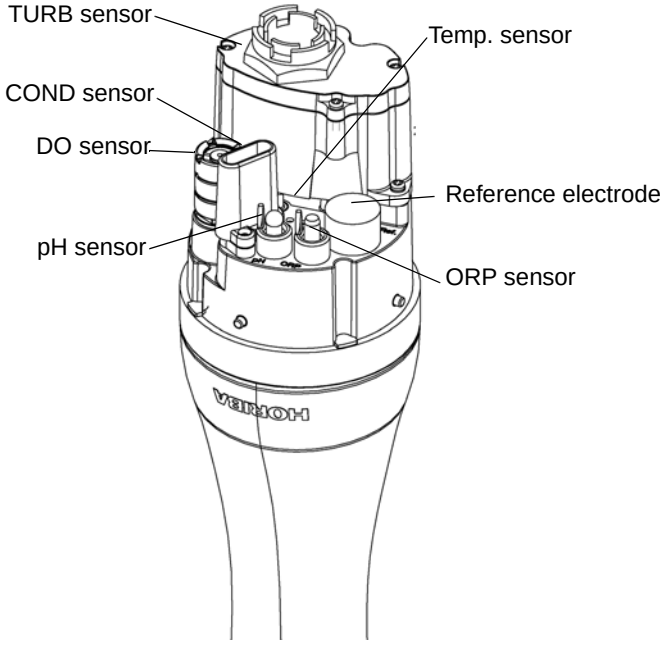
● Sensor probe (U-51)



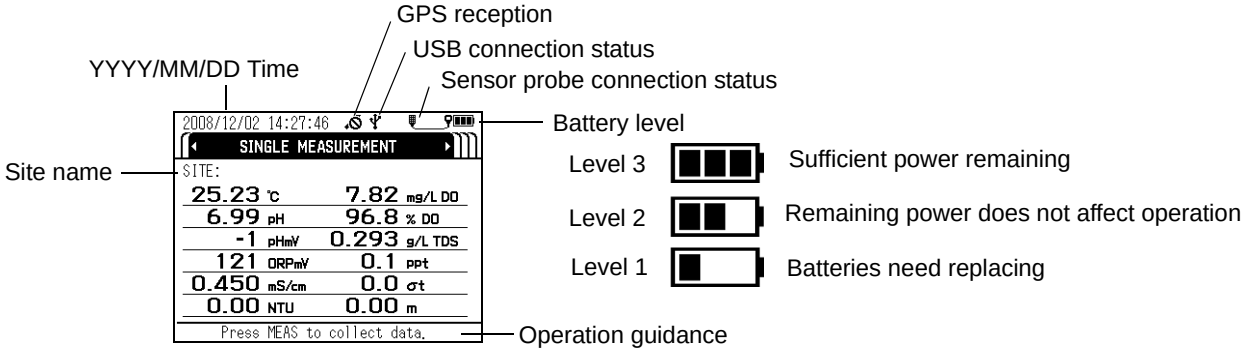
● Sensor probe (U-52)



● Sensor probe (U-53)



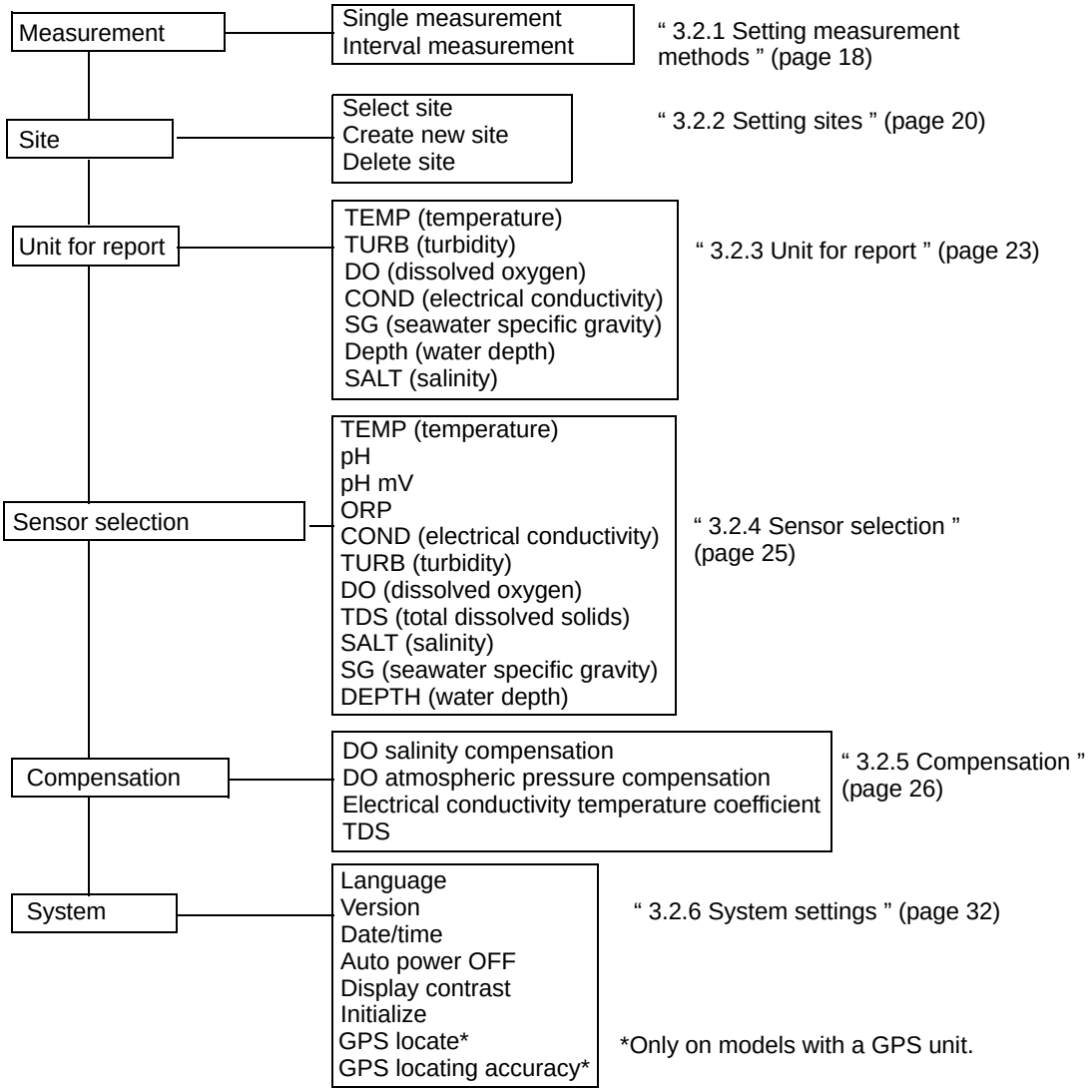
● Display screen



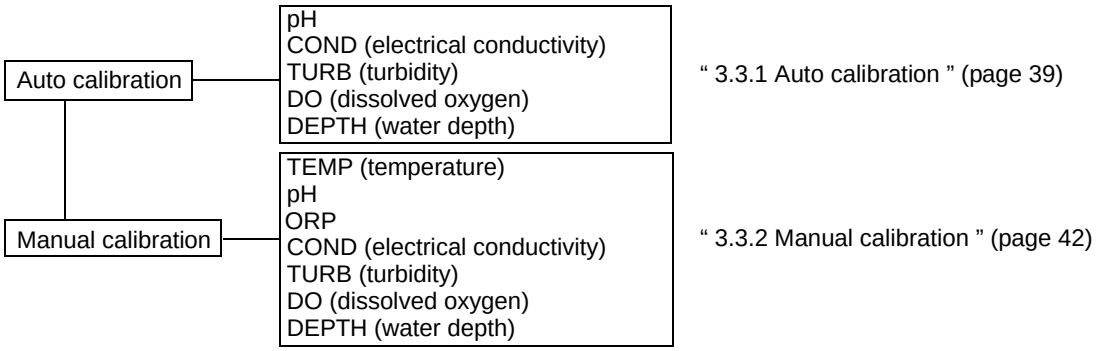
● Operation key

	Key name	description
	POWER key	Turns the system's power ON/OFF. The initial screen appears immediately after turning the power ON. Press and hold down the POWER key for about 3 seconds to turn the power ON and OFF.
	MEAS key	When pressed in the measurement screen, used to set the measurement values of all the measurement parameters. Measurement values flash until the data stabilizes.
		When pressed in the setting, calibration or data operation screen, returns to the measurement screen.
	ENTER key	Used to execute functions, set entered values or store data in memory.
	CAL key	Switches to the calibration screen.
	ESC key	Returns to the immediately preceding operation.
	LIGHT key	Turns the backlight ON/OFF. ● Using the backlight shortens battery life. ● The backlight does not light for about 3 seconds after power ON. ● When the sensor probe is connected while the display's backlight is lit, the backlight goes out for about 3 seconds.
	Left key	Moves the cursor to the left.
	Right key	Moves the cursor to the right.
	Up key	Moves the cursor up.
	Down key	Moves the cursor down.

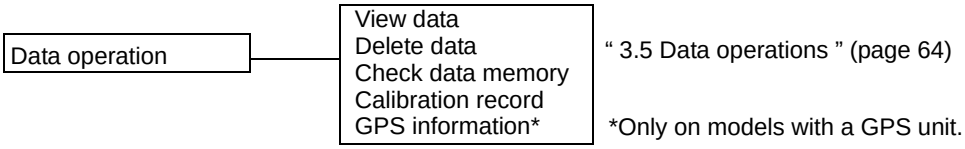
2.4 Setting menu items



2.5 Calibration menu items



2.6 Data operation menu items



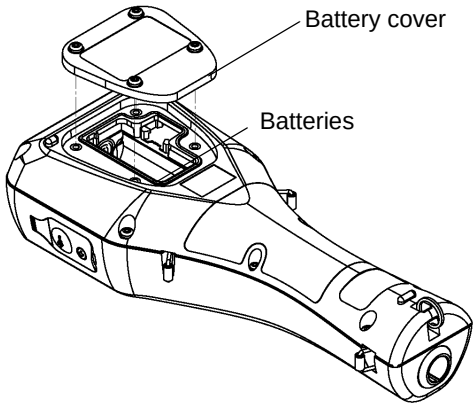
3 Basic Operation

3.1 System setup

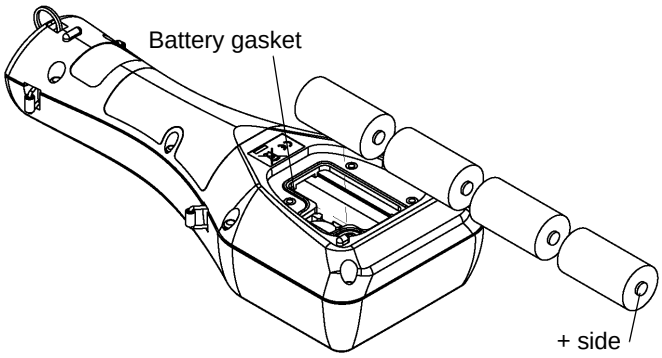
3.1.1 Inserting and replacing the batteries

The control unit is shipped without batteries. Follow the steps below to insert the batteries when using the system for the first time or replacing old batteries.

1. **Loosen the 4 screws on the battery cover by using No. 2 Phillips head screwdriver and remove the cover.**



2. **If replacing the batteries, discard the old batteries.**
3. **Insert new batteries in the control unit.**
   Check that the battery gasket is not dirty or twisted.



4. **Replace the battery cover and fasten it with the 4 screws.**
   Tighten the screws to less than 0.5 N·m.

Note

- **Data and settings will not be lost when the batteries are replaced.**
- **If dirty or twisted, the battery gasket will fail to keep the batteries dry. Check its condition before closing the cover.**
- **To ensure long service life, replacing the battery gasket periodically (once a year) is recommended.**

Precautions when using dry cell batteries

- **Batteries to use: LR14 alkaline dry cell batteries (C-size dry cell batteries) or rechargeable nickel-metal hydride dry cell batteries (C-size)**
  Do not use manganese batteries.
- **Dry cell batteries used incorrectly may leak or burst. Always observe the following**
  - Orient the batteries correctly (positive and negative ends in correct positions).
  - Do not combine new and used batteries, or batteries of different types.
  - Remove the batteries when not using the system for a prolonged period.
  - If batteries leak, have the system inspected at your nearest Horiba service station.

● Battery life

- The battery life for continuous operation when using C-size alkaline dry cell batteries is about 70 hours.
- Using the backlight consumes a proportionate amount of battery power, shortening battery life.
- Searching position information using the GPS unit consumes a proportionate amount of battery power, shortening battery life.
- Nickel-metal hydride secondary batteries can be used, but the battery life is not guaranteed since it will vary according to usage (number of times data is saved, number of charges and amount of each charge). In general, secondary batteries have one-half to one-third the life of C-size alkaline batteries.
- The 70-hour battery life figure applies to a control unit operating temperature of 20°C or more. The battery characteristics shorten the battery life at operating temperatures lower than 20°C, so check the remaining battery level, and replace the batteries before it reaches Level 1.
- The batteries packed with the system at the time of shipment are for checking operation. Their life is not guaranteed.
- The 70-hour battery life figure is the amount of operating time the batteries can provide until the system stops operating. The system may fail during operation if the remaining battery level is low, so it is a good idea to check the remaining battery level and replace the batteries with new ones well before the batteries run out completely.

U-51/52

Battery life: 70 hours (backlight off)

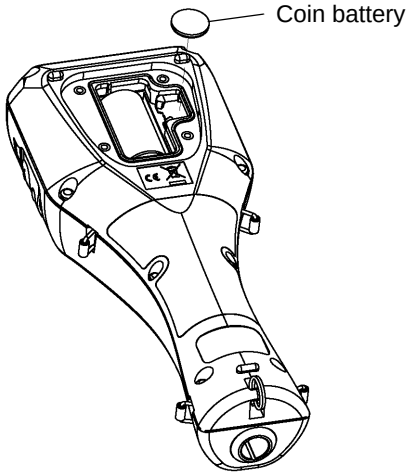
U-53

Battery life: 500 measurements (backlight off)

- Since U-53 is designed for turbidity measurement with wiper, its battery life is estimated in terms of the number of turbidity measurement sequences performed.
- Battery power is also consumed by measurement operations other than turbidity measurement.
- The battery life when turbidity measurement is not performed is about 70 hours.

3.1.2 Replacing the coin battery

- Coin battery to use: CR-2032
- The coin battery is only for the clock. It will provide problem-free operation for three years, but when using the clock continuously, it should be replaced every two years as a precaution.
- When replacing the coin battery for the clock, leave the control unit ON. If the coin battery is replaced when the control unit is turned OFF, the clock will be reset to the default settings.



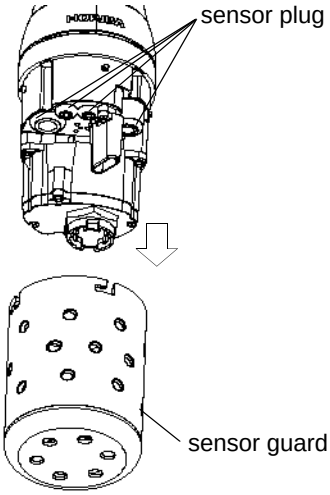
3.1.3 Attaching sensors

Note

- **When attaching or replacing a sensor, wipe any moisture off the sensor probe and sensor.**
- **Be sure to keep water out of sensor connectors. If moisture comes in contact with a sensor connector, blow-dry it with dry air.**
- **The sensor probe is not waterproof when the sensor is not mounted.**
- **Take care not to tighten the sensor too much.**

● Attaching the pH sensor

1. **Remove the sensor guard.**



2. **Remove the sensor plug.**

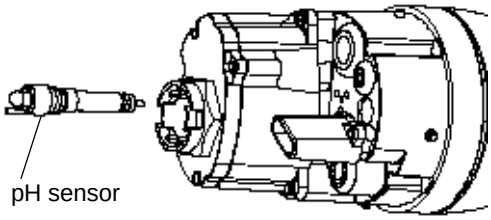
3. **Coat the pH sensor O-ring with a thin layer of silicon grease (part No. 3014017718).**

Note

Be sure no grease from the O-ring gets on the sensor connector. If the sensor connector gets grease on it, wipe it off with a soft cloth soaked in alcohol.

4. **Make sure there is no moisture on the sensor probe's sensor connector (marked "pH").**

5. **Fasten the pH sensor securely by hand.**



6. **Clean the sensor with an alcohol-soaked cloth.**

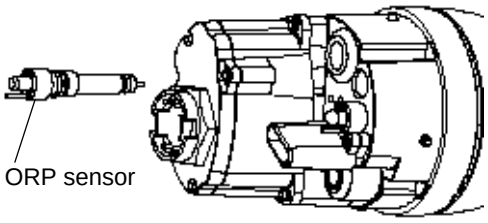
Attaching the ORP sensor

1. **Remove the sensor guard.**
2. **Remove the sensor plug.**
3. **Coat the ORP sensor O-ring with a thin layer of grease (part No. 3014017718).**

Note

Be sure no grease from the O-ring gets on the sensor connector. If the sensor connector gets grease on it, wipe it off with a soft cloth soaked in alcohol.

4. **Make sure there is no moisture on the sensor probe's sensor connector (marked "ORP").**
5. **Fasten the ORP sensor securely by hand.**



6. **Clean the sensor with an alcohol-soaked cloth.**

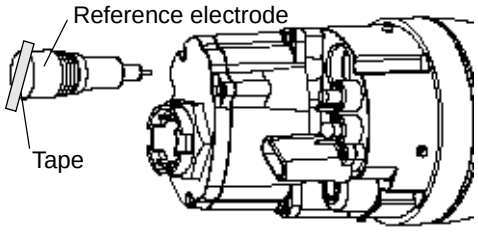
Attaching the reference electrode

1. **Remove the sensor guard.**
2. **Remove the sensor plug.**
3. **Coat the reference electrode O-ring with a thin layer of grease (part No. 3014017718).**

Note

Be sure no grease from the O-ring gets on the sensor connector. If the sensor connector gets grease on it, wipe it off with a soft cloth soaked in alcohol.

4. **Make sure there is no moisture on the sensor probe's sensor connector (marked "REF").**
5. **Fasten the reference electrode securely by hand.**
6. **Remove the tape from the liquid junction part of the reference electrode.**



Attaching the dissolved oxygen (DO) sensor

1. **Remove the membrane cap mounted on the DO sensor beforehand, and replace it with the new membrane cap provided. Replace the internal solution with fresh solution. The main component of the internal solution is potassium chloride (KCl), so the old solution can be disposed of down a sink or other drain.**

Reference

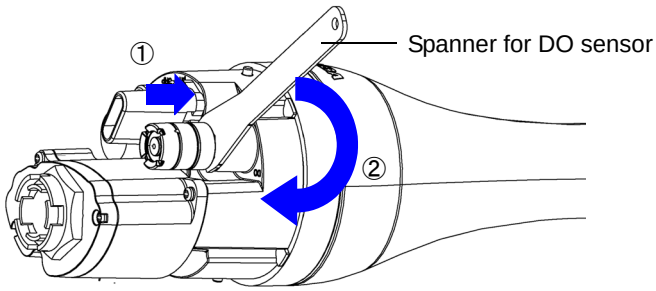
“ 4.5 Replacing the membrane cap ” (page 87)

2. **Screw in the DO sensor to attach it, allowing the internal solution to overflow slightly.**
3. **Use a soft cloth to wipe off the internal solution that overflowed onto the DO sensor.**
4. **Remove the sensor guard.**
5. **Remove the sensor plug.**
6. **Coat the DO sensor O-ring with a thin layer of grease (part No. 3014017718).**

Note

Be sure no grease from the O-ring gets on the sensor connector. If the sensor connector gets grease on it, wipe it off with a soft cloth soaked in alcohol.

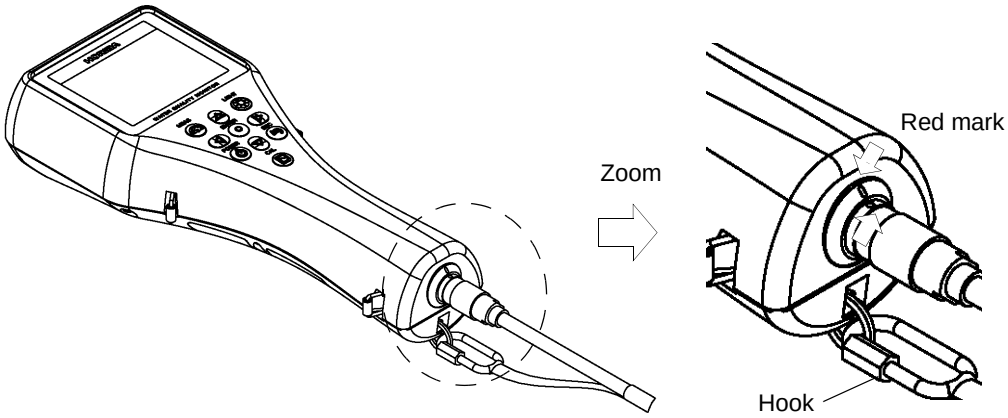
7. **Make sure there is no moisture on the sensor probe’s sensor connector (marked "DO").**
8. **Fasten the DO sensor securely using the spanner for DO sensor.**
   - Hold the DO sensor with the provided spanner for DO sensor and push the sensor down. (Step 1 in figure below)
   - Screw the DO sensor in place. (Step 2 in figure below)



3.1.4 Connecting the control unit and sensor probe

Note

Connect the control unit with its power OFF.

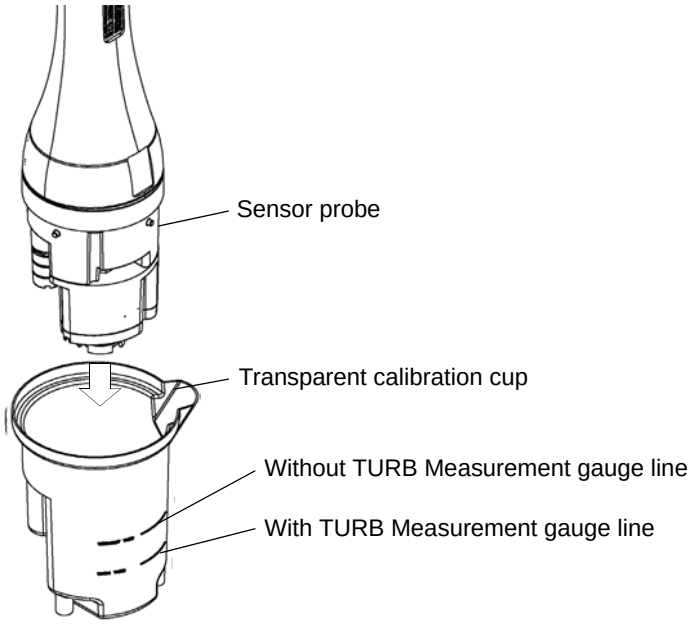


1. **Align the red mark on the connector, and press the connector in until you hear it click.**
2. **Connect the cable's hook to the display.**

3.1.5 Conditioning

Carry out the steps below when using the unit for the first time or when the system has not been used for 3 months or longer.

1. **Fill the transparent calibration cup to the line with pH 4 standard solution.**
   The transparent calibration cup has With TURB Measurement and Without TURB Measurement gauge lines.
2. **Insert the sensor probe in the transparent calibration cup.**



Note

Check that all sensors are attached.

3. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON. Leave the unit for at least 20 minutes to condition the sensors.**

Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

Tip

- **The procedure for immersing the sensor probe in the pH standard solution is the same as that described in " 3.3.1 Auto calibration " (page 39).**
  Auto calibration can be performed using the same pH 4 standard solution that was used in the conditioning procedure.
- **Immersing the sensor in the standard solution is generally required for sensor conditioning, but a voltage supply is required for DO sensor conditioning. Turning ON the power of the control unit is necessary during sensor conditioning.**

3.1.6 GPS (U-52G, U-53G)

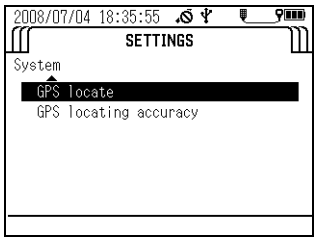
The GPS position measurement precision is proportional to the GPS position measurement time. When the position measurement precision increases, the position measurement time also increases. See " ● GPS locating accuracy" (page 17) for how to set the position measurement precision. See " ● GPS locate" (page 15) below for how to check acquired GPS data.

● GPS locate

1. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

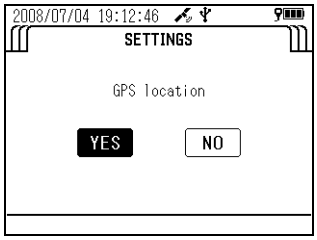
2. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**

3. **Press the down (▽) key to move the cursor to "GPS locate", then press the ENTER key.**



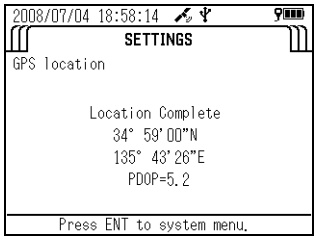
4. **The message "Press ENT key to start position measurement." appears. Press the ENTER key.**

5. **The message "Execute GPS position measurement?" appears. Move the cursor to "YES", then press the ENTER key.**

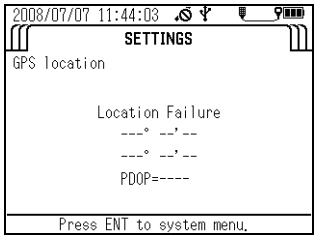


6. **The message "Warming up. Please wait." appears. Wait until the system has finished warming up (about 10 seconds).**

- Position measurement starts automatically when warmup has finished. Position measurement is performed up to 10 times.
- The GPS location complete screen appears after successful position measurement.

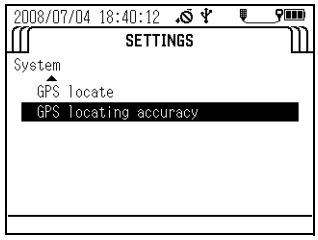


- The GPS location failure screen appears after position measurement has failed. Redo the measurement in a location free from obstacles, or wait for the meteorological conditions to improve before redoing the measurement.

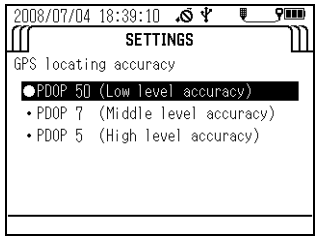


● GPS locating accuracy

1. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
2. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**
3. **Press the down (▽) key to move the cursor to "GPS locating accuracy", then press the ENTER key.**



4. **The screen below appears. Move the cursor to the locating accuracy, then press the ENTER key. The black circle (●) indicates the currently set precision.**



3.2 Settings

3.2.1 Setting measurement methods

This section describes how to set the measurement method.

● Measurement methods

● U-51/U-52

Single measurement	Pressing the MEAS key acquires the 5-second average for the selected measurement parameter.
Interval measurement	Pressing the MEAS key acquires and saves the 5-second average for the selected measurement parameter in the set interval. The measurement interval can be set to any value between 10 seconds and 24 hours.

● U-53

The U-53 turbidity sensor uses a tungsten lamp. The lamp lights for about 10 seconds, and the average measurement value acquired during this interval is displayed.

Single measurement	Pressing the MEAS key acquires the 5-second average for the selected measurement parameter after wiper operation. The 10-second average is acquired when measuring turbidity.
Interval measurement	Pressing the MEAS key acquires and saves the 5-second average for the selected measurement parameter in the set interval. The 10-second average is acquired when measuring turbidity. The measurement interval can be set to any value between 10 seconds (final check of this value required; 30 seconds may be better for U-52) and 24 hour.

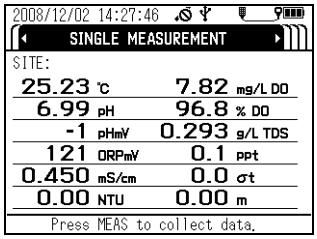
Reference

“ 3.4 Measurement ” (page 61)

● Operation method

1. **Press and hold down the control unit’s POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

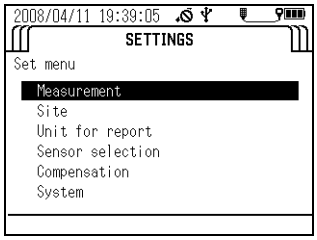


Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

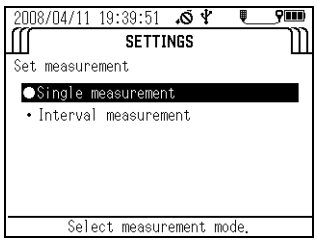
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "Measurement", then press the ENTER key.**



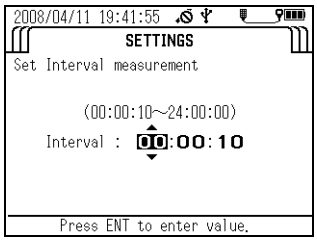
4. **Press the down (▽) key to move the cursor to the desired measurement mode. Press the ENTER key to save the setting.**

The black circle (●) indicates the currently selected measurement mode.



5. **If you selected "Interval measurement", the display switches to the screen used to set the measurement interval. Press the up (△) and down (▽) keys to set the measurement interval.**

The measurement interval can be set to any value between 10 seconds and 24 hours in the case of the U-51 and U-52, or between 30 seconds and 24 hours in the case of the U-53.



3.2.2 Setting sites

The site function allows position data to be connected to corresponding measurement data. Sites have the following specifications and features:

Site names: Text data consisting of up to 20 one-byte alphanumeric characters, spaces, etc.
Site names can be used for control unit searches and as labels for computer processing.
Site names allow measurement data to be saved with a name corresponding to the actual location where it was measured.

You can use site information as a search key when viewing data uploaded by a PC or data saved in the control unit (see " 3.5 Data operations " (page 64)).

- **Selecting sites**

  You can select previously created sites. The black circle (●) indicates the name of the currently selected site. No sites are created at new purchasing or after initialization. Select a site after first creating one from the "Create new site" menu.

- **Creating new sites**

  You can create and save new sites. Up to 20 site names can be registered.

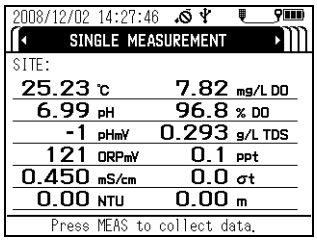
- **Deleting sites**

  You can select a previously created site and delete it.

● **Operation methods**

- **Selecting a site**

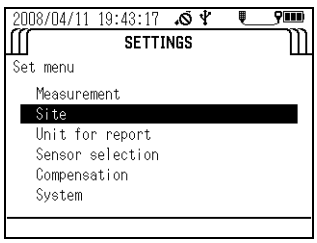
  1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
     The "MEASUREMENT" screen appears after about 10 seconds.



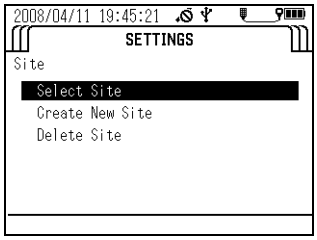
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

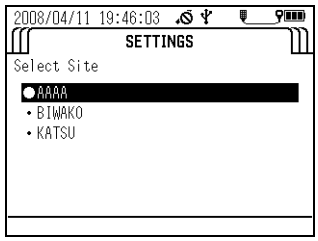
  2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
  3. **Press the down (▽) key to move the cursor to "Site", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Select Site", then press the ENTER key to display the names of the currently saved sites.**



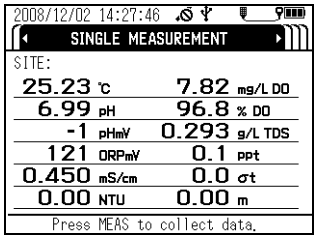
The black circle (●) indicates the currently selected site.



● **Creating a new site**

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

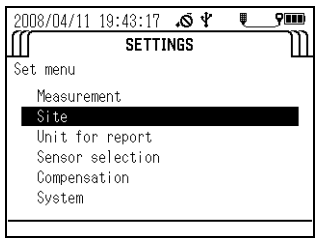


Note

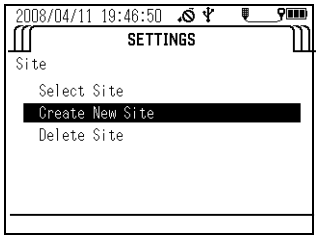
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

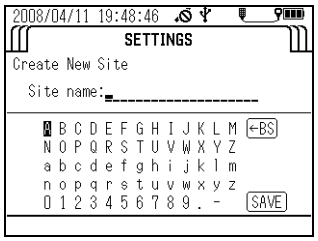
3. **Press the down (▽) key to move the cursor to "Site", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Create New Site", then press the ENTER key.**
Enter the desired site name (up to 20 alphanumeric non-Asian width characters).

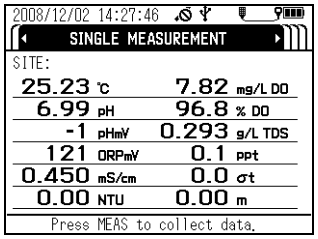


5. **Press the up (△), down (▽), right (▷), and left (◁) keys to move the cursor to each letter or number to use in the name, then press the ENTER key to confirm the entered characters. To delete incorrectly entered characters, move the cursor to "BS" and press the ENTER key to start deleting from the last character. When you have finished entering the name, save it by moving the cursor to "SAVE" and pressing the ENTER key.**



● **Deleting a site**

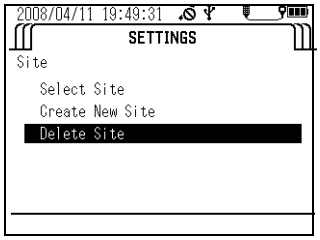
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
The "MEASUREMENT" screen appears after about 10 seconds.



Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

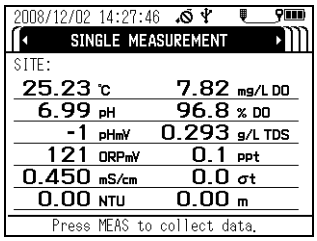
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**



3. **Press the down (▽) key to move the cursor to "Site", then press the ENTER key.**

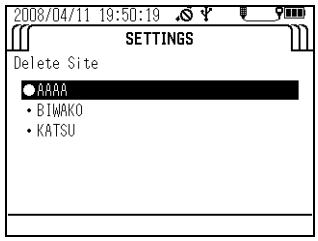
4. **Press the down (▽) key to move the cursor to "Delete Site", then press the ENTER key.**

   A list of the currently saved sites appears. The black circle (●) indicates the currently selected site.



5. **Press the down (▽) key to move the cursor to the site to delete, then press the ENTER key to delete it.**

   The currently selected site can be deleted after a different site has been selected from the site selection menu or after all unselected sites have been deleted. The same site name cannot be registered more than once.



3.2.3 Unit for report

Note

Units can only be selected when the sensor probe is connected.

Follow the steps below to set the measurement units of measurement parameters. No units are displayed if a measurement parameter has not been selected in the measurement parameter selection screen (see “ 3.2.4 Sensor selection ” (page 25)).

1. **Press and hold down the control unit’s POWER key for about 3 seconds to turn the power ON.**

   The "MEASUREMENT" screen appears after about 10 seconds.

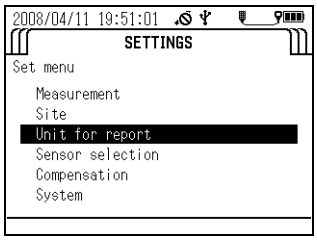
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

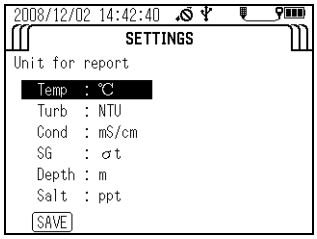
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "Unit for report", then press the ENTER key.**

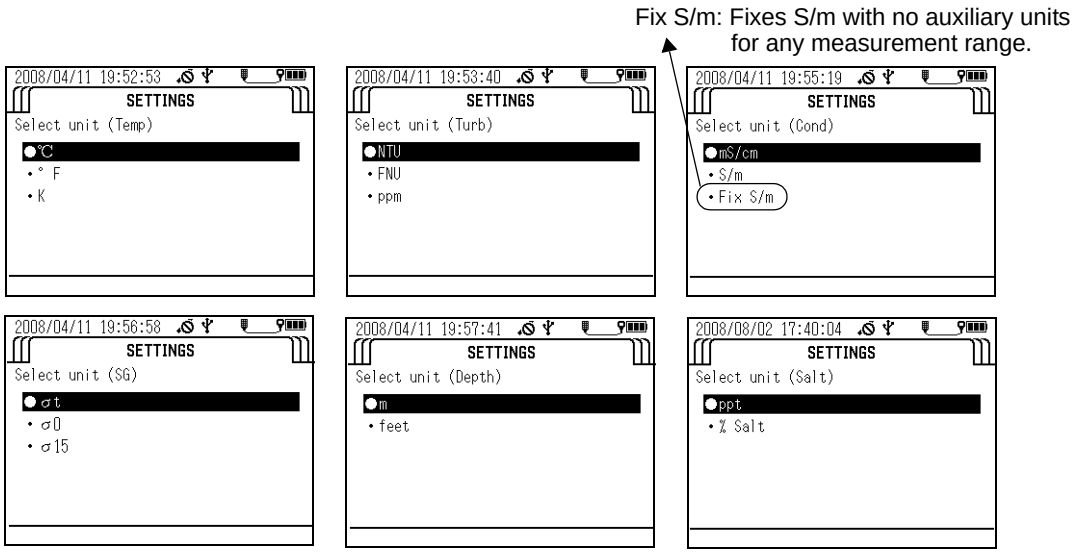
A list of the currently selected measurement parameters and their units appears. Note that measurement parameters not selected (in the measurement parameter selection screen) are not displayed.



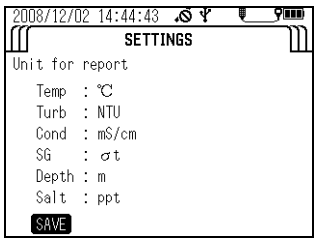
4. **Press the up (△) and down (▽) keys to move the cursor to the item to change, then press the ENTER key.**



5. **A list of the units that can be selected appears. The black circle (●) indicates the currently selected unit. Press the up (△) and down (▽) keys to move the cursor to the desired unit, then press the ENTER key.**



6. **To save the changes, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key. If you do not want to save the changes, press the ESC key.**



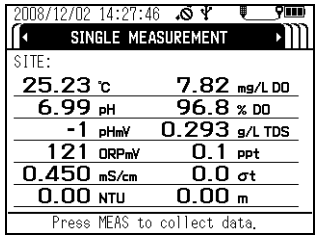
3.2.4 Sensor selection

Note

Measurement parameters can only be selected when the sensor probe is connected.

You can set between 1 and 11 measurement parameters to display in the control unit screen. Follow the steps below to select the desired measurement parameters.

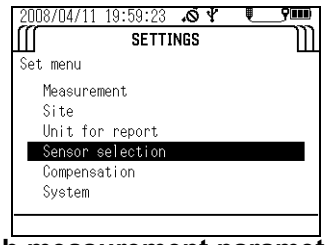
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



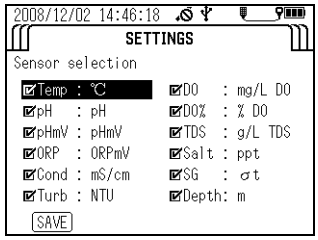
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "Sensor selection", then press the ENTER key.**
   A list of the measurement parameters that can be set and the currently set units are displayed.



4. **Move the cursor to each measurement parameter to change, then press the ENTER key.**
   A check in the check box of a measurement parameter indicates it will be displayed.
5. **To save the changes, press the up (△), down (▽), left (◁) and right (▷) keys to move the cursor to SAVE, then press the ENTER key. If you don't want to save the changes, press the ESC key.**



Note

Available measurement parameters differ according to product specifications.

3.2.5 Compensation

Note

Compensation settings can only be made when the sensor probe is connected.

U-50 series have following functions of compensation.

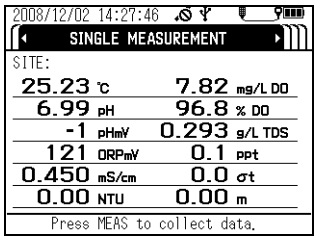
- Salinity compensation and atmospheric pressure compensation for dissolved oxygen (DO)
- Temperature compensation for conductivity (COND)
- Setting total dissolved solid (TDS) coefficient for TDS

● Salinity compensation (DO)

The dissolved oxygen (DO) value is presented higher than actual value if salinity compensation is not added, because the increase of salinity gives higher DO value. To obtain correct value salinity compensation is needed. The following modes are available for calculation of salinity compensation.

AUTO:	Salinity compensation is performed automatically with salinity converted from conductivity.
Value input:	Press the up (△) and down (▽) keys to enter a setting value when the salinity is known.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
The "MEASUREMENT" screen appears after about 10 seconds.

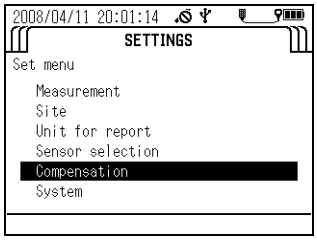


Note

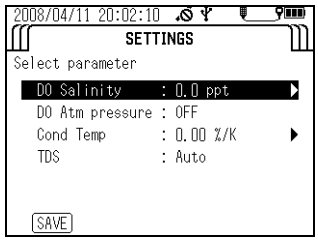
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

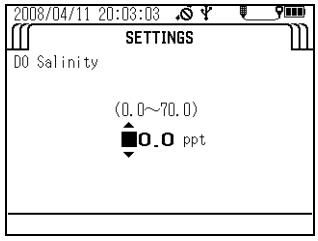
3. **Press the down (▽) key to move the cursor to "Compensation", then press the ENTER key.**



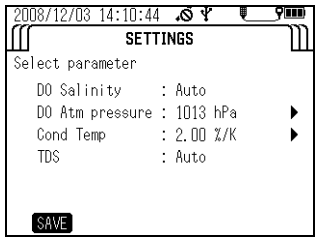
4. **Press the down (▽) key to move the cursor to "DO Salinity", then press the ENTER key to toggle the setting between "Auto" and "Input mode".**
   Default: Auto



5. **If you selected "Input mode", press the right (▷) key to display the compensation value input screen. Press the up (△) and down (▽) keys to enter the desired value, then press the ENTER key to set it.**



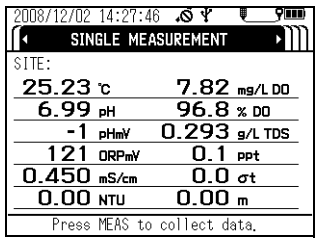
6. **To save the change, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key. If you don't want to save the change, press the ESC key.**



● **Atmospheric pressure compensation (DO)**

Differences in the atmospheric pressure of the measurement location influence the Dissolved Oxygen (DO) measurement. By setting (input) the actual atmospheric pressure of the measurement location into the control unit, it is possible to standardize the measured Dissolved Oxygen (DO) value to a value at the standard atmospheric pressure (1013 hPa).

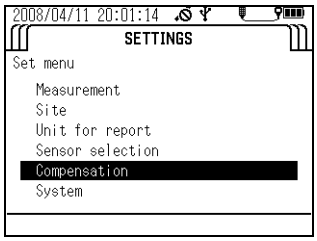
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



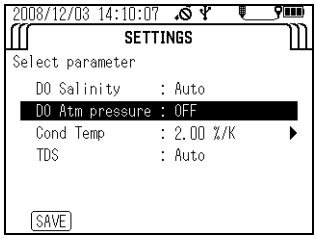
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

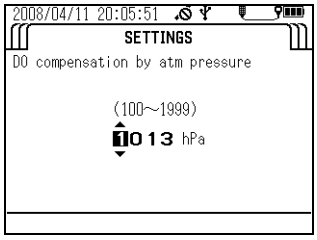
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "Compensation", then press the ENTER key.**



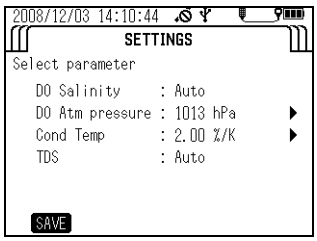
4. **Press the down (▽) key to move the cursor to "Cond Temp", then press the ENTER key to toggle the setting between "OFF" and "Input mode".**
   Default: OFF



5. **If you selected "Input mode", press the right (▷) key to display the compensation value input screen. Press the up (△) and down (▽) keys to enter the desired value, then press the ENTER key to set it.**



6. **To save the change, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key. If you don't want to save the change, press the ESC key.**

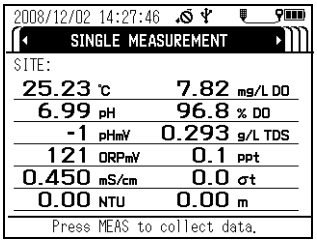


● Temperature compensation for conductivity (COND)

Sample conductivity (COND) varies with temperature, and this control unit uses a temperature compensation coefficient to automatically standardize the conductivity (COND) at 25°C. The initial setting coefficient is 2%/K, which is the generally used.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

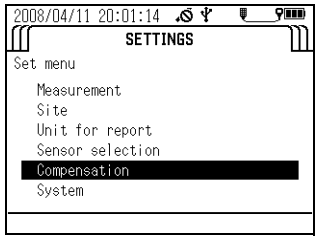


Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

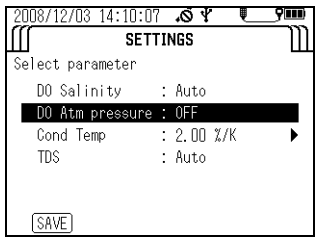
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "Compensation", then press the ENTER key.**

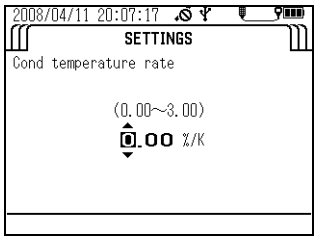


4. **Press the down (▽) key to move the cursor to "Cond Temp", then press the ENTER key to toggle the setting between "OFF" and "Input mode".**

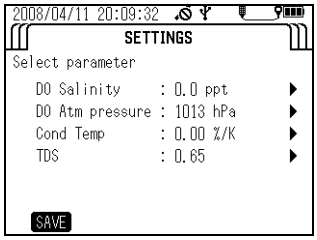
Default: 2.00%/K



5. **If you selected "Input mode", press the right (▷) key to display the compensation value input screen. Press the up (△) and down (▽) keys to enter the desired value, then press the ENTER key to set it.**



6. **To save the change, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key.**
If you don't want to save the change, press the ESC key.



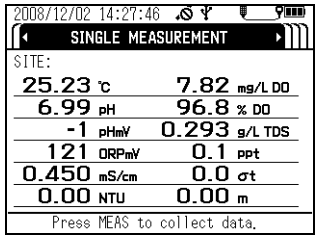
● Setting a total dissolved solid (TDS) coefficient

The total dissolved solid amount (TDS) is a converted value obtained by multiplying the conductivity (COND) by a known coefficient. The coefficient initially set for the control unit is based on a conversion for KCl and $CaCO_3$ solutions and it depends on the conductivity (COND) value as shown below.

Conductivity (COND) (S/m)	Conversion coefficient
< 0.05	0.65
0.05 to 0.5	0.64
0.5 to 1	0.63
1 to 3	0.62
3 to 5	0.61
> 5	0.60

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

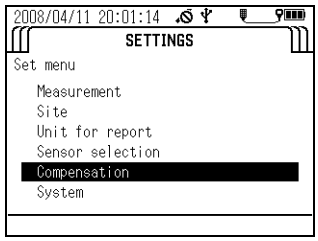


Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

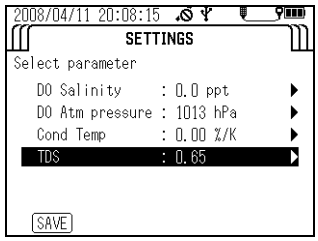
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "Compensation", then press the ENTER key.**

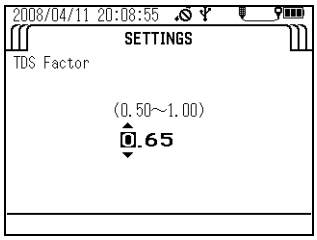


4. **Press the down (▽) key to move the cursor to "TDS", then press the ENTER key to toggle the setting between "AUTO" and "Input mode".**

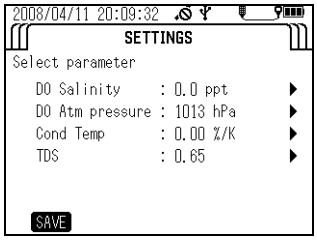
Default: Auto



5. **If you selected "Input mode", press the right (▷) key to display the compensation value input screen. Press the up (△) and down (▽) keys to enter the desired value, then press the ENTER key to set it.**



6. **To save the change, press the up (△) and down (▽) keys to move the cursor to SAVE, then press the ENTER key. If you don't want to save the change, press the ESC key.**



3.2.6 System settings

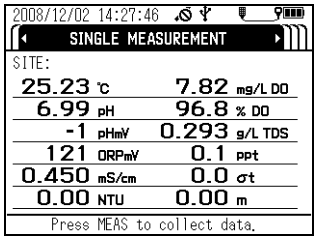
The system settings let you change the display language, check the system software version, set the date/time, set the auto power OFF time, set the display contrast, and initialize the settings.

● **Display language**

Follow the steps below to select either English or Japanese as the display language.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

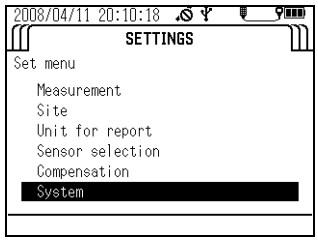


Note

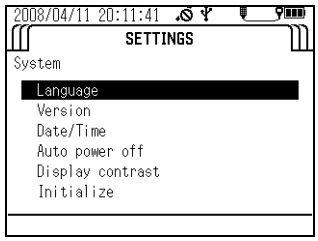
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

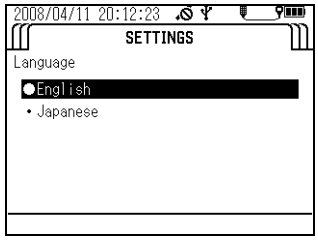
3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Language", then press the ENTER key.**



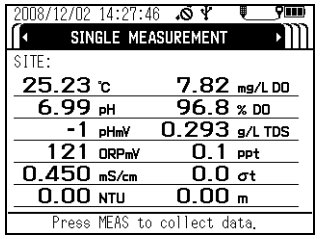
5. **A list of the supported display languages appears. Press the up (△) and down (▽) keys to move the cursor to the desired language, then press the ENTER key.**
The black circle (●) indicates the currently selected display language.



● Version

Follow the steps below to display the program No. and version of the control unit and sensor probe software.
The program No. and version of the sensor probe software will not be displayed if the sensor probe is not connected.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
The "MEASUREMENT" screen appears after about 10 seconds.

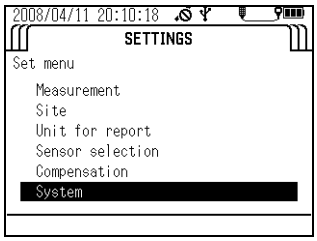


Note

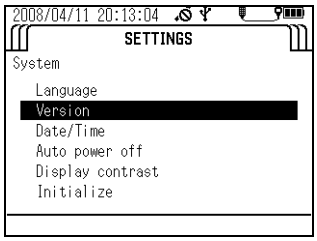
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**



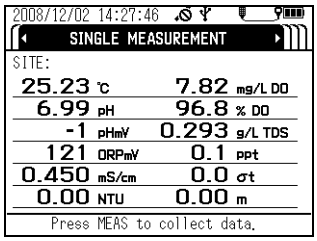
4. **Press the down (▽) key to move the cursor to "Version", then press the ENTER key.**
The program No. of the control unit and sensor probe software appears.



● Setting the date/time

Follow the steps below to set the date and time.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
The "MEASUREMENT" screen appears after about 10 seconds.

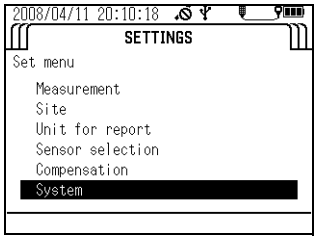


Note

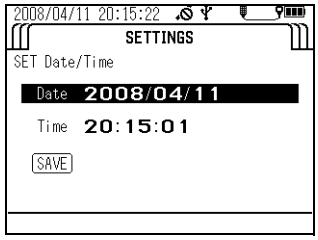
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**

3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**

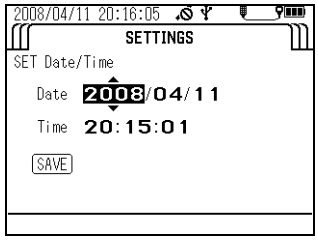


4. **Press the down (▽) key to move the cursor to "Date/time", then press the ENTER key.**

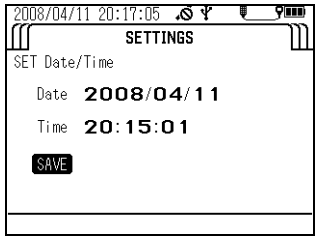


5. **Move the cursor to the date, then press the ENTER key.**

6. **Press the right (▷) key to move the cursor to the year, month, day, hour, minute and second, and press the up (△) and down (▽) keys to enter each value.**



7. **When finished entering settings, press the ENTER key to move the cursor to SAVE, then press the ENTER key again to save the settings.**

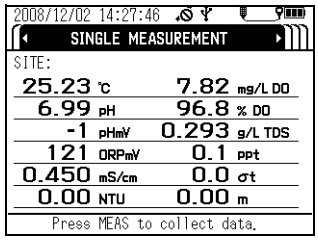


● Setting the auto power OFF time

Follow the steps below to set the time for the auto power OFF function (which turns the power OFF automatically when no operation is performed for the preset amount of time).

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

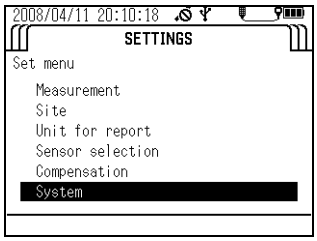
The "MEASUREMENT" screen appears after about 10 seconds.



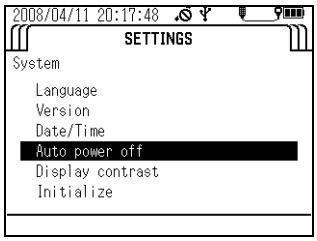
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

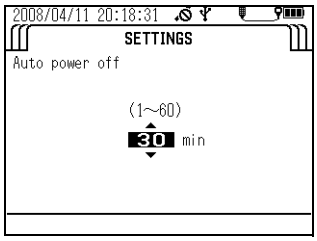
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Auto power off", then press the ENTER key.**



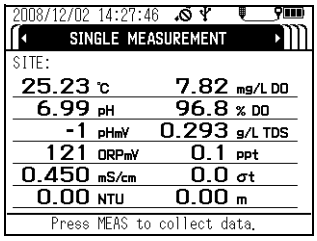
5. **Press the up (△) and down (▽) keys to select the desired time setting, then press the ENTER key.**
   You can select OFF, or settings of 1, 2, 5, 10, 20, 30 or 60 minutes.
   Default: 30 minutes



● Display contrast

Follow the steps below to adjust the display's contrast.

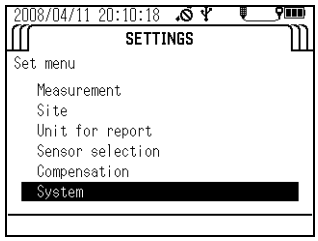
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



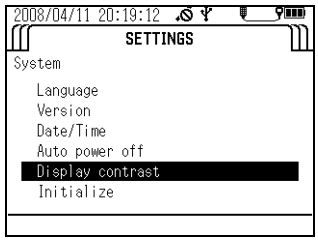
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

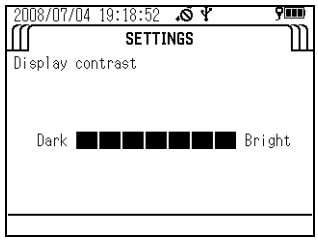
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**



4. **Press the down (▽) key to move the cursor to "Display contrast", then press the ENTER key.**



5. **Press the left (◁) and right (▷) keys to adjust the contrast.**
   Adjustment can be made in 26 steps.

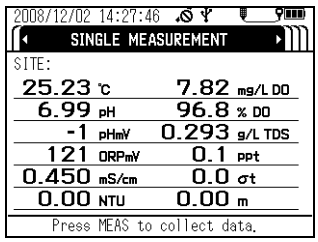


6. **Press the ENTER key.**

● Initialization

Follow the steps below to restore all the settings except date/time to their factory defaults. Factory default calibration data for the electrical conductivity and turbidity sensors will also be deleted at the same time.

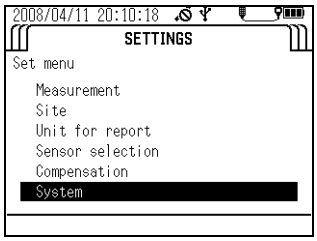
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



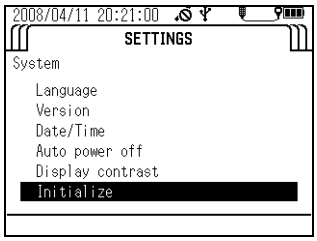
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

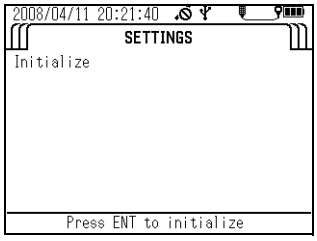
2. **Press the right (▷) key to switch the display to the "SETTINGS" screen.**
3. **Press the down (▽) key to move the cursor to "System", then press the ENTER key.**



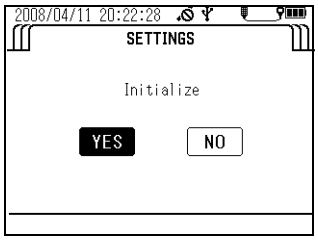
4. **Press the down (▽) key to move the cursor to "Initialize", then press the ENTER key.**



5. **Press the ENTER key again.**



6. **A confirmation message appears asking whether to execute initialization. Press the left (◁) key to move the cursor to YES, then press the ENTER key.**
   The message "Initialize Complete" appears to indicate the process has finished.



3.3 Calibration

To obtain correct measurement values, the sensors need to be calibrated using standard solution before measurement. You can select simultaneous auto calibration of the pH, COND and TURB sensors in pH4 standard solution and DO and DEP sensors simultaneously in air, or manual calibration of individual measurement parameters. You can check the result of the previous calibration using the procedure on " 3.5.4 Checking the calibration record " (page 70).

Note

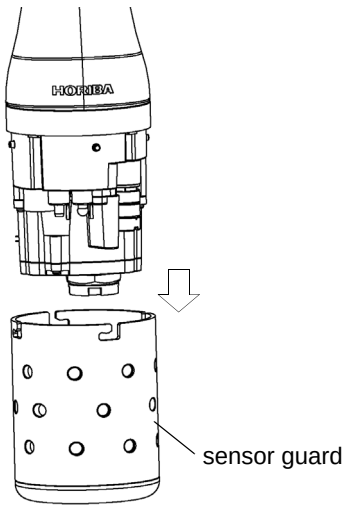
- **Wait at least 20 minutes after turning the system power ON before calibrating the DO sensor.**
- **Make the DO and COND compensation settings before calibration since these settings are applied during calibration.**
- **You can select only the desired parameters for calibration and calibrate just those parameters (see " 3.2.4 Sensor selection " (page 25)).**
- **Use about 200 mL of standard solution in the calibration cup.**
- **Calibration data is stored in the sensor probe.**

3.3.1 Auto calibration

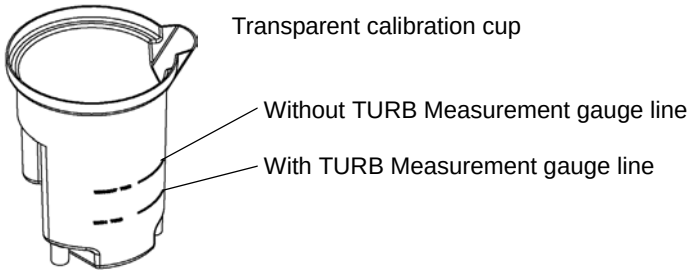
Tip

- **The following parameters are calibrated (at 25°C):**
  pH: Set to 4.01 (zero-point calibration); the span is adjusted to the factory default value.
  COND: 0.449 S/m (4.49 mS/cm, span calibration); the zero point is adjusted to the factory default value.
  TURB: 0 NTU (zero-point calibration); the span is adjusted to the factory default value.
  DO: 8.92 mg/L (span calibration); the zero point is adjusted to the factory default value.
  DEP: 0 m (zero-point calibration); the zero point is adjusted to the factory default value.
- **If the air temperature changes, the readout value may not be stable. Ensure that the ambient air temperature is the same temperature as the calibration solution, because the internal probe temperature sensor and external temperature sensor (in the calibration solution) are used for the auto calibration. Allow the probe and standard solution to equilibrate for 1 hour if a thermometer is not available to verify that these temperatures are the same.**
- **Do not hold the probe while performing the auto calibration. Body temperature may elevate the internal temperature sensor measurement creating DO calibration error.**

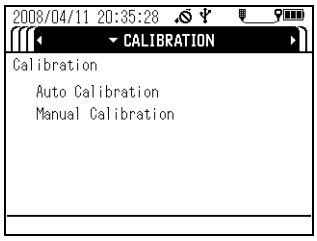
1. **Remove the sensor guard and wash the sensor probe 2 or 3 times with deionized water.**



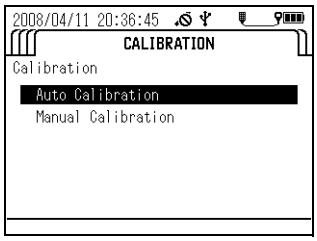
2. **Remove the transparent calibration cup.**
3. **Fill the transparent calibration cup to the line with pH 4 standard solution.**
   The transparent calibration cup has With TURB Measurement and Without TURB Measurement gauge lines.



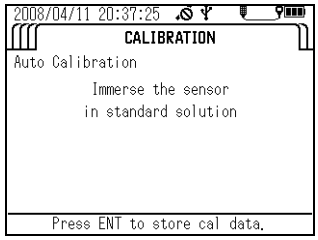
4. **Press the control unit's CAL key to set the calibration mode.**

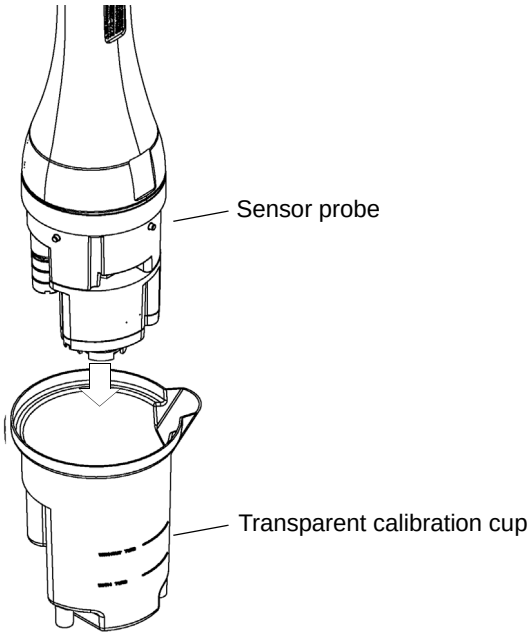


5. **Press the down (▽) key to move the cursor to "Auto Calibration", then press the ENTER key.**

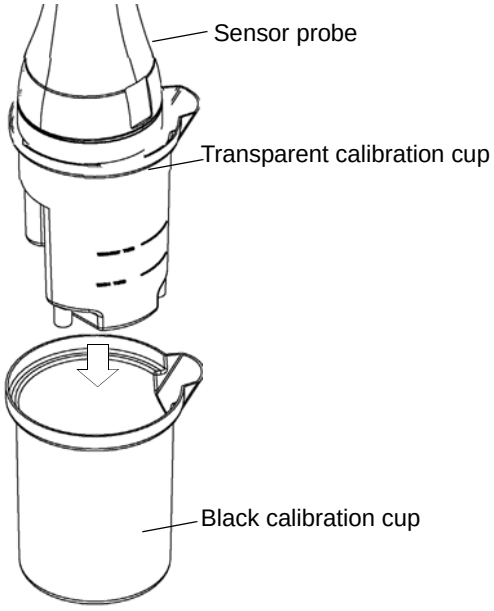


6. **Immerse the sensor probe in the transparent calibration cup.**
Check that the pH sensor, ORP sensor, reference electrode, COND sensor, TURB sensor and temperature sensor are submerged in the pH 4 standard solution and check that there are no air bubbles on the sensor.





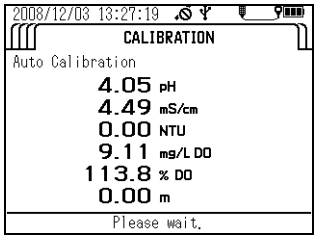
7. **With the sensor probe still in the transparent calibration cup, place the transparent calibration cup into the black calibration cup.**



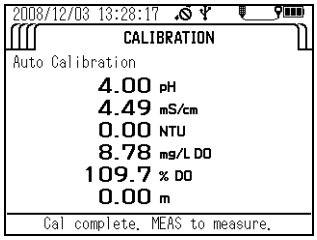
8. **When all the sensor values have stabilized, press the ENTER key to start calibration.**

Note

Do not remove the sensor probe from the calibration solution. U-53 turbidity data will display "----" until the calibration is completed.



Calibration is finished when the message "Cal complete. MEAS to measure." appears. Press the MEAS key to set the measurement screen, then start measurement.



If a calibration error occurs, start calibration after first resolving the issue according to the instructions in " 4.6 Troubleshooting " (page 89).

3.3.2 Manual calibration

The procedures below describe how to calibrate each sensor individually.

Note

The displayed units are the units set by selecting "Unit for report" in the "SETTINGS" screen.

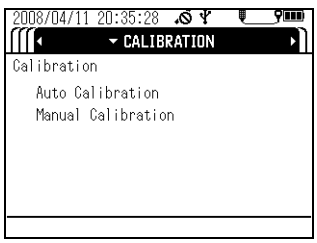
● **Temperature (TEMP) calibration**

1. **Fill a bucket or similar container with water of a known temperature, and insert the sensor probe in it.**

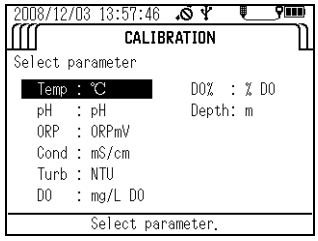
Wait 5 minutes before starting calibration to allow the sensor probe temperature to stabilize.

2. **Press the control unit's CAL key to set the calibration mode.**

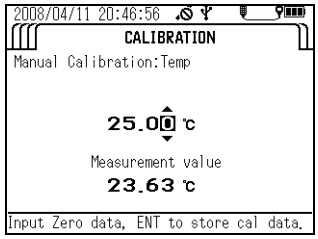
3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



4. **In the parameter selection screen, move the cursor to “Temp”, then press the ENTER key.**



5. **Press the up (△) and down (▽) keys to set the calibration value - the temperature of the water containing the submerged sensor probe.**



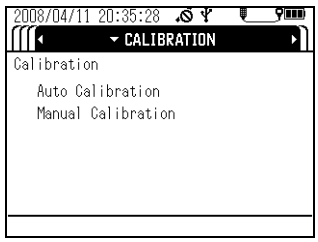
6. **Check that “Measurement value” has stabilized, then press the ENTER key to start calibration.**
   Calibration is finished when the message “Cal complete. CNT to measure.” appears.

● pH calibration

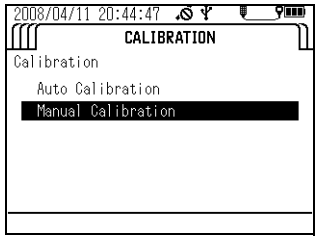
Note

You can select one calibration point (zero-point calibration) or two calibration points (zero-point calibration and span calibration). Carry out two calibration procedures to ensure good measurement precision throughout all measurement ranges.

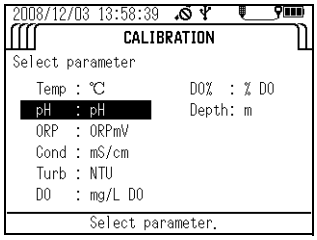
1. **Calibrate the zero point. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with pH 7 standard solution.**
2. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
3. **Press the control unit’s CAL key to set the calibration mode.**



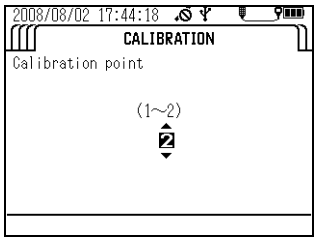
4. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



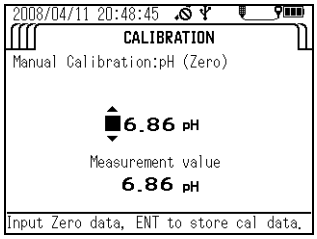
5. **In the parameter selection screen, move the cursor to "pH", then press the ENTER key.**



6. **Set the number of calibration points, then press the ENTER key.**



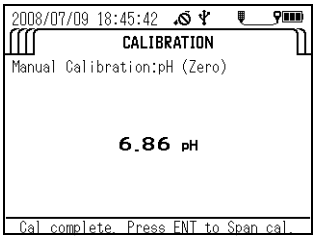
7. **Press the up (△) and down (▽) keys to set the pH value of the pH 7 standard solution containing the submerged sensor probe at the measurement temperature**



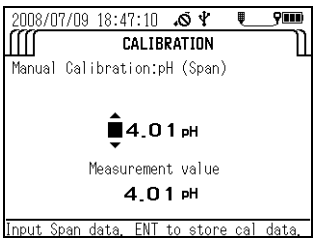
Temp. (°C)	pH 4 standard solution Phthalate	pH 7 standard solution Neutral phosphate	pH 9 standard solution Borate
0	4.01	6.98	9.46
5	4.01	6.95	9.39
10	4.00	6.92	9.33
15	4.00	6.90	9.27
20	4.00	6.88	9.22
25	4.01	6.86	9.18
30	4.01	6.85	9.14
35	4.02	6.84	9.10
40	4.03	6.84	9.07
45	4.04	6.84	9.04

8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

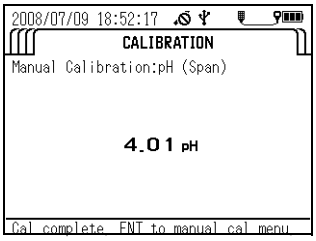
9. **Press the ENTER key to start the span calibration procedure when the message "Cal complete. Press ENT to Span cal." appears.**



10. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with pH 4 or pH 9 standard solution.**
11. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
12. **Press the up (△) and down (▽) keys to set the pH value of the pH 4 or pH 9 standard solution containing the submerged sensor probe at the measurement temperature.**



13. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
14. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter**

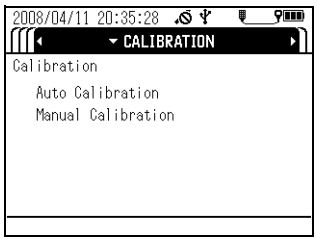


● ORP calibration

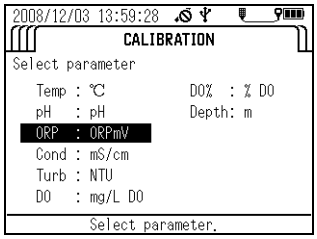
Note

- **If the prepared ORP standard solution is left in open air for one hour or more, the solution may be transformed. For this reason ORP standard solution cannot be stored.**
  Calibrate within one hour of preparing the solution.
- **When measuring sample with low concentrations of oxidants and reductants after conducting an operational check using a standard substance, the measured values may not stabilize or the results of measurement might not be repeatable. If this is the case, start the measurement after immersing the sensors in the sample water sufficiently.**
- **Note that when measuring the ORP of solution with extremely low concentrations of oxidants and reductants, such as tap water, well water, or water treated with purifying equipment, there may be less responsiveness, repeatability, and stability, in general.**
- **When alkaline ion water is left for 5 minutes, its ORP undergoes changes significantly. Always measure alkaline ion water promptly.**

1. **Fill a clean beaker with one bag of ORP standard powder No. 160-22 or No. 160-51. Add 250 mL of deionized water and agitate the solution thoroughly (there will be some excess quinhydrone (a black powder) that floats on the surface when agitating the solution). Fill the transparent calibration cup to the reference line with this standard solution.**
2. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
3. **Press the control unit's CAL key to set the calibration mode.**
4. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



5. **In the parameter selection screen, move the cursor to ORP, then press the ENTER key.**



6. **Press the up (△) and down (▽) keys to set the mV value of the ORP standard solution containing the submerged sensor probe at the measurement temperature.**

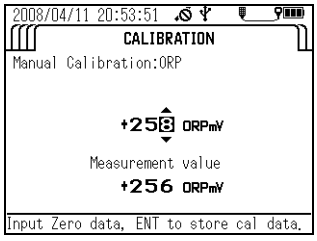


Table 1 Indicated value of ORP standard solution at various temperatures (mV)

Temperature	160-22	16051
5	+274	+112
10	+271	+107
15	+267	+101
20	+263	+95
25	+258	+89
30	+254	+83
35	+249	+76
40	+244	+69

7. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

8. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**

● Conductivity (COND) calibration

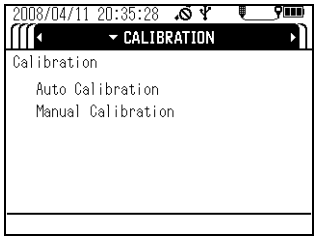
Note

- **To support a wide range of sample concentrations, electrical conductivity is divided into three measurement ranges: 0.0 mS/m to 99.9 mS/m, 0.090 S/m to 0.999 S/m, and 0.9 S/m to 9.99 S/m.**
- **When manually calibrating conductivity, you can select two calibration points (one zero-point calibration point and a span calibration point for one of the three measurement ranges) or four calibration points (one zero-point calibration point and span calibration points for all three measurement ranges). Carry out the four calibration points to ensure good measurement precision throughout all measurement ranges.**
- **Make the compensation setting before calibration since this setting is applied during calibration. (Refer to " 6.5.3 Temperature coefficient " (page 104)).**

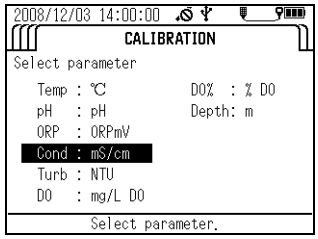
1. **Prepare the standard solution. Dry Potassium chloride (KCl) powder (high-grade commercially available) at 105°C for two hours, and leave it to cool in a desiccator.**
2. **Consult the following table and weigh potassium chloride (KCl), then prepare three standard potassium chloride (KCl) solutions following the procedure below.**

Potassium chloride (KCl) standard solution	Conductivity (COND) value	Potassium chloride (KCl) mass (g) at solution temperature of 25 °C	Calibration range
0.005 mol/L	71.8 mS/m (0.718 mS/cm)	0.373	0.0 mS/m to 99.9 mS/m (0.00 mS/cm to 0.999 mS/cm)
0.050 mol/L	0.667 S/m (6.67 mS/cm)	3.73	0.090 S/m to 0.999 S/m (1.00 mS/cm to 9.99 mS/cm)
0.500 mol/L	5.87 S/m (58.7 mS/cm)	37.2	0.9 S/m to 9.99 S/m (10.0 mS/cm to 99.9 mS/cm)

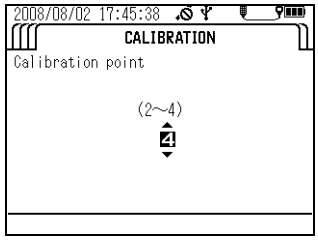
3. **Dissolve the weighed Potassium Chloride (KCl) in deionized water.**
4. **Put the dissolved Potassium Chloride (KCl) into a 1 L measuring flask, and fill to the 1 L mark with deionized water.**
5. **Calibrate the zero point. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then remove all moisture from the sensor probe (it will be calibrated in air).**
6. **Press the control unit's CAL key to set the calibration mode.**
7. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



8. **In the parameter selection screen, move the cursor to “Cond”, then press the ENTER key.**



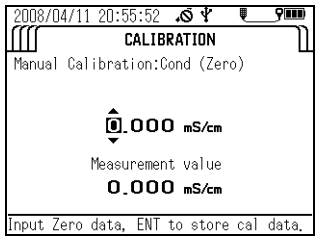
9. **Set the number of calibration points, then press the ENTER key.**



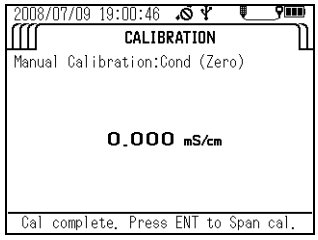
The instructions below assume that four calibration points have been set.

10. **Press the up (△) and down (▽) keys to set the "Cond" value to 0.0 mS/m (0.000 mS/cm).**

11. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



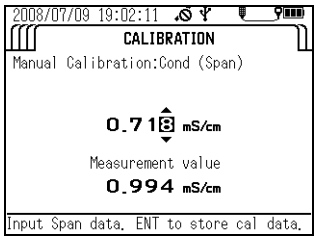
12. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the first span calibration procedure.**



13. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 71.8 mS/m (0.718 mS/cm) standard solution.**

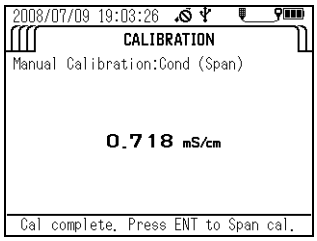
14. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

15. **Press the up (△) and down (▽) keys to set the "Cond" value to 71.8 mS/m (0.718 mS/cm).**
Calibration range = 0 mS/m to 99.9 mS/m (0 mS/cm to 0.999 mS/cm)



16. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

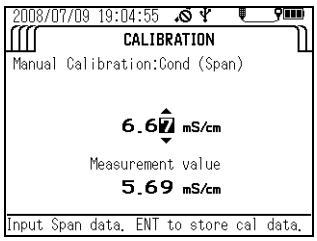
17. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**



18. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 0.667 S/m (6.67 mS/cm) standard solution.**

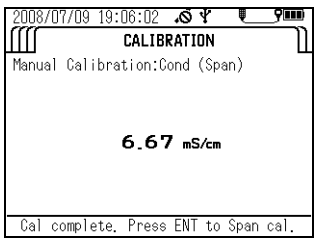
19. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

20. **Press the up (△) and down (▽) keys to set the "Cond" value to 0.667 S/m (6.67 mS/cm).**
Calibration range = 0.100 S/m to 0.999 S/m (1.00 mS/cm to 9.99 mS/cm)



21. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

22. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**

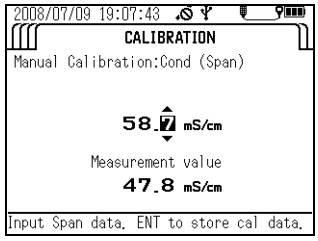


23. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 5.87 S/m (58.7 mS/cm) standard solution.**

24. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

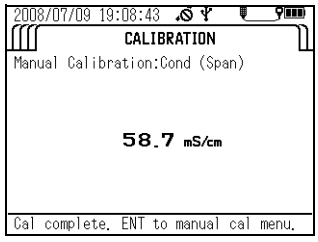
25. **Press the up (△) and down (▽) keys to set the "Cond" value to 5.87 S/m (58.7 mS/cm).**

Calibration range = 1.00 S/m to 10.00 S/m(10.0 mS/cm to 100.0 mS/cm)



26. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**

27. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**



● Turbidity (TURB) calibration

Note

- **To support a wide range of sample concentrations, turbidity is divided into three measurement ranges: 0.0 to 9.9 NTU, 10 to 100 NTU, and over 100 NTU.**
- **When manually calibrating turbidity, you can select two calibration procedures (one zero-point calibration procedure and a span calibration procedure for one of the three measurement ranges), three calibration procedures (one zero-point calibration procedure and a span calibration procedure for two of the three measurement ranges) or four calibration procedures (one zero-point calibration procedure and span calibration procedures for all three measurement ranges). Carry out the four calibration procedures to ensure good measurement precision throughout all measurement ranges.**
- **Always use the calibration cup provided. Using other containers can create effects from ambient light that cause incorrect calibration.**

● Preparing the standard solutions

1. **Weigh out 5.0 g of hydrazine sulfate (commercial special grade or above), and dissolve it in 400 mL of deionized water. Dissolve 50 g of hexamethylene tetramine (commercial special grade or above) in 400 mL of deionized water in anther flask.**
2. **Mix the two solutions and add deionized water until the total solution volume is 1000 mL, and mix well. Store this solution at a temperature of 25°C ±3°C for 48 hours.**
   The turbidity value (TURB) of this solution is equivalent to 4000 NTU.
3. **Dilute 4000 NTU-solution 5 times (use a pipette to measure 50 mL of the 4000 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 800 NTU.
4. **Dilute 800 NTU solution 10 times (use a pipette to measure 25 mL of the 800 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 80 NTU.
5. **Dilute 80 NTU solution 10 times (use a pipette to measure 25 mL of the 80 NTU solution and pour it into a 250 mL measuring flask, and fill up to 250 mL meniscus)**
   The turbidity value (TURB) of this solution is equivalent to 8 NTU.

Note

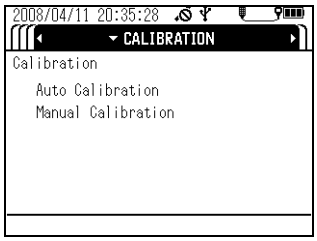
Instead of the standard solutions above, you can use other standard solutions of known concentration measured with other standard instruments.

● U-52, U-53 turbidity calibration

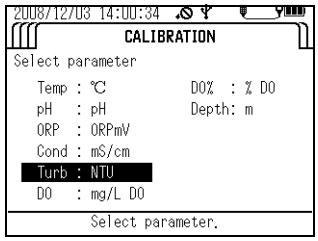
Set the number of calibration points.

You can set between 2 and 4 points.

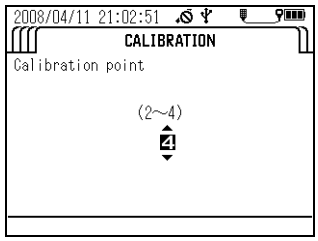
1. **Press the control unit's CAL key to set the calibration mode.**
2. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



3. **In the parameter selection screen, move the cursor to "Turb", then press the ENTER key.**



4. **Press the up (△) and down (▽) keys to set the number of calibration points, then press the ENTER key.**

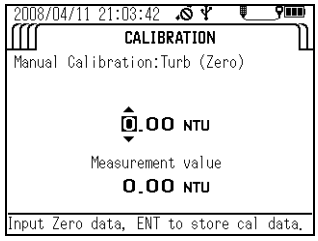


The instructions below assume that four calibration points have been set.

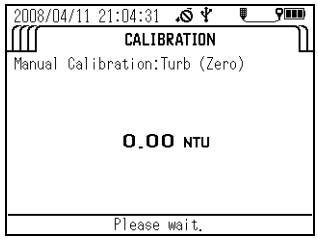
5. **Calibrate the zero point. Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with deionized water.**

6. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

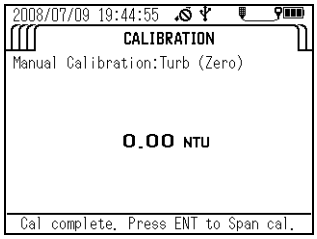
7. **Press the up (△) and down (▽) keys to set the "Turb" value to 0.0 NTU.**



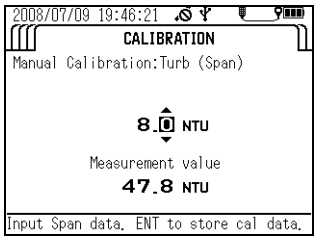
8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



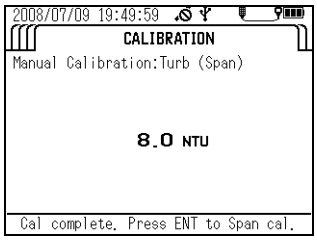
9. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the first span calibration procedure.**



10. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 8 NTU standard solution, or a standard solution of known concentration between 0.1 and 10 NTU.**
11. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
12. **Press the up (△) and down (▽) keys to set the "TURB" value to 8 NTU, or to the known concentration of the standard solution between 0.1 and 10 NTU. (Input range = 0 NTU to 9.9 NTU (U-51) or 0 NTU to 9.99 NTU (U-52))**

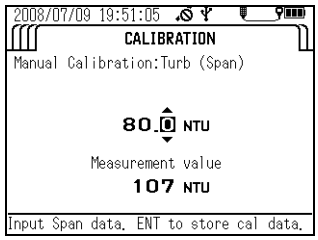


13. **Check that "Current measurement value" has stabilized, then press the ENTER key to start calibration.**
14. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**

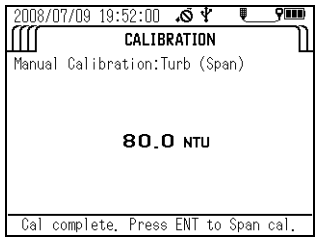


15. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 80 NTU standard solution, or a standard solution of known concentration between 10 and 100 NTU.**
16. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**

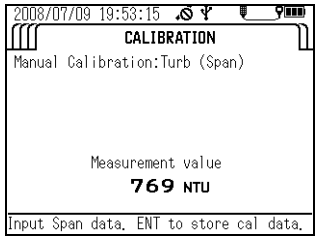
17. **Press the up (△) and down (▽) keys to set the "Turb" value to 80 NTU, or to the known concentration of the standard solution between 10 and 100 NTU. (Input range = 10.0 NTU to 99.9 NTU)**



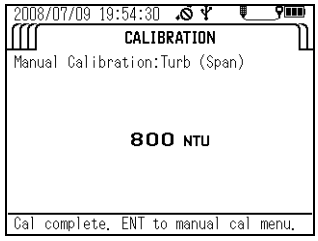
18. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
19. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the next span calibration procedure.**



20. **Wash the transparent calibration cup 2 or 3 times with deionized water, then fill it to the reference line with 800 NTU standard solution, or a standard solution of known concentration 100 NTU above.**
21. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the transparent calibration cup.**
22. **Press the up (△) and down (▽) keys to set the "TURB" value to 800 NTU, or to the known concentration of the standard solution 100 NTU above.**
(Input range = 100 NTU to 800 NTU (U-51), 100 NTU to 1000 NTU (U-52))



23. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
24. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**



● Dissolved oxygen (DO) calibration

Note

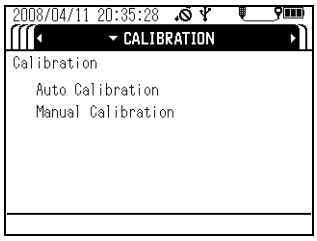
- **You can select one calibration procedure (span calibration) or two calibration procedures (zero-point calibration and span calibration). Carry out the two calibration procedures to ensure good measurement precision throughout all measurement ranges.**
- **It is necessary to prepare new solution before calibration of the Dissolved Oxygen (DO) sensor.**
- **The calibration cup (included) cannot be used to manually calibrate the DO sensor. Use a suitable bottle in which the DO sensor and the temperature sensor can be immersed.**
- **Wait at least 20 minutes after turning the system power ON before calibrating the DO sensor.**
- **Make the compensation setting before calibration since the setting is applied during calibration.**
- **The DO sensor is affected by flow. When performing span calibration with saturated dissolved oxygen water, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) or agitate the saturated dissolved oxygen water.**

1. **Prepare the standard solution.**

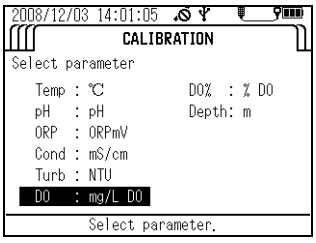
- Add about 50 g of sodium sulfite to 1000 mL of water (either deionized water or tap water) and stir the mixture to dissolve the sodium sulfite in it.
- Pour 1 to 2 liters of water into a suitable flask (either deionized water or tap water). Using a air pump, feed air into the water and aerate the solution until oxygen is saturated.

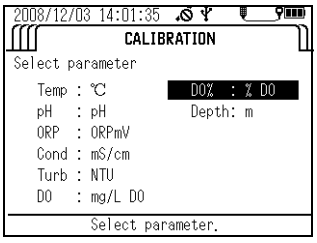
2. **First, calibrate the zero point. Press the control unit's CAL key to set the calibration mode.**

3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**

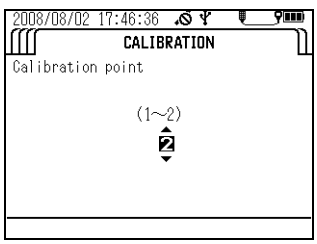


4. **In the parameter selection screen, move the cursor to DO or DO%, then press the ENTER key.**



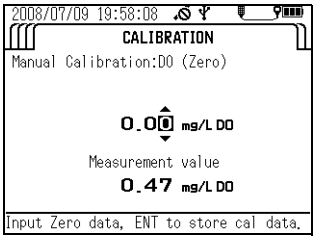


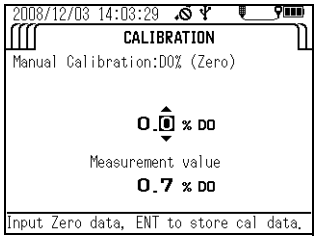
5. **Set the number of calibration procedures, then press the ENTER key.**



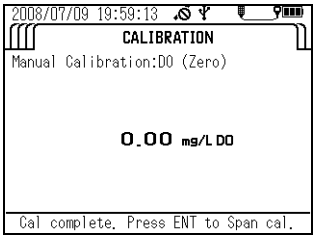
The instructions below assume that two calibration points have been set.

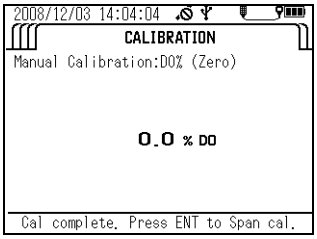
6. **Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then submerge the sensor probe in the bottle.**
7. **Press the up (△) and down (▽) keys to set the DO value to 0.00 mg/L or 0.0%.**



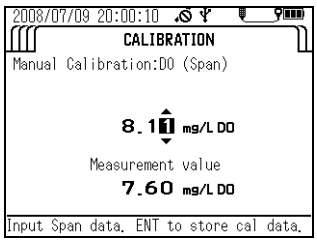


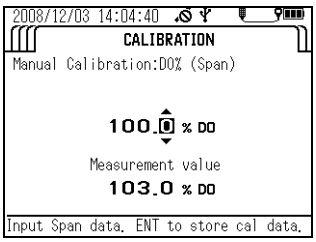
8. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
9. **When the message "Cal complete. Press ENT to Span cal." appears, press the ENTER key to start the span calibration procedure.**



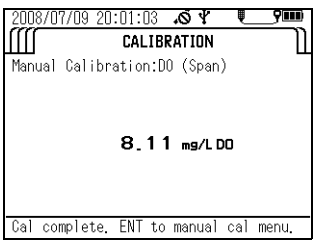


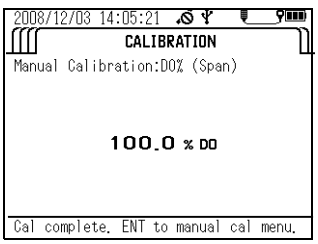
10. **Wash the sensor probe 2 or 3 times with deionized water to remove any dirt, then submerge the sensor probe in the container filled with the span solution.**
11. **Press the up (△) and down (▽) keys to set the DO value to the saturated dissolved oxygen value (mg/L) of the water at that temperature or the dissolved oxygen saturation ratio.**





12. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**
13. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**





Amounts of saturated dissolved oxygen in water at various temperatures (salinity=0.0%)

JIS K0101

Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	14.16						
1	13.77	11	10.67	21	8.68	31	7.42
2	13.40	12	10.43	22	8.53	32	7.32
3	13.04	13	10.20	23	8.39	33	7.22
4	12.70	14	9.97	24	8.25	34	7.13
5	12.37	15	9.76	25	8.11	35	7.04
6	12.06	16	9.56	26	7.99	36	6.94
7	11.75	17	9.37	27	7.87	37	6.86
8	11.47	18	9.18	28	7.75	38	6.76
9	11.19	19	9.01	29	7.64	39	6.68
10	10.92	20	8.84	30	7.53	40	6.59

ISO5814

Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	14.62				
1	14.22	11	11.03	21	8.91
2	13.83	12	10.78	22	8.74
3	13.46	13	10.54	23	8.58
4	13.11	14	10.31	24	8.42
5	12.77	15	10.08	25	8.26
6	12.45	16	9.87	26	8.11
7	12.14	17	9.66	27	7.97
8	11.84	18	9.47	28	7.83
9	11.56	19	9.28	29	7.69
10	11.29	20	9.09	30	7.56

● **Span setting values for calibration in air**

The software should display these values when auto calibration is performed.
Use this table to input values for manual span calibrations in air.

Tip

The DO measurement value of "air-saturated water" and air are different.
Due to the pressure difference against the membrane in air versus the membrane in water, the measurement value in air is about 10% higher than the value of air-saturated water on average.

Amounts of saturated dissolved oxygen in air at various temperatures

Following tables are applicable only to the air calibration of the U-50 DO sensor. Do not use them for other purpose.

Air calibration value in adopting evaluation based on JIS K0101

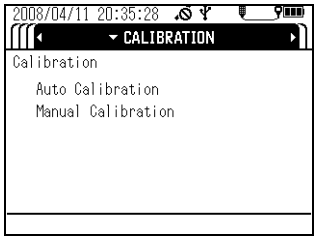
Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)	Temp (°C)	DO (mg/L)
0	15.58						
1	15.15	11	11.74	21	9.55	31	8.16
2	14.74	12	11.47	22	9.38	32	8.05
3	14.34	13	11.22	23	9.23	33	7.94
4	13.97	14	10.97	24	9.08	34	7.84
5	13.61	15	10.74	25	8.92	35	7.74
6	13.27	16	10.52	26	8.79	36	7.63
7	12.93	17	10.31	27	8.66	37	7.55
8	12.62	18	10.10	28	8.53	38	7.44
9	12.31	19	9.91	29	8.40	39	7.35
10	12.01	20	9.72	30	8.28	40	7.25

Air calibration value in adopting evaluation based on ISO5814

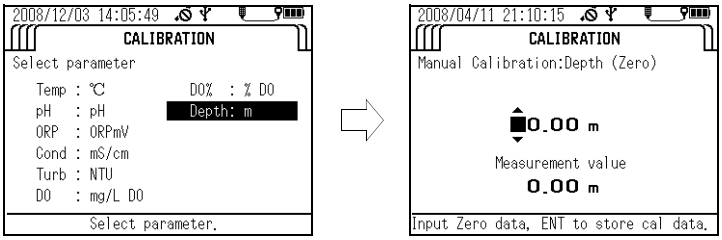
Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)	Temp. (°C)	DO (mg/L)
0	16.08				
1	15.64	11	12.13	21	9.80
2	15.21	12	11.86	22	9.61
3	14.81	13	11.59	23	9.44
4	14.42	14	11.34	24	9.26
5	14.05	15	11.09	25	9.09
6	13.70	16	10.86	26	8.92
7	13.35	17	10.63	27	8.77
8	13.02	18	10.42	28	8.61
9	12.72	19	10.21	29	8.46
10	12.42	20	10.00	30	8.32

● **Water depth (DEPTH) calibration**

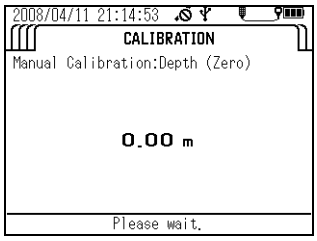
1. **Calibrate the zero point. Wash the sensor probe 2 or 3 times in deionized water to remove any dirt, then remove all moisture from the sensor probe (it will be calibrated in air).**
2. **Press the control unit's CAL key to set the calibration mode.**
3. **Press the down (▽) key to move the cursor to "Manual Calibration", then press the ENTER key.**



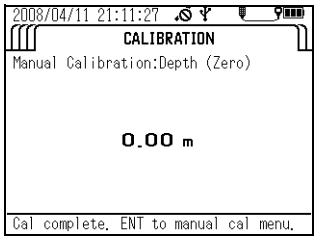
4. **In the parameter selection screen, move the cursor to "Depth", then press the ENTER key.**



5. **Press the up (△) and down (▽) keys to set the "Depth" value to 0.00 m.**
6. **Check that "Measurement value" has stabilized, then press the ENTER key to start calibration.**



7. **Calibration is finished when the message "Cal complete. ENT to manual cal menu." appears. Press the ENTER key to return to the calibration parameter selection screen.**



3.4 Measurement

You can perform measurement by either of the methods below.

- Storing data in memory manually with reference to the measurement value (single measurement)
- Having data stored in memory automatically and continuously
  U-51/U-52: Interval measurement (minimum memory interval of 10 seconds)
  U-53: Interval measurement (minimum memory interval of 30 seconds)

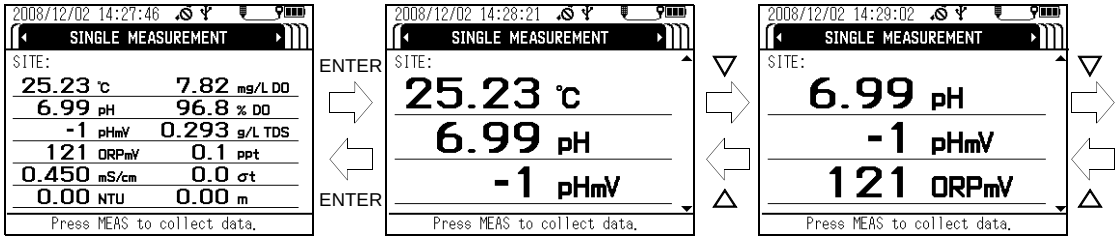
Select the measurement method that meets your requirements.

Note

- **Lower sensor probe slowly when submerging them in samples.**
- **Sensors may break if sensor probe are dropped from a height of 1 meter or more.**
- **Do not submerge sensor probe in water depths of over 30 meters. Sensor probe are only resistant to water pressure of up to 30 meters.**
- **After turning the power ON, check that the DO readout value has stabilized before starting measurement (takes around 20 minutes).**

Tip

- **When on the measurement screen, pressing the ENTER key enlarges the display and shows three measured values at a time.**
- **Pressing the up (△) and down (▽) keys scrolls through the measured values one item at a time.**
- **Pressing the ENTER key again reverts to the normal measurement screen display.**



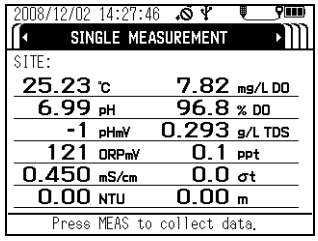
Measurement screen Normal Enlarged

3.4.1 Storing data in memory manually

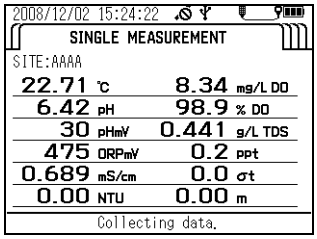
Follow the steps below to manually store data in memory while referring to the measurement value to check the readout value is stable.

● **U-51/U-52**

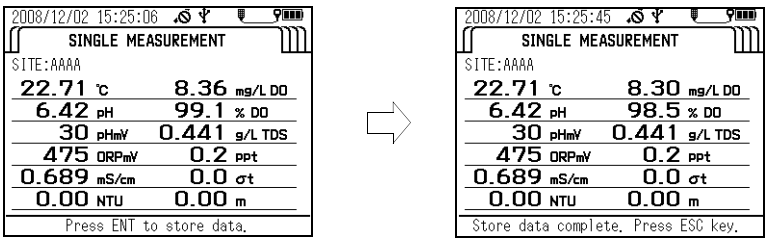
1. **Check that each sensor and sensor guard is mounted.**
2. **Check that "SINGLE MEASUREMENT" has been selected in the measurement screen.**



3. **Submerge the sensor probe in the sample, gently shaking them in the sample to remove any air bubbles from the sensors.**
   If the sample is non-flowing, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) to ensure that fresh sample is continuously supplied to the DO sensor.
4. **When the measurement values are stable, press the MEAS key to acquire the 5-second average.**



5. **Press the ENTER key to save the held measurement values, or press the ESC key to cancel the operation.**

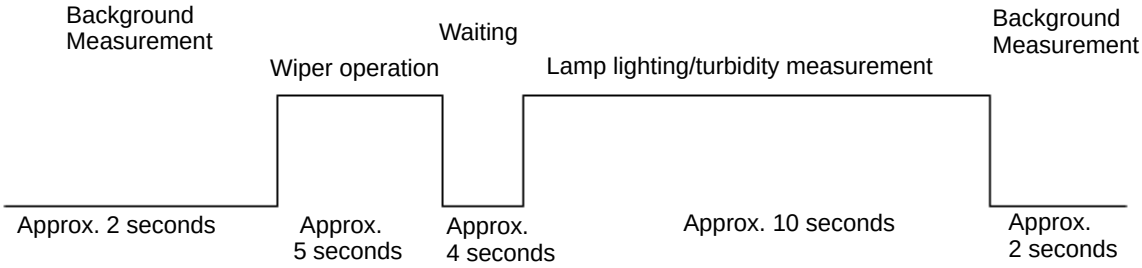


● U-53

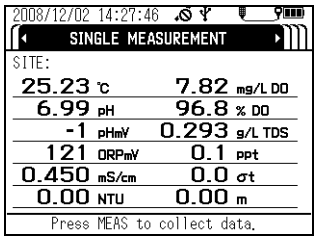
Note

Do not perform turbidity measurement in air as it may damage the wiper.

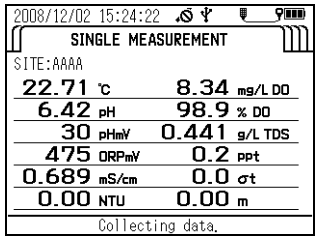
U-53 turbidity measurement follows the sequence below. The measurement values are held after each sequence.



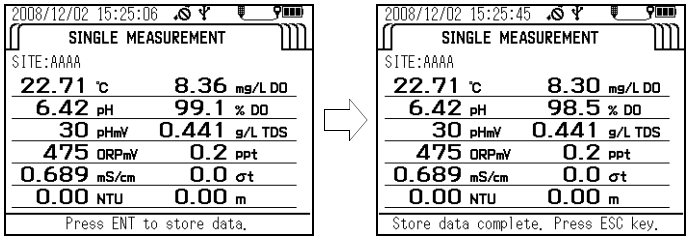
1. **Check that each sensor and sensor guard is mounted.**
2. **Check that "SINGLE MEASUREMENT" has been selected in the measurement screen.**



3. **Submerge the sensor probe in the sample, gently shaking them in the sample to remove any air bubbles from the sensors.**
   If the sample is non-flowing, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) to ensure that fresh sample is continuously supplied to the DO sensor.
4. **When the non-turbidity meter measurement values are stable, press the MEAS key to start the sequence above.**



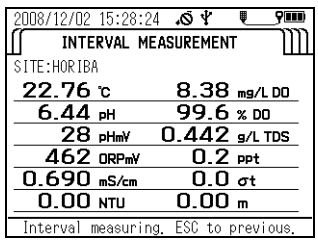
5. **When the sequence has finished, hold the measurement values. Press the ENTER key to store the held measurement values, or press the ESC key to cancel the operation.**



3.4.2 Automatic, continuous measurement

● Interval measurement

1. **Select the "Interval measurement" measurement setting (see " 3.2.1 Setting measurement methods " (page 18)).**
2. **Press the up (△) and down (▽) keys to set the interval value to the desired value (U-51/U-52: minimum interval: 10 seconds, U-53: minimum interval: 30 seconds), then press the ENTER key.**
   The measurement screen appears automatically, and the system becomes ready for measurement.
3. **Check that each sensor and sensor guard is mounted.**
4. **Submerge the sensor probe in the sample, gently shaking them in the sample to remove any air bubbles from the sensors.**
   If the sample is non-flowing, move the cable slowly up and down (move the sensor probe at a rate of roughly 20 to 30 cm a second) to ensure that fresh sample is continuously supplied to the DO sensor.
5. **Press the ENTER key to start measurement.**



3.5 Data operations

Use the procedures below to retrieve data stored in memory, delete all the data, check the remaining data memory capacity, and check the calibration record.

3.5.1 Displaying data

For maximum efficiency, there are 3 methods of displaying data.

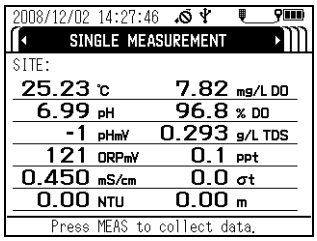
- Displaying the data for a specified site
- Displaying the data for a specified date/time
- Displaying all the data

Use the method that best suits your requirements.

● **Displaying the data for a specified site**

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

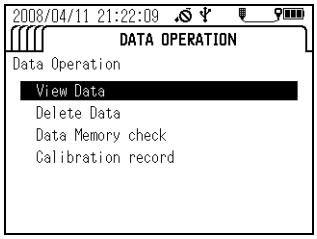


Note

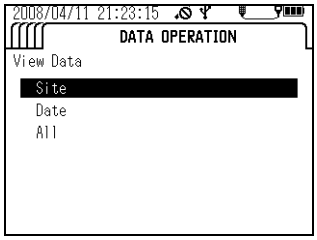
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**

3. **Press the down (▽) key to move the cursor to "View Data", then press the ENTER key.**

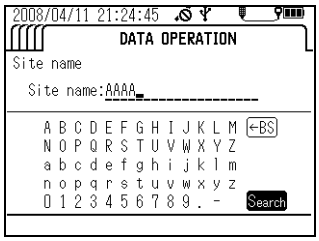


4. **Move the cursor to "Site", then press the ENTER key.**



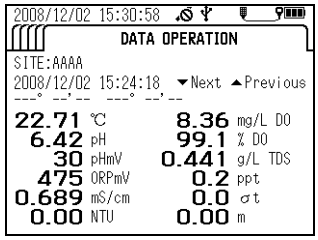
5. **Press the up (△), down (▽), left (◁) and right (▷) keys to enter the site to retrieve.**

6. **Move the cursor to "Search", then press the ENTER key.**



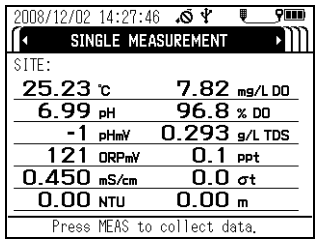
All site names that begin with the entered text are displayed.
The most recently measured data for the entered site is displayed.

7. **Press the up (△) and down (▽) keys to display earlier data.**



● Displaying the data for a specified date/time

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
The "MEASUREMENT" screen appears after about 10 seconds.

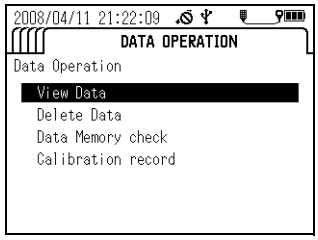


Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

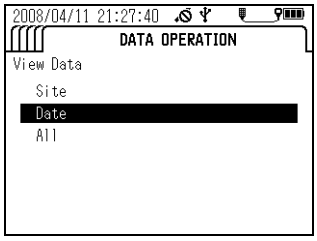
2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**

3. **Press the down (▽) key to move the cursor to "View Data", then press the ENTER key.**



4. **Move the cursor to "Date", then press the ENTER key.**

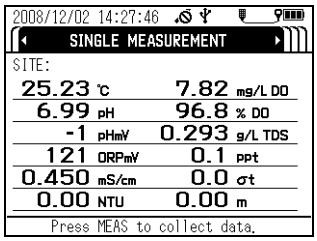
5. **With the cursor on the Date, press the ENTER key.**



6. **Press the up (△), down (▽), left (◁) and right (▷) keys to enter the desired date/ time, then press the ENTER key to apply the setting.**
7. **The cursor moves to "Search". Press the ENTER key to start the search.**
8. **Press the up (△) and down (▽) keys to display earlier data.**

● Displaying all the data

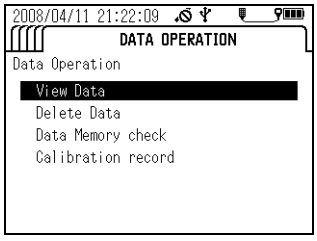
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



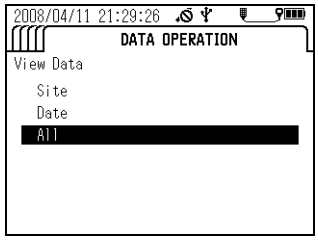
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**
3. **Press the down (▽) key to move the cursor to "View Data", then press the ENTER key.**



4. **Move the cursor to "All", then press the ENTER key.**
The most recently measured data is displayed.

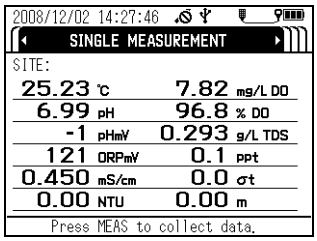


5. **Press the up (△) and down (▽) keys to display earlier data.**

3.5.2 Deleting data

Follow the steps below to delete all the data stored in memory.

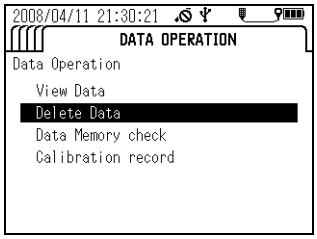
1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.



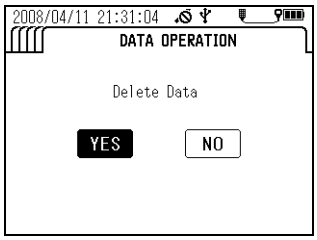
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**
3. **Press the down (▽) key to move the cursor to "Delete Data", then press the ENTER key.**



4. **Press the left (◁) key to move the cursor to YES, then press the ENTER key.**
   All the data has been deleted when the indicator appears along with the message "No data exists".

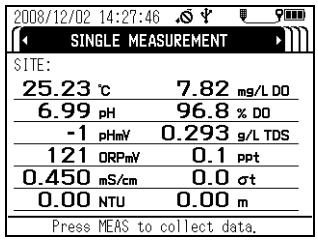


3.5.3 Checking the data memory

You can check the used data capacity and the remaining data capacity.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.

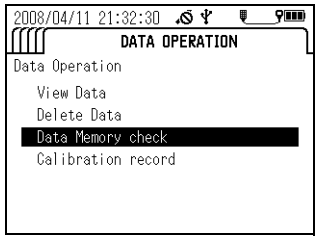


Note

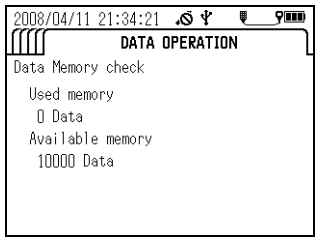
The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**

3. **Press the down (▽) key to move the cursor to "Data Memory Check", then press the ENTER key.**



The amount of memory in use and amount of available memory are displayed.

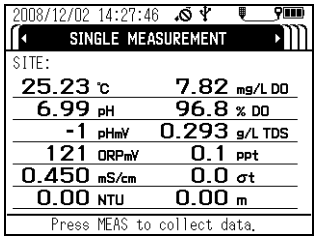


3.5.4 Checking the calibration record

Follow the steps below to check the latest calibration history.

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**

The "MEASUREMENT" screen appears after about 10 seconds.



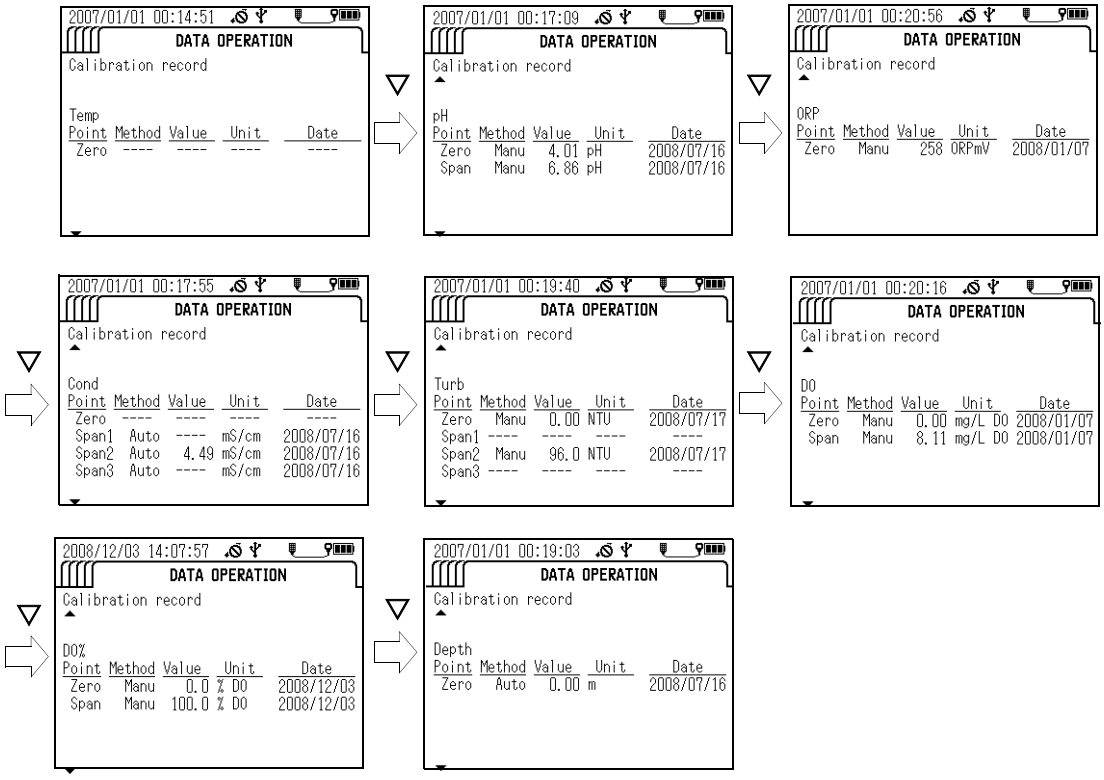
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Press the right (▷) key 3 times to display the "DATA OPERATION" screen.**

3. **Press the down (▽) key to move the cursor to "Calibration record", then press the ENTER key.**

The latest calibration record is displayed.



3.5.5 GPS data operations

The menu for GPS data operations appears on the display to which the GPS unit is mounted.

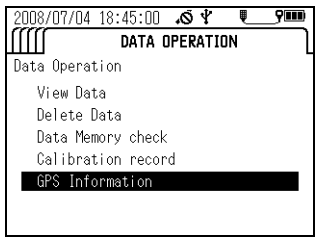
● GPS information

Follow the steps below to display acquired GPS information.

Note

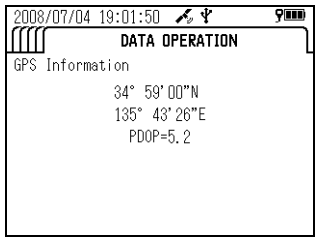
Turning the power OFF erases the GPS information.

1. **Press the right (▷) key to switch the display to the "DATA OPERATION" screen.**
2. **the down (▽) key to move the cursor to "GPS Information", then press the ENTER key.**

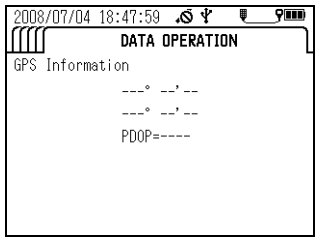


The last GPS information acquired is displayed.

● When received data exists

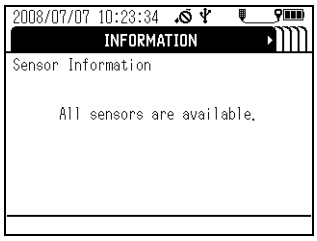


● When no received data exists

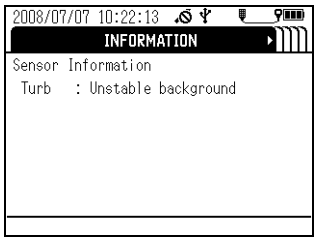


3.6 Sensor information

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power ON.**
   The "MEASUREMENT" screen appears after about 10 seconds.
2. **Press the left (◁) key once to display the "INFORMATION" screen.**
   The "Sensor Information" screen displays the sensor probe's status.
   ● When the sensor probe is normal, the display below appears.



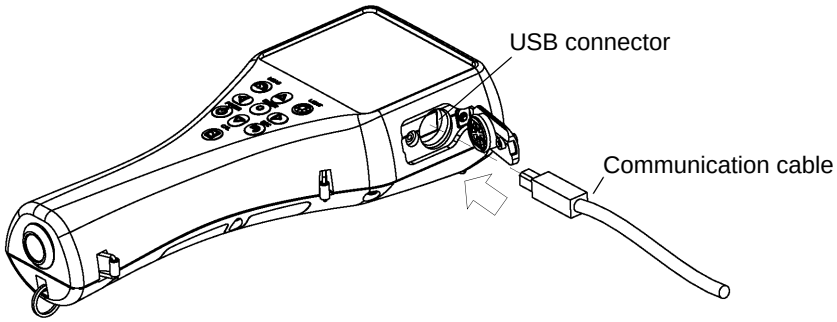
● When there is a sensor probe problem, individual measurement parameters generate messages such as the one shown below. Follow the troubleshooting information to remove the problem before continuing to operate the system.



3.7 USB communication

The separately-sold, dedicated PC connection cable comes with data collection software. This software allows data to be downloaded from the control unit in CSV format.
This section contains instructions for communication commands used for USB communication.

● Connecting the cable



Dedicated cable
Part name: Communication cable (with data collection software)
Part no.: 3200174823

● Cautions when using USB communication

Take care to observe the following when using USB communication.

- Use the dedicated cable (with data collection software) or a commercially-available USB cable (A-B type) to connect to a PC.
- Be sure to match the transmission format on the control unit and the computer.
  The control unit uses the following transmission format:

Baud rate:	19200 bps
Number of stop bits:	1 bit
Data bit length:	8 bits
Parity:	None
Flow control:	None

Tip

If the transmission formats do not match, a communication error occurs and USB communication will not function normally. After changing the transmission format, restart the control unit and the computer.

- If received data is not sent back or an error occurs after a data request has been sent, adjust the program configuration so that it allows a little waiting time before a data request is sent again. This will enable more stable communication.
- The unit does not use DCD, CTS, or DSR signals. Take care of this when creating programs.

3.7.1 Communication settings

Baud rate:	19200 bps
Number of stop bits:	1 bit
Data bit length:	8 bits
Parity:	None
Flow control:	None

3.7.2 Commands

● Instant data requests

● Request command format

#	RD	@	XX	[CR]	[LF]
1	2	3	4		

1	Header	1 character
2	Command	2 characters
3	Delimiter character	1 character
4	Frame check sequence (FCS)	2 characters

The two ASCII-code characters created by converting the 8 bits of data created by successively combining the value of each character from # through @ in an exclusive OR (XOR) operation with the value of the next character.

Example: #RD@

(1)	0	XOR	35	(ASCII code of # symbol)	⇒	35
(2)	35	XOR	82	(ASCII code of R)	⇒	113
(3)	113	XOR	68	(ASCII code of D)	⇒	53
(4)	53	XOR	64	(ASCII code of @ symbol)	⇒	117 (decimal) ↓ 75 (hex) ↓ Sets "75".

Example: 35 XOR 82 operation

35 in binary	⇒	0	0	1	0	0	0	1	1	
82 in binary	⇒	0	1	0	1	0	0	1	0	
XOR result		0	1	1	1	0	0	0	1	⇒ 113 (decimal)

Note: Set "XX" if you do not want to test for communication frame errors with FCS.

● Response format

#	RD	AAAAAAAAAAAAAAAAAAAA	X	X	XXXX	XX	X	X	XXXXX	X
1	2	3	4	5	6	7	8	9	10	11

XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41

XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X
42	43	44	45	46	47	48	49	50	51	52	53	54	55	56

XX	X	X	XXXXX	X	XX	X	X	XXXXX	X	XX	X	X	XXXXX	X
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71

XX	XX	XX	XX	XX	XX	XX	XX	XX	X	X	XXX	XX	XX	X	X	@	XX	[CR]	[LF]
72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89		

1	Header		1 character
2	Command		2 characters
3	Site name	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ( )	20 characters
4	Probe status	(3) Status code	1 character
5	Probe error	(4) Status error code	1 character
6	Unused		4 characters
7	Parameter 1 code	(1) Parameter code	2 characters
8	Parameter 1 status	(5) Parameter status code	1 character
9	Parameter 1 error	(6) Parameter error code	1 character
10	Parameter 1 data	5 characters including decimal point, right-justified with blanks filled	5 characters
11	Parameter 1 unit	(2) Unit code	1 character
12	Parameter 2 code	(1) Parameter code	2 characters
13	Parameter 2 status	(5) Parameter status code	1 character
14	Parameter 2 error	(6) Parameter error code	1 character
15	Parameter 2 data	5 characters including decimal point, right-justified with blanks filled	5 characters
16	Parameter 2 unit	(2) Unit code	1 character
17	Parameter 3 code	(1) Parameter code	2 characters
18	Parameter 3 status	(5) Parameter status code	1 character
19	Parameter 3 error	(6) Parameter error code	1 character
20	Parameter 3 data	5 characters including decimal point, right-justified with blanks filled	5 characters
21	Parameter 3 unit	(2) Unit code	1 character
22	Parameter 4 code	(1) Parameter code	2 characters
23	Parameter 4 status	(5) Parameter status code	1 character
24	Parameter 4 error	(6) Parameter error code	1 character
25	Parameter 4 data	5 characters including decimal point, right-justified with blanks filled	5 characters
26	Parameter 4 unit	(2) Unit code	1 character
27	Parameter 5 code	(1) Parameter code	2 characters
28	Parameter 5 status	(5) Parameter status code	1 character
29	Parameter 5 error	(6) Parameter error code	1 character
30	Parameter 5 data	5 characters including decimal point, right-justified with blanks filled	5 characters
31	Parameter 5 unit	(2) Unit code	1 character
32	Parameter 6 code	(1) Parameter code	2 characters
33	Parameter 6 status	(5) Parameter status code	1 character
34	Parameter 6 error	(6) Parameter error code	1 character

35	Parameter 6 data	5 characters including decimal point, right-justified with blanks filled	5 characters
36	Parameter 6 unit	(2) Unit code	1 character
37	Parameter 7 code	(1) Parameter code	2 characters
38	Parameter 7 status	(5) Parameter status code	1 character
39	Parameter 7 error	(6) Parameter error code	1 character
40	Parameter 7 data	5 characters including decimal point, right-justified with blanks filled	5 characters
41	Parameter 7 unit	(2) Unit code	1 character
42	Parameter 8 code	(1) Parameter code	2 characters
43	Parameter 8 status	(5) Parameter status code	1 character
44	Parameter 8 error	(6) Parameter error code	1 character
45	Parameter 8 data	5 characters including decimal point, right-justified with blanks filled	5 characters
46	Parameter 8 unit	(2) Unit code	1 character
47	Parameter 9 code	(1) Parameter code	2 characters
48	Parameter 9 status	(5) Parameter status code	1 character
49	Parameter 9 error	(6) Parameter error code	1 character
50	Parameter 9 data	5 characters including decimal point, right-justified with blanks filled	5 characters
51	Parameter 9 unit	(2) Unit code	1 character
52	Parameter 10 code	(1) Parameter code	2 characters
53	Parameter 10 status	(5) Parameter status code	1 character
54	Parameter 10 error	(6) Parameter error code	1 character
55	Parameter 10 data	5 characters including decimal point, right-justified with blanks filled	5 characters
56	Parameter 10 unit	(2) Unit code	1 character
57	Parameter 11 code	(1) Parameter code	2 characters
58	Parameter 11 status	(5) Parameter status code	1 character
59	Parameter 11 error	(6) Parameter error code	1 character
60	Parameter 11 data	5 characters including decimal point, right-justified with blanks filled	5 characters
61	Parameter 11 unit	(2) Unit code	1 character
62	Parameter 12 code	(1) Parameter code	2 characters
63	Parameter 12 status	(5) Parameter status code	1 character
64	Parameter 12 error	(6) Parameter error code	1 character
65	Parameter 12 data	5 characters including decimal point, right-justified with blanks filled	5 characters
66	Parameter 12 unit	(2) Unit code (6) Parameter error code	1 character
67	Parameter 13 code	(1) Parameter code	2 characters
68	Parameter 13 status	(5) Parameter status code	1 character
69	Parameter 13 error	(6) Parameter error code	1 character
70	Parameter 13 data	5 characters including decimal point, right-justified with blanks filled	5 characters
71	Parameter 13 unit	(2) Unit code	1 character
72	Year	00 to 99	2 characters

73	Month	01 to 12	2 characters
74	Day	01 to 31	2 characters
75	Hour	00 to 23	2 characters
76	Minute	00 to 59	2 characters
77	Second	00 to 59	2 characters
78	Longitude (degrees)	00 to 90 or "--" (no GPS data)	2 characters
79	Longitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
80	Longitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
81	Unused	1 character	1 character
82	North latitude/South latitude	N: North; S: South	1 character
83	Latitude (degrees)	000 to 180 or "---" (no GPS data)	3 characters
84	Latitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
85	Latitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
86	Unused		1 character
87	East longitude/West longitude	E: East; W: West	1 character
88	Delimiter character		1 character
89	Frame check sequence (FCS)		2 characters

● Memory data requests

● Request command format

#	RM	X	X	AAAAAAAAAAAAAAAAAAAA	XX	XX	XX	@	XX	[CR]	[LF]
1	2	3	4	5	6	7	8	9	10		

1	Header		1 character
2	Command		2 characters
3	Data specification[*1]	0: Start search; 1: Next data item; 2: Previous data item; 3: Request same data again	1 character
4	Search method specification	0: All data; 1: Site search; 2: Date search	1 character
5	Search site[*2]	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ( )	20 characters
6	Search year[*3]	00 to 99	2 characters
7	Search month[*3]	01 to 12	2 characters
8	Search day[*3]	01 to 31	2 characters
9	Delimiter character		1 character
10	Frame check sequence (FCS)		2 characters

*1: When sending the RM command, first send 0 [Start search], then 1 [Next data item], 2 [Previous data item] or 3 [Request same data again].

*2: [Search site] is only needed when [Site search] is specified as the search method. If another search method is specified, fill this field with spaces.

*3: [Search year], [Search month] and [Search day] are only needed when [Date search] is specified as the search method. If another search method is specified, fill this field with spaces.

● **Response format**

(when data exists)

```
#   RM  AAAAAAAAAAAAAAAAAAAA   XX  X   X   XXXXX  X
1   2   3                      4   5   6   7      8

XX  X   X   XXXXX  X   XX  X   X   XXXXX  X   XX  X   X   XXXXX  X
9   10  11  12      13  14  15  16  17      18  19  20  21  22      23

XX  X   X   XXXXX  X   XX  X   X   XXXXX  X   XX  X   X   XXXXX  X
24  25  26  27      28  29  30  31  32      33  34  35  36  37      38

XX  X   X   XXXXX  X   XX  X   X   XXXXX  X   XX  X   X   XXXXX  X
39  40  41  42      43  44  45  46  47      48  49  50  51  52      53

XX  X   X   XXXXX  X   XX  X   X   XXXXX  X   XX  X   X   XXXXX  X
54  55  56  57      58  59  60  61  62      63  64  65  66  67      68

XX  XX  XX  XX  XX  XX  XX  XX  XX  X   X   XXX  XX  XX  X   X   @   XX  [CR]  [LF]
69  70  71  72  73  74  75  76  77  78  79  80   81  82  83  84  85  86
```

1	Header		1 character
2	Command		2 characters
3	Site name	Upper- and lowercase letters, numbers, periods (.) hyphens (-) and spaces ( )	20 characters
4	Parameter 1 code	(1) Parameter code	2 characters
5	Parameter 1 selection	0: No selection; 1: Selection made	1 character
6	Parameter 1 error	(6) Parameter error code	1 character
7	Parameter 1 data	5 characters including decimal point, right-justified with blanks filled	5 characters
8	Parameter 1 unit	(2) Unit code	1 character
9	Parameter 2 code	(1) Parameter code	2 characters
10	Parameter 2 selection	0: No selection; 1: Selection made	1 character
11	Parameter 2 error	(6) Parameter error code	1 character
12	Parameter 2 data	5 characters including decimal point, right-justified with blanks filled	5 characters
13	Parameter 2 unit	(2) Unit code	1 character
14	Parameter 3 code	(1) Parameter code	2 characters
15	Parameter 3 selection	0: No selection; 1: Selection made	1 character
16	Parameter 3 error	(6) Parameter error code	1 character
17	Parameter 3 data	5 characters including decimal point, right-justified with blanks filled	5 characters
18	Parameter 3 unit	(2) Unit code	1 character
19	Parameter 4 code	(1) Parameter code	2 characters
20	Parameter 4 selection	0: No selection; 1: Selection made	1 character

21	Parameter 4 error	(6) Parameter error code	1 character
22	Parameter 4 data	5 characters including decimal point, right-justified with blanks filled	5 characters
23	Parameter 4 unit	(2) Unit code	1 character
24	Parameter 5 code	(1) Parameter code	2 characters
25	Parameter 5 selection	0: No selection; 1: Selection made	1 character
26	Parameter 5 error	(6) Parameter error code	1 character
27	Parameter 5 data	5 characters including decimal point, right-justified with blanks filled	5 characters
28	Parameter 5 unit	(2) Unit code	1 character
29	Parameter 6 code	(1) Parameter code	2 characters
30	Parameter 6 selection	0: No selection; 1: Selection made	1 character
31	Parameter 6 error	(6) Parameter error code	1 character
32	Parameter 6 data	5 characters including decimal point, right-justified with blanks filled	5 characters
33	Parameter 6 unit	(2) Unit code	1 character
34	Parameter 7 code	(1) Parameter code	2 characters
35	Parameter 7 selection	0: No selection; 1: Selection made	1 character
36	Parameter 7 error	(6) Parameter error code	1 character
37	Parameter 7 data	5 characters including decimal point, right-justified with blanks filled	5 characters
38	Parameter 7 unit	(2) Unit code	1 character
39	Parameter 8 code	(1) Parameter code	2 characters
40	Parameter 8 selection	0: No selection; 1: Selection made	1 character
41	Parameter 8 error	(6) Parameter error code	1 character
42	Parameter 8 data	5 characters including decimal point, right-justified with blanks filled	5 characters
43	Parameter 8 unit	(2) Unit code	1 character
44	Parameter 9 code	(1) Parameter code	2 characters
45	Parameter 9 selection	0: No selection; 1: Selection made	1 character
46	Parameter 9 error	(6) Parameter error code	1 character
47	Parameter 9 data	5 characters including decimal point, right-justified with blanks filled	5 characters
48	Parameter 9 unit	(2) Unit code	1 character
49	Parameter 10 code	(1) Parameter code	2 characters
50	Parameter 10 selection	0: No selection; 1: Selection made	1 character
51	Parameter 10 error	(6) Parameter error code	1 character
52	Parameter 10 data	5 characters including decimal point, right-justified with blanks filled	5 characters
53	Parameter 10 unit	(2) Unit code	1 character
54	Parameter 11 code	(1) Parameter code	2 characters
55	Parameter 11 selection	0: No selection; 1: Selection made	1 character
56	Parameter 11 error	(6) Parameter error code	1 character
57	Parameter 11 data	5 characters including decimal point, right-justified with blanks filled	5 characters
58	Parameter 11 unit	(2) Unit code	1 character
59	Parameter 12 code	(1) Parameter code	2 characters

60	Parameter 12 selection	0: No selection; 1: Selection made	1 character
61	Parameter 12 error	(6) Parameter error code	1 character
62	Parameter 12 data	5 characters including decimal point, right-justified with blanks filled	5 characters
63	Parameter 12 unit	(2) Unit code	1 character
64	Parameter 13 code	(1) Parameter code	2 characters
65	Parameter 13 selection	0: No selection; 1: Selection made	1 character
66	Parameter 13 error	(6) Parameter error code	1 character
67	Parameter 13 data	5 characters including decimal point, right-justified with blanks filled	5 characters
68	Parameter 13 unit	(2) Unit code	1 character
69	Year	00 to 99	2 characters
70	Month	01 to 12	2 characters
71	Day	01 to 31	2 characters
72	Hour	00 to 23	2 characters
73	Minute	00 to 59	2 characters
74	Second	00 to 5	2 characters
75	Longitude (degrees)	00 to 90 or "--" (no GPS data)	2 characters
76	Longitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
77	Longitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
78	Unused		1 character
79	North latitude/South latitude	N: North; S: South	1 character
80	Latitude (degrees)	000 to 180 or "---" (no GPS data)	3 characters
81	Latitude (minutes)	00 to 59 or "--" (no GPS data)	2 characters
82	Latitude (seconds)	00 to 59 or "--" (no GPS data)	2 characters
83	Unused		1 character
84	East longitude/West longitude	E: East; W: West	1 character
85	Delimiter character		1 character
86	Frame check sequence (FCS)		2 characters

When no data exists, or memory is at capacity)

#	RM	@	XX	[CR]	[LF]
1	2	3	4		

1	Header	1 character
2	Command	2 characters
3	Delimiter character\	1 character
4	Frame check sequence (FCS)	2 characters

● Memory data count request

● Request command format

#	RN	@	XX	[CR]	[LF]
1	2	3	4		

1	Header	1 character
2	Command	2 characters
3	Delimiter character\	1 character
4	Frame check sequence (FCS)	2 characters

● Response format

#	RN	XXXXX	@	XX	[CR]	[LF]
1	2	3	4	5		

1	Header		1 character
2	Command		2 characters
3	Total data count	0 to 10000	5 characters
4	Delimiter character\		1 character
5	Frame check sequence (FCS)		2 characters

● Command parse failure response

#	??	X	XX	X	@	XX	[CR]	[LF]
1	2	3	4	5	6	7		

1	Header	1 character
2	Command	2 characters
3	Command parse failure reason*4	1 character
4	Received command*5	2 characters
5	(3) Status code for probe status*5	1 character
6	Delimiter character	1 character
7	Frame check sequence (FCS)	2 characters

*4: List of command parse failure reasons

1: Frame length error
2: FCS mismatch
3: Undefined command
4: Data error
5: Data out of range
6: No "@" delimiter character
7: No "#" header character
8: No [Carriage return] + [Line feed] footer
9: Cannot accept command in this timing.

*5: Only set for command parse failure reason 9, [Cannot accept command in this timing]. Otherwise this field is filled with spaces.

4 Maintenance

Tip

HORIBA recommends regular manufacturer maintenance checks in order to ensure a long product life.

4.1 Routine care

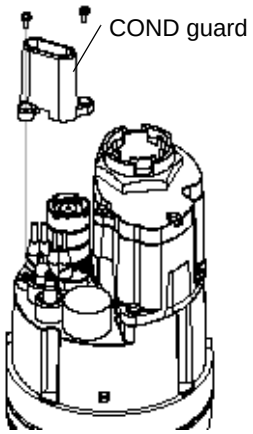
● **After measurement**

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power OFF.**

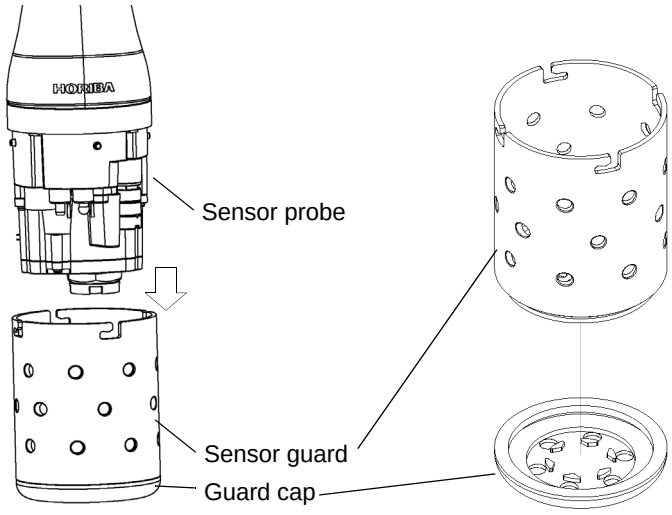
Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Remove the sensor guard, and clean the sensor with tap water.**
3. **Clean the turbidity sensor with the cleaning brush provided.**
4. **Remove the two screws securing the COND guard, and the COND guard itself, and use a test tube brush to gently remove any dirt from the electrical conductivity electrode.**



5. **Wipe off any dirt with a soft cloth. If parts are very dirty, clean them with neutral detergent, then rinse them. If parts are contaminated by oil, wipe it off with a soft cloth soaked in alcohol.**
6. **Put the COND guard back in place.**
7. **Remove the sensor guard's guard cap, wash off any dirt with tap water, then put the guard cap back in place.**



4.2 Every 2 months maintenance

● Dissolved oxygen (DO) sensor

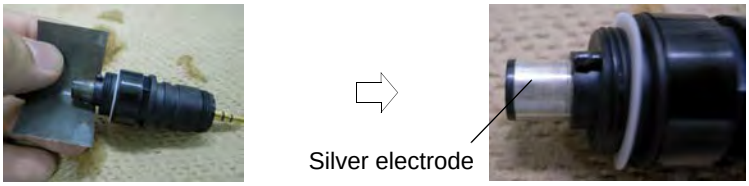
Note

- **The DO sensor's internal solution is potassium chloride (KCl). Although KCl is harmless, protective equipment such as gloves and goggles should be worn when working with it.**
- **Internal solution can be disposed of down a sink.**

- Replace the membrane cap.
- Polish the gold and silver electrodes when replacing the membrane cap.
  The gold electrode does not need to be polished if it is not dirty.

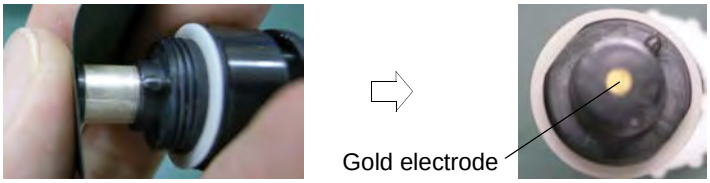
● **Silver electrode**

Polish a silver electrode part with sandpaper (#500) and then wash metal electrode parts with water.



● **Gold electrode**

Polish a gold electrode part with sandpaper (#8000) and then wash metal electrode parts with water.



Replace a membrane cap after clean metal electrodes parts.
Refer to “ 4.5 Replacing the membrane cap ” (page 87).

● **Reference electrode**

Note

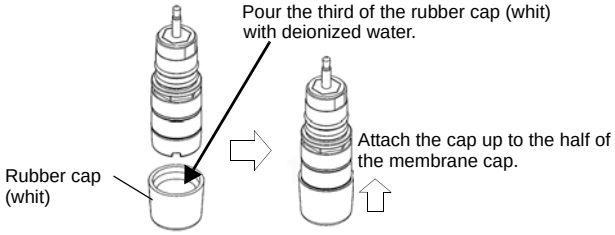
- **The pH reference internal solution is potassium chloride (KCl). Although KCl is harmless, protective equipment such as gloves and goggles should be worn when working with it.**
- **Internal solution can be disposed of down a sink.**

1. **Remove the rubber liquid junction plug from the reference electrode and dispose of the internal solution.**
2. **To prevent air entering, fill the reference electrode to the brim with its internal solution (No. 330).**
3. **Put the rubber liquid junction plug back in place.**
   If the rubber liquid junction plug is dirty, replace the liquid junctions (set of two; No. 9037005100). The reference electrode's internal solution will spill when replacing the liquid junctions. Rinse parts with tap water and dry them with a soft cloth.

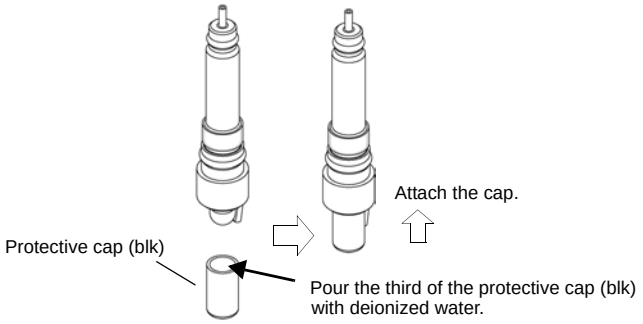
4.3 Storage

● Short-term (under 2 months) storage

- Before storing the DO sensor, pour the third of the rubber cap (whit) provided with deionized water and cover the DO sensor with them.



- Before storing the pH sensor, pour the third of the protective cap (blk) provided with deionized water and cover the pH sensor with them.



Note

Before measuerment, remove the rubber cap (whit) and the protective cap (blk).

● Long-term (2 months or more) storage

- Remove a membrane cap from DO sensor, and wash the gold electrode and silver electrode parts with water. Wipe off the moisture before storing DO sensor in the pack.
- Prevent internal solution seeping out of the reference chip by taping over the point of seepage with electrical tape.
- Before storing the system, remove the control unit's batteries to prevent battery leakage.

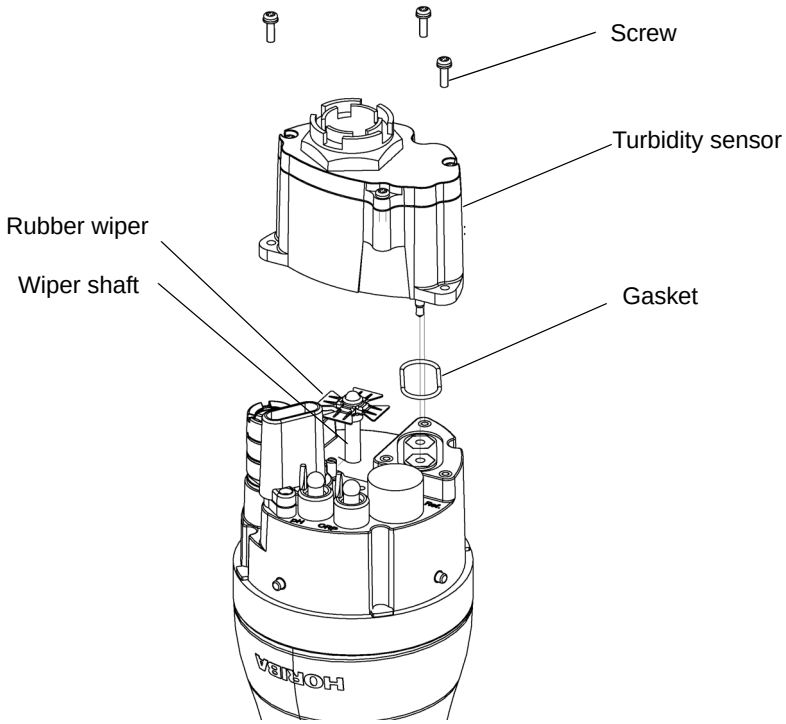
4.4 Replacing the turbidity sensor

1. **Press and hold down the control unit's POWER key for about 3 seconds to turn the power OFF.**

Note

The operation keys are designed to operate using the pad of a finger, sharp objects can tear the control unit cover damaging the operation keys.

2. **Remove the sensor guard, and clean the sensor probe with tap water.**
3. **Use dry air to blow away and dry off any moisture.**
4. **Remove the three screws holding the turbidity sensor by using No. 2 Phillips head screwdriver.**
5. **Pull out the turbidity sensor horizontally.**
6. **Remove the rubber wiper and gasket, and use a soft cloth to wipe off any dirt from the wiper shaft and turbidity sensor attachment. If parts are very dirty, use a soft cloth soaked in neutral detergent or alcohol.**
7. **Replace the rubber wiper and gasket with new ones. Coat the gasket with a thin layer of grease (No. 3014017718).**
8. **Attach the new turbidity sensor and fasten it in place with the three screws.**
9. **Perform four-point calibration before using the sensor.**



4.5 Replacing the membrane cap

● Replacement procedure

1. **Prepare the DO sensor.**

- Take a DO sensor out of pack (newly purchasing).
- Remove a DO sensor from the sensor probe (after use).



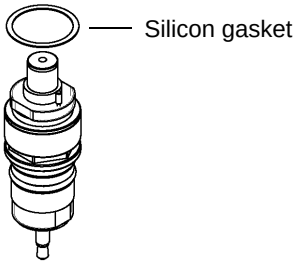
Newly purchasing



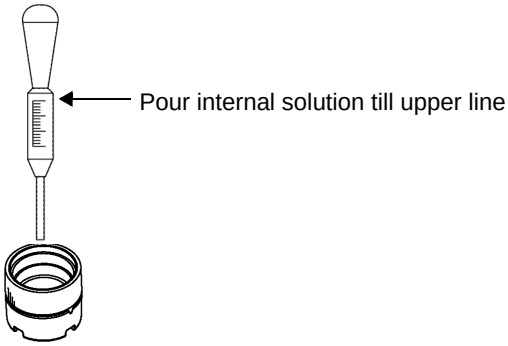
Undo a DO sensor from the sensor probe

- Twist a membrane cap from DO sensor.
- Wash the gold electrode and silver electrode parts with water.

2. **Replace the silicone gasket with a new one.**



3. **Pour internal solution into a membrane cap with a dropper.**

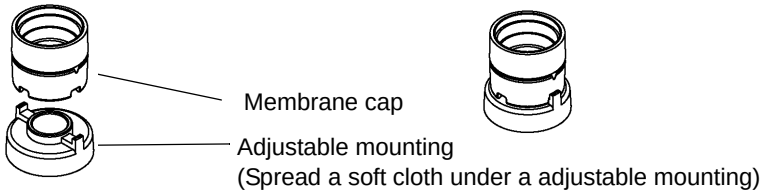


- Check air bubbles in a membrane cap.

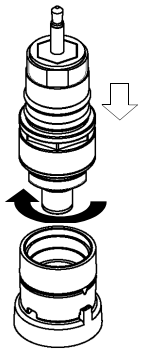


Pick a Cap up and drop it down, if there is air bubbles in internal solution of it.

4. **Set up a membrane cap on a adjustable mounting.**



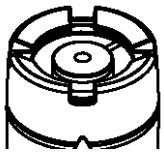
5. Attach a membrane cap to DO sensor



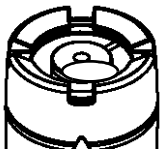
Twist a DO sensor
with holding a membrane cap tight.

6. Check for membrane surface

Check air bubbles in a membrane cap.



Good: Limited air bubbles



NG: Air bubbles of more than 5 mm in diameter

- NG → Replace a membrane cap again.
- Check that span calibration can be performed.

If the membrane cap is not attached correctly, sensitivity may be lost or response speed may decrease.

4.6 Troubleshooting

Note

If the sensor probe is removed while the control unit is indicating an error, errors cannot be canceled by using the ESC key. Either reconnect the sensor probe or restart the control unit.

4.6.1 Error displays

Error	Cause	Solution
Probe ADC error	Internal IC failure	Contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error/Factory	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error/User	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.
Turbidity sensor light source error	Turbidity sensor light source failure	Turn the power OFF, wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor.
Turbidity sensor wiper motor error	The turbidity sensor wiper is not operating.	Press the ESC key. Check there are no obstacles near the wiper, then perform the measurement again. If the error persists, the motor will need to be replaced. Contact your nearest sales outlet to have the sensor probe repaired.
Probe capacitor error	Low battery voltage or internal IC failure	Turn the power OFF. Replace the display's batteries. If the error persists, contact your nearest sales outlet to have the sensor probe repaired.
Probe EEPROM error	Internal IC failure	Press the ESC key, then redo the operation. If the error persists, turn the power OFF, then restart the system (the current data will not be saved). If the error still persists, contact your nearest sales outlet to have the display repaired.
Probe board error	Probe board failure	Turn the power OFF. Contact your nearest sales outlet to have the sensor probe repaired.

Error	Cause	Solution
Zero-point calibration error	pH sensor 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn.	pH sensor 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	COND sensor 1. There is moisture on the sensor. 2. The sensor is dirty. 3. The COND sensor is broken.	COND sensor 1. Blow-dry the moisture off the sensor. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	TURB sensor 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed.	TURB sensor 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	DO sensor 1. There are air bubbles in the internal solution. 2. The DO sensor has failed.	DO sensor 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the DO sensor.
	Water depth sensor 1. The water depth sensor is dirty. 2. The water depth sensor has failed.	Water depth sensor 1. Clean the water depth sensor. 2. Contact your nearest sales outlet.

Error	Cause	Solution
Span calibration error	pH sensor 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn.	pH sensor 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	ORP sensor 1. The ORP standard solution is contaminated. 2. The ORP electrode is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The ORP electrode has failed.	ORP sensor 1. Replace the standard solution with new solution. 2. Clean the ORP electrode. 3. Refil the reference electrode's internal solution. 4. Replace the ORP electrode.
	COND sensor 1. The calibration solution is not correct. 2. The sensor is dirty. 3. The COND sensor has failed.	COND sensor 1. Use the correct calibration solution for calibration. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	TURB sensor 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed.	TURB sensor 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	DO sensor 1. The diaphragm is torn. 2. There are air bubbles in the internal solution. 3. The DO sensor has failed.	DO sensor 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 3. Replace the DO sensor.
	Temperature sensor The temperature sensor has failed.	Temperature sensor Contact your nearest sales outlet.
Calibration stability error	The calibration value of an individual parameter is not stable. 1. The sensor is dirty. 2. The sensor has not adjusted to the standard solution. 3. The temperature was unstable during calibration.	1. Clean the sensor. 2. Fill the transparent calibration cup with pH 4 standard solution, and wait for at least 20 minutes of conditioning before starting calibration. 3. Start calibration after the temperature has stabilized.
Turbidity calibration error	Error in turbidity measurement sequence	Turbidity calibration failed. Redo calibration after removing the displayed error.
Wet check	The cable connector is submerged.	Turn the power OFF and disconnect the cable connector. Wipe or blow-dry off all the water droplets on the probe. If the error persists, contact your nearest sales outlet to have the display and sensor probe repaired.
Power voltage error	The display's power board has failed.	This error could also be caused by poor cable contact. Turn the power OFF and disconnect the cable connector. Reconnect the connector and turn the power ON. If the error persists, contact your nearest sales outlet to have the display and sensor probe repaired.
Turbidity lamp power voltage error	The remaining battery level is low.	Turn the power OFF and replace the display's batteries with new ones.

Error	Cause	Solution
Display RTC error	The time display is incorrect.	Replace the coin battery.
Display FROM error	Internal IC failure	Contact your nearest sales outlet to have the control unit repaired.
Display EEPROM error	Internal IC failure	Contact your nearest sales outlet to have the control unit repaired.
Display save error	Insufficient memory space	Move data from the display, use the data operations screen to delete data, then redo the measurement.
Measurement sequence error	● When the measurement item is turbidity 1. The battery power is low. 2. The wiper is not operating normally. 3. The light source lamp is not lit. ● If items other than turbidity are also displayed 4. Board failure	1. Replace the batteries with new ones. 2. Check there are no obstacles near the wiper, then redo the measurement. If the error persists, the motor will need to be replaced. Contact your nearest sales outlet to have the sensor probe repaired. 3. Wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor. 4. Contact your nearest sales outlet to have the sensor probe repaired.
Out of measurement range	The attempted measurement is outside the measurement range supported for that item.	The system must be used within its supported measurement ranges.
Last zero-point calibration invalid	pH sensor 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn.	pH sensor 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	COND sensor 1. There is moisture on the sensor. 2. The sensor is dirty. 3. The COND sensor has failed.	COND sensor 1. Blow-dry the moisture off the sensor. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	TURB sensor 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed.	TURB sensor 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	DO sensor 1. There are air bubbles in the internal solution. 2. The DO sensor has failed.	DO sensor 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the DO sensor.
	Water depth sensor 1. The water depth sensor is dirty. 2. The water depth sensor has failed.	Water depth sensor 1. Clean the water depth sensor. 2. Contact your nearest sales outlet.
Out of measurement range	[See above.]	[See above.]
Last zero-point calibration invalid		

Error	Cause	Solution
Last span calibration invalid	pH sensor 1. The pH standard solution is contaminated. 2. The pH-responsive membrane is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The pH-responsive membrane is torn.	pH sensor 1. Replace the standard solution with new solution. 2. Clean the pH-responsive membrane. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	ORP sensor 1. The ORP standard solution is contaminated. 2. The ORP electrode is dirty. 3. The concentration of the reference electrode's internal solution has changed. 4. The ORP sensor glass is broken.	ORP sensor 1. Replace the standard solution with new solution. 2. Clean the ORP electrode. 3. Refil the reference electrode's internal solution. 4. Replace the sensor.
	COND sensor 1. The calibration solution is not correct. 2. The sensor is dirty. 3. The COND sensor has failed.	COND sensor 1. Use the correct calibration solution for calibration. 2. Clean the sensor. 3. Contact your nearest sales outlet.
	TURB sensor 1. There are air bubbles on the cell. 2. The cell window is dirty. 3. The sensor is being affected by ambient light. 4. The solution is dirty. 5. The TURB sensor has failed.	TURB sensor 1. Shake the sensor probe vigorously. 2. Clean the cell window. 3. Calibrate using the calibration cup provided. 4. Replace the solution with new solution. 5. Replace the TURB sensor.
	DO sensor 1. The diaphragm is torn. 2. There are air bubbles in the internal solution. 3. The DO sensor has failed.	DO sensor 1. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 2. Replace the diaphragm with a new one, and fill the DO sensor with new internal solution. 3. Replace the DO sensor.
	Temperature sensor ● The temperature sensor has failed.	Temperature sensor ● Contact your nearest sales outlet.
Out of measurement range Last zero-point calibration invalid	[See above.]	[See above.]
Last span calibration invalid	The calibration value of an individual parameter is not stable. 1. The sensor is dirty. 2. The sensor has not adjusted to the standard solution. 3. The temperature was unstable during calibration.	1. Clean the sensors. 2. Fill the transparent calibration cup with pH 4 standard solution, and wait for at least 20 minutes of conditioning before starting calibration. 3. Start calibration after the temperature has stabilized.
Out of measurement range Last zero-point calibration invalid	[See above.]	[See above.]
Calibration value is factory default value.	Internal IC failure	Turn the power OFF, then restart the system. If the error persists, initialize the system from the "System" menu. If the error still persists, contact your nearest sales outlet to have the sensor probe repaired.

Error	Cause	Solution
Sample is unstable.	1. The concentration of the sample is unstable. 2. External light disturbance has affected the sensor. 3. Water has entered the turbidity sensor's connector.	1. Use a stirrer to agitate the sample during measurement. 2. Perform measurement away from direct sunlight. 3. Turn the power OFF, wipe off any water droplets on the probe, then remove the turbidity sensor. Check there are no water droplets around the turbidity sensor connector, then mount the sensor again. If the error persists, replace the turbidity sensor.

4.6.2 Error displays in sensor information

Error display	Cause	Solution
Measurement sequence error	Measurement sequence error	Turn the power OFF, then restart the system. If the error persists, have the probe repaired.
Out of measurement range	The measurement value is outside the measurement range.	Samples for measurement must be within the measurement range.
Last calibration invalid	The last calibration failed.	Redo calibration.
Calibration invalid	The calibration value is the factory default value.	Redo calibration.
Background unstable	The U-53 turbidity sensor is exposed to direct light.	Mount the guard cap and sensor guard and perform measurement away from direct sunlight.
	The turbidity value changed rapidly during measurement.	Measure a sample that has stable turbidity.

5 Specifications

Specification		Basic value	Model				
			U-51	U-52	U-52G	U-53	U-53G
Sensor probe	Measurement temperature range	−10°C to 55°C	✓	✓	✓	✓	✓
	Maximum sensor outer diameter	Approx. 96 mm					
	Sensor length	Approx. 340 mm					
	Cable length	2 m (standard) 10 m/30 m (options)					
	Mass	Approx. 1800 g					
	Auto calibration function	Uses pH 4 standard solution.					
	Measurement depth	30 m max.	✓	✓	✓	✓	✓
	Wet-part materials*3	PPS, glass, SUS316L, SUS304, FKM, PEEK, Q, titanium, FEP membrane, POM					
	Waterproofing standard	IP-68					
Control unit	Outer dimensions (W × D × H)	115 × 66 × 283 mm	✓	✓	—	✓	—
		115 × 66 × 335 mm	—	—	✓	—	✓
	Mass	Approx. 800 g	✓	✓	✓	✓	✓
	LCD	320 × 240 mm graphic LCD (monochrome) with backlight	✓	✓	✓	✓	✓
	Memory data items	10000	✓	✓	✓	✓	✓
	Communication interface	USB peripheral	✓	✓	✓	✓	✓
	Batteries	C-size dry cells (×4)	✓	✓	✓	✓	✓
	Waterproofing standard	IP-67	✓	✓	✓	✓	✓
	GPS unit	● Reception method (12 channel parallel) ● Measurement precision [With PDOP (high precision): 30 m or less (2 drms)]	—	—	✓	—	✓
	Estimated battery life*1	—	70 hours (no backlight)			500 measurements (no backlight)	
	Storage temperature range	−10°C to 60°C	✓	✓	✓	✓	✓
	Ambient temperature range	−5°C to 45°C					

Specification		Basic value	Model				
			U-51	U-52	U-52G	U-53	U-53G
pH measurement Two calibration	Measurement method	Glass electrode method	✓	✓	✓	✓	✓
	Range	pH 0 to 14					
	Resolution	0.01 pH					
	Precision*2	±0.1 pH					
Dissolved oxygen measurement ● Salinity conversion (0 to 70 PPT, automatic) ● Automatic temperature compensation	Measurement method	Polarographic method	✓	✓	✓	✓	✓
	Film thickness	25 μm					
	Range	0 mg/L to 50.0 mg/L					
	Resolution	0.01 mg/L					
	Precision*2	0 mg/L to 20 mg/L: ±0.2 mg/L 20 mg/L to 50 mg/L: ±0.5 mg/L					
Electrical conductivity measurement ● Auto range ● Automatic temperature conversion (25°C)	Measurement method	Four-AC-electrode method	✓	✓	✓	✓	✓
	Range	0 S/m to 10 S/m (0 mS/cm to 100 mS/cm)					
	Resolution	0.000 mS/cm to 0.999 mS/cm: 0.001 1.00 mS/cm to 9.99 mS/cm: 0.01 10.0 mS/cm to 99.9 mS/cm: 0.1 0.0 mS/m to 99.9 mS/m: 0.1 0.100 S/m to 0.999 S/m: 0.001 1.00 S/m to 9.99 S/m: 0.01					
	Precision*2	1% of full-scale (midpoint of two calibration points)					
Salinity measurement	Measurement method	Electrical conductivity conversion	✓	✓	✓	✓	✓
	Range	0 PPT to 70 PPT (parts per thousand)					
	Resolution	0.1 PPT					
	Precision	±3 PPT					
TDS (total dissolved solid) measurement ● Conversion coefficient setting	Measurement method	Electrical conductivity conversion	✓	✓	✓	✓	✓
	Range	0 g/L to 100 g/L					
	Resolution	0.1% of full-scale					
	Repeatability	±2 g/L					
	Precision	±5 g/L					
Seawater specific gravity measurement ● σt, σ0, σ15 display	Measurement method	Electrical conductivity conversion	✓	✓	✓	✓	✓
	Range	0 σt to 50 σt					
	Resolution	0.1 σt					
	Precision	±5 σt					

Specification		Basic value	Model				
			U-51	U-52	U-52G	U-53	U-53G
Temperature measurement	Measurement method	Platinum temperature sensor	✓	✓	✓	✓	✓
	Range	−10°C to 55°C					
	Resolution	0.01°C					
	Sensor	Platinum temperature sensor, JIS Class B (0.3 + 0.005 |t|)					
Turbidity measurement	Measurement method		–	LED forward 30° transmission/ scattering method		Tungsten lamp 90° transmission scattering method	
	Range			0 NTU to 800 NTU		0 NTU to 1000 NTU	
	Resolution			0.1 NTU		0.01 NTU	
	Precision*2			±5%of readout or ±1 NTU, whichever is larger		● ±0.5NTU (for 0 NTU to 10 NTU measurement range) ● 3% of readout or 1 NTU, whichever is larger (for 10 NTU to 1000 NTU measurement range)	
	Turbidity sensor wiper			–		✓	
Water depth measurement	Measurement method	Pressure method	–	–	✓	✓	✓
	Range	0 m to 30 m					
	Resolution	0.05 m					
	Precision*2	±0.3 m					
ORP (oxidation reduction potential) measurement	Measurement method	Platinum electrode method	✓	✓	✓	✓	✓
	Range	−2000 ～ +2000 mV					
	Resolution	1 mV					
	Precision*2	±15 mV					

*1: Battery life is estimated under following conditions.
- Continuous operation
- Using batteries: C-size alkaline dry cells
- Ambient temperature of the control unit: 20°C or more
- Backlight off

*2: The precision is defined by measuring the standard solution in the following cases.
- Turbidity and conductivity: after four point calibration
- pH and DO: after two point calibration
- Water depth and ORP: after one point calibration

*3: Metallic parts are made of stainless steel. Immersing in seawater may erode metallic parts.

6 Reference

6.1 Consumable parts

● Sensor

Name	Model	No.	Description
pH sensor	#7112	3014057312	Standard type pH sensor
pH sensor ToupH	#7113	3200170923	Tough glass type pH sensor
ORP sensor	#7313	3200170920	
DO sensor	#7543	3200170924	
Reference electrode	#7210	3200043582	
R bush unit	—	3200043587	Reference electrode liquid junction
TURB cell U-52	#7800	3200172803	For U-52/U-52G
TURB cell U-53	#7801	3200172800	For U-53/U-53G
Membrane cap	—	3200170194	For DO sensor

● Standard solution and inner solution

Name	Model	No.	Description
pH 4 (For automatic calibration) 500 mL	#100-4	3200043638	Standard solution for auto calibration. Also used for manual pH span calibration.
pH 4 (For automatic calibration) 4 L	#140-4	3200174430	
pH 7 500 mL	#100-7	3200043637	Standard solution for pH zero-point calibration.
pH 9 500 mL	#100-9	3200043636	Standard solution for pH manual span calibration.
Powder for ORP standard solution 10 packs	#160-51	3200043618	For ORP calibration.
Powder for ORP standard solution 10 packs	#160-22	3200043617	
Inner solution for DO sensor, 50 mL	#306	3200170938	Internal solution for DO sensor.
Internal solution for pH, 250 mL	#330	3200043641	Supplementary internal solution for pH reference electrode.

● Others

Name	Model	No.	Description
Silicone grease	—	3014017718	Silicone grease for coating sensor O-ring.
Sponge brush unit	—	3200169531	Brush for cleaning sensor probe.
O-ring set for reference electrode	—	3200169376	O-rings for reference electrode.
O-ring set for DO sensor	—	3200169426	O-rings for DO sensor.
Rubber cap set for sensor guard	—	3200169428	Rubber caps used between sensor guard and sensor probe.
O-ring set for pH and ORP sensor	—	3200169520	O-rings for pH and ORP sensors.
Wiper unit	—	3200169789	Rubber wiper for U-53/U-53G turbidity sensors.
Protective cap (blk) for pH sensor	—	3200175019	Cap attached to tip of pH sensor for sensor probe storage.
Rubber cap (whit) for DO sensor	—	3200175020	Cap attached to tip of DO sensor for sensor probe storage.

6.2 Options sold separately

Name	Model	No.	Description
Bag	U-5030	3200174772	Storage bag for sensor probes and flow cell. Can be carried in one hand.
Flow cell assy	—	3200156570	Used when collecting measurement samples by pump.
Probe guard	—	3200167002	Used for taking measurements in locations where there is a current or where there is a thick layer of sludge.
Communication cable	—	3200174823	A PC connection cable. Comes with data collection software.

6.3 pH measurement

6.3.1 Principle of pH measurement

U-50 series use the glass electrode method for pH measurements. The glass electrode method measures a potential difference between the glass film for pH and the reference electrode. For more information, refer to “JIS Z 8802 pH measurement method”.

6.3.2 Temperature compensation

The electromotive force generated by the glass electrode changes depending on the temperature of the solution.

Temperature compensation is used to compensate for the change in electromotive force caused by temperature.

This function does not compensate the change in pH caused by the temperature of the solution. When pH is to be measured, the temperature of the solution must be recorded along with that pH value, even if a pH meter has automatic temperature compensation function. If the solution temperature is not recorded, the results of the pH measurement may be meaningless.

6.3.3 Standard solutions

When measuring pH, the pH meter must be calibrated using standard solution. There are five kinds of standard solutions specified in “JIS Z 8802 pH measurement”. For normal measurement, two of standard solutions with pH of 4, 7, and 9 are sufficient to accurately calibrate the meter.

For standard solutions, refer to “JIS Z 8802 pH measurement”.

pH 4 standard solution: (Phthalate)	0.05 mol/L potassium hydrogen phthalate aqueous solution
pH 7 standard solutio: (Neutral phosphate)	0.025 mol/L potassium dihydrogenphosphate, 0.025 mol/L disodium hydrogenphosphate aqueous solution
pH 9 standard solution: (Borate)	0.01 mol/L sodium tetraborate aqueous solution

Table 2 pH values of pH standard solutions at various temperatures settings

Temp. (℃)	pH 4 standard solution Phthalate	pH 7 standard solution Neutral phosphate	pH 9 standard solution Borate
0	4.01	6.98	9.46
5	4.01	6.95	9.39
10	4.00	6.92	9.33
15	4.00	6.90	9.27
20	4.00	6.88	9.22
25	4.01	6.86	9.18
30	4.01	6.85	9.14
35	4.02	6.84	9.10
40	4.03	6.84	9.07
45	4.04	6.84	9.04

6.4 DO measurement

6.4.1 Principle of DO measurement

Dissolved oxygen (DO) refers to the amount of oxygen that is contained in water.
The concentration of dissolved oxygen is generally given as mg/L or as a percentage value (the dissolved oxygen saturation ratio).
Dissolved oxygen is essential for maintaining the self-purifying ability of rivers and seas and also for fish to live. The concentration of dissolved oxygen acts as an indicator of water quality. It is often measured when processing waste water and managing water quality. Fig. 1 provides an overview of the principles behind dissolved oxygen sensor measurement.

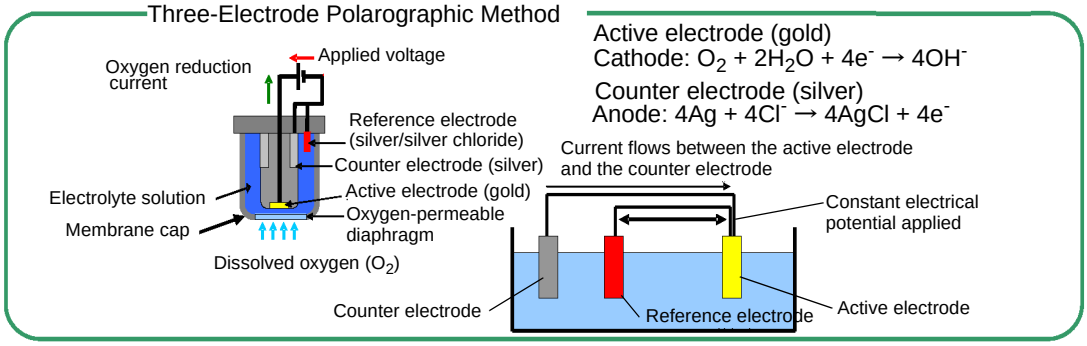


Fig. 1 Overview of principles behind dissolved oxygen sensor

The polarographic oxygen sensor is an enclosed sensor wherein voltage is applied to a cathode made of a precious metal (such as gold or platinum) and an anode also made of a precious metal (such as silver) via an external circuit, and a cap with an oxygen permeable diaphragm (membrane) is filled with electrolyte solution. As indicated in Fig. 1, the concentration of dissolved oxygen can be measured by measuring the current proportional to the amount of reduced oxygen when oxygen that has dispersed through the oxygen permeable diaphragm produces a reductive reaction on the surface of the active electrode (gold). The method of measuring dissolved oxygen based on the above principle is called the Membrane Electrode Method. Compared to the Chemical Analysis Method, which requires complicated pre-processing to alleviate the effect of reduced materials and oxidizing materials, this method allows dissolved oxygen to be measured very easily. It is also easy to remove undesired buildup from the silver electrode by polishing and cleaning if an insulator forms on it due to oxidation, making the method reusable.

6.4.2 Salinity calibration

When the solution and air come into contact and form an equilibrium (i.e. saturation), the relationship between the concentration of dissolved oxygen in the solution, C, [mol/L], and the partial pressure of oxygen in the air, Ps, [MPa/(mg/L)], can be represented by the following formula:

$$C = Ps/H$$

Where H [MPa/(mg/L)] is the Henry constant, a value that changes according to the composition of the solution. As H typically becomes larger as the salinity of the water increases, C becomes smaller.

The DO sensor detects the partial pressure of oxygen (Ps) in the above formula. Accordingly, if the DO sensor is immersed in deionized water saturated with air, or in an aqueous solution containing salt, the output current does not change, resulting in an erroneous measurement. For example, when salt is added to a sample, the amount of oxygen that can be dissolved in the solution decreases, but because the partial pressure of oxygen does not change, the value displayed by the control unit stays the same regardless of salt content. This concept is indicated in graph form below. (Fig. 2)

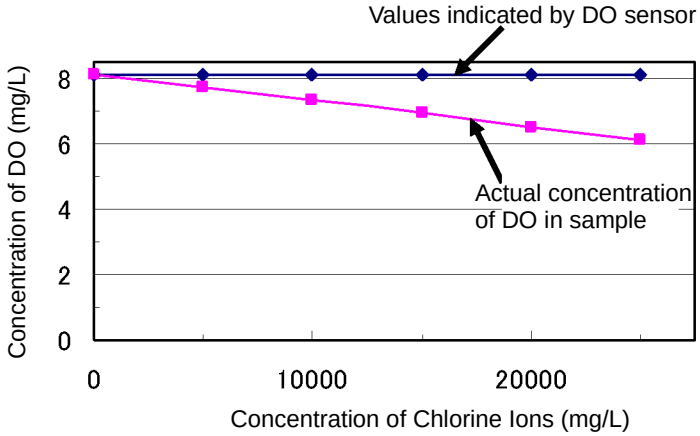


Fig. 2 Relationship between chlorine ion concentration and dissolved oxygen concentration

In samples with a high salt concentration, the solubility of oxygen is lower, but as the partial pressure of oxygen does not change, the value actually indicated on the control unit is higher than the actual value. In order to obtain a measurement of the concentration of dissolved oxygen in an aqueous solution that contains salt, it is therefore necessary to first perform salinity compensation. Conventionally, dissolved oxygen sensors have performed salinity compensation by inputting the salinity of the sample. This is fine as long as the salinity is already known. However, in most cases salinity is unknown, so even if dissolved oxygen sensors contained a salinity compensation function, it was of no practical use.

The U-50 Series can calculate and measure salinity in samples from electrical conductivity values, and can thus be used to automatically compensate for salinity.

6.5 Conductivity (COND) measurement

6.5.1 Four-AC-electrode method

Conductivity is an index of the flow of electrical current in a substance.

Salts dissolved in water are separated into cations and anions. Such solution is called electrolytic solution.

Electrolytic solution has the property of allowing the flow of current according to Ohm's law. This property is referred

to as ionic conductivity, since current flow is caused by ion movement in electrolytic solution.

Metals, on the other hand, allow the flow of current by means of electrons. This property is called electronic conductivity,

which is distinguished from ionic conductivity.

A cube with 1 m on each side, as shown in Fig. 3, is used to demonstrate an electrolytic solution. Two electrode plates are placed on opposite sides, and the cube is filled with solution. If the resistance between these two electrode plates is represented by r(Ω), the conductivity of the solution L($S \cdot m^{-1}$) is represented as L=1/r. S stands for Siemens, a unit of measurement of conductance.

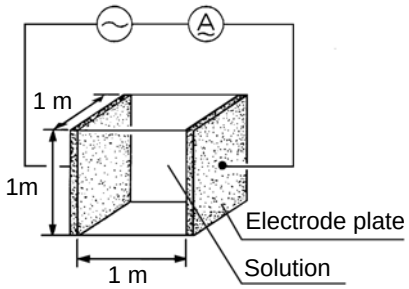


Fig. 3 Definition of conductivity

The most general method for measuring conductivity is based on the above principle, and is called the 2-electrode method.

In the 2-electrode method the influence of polarization cannot be ignored for solutions with high conductivity and conductivity cannot be measure accurately. In addition, contamination on the surface of the electrode increases apparent resistance, resulting in inaccurate measurement of conductivity.

The U-50 series has adopted the 4-electrode method to overcome these disadvantages of the the 2-electrode method.

As shown in Fig. 4, the U-50 series uses two voltage-detecting electrodes and two voltage-applying electrodes, for a total of four electrodes. The voltage-detecting electrodes are for detecting AC voltage, and the voltage-applying electrodes are for applying AC voltage.

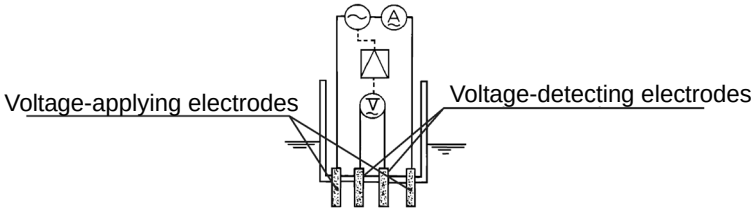


Fig. 4 Principle of the 4-electrode method

Let us assume that the current, I(A), flows in a sample of conductivity L – under automatic control of the voltage-applying electrodes – so that the voltage at the voltage-detecting-electrodes, E(V), remains constant at all times.

Then, the resistance of the sample, R(Ω), across the voltage-detecting electrodes is represented as R=E/I. The resistance, R, of the sample is inversely proportional to its conductivity, L. Accordingly, a measurement of current, Is,

of a standard solution of known conductivity, Ls, enables calculation of conductivity of a sample according to the formula L = Ls (I/Is) from the ratio L : Ls = I : Is.

Even in the 4-electrode method, polarization occurs, since AC current flows in the voltage-applying electrodes. The voltage-detecting electrodes are, however, free from the effects of polarization, since they are separated from the voltage-applying electrodes, and furthermore, current flow is negligible. Therefore, the 4-electrode method is an excellent method to enable measurement of conductivity covering a very high range.

6.5.2 SI units

New measurement units, called SI units, have been in use from 1996. Accordingly, the U-50 series also uses SI units. The following conversion table is provided for people who use the conventional kind of conductivity meter.

Note that along with the change in unit systems, the measurement values and cell counts have also changed.

	Former units	→	SI unit
Measurement value	0.1 mS/cm	→	0.01 S/m
	1 mS/cm	→	0.1 S/m
	100 mS/cm	→	10 S/m

6.5.3 Temperature coefficient

In general, the conductivity of a solution varies largely with its temperature.

The conductivity of a solution depends on the ionic conductivity, described earlier. As the temperature rises, conductivity becomes higher since the movement of the ions becomes more active.

The temperature coefficient shows the change in % of conductivity per °C, with a certain temperature taken as the reference temperature. This is expressed in units of %/°C. The temperature coefficient assumes the premise that the conductivity of a sample changes linearly according to temperature.

Strictly speaking, with actual samples, however, conductivity changes along a curve. Furthermore, the cuve varies with the type of sample. In the ranges of smaller temperature changes, however, samples are said to have the temperature coefficient of 2%/°C (at reference temperature 25°C); this holds for most samples, except in certain special cases.

(The temperature coefficients for various types of solutions are listed on the next page.)

The U-50 series uses an automatic temperature conversion function to calculate conductivity at 25°C at a temperature

coefficient of 2 %/°C based on the measured value of the temperature. Results are displayed on the readout.

The U-50 series's temperature conversion function is based on the following formula.

$L_{25} = L_t / \{ 1 + K (t - 25) \}$

L_{25} : Conductivity of solution converted to 25°C

t : Temperature of solution at time of measurement (°C)

L_t : Conductivity of solution at t (°C)

K : Temperature coefficient (%/°C)

● Conductivity and temperature coefficient for various solutions

Conductivity and related temperature coefficients of representative substances (at 25°C) are shown in the table below.

Substance	Temp. (ºC)	Conc. (wt%)	Cond. (S/m)	Temp.coef. (%/°C)	Substance	Temp. (ºC)	Conc. (wt%)	Cond. (S/m)	Temp.coef. (%/°C)
NaOH	15	5	19.69	2.01	NaCl	18	5	6.72	2.17
		10	31.24	2.17			10	12.11	2.14
		15	34.63	2.49			15	16.42	2.12
		20	32.70	2.99			20	19.57	2.16
		30	20.22	4.50			25	21.35	2.27
		40	11.64	6.48	Na_2SO_4	18	5	4.09	2.36
KOH	15	25.2	54.03	2.09			10	6.87	2.49
		29.4	54.34	2.21			15	8.86	2.56
		33.6	52.21	2.36	Na_2CO_3	18	5	4.56	2.52
		42	42.12	2.83			10	7.05	2.71
NH_3	15	0.1	0.0251	2.46			15	8.36	2.94
		1.6	0.0867	2.38	KCl	18	5	6.90	2.01
		4.01	0.1095	2.50			10	13.59	1.88
		8.03	0.1038	2.62			15	20.20	1.79
		16.15	0.0632	3.01			20	26.77	1.68
HF	18	1.5	1.98	7.20			21	28.10	1.66
		4.8	5.93	6.66	KBr	15	5	4.65	2.06
		24.5	28.32	5.83			10	9.28	1.94
HCl	18	5	39.48	1.58			20	19.07	1.77
		10	63.02	1.56	KCN	15	3.25	5.07	2.07
		20	76.15	1.54			6.5	10.26	1.93
		30	66.20	1.52			—	—	—
H_2S0_4	18	5	20.85	1.21	NH_4Cl	18	5	9.18	1.98
		10	39.15	1.28			10	17.76	1.86
		20	65.27	1.45			15	25.86	1.71
		40	68.00	1.78			20	33.65	1.61
		50	54.05	1.93			25	40.25	1.54
		60	37.26	2.13	NH_4NO_3	15	5	5.90	2.03
		80	11.05	3.49			10	11.17	1.94
		100.14	1.87	0.30			30	28.41	1.68
		—	—	—			50	36.22	1.56
HNO_3	18	6.2	31.23	1.47	$CuSO_4$	18	2.5	10.90	2.13
		12.4	54.18	1.42			5	18.90	2.16
		31	78.19	1.39			10	32.00	2.18
		49.6	63.41	1.57			15	42.10	2.31
		62	49.64	1.57	CH_3COOH	18	10	15.26	1.69
H_3PO_4	15	10	5.66	1.04			15	16.19	1.74
		20	11.29	1.14			20	16.05	1.79
		40	20.70	1.50			30	14.01	1.86
		45	20.87	1.61			40	10.81	1.96
		50	20.73	1.74			60	4.56	2.06

6.6 Salinity (SAL) conversion

The U-50 series is designed to calculate salinity as well as the other parameters.
Note that the “salinity” here is the salinity of sea water. There is a constant relation between conductivity and salinity at certain temperatures.
Therefore, if data on the conductivity and temperature are available, the corresponding salinity can be known. In other words, the salinity measurement of the U-50 series is based on the principle of calculating the salt content, making use of the measured values of conductivity and temperature.
Note therefore, that measured results of all substances whose conductivity is detected are displayed as salinity. For example, the measured result is displayed as NaCl concentration, even if in fact the sample component is, hydrochloric acid (HCl).

6.7 TDS conversion

TDS is short for Total Dissolved Solids and means the total dissolved solid amount.
The conductivity of a solution is affected by the amount of salinity, minerals, and dissolved gases. That is, conductivity is an index that shows the total amount of all substances in the solution. Of these substances, TDS indicates only the amount of dissolved solids.
TDS can be used for a comparison of the state of substances composed of a single component such as NaCl. However, the use of TDS for the comparison of solutions of different types causes serious errors.
Conductivity and TDS are expressed by the following formulas.
Conductivity in SI units (S/m) ..... TDS(g/L) = L (S/m) $\times$ K $\times$ 10
TDS(g/L) = L (mS/m) $\times$ K $\div$ 100
Conductivity in the old units (mS/cm) ..... TDS(g/L) = L (mS/cm)$\times$ K
K = TDS coefficient
Initial settings use the values listed in the table (Page 80) that generally uses TDS coefficients.
For accurate TDS comparisons, find the TDS coefficient from measured conductivity values. Then set the value thus obtained and make measurements.

6.8 σt conversion

- **Specific gravity of seawater**

The density and specific gravity of seawater are equal numerically and generally are not distinguished strictly. Since seawater density ρ is between 1.000 and 1.031, 1 is subtracted from ρ and σ is obtained by multiplying the value by 1000.
The resultant value is used as the specific gravity of seawater.
$\sigma = (\rho - 1) \times 1000$
The density of seawater ρ is expressed by function of temperature, hydraulic pressure, and salinity. The density of seawater under the atmospheric pressure is expressed as σ_t. The density of seawater under the atmospheric pressure is determined by temperature and salinity.
The U-50 Series models make salinity measurement through temperature measurements and conductivity conversion and find σ_t through calculations.
In Japan σ_{15} at 15°C is called a standard specific gravity and widely used while in foreign countries σ_0 at 0°C is employed. σ_{15} and σ_0 are determined by the function of salinity.
In ocean surveys, in particular, these values σ_t, σ_{15}, and σ_0 are more widely used than conductivity and salinity and, in the U-50 Series models, newly added as measurement components.

6.9 Turbidity (TURB) measurement

6.9.1 Principle of turbidity measurement

U-52 and U-53 sensors measure turbidity using the Transmitting and Scattering Method shown in Fig. 5. U-52 sensors use a pulse light LED (infra-red emitting diode) as a light source, and detect scattered light from a 30° angle off center. U-53 sensors use a tungsten lamp as a light source and detect scattered light from a 90° angle. Both models display turbidity as a ratio of scattered light to transmitted light to reduce the affect of the color of the sample. The U-53 method conforms to EPA Method 180.1, and employs wipers to reduce the affect of air bubbles.

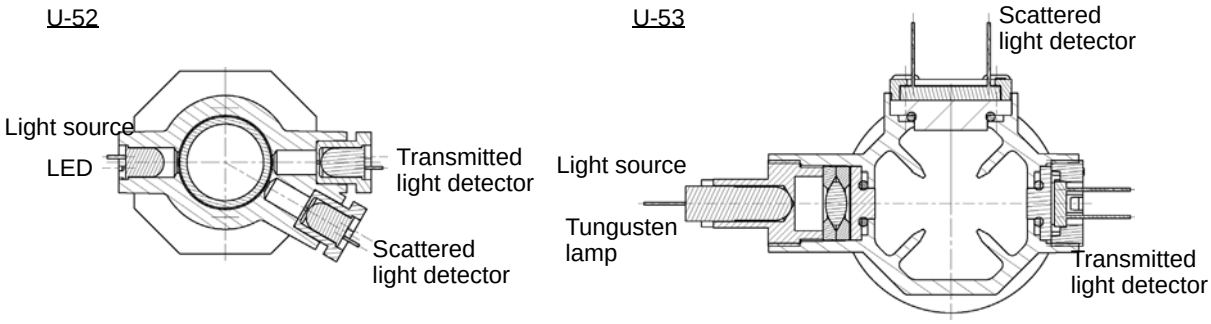


Fig. 5 Turbidity cell

6.9.2 Standard solution

U-50 series can perform calibration using formazin (NTU) or kaolin standard solutions as a turbidity standard solution. However, units for the solution used for calibration should be displayed in measurements. Do not use more than 400 mg/L of kaolin standard solution because it increases precipitation speed, resulting in measurement error.

6.10 Depth (DEPTH) measurement

6.10.1 Principle of depth measurement

For the W-22XD and W-23XD models, depth measurement can be made through use of a pressure gauge. The principle of the depth measurement uses the relation between depth and pressure.

Although the measurement with the depth sensor is affected by atmospheric pressure, the depth sensor, however, makes zero-point adjustments through the automatic calibration before measurements.

6.10.2 Influence of temperature and calibration

The depth sensor depends greatly on temperature. For a wide difference between the temperature at which the sensor has been automatically calibrated and the temperature of the measurement sample, the sensor can make depth measurements with a higher accuracy by the following method:

1. **Immerse the depth sensor of the sensor probe in the sample.**
2. **Keep the sensor immersed in the sample for about 30 minutes until the temperatures of the sensor and the sample are the same.**
3. **Then make the zero calibration of the sensor manually.**

6.11 Oxidation reduction potential (ORP) measurement

6.11.1 Principle of ORP measurement

ORP is an abbreviation for oxidation-reduction potential. ORP is the energy level (potential) determined according to the state of equilibrium between the oxidants (M^{Z+}) and reductants $M^{(Z-N)+}$ that coexist within a solution.

$$M^{Z+} + ne^- \Leftrightarrow M^{(Z-N)+} \quad \cdots (1)$$

If only the solution, forming the ORP measuring system shown in Fig. 6. The difference of potential between two electrodes is generally expressed by the following equation.

$$E = E_0 - \frac{RT}{nF} \ln \frac{a_M{}^{(z-n)+}}{a_M{}^{z+}} \quad \cdots (2)$$

E: Electric potential E_0 : Constant R: Gas constant T : Absolute temperature
n: Electron count F : Faraday constant a : Activity

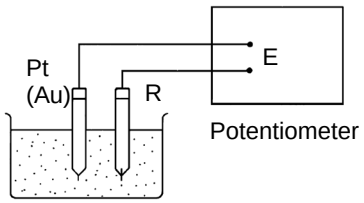


Fig. 6 Measuring mV

For example, for a solution in which trivalent iron ions coexist with bivalent iron ions, equations 1 and 2 would be as follows.

$$Fe^{3+} + e^- \Leftrightarrow Fe^{2+} \quad \cdots (1)$$

$$E = E_0 - \frac{RT}{F} \ln \frac{a_{Fe}{}^{2+}}{a_{Fe}{}^{3+}} \quad \cdots (2)$$

When only one type of state of equilibrium uniquely by equation (Fe^{3+}) and the reductant (Fe^{2+}) (using the equation $a_{Fe}{}^{2+}/ a_{Fe}{}^{3+}$). Actually, however many kinds of states of equilibrium exist simultaneously between various kinds of ions, in most solutions. This means that under actual circumstances, ORP cannot be expressed using the simple equation shown above and that the physical and chemical significance with respect to the solution is not very clear.
In this respect, the value of ORP must be understood to be only one indicator of the property of a solution. The measurement of ORP is widely used, however, as an important index in the analysis of solutions (potentiometric titration) and in the waste water treatment.

6.11.2 Standard electrode (reference electrode) types and ORP

The ORP is obtained comparing with corresponding reference electrode employed.
If different kinds of reference electrodes are used for measurement, the ORP value of the same solution may appear to be different. HORIBA's reference electrode uses Ag/AgCl with 3.33 mol/L KCl as inner solution. According to general technical literature, normal hydrogen electrodes (N.H.E.) are often used as the standard electrode.
The relationship between N.H.E. and the ORP that is measured using an Ag/AgCl with 3.33 mol/L KCl electrode is expressed by the following equation.
$E_{N.H.E.} = E + 206 - 0.7(t - 25)$ mV t = 0 - 60°C
$E_{N.H.E.}$: Measured ORP value using N.H.E. as the reference electrode

E: Measured ORP value using Ag/AgCl with 3.33 mol/L KCl as the reference electrode Potential sign

Standard ORP is expressed in the following way, in literature related to electrochemistry and analytical chemistry.

A $Li^{+} + e^{-} \rightarrow Li$

$E_0 = -3.024$ V VS N.H.E.

However, in some literature, the "+" and "-" signs are reversed.

B $Li \rightarrow Li^{+} + e^{-}$

$E_0 = +3.024$ V VS N.H.E.

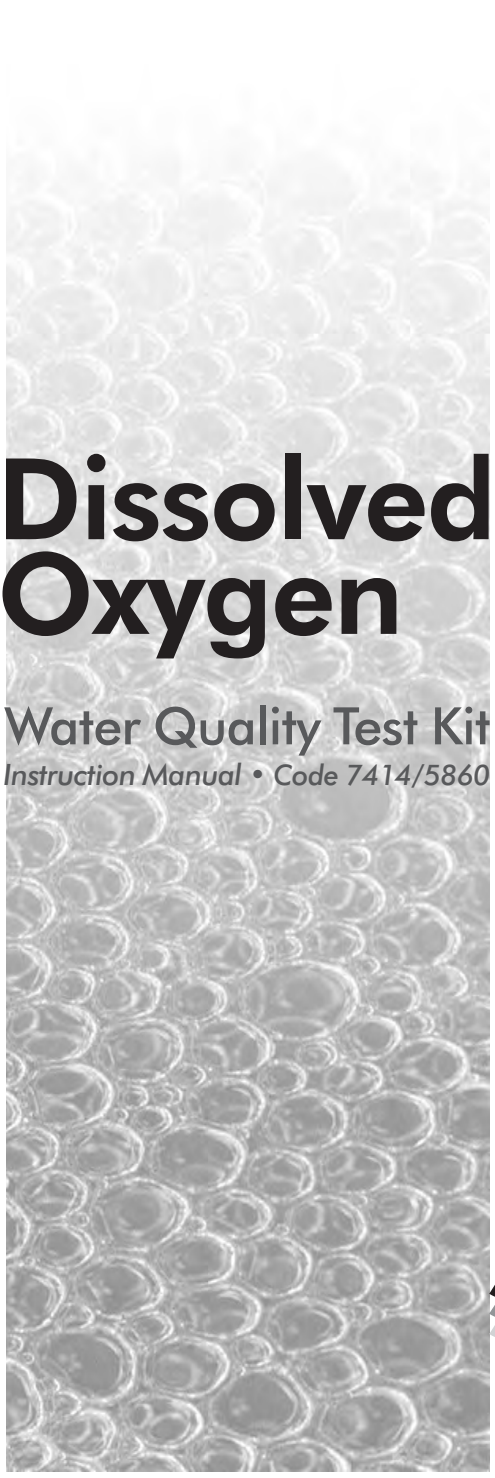
In expressions like B, above, the reaction is just reversed and there is no essential difference. But this kind of expression does invite confusion. The majority of the world, today, is consistent in its use of the signs as they are used in A, above.

For this reason, HORIBA, too, uses signs concerning ORP that are consistent with A, above.

Dissolved Oxygen

Water Quality Test Kit

Instruction Manual • Code 7414/5860



LaMotte

INTRODUCTION

Aquatic animals need dissolved oxygen to live. Fish, invertebrates, plants, and aerobic bacteria all require oxygen for respiration. Oxygen dissolves readily into water from the atmosphere until the water is saturated. Once dissolved in the water, the oxygen diffuses very slowly and distribution depends on the movement of the aerated water. Oxygen is also produced by aquatic plants, algae, and phytoplankton as a by-product of photosynthesis.

The amount of oxygen required varies according to species and stage of life. Dissolved Oxygen levels below 3 ppm are stressful to most aquatic organisms. Dissolved Oxygen levels below 2 or 1 ppm will not support fish. Levels of 5 to 6 ppm are usually required for growth and activity.

This test kit uses the azide modification of the Winkler method for determining dissolved oxygen.

TABLE OF CONTENTS

Page

Kit Contents **2**

Test Procedure

Part 1: Collecting a Water Sample 3

Part 2: Adding the Reagents 4

Part 3: Titration 5

EPA Compliance **8**

Dissolved Oxygen Fact Sheet **10**

General Safety Precautions **13**

Use Proper Analytical Techniques **14**

Material Safety Data Sheets **15**

Kit Diagrams **21**

Short Form Instructions ..... **Back Cover**

WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision

KIT CONTENTS

QUANTITY	CONTENTS	CODE
30 mL	*Manganous Sulfate Solution	*4167-G
30 mL	*Alkaline Potassium Iodide Azide	*7166-G
50 g	*Sulfamic Acid Powder (7414 Kit)	*6286-H
30 mL	*Sulfuric Acid, 1:1 (5860 Kit)	*6141WT-G
60 mL	*Sodium Thiosulfate, 0.025N	*4169-H
30 mL	Starch Indicator Solution	4170WT-G
1	Spoon, 1.0 g, plastic (7414 Kit)	0697
1	Direct Reading Titrator	0377
1	Test Tube, 5-10-12.9-15-20-25 mL, glass, w/cap	0608
1	Water Sampling Bottle, 60 mL, glass	0688-DO

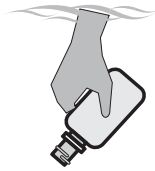
***WARNING:** Reagents marked with a * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents see MSDS CD or www.lamotte.com. To obtain a printed copy, contact LaMotte by email, phone or fax.

To order individual reagents or test kit components, use the specified code numbers.

TEST PROCEDURE

PART 1 - COLLECTING THE WATER SAMPLE

1.



Rinse the Water Sampling Bottle (0688-DO) with the sample water.

2.



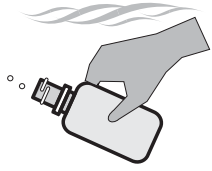
Tightly cap the bottle, and submerge it to the desired depth.

3.



Remove the cap and allow the bottle to fill.

4.



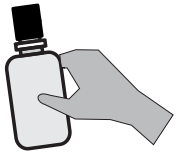
Tap the sides of the bottle to dislodge any air bubbles.

5.



Replace the cap while the bottle is still submerged.

6.



Retrieve the bottle and make sure that no air bubbles are trapped inside.

TEST PROCEDURE

PART 2 - ADDING THE REAGENTS

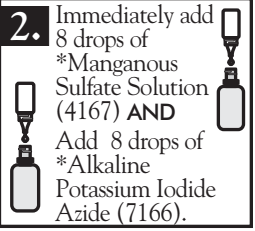
NOTE:

Be careful not to introduce air into the sample while adding the reagents.

1. Remove the cap from the bottle.



2. Immediately add 8 drops of *Manganous Sulfate Solution (4167) **AND** Add 8 drops of *Alkaline Potassium Iodide Azide (7166).



3.



Cap the bottle and mix by inverting several times. A precipitate will form.

4.



Allow the precipitate to settle below the shoulder of the bottle.

5.

For Kit Code 7414:
Immediately use the 1.0 g spoon (0697) to add one level measure of *Sulfamic Acid Powder (6286).

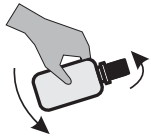


OR

For Kit Code 5860:
Add 8 drops of *Sulfuric Acid, 1:1 (6141WT).



6. Cap and gently invert the bottle to mix the contents until the precipitate and the reagent have totally dissolved. The solution will be clear yellow to orange if the sample contains dissolved oxygen.



NOTE: At this point the sample has been "fixed" and contact between the sample and the atmosphere will not affect the test result. Samples may be held at this point and titrated later.

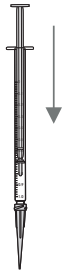
TEST PROCEDURE

PART 3 - THE TITRATION

1. Fill the titration tube (0608) to the 20 mL line with the fixed sample. Cap the tube.



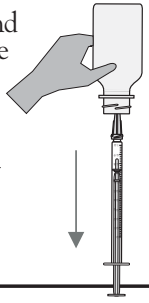
2. Depress plunger of the Titrator (0377).



3. Insert the Titrator into the plug in the top of the *Sodium Thiosulfate, 0.025N (4169) titrating solution.



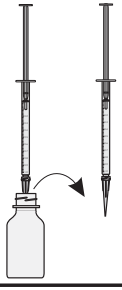
4. Invert the bottle and slowly withdraw the plunger until the large ring on the plunger is opposite the zero (0) line on the scale.



NOTE:

If small air bubbles appear in the Titrator barrel, expel them by partially filling the barrel and pumping the titration solution back into the reagent container. Repeat until bubble disappears.

5. Turn the bottle upright and remove the Titrator.



NOTE:

If the sample is a very pale yellow, go to Step 9.

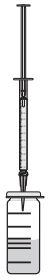


continued . . .

TEST PROCEDURE

6.

Insert the tip of the Titrator into the opening of the titration tube cap.



7.



Slowly depress the plunger to dispense the titrating solution until the yellow-brown color changes to a very pale yellow. Gently swirl the tube during the tiration to mix the contents.

8.

Carefully remove the Titrator and cap. Do not to disturb the Titrator plunger.



9.

Add 8 drops of Starch Indicator Solution (4170WT). The sample should turn blue.

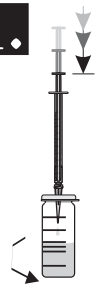


10.

Cap the titration tube. Insert the tip of the Titrator into the opening of the titration tube cap.



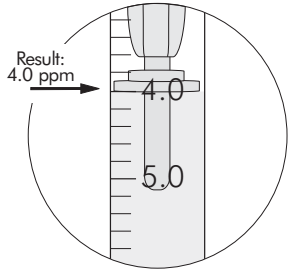
11.



Continue titrating until the blue color disappears and the solution becomes colorless.

12.

Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Record as ppm Dissolved Oxygen. Each minor division on the Titrator scale equals 0.2 ppm.



TEST PROCEDURE

NOTE:

If the plunger ring reaches the bottom line on the scale (10 ppm) before the endpoint color change occurs, refill the Titrator and continue the titration. Include the value of the original amount of reagent dispensed (10 ppm) when recording the test result.

NOTE:

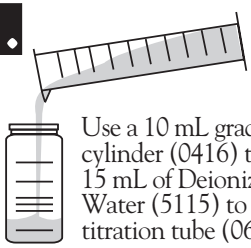
When testing is complete, discard titrating solution in Titrator. Rinse Titrator and titration tube thoroughly. DO NOT remove plunger or adapter tip.



EPA COMPLIANCE

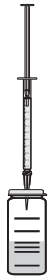
To qualify as an EPA accepted test, and to achieve the greatest accuracy, the Sodium Thiosulfate Solution, 0.025N (4169) must be standardized daily. This procedure follows Standard Methods for the Examination of Water and Wastewater. Numbers in ( ) are for LaMotte products. These products are not included in this kit but can be ordered from LaMotte Company by using the specified code number.

1.



Use a 10 mL graduated cylinder (0416) to add 15 mL of Deionized Water (5115) to the titration tube (0608).

2.



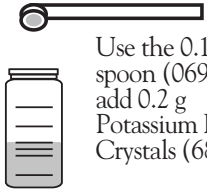
Use a Direct Reading Titrator, 0-1 Range (1.0 mL capacity) (0376) to add 2 mL of Potassium Bi-iodate (7346).

3.

Add 2 drops of Sulfuric Acid, 5N (8517WT).



4.



Use the 0.1 g spoon (0699) to add 0.2 g Potassium Iodide Crystals (6809).

5.

Swirl to dissolve. Solution will turn yellowish brown.



6.



Fill another Direct Reading Titrator (0376) with Sodium Thiosulfate Solution, 0.025N (4169).

EPA COMPLIANCE

7.

While gently swirling the tube, add Sodium Thiosulfate, 0.025N until the color fades to pale yellow. It will be necessary to refill the Direct Reading Titrator.



8.

Add 3 drops of Starch Indicator Solution (4170WT). The solution will turn blue.



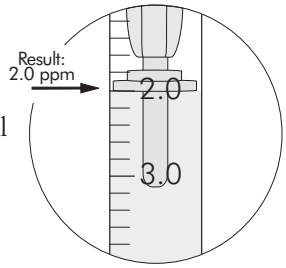
9.

Continue adding Sodium Thiosulfate, 0.025N until the blue color disappears and the solution is colorless.



10.

Read the test result directly from the scale where the large ring on the Titrator meets the Titrator barrel. Include the value of the original amount dispensed (1 mL). If the reading is 2.0 +/-0.1 mL, the Sodium Thiosulfate, 0.025N (4169) is satisfactory. If not, discard and replace with new reagent.



DISSOLVED OXYGEN FACT SHEET

Oxygen is critical to the survival of aquatic plants and animals, and a shortage of dissolved oxygen is not only a sign of pollution, it is harmful to fish. Some aquatic species are more sensitive to oxygen depletion than others, but some general guidelines to consider when analyzing test results are:

5–6 ppm	**Sufficient for most species**
<3 ppm	**Stressful to most aquatic species**
<2 ppm	**Fatal to most species**

Because of its importance to the fish's survival, aquaculturists, or "fish farmers," and aquarists use the dissolved oxygen test as a primary indicator of their system's ability to support healthy fish.

WHERE DOES THE OXYGEN COME FROM?

The oxygen found in water comes from many sources, but the largest source is oxygen absorbed from the atmosphere. Wave action and splashing allows more oxygen to be absorbed into the water. A second major source of oxygen is aquatic plants, including algae; during photosynthesis plants remove carbon dioxide from the water and replace it with oxygen.

Absorption

Oxygen is continuously moving between the water and surrounding air. The direction and speed of this movement is dependent upon the amount of contact between the air and water. A tumbling mountain stream or windswept, wave-covered lake, where more of the water's surface is exposed to the air, will absorb more oxygen from the atmosphere than a calm, smooth body of water. This is the idea behind aerators: by creating bubbles and waves the surface area is increased and more oxygen can enter the water.

Photosynthesis

In the leaves of plants, one of the most important chemical processes on Earth is constantly occurring: photosynthesis. During daylight, plants constantly take carbon dioxide from the air, and in the presence of water convert it to oxygen and carbohydrates, which are used to produce additional plant material. Since photosynthesis requires light, plants do not photosynthesize at night, so no oxygen is produced. Chemically, the photosynthesis reaction can be written as:

$$\text{Light} + n\text{CO}_2 + n\text{H}_2\text{O} \longrightarrow (\text{C}_2\text{HO})n + n\text{O}_2$$

Light + Carbon Dioxide + Water ⟶ Carbohydrate + Oxygen

WHERE DOES THE OXYGEN GO?

Once in the water, oxygen is used by the aquatic life. Fish and other aquatic animals need oxygen to breathe or respire. Oxygen is also consumed by bacteria to decay, or decompose, dead plants and animals.

Respiration

All animals, whether on land or underwater, need oxygen to respire, grow and survive. Plants and animals respire throughout the night and day, consuming oxygen and producing carbon dioxide, which is then used by plants during photosynthesis.

Decomposition

All plant and animal waste eventually decomposes, whether it is from living animals or dead plants and animals. In the decomposition process, bacteria use oxygen to oxidize, or chemically alter, the material to break it down to its component parts. Some aquatic systems may undergo extreme amounts of oxidation, leaving no oxygen for the living organisms, which eventually leave or suffocate.

OTHER FACTORS

The oxygen level of a water system is not only dependent on production and consumption. Many other factors work together to determine the potential oxygen level, including:

- **Salt vs. fresh water** - Fresh water can hold more oxygen than salt water.
- **Temperature** - Cold water can hold more oxygen than warm water.
- **Atmospheric pressure (Altitude)** - The greater the atmospheric pressure the more oxygen the water will hold.

TESTING DISSOLVED OXYGEN

Dissolved oxygen is often tested using the Azide modification of the Winkler method. When testing dissolved oxygen it is critical not to introduce additional oxygen into the sample. Many people avoid this problem by filling the sample bottle all the way and allowing the water to overflow for one minute before capping.

The first step in a DO titration is the addition of Manganous Sulfate Solution (4167) and Alkaline Potassium Iodide Azide Solution (7166). These reagents react to form a white precipitate, or floc, of manganous hydroxide, $Mn(OH)_2$. Chemically, this reaction can be written as:

$$MnSO_4 + 2KOH \longrightarrow Mn(OH)_2 + K2SO_4$$

Manganous Sulfate + Potassium Hydroxide ⟶ Manganous Hydroxide + Potassium Sulfate

Immediately upon formation of the precipitate, the oxygen in the water oxidizes an equivalent amount of the manganous hydroxide to brown-colored manganic hydroxide. For every molecule of oxygen in the water, four molecules of manganous hydroxide are converted to manganic hydroxide. Chemically, this reaction can be written as:

$$4Mn(OH)_2 + O_2 + 2H_2O \longrightarrow 4Mn(OH)_3$$

Manganous Hydroxide + Oxygen + Water ⟶ Manganic Hydroxide

After the brown precipitate is formed, a strong acid, such as Sulfamic Acid Powder (6286) or Sulfuric Acid, 1:1 (6141) is added to the sample. The acid converts the manganic hydroxide to manganic sulfate. At this point the sample is considered "fixed" and concern for additional oxygen being introduced into the sample is reduced. Chemically, this reaction can be written as:

$$2Mn(OH)_3 + 3H_2SO_4 \longrightarrow Mn_2(SO_4)_3 + 6H_2O$$

Manganic Hydroxide + Sulfuric Acid ⟶ Manganic Sulfate + Water

Simultaneously, iodine from the potassium iodide in the Alkaline Potassium Iodide Azide Solution is oxidized by manganic sulfate, releasing free iodine into the water. Since the manganic sulfate for this reaction comes from the reaction between the manganous hydroxide and oxygen, the amount of iodine released is directly proportional to the amount of oxygen present in the original sample. The release of free iodine is indicated by the sample turning a yellow-brown color. Chemically, this reaction can be written as:

$$Mn_2(SO_4)_3 + 2KI \longrightarrow 2MnSO_4 + K_2SO_4 + I_2$$

Manganic Sulfate + Potassium Iodide ⟶ Manganous Sulfate + Potassium Sulfate + Iodine

The final stage in the Winkler titration is the addition of sodium thiosulfate. The sodium thiosulfate reacts with the free iodine to produce sodium iodide. When all of the iodine has been converted the sample changes from yellow-brown to colorless. Often a starch indicator is added to enhance the final endpoint. Chemically, this reaction can be written as:

$$2Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + 2NaI$$

Sodium Thiosulfate + Iodine ⟶ Sodium Tetrathionate + Sodium Iodide

GENERAL SAFETY PRECAUTIONS

1.





Store the test kit in a cool, dry area.

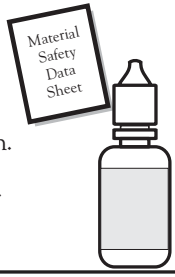
2.



Read all instructions and note precautions before performing the test procedure.

3.

Read the labels on all reagent bottles. Note warnings and first aid information. Read all Material Safety Data Sheets.



4.



Keep all equipment and reagent chemicals out of the reach of young children.

5. Avoid contact between reagent chemicals and skin, eyes, nose, and mouth.



6. Wear safety glasses when performing test procedures.



7.



In the event of an accident or suspected poisoning, immediately call the Poison Center phone number in the front of your local telephone directory or call a physician. Additional information for all LaMotte reagents is available in the United States, Canada, Puerto Rico, and the US Virgin Islands from Chem-Tel by calling 1-800-255-3924. For other areas, call 813-248-0585 collect to contact Chem-Tel's International access number. Each reagent can be identified by the four digit number listed on the upper left corner of the reagent label, in the contents list and in the test procedures.

USE PROPER ANALYTICAL TECHNIQUES

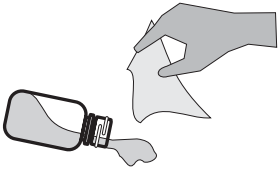
1. Use test tube caps or stoppers, not your fingers, to cover tubes during shaking or mixing.



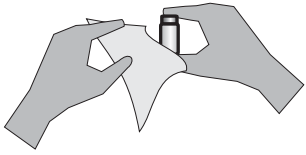
2. Hold dropper bottles vertically upside-down, and not at an angle, when dispensing a reagent. Squeeze the bottle gently to dispense the reagent one drop at a time.



3. Wipe up any reagent chemical spills immediately.



4. Thoroughly rinse test tubes before and after each test.



5. Tightly close all containers immediately after use. Do not interchange caps from containers.

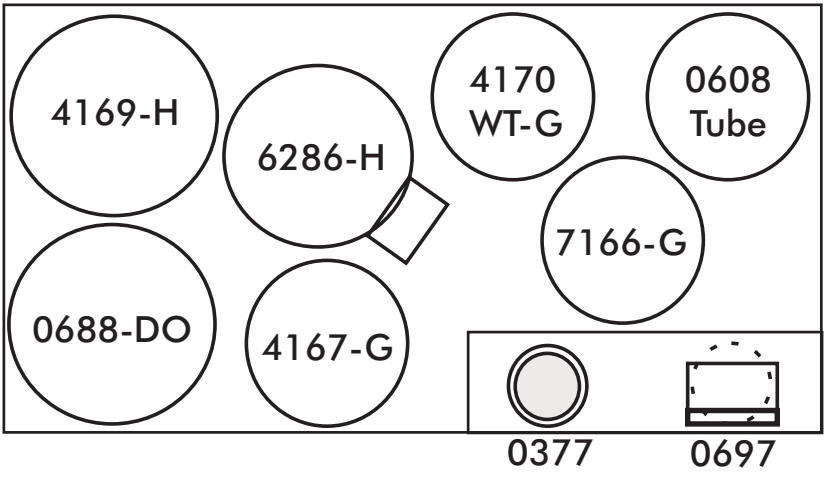


6. Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect reagents from extremes of temperature.



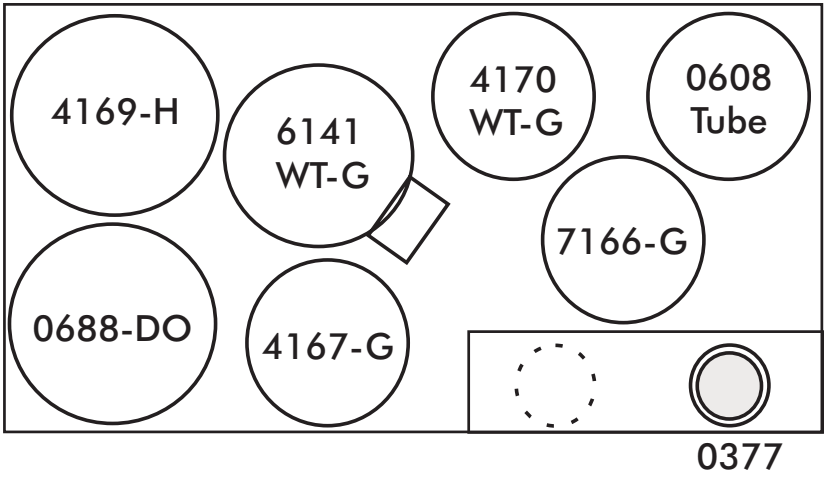
DISSOLVED OXYGEN KIT · CODE 7414

Instructions



DISSOLVED OXYGEN KIT · CODE 5860

Instructions



SHORT FORM INSTRUCTIONS

Read all instructions before performing test. Use this guide as a quick reference.

1. Fill Water Sampling Bottle (0688-DO).
2. Add 8 drops of *Manganous Sulfate Solution (4167).
3. Add 8 drops of *Alkaline Potassium Iodide Azide (7166).
4. Cap and mix.
5. Allow precipitate to settle.
6. Use the 1.0 g spoon to add *Sulfamic Acid Powder (6286) or add 8 drops of Sulfuric Acid, 1:1 (6141WT).
7. Cap and mix until reagent and precipitate dissolve.
8. Fill test tube (0608) to the 20 mL line.
9. Fill Titrator with *Sodium Thiosulfate, 0.025N (4169).
10. Titrate until sample color is pale yellow. DO NOT DISTURB TITRATOR.
11. Add 8 drops of Starch Indicator (4170WT).
12. Continue titration until blue color just disappears and solution is colorless.
13. Read result in ppm Dissolved Oxygen.

LaMOTTE COMPANY
Helping People Solve Analytical Challenges®
PO Box 329 • Chestertown • Maryland • 21620 • USA
800-344-3100 • 410-778-3100 (Outside U.S.A.) • Fax 410-778-6394
Visit us on the web at www.lamotte.com

67414-MN • 4/07

Solinst®

Interface Meter Operating Instructions

Model 122

Operating Principal

The Solinst Model 122 Interface Meter has a narrow 5/8" (16 mm) diameter probe. It is CSA approved for use in hazardous locations Class 1, Groups C & D. It has an infra-red circuit which detects the presence of a liquid. A conductivity circuit differentiates between conductive liquid (water) and non-conductive liquid (LNAPL or DNAPL product).

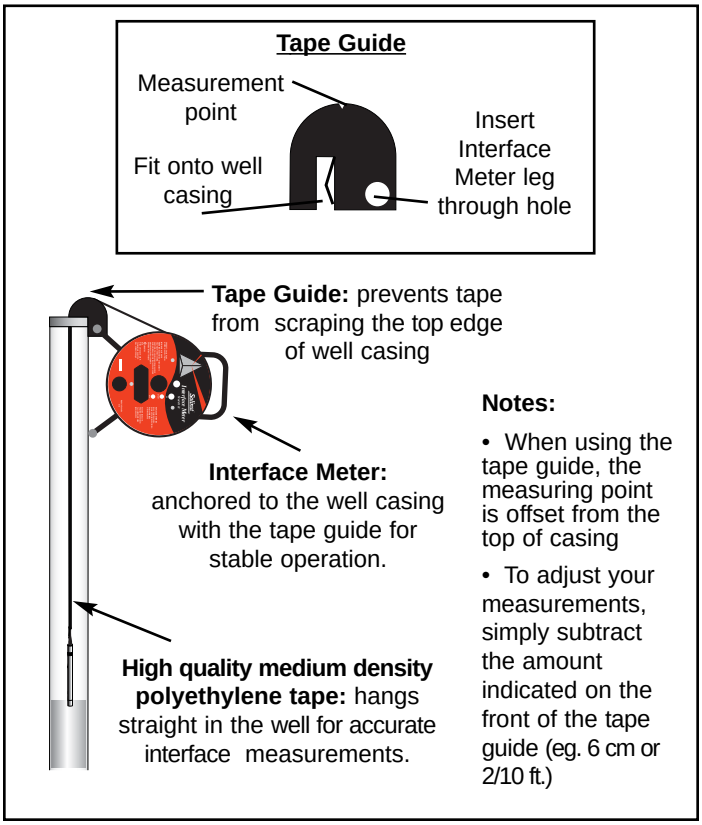
Equipment Check

Before beginning any measurements, check the electronics and battery condition by pushing the 'Start' button. A brief tone and red light indicate that the meter is functional.

A flashing green light indicates the meter is on. It will automatically turn off after 10 minutes to preserve battery life.

Using the Tape Guide

1. The tape guide has been designed to: improve accuracy when reading interface measurements; to prevent tape being cut by well casing; and to allow the tape and probe to hang straight from the side of the well.
2. If interface measurements are being taken in a 2" dia. well then simply fit the small end of the tape guide onto the edge of the well casing.
3. The small end must be inserted if the Interface Meter is to be suspended from the tape guide.
4. Insert the leg of the Interface Meter into the hole on the Tape Guide.
5. Once inserted, rest the Interface Meter on the side of the well casing.



Field Measurements

IMPORTANT

1. To meet safety requirements and to protect the electronics from damage, always ground the meter by attaching the grounding clip to the well casing or to a suitable ground rod.

2. Push the 'Start' button. A brief tone and light indicate that the meter is functional and the flashing green light indicates that the meter is on. The meter automatically turns off after 10 minutes. Press the 'Start' button as necessary during operation to turn the meter back on.
3. Place the slotted part of the tape guide onto the edge of the well casing. Lay the Interface Meter tape into the groove on the top of the tape guide. Measurements will be read at the apex of the V-notch on the tape guide.

Note: When using the tape guide, remember to subtract the compensation factor stamped onto the side of the guide from each measurement.

4. A steady tone and light indicates a non-conductive liquid (eg. product). An intermittent tone and light indicates a conductive liquid (eg. water).
5. For floating product (LNAPL), take the air/product interface measurement on the way into the liquid, and the water/product interface on the way up. When passing through product into water, some product may adhere to the probe sensors due to surface tension. Therefore, when water is detected below product, the probe should be raised and lowered rapidly in a short vertical motion to remove any product that may have been carried down with the probe.
6. The water/product interface should then be measured as the probe is raised very slowly back up. Once the interface is detected the probe can be raised and lowered in small increments to precisely determine the interface.
7. Repeat measurements to confirm water/product interface.
8. To determine the thickness of product, subtract the water/product interface from the product/air interface.
9. To determine if there is any sinking product (DNAPL) in the well, continue lowering the probe slowly. If steady signals activate, determine the top of the sinking layer by reading directly from the tape. Continue lowering the probe slowly until the tape slackens when the well bottom is reached. Read the level directly from the tape and subtract one from the other to determine thickness.
10. Upon completion of readings clean the tape and probe; as described overleaf.

Cleaning and Maintenance

After each use, the tape should be wiped clean and carefully rewound onto the reel.

The probe should be cleaned as follows:

- Wash probe thoroughly with a non-abrasive mild detergent. **DO NOT USE ANY SOLVENTS**. Use a soft cloth around the pins on the end of the probe to remove all product. **For the P2 Probe** use the brush provided through side and base holes to remove all product from inner part of the probe.

  USE LUKE-WARM, NOT HOT WATER. DAMAGE TO PROBE MAY RESULT.
- Rinse probe thoroughly with distilled water, wipe dry
- Return the probe to the holder

Other suitable cleaning method:

- Steam clean tape only

Battery Replacement

Push battery drawer in and up and then release. The battery drawer should eject slightly, allowing it to be pulled out. Replace the two 9V batteries with alkaline batteries.

Other General Tips:

1. Probe should be cleaned after each use.
2. Always use grounding cable
3. Do not drop probe: damage to probe tip may result.
4. If battery is weak, the start tone will not sound, and flashing "green" light will be off. Replace both batteries.
5. Before storage, make sure the meter is turned off.

Troubleshooting

Instruments will not turn on:

1. Replace batteries.
2. Check the polarity of the batteries are correct in the battery drawers.
3. Check 12-pin connector inside reel for loose wire/pin. Access by removing three screws on faceplate. Ensure instrument is laying on its back frame so the tape does not unwind.
4. Push button could be faulty, please contact Solinst.

Instrument turns on, but immediately shuts off, or instrument does not shut-off, except after 10 min, automatic shutdown:

1. Check batteries, replace if necessary.
2. Dirt or debris may be causing the on/off buttons to stick. Use short blast of air to try to free up buttons.
3. Check 12-pin connector inside reel for loose wire/pin. Access by removing three screws on faceplate. Ensure instrument is laying on its back frame so the tape does not unwind.
4. Push button could be faulty, please contact Solinst.

Instrument does not detect liquid:

1. Check batteries, replace if necessary.
2. Clean probe tip-follow Cleaning/Maintenance Instructions.
3. Reel or probe circuitry could be damaged, please contact Solinst.

When instrument is turned on, it immediately sounds product tone or water tone:

1. Probe optical sensor may be dirty. Clean according to Cleaning and Maintenance instructions.
2. Possible weak batteries, replace both.
3. Water has leaked into the probe. Remove three small screws and slide the probe down from the tape portion (remember polarity of the green and white wire). Dry out probe, wipe and inspect o-ring, replace if necessary and/or lubricate with silicon grease. Replace probe remembering polarity.
4. Check 12-pin connector inside reel for loose wire/pin. Access by removing three screws on faceplate. Ensure instrument is laying on its back frame so the tape does not unwind.
5. Reel or probe circuitry could be damaged, please contact Solinst.

Chirping or 'Warbling' sound being emitted:

1. Clean probe.
2. Possible water in probe (see troubleshooting under 'When instrument turned on, instrument emits product or water tone').
3. Reel or probe circuitry could be damaged, please contact Solinst.

Instrument detects "product" as "water".

1. Thoroughly dry the stainless steel shroud covering the probe tip.
2. Product may have degraded; if it has a detectable level of conductivity it will read water. This can be checked by placing the probe in pure phase product, a steady tone & light should be observed.

For further information contact: Solinst Canada Ltd.
Fax: +1 (905) 873-1992;(800) 516-9081 Tel: +1 (905) 873-2255;(800) 661-2023
35 Todd Road, Georgetown, Ontario Canada L7G 4R8
E-mail: instruments@solinst.com Web: http://www.solinst.com

Solinst®

MultiRAE
User's Guide



RAE SYSTEMS

Rev C
November 2011
P/N: M01-4003-000

Product Registration

Register your product online by visiting:

http://www.raesystems.com/support/product-registration

By registering your product, you can:

- Receive notification of product upgrades or enhancements
- Be alerted to Training classes in your area
- Take advantage of RAE Systems special offers and promotions

© 2011 RAE Systems, Inc.

Contents

1 Standard Contents 6
2 General Information 7
2.1 Key Features 8
3 User Interface 9
3.1 Display Overview 9
3.1.1 Status Indicator Icons 9
3.1.2 LCD Flip 10
3.1.3 Keys & Interface 10
3.2 Screen Display For Various Numbers Of Active Sensors 11
3.3 Menus 12
4 Battery 15
4.1 Using The Charging Cradle 15
4.2 Using The Travel Charger 15
4.3 Replacing A Battery 16
4.4 Battery States 16
4.5 Alkaline Battery Pack 16
5 Turning The MultiRAE On And Off 18
5.1 Turning The MultiRAE On 18
5.2 Turning The MultiRAE Off 18
5.3 Testing Alarm Indicators 18
5.4 Pump Status 19
5.5 Calibration Status 19
6 Modes Of Operation 20
6.1 Hygiene Operation Mode 20
6.2 Search Operation Mode 20
6.3 Basic User Mode 20
6.4 Advanced User Mode 20
7 Programming 20
7.1 Enter Programming In Advanced Mode 20
7.2 Enter Programming In Basic Mode 21
7.3 Menus And Submenus 22
7.3.1 Editing And Selecting Parameters And Sensors 22
7.3.2 Calibration 23
7.3.2.1 Fresh Air 23
7.3.2.2 Multi Sensor Span 23
7.3.2.3 Single Sensor Zero 23
7.3.2.4 Single Sensor Span 23
7.3.2.5 Cal. Reference 23
7.3.2.6 Change Cal. Gas 23
7.3.2.7 Multi Cal Select 24
7.3.2.8 Change Span Value 24
7.3.2.9 Change Span2 Value 24
7.3.3 Measurement 24
7.3.3.1 Sensor On/Off 24
7.3.3.2 Change Meas. Gas 25
7.3.3.3 Measurement Units 25
7.3.4 Alarms 26
7.3.4.1 Alarm Limits 26
7.3.4.2 Alarm Mode 26
7.3.4.3 Alarm Settings 26
7.3.4.4 Comfort Beep 26
7.3.4.5 Man Down Alarm 26
7.3.5 Datalog 27
7.3.5.1 Clear Datalog 27
7.3.5.2 Datalog Interval 27

7.3.5.3 Sensor Selection 28
7.3.5.4 Data Selection 28
7.3.5.5 Datalog Type 28
7.3.5.6 Memory Full Action 29
7.3.6 Wireless 29
7.3.7 Monitor 29
7.3.7.1 LCD Contrast 29
7.3.7.2 Operation Mode 29
7.3.7.3 Pump Speed 29
7.3.7.4 Zero At Start 29
7.3.7.5 Fast Startup 29
7.3.7.6 Temperature Units 29
7.3.7.7 Language 30
7.3.7.8 Site ID 30
7.3.7.9 User ID 30
7.3.7.10 Date Format 30
7.3.7.11 Date 30
7.3.7.12 Time Format 30
7.3.7.13 Time 30
7.3.7.14 User Mode 30
7.3.7.15 Backlight 30
7.3.7.16 LCD Flip 30
8 Calibration And Testing 31
8.1 Bump Testing And Calibration 31
8.1.1 Bump (Functional) Testing 31
8.2 Zero/Fresh Air Calibration 31
8.2.1 Zero Calibration For A CO_2 Sensor 31
8.2.2 Fresh Air Calibration 31
8.2.3 Single-Sensor Zero Calibration 32
8.3 Span Calibration 32
8.3.1 Multi-Sensor Span Calibration 33
8.3.2 Single-Sensor Span Calibration 34
8.4 Testing The Gamma Sensor 34
9 Datalog Transfer, Monitor Configuration, and Firmware Upgrades Via Computer 35
9.1 Downloading Datalogs And Performing PC-Based Instrument Configuration and Firmware Upgrades 35
10 Maintenance 36
10.1 Removing/Installing The Rubber Boot 36
10.2 Replacing The Filter 36
10.3 Replacing The Inlet 36
10.4 Removing/Cleaning/Replacing A PID (Pump Version Only) 37
10.5 Removing/Cleaning/Replacing Sensor Modules 38
10.6 Replacing The Pump 39
11 Alarms Overview 39
11.1 Alarm Signals 39
11.2 Changing The Alarm Mode 39
11.3 Alarm Signal Summary 40
12 Troubleshooting 43
13 Diagnostic Mode 44
13.1 Entering Diagnostic Mode 44
13.2 Exiting Diagnostic Mode 44
13.3 Navigating Diagnostic Mode 44
14 Specifications 46
15 Technical Support 50
16 RAE Systems Contacts 51

⚠ WARNINGS ⚠

Read Before Operating

This manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions.

CAUTION!

Never operate the monitor when the cover is removed. Remove the monitor rear cover or battery only in an area known to be non-hazardous.

ANY RAPID UP-SCALE READING FOLLOWED BY A DECLINING OR ERRATIC READING MAY INDICATE A GAS CONCENTRATION BEYOND UPPER SCALE LIMIT, WHICH MAY BE HAZARDOUS.

TOUTE LECTURE RAPIDE ET POSITIVE, SUIVIE D'UNE BAISSE SUBITE AU ERRATIQUE DE LA VALEUR, PEUT INDIQUER UNE CONCENTRATION DE GAZ HORS GAMME DE DÉTECTION QUI PEUT ÊTRE DANGEREUSE

ONLY THE COMBUSTIBLE GAS DETECTION PORTION OF THIS INSTRUMENT HAS BEEN ASSESSED FOR PERFORMANCE.

UNIQUMENT, LA PORTION POUR DÉTECTOR LES GAZ COMBUSTIBLES DE CET INSTRUMENT A ÉTÉ ÉVALUÉE.

CAUTION: BEFORE EACH DAY'S USAGE, SENSITIVITY OF THE LEL SENSOR MUST BE TESTED ON A KNOWN CONCENTRATION OF METHANE GAS EQUIVALENT TO 20 TO 50% OF FULL-SCALE CONCENTRATION. ACCURACY MUST BE WITHIN 0 AND +20% OF ACTUAL. ACCURACY MAY BE CORRECTED BY CALIBRATION PROCEDURE.

ATTENTION: AVANT CHAQUE UTILISATION JOURNALIERE, VERIFIER LA SENSIBILITE DU CAPTEUR DE LIE AVEC UNE CONCENTRATION CONNUE DE METHANE EQUIVALENTE DE 20 A 50% DE LA PLEINE ECHELLE. LA PRECISION DOIT ETRE COMPRISE ENTRE 0 ET 20% DE LA VALEUR VRAIE ET PEUT ETRE CORRIGEE PAR UNE PROCEDURE D'ETALONNAGE.

CAUTION: HIGH OFF-SCALE READINGS MAY INDICATE AN EXPLOSIVE CONCENTRATION.

ATTENTION: DES LECTURES HAUTES ET HORS D'ECHELLE PEUVENT INDIQUER DES CONCENTRATIONS DE GAZ INFLAMMABLES

CAUTION: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

Note: Users are recommended to refer to ISA-RP12.13, Part II-1987 for general information on installation, operation, and maintenance of combustible gas detection instruments.

The MultiRAE multi-gas detector must be calibrated if it does not pass a bump test, or at least once every 180 days, depending on use and sensor exposure to poisons and contaminants.

SPECIAL CONDITIONS FOR SAFE USE

1. The PGM-62xx shall only be fitted with RAE Systems Battery Pack type M01-3051-000 or M01-3053-000 or Battery Adapter M01-3052-000 or M01-3054-000 fitted with Duracell MN1500 batteries.
2. The PGM62xx shall only be charged outside hazardous areas.
3. No precautions against electrostatic discharge are necessary for portable equipment that has an enclosure made of plastic, metal, or a combination of the two, except where a significant static-generating mechanism has been identified. Activities such as placing the item in a pocket or on a belt, operating a keypad or cleaning with a damp cloth, do not present a significant electrostatic risk. However, where a static-generating mechanism is identified, such as repeated brushing against clothing, then suitable precautions shall be taken, e.g., the use of anti-static footwear.

The model PGM62xx is certified according to the IECEx scheme, ATEX and cCSAus (for US and Canada). PGM62xx is intrinsically safe and may be used in hazardous locations. SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

MARKING

The product is marked with the following information:

RAE SYSTEMS
3775 N. 1st. St., San Jose
CA 95134, USA

Type PGM62x0, PGM 62x6, PGM 62x8
Serial No/matrix: XXX-XXXX-000

IECEx SIR 11.0069X, Ex ia IIC T4 Ga (PGM62x0/PGM62x6) Ex ia d IIC T4 Gb (PGM62x8)	CE 0575 SIRA 11ATEX2152X Ex II 1G Ex ia IIC T4 Ga (PGM62x0/PGM62x6) Ex II 2G Ex ia d IIC T4 Gb (PGM62x8)	c SP us Exia Cl I, Dv 1 Gr. A, B, C, D, T4 C22.2 No 152-1984 ISA-12.13.01-2000

Warnings: Understand manual first before operating.
Warning: Do not change batteries in hazardous location.
Do not mix old/new or different type of batteries

PGM62x0: Use only RAE Systems battery pack, PN: M01-3051-000 or M01-3052-000.
PGM62x6/62x8: Use only RAE Systems battery pack, PN: M01-3053-000 or M01-3054-000.
Um: 20V
-20º C ≤ Tamb ≤ +50º C

Operation Area and Conditions

Hazardous Areas classified by Zones

PGM62x0/PGM62x6 are intended to be used in hazardous areas zone 0, zone 1 or zone 2, and PGM62x8 in hazardous areas zone 1 or zone 2 within the temperature range of -20º C to +50º C, where gases of explosion groups IIA, IIB or IIC and T4 may be present.

Hazardous Areas classified by Divisions

PGM62x0/PGM62x6/PGM62x8 are intended to be used in hazardous areas classified for Class I Div. 1 or 2, within the temperature range of -20º C to +50º C, where gases of explosion groups A, B, C or D and temperature class T4 may be present.

WARNINGS:

1. NDIR sensors shall not be installed in PGM62x0 or PGM 62x6 models.
2. NDIR LEL sensors shall not be installed in PGM62x8 diffusion models bearing **cCSAus** logo.

Proper Battery Disposal

This product may contain one or more sealed lead-acid, nickel-cadmium (NiCd), nickel-metal hydride (NiMH), lithium (Li), or lithium-ion batteries. Specific battery information is given in this user guide. Batteries must be recycled or disposed of properly.



This symbol (crossed-out wheeled bin) indicates separate collection of waste electrical and electronic equipment in the EU countries. Please do not throw the equipment into the domestic refuse. Please use the return and collection systems available in your country for the disposal of this product.

Proper Product Disposal At End Of Life



At the end of its life, this product must undergo separate collection and recycling from general or household waste. The black bar below the symbol indicates that the product was put on the market after August 13, 2005.



1 Standard Contents

The MultiRAE is available in four configurations, each with different kits, outlined below.

MultiRAE Pro	MultiRAE
MultiRAE Pro monitor with pump, sensors, battery, and wireless options as specified and protective rubber boot, filter, and belt clip installed	MultiRAE monitor with pump, sensors, battery, and wireless options as specified and protective rubber boot, filter, and belt clip installed
Travel charger / PC communications adapter	Travel charger / PC communications adapter
Desktop charging / PC communications cradle	Desktop charging / PC communications cradle
PC communication cable	PC communication cable
AC adapter	AC adapter
Calibration adapter	Calibration adapter
6" flexible probe	6" flexible probe
Alkaline battery adapter (included with rechargeable configurations only)	Alkaline battery adapter (included with rechargeable configurations only)
3 spare filters	3 spare filters
PID sensor cap removal tool	PID sensor cap removal tool
PID zeroing adapter	Hex tool
Hex tool	QuickStart Guide
QuickStart Guide	CD with documentation
CD with ProRAE Studio II instrument configuration and data management software	CD with ProRAE Studio II instrument configuration and data management software
CD with documentation	Calibration and test certificate
Calibration and test certificate	Warranty / registration card
Technical Note TN-106 with ionization energies and correction factors for 300+ VOCs	Technical Note TN-106 with ionization energies and correction factors for 300+ VOCs
Warranty / registration card	Ships in a hard transport case
IP-67/decontamination valve	
Ships in a Pelican case	

MultiRAE Lite Diffusion	MultiRAE Lite Pumped
MultiRAE Lite monitor with sensors, battery, and wireless options as specified and protective rubber boot installed	MultiRAE Lite monitor with pump, sensors, battery, and wireless options as specified and protective rubber boot, filter, and belt clip installed
Travel charger / PC communications adapter	Travel charger / PC communications adapter
PC communication cable	PC communication cable
AC adapter	AC adapter
Calibration adapter	Calibration adapter
Alkaline battery adapter (included with rechargeable configurations only)	Alkaline battery adapter (included with rechargeable configurations only)
Hex tool	3 spare filters
QuickStart Guide	PID sensor cap removal tool
CD with documentation	Hex tool
CD with ProRAE Studio II instrument configuration and data management software	QuickStart Guide
Calibration and test certificate	CD with documentation
Warranty / registration card	CD with ProRAE Studio II instrument configuration and data management software
	Calibration and test certificate
	Warranty / registration card

Note: A decontamination plug is standard with the MultiRAE Pro and optional with other models. It enhances the IP rating of the instrument from IP-65 to IP-67 (to dust- and water-proof for temporary immersion).

2 General Information

The MultiRAE is a family of multi-threat gas detectors that combine continuous monitoring capabilities for volatile organic compounds (VOCs), toxic and combustible gases, and radiation, with Man Down Alarm functionality in one highly portable instrument. MultiRAE monitors offer an industry-leading selection of interchangeable field-replaceable electrochemical, combustible, infrared, PID (photoionization detector), and gamma radiation sensors to fit a wide variety of applications. The MultiRAE family's wireless capability elevates worker protection to the next level by providing safety officers real-time access to instrument readings and alarm status from any location for better visibility and faster response.

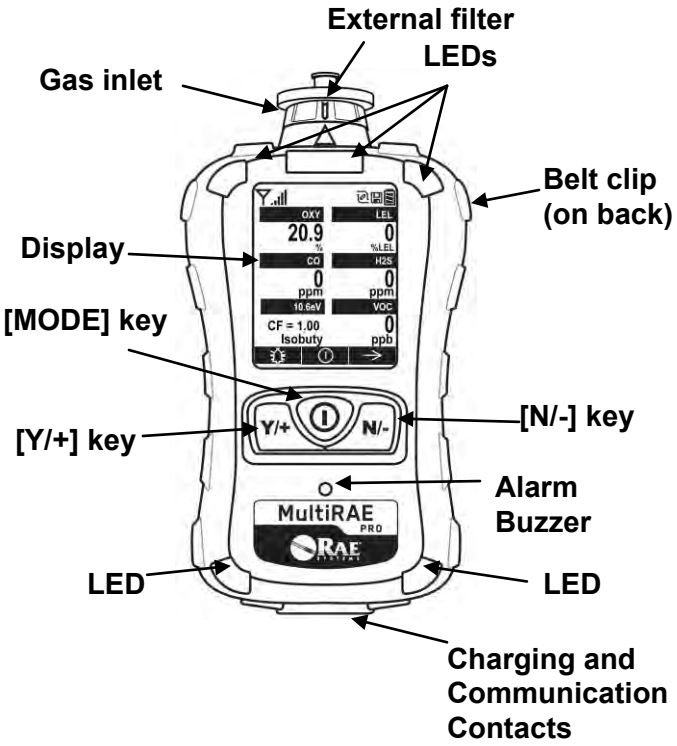
Notes:

- ClO_2 and H_2S sensors cannot be installed in the same instrument.
- NO and NH_3 sensors cannot be installed in the same instrument.
- NDIR combustible sensors are not supported on the diffusion version with CSA certification.
- The PID sensor requires a pumped configuration.
- If a %Vol. NDIR sensor is installed in an instrument, a catalytic bead %LEL sensor must also be installed in the instrument for CSA certification.

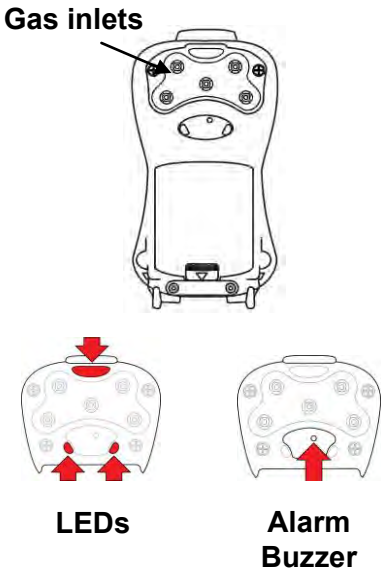
2.1 Key Features

- All-in-one continuous monitoring capabilities for radiation, VOCs, oxygen, toxic and combustible gases, for a total of up to six threats at a time
- Highly customizable with over 30 field-interchangeable intelligent sensor options
- Wireless access to real-time instrument readings and alarm status from any location
- Unmistakable five-way local and remote wireless notification of alarm conditions, including Man Down Alarm
- Large graphical display with easy-to-use, icon-driven user interface
- Simple maintenance with easily accessible sensors, pump, and plug-and-play Li-ion battery
- Fully-automated bump testing and calibration with AutoRAE 2

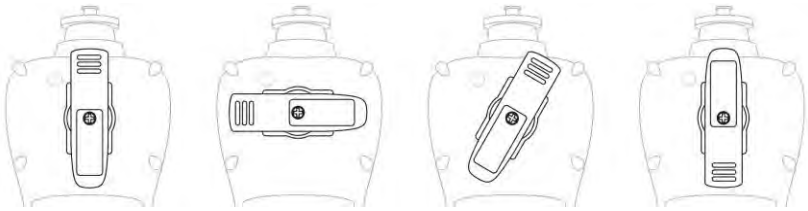
MultiRAE With Pump, front view



MultiRAE Diffusion Model, rear view



Note: The front of the diffusion model of the MultiRAE is the same as the pumped model, but instead of a single inlet, there are five inlets on the back side, as well as an extra alarm buzzer and LEDs.



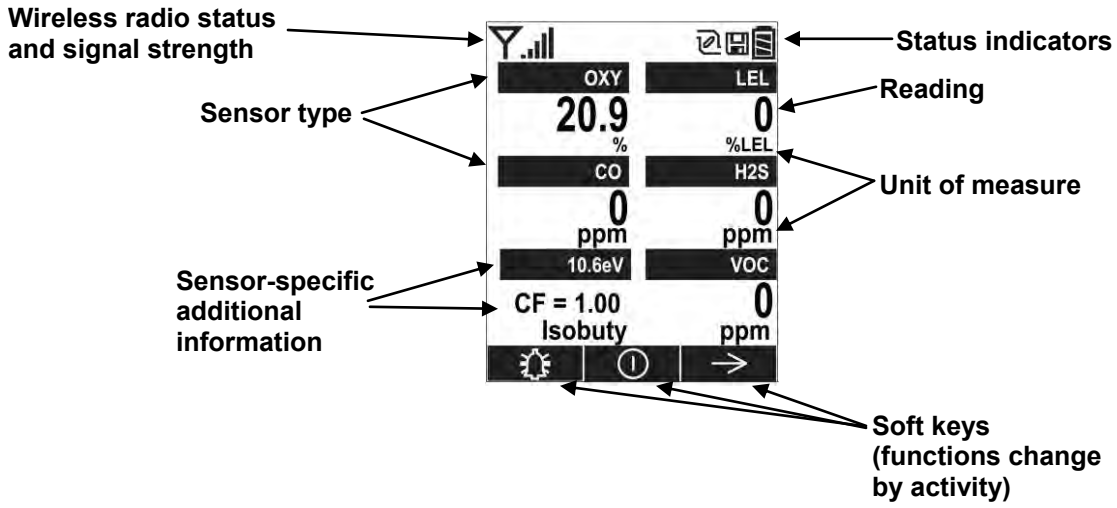
The belt clip on the back of the pump-equipped MultiRAE can be swiveled for holding it at different angles.

3 User Interface

The MultiRAE's user interface consists of the display, LEDs, an alarm buzzer, and three keys.

3.1 Display Overview

The LCD display provides visual feedback that includes the sensor types, readings, time, battery condition, and other functions.



3.1.1 Status Indicator Icons

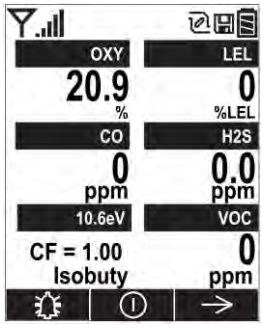
Along the top of most screens are status indicators that tell you whether a function is operating and/or its strength or level.

Icon	Function
	Wireless status (shown when wireless is on, blank when off)
	Wireless strength (0 to 5 bars)
	Pump status (only on pump-equipped models)
	Datalogging status (shown when datalogging is on, blank when off)
	Battery status (three segments show battery charge level)

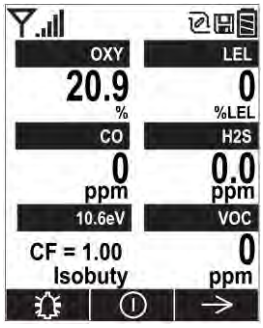
3.1.2 LCD Flip

The MultiRAE senses its vertical/horizontal orientation, and can automatically flip the display180 degrees, making it easy to read if the MultiRAE is upside down. (You can turn this feature on or off in Programming Mode, under "Monitor.")





As the MultiRAE is tilted, the sensor detects its orientation and inverts the screen when it past its horizontal position.



3.1.3 Keys & Interface

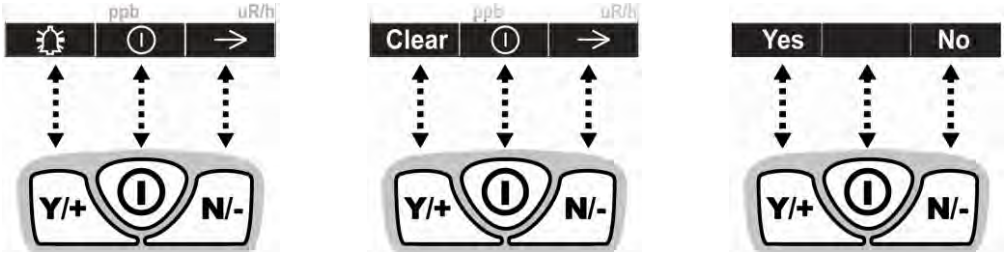
The MultiRAE has three buttons:



Y/+ MODE N/-

In addition to their labeled functions, the keys labeled [Y/+], [MODE], and [N/-] act as "soft keys" that control different parameters and make different selections within the instrument's menus. From menu to menu, each key controls a different parameter or makes a different selection.

Three panes along the bottom of the display are "mapped" to the keys. These change as menus change, but at all times the left pane corresponds to the [Y/+] key, the center pane corresponds to the [MODE] key, and the right pane corresponds to the [N/-] key. Here are examples that show the relationships of the keys and functions:



In addition to the functions described above, any of the buttons can be used to manually activate display backlighting. Press any button when the backlighting is off to turn it on.

3.2 Screen Display For Various Numbers Of Active Sensors

The MultiRAE family of instruments can accommodate from one to five sensors (some are dual sensors), depending on the configuration. In order to maximize readability and the amount of information shown, the display is automatically reconfigured, according to the number and types of sensors in the MultiRAE.

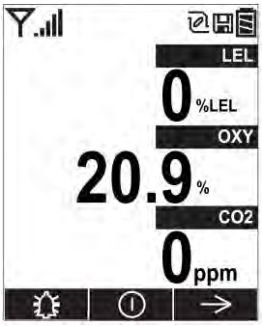
If the configuration includes five sensors, and one of them is a PID, then the lamp value (9.8eV or 10.6eV) is shown, along with the currently applied correction factor (CF).



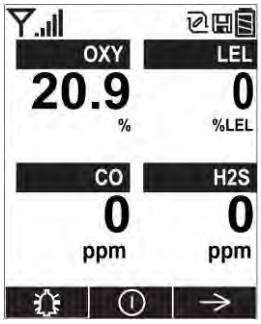
One sensor.



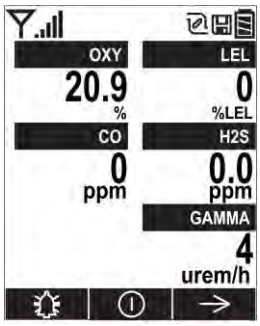
Two sensors.



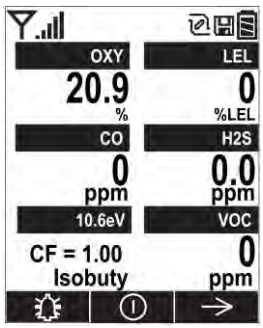
Three sensors.



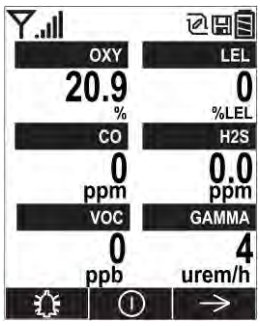
Four sensors.



Five sensors, including Gamma radiation sensor



Five sensors, including PID, showing lamp type and correction factor.



Six-threat configuration with CO+H2S combo sensor

3.3 Menus

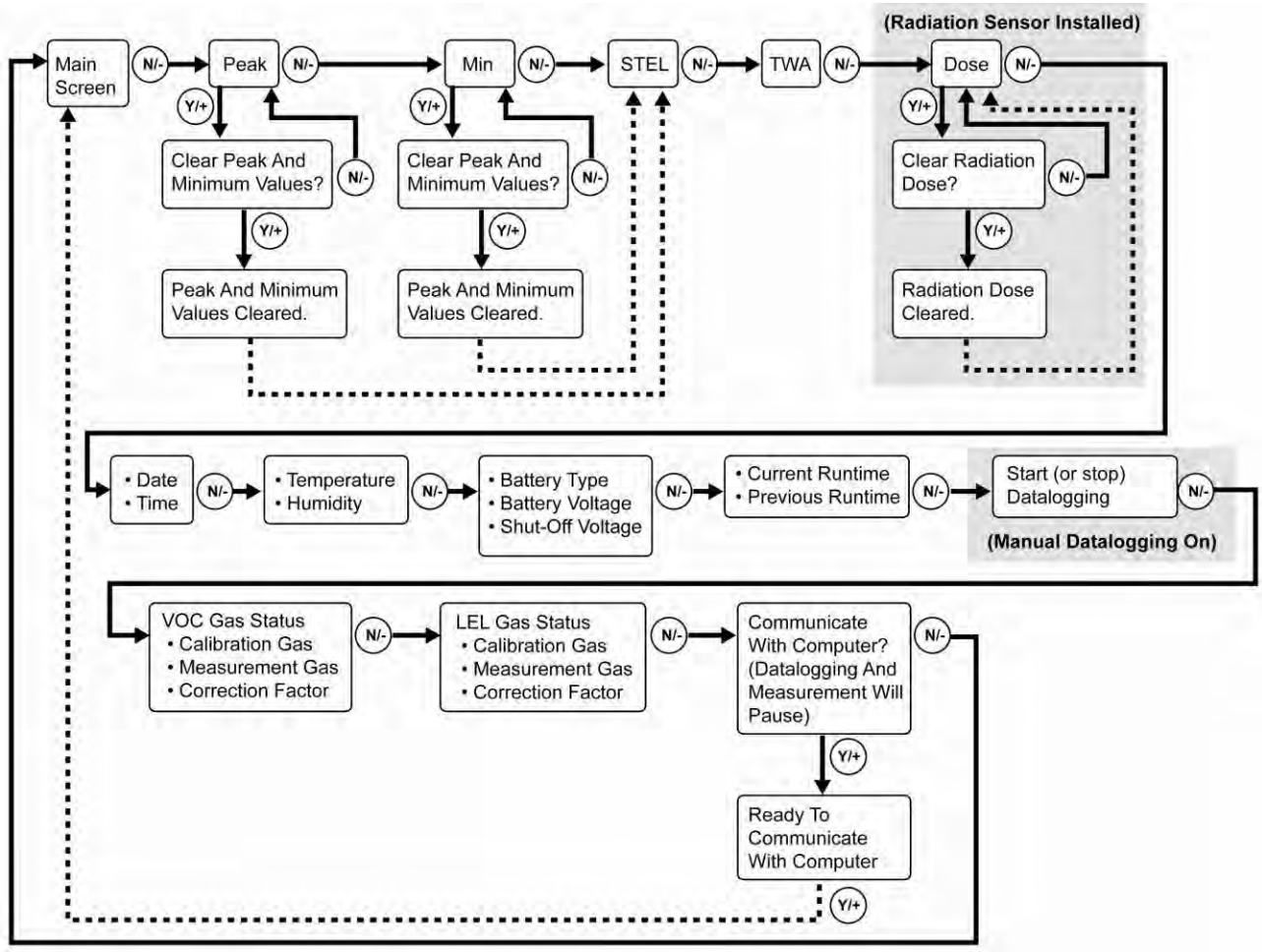
The reading menus are easy to step through by pressing the [N/-] button.

Hygiene Mode, in which sampling is continuous, allows you to clear peak and minimum values at any time.

Search Mode allows you to clear peak and minimum values, but samples only when you tell it to sample. This allows you to save sample readings as individual events in the datalog.

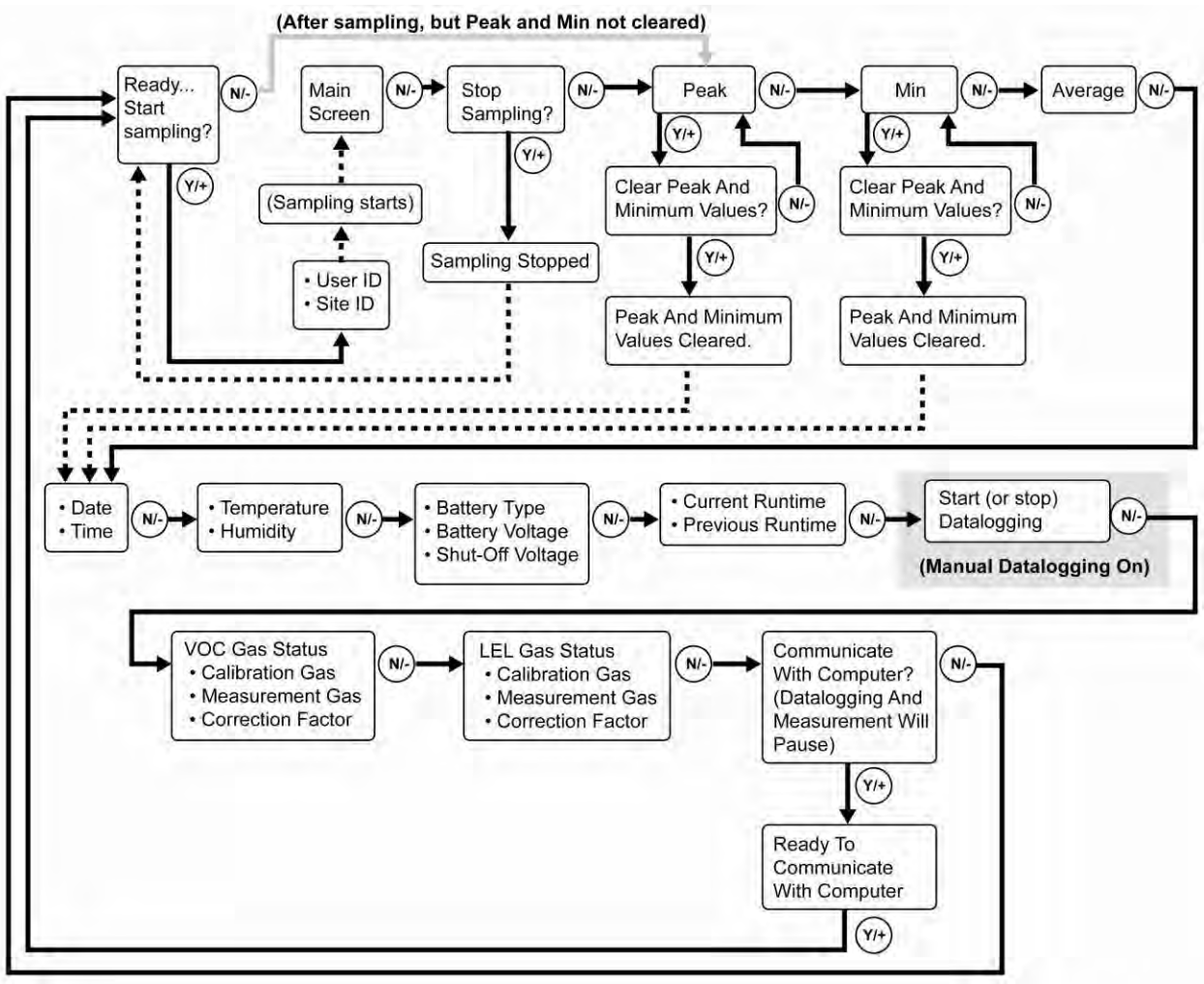
Note: You can switch between Hygiene and Search modes via the Programming Menu (Select Monitor and then Operation Mode).

Hygiene Mode



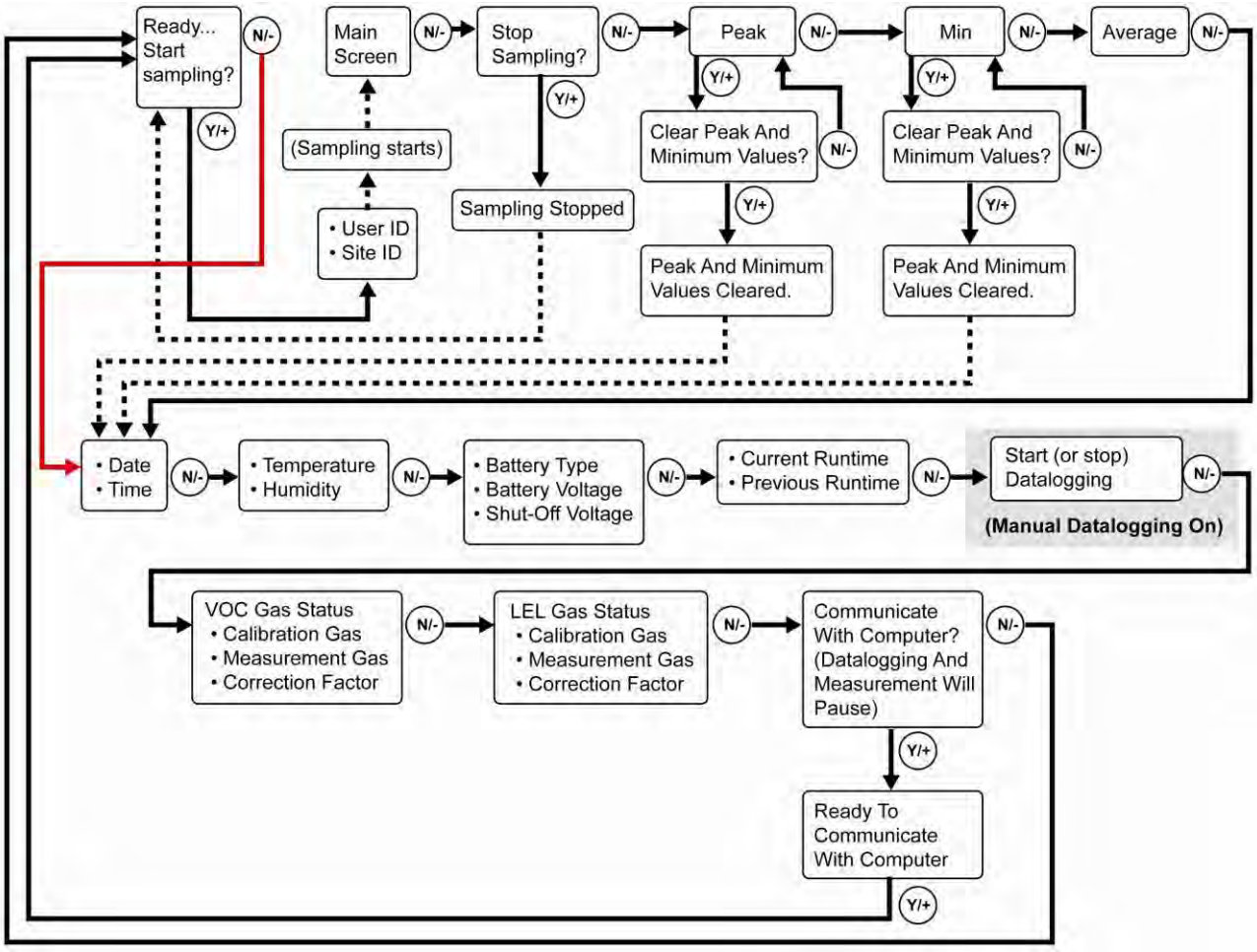
Note: Dashed line indicates automatic progression.

Search Mode



Note: Dashed line indicates automatic progression.

Note: If the Peak or Min is cleared, the Average is also cleared. In addition, each cycle through the main screen after they are cleared will route from "Ready… Start sampling?" directly to Date and Time if you press [N/-] (see red line in diagram below), until you perform a new sample. Also, if you start sampling again and stop sampling, clear the Peak, or clear the Min, it advances to Date and Time, as well.



Note: Dashed line indicates automatic progression.

4 Battery

Always fully charge the battery before using the MultiRAE. Its Li-ion battery is charged by placing the MultiRAE in its cradle or using the travel charger. Contacts on the bottom of the instrument meet the cradle's contact pins, transferring power.

There are two types of output power for battery packs or adapters. Battery pack (PN: M01-3051-000) and adapter (PN: M01-3052-000) are used for MultiRAE's model number PGM-62x0. Battery pack (PN: M01-3053-000) and adapter (PN: M01-3054-000) are used for model number PGM-62x6/PGM-62x8.

Note: Before setting the MultiRAE into its charging cradle or attaching its travel charger, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft, dry cloth. Do not use solvents or cleaners.

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge, remove or replace the battery only in an area known to be non-hazardous! Do not mix old and new batteries or batteries from different manufacturers.

4.1 Using The Charging Cradle

Follow this procedure to charge the MultiRAE:

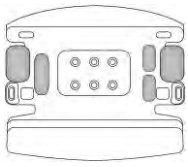
1. Plug the AC/DC adapter into the MultiRAE's cradle.
2. Plug the AC/DC adapter into the wall outlet.
3. Place the MultiRAE into the cradle and press down until it is locked in place.

The MultiRAE begins charging automatically. The LED in the cradle should glow red to indicate charging. When charging is complete, the LED in the cradle glows green.

4.2 Using The Travel Charger

Follow these steps to use the travel charger.

Before attaching the travel charger, check that it is aligned correctly with the base of the MultiRAE. There are two alignment points on one side and one alignment point on the other side, designed to mate with matching points on the bottom of the MultiRAE:



1. Check bottom of MultiRAE Travel Charger's alignment pins for correct orientation with the MultiRAE.



2. Align travel charger with bottom of MultiRAE.

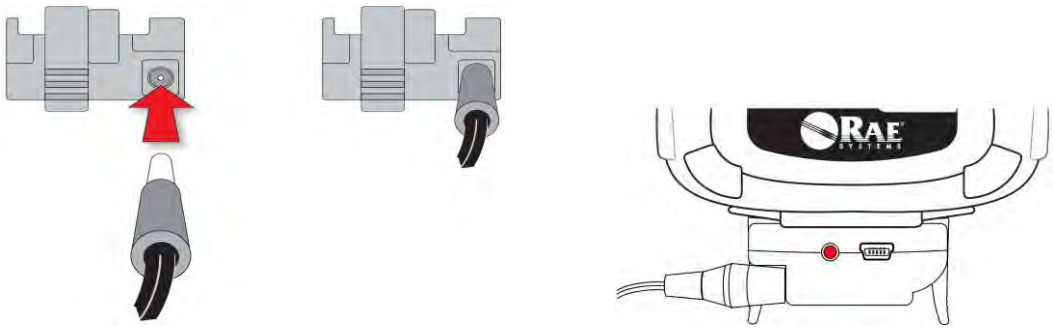


3. Press travel charger onto bottom of MultiRAE.



4. Make sure the travel charger is firmly attached.

Next, put the plug from the power supply into the jack on the side of the travel charger:

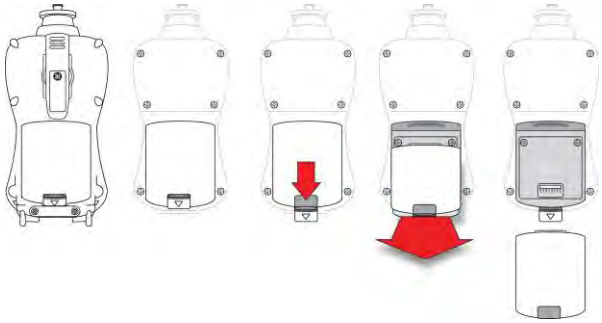


Plug the other end of the charger into a power source (AC outlet or 12VDC mobile power port, depending on the model). When power is applied and the MultiRAE's battery is charging, the LED glows red. The LED glows green when the battery is fully charged.

4.3 Replacing A Battery

The MultiRAE battery packs are plug-and-play, and can be replaced on the go without tools. To replace the MultiRAE battery:

1. Remove the battery adapter from the instrument by sliding the tab and tilting out the adapter. **Note:** The belt clip and rubber boot are removed in the illustration for clarity. They can be left on while replacing a battery.



2. Tilt a fully charged battery (or alkaline battery adapter) into the battery compartment and place it in the instrument.
3. Slide the tab back into place to secure the battery.

4.4 Battery States

The battery icon on the display shows how much charge is in the battery and alerts you to any charging problems.

				
Full charge	**2/3 charge**	**1/3 charge**	**Low charge**	**Battery alert**

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the "empty battery" icon blinks on and off once per second. The instrument automatically powers down within 10 minutes, after which you will need to either recharge the battery, or replace it with a fresh one with a full charge.



4.5 Alkaline Battery Pack

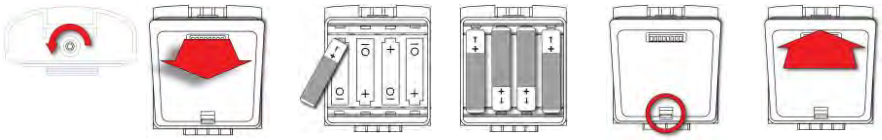
An alkaline battery adapter is supplied with each instrument. The adapter (part number M01-3054-000) is installed and removed just like the rechargeable battery. It accepts four AA alkaline batteries (use only Duracell

MN1500) and provides approximately 8 hours of normal operation. (An optional rechargeable lithium-ion battery pack, part number M01-3053-000.)

Note: The vibration alarm is disabled whenever the alkaline adapter is used.

To replace the alkaline adapter's batteries:

1. Remove the hex-socket screw at the end of the adapter.
2. Lift the cover off the battery compartment.
3. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
4. Replace the cover and replace the hex screw.



IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline battery pack and will not allow recharging. If you place the instrument in its Travel Charger or Charging Cradle, the alkaline battery will not be recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument. If you try to charge alkaline batteries installed in the instrument, the Charging Cradle or Travel Charger's charging LED does not glow, indicating that it will not charge them.

The alkaline battery adapter accepts four AA alkaline batteries (use only Duracell MN1500). Do not mix old and new batteries or batteries from different manufacturers.

Note: When replacing alkaline batteries, dispose of old ones properly.

5 Turning The MultiRAE On And Off

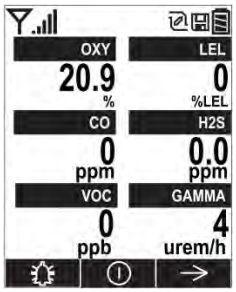
5.1 Turning The MultiRAE On

With the instrument turned off, press and hold the [MODE] key until the audible alarm stops, and then release.

When starting up, the MultiRAE turns the backlight on and off, beeps once, blinks once, and vibrates once. A RAE Systems logo (or a company name) should appear first. This is followed by a progression of screens that tell you the MultiRAE's current settings:

- Product model number, serial number and firmware version.
- List of installed sensors.
- Current date, time and temperature.
- User mode,
- Battery type, voltage, shutoff voltage.
- Alarm mode.
- Datalog period (if it is activated).
- Sensor information such as production/expiration/calibration date and alarm limit settings.

Then the MultiRAE's main reading screen appears. It takes 1 to 2 minutes for sensors to show a reading, so if any have not warmed up by the time the main screen is shown, you will see "- -" instead of a numerical value until the sensor provides data (typically less than 2 minutes). Then it displays instantaneous readings similar to the following screen (depending on the sensors installed) and is ready for use.



Note: If the battery is completely empty, then the display briefly shows the message "Battery Fully Discharged," and the MultiRAE shuts off. You should charge the battery or replace it with a fully charged battery before turning it on again.

5.2 Turning The MultiRAE Off

Press and hold [MODE]. A 5-second countdown to shutoff begins. You must hold your finger on the key for the entire shutoff process until the MultiRAE is powered off.

Caution: The alarm is very loud. During startup, you can mute most of the sound by holding a finger over the alarm port. Do not put tape over the alarm port to permanently mute it.

5.3 Testing Alarm Indicators

Under normal-operation mode and non-alarm conditions, the buzzer, vibration alarm, LED, and backlight can be tested at any time by pressing [Y/+] once.

IMPORTANT!

If any of the alarms does not respond to this test, check the Alarm Settings in Programming Mode. It is possible that any or all of the alarms have been turned off. If all of the alarms are turned on, but one or more of them (buzzer, LED lights, or vibration alarm) does not respond to this test, do not use the instrument. Contact your RAE Systems distributor for technical support.

5.4 Pump Status

IMPORTANT!

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:



If there is a pump failure or obstruction that disrupts the pump, the alarm sounds and you see this icon blinking on and off:



Once the obstruction is removed, you can try to restart the pump by pressing the Y/+ button. If the pump does not restart, and the pump stall alarm continues, consult the Troubleshooting section of this guide or contact RAE Systems Technical Support.

Note: Pump Status is not indicated on diffusion MultiRAEs.

5.5 Calibration Status

The instrument displays this icon next to the sensor that requires calibration:



Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor module has been replaced with one whose calibration is overdue.
- The defined period of time between calibrations has been exceeded.
- If you have changed the calibration gas type without recalibrating the instrument.
- The sensor has failed a previous calibration.

6 Modes Of Operation

The MultiRAE has two operation modes and two user modes.

6.1 Hygiene Operation Mode

Hygiene Mode provides continuous monitoring.

6.2 Search Operation Mode

Search Mode provides monitoring only when monitoring is turned on. This allows specific samples to be taken at different times, rather than continuously.

6.3 Basic User Mode

In Basic User Mode, some restrictions are applied, including password protection that guards against entering Programming Mode by unauthorized personnel.

6.4 Advanced User Mode

In Advanced User Mode, there are no access restrictions (you do not need a password), and MultiRAE provides the indications and data you need most for typical monitoring applications.

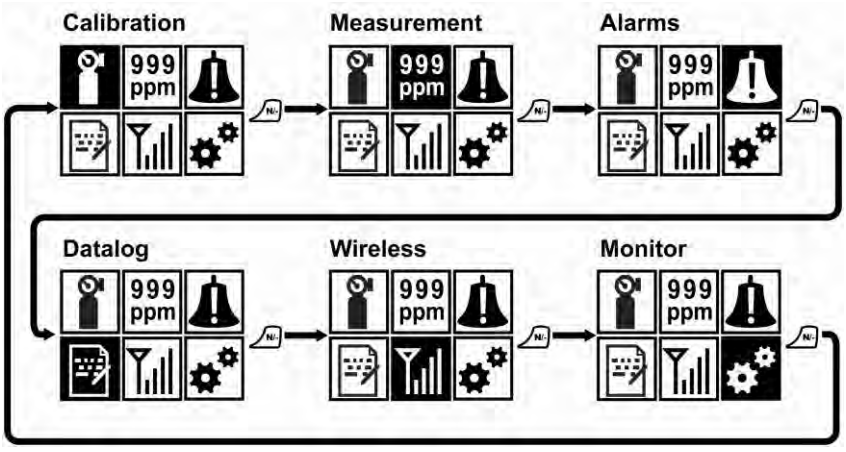
7 Programming

The menu in Programming Mode is to adjust settings, calibrate sensors, and initiate communication with a computer. It has the following submenus:

- Calibration
- Measurement
- Alarms
- Datalog
- Wireless
- Monitor

7.1 Enter Programming In Advanced Mode

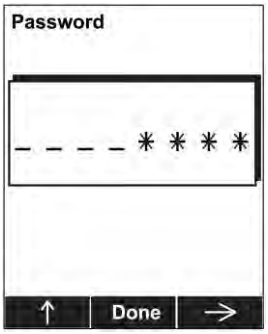
1. To enter Programming Mode, press and hold [MODE] and [N/-] until you see the Calibration screen. No password is necessary in Advanced Mode.
2. Press [N/-] to step through the programming screens.



To enter a menu and view or edit parameters in its submenus, press [Y/+].

7.2 Enter Programming In Basic Mode

1. To enter Programming Mode, press and hold [MODE] and [N/-] until you see the Password screen.



2. Input the 4-digit password:

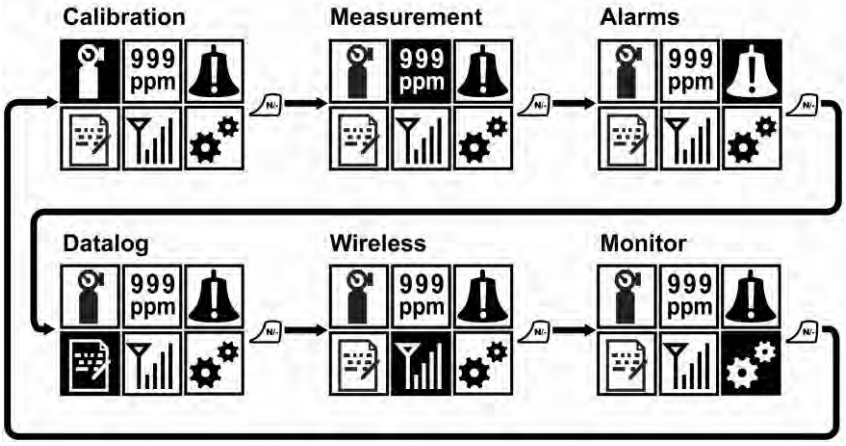
- Increase the number from 0 through 9 by pressing [Y/+].
- Step from digit to digit using [N/-].
- Press [MODE] when you are done.

If you make a mistake, you can cycle through the digits by pressing [N/-] and then using [Y/+] to change the number in each position.

Note: The default password is 0000.

Note: The password screen only appears when you enter the Programming Mode the first time after turning the instrument on in Basic Mode. If you have input the correct password, you do not have to input it again to enter Programming Mode until you turn the instrument off and on again.

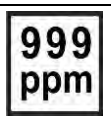
Once you enter Programming Mode, the Calibration screen is shown. Press [N/-] to step through the programming screens.



To enter a menu and view or edit parameters in its submenus, press [Y/+].

7.3 Menus And Submenus

In Programming Mode, menus and submenus are organized as shown here:

					
Calibration	**Measurement**	**Alarms**	**Datalog**	**Wireless***	**Monitor**
Fresh Air	Sensor On/Off	Alarm Limits	Clear Datalog		LCD Contrast
Multi Sensor Span	Change Meas. Gas	Alarm Mode	Datalog Interval		Operation Mode
Single Sensor Zero	Measurement Units	Alarm Settings	Sensor Selection		Pump Speed**
Single Sensor Span		Comfort Beep	Data Selection		Zero At Start
Cal. Reference		Man Down Alarm	Datalog Type		Fast Startup
Change Cal. Gas			Memory Full Action		Temperature Units
Multi Cal Select					Language
Change Span Value					Site ID
Change Span2 Value***					User ID
					Date Format
					Date
					Time Format
					Time
					User Mode
					Backlight
					LCD Flip

* Wireless is still in development.
** Pump-equipped version only.
***By default, only a ppb PID sensor (used only in MultiRAE Pro) has 3-point calibration enabled. Third-point calibration can be enabled for the MultiRAE PID (high-range) sensor via ProRAE Studio 2. The MultiRAE Lite PID sensor only supports 2-point calibration.

7.3.1 Editing And Selecting Parameters And Sensors

There are a few basic ways to edit parameters, select sensors, and perform other activities in the MultiRAE. The actions performed by pressing keys always match 1-to-1 with the boxes along the bottom of the display and the three keys. Some parameters are edited by scrolling and selecting individual items (black bars behind white text act as highlighters). Some include a choice via "radio buttons," where only one item in a list can be selected, while other menus use boxes for you to "check" with an "X," and these allow for multiple items in a list to be selected. In all cases of editing, you can save or undo your choice.

7.3.2 Calibration

Use this menu to perform zero or span calibration for one or more sensors, and change the gas concentration value assumed to be used in span calibration, as well as zero calibration and calibration reference gas.

7.3.2.1 Fresh Air

This procedure determines the zero point of the sensor calibration curve for all the sensors that require a zero calibration.

7.3.2.2 Multi Sensor Span

Depending on the configuration of your MultiRAE and span gas you have, you can perform a span calibration simultaneously on multiple sensors.

7.3.2.3 Single Sensor Zero

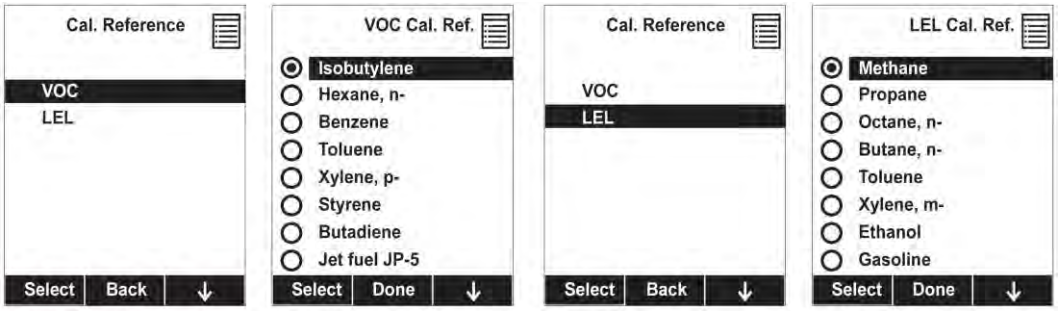
This allows you to perform zero (fresh air) calibration on individual sensors.

7.3.2.4 Single Sensor Span

Instead of performing a span calibration on more than one sensor simultaneously, you can select a single sensor and perform a span calibration.

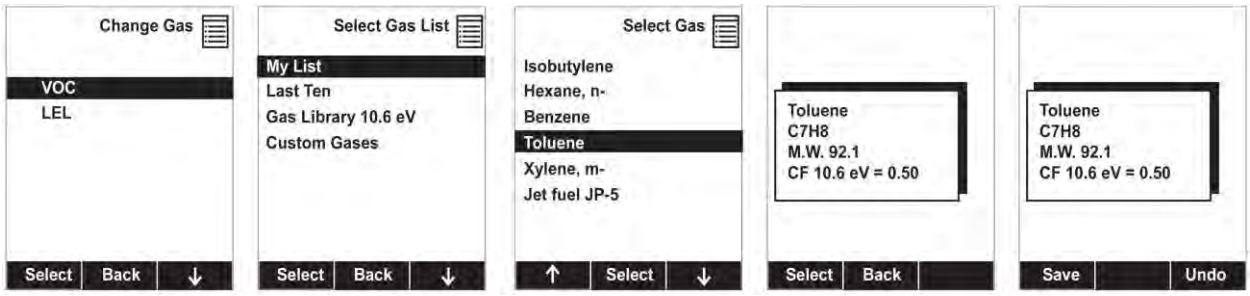
7.3.2.5 Cal. Reference

It is sometimes desirable to calibrate a sensor (PID for VOC, and LEL) with a specific gas for best response to a gas you are surveying. Changing the gas requires selecting the right calibration reference gas in the MultiRAE. Choose the sensor, and then select from the list of reference gases.



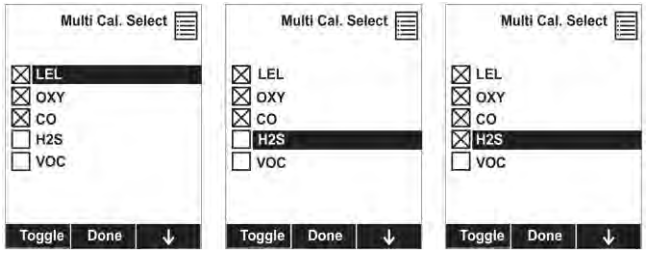
7.3.2.6 Change Cal. Gas

You can change the calibration gas for the MultiRAE's PID and LEL sensors. Select from a custom list that you create (My List), the last ten gases used, the built-in gas library for your PID lamp (taken from RAE Systems' Technical Note TN-106), and custom gases. Each gas is shown in the list for selection and the screen automatically changes to show its full name, chemical formula, molecular weight (M.W.) and correction factor (CF).



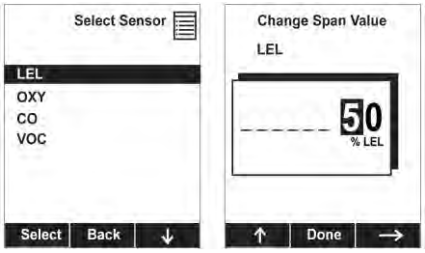
7.3.2.7 Multi Cal Select

You can select one or more sensors to be calibrated at a time. An "X" in a box to the left of a sensor's name indicates it is selected.



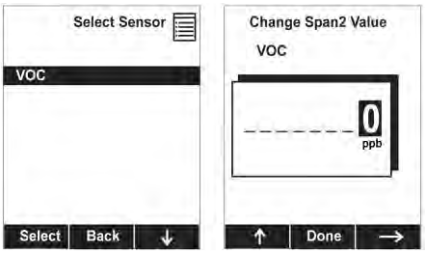
7.3.2.8 Change Span Value

You can individually set the span gas value for each sensor. The units of measure (ppm, %LEL, etc.) are shown on the display.



7.3.2.9 Change Span2 Value

If your MultiRAE is equipped with a PID sensor, you can set the span gas value for a third calibration point (Span2). The unit of measure is shown on the display.



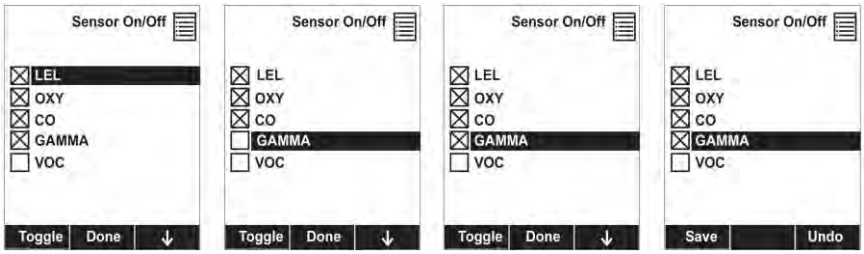
Note: By default, only a ppb PID sensor (used only in MultiRAE Pro) has 3-point calibration enabled. Third-point calibration can be enabled for the MultiRAE PID (high-range) sensor via ProRAE Studio 2. The MultiRAE Lite PID sensor only supports 2-point calibration.

7.3.3 Measurement

The submenus for Measurement include Sensor On/Off, Change Measurement Gas, and VOC and Gamma (if equipped) Measurement Units.

7.3.3.1 Sensor On/Off

You can turn sensors on or off via this set of submenus. An "X" in a box to the left of a sensor's name indicates it is turned on.

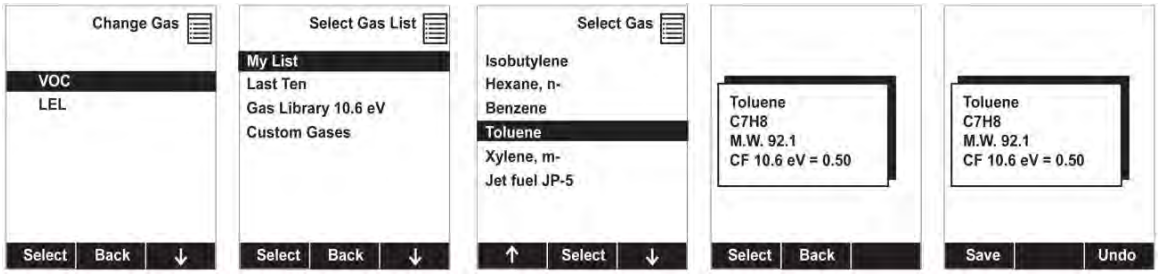


7.3.3.2 Change Meas. Gas

The MultiRAE has extensive onboard gas libraries for combustible gases and VOCs that you can use to configure your MultiRAE to automatically apply the appropriate correction factors and produce readings in the units of the desired combustible gas or VOC.

Measurement gases are organized in four lists:

- **My List** is a customized list of gases that you create. It contains a maximum of 10 gases and can only be built in ProRAE Studio II on a PC and transferred to the instrument. **Note:** The first gas in the list is always isobutylene (it cannot be removed from the list).
- **Last Ten** is a list of the last ten gases used by your instrument. The list is built automatically and is only updated if the gas selected from Custom Gases or Library is not already in the Last Ten. This ensures that there is no repetition.
- **Gas Library** is a library that consists of many of the gases found in RAE Systems' Technical Note TN-106 (available online at www.raesystems.com).
- **Custom Gases** are gases with user-modified parameters. Using ProRAE Studio II, all parameters defining a gas can be modified, including the name, span value(s), correction factor, and default alarm limits.



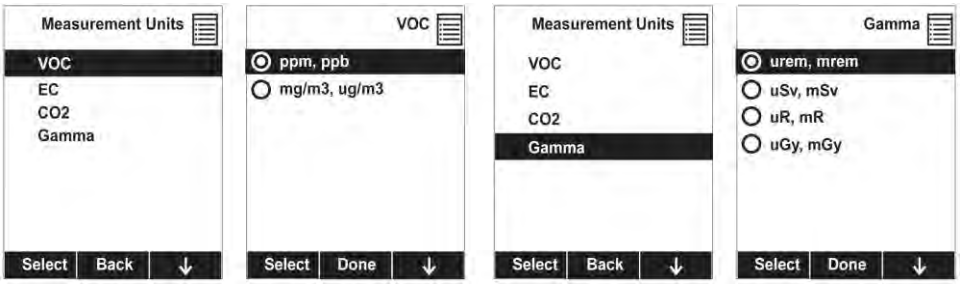
7.3.3.3 Measurement Units

In some cases, the measurement unit for displaying data from sensors can be changed. Standard available measurement units include:

Abbreviation	Unit	Sensor Type
ppm, ppb	parts per million, parts per billion	PID for VOC
mg/m3, ug/m3	milligrams per cubic meter, micrograms per cubic meter	PID for VOC
ppm, mg/m3	parts per million, milligrams per cubic meter	EC (electrochemical)
ppm Only, %VOL only, Auto Range	parts per million, percent by volume, automatically switch from ppm to %VOL at 10000 ppm and higher*	CO_2
urem, mrem	microrems and millirems	Gamma
uSv, mSv	microSieverts and milliSieverts	Gamma
uR, mR	microRoentgens and milliRoentgens	Gamma
uGy, mGy	microGrays and milliGrays	Gamma

* The CO_2 switch point from ppm to %VOL can be changed via ProRAE Studio 2.

Here are two examples of menu hierarchies (select the sensor type and then the measurement unit):



7.3.4 Alarms

Use this menu to change high, low, STEL, and TWA alarm limits - the points at which alarms are triggered. It can also change alarm mode (latched or automatic reset) and alarm output methods (combinations of light, buzzer, and vibration alarm indications).

7.3.4.1 Alarm Limits

There are four groups of alarm settings that you can adjust for each individual sensor for which a particular alarm type is available.

Settings:

- High Alarm
- Low Alarm
- STEL Alarm
- TWA Alarm

Note: Some alarm settings are not applicable to all sensors. If a setting is irrelevant to a sensor (for example, STEL for a gamma radiation sensor), then that sensor does not appear in the list.

7.3.4.2 Alarm Mode

You can program the MultiRAE so that there are two ways to shut off an alarm:

Auto Reset	When the alarm condition is no longer present, the alarm stops and resets itself.
Latch	You can manually stop the alarm when one is triggered. The latched setting only controls alarms for High Alarm, Low Alarm, STEL Alarm, and TWA alarm.

7.3.4.3 Alarm Settings

You can enable/disable any combination of light (LEDs), buzzer, and vibration alarms.

Settings:

- All Enabled
- Light
- Vibration
- Buzzer
- Buzzer & Light
- Buzzer & Vibration
- Vibration & Light
- All Disabled

7.3.4.4 Comfort Beep

A Comfort Beep is a single beep of the audible alarm at 60-second intervals that reminds the person using the MultiRAE that it is functioning. It can be turned on or off.

7.3.4.5 Man Down Alarm

The Man Down Alarm is a critical and potentially lifesaving safety feature of every MultiRAE. The Man Down Alarm is based on the premise that if the instrument is motionless when it is not supposed to be, something wrong may be happening to its user. If that is the case, the MultiRAE blasts the alarm not only locally on the instrument, but also remotely, over the RAE Systems Dedicated Wireless Network to notify people in the vicinity, as well as remote safety officers at the command center, that a person is down, so that help can get on the way quickly.

When the Man Down feature is on and there is no gas or radiation alarm, the MultiRAE senses that it is motionless for the amount of time set in the "Motionless Time" parameter. If the instrument is not moved during that time, then a pre-alarm is activated to alert the user, and shows the "Are You OK?" screen. Pressing [Y/+] clears the alarm and returns the MultiRAE to its normal operation. Pressing [N/-] sets it into Man Down Alarm (and if wireless connectivity is enabled, a Man Down message is sent in real time to remote observers). If neither key is pressed, then after the countdown, it goes into Man Down Alarm (again sending a message to remote observers if wirelessly enabled).





Settings are available for:

- Off/On
- Motionless Time (time the instrument is motionless before initiating a pre-alarm)
- Motion Sensitivity (set to low, medium, or high to compensate for ambient vibration or motion)
- Warning Time (countdown, in seconds, from pre-alarm to Man Down alarm)

When the Man Down alarm is activated, the buzzer sounds and LEDs flash continuously, and a countdown begins.

- If the MultiRAE's user presses [Y/+] for "Yes" in response to the "Are You OK?" question on the screen before the countdown reaches zero, the Man Down alarm stops and the main reading screen is displayed.
- If the person does not press [Y/+] for "Yes" in response to the "Are You OK?" question on the screen before the countdown reaches zero, the Man Down alarm is sounded and LEDs flash continuously.
- If the person presses [N/-] during the countdown, answering the "Are You OK?" question with "No," the Man Down alarm starts.

If wireless connectivity is enabled, a Man Down message is also sent to remote observers.

7.3.5 Datalog

The instrument displays a floppy disk icon to indicate that a datalog is being recorded. The instrument stores the measured gas concentration for each sensor, date and time for each measurement, Site ID, User ID, and other parameters. The MultiRAE memory is sufficient to record six months' worth of data for five sensors at one-minute intervals. All data are retained (even after the unit is turned off) in non-volatile memory so that they can be downloaded at a later time to a PC.

7.3.5.1 Clear Datalog

This operation erases all data stored in the datalog.

Note: Once the datalog is cleared, the data cannot be recovered.

7.3.5.2 Datalog Interval

Intervals are shown in seconds. The default value is 60 seconds. The maximum interval is 3600 seconds, and the minimum is 1 second.

7.3.5.3 Sensor Selection

You can choose which sensors' data are included in the datalog. The entire list of installed sensors is shown, and you can individually select whether their data is included.

Note: Turning a sensor off in the list does not change or erase its settings.

7.3.5.4 Data Selection

Data Selection allows you to select which types of data are stored and made available when you download your datalog to a computer via ProRAE Studio II (version 1.04 or higher) software.

You can choose any or all of four types of data (you must choose at least one):

- Minimum
- Average
- Maximum
- Real Time

7.3.5.5 Datalog Type

The instrument offers three options for starting the datalogging process:

Auto	Automatically collects datalog information every time the instrument is sampling until the datalog memory is full.
Manual	Datalogging occurs only when you manually initiate it (see below for details).
Snapshot	Datalogs only during snapshot (single-event capture, initiated by pressing [MODE]) sampling.

Note: You can only choose one datalog type to be active at a time.

About Manual Datalog

When the instrument is set to Manual Datalog, you can turn datalogging on and off by repeatedly pressing [N/-] and stepping through the screens from the main display until you reach the screen that says "Start Datalog?"

- When you reach the screen that says "Start Datalog?" press [Y/+] to start it. You see "Datalog Started," confirming that datalogging is now on. You can turn it off by pressing [Y/+] again.
- If datalogging is running, you can leave it running. However, if you want to turn it off, follow this procedure:

  Press [N/-] repeatedly to step through the screens until you reach the screen that says, "Stop Datalog?" press [Y/+] to stop datalogging. The screen displays "Datalog Stopped" for a few seconds, before displaying "Start Datalog?" and the datalog interval. You can restart it anytime by pressing [Y/+].

About Snapshot Datalog

When the instrument is in Snapshot datalogging mode, it captures a single "snapshot" of the data at the moment of your choosing. All you have to do is press [MODE] each time you want to capture a snapshot of the data at that instant.



No snapshot.



Press [MODE] for snapshot.



Datalog icon is shown during snapshot

7.3.5.6 Memory Full Action

When the internal datalog memory is full, the MultiRAE can either stop collecting data (Stop when full) or go back to the beginning and overwrite the data from the first entry, second entry, etc. (Wraparound).

7.3.6 Wireless

This feature is currently in development.

7.3.7 Monitor

The submenus under "Monitor" control the LCD's contrast, operation mode, pump speed, and other parameters.

7.3.7.1 LCD Contrast

The display's contrast can be increased or decreased from its default setting. You may not need to ever change the default setting, but sometimes you can optimize the display to suit extreme temperature and ambient brightness/darkness conditions.

Use the [Y/+] and [N/-] keys to decrease or increase LCD contrast, respectively. When you are done, select "Done" and save your change or "Undo" to abort changes and revert to the original setting. If no change is made, you can simply exit LCD Contrast.

7.3.7.2 Operation Mode

There are two operation modes, outlined below.

Hygiene Mode

When the MultiRAE is in Hygiene Mode, it continuously monitors, and if datalogging is on, it saves data continuously.

Search Mode

When the instrument is in Search Mode, it only samples when you activate sampling. When you see the display that says, "Ready…Start sampling?" press [Y/+] to start. The pump turns on and the instrument begins collecting data. To stop sampling, press [N/-] while the main display is showing. You will see a new screen that says, "Stop sampling?" Press [Y/+] to stop sampling. Press [N/-] if you want sampling to continue.

7.3.7.3 Pump Speed

If the MultiRAE is equipped with a pump, the pump can operate at two speeds, high and low. Running at low speed is quieter, extends pump lifespan, and conserves a small amount of power. There is almost no difference in sampling accuracy.

7.3.7.4 Zero At Start

If your MultiRAE has been configured to perform a zero (fresh air) calibration upon startup, called Zero At Start, then the startup routine is interrupted so that you can perform a fresh air calibration.

If you do not want to perform a zero calibration, press [MODE] to bypass it. If you start a zero calibration and want to abort it, press [N/-], and the calibration stops and the main display is shown.

7.3.7.5 Fast Startup

Fast Startup skips showing you many settings and is best suited to environments where the MultiRAE is turned on and off very often during a given day. If Fast Startup is not selected, then when the instrument starts, it shows you details of each sensor, including calibration information, high and low alarm settings, etc.

7.3.7.6 Temperature Units

The display unit of the internal temperature sensor can be switched between Fahrenheit and Celsius.

7.3.7.7 Language
English is the default language, but other languages can also be selected for the instrument.

7.3.7.8 Site ID
Choose and enter an 8-digit Site ID to uniquely identify the particular site where the instrument is to be used. The first four digits can be an alphabet letter or number, while the last four digits can only be numbers. This Site ID is included in the datalog report.

Note: Advance through the alphabet and numbers (0 through 9) by one with each press of the [Y/+] key. To scroll quickly, hold down the [Y/+] key for as long as you want it to scroll rapidly.

7.3.7.9 User ID
Enter an 8-digit alphanumeric User ID to uniquely identify a user. This User ID is included in the datalog report.

Note: Advance through the alphabet and numbers (0 through 9) by one with each press of the [Y/+] key. To scroll quickly, hold down the [Y/+] key for as long as you want it to scroll rapidly.

7.3.7.10 Date Format
Month (MM) and Day (DD) have two digits each, while the year (YYYY) uses four digits. The Date can be expressed in three different formats:

- MM/DD/YYYY
- DD/MM/YYYY
- YYYY/MM/DD

7.3.7.11 Date
Set the date according to the format selected in Date Format.

7.3.7.12 Time Format
The time format can be either of these two options:

- 12 Hour (AM/PM)
- 24 Hour

7.3.7.13 Time
Regardless of the Time Format you select, the MultiRAE's time must be set using the 24-hour format, following hours, minutes, and seconds (HH:MM:SS).

7.3.7.14 User Mode
Two User Modes are available: Advanced and Basic. The Advanced User Mode allows a greater number of parameters to be changed than Basic User Mode. It can be used with either of the Operation Modes, Hygiene or Search. No password is required to enter the Programming Menu when in Advanced User Mode.

7.3.7.15 Backlight
The display's backlight can be set to illuminate either automatically, based on ambient light conditions, or manually, or it can be shut off.

7.3.7.16 LCD Flip
The display can be configured to flip 180° automatically when the MultiRAE is turned upside-down. The LCD Flip feature can be set to On or Off.

8 Calibration And Testing

8.1 Bump Testing And Calibration

RAE Systems recommends a bump test be performed periodically on the MultiRAE. A bump test is defined as a brief exposure of the monitor to the calibration gas to show response and trigger the lowest alarm set point for each sensor.

- The MultiRAE multi-gas detector must be calibrated if it does not pass a bump test, or at least once every 180 days, depending on use and sensor exposure to poisons and contaminants.
- Calibration intervals and bump test procedures may vary due to national legislation.

8.1.1 Bump (Functional) Testing

RAE Systems recommends periodic bump testing to confirm that the sensors and alarms are functional. Test each sensor with an appropriate test gas in a concentration not less than the sensor's low alarm setting. To pass, each sensor should go at least to a low alarm. With the MultiRAE in Normal Mode:

1. Connect the calibration gas cylinder, flow regulator, and calibration adapter to the MultiRAE and start the gas flow.
2. Make sure the unit goes into at least a low alarm for each of the tested sensors and that the buzzer produces at least two beeps per second, the LED lights flash on and off, and the vibration alarm functions. The display backlight should illuminate and an alarm message should be shown in the display.
3. Turn off the gas flow.
4. Remove the calibration adapter.

8.2 Zero/Fresh Air Calibration

This operation sets the zero point of the sensor calibration curve for clean air. It should be performed before other calibrations.

Note: If you use a zero air cylinder, you must use the MultiRAE Calibration Adapter. Using a calibration adapter is not necessary for calibration in fresh air.

8.2.1 Zero Calibration For A CO_2 Sensor

Important! If your MultiRAE is equipped with a CO_2 sensor, it must be zero calibrated using 100% Nitrogen (N_2), which is inert, instead of fresh air or zero air. You can also use CO_2-free isobutylene, which is convenient to use for zeroing the CO_2 sensor and span calibrating a VOC sensor.

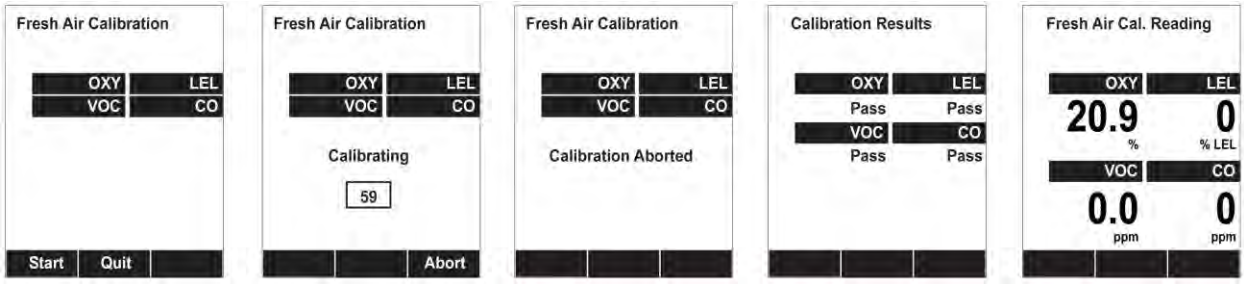
8.2.2 Fresh Air Calibration

This procedure determines zero points of most sensors. The MultiRAE should be zero-calibrated in clean air with 20.9% oxygen or with a cylinder of clean zero air.

At the Calibration menu, select "Fresh Air" by pressing [Y/+] once to enter fresh air calibration.



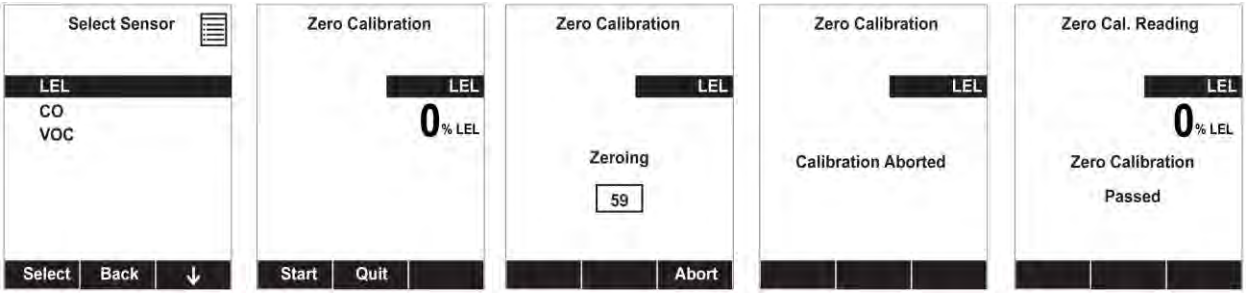
After a timer countdown, the zero calibration is done. The LCD displays the sensor names and tells you whether each calibration passed or failed, followed by the sensor readings.



Note: You can abort the calibration at any time during the countdown by pressing [N/-].

8.2.3 Single-Sensor Zero Calibration

Select the sensor and then start the calibration by pressing [Y/+]. You can abort the procedure anytime by pressing [N/-].



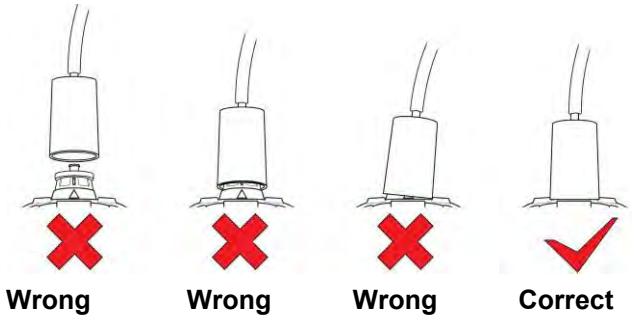
8.3 Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor.

MultiRAE Equipped With A Pump

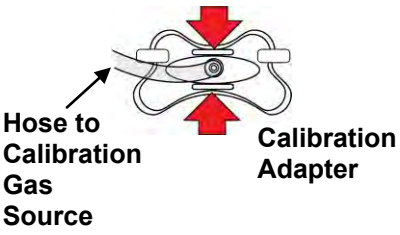
With its pump speed setting of low or high, a MultiRAE normally draws in air at a flow rate of between 200 cc/min and 300 cc/min. RAE Systems recommends that a calibration cap to be used with calibration gas flow rates from 500 cc/min to 1000 cc/min.

WARNING: Make sure the calibration cap clips on and stays in the correct position during calibration, as illustrated below. Otherwise, the calibration cap must be manually held in the correct position.

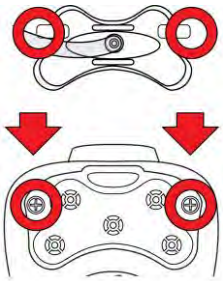


MultiRAE Lite Diffusion Model (No Pump)

Because there is no single inlet on the diffusion (non-pumped) version of the MultiRAE, a Calibration Adapter is used for supplying calibration gas to all sensors at one time. Follow these steps for attaching the Calibration Adapter.



Grasp the small handles on the Calibration Adapter.



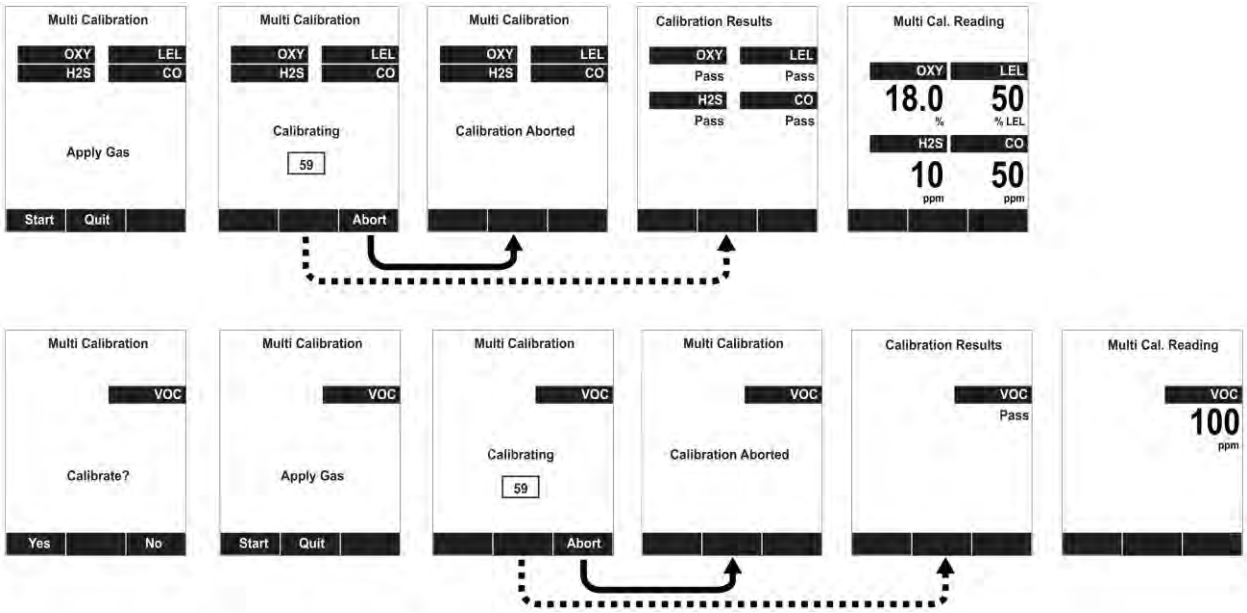
Align the Calibration Adapter's two connectors with the screws on both sides of the MultiRAE's gas inlets.



Make sure the connectors are securely in place before starting the flow of calibration gas. (The Calibration Adapter has small grooves on its underside to allow gas to escape after passing over the sensors.

8.3.1 Multi-Sensor Span Calibration

This lets you perform a span calibration on multiple sensors simultaneously. It requires using the appropriate span gas and that the concentration labeled on the gas cylinder matches the concentration programmed in the MultiRAE.



1. Attach the calibration adapter and gas to the MultiRAE.
2. Start the flow of gas and then press [Y/+] to begin calibration. A countdown screen is shown. You can abort the calibration at any time during the countdown by pressing [N/-].

If the calibration reaches its conclusion, it shows the sensor names and tells you whether the calibration passed or failed, followed by the sensor readings.

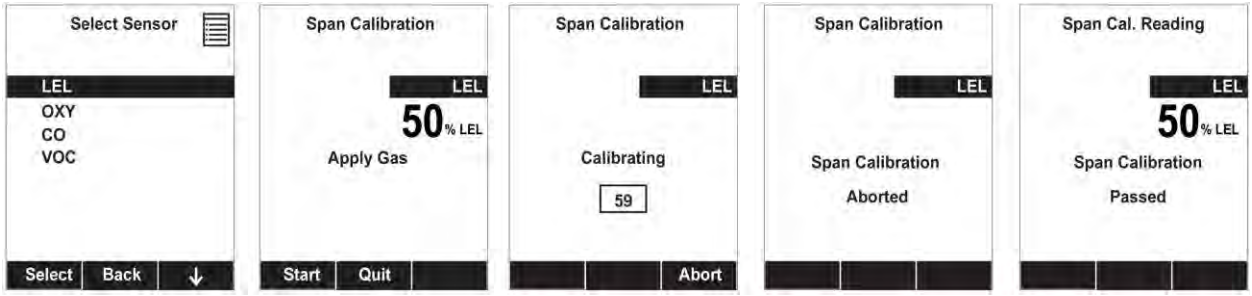
8.3.2 Single-Sensor Span Calibration

To perform span calibration of an individual sensor, follow these steps:

1. At the Calibration Menu, select "Single Sensor Span."
2. Select a sensor from the list.
3. Connect the calibration adapter and connect it to a source of calibration gas.
4. Start the flow of calibration gas.
5. Verify that the displayed calibration value meets the concentration label on the gas cylinder.



6. Press [Y/+] to start calibrating. You can abort the calibration at any time during the countdown by pressing [N/-].



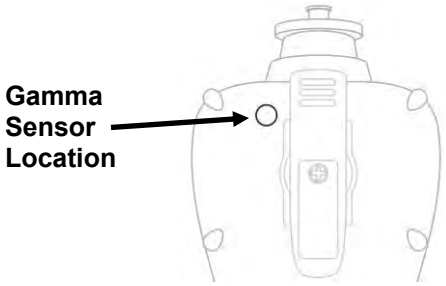
After a timer countdown, the span calibration is done. The LCD will display whether the calibration was successful and the reading for that calibration gas.

Note: If the sensor calibration fails, try again. If calibration fails again, turn off the power and then replace the sensor.

WARNING: Do not replace sensors in hazardous locations

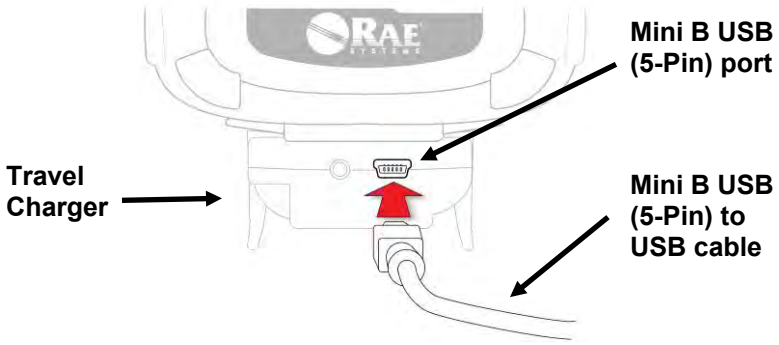
8.4 Testing The Gamma Sensor

The gamma radiation sensor does not require user calibration. You can check it by placing a check-source on the rear of the MultiRAE equipped with a gamma sensor to check the readings. There is a raised dot on the rubber boot that marks where the sensor is located inside the instrument.



9 Datalog Transfer, Monitor Configuration, and Firmware Upgrades Via Computer

Datalogs can be downloaded from the MultiRAE to a computer, and firmware updates can be uploaded to the MultiRAE via the USB port on the Travel Charger or Charging Cradle. Use the included Mini B USB (5-pin)-to-USB cable to connect the Travel Charger or Charging Cradle to a computer running ProRAE Studio II (version 1.04 or higher).



9.1 Downloading Datalogs And Performing PC-Based Instrument Configuration and Firmware Upgrades

The MultiRAE communicates with a PC running ProRAE Studio II Instrument Configuration and Data Management software (version 1.04 or higher) to download datalogs, configure the instrument, or upload new firmware.

The MultiRAE must be connected to a PC through the supplied Charging / PC Communications Cradle and must be in the PC communications mode.

1. Use the supplied PC Communications Cable (USB to mini-USB cable) to connect the Cradle or Travel Charger to a PC.
2. Turn on the MultiRAE. Make sure it is running in Normal mode (with the main measurement screen showing).
3. Insert the MultiRAE in the cradle.
4. Activate the PC communications mode on the MultiRAE by pressing [N/-] repeatedly, starting from the main measurement screen until you reach the "Communicate With Computer?" screen.
5. Press [Y/+]. Measurement and datalogging stop, and the instrument is now ready to communicate with the PC. The display now says "Ready To Communicate With Computer."
6. Start up the ProRAE Studio II software, enter a password, and detect the instrument following the directions provided in the ProRAE Studio II User's Manual.
7. Follow the instructions in the ProRAE Studio II User's Manual to download the datalog, configure the instrument settings, or update the MultiRAE's firmware.
8. When you are done, press [Y/+] to exit the PC communications mode on the MultiRAE. The instrument returns to operating in Normal mode.

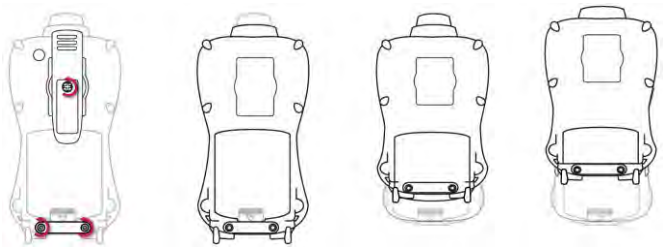
10 Maintenance

The MultiRAE requires little maintenance, aside from replacing sensors, the filter, and the battery. If the instrument is equipped with a pump, it may need replacement, as well. If the instrument has a PID, then the PID sensor lamp and sensor electrode panel may require periodic cleaning.

10.1 Removing/Installing The Rubber Boot

In order to open the MultiRAE, it is necessary to remove the belt clip and the rubber boot. Note that there are two hex screws on the bottom rear side that secure the boot.

1. Remove the belt clip by unscrewing the Philips screw (pumped version only).
2. Remove the two hex screws located below the battery area.
3. Pull the bottom of the boot back over the rear side of the instrument.
4. Carefully slide the boot upward, and slide it over the D-ring and clamp.



10.2 Replacing The Filter

Pumped Version

If a filter is dirty or clogged, remove it by unscrewing it from the inlet. Discard it and replace it with a new filter.

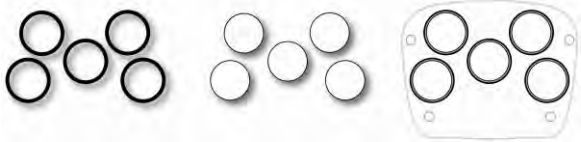


Diffusion Version

If the filters appear dirty, remove the rear cover to access them (this requires removing the rubber boot first).



Remove the four screws holding the sensor compartment cover in place.



Remove the O-rings and then remove the filters. Replace them with new filters and return the O-rings to their proper locations.

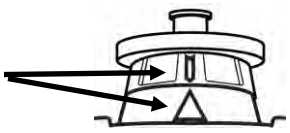


Replace the rear cover and tighten the four screws.

10.3 Replacing The Inlet

When you remove the nozzle, unscrew it in the same manner as the filter. When replacing it, make sure that the arrow on the front points to the triangle on the rubber boot.

Match arrow on nozzle to triangle on rubber boot



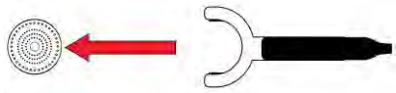
10.4 Removing/Cleaning/Replacing A PID (Pump Version Only)

Note: If you need to access a PID for cleaning or replacement, you must remove the rubber boot and belt clip first.

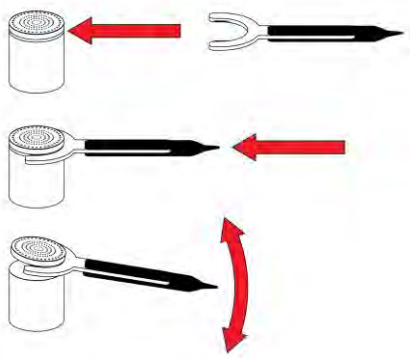
1. Turn off the instrument.
2. Remove the four screws in holding the MultiRAE sensor compartment cover in place.
3. Remove the cover to expose the sensors.



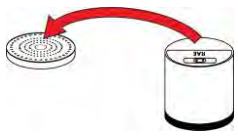
4. Gently lift out the PID module with your fingers.
5. If the module requires replacement (for example, because the lamp does not illuminate, or the module has been used past its expiration date), place a new module into the slot, being careful to match the indexing keys. The sensor can only go into its slot one way.
6. If you want to open the sensor module to inspect and clean the lamp and sensor electrode panel, you must use the special tool (part number G02-0306-003, package of three). Its "C"-shaped end has small "teeth" inside. Slide the tool so that the teeth slip into the notch between the module's cap and body:



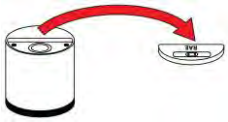
7. Gently pry up the cap using a rocking motion:



8. Once the cap is removed, set it aside.



9. Now lift the sensor electrode panel from the module:



10. Clean the sensor electrode panel in a solution of methanol lamp cleaner (included, along with cleaning swabs, in a PID Lamp Cleaning Kit, part number 081-0002-000), and allow it to dry.

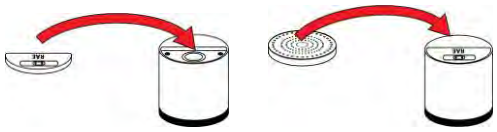
11. Clean the lamp's window with a cleaning swab dipped in methanol lamp cleaner, and allow it to dry. Do not touch the lamp window with your fingers, as the residual oils will shorten its life.



12. Inspect the electrical contacts. Clean them with a swab dipped in lamp cleaner if they appear to need cleaning:



13. Reassemble the sensor module by placing the sensor electrode panel back in place and firmly pressing the cap back onto the top.



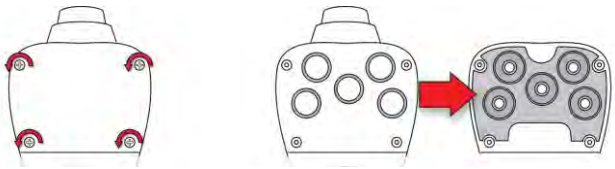
14. Place the sensor module back into the MultiRAE. Make sure the index points are aligned (it can only go in one way).
15. Reinstall the rear cover.
16. Tighten all four screws.

Note: Always calibrate the MultiRAE after replacing the sensor module.

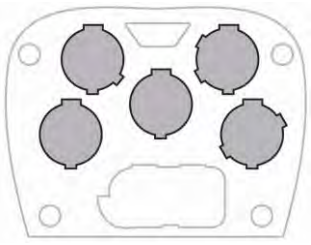
10.5 Removing/Cleaning/Replacing Sensor Modules

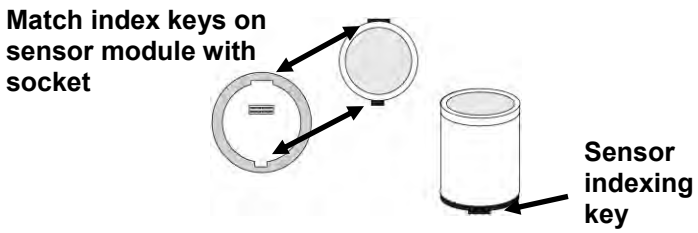
WARNING! Do not replace sensors in hazardous locations.

All sensors are located inside the sensor compartment in the upper half of the MultiRAE. They are accessed by removing the cover that is held on by four screws.



1. Turn off the instrument.
2. Remove the four screws holding the sensor compartment.
3. Remove the cover. The sensors are plugged into the slots.
4. Gently lift out the desired sensor module with your fingers.
5. Install the replacement sensor. It can only go into its slot one way. The connector inside the MultiRAE and the indexing guides are good visual indicators of how to set the sensor into position. Make sure the indexing keys are aligned and that the sensor is seated firmly.

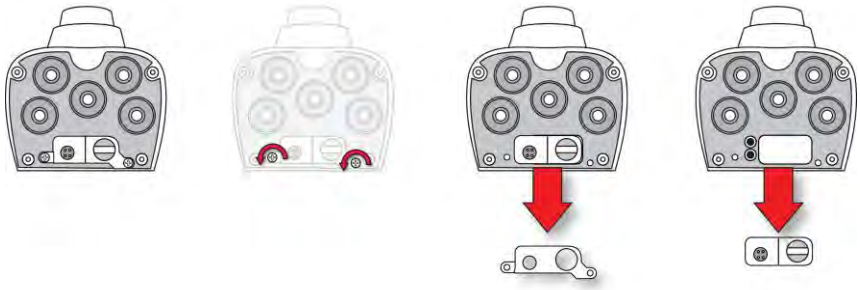




10.6 Replacing The Pump

If your MultiRAE has a pump and it requires replacement, follow these steps. Make sure the battery is removed before proceeding.

1. Remove the rear cover.
2. The pump is held in place by a metal bracket and two Philips screws. Remove the two screws.
3. Lift off the metal bracket.
4. Pressing down on the gas plate with one hand, pull the pump straight out. It has an inlet and outlet that are held in the two holes with rubber gaskets to the left of the pump cavity.



5. Press a new pump into place (a small amount of wiggling helps), making sure that both the inlet and outlet from the pump go into the two holes.
6. Place the metal bracket over the pump.
7. Insert and tighten the two screws that attach the bracket to the housing.
8. Replace the cover.
9. Turn on the instrument and check for proper pump operation.

11 Alarms Overview

The MultiRAE provides an unmistakable five-way alarm notification system that combines local alarms on the device with real-time remote wireless alarm notification to take worker safety to the next level. Local alarms include audible buzzer alarm, visible alarm via bright LED lights, vibration alarm, and an alarm notification on the display. These can be programmed or selectively turned on or off.

Note: The vibration alarm is automatically disabled whenever the alkaline adapter is used.

11.1 Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits for Low, High, TWA and STEL alarm. If the concentration exceeds any of the preset limits, the alarms are activated immediately to warn both the MultiRAE user and a remote safety officer (if wireless is enabled) of the alarm condition.

In addition, the MultiRAE alarms if one of the following conditions occurs: battery voltage low, pump blocked, PID lamp failed, etc.

When the low battery alarm occurs, there may be approximately 10 minutes of operating time remaining. In this case, it is recommended that you promptly change or charge the battery in a non-hazardous location.

11.2 Changing The Alarm Mode

Your choices are Auto Reset and Latched. A latched alarm stays on until you acknowledge the alarm by pressing a button. An auto-reset alarm turns off when the condition that set off the alarm is no longer present (for instance, a high H2S reading that exceeds the preset threshold and triggers an alarm, but then lowers below that threshold, turning the alarm off).

1. Enter the Alarm Mode sub-menu of the Alarms section under the Programming Menu.
2. Select Auto Reset or Latched by pressing [N/-] to select, and [Y/+] to confirm the choice.
3. Press [Y/+] to save your selection.

11.3 Alarm Signal Summary

Hygiene Mode

Alarm Type	Buzzer & LED	Display	Vibration	Reading	Backlight	Priority
Super Alarm	4 beeps/sec	"Super Alarm" screen	400ms	-	On	Highest
Man Down Alarm	3 beeps/sec	"Man Down Alarm" screen	400ms	-	On	
Man Down Warning	2 beeps/sec	"Are you OK" screen	400ms	-	On	
Fail	3 beeps/sec	"Lamp" at PID location "Off" at LEL location	400ms	Blinking reading	On	
Pump	3 beeps/sec	Blinking pump symbol	400ms	Reading	On	
Max	3 beeps/sec	"Max" at sensor location	400ms	Blinking reading	On	
Over Range	3 beeps/sec	"Over" at sensor location	400ms	Blinking 9999	On	
High	3 beeps/sec	"High" at sensor location	400ms	Reading	On	
Low	2 beeps/sec	"Low" at sensor location	400ms	Reading	On	
Negative	1 beep/sec	"Neg" at sensor location	400ms	0	On	
STEL	1 beep/sec	"STEL" at sensor location	400ms	Reading	On	
TWA	1 beep/sec	"TWA" at sensor location	400ms	Reading	On	
Calibration	1 beep/sec	"Cal" at sensor location	400ms	Reading	On	
Datalog Full	1 beep/sec	Blinking datalog symbol	400ms	Reading	On	
Calib Due	-	Bottle symbol	-	Reading	-	
Battery	1 beep/min	Blinking battery symbol	400ms	Reading	Stays as is	
Nwk Lost	1 beep/min	Blinking RF offline symbol	400ms	Reading	On	
Nwk Joined	1 beep	RF symbol with RSSI	400ms	Reading	On	
Comfort Beep	1 beep/min no LED flash	-	-	Reading	-	Lowest

Notes

"Negative" means that the reading is below zero.
"Nwk Lost" means "Network Lost." This indicates that the MuliRAE has lost wireless connectivity with its network.
"Nwk Joined" means that the MultiRAE has joined a wireless network.

Search Mode

Alarm Type		Buzzer & LED	Display	Vibration	Reading	Backlight	Priority
Super Alarm		4 beeps/sec	"Super Alarm" screen	400ms	-	On	Highest
Man Down Alarm		3 beeps/sec	"Man Down Alarm" screen	400ms	-	On	
Man Down Warning		2 beeps/sec	"Are You OK?" screen	400ms	-	On	
Fail		3 beeps/sec	"Lamp" at PID location "Off" at LEL location	400ms	Blinking reading	On	
Pump		3 beeps/sec	Blinking pump symbol	400ms	Reading	On	
Max		3 beeps/sec	"Max" at sensor location	400ms	Blinking reading	On	
Over Range		3 beeps/sec	"Over" at sensor location	400ms	Blinking 9999	On	
Geiger Counter style Alarm	G7 (>High)	7 beeps(30ms)/sec	No change	400ms	Reading	On	
	G6	6 beeps(40ms)/sec					
	G5	5 beeps(50ms)/sec					
	G4	4 beeps(60ms)/sec					
	G3	3 beeps(70ms)/sec					
	G2	2 beeps(80ms)/sec					
	G1 (>Low)	1 beep(90ms)/sec					
Negative		1 beep/sec	"Neg" at sensor location	400ms	0	On	
STEL		1 beep/sec	"STEL" at sensor location	400ms	Reading	On	
TWA		1 beep/sec	"TWA" at sensor location	400ms	Reading	On	
Calibration		1 beep/sec	"Cal" at sensor location	400ms	Reading	On	
Datalog Full		1 beep/sec	Blinking datalog symbol	400ms	Reading	On	
Calib Due		-	Bottle symbol	-	Reading	-	
Battery		1 beep/min	Blinking battery symbol	400ms	Reading	Stays as is	
Nwk Lost		1 beep/min	Blinking RF offline symbol	400ms	Reading	On	
Nwk Joined		1 beep	RF symbol with RSSI	400ms	Reading	On	

General Alarms

Message	Condition	Alarm Indications
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second
OVR	Gas exceeds sensor's measurement range	3 beeps/flashes per second
MAX	Gas exceeds electronic circuit's maximum range	3 beeps/flashes per second
LOW	Gas exceeds "Low Alarm" limit*	2 beeps/flashes per second
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second
Crossed pump icon flashes	Inlet blocked or pump failure	3 beeps/flashes per second
"Lamp" flashes	PID lamp failure	3 beeps/flashes per second
Empty battery icon flashes	Low battery	1 flash, 1 beep per minute
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Zero gas reading measures less than number stored in calibration	1 beep/flash per second

* For oxygen, "low alarm limit" means a concentration is lower than the low alarm limit.

12 Troubleshooting

Problem	Possible Reasons & Solutions
Cannot turn on power after charging the battery	**Reasons:** Defective charging circuit. Defective battery. **Solutions:** Replace battery or charger. Try another charge of battery.
Lost password	**Solutions:** Call Technical Support at +1 408-952-8461 or toll-free at +1 888-723-4800
Buzzer, LED lights, and vibration motor inoperative	**Reasons:** Buzzer and/or other alarms disabled. Bad buzzer. **Solutions:** Check under "Alarm Settings" in Programming Mode that buzzer and/or other alarms are not turned off. Call authorized service center.
"Lamp" message when power on. Lamp alarm.	**Reasons:** Low ion concentration inside PID lamp especially in cold environment when first powered on. Defective PID lamp or defective circuit. **Solutions:** Turn the unit off and back on. Replace UV lamp.
Pump failed message. Pump alarm.	**Reasons:** Inlet probe blocked. Direct connection to a gas outlet while the gas value is turned off. Water trap filter sucks in water. Water trap filter too dirty. Water condensed along the inlet probe. Bad pump or pump circuit. **Solutions:** Remove the blocking objects and then press [Y/+] key to reset the pump alarm. Replace contaminated water trap filter. Be careful not to allow water condensation inside the unit. Replace the pump.

If you need replacement parts, a list is available online:

www.raesystems.com

13 Diagnostic Mode

In Diagnostic Mode, the MultiRAE provides raw counts for sensor, battery, and other readings, as well as a list of installed sensors and information about them (expiration date, serial number, etc.). Most of these screens are useful only to service technicians. A few allow access for changing settings.

The MultiRAE's Diagnostic Mode can only be accessed at startup time. In Diagnostic Mode, MultiRAE displays readings in raw counts instead of units such as parts per million (ppm).

13.1 Entering Diagnostic Mode

1. With the MultiRAE turned off, press and hold both [MODE] and [Y/+].
2. When the display turns on and the password screen appears, release the keys.
3. Enter the 4-digit password (the password is the same as the one for the Programming Mode; the default password is 0000):

   - Step from one position in the four-character string to the other by pressing [N/-].
   - Press [Y/+] repeatedly to select a desired number. Numbers increase from 0 to 9.
   - Once 9 is reached, pressing [Y/+] again "wraps" around back to 0.

4. When you are done, press [MODE]. If you input the correct password, you see the "Product Model" screen.

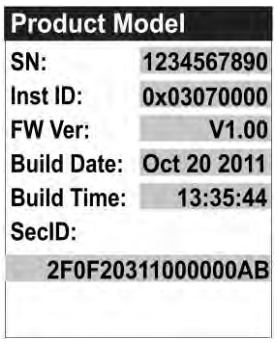
13.2 Exiting Diagnostic Mode

1. Turn off the MultiRAE by pressing and holding [MODE]. There will be a standard shutoff countdown.
2. When the instrument shuts off, you will be alerted. Release your finger.

Note: The next time you start MultiRAE, hold only [MODE], and it will automatically start in Normal Mode.

13.3 Navigating Diagnostic Mode

Step through Diagnostic Mode by pressing [MODE]. The first screen you see is information about the product, including the serial number, firmware version, etc.:



Press [MODE] to advance through the screens:

- Sensor Firmware
- ExtFlash
- Sensor Installed
- Location 1
- Location 2
- Location 3
- Location 4
- Location 5

- Socket Raw Count
- Calibration Data
- Buzzer
- Pump
- Battery
- RTC (real-time clock)
- Lights/Vibrator
- T.H. (temperature and humidity)
- LCD Contrast
- Position Sensor
- Communicate With Computer? (Datalogging And Measurement Will Pause)

14 Specifications

Instrument Specifications

Size	7.6" H x 3.8" W x 2.6" D (193 x 96.5 x 66 mm)
Weight	Pumped models: 31 oz. (880 g) Diffusion models: 26.8 oz. (760 g)
Sensor	Over 30 intelligent interchangeable field-replaceable sensors, including Gamma radiation, ppb and ppm PIDs, electrochemicals for toxics and oxygen, combustible LEL and NDIR, and CO_2 NDIR
Battery Options	• Rechargeable Li-ion (~12 hours runtime, pumped/18 hours, diffusion; < 6 hours recharge time) • Alkaline adapter for 4 x AA batteries (~ 6 hours runtime, pumped/8 hours, diffusion)
Display	• Monochrome graphical LCD display (128 x 160) with backlighting (activated automatically in dim ambient lighting conditions, when monitor is in alarm, or with a button press) • Automatic screen flipping.
Display Readout	• Real-time reading of gas concentrations; PID measurement gas and correction factor; battery status; datalogging on/off; wireless on/off and reception quality. • STEL, TWA, peak, and minimum values
Keypad	1 operation and 2 programming keys (MODE, Y/+, and N/-)
Sampling	Built-in pump or diffusion. Average flow rate, pumped: 250 cc/min. Auto shutoff in low-flow conditions
Calibration	Automatic with AutoRAE 2 Test and Calibration Station or manual
Alarms	• Wireless remote alarm notification; multi-tone audible (95 dB @ 30 cm), vibration, visible (flashing bright red LEDs), and on-screen indication of alarm conditions • Man Down Alarm with pre-alarm and real-time remote wireless notification
Datalogging	• Continuous datalogging (six months for 5 sensors at 1-minute intervals, 24/7) • User-configurable datalogging interval (from 1 to 3,600 seconds)
Communication and Data Download	• Data download and instrument set-up and upgrades on PC via charging and PC communication cradle, travel charger, or AutoRAE 2 Automated Test and Calibration Station[1] • Wireless data and status transmission via built-in RF modem (optional)
Wireless Network	RAE Systems Dedicated Wireless Network
Wireless Frequency	ISM license-free bands
Wireless Range (Typical)	656 feet (200 meters)
EM Immunity	No effect when exposed to 0.43mW/cm^2 RF interference (5-watt transmitter at 12")
Operating Temperature	-4° to 122° F (-20° to 50° C)

Instrument Specifications *continued*	
Humidity	0% to 95% relative humidity (non-condensing)
Dust and Water Resistance	IP-65 (pumped), IP-67 (diffusion)
Hazardous Location Approvals	Exia Class I, Division 1, Groups A, B, C, D, T4 SIRA 11ATEX2152X, CE 0575 Ex II 1G Ex ia IIC T4 Ga (for PGM62x0/PGM62x6) SIRA 11ATEX2152X, CE 0575 Ex II 2G Ex ia d IIC T4 Gb (for PGM62x8) UM=20V IECEx SIR 11.0069X, Ex ia IIC T4 Ga (for PGM62x0/PGM62x6) IECEx SIR 11.0069X, Ex ia d IIC T4 Gb (for PGM62x8)
CE Compliance (European Conformity)	EMC directive: 2004/108/EC R&TTE directive: 1999/5/EC ATEX directive: 94/9/EC
Performance Tests	LEL CSA C22.2 No. 152; ISA-12.13.01
Languages	Arabic, Chinese, Czech, Danish, Dutch, English, French, German, Indonesian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Russian, Spanish, and Swedish
Warranty	• Two years on non-consumable components and catalytic LEL, CO, H_2S, and O_2 sensors • One year on all other sensors, battery, and other consumable parts
Specifications are subject to change.	

Sensor Specifications

Radiation Sensor	Range	Resolution
Gamma	0 to 20,000 microREM/h	1 microREM/h
PID Sensors	**Range**	**Resolution**
VOC 10.6 eV (HR) VOC 10.6 eV (ppb) VOC 9.8 eV [1]	0.1 to 5,000 ppm 10 ppb to 2,000 ppm 0.1 to 1,000 ppm	0.1 ppm 10 ppb 0.1 ppm
Combustible Sensors	**Range**	**Resolution**
Catalytic bead LEL NDIR (0-100% LEL Methane) NDIR (0-100% Vol. Methane)	0 to 100% LEL 0 to 100% LEL 0 to 100% Vol.	1% LEL 1% LEL 0.1% Vol.
Carbon Dioxide Sensor	**Range**	**Resolution**
Carbon Dioxide (CO_2) NDIR	0 to 50,000 ppm	100 ppm
Electrochemical Sensors	**Range**	**Resolution**
Ammonia (NH_3)	0 to 100 ppm	1 ppm
Carbon Monoxide (CO) Carbon Monoxide (CO), Ext. Range Carbon Monoxide (CO), H_2-comp.	0 to 500 ppm 0 to 2,000 ppm 0 to 2,000 ppm	1 ppm 10 ppm 10 ppm
Carbon Monoxide (CO) + Hydrogen Sulfide (H_2S) Combo	0 to 500 ppm 0 to 200 ppm	1 ppm 0.1 ppm
Chlorine (Cl_2)	0 to 50 ppm	0.1 ppm
Chlorine Dioxide (ClO_2)	0 to 1 ppm	0.03 ppm
Ethylene Oxide (EtO-A) Ethylene Oxide (EtO-B) Ethylene Oxide (EtO-C), Ext. Range	0 to 100 ppm 0 to 10 ppm 0 to 500 ppm	0.5 ppm 0.1 ppm 10 ppm
Formaldehyde (HCHO)	0 to 10 ppm	0.01 ppm
Hydrogen (H_2)	0 to 1,000 ppm	2 ppm
Hydrogen Chloride (HCl)	0 to 15 ppm	1 ppm
Hydrogen Cyanide (HCN)	0 to 50 ppm	0.5 ppm
Hydrogen Fluoride (HF)	0 to 10 ppm	0.1 ppm
Methyl Mercaptan (CH_3-SH)	0 to 10 ppm	0.1 ppm
Nitric Oxide (NO)	0 to 250 ppm	0.5 ppm
Nitrogen Dioxide (NO_2)	0 to 20 ppm	0.1 ppm
Oxygen (O_2)	0 to 30% Vol.	0.1% Vol.
Phosgene ($COCl_2$)	0 to 1 ppm	0.02 ppm
Phosphine (PH_3) Phosphine (PH_3), Ext. Range	0 to 20 ppm 0 to 1,000 ppm	0.1 ppm 1 ppm
Sulfur Dioxide (SO_2)	0 to 20 ppm	0.1 ppm

All specifications are subject to change without notice.

LEL Range, Resolution & Response Time

LEL 0-100% 1 % 15 sec

LEL Cross-Sensitivity

Compound	LEL Relative Sensitivity*	LEL CF
Methane	100	1.0
Propane	62	1.6
Propene	67	1.5
n-Butane	50	2.0
Isobutylene	67	1.5
n-Pentane	45	2.2
n-Hexane	43	2.3
Cyclohexane	40	2.5
Benzene	45	2.2
Toluene	38	2.6
n-Heptane	42	2.4
n-Octane	34	2.9
Turpentine	34	2.9
Leaded Gasoline	48	2.1
Methanol	67	1.5
Ethanol	59	1.7
Isopropanol	38	2.6
Acetone	45	2.2
Methyl Ethyl Ketone	38	2.6
Ethyl Acetate	45	2.2
Carbon Monoxide	75	1.2
Hydrogen	91	1.1
Ammonia	125	0.80

* Response of the RAE Systems LEL sensor to a range of gases at the same LEL, expressed as percent of methane response (=100). These figures are for guidance only and are rounded to the nearest 5%. For the most accurate measurements, the instrument should be calibrated with the gas under investigation. See RAE Systems Technical Note TN-156 for more details and other compounds.

Caution:
Refer to RAE Systems Technical Note TN-144 for LEL sensor poisoning.

Year Of Manufacture

To identify the year of manufacture, refer to the serial number of the instrument.

The second to last digit in the serial number indicates the year of manufacture. For example, "M" indicates the manufacturing year is 2010.

First digit	Year
J	2008
K	2009
M	2010
N	2011
P	2012
Q	2013
R	2014
S	2015
T	2016
U	2017
V	2018
W	2019

15 Technical Support

To contact RAE Systems Technical Support Team:

Monday through Friday, 7:00AM to 5:00PM Pacific (US) Time
Phone (toll-free): +1 888-723-4800
Phone: +1 408-952-8461
Email: tech@raesystems.com

Critical after-hours support is available:
+1 408-952-8200 select option 9

16 RAE Systems Contacts

RAE Systems
World Headquarters
3775 N. First St.
San Jose, CA 95134-1708 USA
Phone: +1 408.952.8200
Fax: +1 408.952.8480

E-mail: customerserv@raesystems.com
Web Site: www.raesystems.com

RAE Systems Technical Support
Monday through Friday, 7:00AM to 5:00PM Pacific Time
Phone: +1.408.952.8461
Email: tech@raesystems.com

Critical after-hours support is available
+1.408.952.8200 select option 9

RAE Systems Europe ApS
Kirstinehøj 23 A
DK-2770 Kastrup
Denmark
Phone: +45 86 52 51 55
Fax: +45 86 52 51 77
orders@raeeurope.com
sales@raeeurope.com
service@raeeurope.com
Web: www.raesystems.eu

RAE Systems UK Ltd
D5 Culham Innovation Centre
Culham Science Centre
Abingdon, Oxon OX14 3DB
United Kingdom
Phone: +44 1865408368
Fax: +44 1235531119
Mobile: +44 7841362693
Email: raeuk@raeeurope.com

RAE Systems France
336, rue de la fée des eaux
69390 Vernaison
France
Phone: +33 4 78 46 16 65
Fax: +33 4 78 46 25 98
Email: info-france@raeeurope.com
Web: www.raesystems.fr

RAE BeNeLux BV
Hoofdweg 34C
2908 LC Capelle a/d IJssel
The Netherlands
Phone: +31 10 4426149
Fax: +31 10 4426148
Email: info@rae.nl
Web: www.rae.nl

RAE Systems Spain, s.l.
Av. Remolar, 31
08820 El Prat de Llobregat
Spain
Phone: +34 933 788 352
Fax: +34 933 788 353
Mobile: +34 687 491 106
Email: mdelgado@raespain.com
Web: www.raespain.com

RAE Middle East
LOB 7, Ground Floor, Office 19
Jebel Ali Free Zone
Dubai, United Arab Emirates
Phone: +971.4.887.5562
Email: mesales@raesystems.com

RAE Systems (Hong Kong) Ltd.
Room 8, 6/F, Hong Leong Plaza
33 Lok Yip Road
Fanling, N.T, Hong Kong
Phone: +852.2669.0828
Fax: +852.2669.0803
Email: hksales@raesystems.com

RAE Systems Japan
403 Plaza Ochanomizu Bldg. 2-1
Surugadai Kanda Chiyoda-Ku
Tokyo, Japan
Phone: 81-3-5283-3268
Fax: 81-3-5283-3275
Email: jpsales@raesystems.com

RAE Systems Korea
#1010, DaeMyungAnsVill First,
Sang-Dong 412-2, Wonmi-Gu, Bucheon,
Kyungki-Do, Korea
Phone: 82-32-328-7123
Fax: 82-32-328-7127
Email: krsales@raesystems.com



RAE Systems
World Headquarters
3775 N. First St.
San Jose, CA 95134-1708 USA
Phone: 408.952.8200
Fax: 408.952.8480

E-mail: customerserv@raesystems.com
Web Site: www.raesystems.com

Rev C
November 2011
P/N: M01-4003-000

APPENDIX B

RESUMES

Diane Conroy

Project Manager

EXPERIENCE SUMMARY



Ms. Diane Conroy is a project manager with 9 years of experience in environmental compliance reporting, environmental permitting, site remediation, and statistical data analysis. The most recent 4 years have primarily been focused on Air Quality Compliance and Permitting. Her project work experience includes periodic groundwater, surface water, air quality, and soil compliance reporting, remedial environmental assessments, including alternative environmental impact statements, emission statements, volume calculations, cost estimation, certification reports, and quality assurance.

RELEVANT EXPERIENCE

Air Quality

- Assists with preparing Title V air quality operating permit applications, both initial permits and permit modifications, at various landfill sites on the East Coast and in the Midwest.
- Assists with the removal of Title V air quality operating permits, at landfill sites on the East Coast and in the Midwest.
- Assists with permitting efforts for equipment such as flares, engines/generators, boilers, screeners/trommels, parts washers, etc.
- Assists with annual Emissions Statements, annual greenhouse gas reporting, and semi-annual New Source Performance Standards (NSPS) monitoring reports at various landfill sites on the East Coast.
- Uses the Radius and TANKS software affiliated with these required documents for various landfill sites in New Jersey.
- Completes calculations for emissions (total, potential, and fugitive) and prepares risk assessments at various landfill sites.
- Assists with Environmental Improvement Pilot Study permit applications.
- Conducts indoor and ambient air sampling and reporting at various commercial sites in New Jersey.
- Performs inspections of air pollution control system and associated equipment, such as exhaust fans and dust suppression systems, at various transfer stations in New York.

Landfill Gas

- Conducts landfill gas well monitoring, landfill gas perimeter probe monitoring, and surface emissions monitoring, and completed associated reporting at a landfill site in New Jersey.
- Prepares landfill gas well schedules, cost estimates, and project certification reports for landfill gas well replacement and hydrogen sulfide removal technology at various landfill sites in New Jersey.

Education

B.S., Environmental Science, University at Albany, NY, 2012

Area of Expertise

Environmental Permitting
Environmental Compliance & Reporting

Training/Certifications

OSHA 40-hr. HAZWOPER Training
NJDEP Air Quality Permitting Training
Sanitas Groundwater Statistical Analysis Software Training
NYS DEC Sediment and Erosion Control Training
Air Quality Regulations Training
First Aid/CPR/AED Training
Confined Space Entry and Rescue Training

Office

Middletown, NY

Years of Experience

Since 2014 (9 years)

Years within firm

Since 2014 (9 years)

Contact

diane.conroy@tetratech.com

Water Quality

- Conducts groundwater well, surface water, and stormwater monitoring and sampling at several landfill sites in New York and New Jersey.
- Prepares semi-annual groundwater monitoring reports with and without performing statistical analysis, via Sanitas software, on provided groundwater data for various landfill sites in New Jersey.
- Prepares groundwater quality maps utilizing EnviroInsite and AutoCAD software.

Soil

- Conducts sediment sampling at a landfill site in New York.
- Reviews analytical results, geotechnical results, and prepares acceptance letters pertaining to materials entering landfills during construction projects in various locations in New Jersey.

Remediation

- Assists with preparing New Jersey Department of Environmental Protection (NJDEP) Ground Water Classification Exception Area Reports, Biennial Certification Monitoring Reports for Ground Water Classification Exception Areas, Quality Assurance Project Plans, and NJDEP Receptor Evaluations for various sites in New Jersey.
- Conducts annual inspections, prepares storage tank applications, and prepares Spill Prevention Reports for various Chemical Bulk Storage and Petroleum Bulk Storage facilities in New York.

Design

- Prepares well schedules, quantity estimates, modifications for final cover design, and used the HELP3 Model software affiliated with stormwater design work for construction projects at various sites in New Jersey.

Facilities

- Assists with preparing Local Solid Waste Management Plans for various counties in New York.

Field Technician

- Performs landfill gas monitoring and sampling at various landfill sites in New Jersey.
- Performs groundwater, surface water, and sediment monitoring and sampling at various landfill sites in New York and New Jersey.
- Performs stormwater compliance inspections and sampling at various sites throughout New York.
- Performs indoor and ambient air quality sampling at various commercial sites in New Jersey.
- Performs liner installation quality assurance at a composting facility in New York.

PRESENTATIONS

- Conroy, D. (2023) Scrap Metal Facilities in the Regulatory Spotlight. New Jersey Solid Waste Association of North America Spring Conference, April 27. Atlantic City, NJ.
- Conroy, D. (2023) Once a Title V, Always a Title V…Or Not?. New York Solid Waste Association of North America Federation Conference, May 23. Bolton Landing, NY.

TETRA TECH

Nicole Scalla

Environmental Engineer

EXPERIENCE SUMMARY



Mrs. Scalla is an environmental engineer reporting out of the Middletown, New York office. Currently, her primary responsibilities include providing engineering support, assist in field activities, and support large clients and their project goals.

Mrs. Scalla's education included coursework in construction design, hydrology, fluid mechanics, wastewater and drinking water treatment design, and energy.

RELEVANT EXPERIENCE

Construction Design and Remediation

City of Brooklyn; Multiple Brownfields Cleanup Sites (BCPs); Gowanus Section; July 2022 - October 2023

- Performed multiple site investigations including soil and groundwater monitoring, air monitoring, and general construction oversight.
- Assisted in the design and implementation of sub-slab depressurization systems and soil vapor extraction systems.
- Spearheaded communications between the client and all regulatory agencies including the New York State Department of Environmental Conservation (NYS DEC), New York State Department of Environmental Protection (NYS DEP), and the United States Environmental Protection Agency (US EPA), while assuring all regulatory standards were met in accordance with construction activities.

City of Bayonne; Inter-Matex Tank Terminal (IMTT); Bayonne, NY: November 2023 - Present

- Assisting in all field activities including groundwater and soil sampling, as well as drone aerial investigations targeting multiple points of contamination throughout the site.
- Offer technical support (data tabulation, report writing, proposal work, and AutoCad).

Education

BS, Civil Engineering,

Manhattan College 2021

Area of Expertise

Environmental Remediation

Soil & Groundwater Sampling

Construction Oversight

Registrations/Affiliations

American Society of Civil Engineers (ASCE)

Training/Certifications

OSHA 30 Hour Construction Safety Course

OSHA 40-hour HAZWOPER

Office

Middletown, New York

Years of Experience

Since 2022 (2 years)

Years with Firm

Since 2023 (1 year)

Contact

nicole.scalla@tetratech.com

TETRA TECH

Jiss Phillip, EIT

Environmental Engineer

EXPERIENCE SUMMARY

Jiss Philip is an environmental engineer with experience in remedial investigation, feasibility studies, remedial design, AutoCAD construction drawings, specifications, cost estimates, groundwater sampling, sediment sampling, soil sampling, pump station designs, and shop drawing reviews. Jiss has prepared groundwater contour maps, contaminant ISO concentration drawings, chemical box figures summarizing analytical data, and hydraulic calculations. She has also been involved in engineering design, planning, and project coordination for water and wastewater projects.

RELEVANT EXPERIENCE

Raritan Bay Slag Superfund Site, USEPA Region 2, Laurence Harbor, NJ

As Task Lead and Project Engineer assisted with preparing QAPP and HASP for a pre-design investigation to refine the delineation of lead-contaminated soils and sediments along the Laurence Harbor coast. Served as the task lead for the pre-design investigation and when needed helped the field crew, directing soil boring installations, logging soil cores, collecting soil grab samples, running an air monitoring program, and sequencing work with respect to the tide cycle. During fieldwork, utilized a project-specific mobile phone application to track soil borings, samples, and project progress. The fieldwork consisted of a total of 250 direct push/sediment boring locations plus 5 geotechnical soil boring locations. Following fieldwork, assisted in the preparation of the field investigation report and pre-design investigation report. Contributed to draft remedial design, interpreting analytical results to develop excavation areas and depths in Civil 3D, calculating proposed excavation volumes, creating draft design drawing sets, providing assumptions for rock wall restoration, and preparing specifications and cost estimates. Later assisted with the technical review of remedial design by others.

NYSDEC, Standby State Superfund Contract, Magna Metals, Cortland Manor, NY

As an environmental engineer, provided environmental engineering support and was involved in preparing the pre-design investigation and remedial design for the former metals plating site. The PDI included 12 borings advanced to bedrock around 9 leach pits, a collection of 100 sediment samples from a 3-acre pond, and 60 samples from approximately 800 linear feet of Furnace Brook. Assisted in collecting from the pond and Furnace Brook. The RD consisted of removal of the leach pits and excavation of contaminated soil to bedrock using sheet piling, dredging of pond and wetland sediments, and excavation of approximately 800 feet of Furnace Brook.

Education

MS, Environmental Engineering, 2012

BS, Environmental Engineering, 2007

Area of Expertise

Soil, Groundwater, and Sediment Investigation

Pre-Design Investigations

Engineering Analysis

Feasibility Study Preparation

Registrations/Affiliations

Engineering-Training (NJ)

Training/Certifications

OSHA 40-hour HAZWOPER

OSHA 8-hour Refresher

Department of Transportation Hazardous Materials Transportation Trained

10-hour Construction Safety and Health Trained

Office

Middletown, NY

Years of Experience

Since 2012 (11 years)

Years with Firm

Since 2022 (1 year)

Contact

Jiss.phillip@tetratech.com

USACE KC District, Quanta Resources Superfund Site OU1, Borough of Edgewater, Hudson County, NJ

As an environmental engineer, provided environmental engineering support and has been involved in oversight of the PRP's RI/FS field activities; preparing field reports and evaluating investigation data for the Quanta Site, which consists of an approximate 24-acre upland area (OU1) and 20-acre impacted sediment area in the Hudson River (OU2). There are large amounts of coal tar and oil NAPL in the subsurface of the site as well as high-concentration arsenic areas (HCAA) with concentrations greater than 10,000 mg/kg. The selected remedy for the upland portion of the site included a site-wide cap, vertical barrier cut-off wall along the Hudson River bulkhead, in-situ solidification/stabilization (ISS) of the shallow NAPL, collection of deeper NAPL and chemical stabilization of the HCAA. If the stabilization of the arsenic was not effective, a sheet pile hydraulic barrier and P&T system were to be installed around the HCAA. Provided oversight of the PDI and remedial design activities including the ISS pre-design investigation, VI sampling, and NAPL recovery operations. The bench test consisted of a collection of several NAPL samples that were mixed with reagents at various percentages to assess the optimal design mixture to solidify the NAPL at the site. The samples were evaluated for unconfined compressive strength, hydraulic conductivity, and leachability of contaminants. Leachability testing included EPA pre-method 14, 15, and ANSI 16.1 which was used to calculate a percent reduction in leached contaminants. Once an optimal reagent mixture was selected, a field demonstration was conducted consisting of four 20- by 20-foot test areas where different soil mixing techniques (auger and excavator) were evaluated.

USEPA Region 2, Remedial Action Contract, Fair Lawn Well Field Superfund Site, Bergen County, NJ

As an environmental engineer, provided environmental engineering support and was involved in oversight of the PRP's RI/FS field activities; collecting and analyzing split samples; preparing field reports and evaluating investigation data.

USEPA Region 2, Remedial Action Contract, Gowanus Canal Superfund Site, Brooklyn, NY

As an environmental engineer, provided environmental engineering support and groundwater monitoring.

USEPA Region 2, Remedial Action Contract, Ellenville Scrap Iron and Metal Superfund Site, Ulster County, NY

As an environmental engineer, provided environmental engineering support for the Ellenville Scrap Metal Superfund Site, which included the preparation of an RI/FS. Assisted in the compilation of the investigation data into AutoCAD figures, including a summary of sampling analytical results, groundwater contour maps, geologic cross-sections, groundwater contaminant plume ISO concentration maps, site location maps, and investigation sample location maps. Investigation samples included soil gas, surface soil, geoprobe subsurface soil, test pits, post-excavation, hydropunch, groundwater, surface water, sediment, and leachate. Assisted in the completion of an FS, including three groundwater alternatives and four soil remedial alternatives. The FS deliveries consisted of a remedial alternative selection and remedial alternative evaluation technical memorandum as well as the combined FS. Prepared detailed screening tables outlining the remedial technology identification and screening for soil, groundwater, and solid waste, alternative identification and screening for groundwater, soil, and solid waste, and alternative individual and comparative evaluations. Completed detailed cost estimates for each alternative as part of the evaluation process, including quantity take-offs for the major cost items. Also prepared a conceptual final grading plan for two 6 NYCRR Part 360 cap alternatives. Coordinated the QC review of the three FS deliverables by incorporating the comments from multiple reviewers and assembling the final documents.

USEPA Region 2, Remedial Action Contract, Peninsula Boulevard Groundwater Plume Superfund Site, Hewlett, NY

As an environmental engineer, provided environmental engineering support for the Peninsula Boulevard Groundwater Plume Site, which included the preparation of an RI/FS. Assisted in the compilation of the investigation data into AutoCAD figures including a summary of sampling analytical results, geologic cross-sections, groundwater contaminant plume ISO concentration maps, site location maps, and investigation sample location maps. Investigation samples included surface soil, hydropunch, groundwater, surface water, and sediment.

USACE, Kansas City District/USEPA Region 2, Imperial Oil Superfund Site, Monmouth County, NJ

As an environmental engineer, provided environmental engineering support for the Imperial Oil Superfund Site in Monmouth County, NJ, which is currently in the RA phase. The RA consisted of the removal and off-site disposal of approximately 200,000 tons of LNAPL, PCB, TPH, VOCs, SVOCs, and metal-impacted soils. The RD includes the installation of over 2,000 linear feet of slurry wall 500 feet of which is an I-beam/Portland cement structural retaining wall to provide side slope stability during excavation. Assisted with peer review of the contractor shop drawing submittals and preparing responses to RFIs.

USACE, Kansas City District/USEPA Region 2, Remedial Design and Remedial Action, Rockaway Borough Well Field Superfund Site, Morris County, NJ

As an environmental engineer, provided environmental engineering support to the Rockaway Borough Superfund Site. The remedial investigation, design, and actions included a 100 cfm SVE system in the source area and a 230-gpm pump and treat system.

Erich Zimmerman, PE

Senior Remediation Engineer | Client Manager

EXPERIENCE SUMMARY



Mr. Erich Zimmerman has more than 39 years of experience in environmental investigation, remediation and compliance, program management, and client management within the electroplating, chemical, and consulting industries. He has broad-based experience managing accounts and complex projects for industrial, private sector, and public sector stakeholders. He is a Senior Remediation Engineer and Client Manager at Tetra Tech and serves as the Environmental Practice Lead for the Solid Waste East operating unit. Mr. Zimmerman is registered as a Professional Engineer in New York, New Jersey, Pennsylvania, and North Carolina. He is a patent holder for innovative soil and groundwater remediation technologies.

RELEVANT EXPERIENCE

Site Investigation/Remediation

New York State Standby Engineering Contract – State Superfund Program, NY

- Contract Manager/Client Manager under NYS Standby Engineering Contract D007625 for the NYSDEC Division of Environmental Remediation. Responsible for program oversight, staff assignment, client communications, and budgeting associated with the execution of 52 projects with authorized budgets of more than $43 million. Also responsible for technical oversight of feasibility studies, remedial designs, remedial action work plans, or remedial action services.

CERCLA Investigation and Remediation, Ford Motor Company – Ringwood, NJ

- Account manager/project manager for a $30 million complex, multi-faceted Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) project located within a mining community in Northern New Jersey. The Ringwood site is the first and only site to have been removed from the National Priorities List and later relisted. Work included budget preparation and review, project staffing, reviewing health and safety procedures and deliverables, coordinating investigation and remedial activities, client communications, interfacing with the United States Environmental Protection Agency (USEPA) and the New Jersey Department of Environmental Protection (NJDEP), and representing Ford and ARCADIS within the community and at public meetings.

Education

BS, Chemical Engineering, Pennsylvania State University 1985

Area of Expertise

Site Investigation, Remedial Design, and Remedial Construction

Single- and Two-Phase Vacuum Extraction

Conceptual Design of Pollution Control Equipment

Waste Minimization for Chemical and Industrial Facilities

Registrations/Affiliations

Licensed Professional Engineer in AL, NC, NJ, NY, and PA

Air & Waste Management Association

Training/Certifications

OSHA 40-hr. Worker Protection Certification, 1987

OSHA 8-hr. Site Supervisor Training, 1988

OSHA 8-hr Refresher (Current)

Office

Middletown, NY

Years of Experience

Since 1985 (39 years)

Years with Firm

Since 2021 (3 years)

Contact

erich.zimmerman@tetratech.com

New York State Brownfields Investigation and Remediation, Ford Motor Company – Ramapo, NY

- Program/project manager for a $10 million project requiring the remediation of paint sludge and impacted soil/fill material within an active water supply well field in Ramapo, New York. The project was administered through the New York Brownfields Cleanup Program and required compliance with Part 375 remediation requirements. Served as the lead engineer for stamping Remedial Design Drawings and Specifications; technical oversight of all remedial design activities; budget preparation and review; project staffing; reviewing health and safety procedures and deliverables; coordinating investigation and remedial activities; client communications; interfacing with the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Army Corps of Engineers (USACE); and representing the client within the community, in meetings with the Town of Ramapo and United Water, and at public meetings.

RCRA RI/FS for Pesticide Manufacturer – Montgomery, AL

- Project manager for all Remedial Investigation and Feasibility Study (RI/FS), Remedial Design/Remedial Action (RD/RA) activities at an abandoned DDT manufacturing facility for a confidential chemical manufacturing corporation. The project included performing a $5 million remedial investigation, a focused feasibility study for the evaluation of groundwater remediation technologies, human health and ecological risk assessments, and a soil/sediment treatability study to evaluate innovative remedial technologies, including white rot fungus bioremediation, low-temperature thermal desorption, chemical dechlorination, soil flushing, and supercritical fluid extraction.

RFI/CMS for Active Fluorochemicals Plant – Calvert City, KY

- Project manager for all Resource Conservation and Recovery Act (RCRA) RCRA Facility Investigation/Compliance Monitoring Strategy (CMS) activities at an active plant for a confidential chemical manufacturer. The project included the performance of two simultaneous RFIs covering seventeen SWMUs. Investigatory programs included the installation of nested wells within limestone bedrock to evaluate acid-induced solution channels and the installation of dozens of soil borings within the plant confines to delineate the extent of fluorochemical and mercury migration.

Brownfields Investigation/Redevelopment – Phoenixville, PA

- Managed site investigation and stabilization activities at a former boiler manufacturing site regulated under the Pennsylvania Hazardous Sites Cleanup Act. The project scope included the inventory, stabilization, and characterization of more than 600 unlabeled drums; characterization of site soil, groundwater, and sediments; an inventory and characterization of underground tanks, pits, sumps, and cisterns; and an estimate of potential site remedial costs. Subsequently oversaw the recovery of materials and demolition of the buildings in preparation for land redevelopment.

MGP Investigation/Remediation/Redevelopment – Conshohocken, PA

- Managed the investigation and subsequent remediation of a former manufactured gas plant site along the Schuylkill River in the Philadelphia area. The project entailed the delineation of soils contaminated with cyanide, heavy metals, and coal tar compounds; the excavation and disposal of approximately 2,500 tons of contaminated soils; underground storage tank (UST) removal; debris and drum removal; and the installation of a groundwater monitoring well network. All soil removal work was conducted on supplied air (Level B). Working closely with the client, the Pennsylvania Department of Environmental Protection (PADEP), the hotel construction crew, and the local union, the project was completed within the aggressive schedule required for the redevelopment of the site and construction of the hotel foundation and represented a departure from Pennsylvania's Pre-Act 2 requirement of remediation to background standards.

High-Temperature Thermal Desorption System Design/Installation, FE Cooper Lumber Site – Hopewell, PA

- Project manager/lead engineer for the design of a high-temperature thermal desorption system for the on-site treatment of approximately 70,000 tons of soil at the FE Cooper Lumber Site in Bedford County, Pennsylvania. Soils at the site were contaminated with creosote from former wood treatment operations. Responsible for the preparation of work plans, design reports, design drawings, technical specifications, bid documents, and

engineering estimates for the performance of work. Also responsible for the oversight of equipment installation and communication with local representatives.

PCB/Dioxin Remediation, Crown Industries Site – Pike County, PA

- Project manager for investigation and remediation of the Crown Industries site in Pike County, Pennsylvania. Soil and weathered bedrock at the facility were contaminated with dioxins, polychlorinated biphenyls (PCBs), and metals from former metal salvage operations. Responsible for the preparation of work plans, design reports, design drawings, technical specifications, bid documents, and engineering estimates for remedial action activities at the site. Subsequently responsible for oversight of construction activities.

Groundwater Treatment System Design, Evor Phillips Leasing Company Site – NJ

- Managed the design of a 250-gallon per minute (gpm) inorganics wastewater treatment system, treatment system building, and wastewater infiltration gallery to be constructed under a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) interim response for the Evor Phillips Leasing Company site. Responsible for the preparation of work plans, procurement packages, schedules, and costs for the performance of the treatability studies, aquifer pump tests, and other pre-design activities. Also responsible for the evaluation of alternative treatment technologies, an evaluation of the existing organic treatment system, the selection of treatment equipment, the preparation of design drawings, construction specifications, the construction schedule, and construction cost estimate.

Groundwater Treatment System Design, SS White Products – Newark, NJ

- Project manager for the delineation and remediation of groundwater impacted with petroleum hydrocarbons and chlorinated organics. The project involved the installation of nested monitoring wells within fractured bedrock, the installation of an interim passive recovery system to halt the migration of light non-aqueous phase liquids (LNAPLs), and the design of a groundwater recovery system for dissolved chlorinated organics.

Groundwater Treatment/LNAPL Removal, Corporate Retailer – Multiple Locations

- Project manager and site engineer for the removal of underground storage tanks (USTs) at multiple locations for a major retailer's automotive service centers. Projects entailed the negotiation of the work scope with state and local regulatory authorities, the removal of numerous gasoline and fuel oil USTs, the excavation and disposal of contaminated soil, the installation of a monitoring/extraction well network, and the installation/operation of groundwater recovery and treatment systems. An air-operated bladder pump network was used at each site to contain and recover contaminated groundwater and LNAPLs and transfer fluids to an oil/water separator system for treatment. Treated groundwater was subsequently passed through activated carbon for polishing before discharge to the local sanitary sewer system.

Airport/Military Remediation and Compliance

AST Compliance, Fuel Spill and De-Icer Fluid Remediation, Niagara Falls International Airport – NY

- Project manager for a multi-faceted project at the Niagara Falls International Airport. The project involved compliance for all aboveground storage tanks (ASTs) per national and New York State AST regulations, the performance of Spill Prevention, Control, and Countermeasure (SPCC) audits in compliance with national petroleum discharge regulations, and the remediation of portions of the property impacted by releases of de-icing fluids and jet fuel. The project was completed in full compliance with national and NYSDEC Site Remediation and Spill Division requirements.

Vacuum Extraction System Design, U.S. Navy – Pearl Harbor, HI

- Lead engineer providing design review for the installation of a soil vacuum extraction and treatment system for the U.S. Navy in Pearl Harbor. Project responsibilities included review of the system design and evaluation of the operation and maintenance (O&M) manual for the vacuum extraction and catalytic oxidizer systems.

Design and Operation of a Proprietary UST Tank Strapping System, U.S. Navy, Pacific Rim

- Project manager/lead engineer for the design and installation of a skid-mounted tank strapping system for the Navy Pacific Rim contract. The system was capable of removing water, gasoline, JP4, JP5, and fuel oil from USTs while simultaneously recording the instantaneous flow rate, total volume of product removed, and change in

product depth over time. The skid-mounted system was constructed in a modular fashion on a standard wooden skid to accommodate easy shipping and field assembly requirements in remote locations. The project resulted in a savings to the Navy of over $160,000 for equipment fabrication.

Air Sparge/Vacuum Extraction System Design, USACE – AK

- Lead engineer providing design review and process engineering design preparation for a groundwater remediation project, including approximately 200 air sparge/vacuum extraction points at an active airfield in Alaska for the USACE. The project included air sparging and vacuum extraction for enhancement of biodegradation of petroleum-contaminated soil and groundwater.

PATENTS

- U.S. Patent No. 5,050,676, Process for Two-Phase Vacuum Extraction of Soil Contaminants
- U.S. Patent No. 5,197,541, Apparatus for Two-Phase Vacuum Extraction of Soil Contaminants

APPENDIX C

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) UNDER NYSDEC'S PART 375 REMEDIAL PROGRAMS

NEW YORK STATE OF OPPORTUNITY.

Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

November 2022



Table of Contents

Objective 1
Applicability 1
Field Sampling Procedures 1
Analysis and Reporting 2
Routine Analysis 2
Additional Analysis 2
Data Assessment and Application to Site Cleanup 3
Water Sample Results 3
Soil Sample Results 3
Testing for Imported Soil 4
Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS 5
Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids 6
Appendix C - Sampling Protocols for PFAS in Monitoring Wells 8
Appendix D - Sampling Protocols for PFAS in Surface Water 10
Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells 12
Appendix F - Sampling Protocols for PFAS in Fish 14
Appendix G - PFAS Analyte List 22
Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids 24

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020
Soil Sample Results, page 10	"The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase."	"Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. " [Interim SCO Table] "PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. "	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs. If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable. PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	"In addition, further assessment of water may be warranted if either of the following screening levels are met: a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L"	Deleted	6/15/2021

Citation and Page Number	Current Text	Corrected Text	Date
Routine Analysis, Page XX	Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP)… criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids).	Deleted	5/31/2022
Analysis and Reporting, Page XX	As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.	Deleted	5/31/2022
Routine Analysis, Page XX	LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media.	EPA Method 1633 is the procedure to use for environmental samples.	
Soil Sample Results, Page XX	Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6	
Appendix A	"Include in the text… LC-MS/MS for PFAS using methodologies based on EPA Method 537.1"	"Include in the text ….EPA Method 1633"	
Appendix A	"Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101"	Deleted	
Appendix B	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	

Citation and Page Number	Current Text	Corrected Text	Date
Appendix C	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix D	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix G		Updated to include all forty PFAS analytes in EPA Method 533	
Appendix H		Deleted	
Appendix I	Appendix I	Appendix H	
Appendix H	"These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report."	"These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER)."	
Appendix H	"The holding time is 14 days…"	"The holding time is 28 days…"	
Appendix H, Initial Calibration	"The initial calibration should contain a minimum of five standards for linear fit…"	"The initial calibration should contain a minimum of six standards for linear fit…"	
Appendix H, Initial Calibration	Linear fit calibration curves should have an R^2 value greater than 0.990.	Deleted	
Appendix H, Initial Calibration Verification	Initial Calibration Verification Section	Deleted	
Appendix H	secondary Ion Monitoring Section	Deleted	
Appendix H	Branched and Linear Isomers Section	Deleted	

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments, or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix G) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

EPA Method 1633 is the procedure to use for environmental samples. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist. Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below.

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values:

Guidance Values for Anticipated Site Use	PFOA (ppb)	PFOS (ppb)
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	1.1	3.7

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange

[2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by EPA Method 1633
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
-
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the latest guidelines developed by the Division of Fish and Wildlife (DFW) entitled “General Fish Handling Procedures for Contaminant Analysis” (Ver. 8).

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

   1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

   2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

   3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

   1. Project and Site Name.

   2. DEC Region.

   3. All personnel (and affiliation) involved in the collection.

   4. Method of collection (gill net, hook and line, etc.)

   5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

   1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

   2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

   3. Date collected.

   4. Sample location (waterway and nearest prominent identifiable landmark).

   5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **The Bureau of Ecosystem Health will supply the bags.** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with

the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **The Bureau of Ecosystem Health will supply the larger bags.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:

No materials containing Teflon.
No Post-it notes.
No ice packs; only water ice or dry ice.
Any gloves worn must be powder free nitrile.
No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
Wash hands after handling any food containers or packages as these may contain PFCs.
Keep pre-wrapped food containers and wrappers isolated from fish handling.
Wear clothing washed at least six times since purchase.
Wear clothing washed without fabric softener.
Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name _____ DEC Region _____

Collections made by (include all crew) _____

Sampling Method: Electrofishing Gill netting Trap netting Trawling Seining Angling Other _____

Preservation Method: Freezing Other _____ Notes (SWFDB survey number): _____

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, _____, of _____ collected the
(Print Name) (Print Business Address)

following on _____, 20____ from _____
(Date) (Water Body)

in the vicinity of _____
(Landmark, Village, Road, etc.)

Town of _____, in _____ County.

Item(s) _____

_____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on _____, 20_____.

_____ _____
Signature Date

I, _____, received the above mentioned sample(s) on the date specified and assigned identification number(s) _____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

_____ _____
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonic acids	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluoropentanesulfonic acid	PFPeS	2706-91-4
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorononanesulfonic acid	PFNS	68259-12-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
	Perfluorododecanesulfonic acid	PFDoS	79780-39-5
Perfluoroalkyl carboxylic acids	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUnA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	376-06-7
Per- and Polyfluoroether carboxylic acids	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Fluorotelomer sulfonic acids	4:2 Fluorotelomer sulfonic acid	4:2-FTS	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2-FTS	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2-FTS	39108-34-4
Fluorotelomer carboxylic acids	3:3 Fluorotelomer carboxylic acid	3:3 FTCA	356-02-5
	5:3 Fluorotelomer carboxylic acid	5:3 FTCA	914637-49-3
	7:3 Fluorotelomer carboxylic acid	7:3 FTCA	812-70-4
Perfluorooctane sulfonamides	Perfluorooctane sulfonamide	PFOSA	754-91-6
	N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8
	N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2
Perfluorooctane sulfonamidoacetic acids	N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA	2991-50-6
Perfluorooctane sulfonamide ethanols	N-methylperfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
	N-ethylperfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2

Group	Chemical Name	Abbreviation	CAS Number
Ether sulfonic acids	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUdS	763051-92-9
	Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7

Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER). Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 28 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of six standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

APPENDIX L - SITE MANAGEMENT FORM

SITE-WIDE INSPECTION FORM
CAROL CLEANERS/GGP STATEN ISLAND MALL
STATEN ISLAND, RICHMOND COUNTY, NEW YORK
SITE NO. 2-43-020

Name of Inspector: _____

Company of Inspector: Tetra Tech

Date of Inspection: _____

Current Site Conditions: _____

_____

_____

Institutional Controls Inspection

Institutional Control: Environmental Easement

Current Use of Site: _____

Complies with Easement? _____Yes _____No

Explain if no: _____

_____

_____

Does it appear that all environmental easement restrictions have been followed?

_____Yes _____No

Explain if no: _____

_____

_____

Has a change of use occurred since the last certification? _____Yes _____No

Explain if yes: _____

_____

Engineering Controls Inspection – Cover (Cap) System

General description of cover or cap. Attach digital photographs or other supporting information as needed: _____

_____

_____

Are there any cracks in the building slabs or building walls? Yes_____No

Explain if yes: _____

_____

Has the cover or cap been penetrated? _____Yes _____No

Explain if yes: _____

_____

_____

Have any structures been constructed since the last inspection? _____Yes _____No

Explain if yes: _____

_____

_____

Have cover or cap conditions changed since the last inspection? _____Yes _____No

Explain if yes: _____

_____

_____

Is any maintenance of the cover or cap required? _____Yes _____No

Explain if yes: _____

_____

_____

Additional observations/notes: _____

_____

_____

Engineering Controls Inspection – Sub-Slab Depressurization System (SSD System)

General description of system. Attach digital photographs or other supporting information as needed: _____

_____

_____

System operating properly? _____Yes _____No

Explain if no: _____

_____

_____

System maintaining depressurization? _____Yes _____No

Explain if no: _____

_____

_____

System recommissioned & resampled during inspection period? _____Yes _____No

Explain if yes/general results of resampling: _____

_____

_____

Is the SMP readily available on site? _____Yes _____No

Explain if no: _____

_____

_____

Based on site records, when was the last inspection, maintenance, or repair event?

_____

_____

_____

Based on site records, was the system in-operational for any amount of time since the last inspection, maintenance, or repair event? If so, for how long? Provide details if yes:

_____

_____

_____

Does all visible SSDS piping appear intact and undamaged? _____Yes _____No

Explain if no: _____

_____

_____

Have any intake points been constructed at the roof near (less than 10 feet) the SSDS blower discharge points? _____Yes _____No

Explain if yes: _____

_____

_____

Is/are the SSD system blower(s) operational at the time of the inspection? _____Yes _____No

Explain if no: _____

_____

_____

What are the blower vacuum readings? Identify them and list the vacuum below:

Blower 1: _____

Blower 2: _____

Blower 3: _____

Is the SSD blower expelling air at the discharge point? _____Yes _____No

If not, provide details: _____

_____

_____

Have dust and debris (if present) been removed from the surface of the blower?

_____Yes _____No

Explain if no: _____

_____

_____

Have dirty or clogged filter cartridges (if present) been replaced? _____Yes _____No

Explain of not: _____

_____

_____

What are the vacuum monitoring point readings? Identify below as appropriate:

Monitoring Point 1: _____

Monitoring Point 2: _____

Monitoring Point 3: _____

Monitoring Point 4: _____

Monitoring Point 5: _____

Monitoring Point 6: _____

Monitoring Point 7: _____

Monitoring Point 8: _____

Additional Monitoring Points?

Engineering Controls Inspection – Monitored Natural Attenuation

Evidence of unauthorized well installation? _____Yes _____No

Explain if yes: _____

_____

_____

Monitor wells locked and in good condition? _____Yes _____No

Explain if no: _____

_____

_____

Engineering Controls Inspection – Stormwater System

General description of the stormwater system. Attach digital photographs or other supporting information as needed: _____

_____

_____

Has the stormwater system been compromised? _____Yes _____No

Explain if yes: _____

_____

_____

Have site conditions changed since the last inspection? _____Yes _____No

Explain if yes: _____

_____

_____

Is any maintenance of the storm water system required? _____Yes _____No

Explain if yes: _____

_____

_____

Additional observations/notes: _____

_____

_____

APPENDIX M FIELD ACTIVITIES PLAN

Carol Cleaners, Staten Island Mall Site

Field Activities Plan for
Carol Cleaners, Staten Island Mall Site
Staten Island, New York

NOVEMBER 26, 2025
209-4213307

PRESENTED TO

Brookfield Properties Retail
350 N Orleans Street, Suite 300
Chicago, IL 60654

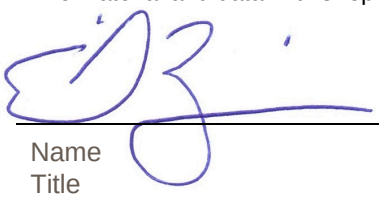
SUBMITTED BY

Tetra Tech
100 Crystal Run Road, Suite 101
Middletown, New York 10941

P +1.877.294.9070
F +1.877.845.1456
tetratech.com

REPORT CERTIFICATION

The material and data in this report were prepared under the supervision and direction of the undersigned.



11/26/2025

Name
Title
Date

Name
Title
Date

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1

2.0 QUALITY ASSURANCE REQUIREMENTS / DATA QUALITY OBJECTIVES 2-2

3.0 GROUNDWATER MONITORING 3

3.1.1 Groundwater Monitoring 3

3.1.2 Groundwater Sampling 3

4.0 INDOOR AIR SAMPLING AND SUB-SLAB VAPOR SAMPLING 4

4.1.1 Indoor Air Sampling 4

4.1.2 Sub-Slab Vapor Sampling 4

TABLES

Table 1 Analytical Parameters, Groundwater Sampling 3

FIGURES

Figure 1 Proposed Groundwater Sampling Locations

Figure 2 Proposed Vapor Sample Locations

APPENDICES

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

1.0 INTRODUCTION

This Field Sampling Plan (FSP) has been developed to describe the objectives and procedures for the sampling and analyses of groundwater sampling, indoor air sampling, and sub-slab vapor sampling, following the implementation of the remedy at the Former Carol Cleaners Site. In addition, the Quality Assurance Project Plan (QAPP) should be consulted where specific sampling and analysis procedures and methods are referenced.

The environmental media to be sampled, and the purpose for collecting and analyzing environmental samples, is described below in the sections that follow.

2.0 QUALITY ASSURANCE REQUIREMENTS / DATA QUALITY OBJECTIVES

Quality assurance requirements are specified in this document in individual sections and the data quality objectives and QA/QC requirements are delineated in the QAPP.

3.0 GROUNDWATER MONITORING

3.1.1 Groundwater Monitoring

Groundwater sampling and monitoring has been conducted at the former Carol Cleaners Site to assess groundwater conditions and monitor the effectiveness of the remedial action at reducing chlorinated volatile organic compounds (CVOCs) to concentrations below groundwater quality standards. Groundwater monitoring is currently conducted on an annual basis.

3.1.2 Groundwater Sampling

Prior to sampling, the wells will be opened, and head-space VOC readings will be collected using a photoionization detector (PID). Water level measurements will be taken prior to sampling. The groundwater samples will then be collected from the wells by a bladder or peristaltic pump, taking care to cause minimal agitation or turbulence. The groundwater will be passed through a flow-through cell and water quality will be recorded. The wells will be purged and sampled using the low-flow or minimal draw-down technique which monitors groundwater quality parameters until three consecutive rounds of readings stabilize to within an established range indicating no significant change. Low-flow sampling will be in accordance with Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling (USEPA, March 1998). After purging, the samples will be transferred immediately to the appropriate laboratory-supplied containers. Once filled, the containers will be placed immediately in ice-filled coolers for shipment to the laboratory. No filtered groundwater samples will be collected.

The samples will be submitted to a NYSDOH ELAP-certified laboratory under standard chain of custody procedures along with a blind field duplicate, trip blank and a field blank; as well as sufficient sample quantity for site-specific matrix spike/matrix spike duplicate analyses. The samples will be analyzed for site-specific VOCs and SVOCs and additional parameters as shown in Table 1. Based on the analytical results, the frequency of sampling may be reduced, or monitoring may be discontinued with approval from the NYSDEC and the NYSDOH. Proposed groundwater sampling locations are shown on Figure 1.

Table 1 - Analytical Parameters, Groundwater Sampling

Sampling Location	Analytical Parameters	Schedule
MW-2, MW-3, MW-3D, MW-5, MW-8, MW-16, MW-17, MW-18, MW-19, MW-20, MW-21, MW-22 and MW-24	VOCs (EPA Method 8260)	Annually
MW-2, MW-3, MW-16, MW-17, MW-19 and MW-22	1,4-Dioxane using MS Volatiles (SW846 8260D by SIM), PFAS using USEPA Method 1633	Annually

4.0 INDOOR AIR SAMPLING AND SUB-SLAB VAPOR SAMPLING

Indoor air and sub-slab vapor sampling have been performed previously at the site to confirm the efficacy of the existing sub-slab depressurization system. Based on the lack of CVOC-impacted soil and the observed decrease in CVOC concentrations in groundwater proximal to the on-site buildings because of groundwater injection/bioremediation activities, testing of sub-slab vapor and indoor air will be conducted to evaluate whether it is necessary to continue operation of the SSD system. This includes shutting down the system for a period of three weeks subsequent to authorization from the NYSDEC and then conducting the testing by having one sub-slab and one indoor air sample collected from the Carvel, Mon Amie Nails, former Carol Cleaners, and former Babies R Us tenant spaces. A total of two separate heating season sampling events will be conducted, one during the fall (November to December) and one in the winter (January to March). Sampling would also be conducted in the event the system requires recommissioning.

4.1.1 Indoor Air Sampling / Sub-Slab Vapor Sampling

As discussed previously with the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH), two separate heating season sampling events will be conducted, one during the fall (November to December) and one in the winter (January to March). The existing sub-slab depressurization system (SSDS) will be shut down for a minimum of 30 days prior to each event to allow indoor air and sub-slab vapor pressures to stabilize. At the end of the 30-day period, two staff will mobilize to the site and install a total five sub-slab vapor sampling points through the concrete slab within the former Carol Cleaners and Babies-R-Us buildings. Proposed sampling locations are identified on Figure 1.

Each sampling point will be installed by drilling a 5/8-inch hole through the concrete, perforating the sub-slab vapor barrier (if present) and inserting a brass Vapor Pin® sampling port within the hole using a hammer drill. The sampling port will remain within the concrete hole as shown on the attached photos. The contractor proposed to use flush-mount sampling points to minimize the impact on surrounding building operations. To that end, the sampling points will be completed with a 2-inch diameter stainless steel cover mounted flush with the concrete floor. Per the manufacturer's specifications for leak testing, the contractor will perform a water dam leak test prior to sample collection. This method involves installing a 2" diameter pvc pipe approximately 2" long over the hole. VOC-free modeling clay is used to create a seal between the floor and the pvc pipe. Distilled water is then poured into the hole and added to approximately halfway up on the pvc pipe. The sample port is then purged. If the water level remains constant, no leaks are present, and sampling can commence. Another option recommended by the manufacturer is to use a 4-gas meter to purge the sample location. If no leaks are present, the oxygen levels will decrease and remain well below atmospheric levels, confirming an airtight seal has been established.

Prior to sampling, the contractor staff will photograph and survey the building interior for cleaning agents, gasoline cans or other containers potentially containing volatile organics. If identified, the contractor will inventory these materials and inform building management so that these materials may be removed from the building prior to sampling as the presence of these materials may influence the results of indoor air and/or sub-slab vapor testing.

After the interior materials assessment, the contractor will position two Suma® canisters at each of the five sub-slab sampling locations within the building and collect indoor air and sub-slab vapor samples over a 24-hour period. The indoor air samples will be collected from the breathing zone at 3-5 feet above the floor. The contractor will return the next day to collect the canisters, and they will be submitted to an ELAP-certified laboratory for volatile organics analysis by USEPA Method TO-15. All sampling will be performed in accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006).

Prior to the performance of sampling, the contractor will visually inspect the building floors for cracks, drains, holes or other potential preferential pathways. They will also document the current facility heating/cooling system

status to confirm whether the system is operational, assess whether the indoor pressure is positive or negative, and confirm the location of air intake and exhaust vents.

Upon the receipt of laboratory results, the contractor will prepare a draft letter report, inclusive of tables and figures, summarizing the work performed and the results of laboratory analysis. The letter report will be submitted to the NYSDEC and the NYSDOH for review and comment. Upon receipt of comments, the contractor will incorporate the comments into a revised letter report for submittal to the NYSDEC and the NYSDOH.



LEGEND:

MW–9	ABANDONED WELL
MW–3D	BEDROCK WELL
MW–13	OVERBURDEN WELL

SOURCE:
BACKGROUND AERIAL DOWNLOADED FROM NEAR MAP PROGRAM, DATED 2021–10–19.

0 100 200
SCALE IN FEET

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

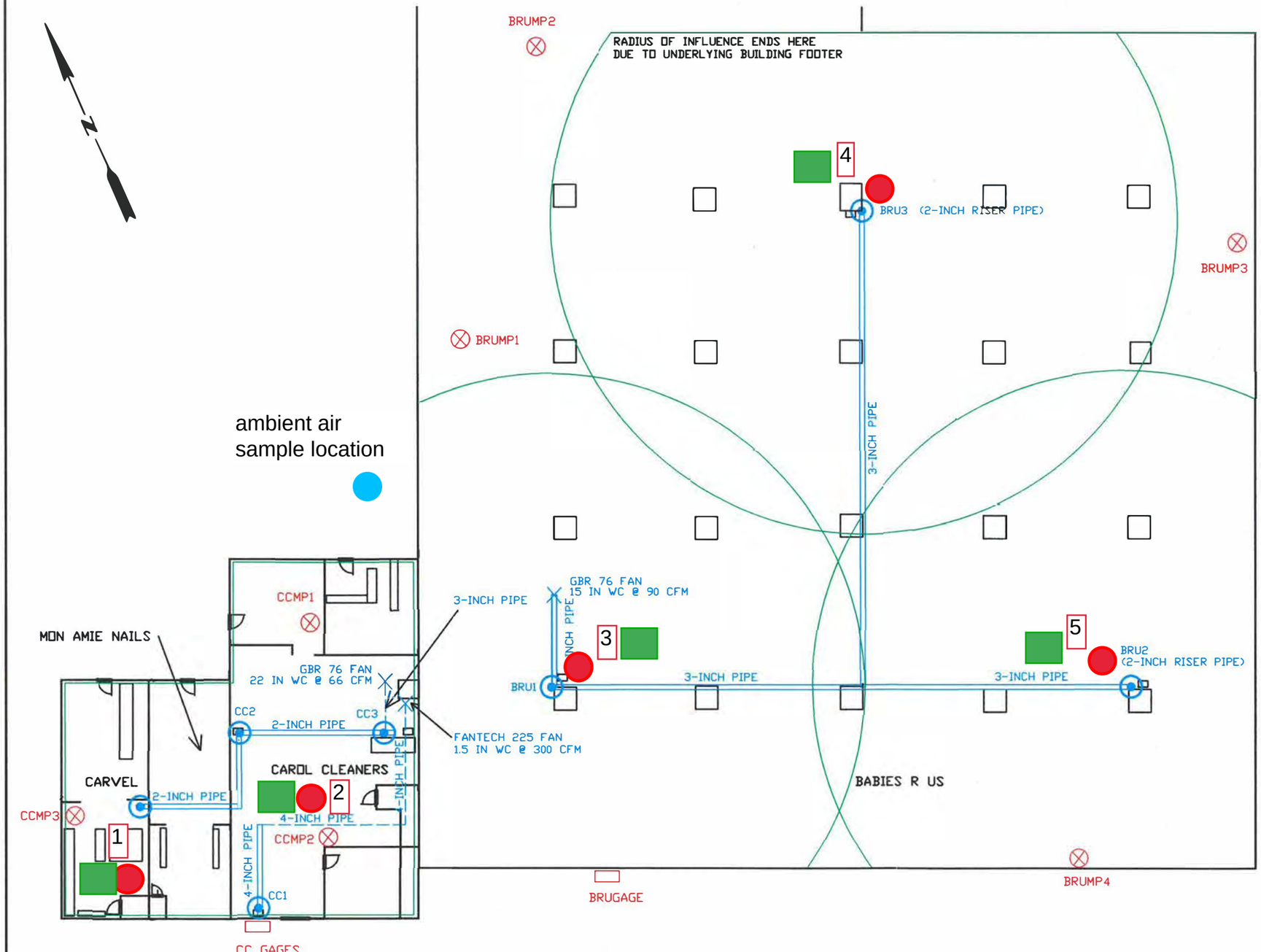
TETRA TECH

ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

GGP STATEN ISLAND MALL, LLC
CAROL CLEANERS – THE CROSSINGS
STATEN ISLAND, NEW YORK
Groundwater Sampling Locations

FIGURE NO.
1
PROJECT NO.
4213307

File: \\tt.local\ceg\625\PROJECTS\BROOKFIELD PROPERTIES RETAIL\4213307 – FORMER CAROL CLEANERS SITE_Project Drawings\213307–F–02–SITE PLAN.DWG Layout: FIGURE 02 User: JISS.PHILIP Feb 02, 2024 – 9:30am



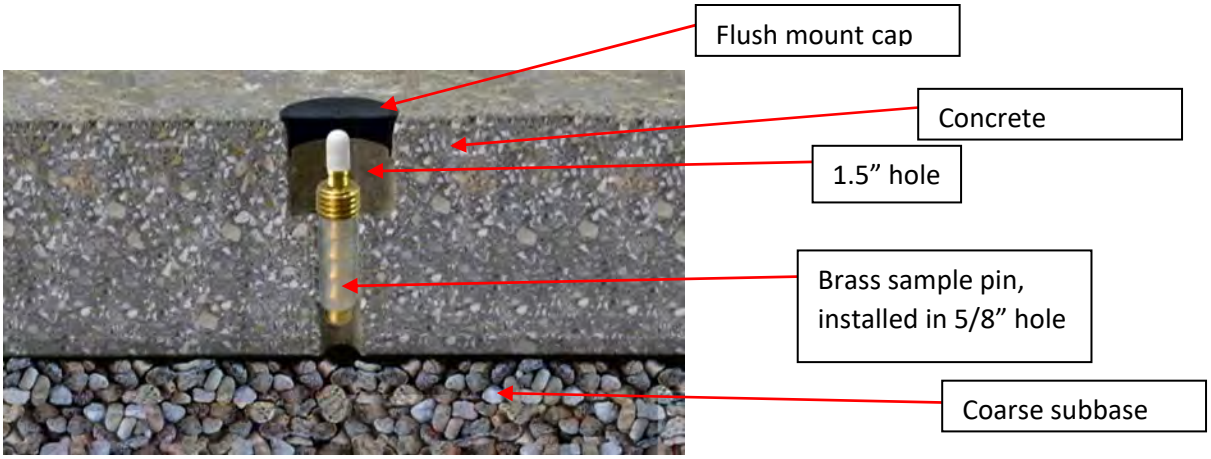
LEGEND

- SUCTION POINT LOCATION WITH DESIGNATION (CC1)
- TEST LOCATION WITH DESIGNATION
- PVC PIPING
- PIPING LOCATED ON ROOF OF BUILDING
- LOCATION OF FAN ON ROOF OF BUILDING WITH TYPE (GBR 76 FAN)
- PROPOSED EFFECTIVE RADIUS OF INFLUENCE EXERTED BY BLOWER FAN
- MAGNAHELIC GAGE LOCATION
- PROPOSED INDOOR AIR SAMPLING LOCATION
- PROPOSED SUB-SLAB VAPOR SAMPLING LOCATION
- 1 SAMPLE LOCATION NUMBER

GGP STATEN ISLAND MALL, LLC
STATEN ISLAND, NEW YORK

FIGURE 2 - PROPOSED VAPOR SAMPLING LOCATIONS

FILE: ROUSE/2016-9asbuilt	DRAWN BY: JM	CHECKED BY: CS	DATE: / /







Modeling clay used to create seal between concrete floor and pvc pipe.

Distilled water added to confirm no leaks.

APPENDIX A

GUIDANCE FOR EVALUATING SOIL VAPOR INTRUSION IN THE STATE OF NEW YORK

FINAL

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

October 2006

NOTE: Updates to this final guidance are available at
health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Prepared by:



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

Soil Vapor Intrusion Guidance Release History

October 2006 — Current version
February 2005 — Public comment draft

Contact Information

Comments and questions on the guidance may be sent to the following:

New York State Department of Health
Bureau of Environmental Exposure Investigation
Flanigan Square, Room 300
547 River Street
Troy, New York 12180-2216

Email: BEEI@health.state.ny.us
Telephone: 1-800-458-1158, extension 27850

New York State Departments of Health and Environmental Conservation — Web Sites on Soil Vapor Intrusion

This guidance, policy documents, training documents, fact sheets, etc. are available to the public on the following web sites:

New York State Department of Health
http://www.health.state.ny.us/environmental/indoors/vapor_intrusion

New York State Department of Environmental Conservation
http://www.dec.state.ny.us/website/der/guidance/vapor/index.html

As new information becomes available (e.g., revisions or amendments to the guidance, new fact sheets, etc.), these web sites will be updated accordingly.

Preface

This guidance has been prepared by the New York State Department of Health (NYSDOH) in consultation with the New York State Department of Environmental Conservation (NYSDEC) — collectively referred to as "the State" throughout this document. It is intended as general guidance for parties evaluating soil vapor intrusion in the State of New York. The guidance is not a regulation, rule or requirement.

The guidance describes the State's methodology for evaluating soil vapor intrusion at a site. It reflects our experience in conducting soil vapor intrusion investigations and presents a reasonable and practical approach to identifying and addressing current and potential human exposures to contaminated subsurface vapors associated with known or suspected volatile chemical contamination. The approach presented is analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns.

The guidance is organized into five sections:

Section 1 introduces the concept of soil vapor intrusion, associated human exposure issues, factors affecting soil vapor intrusion, factors affecting indoor air quality, and the general approach recommended to evaluating vapor intrusion;

Section 2 provides guidance on collecting appropriate and relevant data that can be used to identify current or potential human exposures;

Section 3 discusses how the investigation data are evaluated, recommends actions based on the evaluation, and presents tools that are used when determining appropriate actions to address exposures;

Section 4 provides an overview of soil vapor intrusion mitigation methods and basic recommendations pertaining to their selection for use, installation and design, post-mitigation testing, operation, maintenance and monitoring, termination of operation, and annual certification; and

Section 5 describes outreach techniques commonly used to inform the community about soil vapor intrusion issues.

The State recommends that the guidance be considered anywhere soil vapor intrusion is evaluated in the State of New York — whether the evaluation is undertaken voluntarily by a corporation, a municipality, or private citizen, or whether it is performed under one of the State's environmental remediation programs.

PLEASE NOTE:

- While soil vapor intrusion can also occur with "naturally-occurring" subsurface gases (e.g., radon, methane and hydrogen sulfide), the document discusses soil vapor intrusion in terms of environmental contamination only.
- The guidance document addresses soil vapor intrusion. However, vapor intrusion can also occur through direct volatilization of contaminants from groundwater into indoor air. This can occur when, for example, a basement slab is in contact with contaminated groundwater, contaminated groundwater enters (floods) a basement or crawl space, or contaminated groundwater enters a sump pit drainage system. In such cases, volatile

chemicals can be transferred directly from groundwater to indoor air without the intervening contamination of soil vapor. Although exposures of this nature are not discussed in this guidance, they should be addressed on a site-specific and building-specific basis.

- Throughout the guidance references are made to specific brands of field equipment. These references are for discussion purposes only and are intended to be illustrative. They should not be interpreted as endorsements by the State of any one company or their products.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

ACRONYMNS and ABBREVIATIONS

ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substance and Disease Registry
BASE	Building Assessment and Survey Evaluation
BTSA	[NYSDOH] Bureau of Toxic Substance Assessment
CME	Continuing Medical Education
CSEMs	Case Studies in Environmental Medicine
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
EPA	United States Environmental Protection Agency
GC	Gas Chromatograph
HEI	Health Effects Institute
HVAC	Heating, Ventilating and Air-conditioning
mcg/m^3	micrograms per cubic meter
MeCl	Methylene Chloride
MEK	Methyl Ethyl Ketone; 2-Butanone
MTBE	Methyl-*tert*-Butyl Ether
NAPL	Non-Aqueous Phase Liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
OVM	Organic Vapor Monitor
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene or Perchloroethylene
PID	Photoionization Detector
QA/QC	Quality Assurance/Quality Control
RIOPA	Relationship of Indoor, Outdoor, and Personal Air
SF_6	Sulfur Hexafluoride
SSD	Sub-slab Depressurization System
SIM	Selective Ion Monitoring
SMD	Sub-Membrane Depressurization
SVE	Soil Vapor Extraction
SVOCs	Semi-volatile Organic Compounds
TAL	Target Analyte List
TCA	Trichloroethane
TCDD	Tetrachlorodibenzo-*p*-Dioxin Equivalents
TCE	Trichloroethene
TCL	Target Compound List
VOCs	Volatile Organic Compounds

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

This page is intentionally blank.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Table of Contents

Page

Preface i

Section 1: Introduction 1

1.1 Soil vapor intrusion 1
1.2 Soil vapor intrusion and human exposure 2
1.3 Factors affecting soil vapor migration and intrusion 2
1.4 Factors affecting indoor air quality 5
1.5 General approach to evaluating soil vapor intrusion 6
1.6 Conceptual site model 7
1.7 Applicability of guidance 8
1.7.1 Residential and non-residential settings 8
1.7.2 Chlorinated and non-chlorinated volatile chemical sites 8
1.7.3 Current, new and past remedial sites 8
1.8 Updates to the guidance 8

Section 2: Investigation of the Soil Vapor Intrusion Pathway 9

2.1 Sites at which an investigation is appropriate 9
2.2 Types of samples 9
2.2.1 Soil vapor 9
2.2.2 Sub-slab vapor 10
2.2.3 Crawl space air 10
2.2.4 Indoor air 10
2.2.5 Outdoor air 11
2.3 Phase of a site investigation in which to sample 11
2.4 Time of year in which to sample 12
2.4.1 Soil vapor 12
2.4.2 Buildings 12
2.5 Number of sampling rounds 13
2.6 Sampling locations 14
2.6.1 Soil vapor 14
2.6.2 Sub-slab vapor 16
2.6.3 Indoor air 16
2.6.4 Outdoor air 18
2.7 Sampling protocols 18
2.7.1 Soil vapor 19
2.7.2 Sub-slab vapor 22
2.7.3 Indoor air 24
2.7.4 Outdoor air 26
2.7.5 Tracer gas 26
2.8 Quality assurance/quality control (QA/QC) 29
2.9 Analytical methods 30
2.9.1 Subsurface vapor 30
2.9.2 Indoor air 31
2.9.3 Outdoor air 31

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Page

2.10 Field laboratories and mobile gas chromatographs (GCs) 31
2.11 Surveys and pre-sampling building preparation 31
2.11.1 Pre-sampling building inspection and preparation 31
2.11.2 Product inventory 33
2.12 Role of modeling 34

Section 3: Data Evaluation and Recommendations for Action 35
3.1 Data quality 35
3.2 Overview 35
3.2.1 Nature and extent of contamination in all environmental media 36
3.2.2 Factors that affect vapor migration and intrusion 36
3.2.3 Sources of volatile chemicals 36
3.2.4 Background levels of volatile chemicals in air 37
3.2.5 Relevant standards, criteria and guidance values 38
3.2.6 Completed or proposed remedial actions 40
3.2.7 Past, Current and future land uses 40
3.3 Sampling results and recommended actions 41
3.3.1 Soil vapor 41
3.3.2 Sub-slab vapor 43
3.3.3 Indoor air 45
3.3.4 Outdoor air 48
3.4 Decision matrices 48
3.4.1 Overview 48
3.4.2 Matrices 49
3.4.3 Description of recommended actions 51
3.5 Emergency response 56
3.6 Parcels that are undeveloped or contain unoccupied buildings 56

Section 4: Soil Vapor Intrusion Mitigation 58
4.1 Methods of mitigation 58
4.1.1 Buildings with a basement slab or slab-on-grade foundation 58
4.1.2 Buildings with a crawl space foundation 60
4.1.3 Buildings with dirt floor basements 60
4.1.4 Buildings with multiple foundation types 60
4.1.5 Undeveloped parcels 60
4.1.6 Additional references 60
4.2 Design and installation of mitigation systems 61
4.2.1 General recommendations 61
4.2.2 System-specific recommendations 62
4.2.3 Technical guidance 64
4.3 Post-mitigation or confirmation testing 65
4.3.1 SSD systems with sealing 66
4.3.2 SMD systems with soil vapor retarder 67
4.3.3 HVAC modifications 67
4.3.4 Crawl space ventilation and sealing 68
4.3.5 SVE systems designed to also mitigate exposures 68

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Page

4.4 Operation, maintenance and monitoring of mitigation systems 68
4.4.1 SSD and SMD systems 68
4.4.2 Other mitigation systems 69
4.4.3 Non-routine maintenance 70
4.5 Termination of mitigation system operations 70
4.6 Annual certification and notification recommendations 71

Section 5: Community Outreach 72
5.1 Site contact list 72
5.2 Project staff contact sheet 73
5.3 Fact sheets 73
5.4 Public gatherings 74
5.5 Letters transmitting results 75
5.6 Soil vapor intrusion mitigation information 76
5.7 Toll-free "800" numbers 79
5.8 Door-to-door visits 79
5.9 Document repositories 79
5.10 Medical community outreach 80

References 82

Appendices
Appendix A: Highlights of document revisions A-1
Appendix B: Indoor air quality questionnaire and building inventory B-1
Appendix C: Volatile organic chemicals in air — summary of background databases C-1
Appendix D: NYSDOH's guidelines for chemicals in air — development overview D-1
Appendix E: ASTM's *Standard Practice for Residential Radon Mitigation* E-1
Appendix F: EPA's *Model Standards and Techniques for Control of Radon in New Residential Buildings* F-1
Appendix G: Community outreach tools — additional information G-1
G.1 Contact List G-2
G.2 Fact Sheet G-6
G.3 Public Meeting G-12
G.4 Availability Session G-19
G.5 Toll-free "800" Numbers G-24
G.6 Door-to-door Visits G-26
G.7 Document Repository G-28
Appendix H: NYSDOH fact sheets related to soil vapor intrusion H-1

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Page

Tables

Table 1.1 Environmental factors that may affect soil vapor intrusion 4
Table 1.2 Building factors that affect vapor intrusion 5
Table 1.3 Alternate sources of volatile chemicals in indoor air 6
Table 3.1 Air guideline values derived by the NYSDOH. 39
Table 3.2 General format of a decision matrix 49
Table 3.3 Volatile chemicals and their decision matrices 49
Table C1 NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes. C-6
Table C2 EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method C-10
Table C3 NYSDOH 1997: Control home database C-14
Table C4 EPA 1988: National ambient volatile organic compounds (VOCs) data base update C-18
Table C5 Health Effects Institute 2005: Indoor, outdoor and personal air (RIOPA) data C-20

Figures

Figure 1.1 Generalized diagram of vapor intrusion in a residential setting from groundwater and subsurface soil sources 1
Figure 2.1 Schematic of indoor and outdoor air sampling locations 18
Figure 2.2 Schematics of a generic permanent soil vapor probe and permanent nested soil vapor probes. 20
Figure 2.3 Schematic of a generic sub-slab vapor probe 22
Figure 2.4 Schematics of generic tracer gas applications when collecting soil vapor samples. 28
Figure 5.1 Manometer indicating the SSD system is operating properly 77
Figure 5.2 Example of an illustration showing how a SSD system works 78

Inserts

Section 3.4.2 Soil Vapor/Indoor Air Matrix 1 52
Section 3.4.2 Soil Vapor/Indoor Air Matrix 2 54

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Section 1: Introduction

This section introduces the concept of soil vapor intrusion, associated human exposure issues, factors affecting soil vapor intrusion, factors affecting indoor air quality, and the general approach to evaluating vapor intrusion.

1.1 Soil vapor intrusion

The phrase "soil vapor intrusion" refers to the process by which volatile chemicals migrate from a subsurface source into the indoor air of buildings. Soil vapor, also referred to as soil gas, is the air found in the pore spaces between soil particles (Figure 1.1). Primarily because of a difference between interior and exterior pressures, soil vapor can enter a building through cracks or perforations in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation. For example, heating, ventilation or air-conditioning (HVAC) systems and/or the operation of large mechanical appliances (e.g., exhaust fans, dryers, etc.) may create a negative pressure that can draw soil vapor into the building. This intrusion is similar to how radon gas enters buildings from the subsurface.

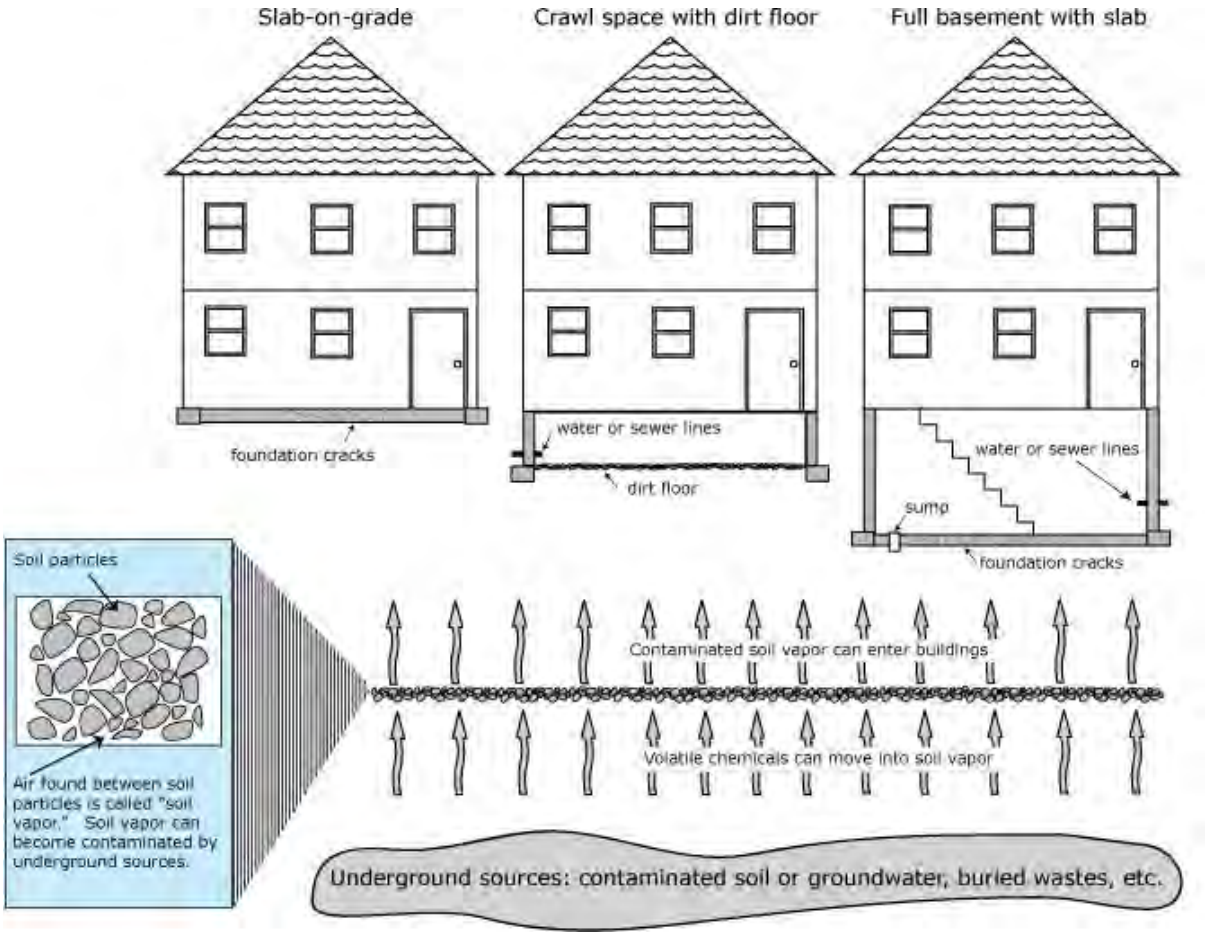


Figure 1.1
Generalized diagram of soil vapor intrusion

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Soil vapor can become contaminated when chemicals evaporate from subsurface sources. Chemicals that can emit vapors are called "volatile chemicals." Volatile chemicals include volatile organic compounds (VOCs), some semi-volatile organic compounds (SVOCs), and some inorganic substances such as elemental mercury. Subsurface sources of volatile chemicals can include the following:

a. groundwater or soil that contains volatile chemicals;

b. non-aqueous phase liquid (NAPL);

c. buried wastes; and

d. underground storage tanks or drums.

If soil vapor is contaminated and enters a building, indoor air quality may be affected.

When contaminated vapors are present in the zone directly next to or under the foundation of a building, vapor intrusion is possible. Soil vapor can enter a building whether the building is old or new, or whether it is on a slab or has a crawl space or basement (Figure 1.1). However, the subsurface source of the contaminated vapor (e.g., contaminated soil or groundwater) does not need to be directly beneath a structure to contaminate the vapor immediately beneath the building's foundation (as suggested in Figure 1.1).

1.2 Soil vapor intrusion and human exposure

Humans can be exposed to contaminated soil vapor when the vapor is drawn into the building due to pressure differences [Section 1.1] and mixed with the indoor air. Inhalation is the primary route of exposure, or the manner in which the volatile chemicals, once in the indoor air, actually enter the body.

Both current and potential exposures are considered when evaluating soil vapor intrusion at sites (i.e., locations of suspected or known environmental contamination). *Current* exposures exist when vapor intrusion is documented in an occupied building. *Potential* exposures exist when volatile chemicals are present in the vapor phase beneath a building, but have not affected indoor air quality due to current site conditions. Potential exposures also exist when there is a chance that contaminated soil vapors may move beneath existing buildings not currently affected, when indoor air is affected but the building is currently unoccupied, or when there is a chance that new buildings can be built over existing subsurface vapor contamination.

Exposure to a volatile chemical due to vapor intrusion does not necessarily mean that health effects will occur. Whether or not a person experiences health effects depends on several factors, including the length of exposure (short-term or acute versus long-term or chronic), the amount of exposure (i.e., dose), the frequency of exposure, the toxicity of the volatile chemical and the individual's sensitivity to the chemical.

1.3 Factors affecting soil vapor migration and intrusion

Predicting the extent of soil vapor contamination from soil or groundwater contamination, as well as the potential for human exposure from soil vapor intrusion into buildings, is complicated by factors that can affect soil vapor migration and intrusion. For example, soil vapor contaminant plumes may not mimic groundwater contaminant plumes since different factors affect the migration pattern of each medium. In addition to the operation of HVAC

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

systems, the operation of kitchen vents in restaurants or of elevators in office buildings may induce pressure gradients that result in the migration of vapor-phase contaminants away from a groundwater source of vapors and toward these buildings. This is similar to when the pumping of production wells or water supply wells draws contaminated groundwater away from its natural flow path.

Factors that can affect soil vapor migration and intrusion generally fall into two categories: environmental and building factors. Examples of environmental factors are provided in Table 1.1, and examples of building factors in Table 1.2. These factors are considered when conducting an investigation of the soil vapor intrusion pathway [Section 2] and when evaluating the results [Section 3].

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Table 1.1 Environmental factors that may affect soil vapor intrusion

Environmental Factor	Description
Soil conditions	Generally, dry, coarse-grained soils facilitate the migration of subsurface vapors and wet, fine-grained or highly organic soils retard migration.
Volatile chemical concentrations	The potential for vapor intrusion generally increases with increasing concentrations of volatile chemicals in groundwater or subsurface soils, as well as with the presence of NAPL.
Source location	The potential for vapor intrusion generally decreases with increasing distance between the subsurface source of vapor contamination and overlying buildings. For example, the potential for vapor intrusion associated with contaminated groundwater decreases with increasing depth to groundwater.
Groundwater conditions	Volatile chemicals dissolved in groundwater may off-gas to the vadose zone from the surface of the water table. If contaminated groundwater is overlain by clean water (upper versus lower aquifer systems or significant downward groundwater gradients), then vapor phase migration or partitioning of the volatile chemicals is unlikely. Additionally, fluctuations in the groundwater table may results in contaminant smear zones. The "smear zone" is the area of subsurface soil contamination within the range of depths where the water table fluctuates. Chemicals floating on top of the water table, such as petroleum components, can sorb onto soils within this zone as the water table fluctuates. Sorption of chemicals can influence their gaseous and aqueous phase diffusion in the subsurface, and ultimately the rate at which they migrate.
Surface confining layer	A surface confining layer (e.g., frost layer, pavement or buildings) may temporarily or permanently retard the migration of subsurface vapors to outdoor air. Confining layers can also prevent rainfall from reaching subsurface soils, creating relatively dry soils that further increase the potential for soil vapor migration.
Fractures in bedrock and/or tight clay soils	Fractures in bedrock and desiccation fractures in clay can increase the potential for vapor intrusion beyond that expected for the bulk, unfractured bedrock or clay matrix by facilitating vapor migration (in horizontal and vertical directions) and movement of contaminated groundwater along spaces between fractures.
Underground conduits	Underground conduits (e.g., sewer and utility lines, drains or tree roots, septic systems) with highly permeable bedding materials relative to native materials can serve as preferential pathways for vapor migration due to relatively low resistance to flow.
Weather conditions	Wind and barometric pressure changes and thermal differences between air and surrounding soils may induce pressure gradients that affect soil vapor intrusion.
Biodegradation processes	Depending upon environmental conditions (e.g., soil moisture, oxygen levels, pH, mineral nutrients, organic compounds, and temperature), the presence of appropriate microbial populations, and the degradability of the volatile chemical of concern, biodegradation in the subsurface may reduce the potential for vapor intrusion. For example, readily biodegradable chemicals in soil vapor may not migrate a significant distance from a source area while less degradable chemicals may travel farther.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Table 1.2 Building factors that may affect vapor intrusion

Building Factor	Description
Operation of HVAC systems, fireplaces, and mechanical equipment (e.g., clothes dryers or exhaust fans/vents)	Operation may create a pressure differential between the building or indoor air and the surrounding soil that induces or retards the migration of vapor-phase contaminants toward and into the building. Vapor intrusion can be enhanced as the air vented outside is replaced.
Heated building	When buildings are closed up and heated, a difference in temperature between the inside and outdoor air induces a stack effect, venting warm air from higher floors to the outside. Vapor intrusion can be enhanced as the air is replaced in the lower parts of the building.
Air exchange rates	The rate at which outdoor air replenishes indoor air may affect vapor migration into a building as well the indoor air quality. For example, newer construction is typically designed to limit the exchange of air with the outside environment. This may result in the accumulation of vapors within a building.
Foundation type	Earthen floors and fieldstone walls may serve as preferential pathways for vapor intrusion.
Foundation integrity	Expansion joints or cold joints, wall cracks, or block wall cavities may serve as preferential pathways for vapor intrusion.
Subsurface features that penetrate the building's foundation	Foundation perforations for subsurface features (e.g., electrical, gas, sewer or water utility pipes, sumps, and drains) may serve as a preferential pathway for vapor intrusion.

1.4 Factors affecting indoor air quality

Chemicals are a part of our everyday life. They are found in the household products we use and in items we bring into our homes. As such, chemicals are found in indoor air of homes not affected by intrusion of contaminated soil vapor. Examples of alternate sources of volatile chemicals in indoor air are given in Table 1.3. Similarly, volatile chemicals can be in the outdoor air that enters a home or place of business. Certain commercial and industrial facilities, such as gasoline stations and dry cleaners, and vehicle exhaust are examples of possible sources of volatile chemicals in outdoor air.

Commonly found concentrations of these chemicals in indoor and outdoor air are referred to as "background levels." These levels are generally determined from the results of samples collected in homes, offices and outdoor areas not known to be affected by external sources of volatile chemicals (for example, a home not known to be near a chemical spill, a hazardous waste site, a dry-cleaner, or a factory). Background sources of volatile chemicals are considered when conducting an investigation of the soil vapor intrusion pathway [Section 2] and when evaluating the results [Section 3].

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Table 1.3 Alternate sources of volatile chemicals in indoor air

Source	Description
Outdoor air	Outdoor sources of pollution can affect indoor air quality due to the exchange of outdoor and indoor air in buildings through natural ventilation, mechanical ventilation or infiltration. Outdoor sources of volatile compounds include automobiles, lawn mowers, oil storage tanks, dry cleaners, gasoline stations, industrial facilities, etc.
Attached or underground garages	Volatile chemicals from sources stored in the garage (e.g., automobiles, lawn mowers, oil storage tanks, gasoline containers, etc.) can affect indoor air quality due to the exchange of air between the garage and indoor space.
Off-gassing	Volatile chemicals may off-gas from building materials (e.g., adhesives or caulk), furnishings (e.g., new carpets or furniture), recently dry-cleaned clothing, or areas (such as floors or walls) contaminated by historical use of volatile chemicals in a building. Volatile chemicals may also off-gas from contaminated groundwater that infiltrates into the basement (e.g., at a sump) or during the use of contaminated domestic well water (e.g., at a tap or in a shower).
Household products	Household products include, but are not limited to, cleaners, mothballs, cigarette smoke, paints, paint strippers and thinners, air fresheners, lubricants, glues, solvents, pesticides, fuel oil storage, and gasoline storage.
Occupant activities	For example, in non-residential settings, the use of volatile chemicals in industrial or commercial processes or in products used for building maintenance. In residential settings, the use of products containing volatile chemicals for hobbies (e.g., glues, paints, etc.) or home businesses. People working at industrial or commercial facilities where volatile chemicals are used may bring the chemicals into their home on their clothing.
Indoor emissions	These include, but are not limited to, combustion products from gas, oil and wood heating systems that are vented outside improperly, as well as emissions from industrial process equipment and operations.

1.5 General approach to evaluating soil vapor intrusion

Since no two sites are exactly alike, the approach to evaluating soil vapor intrusion is dependent upon site-specific conditions. A thorough understanding of the site, including its history of use, characteristics (e.g., geology, geography, identified environmental contamination, etc.) and potentially exposed populations, is used to develop an investigation plan. Existing information is reviewed to determine what data are available and what additional data should be collected (i.e., to guide the investigation). In addition, factors affecting soil vapor migration and intrusion [Section 1.3] and indoor air quality [Section 1.4] are also considered when both conducting an investigation [Section 2] and evaluating the results [Section 3].

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

This data gathering and review process should be repeated until each of the following questions can be answered:

[1] Are subsurface vapors contaminated (i.e., soil vapor as defined in Section 1.1, including vapors located immediately beneath the foundation or slab of a building)? If so, what are the nature and extent of contamination? What is/are the source(s) of the contamination?

[2] What are the current and potential exposures to contaminated subsurface vapors via soil vapor intrusion?

[3] What actions, if any, should be taken to prevent or mitigate exposures related to soil vapor intrusion and to remediate subsurface vapor contamination?

When determining what actions, if any, are appropriate to mitigate current or prevent future human exposures, all information known about a site is considered (i.e., a "whole picture" approach is taken) because each site presents its own unique set of circumstances. This information includes, but is not limited to, the following: nature and extent of contamination in all environmental media, factors affecting vapor migration and intrusion, current and future site uses, off-site land uses, presence of alternate sources of volatile chemicals, and completed or proposed remedial actions.

Actions taken to minimize or prevent exposures typically do not preclude the site from being used for a desired purpose or from being developed. If appropriate, mitigation systems can be installed at existing buildings or installed during the construction of new buildings. In many cases, installation of mitigation systems on new buildings may be a prudent, proactive action. The costs associated with installing a system at the time of a building's construction are often considerably less than the costs associated with retrofitting a system to the building after construction is completed. Furthermore, in many parts of New York State, the mitigation system would also address concerns about human exposures to radon. To learn more about radon in New York State, please refer to the Radon: Frequently Asked Questions Fact Sheet in Appendix H or visit the NYSDOH's web site at http://www.health.state.ny.us/nysdoh/radon/radonhom.htm or contact the NYSDOH's Radon Program at 1-800-458-1158.

1.6 Conceptual site model

In accordance with the NYSDEC's *Draft DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2002), subsurface vapors and soil vapor intrusion should be included in an overall conceptual model for the site. As described in the NYSDEC's technical guidance, a conceptual site model should be used to develop a general understanding of the site to evaluate potential risks to public health and the environment and to assist in identifying and setting priorities for the activities to be conducted at the site. The conceptual site model also identifies potential sources of contamination, types of contaminants and affected media, release mechanisms and potential contaminant pathways, and actual/potential human and environmental receptors.

The components of a conceptual site model specific to soil vapor intrusion are provided throughout Section 1 of the guidance. The general approach for evaluating soil vapor intrusion described in Section 1.5 is analogous to the development of a conceptual site model specific to soil vapor intrusion. For additional information about the use of conceptual site models in the investigation and remediation of sites or a description of the conceptual site model process, the reader is referred to the NYSDEC's technical guidance.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

1.7 Applicability of guidance

This guidance should be considered anywhere soil vapor intrusion is evaluated in the State of New York, whether the evaluation is being undertaken voluntarily by a corporation, a municipality, or private citizen, or under one of the state's environmental remediation programs.

1.7.1 Residential and non-residential settings

The guidance should be followed in residential and non-residential settings where people may be exposed involuntarily to chemicals from soil vapor intrusion.

1.7.2 Chlorinated and non-chlorinated volatile chemical sites

The guidance should be used when evaluating soil vapor intrusion at chlorinated and non-chlorinated volatile chemical sites, including petroleum hydrocarbon sites and manufactured gas plant sites. While the likelihood for exposures related to soil vapor intrusion may differ between sites due to site-specific conditions and chemical-specific properties, the extent of volatile chemical contamination and the nature of the contamination, these factors should be considered when developing the conceptual site model and implementing an investigation plan (as discussed in Sections 1.5 and 1.6). For example, if the conceptual site model suggests that soil vapor intrusion is not a concern at a petroleum hydrocarbon site due to biodegradation, the work plan might include the measurement of select bioparameters (e.g., oxygen, carbon dioxide, methane, etc.), along with the petroleum hydrocarbons, at varying depths to demonstrate bioattenuation in the vadose. The work plan might include sub-slab vapor sampling as well to demonstrate that conditions beneath nearby buildings are also resulting in bioattenuation of the petroleum hydrocarbons.

1.7.3 Current, new and past remedial sites

As discussed in the NYSDEC's Program Policy *DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York* (NYSDEC 2006), the soil vapor intrusion pathway will be evaluated at all completed, current and future remedial sites New York State. This soil vapor intrusion guidance document complements the NYSDEC's policy by providing recommendations on how to evaluate soil vapor intrusion. The combined goal of the policy and guidance documents is to conduct soil vapor intrusion evaluations as efficiently and effectively as possible at all remedial sites in New York.

1.8 Updates to the guidance

The investigation, evaluation, mitigation and remediation of soil vapor are evolving disciplines and this guidance document will be updated periodically, as appropriate. The history of the document's release is provided on the inside of the cover page. In addition, changes to the document are noted in Appendix A. The current version of the document supercedes previous versions. The current version of the guidance is available on the NYSDOH's web site (*http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/*) or by contacting the NYSDOH's Bureau of Environmental Exposure Investigation [see Contact Information on the inside of the cover page]. Revisions or amendments to the guidance will be posted on the NYSDOH's web site.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Section 2: Investigation of the Soil Vapor Intrusion Pathway

Soil vapor is an environmental medium, like groundwater and soil, that should be characterized during the investigation of a site. This section provides guidance on collecting appropriate and relevant data that can be used to identify current or potential human exposures to contaminated subsurface vapors associated with a site. As discussed in Section 1.5, no two sites are exactly alike. Site-specific and/or building-specific conditions may warrant modifying the recommendations herein. Therefore, guidance provided in this section is presented in terms of general steps and strategies that should be applied when approaching an investigation of soil vapor intrusion.

2.1 Sites at which an investigation is appropriate

Data collected to date do not support the use of pre-determined concentrations of volatile chemicals (i.e., screening criteria) in either groundwater or soil to trigger a soil vapor intrusion investigation. Therefore, although the level of investigation may vary, the pathway should be investigated at any site with the following:

a. an existing subsurface source (e.g., on the basis of preliminary environmental sampling) or likely subsurface source (e.g., on the basis of known previous land uses) of volatile chemicals [Section 1.1]; and

b. existing buildings or the possibility that buildings may be constructed near a subsurface source of volatile chemicals.

2.2 Types of samples

The following are types of samples that are collected to investigate the soil vapor intrusion pathway:

a. subsurface vapor samples:

   1. *soil vapor* samples (i.e., soil vapor samples not beneath the foundation or slab of a building) and

   2. *sub-slab vapor* samples (i.e., soil vapor samples immediately beneath the foundation or slab of a building);

b. crawl space air samples;

c. indoor air samples; and

d. outdoor air samples.

The types of samples that should be collected depend upon the specific objective(s) of the sampling, as described below.

2.2.1 Soil vapor

Soil vapor samples are collected to determine whether this environmental medium is contaminated, characterize the nature and extent of contamination, and identify possible sources of the contamination. Our experience to date indicates soil vapor results alone typically cannot be relied upon to rule out sampling at nearby buildings. For example, concentrations of volatile chemicals in sub-slab vapor samples have been substantially higher (e.g., by a factor of 100 or more) than concentrations found in nearby soil vapor

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

samples (e.g., collected at 8 feet below grade near the building). This may be due to differences in factors such as soil moisture content and pressure gradients. Therefore, exposures are evaluated primarily based on sub-slab vapor, indoor air and outdoor air sampling results and soil vapor results are primarily used as a tool to guide these investigations.

Soil vapor sampling results are also used when evaluating the effectiveness of direct or indirect measures to remediate contaminated subsurface vapors. (Soil vapor extraction is an example of a direct remedial measure, and groundwater pumping and treating an indirect measure.)

2.2.2 Sub-slab vapor

Sub-slab vapor samples are collected to characterize the nature and extent of soil vapor contamination immediately beneath a building with a basement foundation and/or a slab-on-grade. Sub-slab vapor sampling results are used in conjunction with indoor air and outdoor air sampling results when evaluating the following:

a. *current* human exposures;

b. the potential for *future* human exposures (e.g., if the structural integrity of the building changes or the use of the building changes); and

c. site-specific attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations).

Sub-slab vapor samples are often collected after soil vapor characterization and/or other environmental sampling (e.g., soil and groundwater characterization) indicate they are warranted. Sub-slab samples are typically collected concurrently with indoor and outdoor air samples. However, outside of the heating season, sub-slab vapor samples may be collected independently depending on the sampling objective (e.g., to characterize the extent of subsurface vapor contamination outside of the heating season to develop a more comprehensive, focused investigation plan for the heating season).

2.2.3 Crawl space air

Similar to sub-slab vapor samples, crawl space air samples are collected to characterize the nature and extent of contamination immediately beneath a building with a crawl space foundation. Crawl space air sampling results are used in conjunction with indoor air and outdoor air sampling results when evaluating the following:

a. *current* human exposures; and

b. the potential for *future* human exposures (e.g., if the structural integrity of the building changes or the use of the building changes).

2.2.4 Indoor air

Indoor air samples are collected to characterize exposures to air within a building, including those with earthen floors. Indoor air sampling results are used when evaluating the following:

a. *current* human exposures;

b. the potential for *future* exposures (e.g., if a currently vacant building should become occupied); and

c. site-specific attenuation factors (e.g., the ratio of indoor air to sub-slab vapor concentrations).

Indoor air samples are often collected after subsurface vapor characterization and other environmental sampling (e.g., soil and groundwater characterization) indicate they are warranted. When indoor air samples are collected, concurrent sub-slab vapor, crawl space air (if applicable) and outdoor air samples are collected to evaluate the indoor air results appropriately. However, indoor air and outdoor air samples, without sub-slab vapor samples, may be collected when confirming the effectiveness of a mitigation system [Section 4].

In addition, site-specific situations may warrant collecting indoor air samples prior to characterizing subsurface vapors and/or without concurrent sub-slab vapor sampling to examine immediate inhalation hazards. Examples of such situations may include, but are not limited to, the following:

a. in response to a spill event to qualitatively and/or quantitatively characterize the contamination;

b. if high readings are obtained in a building when screening with field equipment (e.g., a photoionization detector (PID), an organic vapor analyzer, or an explosimeter) and the source is unknown;

c. if significant odors are present and the source needs to be characterized; or

d. if groundwater beneath the building is contaminated, the building is prone to groundwater intrusion or flooding (e.g., sump pit overflows), and subsurface vapor sampling is not feasible. In these situations, the collection of water samples from the sump may also be appropriate.

2.2.5 Outdoor air

Outdoor air samples are collected to characterize site-specific background outdoor air conditions. Outdoor air samples should be collected simultaneously with indoor air samples to evaluate the potential influence, if any, of outdoor air on the indoor air sampled. Outdoor air samples may also be collected concurrently with soil vapor samples to identify potential outdoor air interferences associated with infiltration of outdoor air into the sampling apparatus while the soil vapor was collected.

2.3 Phase of a site investigation in which to sample

There is no single phase (e.g., preliminary site characterization or remedial investigation) of a site investigation during which sampling to evaluate the soil vapor intrusion pathway is appropriate. Initiation of investigation activities for this specific purpose should be determined on a site-by-site basis. However, if exposures due to soil vapor intrusion appear likely at any point during the investigation, evaluation of this exposure pathway should not be delayed.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

If the locations of likely source areas are reasonably known, sampling earlier during the investigation of a site rather than later is recommended because of the iterative nature of the sampling process [Section 2.5]. However, if current site conditions are not well-defined, then sampling after contamination in other environmental media (e.g., groundwater and soil) has been characterized may be considered. In the latter scenario, groundwater, soil and other site information may be used to guide an investigation of the soil vapor intrusion pathway, such as selecting locations for subsurface vapor samples based on likely migration pathways and source areas [Sections 2.6.1 and 2.6.2]. At a minimum, depth to groundwater and soil stratigraphy should be identified prior to collecting soil vapor samples.

Sampling may be delayed at parcels that are undeveloped or contain unoccupied buildings provided

a. characterization of the parcel is not needed to
    1. address exposures in the surrounding area;
    2. design remedial measures for subsurface vapor contamination; or
    3. monitor or confirm the effectiveness of remedial measures; and
b. measures are in place that assure that the parcel will not be developed, or buildings occupied, without addressing exposure concerns [Section 3.6].

If exposures due to soil vapor intrusion appear likely, and a delay of sampling is contemplated, the State (i.e., the NYSDEC and NYSDOH) should be informed of the contemplated delay and the rationale for the delay. Furthermore, the party contemplating the delay should consider any comments the State may have on the information provided.

2.4 Time of year in which to sample

2.4.1 Soil vapor

Soil vapor samples are collected at any time during the year. Often, sampling is completed during the summer so the results can be used as a tool when selecting buildings to be sampled during the heating season.

2.4.2 Buildings

Sub-slab vapor samples and, unless immediate sampling is appropriate, indoor air samples are typically collected during the heating season because soil vapor intrusion is more likely to occur when a building's heating system is in operation and doors and windows are closed. In New York State, heating systems are generally expected to be operating routinely from November 15th to March 31st. However, these dates are not absolute; the timeframe for sampling may vary depending on factors such as the location of the site (e.g., upstate versus downstate) and the weather conditions for a particular year.

A soil vapor intrusion investigation at a building may be conducted outside of the heating season if the concern for vapor intrusion is greater during another time of year. This may occur at certain industrial buildings, for instance, where HVAC systems are actively managed to control the ratio of recirculated indoor air to make-up air from outside the building. Information about the site and potentially affected structures, including the factors discussed in Section 1.3, should be considered in determining the timing of an investigation.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Samples may be collected at any time of year if exposures due to soil vapor intrusion appear likely. However, samples collected at times when soil vapor intrusion is not expected to have its greatest effect on indoor air quality (typically, samples collected outside of the heating season) should not be used to rule out exposures. For example, results indicating "no further action" or "monitoring required" should be verified when soil vapor intrusion is believed to be most likely to ensure these actions are protective throughout the year.

2.5 Number of sampling rounds

Investigating the soil vapor intrusion pathway usually involves more than one round of subsurface vapor, indoor air and/or outdoor air sampling, for reasons such as the following:

a. to characterize the nature and extent of subsurface vapor contamination (similar to the delineation of groundwater contamination) and to address corresponding exposure concerns;

b. to evaluate fluctuations in concentrations due to

    1. different weather conditions (e.g., seasonal effects),

    2. changes in building conditions (e.g., various operating conditions of a building's HVAC system),

    3. changes in source strength, or

    4. vapor migration or contaminant biodegradation processes (particularly when degradation products may be more toxic than the parent compounds); or

c. to confirm sampling results or the effectiveness of mitigation or remedial systems.

Overall, as discussed in Section 1.5, successive rounds of sampling should be conducted until the following questions can be answered:

a. Are subsurface vapors contaminated? If so, what are the nature and extent of contamination? What is/are the source(s) of the contamination?

b. What are the current and potential exposures to contaminated subsurface vapors?

c. What actions, if any, are appropriate to prevent or mitigate exposures and to remediate subsurface vapor contamination?

Toward this end, multiple rounds of sampling may be appropriate to characterize the nature and extent of subsurface vapor contamination such that

a. both potential and current exposures are addressed [Section 2.6];

b. measures can be designed to remediate subsurface vapor contamination, either directly (e.g., SVE system) or indirectly (e.g., soil excavation or groundwater remediation), given that monitoring and mitigation are considered temporary measures implemented to address exposures related to vapor intrusion until contaminated environmental media are remediated [Section 3.4]; and

c. the effectiveness of remedial measures can be monitored and confirmed (e.g., endpoint sampling) [Section 4.5].

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

2.6 Sampling locations

The general approach for selecting sampling locations as part of a soil vapor intrusion investigation is similar to the approach for the investigation of other environmental media (e.g., soil and groundwater). Sampling locations should be selected with consideration of the conceptual site model [Section 1.6]. These locations should be selected to meet the stated objectives of the sampling program. Additionally, similar to the investigation of soil and groundwater, it is typical to start at a known or suspected source and work outward. The specific approach, however, will be dependent upon site-specific and building-specific conditions.

2.6.1 Soil vapor

If available, existing environmental data (e.g., groundwater and soil data) and site background information should be used to select locations for sampling soil vapor as part of a vapor intrusion investigation. Locations will vary depending upon surface features (e.g., presence or absence of buildings, areas of pavement, or vacant lot) and subsurface characteristics (e.g., soil stratigraphy, buried structures, utility corridors, or clay lenses), as well as the specific purpose of the sampling. Therefore, a figure illustrating proposed sampling locations (with respect to both areal position and depth), actual locations sampled in the field, and relevant on-site and off-site features should be included in all sampling work plans and reports.

Examples of how locations may vary given the specific purpose of the sampling follow. They include general guidelines that should be followed when selecting soil vapor sampling locations:

a. to evaluate the **potential for current on-site or off-site exposures**, samples should be collected
    1. in the vicinity of a building's foundation [see special sampling consideration at the end of Section 2.6.1 if sampling around a building with no surrounding surface confining layer], as well as between the building's foundation and the source (if known and not located beneath the building),
    2. along the site's perimeter, and
    3. at a depth comparable to the depth of foundation footings (determined on a building-specific or site-specific basis) or at least 1 foot above the water table in areas where the groundwater table is less than 6 feet below grade;
b. to evaluate the **potential for future exposures if development** on a known or suspected contaminated area on-site or off-site is possible, representative samples should be collected
    1. in areas with either known or suspected subsurface sources of volatile chemicals, in areas where elevated readings were obtained with field equipment during previous environmental investigations, and in areas of varying concentrations of contamination in the upper groundwater,
    2. in a grid pattern across the area (at an appropriate spacing interval for the size of the area) if information is limited for the area, and
    3. at multiple depths from the suspected subsurface source, or former source, to a depth comparable to the expected depth of foundation footings;

c. to evaluate the **potential for off-site soil vapor contamination**, samples should be collected

   1. along the site's perimeter,
   2. in areas of potential subsurface sources of vapor contamination (e.g., a groundwater plume that has migrated off-site), and
   3. at a depth comparable to the depth of foundation footings (determined on a site-specific basis) or at least 1 foot above the water table in areas where the groundwater table is less than 6 feet below grade;

d. to evaluate on-site and off-site **preferential migration pathways** in areas with low permeability soils, samples should be collected

   1. along preferential soil vapor flow paths, such as sewer lines, utility corridors, trenches, pipelines, and other subsurface structures that are likely to be bedded with higher permeability materials, and
   2. at depths corresponding to these subsurface features (will depend on site-specific conditions);

e. to characterize on-site or off-site **contamination in the vadose zone**, samples should be collected

   1. in areas with either known or suspected sources of volatile chemicals, in areas where elevated readings were obtained with field equipment (e.g., PID) during previous soil and groundwater investigations, and in areas of varying concentrations of contamination in the upper groundwater regime, and
   2. at appropriate depths associated with these areas (will depend on site-specific conditions); and

f. to investigate the **influence of contaminated groundwater or soil on soil vapor** and to characterize the **vertical profile** of contamination, samples should be collected from clusters of soil vapor probes at varying depths in the vadose zone [Figure 2.2, Section 2.7.1] and preferably in conjunction with the collection of groundwater or soil samples.

Soil vapor samples collected at depths shallower than 5 feet below grade may be prone to negative bias due to infiltration of outdoor air. Therefore, samples from these depths should be collected only if appropriate (based on site-specific conditions), and sampling procedures and results should be reviewed accordingly. The depth of sampling near buildings with slab-on-grade foundations is dependent upon site-specific conditions (e.g., building surrounded by grassy or surface confining layer).

When collecting soil vapor samples around a building with no surrounding surface confining layer (e.g., pavement or sidewalk), samples should be located in native or undisturbed soils away from fill material surrounding the building (approximately 10 feet away from the building) to avoid sampling in an area that may be influenced by the building's operations. For example, operation of HVAC systems, fireplaces, or mechanical equipment (e.g., clothes dryers or exhaust fans/vents) in a building may exacerbate the infiltration of outdoor air into the vadose zone adjacent to the building. As a result, soil vapor samples collected in uncovered areas adjacent to the building may not be representative.

Investigations of soil vapor contamination should proceed outward from known or suspected subsurface sources, as appropriate, on an areal basis until the nature and extent of

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
subsurface vapor contamination has been characterized and human exposures have been addressed.

2.6.2 Sub-slab vapor

Existing environmental data (e.g., soil vapor, groundwater and soil data), site background information, and building construction details (e.g., basement, slab-on-grade, or multiple types of foundations, HVAC systems, etc.) should be considered when selecting buildings and locations within buildings for sub-slab vapor sampling.

At a minimum, these general guidelines should be followed when selecting buildings to sample for sub-slab vapors:

a. buildings, including residential dwellings, located above or directly adjacent to known or suspected areas of subsurface volatile chemical contamination should be sampled;

b. buildings in which screening with field equipment (e.g., PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) suggests a completed migration pathway, such as when readings are above background and from unidentified sources or when readings show increasing gradients, should be sampled; and

c. buildings within known or suspected areas of subsurface volatile chemical contamination that are used or occupied by sensitive population groups (e.g., daycare facilities, schools, nursing homes, etc.) should be given special consideration for sampling.

Investigations of sub-slab vapor and/or indoor air contamination should proceed outward from known or suspected sources, as appropriate, on an areal basis until the nature and extent of subsurface vapor contamination has been characterized and potential and current human exposures have been addressed. In cases of widespread vapor contamination and depending upon the basis for making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination [Section 3.3.1]), a representative number of buildings from an identified study area, rather than each building, may be sampled. Prior to implementation, this type of sampling approach should be approved by State agency personnel.

Within a building, sub-slab vapor samples should be collected

a. in at least one central location away from foundation footings, and

b. from the soil or aggregate immediately below the basement slab or slab-on-grade.

The number of sub-slab vapor samples that should be collected in a building depends upon the number of slabs (e.g., multiple slabs-on-grade in a large warehouse) and foundation types (e.g., combined basement and slab-on-grade in a residence). At least one sub-slab vapor sample should be collected from each representative area.

2.6.3 Indoor air

Existing environmental data (e.g., soil vapor, groundwater and soil data), site background information, and building construction details (e.g., basement, slab-on-grade, or multiple types of foundations; number and operation of HVAC systems; elevator shafts; tunnels or other confined-space entry points; etc.) should be considered when selecting buildings and

locations within buildings for indoor air sampling. Indoor air samples are typically collected concurrently with sub-slab vapor and outdoor air samples [Section 2.2.4].

At a minimum, these general guidelines should be followed when selecting buildings to sample for indoor air:

a. where sub-slab vapor samples were collected without indoor air samples, buildings in which elevated concentrations of contaminants were measured in sub-slab vapor samples should be sampled;

b. buildings, including residential dwellings, located above or directly adjacent to known or suspected subsurface sources of volatile chemicals or known soil vapor contamination should be sampled;

c. buildings in which screening with field equipment (e.g., PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) suggests a completed migration pathway, such as when readings are above background and from unidentified sources or when readings show increasing gradients, should be sampled; and

d. buildings within known or suspected areas of subsurface volatile chemical contamination that are used or occupied by sensitive population groups (e.g., daycare facilities, schools, nursing homes, etc.) should be given special consideration for sampling.

To characterize contaminant concentration trends and potential exposures, indoor air samples should be collected

a. from the crawl space area,

b. from the basement (where vapor infiltration is suspected, such as near sump pumps or indoor wells, or in a central location) at a height approximately three feet above the floor to represent a height at which occupants normally are seated and/or sleep,

c. from the lowest level living space (in centrally-located, high activity use areas) at a height approximately three feet above the floor to represent a height at which occupants normally are seated and/or sleep, and

d. if in a commercial setting (e.g., a strip mall), from multiple tenant spaces at a height approximately three feet above the floor to represent a height at which occupants normally are seated.

These locations are illustrated in Figure 2.1.

Investigations of indoor air contamination should proceed outward from known or suspected subsurface sources, as appropriate, on an areal basis until potential and current human exposures associated with soil vapor intrusion have been addressed. In cases of widespread vapor contamination and depending upon the basis for making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination), a representative number of buildings from an identified study area, rather than each building, may be sampled. Prior to implementation, this type of sampling approach should be approved by State agency personnel.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

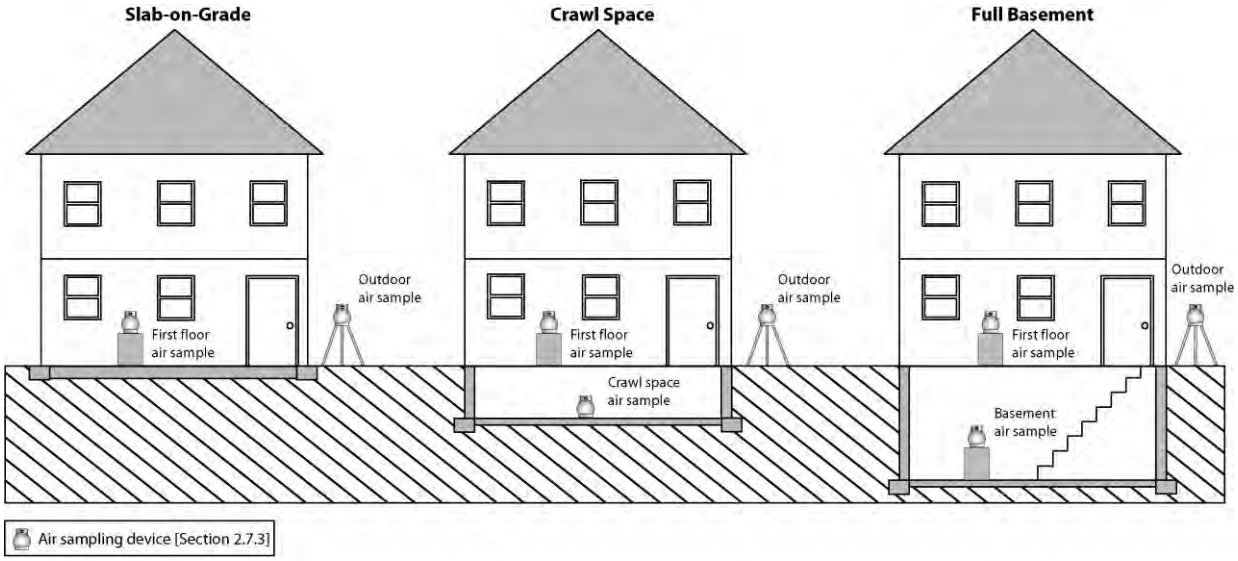


Figure 2.1
Schematic of indoor and outdoor air sampling locations

2.6.4 Outdoor air

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

2.7 Sampling protocols

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

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

2.7.1 Soil vapor

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

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

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

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

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

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

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

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

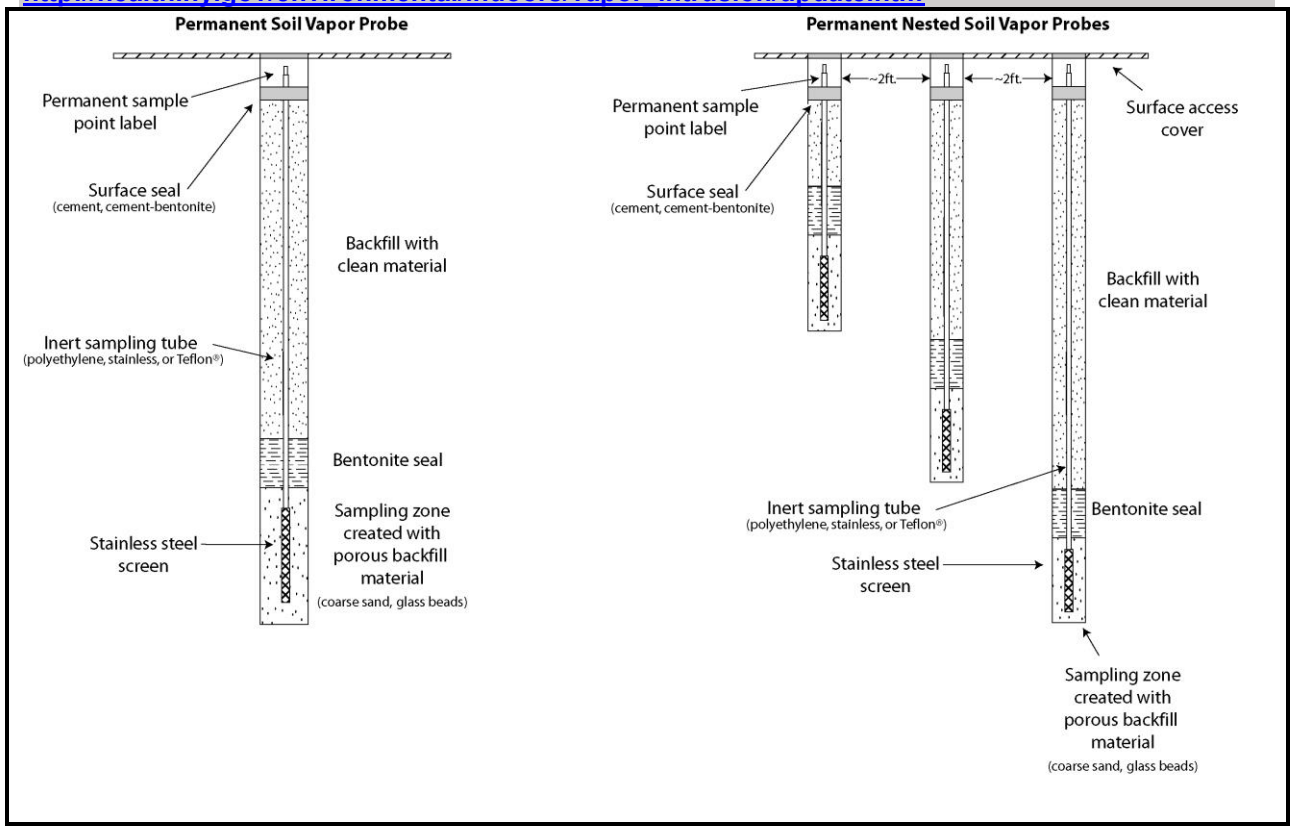


Figure 2.2

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

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

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

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

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

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

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

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

   iii. is certified clean by the laboratory;

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

e. a tracer gas (e.g., helium, butane, sulfur hexafluoride, etc.) should be used when collecting soil vapor samples to verify that adequate sampling techniques are being implemented (i.e., to verify infiltration of outdoor air is not occurring) [Section 2.7.5].

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

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

a. if sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified;

b. outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (north);

c. weather conditions (e.g., precipitation and outdoor temperature) should be noted for the past 24 to 48 hours; and

d. any pertinent observations should be recorded, such as odors and readings from field instrumentation.

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

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

a. sample identification,

b. date and time of sample collection,

c. sampling depth,

d. identity of samplers,

e. sampling methods and devices,

f. purge volumes,

g. volume of soil vapor extracted,

h. if canisters used, the vacuum before and after samples were collected,

i. apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and

j. chain of custody protocols and records used to track samples from sampling point to analysis.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

2.7.2 Sub-slab vapor

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

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

a. permanent recessed probes should be constructed with brass or stainless steel tubing and fittings;

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

c. tubing should not extend further than 2 inches into the sub-slab material;

d. porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.) should be added to cover about 1 inch of the probe tip for permanent installations; and

e. the implant should be sealed to the surface with non-VOC-containing and non-shrinking products for temporary installations (e.g., permagum grout, melted beeswax, putty, etc.) or cement for permanent installations.

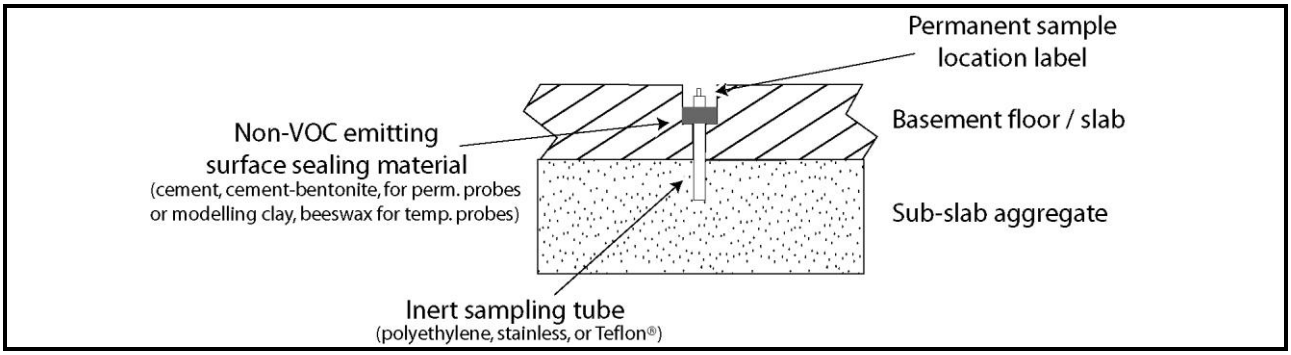


Figure 2.3

Schematic of a generic sub-slab vapor probe

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

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

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

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

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

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

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

    iii. is certified clean by the laboratory;

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

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

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

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

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

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

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

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

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

Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

contaminant sources and other areas), the barometric pressure and photographs to accompany floor plan sketches.

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

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

2.7.3 Indoor air

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

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

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

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

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

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

iii. is certified clean by the laboratory.

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

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

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

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

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

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

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

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

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

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

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

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

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

2.7.4 Outdoor air

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

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

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

2.7.5 Tracer gas

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

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

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

be taken to ensure that the gas used by the laboratory to clean the air sampling container is different from the gas used as a tracer during sampling (e.g., helium).

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

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

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

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

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

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

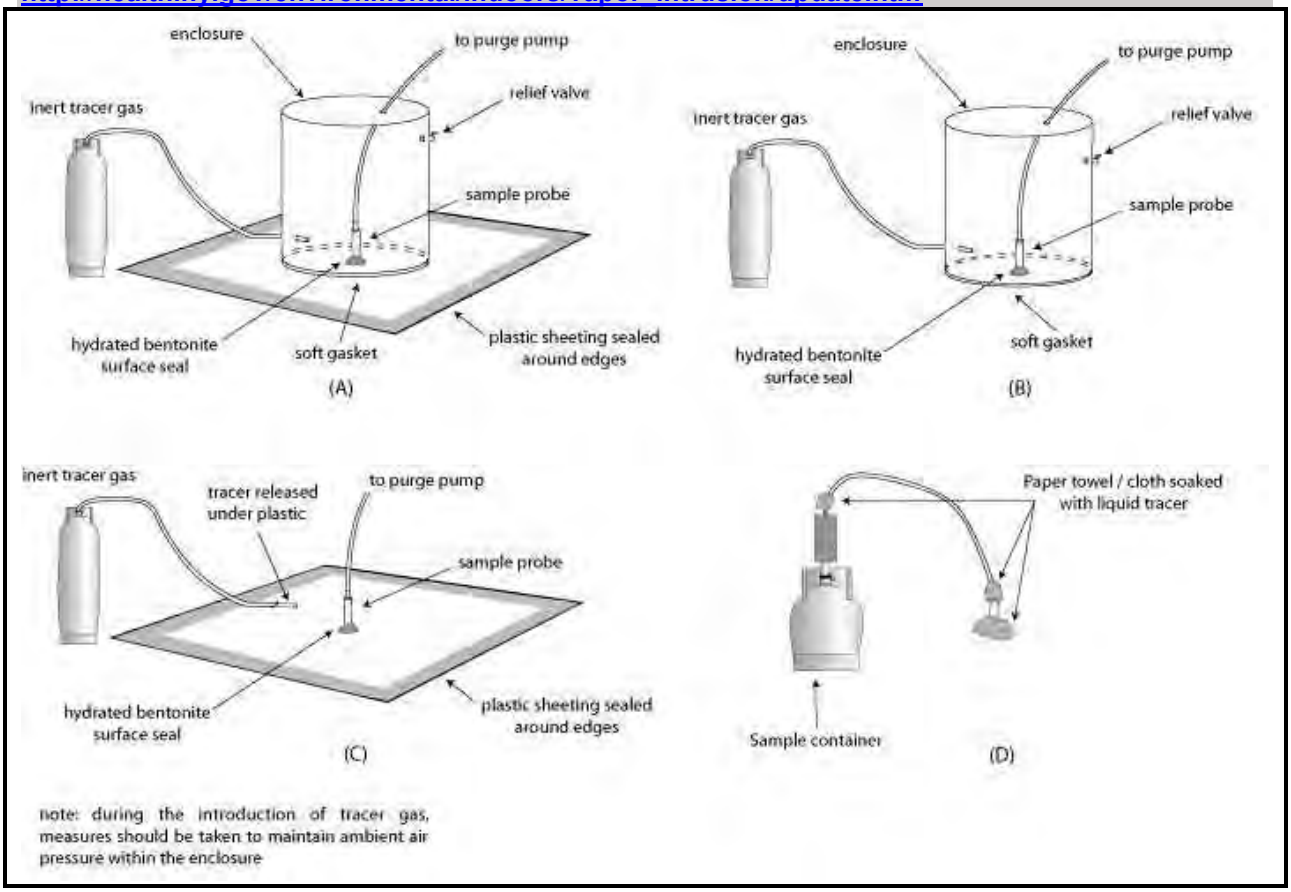


Figure 2.4
Schematics of generic tracer gas applications when collecting soil vapor samples

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

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

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

2.8 Quality assurance/quality control (QA/QC)

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

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

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

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

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

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

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

2.9 Analytical methods

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

Proposed analytical procedures should be identified in work plans. Similarly, the analytical procedures that were used and corresponding reporting limits should be identified when reporting the sampling results. When selecting an appropriate analytical method, the data quality objectives should be considered. As described in Section 3, comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels and with the levels presented in the matrices [Section 3.4.2]. If there are additional data quality objectives, they should be considered also. Typically, a minimum reporting limit of 1 microgram per cubic meter (1 mcg/m^3) or less is sufficient for most analytes. Examples of commonly used analytical methods include the following:

a. EPA Method TO-15 for a wide range of VOCs (e.g., samples from evacuated canisters),

b. NYSDOH Method 311-9 for tetrachloroethene (i.e., samples from perc badges),

c. EPA Method TO-17 for VOCs (e.g., samples collected with sorbent tubes), and

d. EPA Method TO-15 for VOCs with selective ion monitoring (SIM) (e.g., to achieve minimum reporting limits lower than those achieved with Method TO-15 alone).

The laboratory should verify that they are capable of detecting the appropriate analytes and can report them at the appropriate reporting limit.

2.9.1 Subsurface vapor

Soil vapor and sub-slab vapor samples should be analyzed for a wide range of volatile chemicals during the first round of sampling (at a minimum) — unless it can be demonstrated that an abbreviated or site-specific analyte list is appropriate. This is analogous to analyzing groundwater samples for a suite of compounds (e.g., EPA's target analyte list/target compound list (TAL/TCL) chemicals) during the initial rounds of site characterization. Based on the initial sampling results, development and application of a site-specific analyte list may be considered for analysis of subsequent soil vapor and sub-slab vapor samples.

If a site-specific analyte list is developed, it should include the following:

a. volatile chemicals which have been previously detected in environmental media (e.g., soil, groundwater and air) at the site;

b. volatile chemicals which are known or demonstrated constituents of the contamination in question (e.g., petroleum products or tars from former manufactured gas plants); and

c. expected degradation products of the chemicals mentioned in a or b.

A site-specific analyte list might also include indicator compounds to assist in identifying and differentiating subsurface sources of volatile chemical contamination. The following are examples of indicator compounds that have been included in site-specific analyte lists given the nature of the contamination or type of site:

a. gasoline: benzene, toluene, ethylbenzene, xylenes, trimethylbenzene isomers, individual C-4 to C-8 aliphatics (e.g., hexane, cyclohexane, dimethylpentane, 2,2,4-trimethylpentane, etc.), and appropriate oxygenate additives (e.g., methyl-*tert*-butyl ether, ethanol, etc.);

b. middle distillate fuels (#2 fuel oil, diesel and kerosene): n-nonane, n-decane, n-undecane, n-dodecane, ethylbenzene, xylenes, trimethylbenzene isomers, tetramethylbenzene isomers, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene;

c. manufactured gas plant sites: trimethylbenzene isomers, tetramethylbenzene isomers, thiopenes, indene, indane, and naphthalene;

d. natural gas: propane, propene, butane, iso-butane, methylbutane, and n-pentane with lower levels of higher molecular weight aliphatic, olefinic, and some aromatic compounds; and

e. solvent-using industries: the solvent and its expected degradation products (e.g., tetrachloroethene, trichloroethene, dichloroethene(s), and vinyl chloride).

2.9.2 Indoor air

Indoor and outdoor air samples should be analyzed for a wide range of volatile chemicals if there are no existing data for subsurface vapors — unless it can be demonstrated that an abbreviated or site-specific analyte list is appropriate. If indoor air sampling is appropriate based on the levels of volatile chemicals in subsurface vapors, analysis of indoor air samples specifically for those volatile chemicals may be considered.

2.9.3 Outdoor air

Outdoor air samples should be analyzed in a manner consistent with corresponding indoor air samples.

2.10 Field laboratories and mobile gas chromatographs (GCs)

Use of field laboratories and mobile GCs as screening tools when collecting soil vapor samples may be considered on a site-specific basis. However, without ELAP certification, screening tools such as these are not acceptable when collecting sub-slab vapor, indoor air and outdoor air samples for the purpose of evaluating exposures related to soil vapor intrusion. ELAP certification for a particular laboratory does not indicate mobile laboratory or GC certification. Mobile laboratories and GCs have specific certification requirements through ELAP. Questions regarding a mobile laboratory's certification should be directed to the laboratory itself.

2.11 Surveys and pre-sampling building preparation

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

2.11.1 Pre-sampling building inspection and preparation

A pre-sampling inspection should be performed prior to each sampling event to identify and minimize conditions that may interfere with the proposed testing. The inspection should evaluate the type of structure, floor layout, air flows and physical conditions of the building(s) being studied. This information, along with information on sources of potential

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
indoor air contamination [Section 2.11.2], should be identified on a building inventory form. An example of a building inventory form is given in Appendix B. Items to be included in the building inventory include the following:

a. construction characteristics, including foundation cracks and utility penetrations or other openings that may serve as preferential pathways for vapor intrusion;

b. presence of an attached garage;

c. recent renovations or maintenance to the building (e.g., fresh paint, new carpet or furniture);

d. mechanical equipment that can affect pressure gradients (e.g., heating systems, clothes dryers or exhaust fans);

e. use or storage of petroleum products (e.g., fuel containers, gasoline operated equipment and unvented kerosene heaters); and

f. recent use of petroleum-based finishes or products containing volatile chemicals.

Each room on the floor of the building being tested and on lower floors, if possible, should be inspected. This is important because even products stored in another area of a building can affect the air of the room being tested.

The presence and description of odors (e.g., solvent, moldy) and portable vapor monitoring equipment readings (e.g., PIDs, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) should be noted and used to help evaluate potential sources. This includes taking readings near products stored or used in the building. Where applicable, readings should be provided in units that denote the calibration gas (e.g., isobutylene-equivalent ppm, benzene-equivalent ppm, etc.).

Potential interference from products or activities releasing volatile chemicals should be controlled to the extent practicable. Removing the source from the indoor environment prior to testing is the most effective means of reducing interference. Ensuring that containers are tightly sealed may be sufficient. When testing for volatile organic compounds, containers should be tested with portable vapor monitoring equipment to determine whether compounds are leaking. The inability to eliminate potential interference may be justification for not testing, especially when testing for similar compounds at low levels. The investigator should consider the possibility that chemicals may adsorb onto porous materials and may take time to dissipate.

In some cases, the goal of the testing is to evaluate the impact from products used or stored in the building (e.g., pesticide misapplications, school renovation projects). If the goal of the testing is to determine whether products are an indoor volatile chemical contaminant source, the removing these sources does not apply.

Once interfering conditions are corrected (if applicable), ventilation may be appropriate prior to sampling to minimize residual contamination in the indoor air. If ventilation is appropriate, it should be completed 24 hours or more prior to the scheduled sampling time. Where applicable, ventilation can be accomplished by operating the building's HVAC system to maximize outside air intake. Opening windows and doors, and operating exhaust fans may also help or may be appropriate if the building has no HVAC system.

Air samples are sometimes designed to represent typical exposure in a mechanically ventilated building and the operation of HVAC systems during sampling should be noted on the building inventory form [Appendix B]. When samples are collected, the building's HVAC

system should be operating in a manner consistent with normal operating conditions when the building is occupied (e.g., schools, businesses, etc.). Unnecessary building ventilation should be avoided within 24 hours prior to and during sampling. During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 – 75 °F) for at least 24 hours prior to and during the scheduled sampling time.

Depending upon the goal of the indoor air sampling, some situations may warrant deviation from the above protocol regarding building ventilation. In such cases, building conditions and sampling efforts should be understood and noted within the framework and scope of the investigation.

To avoid potential interferences and dilution effects, occupants should make a reasonable effort to avoid the following for 24 hours prior to sampling:

a. opening any windows, fireplace dampers, openings or vents;
b. operating ventilation fans unless special arrangements are made;
c. smoking in the building;
d. painting;
e. using a wood stove, fireplace or other auxiliary heating equipment (e.g., kerosene heater);
f. operating or storing automobile in an attached garage;
g. allowing containers of gasoline or oil to remain within the house or garage area, except for fuel oil tanks;
h. cleaning, waxing or polishing furniture, floors or other woodwork with petroleum- or oil-based products;
i. using air fresheners, scented candles or odor eliminators;
j. engaging in any hobbies that use materials containing volatile chemicals;
k. using cosmetics including hairspray, nail polish, nail polish removers, perfume/cologne, etc.;
l. lawn mowing, paving with asphalt, or snow blowing;
m. applying pesticides;
n. using building repair or maintenance products, such as caulk or roofing tar; and
o. bringing freshly dry-cleaned clothing or furnishings into the building.

2.11.2 Product inventory

The primary objective of the product inventory is to identify potential air sampling interference by characterizing the occurrence and use of chemicals and products throughout the building, keeping in mind the goal of the investigation and site-specific contaminants of concern. For example, it is not appropriate to provide detailed information for each individual container of like items. However, it is appropriate to indicate that "20 bottles of perfume" or "12 cans of latex paint" were present with containers in good condition. This information is used to help formulate an indoor environment profile.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

An inventory should be provided for each room on the floor of the building being tested and on lower floors, if possible. This is important because even products stored in another area of a building can affect the air of the room being tested.

The presence and description of odors (e.g., solvent, moldy) and portable vapor monitoring equipment readings (e.g., PIDs, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) should be noted and used to help evaluate potential sources. This includes taking readings near products stored or used in the building. Where applicable, readings should be provided in units that denote the calibration gas (e.g., isobutylene-equivalent ppm, benzene-equivalent ppm, etc.).

Products in buildings should be inventoried every time air is tested to provide an accurate assessment of the potential contribution of volatile chemicals. If available, chemical ingredients of interest (e.g., analyte list) should be recorded for each product. If the ingredients are not listed on the label, record the product's exact and full name, and the manufacturer's name, address and telephone number, if available. In some cases, material Safety Data Sheets may be useful for identifying confounding sources of volatile chemicals in air. Adequately documented photographs of the products and their labeled ingredients can supplement the inventory and facilitate recording the information.

2.12 Role of modeling

At sites where there is a potential for human exposures to subsurface contamination due to soil vapor intrusion (as described in Section 2.1), use of modeling as the sole means of evaluating potential exposures should be avoided. The limitations of modeling (e.g., exclusion of preferential migration pathways) introduce uncertainty as to whether human exposure is occurring, in absence of actual field data. Conclusions drawn from modeling should be verified with actual field data. For example, if modeling results indicate indoor air concentrations are predicted to be below applicable guidelines or levels of concern, indoor air and/or sub-slab vapor sampling would be appropriate to verify a conclusion that mitigation or other actions are not needed.

Modeling may, however, be used as a tool in the evaluation process. Examples of situations in which modeling may be used as a tool include, but are not limited to, the following:

a. to help identify potential migration pathways on the basis of site-specific conditions;

b. to estimate potential exposures when field samples cannot be collected (e.g., access to collect the samples is denied or buildings have not yet been constructed over the subsurface contamination); and

c. to identify a preferred order for sampling buildings by predicting expected indoor air concentrations within each of the buildings if there are numerous buildings overlying the subsurface contamination.

Use of any model at a site should be discussed with the agencies prior to the model's development and application. If a model is used, it should incorporate site-specific parameters (e.g., attenuation factors, soil conditions, concentrations of volatile chemicals, depth to subsurface source, characteristics of subsurface source, and foundation slab thickness) as much as possible. Furthermore, both the limitations of the model (e.g., exclusion of preferential migration pathways) and the sensitivity of the variables in the model should be understood and identified with the modeling results.

Section 3: Data Evaluation and Recommendations for Action

Section 3 describes the process by which data obtained during the investigation are evaluated. The goals of the evaluation are as follows:

a. to determine what volatile chemicals, if any, are present in the investigated media;

b. to identify the likely cause(s) of their presence; and

c. to identify completed and potential human exposures whether actions to address exposures should be taken.

Also discussed are actions typically recommended based on the evaluation. Actions to remediate the source(s) of soil vapor contamination, such as soil excavation or air-sparge/soil vapor extraction systems, are beyond the scope of this guidance and are not included.

3.1 Data quality

Before the data are evaluated, their representativeness and reliability should be verified. To assess analytical errors and the usability of the data, a qualified person should review the analytical data package and all associated QA/QC information to make sure that

a. the data package is complete;

b. holding times have been met;

c. the QC data fall within the protocol limits and specifications;

d. the data have been generated using established and agreed upon analytical protocols;

e. the raw data confirm the results provided in the data summary sheets and QC verification forms; and

f. correct data qualifiers have been used.

As discussed in Section 2.8, for sites in an environmental remediation program (e.g., State Superfund), a DUSR or equivalent report should be generated in accordance with NYSDEC guidance and should be submitted for regulatory review and approval.

If the investigation was not completed in accordance with the guidelines set forth in Section 2, additional investigation may be appropriate to either replace or complement the existing data. For example, product inventories [Section 2.11.2] filled out incompletely or incorrectly may need to be redone (and in some cases with additional air sampling) so that likely sources of volatile chemicals in the indoor air can be identified and appropriate actions to mitigate exposures can be recommended.

3.2 Overview

The results of individual soil vapor, sub-slab vapor, indoor air and outdoor air samples are not reviewed in isolation. Rather, they are evaluated with the consideration of several additional factors, which include the following:

a. the nature and extent of contamination in *all* environmental media;

b. factors that affect vapor migration and intrusion;

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

c. completed or proposed remedial actions;

d. sources of volatile chemicals;

e. background levels of volatile chemicals in air;

f. relevant standards, criteria and guidance values; and

g. past, current and future land uses.

These factors are described in detail in this subsection.

3.2.1 Nature and extent of contamination in all environmental media

The type of volatile chemicals present and the extent of contamination in all environmental media — including soil, groundwater, subsurface vapors, indoor air and outdoor air — is considered when evaluating the data. Trends in environmental data (e.g., groundwater monitoring results show concentrations of volatile chemicals are decreasing) are also considered. This information is used to identify possible sources of contamination and migration pathways, as well as to recommend appropriate actions to address exposures.

3.2.2 Factors that affect vapor migration and intrusion

As discussed in Section 1.3, there are numerous site-specific environmental factors [Table 1.1] and building factors [Table 1.2] that can affect soil vapor migration and intrusion. This information is used to identify possible sources of contamination and migration pathways, as well as to recommend appropriate actions to address exposures.

3.2.3 Sources of volatile chemicals

An understanding of the likely sources of the chemicals is crucial for determining appropriate actions to address exposure, as well as identifying the parties responsible for implementing the actions. Volatile chemicals that are not site-related may be present in the investigated media for reasons such as the following:

a. *subsurface vapors* — misuse, misapplication, or improper disposal of the chemicals to the subsurface, unidentified subsurface sources of vapor contamination, presence of septic systems (where products, such as cleaning agents or degreasers, may be disposed), biodegradation of natural organic matter in soil, infiltration into the subsurface from a building under positive pressure in which the chemicals are heavily used (i.e., reverse process from soil vapor intrusion), etc.;

b. *indoor air* — use and storage (current or historic) of volatile chemical-containing products, off-gassing from building materials or new furnishings, use of contaminated groundwater during private well usage, infiltration of outdoor air containing volatile chemicals, etc. [Table 1.3]; and

c. *outdoor air* — emissions from automobiles, lawn mowers, oil storage tanks, gasoline stations, dry cleaners or other commercial/industrial facilities, etc. [Table 1.3].

Site-related chemicals may also be present for these same reasons. Information about household products and their ingredients are available on web sites, such as the National Institute of Health's site at http://householdproducts.nlm.nih.gov.

3.2.4 Background levels of volatile chemicals in air

Chemicals are part of our everyday life [Section 1.4]. As such, they are found in the indoor air of buildings not affected by intrusion of contaminated soil vapor. They are also found in the outdoor air that enters a home or place of business. Commonly found concentrations of these chemicals in indoor and outdoor air are referred to as "background levels." Background levels of volatile chemicals are one of the factors considered when evaluating sampling results at a site [Section 3.3.2 – 3.3.4]. Estimates of background levels come from studies where air samples were collected in homes, offices and outdoor areas.

Several studies have been conducted, both nationally and in the State of New York, to provide information on indoor and outdoor air background levels in a variety of settings (e.g., residential or commercial buildings). Each of these studies offers useful information and has its own limitations. Each database provides statistical measures of background levels and the criteria used to select sampling locations. The criteria in some of the studies required that sampling locations not be located near known sources of volatile chemicals (for example, not near a chemical spill, hazardous waste site, dry-cleaner, or factory). The criteria may also have included checking containers of volatile chemicals in or near the building to make sure they are tightly closed or removing those products before samples are taken. Depending on the criteria for site selection and sampling conditions, statistical measures of background levels in a given study may differ from what would be expected if indoor air were sampled in randomly selected homes.

The background databases that are used for evaluating indoor and outdoor air data are introduced below. A more detailed description of each database along with statistical measures of background levels are provided in Appendix C.

a. *NYSDOH 2003: Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes*
   Results of indoor and outdoor air samples collected from 104 single-family fuel oil heated homes throughout New York State. Samples collected in evacuated canisters and analyzed for 69 aromatic, aliphatic, and halogenated hydrocarbons, and ketones by modified EPA Method TO-15. Limitations: only fuel oil heated homes were included, homes were not randomly selected, and five boroughs of New York City were excluded.

b. *EPA 2001: Building Assessment and Survey Evaluation (BASE) Database*
   Study of measured concentrations of volatile organic compounds from 100 randomly selected public and commercial office buildings. Samples collected by evacuated canisters and/or tube methodologies. Limitations: only represents office settings, two methodologies used for sampling and analysis that are not completely overlapping and do not show agreement in results in some cases.

c. *NYSDOH 1997: Control Home Database*
   Indoor and outdoor air samples compiled from 53 residences in New York State that were considered "control Homes" with neighborhood, construction, and occupancy similar to potentially impacted homes that were being investigated at the time. Limitations: multiple methodologies for sampling and analysis, small sample size, and varying detection limits often higher than current background levels.

d. *EPA 1988: National Ambient Volatile Organic Compounds (VOCs) Data Base Update*
   Published and unpublished air data compiled by the EPA in 1988. The document includes data from studies between 1970 to 1987. The database covers more than

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

300 chemicals in indoor and outdoor settings. Limitations: data are compiled from numerous studies with limitations on selection or screening criteria, data are 20-35 years old, indoor air data include both residential and office spaces, sample size for some analytes is very small (less than 10). Outdoor air data include rural, suburban, urban, source dominated and remote locations.

e. *Health Effects Institute (HEI) 2005: Relationship of Indoor, Outdoor, and Personal Air (RIOPA)*

Indoor, outdoor and personal air concentrations of 18 VOCs, 10 carbonyl compounds and particulate matter (PM2.5) were measured in 100 homes in each of 3 cities between the summer of 1999 and the spring of 2001. Limitations: limited numbers of VOCs, passive organic vapor badge method is subject to sampling bias in stationary versus mobile locations, the passive organic vapor badge method is only approved for tetrachloroethene in New York State.

Among the databases, the Upper Fence (see *NOTE below) values from the NYSDOH Fuel Oil Study data may be used as initial benchmarks when evaluating residential indoor air (see Appendix C.1) and the 90th percentile values from the EPA BASE data for indoor air in office and commercial buildings (see Appendix C.2). These initial benchmark values should be considered along with the overall distribution of results in the background database to characterize sampling results from a single building or from multiple buildings in a community. The Health Effects Institute 2005 database and the older NYSDOH and EPA databases can also provide useful information on the range of concentrations found in air. The database or combination of databases that best represents site-specific conditions should be used as the basis for comparison. State agency personnel should review and have the opportunity to comment on the proposed use of other databases or subsets of data within a database for evaluating test results.

*NOTE: The Upper Fence is calculated as 1.5 times the interquartile range (difference between the 25th and 75th percentile values) above the 75th percentile value. It is a boundary estimate used to account for outliers in the data.

3.2.5 Relevant standards, criteria and guidance values

a. *Subsurface vapors*

The State of New York does not have any standards, criteria or guidance values for concentrations of volatile chemicals in subsurface vapors (either soil vapor or sub-slab vapor).

b. *Indoor and outdoor air*

The NYSDOH has developed several guidelines for chemicals in air. The development process is initiated for specific situations. For example, in New York State, particularly in New York City, dry cleaners are often located in apartment buildings. Because air in buildings mixes to some extent and the dry cleaning chemical tetrachloroethene (PCE) is volatile, it may migrate to residential apartments. When the NYSDOH became aware of this problem and how widespread it is, the NYSDOH developed an air guideline for PCE of 100 micrograms per cubic meter (mcg/m^3). In addition to PCE, the NYSDOH has developed guidelines for methylene chloride (also referred to as dichloromethane) and trichloroethene (TCE) in air, as well as dioxin and polychlorinated biphenyls (PCBs) in indoor air. Each guideline went through a peer review process, in which expert scientists outside of the NYSDOH reviewed the technical documentation that describes

the scientific basis for the guidance value. The peer reviewers provided technical comments on the data and methods used to derive the guidelines, each of which were addressed by the NYSDOH. Upon completion of the reviews and responses to comments, the guidelines were finalized.

Air guideline values derived by the NYSDOH are summarized in Table 3.1. Additional information about these guidelines is provided in the following:

- Appendix D — overview of how the NYSDOH develops air guidelines; and
- Appendix H — copies of fact sheets that discuss the air guidelines for PCE and TCE.

The purpose of a guideline is to help guide decisions about the nature of efforts to reduce exposure to the chemical. Reasonable and practical actions should be taken to reduce exposures when indoor air levels are above background, even when they are below the guideline. The urgency to complete these actions increases with indoor air levels, particularly when air levels are above the guideline, and additional actions taken if the initial actions do not sufficiently reduce levels. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce chemical levels in indoor air to as close to background as practical.

Table 3.1 Air guideline values derived by the NYSDOH

Chemical		Air Guideline Value (mcg/m^3)	Reference
methylene chloride (also referred to as dichloromethane)	MeCl	60	1
polychlorinated biphenyls	PCBs	1*	2,3
tetrachlorodibenzo-*p*-dioxin equivalents	TCDD	0.00001*	3,4
tetrachloroethene	PCE	100	5
trichloroethene	TCE	5	6,7

*The guideline is specific to indoor air.

References:

[1] NYSDOH. 1988. Letter from N. Kim to T. Allen, Division of Air, New York State Department of Environmental Conservation. November 28, 1988.
[2] NYSDOH. 1985. Binghamton State Office Building (BSOB) Re-Entry Guidelines: PCBs. Document 1330P. Albany, NY: Bureau of Toxic Substance Assessment.
[3] NYSDOH. 1988. Letter from D. Axelrod to J. Egan, New York State Office of General Services. March 8, 1988.
[4] NYSDOH. 1984. Re-Entry Guidelines. Binghamton State Office Building. Document 0549P. Albany, NY: Bureau of Toxic Substance Assessment.
[5] NYSDOH. 1997. Tetrachloroethene Ambient Air Criteria Document. Albany, NY: Bureau of Toxic Substance Assessment.
[6] NYSDOH. 2003. Letter from N. Kim to D. Desnoyers, Division of Environmental Remediation, New York State Department of Environmental Conservation. October 31, 2003. [Provided in Appendix D.]
[7] NYSDOH. 2006. Final Report: Trichloroethene (TCE) Air Criteria Document. Center for Environmental Health, Bureau of Toxic Substance Assessment. Troy, NY.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.2.6 Completed or proposed remedial actions

The status and effectiveness of actions taken to remediate environmental contamination (e.g., soil removal, groundwater treatment, soil vapor extraction, etc.) are considered when making decisions pertaining to additional sampling and the selection of mitigation actions. For example,

a. if a comparison of pre-remediation and post-remediation subsurface vapor sampling results indicates negligible improvement in the quality of subsurface vapors,

    1. additional sampling may be appropriate to document a decreasing trend in subsurface vapor concentrations;

    2. termination of mitigation system operations may not be appropriate without additional sampling; or

    3. additional remedial actions may be appropriate to address contaminated subsurface vapors;

b. when monitoring a building is appropriate, it may be more cost-effective to install a mitigation system if subsurface contamination is wide-spread and is expected to take many years to remediate; and

c. if exposures in an on-site building will be addressed concurrently by a method selected to remediate subsurface contamination (e.g., a soil vapor extraction system), installation of a mitigation system may be redundant. However, if the remedial system is not expected to be operational in the immediate future, or if it is not expected to mitigate indoor air levels in a reasonable time frame, a mitigation system may still be appropriate. [Refer to Section 4.1 for a description of the appropriate use of concurrent techniques.]

3.2.7 Past, current and future land uses

Past, current and future land uses are considered when evaluating the investigation data and determining appropriate actions for further investigation or measures to address exposures. For example,

a. if the parcel or buildings were historically used for commercial or industrial purposes (e.g., gasoline station, automotive repair facility, electroplating facility, etc.), but are currently used for residential purposes or commercial or industrial purposes where volatile chemicals are not used in current operations, off-gassing of volatile chemicals from building materials [Table 1.3] or additional subsurface sources should be considered;

b. subsurface vapor sampling of a parcel that is undeveloped or contains unoccupied buildings may be appropriate based on the data evaluation. However, sampling may be delayed as discussed in Section 2.3;

c. air sampling of a building may be appropriate based on the data evaluation. However, provisions may be put in place to defer sampling until occupancy of the building is expected; or

d. if actions should be taken to mitigate exposures related to soil vapor intrusion should the site be developed, the appropriate mitigation method will depend upon the proposed land use — a parking lot, recreational field, single-family home, commercial building, high-rise building with underground parking, occupied or unoccupied building, etc. — since each presents a different exposure scenario.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.3 Sampling results and recommended actions

This subsection describes the process for evaluating sampling results. It also describes actions that may be recommended based on the evaluation. The evaluation procedures and actions described may not be directly applicable to samples collected as part of an emergency response. For guidance on how to proceed in such situations, refer to Section 3.5.

3.3.1 Soil vapor

If soil vapor samples are collected from locations where there are no known sources of volatile chemicals, we do not expect the chemicals to reach detectable levels in the samples. However, concentrations of volatile chemicals in soil vapor are commonly detected. This is likely due to several factors, including infiltration of outdoor air into the subsurface (to a limited extent) and background interferences (similar to indoor and outdoor air [Section 3.2.4]).

New York State currently does not have any standards, criteria or guidance values for concentrations of compounds in soil vapor. Additionally, there are currently no databases available of background levels of volatile chemicals in soil vapor. In the absence of this information, soil vapor sampling results are reviewed "as a whole," in conjunction with the results of other environmental sampling and the site conceptual model, to identify trends and spatial variations in the data [Section 3.2.1]. To put some perspective on the data, soil vapor results might be compared to background outdoor air levels [Section 3.2.4], site-related outdoor air sampling results, or the NYSDOH's guidelines for volatile chemicals in air [Table 3.1].

These comparisons are used to

a. identify areas of relatively elevated concentrations of volatile chemicals in soil vapor;
b. select buildings for sub-slab vapor, indoor air and outdoor air sampling;
c. identify possible sources of subsurface vapor contamination;
d. monitor the progress, or verify the completion, of efforts to remediate subsurface vapor contamination (either directly or indirectly); and
e. characterize the nature and extent of subsurface vapor contamination.

When determining appropriate actions, the following should also be considered:

a. Soil vapor results may not indicate a traditional plume-like pattern of contamination (as is often described for groundwater). Rather, the nature and extent of contamination may follow a "hit and miss" pattern.

b. Our experience to date indicates soil vapor results alone typically cannot be relied upon to rule out sampling at nearby buildings. For example, concentrations of volatile chemicals in sub-slab vapor samples have been substantially higher (e.g., by a factor of 100 or more) than concentrations found in nearby soil vapor samples (e.g., collected at 8 feet below grade near the building). This may be due to differences in factors such as soil moisture content and pressure gradients. Therefore, exposures are evaluated primarily based on sub-slab vapor, indoor air and outdoor air sampling results and soil vapor results are primarily used as a tool to guide these investigations.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

There are no concentrations of volatile chemicals in soil vapor that automatically trigger action or no further action. Based on the comparisons and considerations described, the following actions may be recommended:

a. *No further soil vapor sampling*

The nature and extent of subsurface vapor contamination has been adequately characterized with respect to addressing exposures and designing measures to remediate subsurface vapor contamination (either directly or indirectly).

Sub-slab vapor samples, rather than soil vapor samples, will be used to identify potential exposures and to characterize the nature and extent of subsurface vapor contamination since soil vapor results are not following a consistent pattern (i.e., hit and miss).

b. *Additional soil vapor sampling*

To characterize the nature and extent of subsurface vapor contamination if soil vapor results are following a consistent pattern (e.g., traditional plume-like pattern).

To identify possible sources of subsurface vapor contamination.

To verify sampling results that appear inconsistent with previous sampling and/or the current understanding of the site [Sections 3.2.1 and 3.2.2].

To resample locations where results may have been invalidated by short-circuiting (outdoor air infiltration), cross contamination, or other problems.

To monitor the progress, or verify the completion, of efforts to remediate subsurface vapor contamination (either directly or indirectly).

c. *Sub-slab vapor, indoor air and outdoor air sampling*

Generally, if soil vapor results are fairly consistent throughout the study area, buildings closest to the site are sampled first. The investigation then proceeds outward, as appropriate, on an areal basis until potential and current human exposures have been adequately addressed. If there is an area of relatively elevated concentrations of volatile chemicals in soil vapor (when looking at the soil vapor results as a whole), then the buildings in this area are also sampled.

d. *Address exposures related to soil vapor intrusion*

Provisions on parcels may be appropriate so that the parcel will not be developed or buildings occupied without addressing exposure concerns [Sections 2.3 and 3.6].

As discussed previously, soil vapor sampling results alone typically do not drive actions to mitigate exposures in existing buildings. Rather, they guide sampling efforts in buildings. However, a "blanket mitigation" approach may be taken provided the nature and extent of soil vapor contamination has been sufficiently characterized. A "blanket mitigation" approach is where an area is defined within which each building may be offered a mitigation system. The offer is made regardless of what actions may be appropriate based on an evaluation of air results (e.g., no further action or monitoring).

Notes:

a. The recommended actions may be modified or supported upon consideration of the factors given in Section 3.2.

b. Additional sampling may become appropriate based on the migration of subsurface contamination (e.g., contaminated groundwater or vapors) or if environmental monitoring indicates a change in chemical constituents (e.g., the production of degradation products that may be more toxic than the parent compounds).

3.3.2 Sub-slab vapor

The goals of collecting sub-slab vapor samples are to identify potential and current (when collected concurrently with indoor and outdoor air samples) exposures associated with soil vapor intrusion and to characterize the nature and extent of subsurface vapor contamination. As discussed in Sections 3.2.5 and 3.3.1, New York State currently does not have any standards, criteria or guidance values for concentrations of compounds in sub-slab vapor. Additionally, there are no databases available of background levels of volatile chemicals in subsurface vapors.

The detection of volatile chemicals in sub-slab vapor samples does not necessarily indicate soil vapor intrusion is occurring or actions should be taken to address exposures. When making these decisions, the State considers the following:

a. the sampling results — sub-slab vapor, indoor air, outdoor air, soil vapor;

b. background concentrations of volatile chemicals in indoor air;

c. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];

d. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;

e. attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations),

f. the NYSDOH's decision matrices [described in Section 3.4], and

g. the factors described in Section 3.2.

Based on this evaluation, the following actions may be recommended:

a. *No further action*

When the volatile chemical is not detected in the indoor air and sub-slab sample results are not expected to substantially affect indoor air quality.

b. *Take reasonable and practical actions to identify source(s) and reduce exposures*

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

c. *Resampling*

Resampling may also be recommended when the results are not consistent with the conceptual site model. For example, when the sub-slab vapor results of a building do not indicate a need to take action, but the sub-slab vapor results of adjacent buildings indicate a need to take actions to address exposures related to soil vapor intrusion.

Resampling may be appropriate if samples were collected outside of the heating season. As discussed in Section 2.4.2, results obtained outside of the heating season should not be used to rule out exposures related to soil vapor intrusion.

d. *Monitoring*

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended to determine whether concentrations in indoor air or sub-slab vapor have changed. It is also recommended to determine what affect, if any, active soil and groundwater remediation techniques (e.g., chemical oxidation, air sparging, etc.) may be having on subsurface vapor and indoor air quality. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.

e. *Mitigate*

Mitigation may be appropriate to minimize current or potential exposures associated with soil vapor intrusion. Mitigation methods are described in Section 4.

Notes:

a. The recommended actions may be modified or supported upon consideration of the factors given in Section 3.2.

b. Additional sampling may be appropriate based on the migration of subsurface contamination (e.g., contaminated groundwater or vapors) or if environmental monitoring indicates a change in chemical constituents (e.g., the production of degradation products that may be more toxic than the parent compounds).

c. Monitoring and mitigation measures to address exposures related to soil vapor intrusion are considered interim measures implemented until contaminated environmental media (e.g., soil, groundwater and/or soil vapor) are remediated.

d. Actions more protective of human health may be proposed. For example, such a decision may be based on a comparison of the costs associated with resampling or monitoring to the costs associated with installation and monitoring of a mitigation system.

e. Additional sampling associated with post-mitigation testing, operation, maintenance and monitoring activities, and termination of mitigation system operations is described in Section 4.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.3.3 Indoor air

Indoor air samples are used to assess current exposures to volatile chemicals in air. The detection of volatile chemicals in indoor air samples does not necessarily indicate soil vapor intrusion is occurring or actions should be taken to address exposures. When making these decisions, the State considers the following:

a. the sampling results — sub-slab vapor, indoor air, outdoor air, soil vapor;

b. background concentrations of volatile chemicals in indoor air;

c. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];

d. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;

e. attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations), and

f. the NYSDOH's decision matrices [described in Section 3.4], and

g. the factors described in Section 3.2.

When evaluating indoor air data, the results are compared to background levels of volatile chemicals in indoor air [Section 3.2.4], the NYSDOH's guidelines for volatile chemicals in air [Table 3.1], the NYSDOH's decision matrices [Section 3.4], and human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air. This helps to put the results into perspective and to determine the need for action and the urgency with which actions should be taken. As discussed in Section 3.2.5, the urgency to complete reasonable and practical actions to reduce exposures increases with indoor air levels, particularly when air levels are above a guideline.

Generally, if the results are comparable to background levels, then no further action is needed to address *current* human exposures. However, additional sampling may be appropriate if

a. samples were collected at times when vapor intrusion is not expected to have its greatest effect on indoor air quality (typically, samples collected outside of the heating season). As discussed in Section 2.4, these results may not be used to rule out exposures related to soil vapor intrusion;

b. the potential for exposures related to soil vapor intrusion should be monitored based on the sub-slab vapor results [Section 3.3.2]; and/or

c. subsurface conditions change over time (e.g., due to the migration of contaminated groundwater or vapors).

If the concentrations of volatile chemicals are not consistent with background levels, then the likely cause of the exposure should be determined. Understanding the source is crucial for selecting the best method to address exposures. For example, although a volatile chemical may be detected in the sub-slab vapor sample, the results may indicate that indoor air effects are more likely to be coming from products stored in the building or from outdoor air rather than from contaminated soil vapors. Therefore, a sub-slab depressurization system to minimize exposures associated with soil vapor intrusion may not be appropriate.

As discussed in Sections 1.4 and 3.2.3, volatile chemicals may be present in the indoor air due to any one, or a combination, of the following:

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

a. the indoor environment itself and/or building characteristics;

b. off-gassing of volatile chemicals from contaminated water that may enter the building at the tap or shower head, or during flooding events, or contaminated water that rests in a sump or a subsurface drain;

c. outdoor sources; and/or

d. migration from the subsurface (i.e., soil vapor intrusion).

To determine the likely cause, the following assessment is completed:

a. qualitative and quantitative comparisons are made between the types and concentrations of the contaminants found in the indoor air sample(s) and those found in the outdoor air and sub-slab vapor sample;

b. qualitative and quantitative comparisons are made between indoor air results obtained in different locations of the building (e.g., different floors or rooms);

c. indoor air results are compared to the product inventory to evaluate the extent to which indoor sources are affecting indoor air quality; and

d. the indoor air quality questionnaire and building inventory form is reviewed to identify potential preferential pathways for soil vapor intrusion into the building, potential outdoor sources of volatile chemicals to the outdoor air (e.g., gasoline station or dry cleaner), and routes of air distribution within the building (e.g., HVAC system operations, airflow observations, etc.).

If a likely source or multiple sources can be identified from the available information, one or more of the following actions may be recommended given the source:

a. *Indoor source or building characteristics*

Products containing volatile chemicals should be tightly capped. Alternatively, the products can be stored in places where people do not spend much time, such as a garage or outdoor shed. If the products are no longer needed, consideration should be given to disposing of them properly (e.g., hazardous waste cleanup days). The list of products and corresponding readings from field instrumentation provided in the product inventory [Appendix B] can help identify products that may be contributing to the levels that were detected in the indoor air.

If exposures are assumed to be associated with off-gassing of new building materials, paint, etc., resampling may be appropriate to confirm this assumption or to confirm that actions taken to address these exposures have been effective.

b. *Off-gassing from contaminated groundwater within the building*

Measures should be taken to prevent contaminated groundwater from entering the house (e.g., filter on private well supply, sealed sump, etc.).

c. *Outdoor source*

No further action to address exposures related to soil vapor intrusion, unless the evaluation for soil vapor intrusion cannot be completed until outdoor interferences are addressed.

d. *Soil vapor intrusion*

Depending upon the relationship between indoor air concentrations and sub-slab vapor concentrations and the results of environmental sampling in the area, resampling, monitoring or mitigation may be recommended by the State.

1. Resampling, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended when the results are not consistent with the conceptual site model. For example, when indoor air results are comparable or higher than the corresponding sub-slab vapor results and the results do not appear to be due to building characteristics or alternate sources (either indoor or outdoor).

2. Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended to determine whether concentrations in indoor air or sub-slab vapor have changed. It is also recommended to determine what affect, if any, active soil and groundwater remediation techniques (e.g., chemical oxidation, air sparging, etc.) may be having on subsurface vapor and indoor air quality. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.

3. Methods to mitigate exposures related to soil vapor intrusion are described in Section 4.

The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

Likely sources may not be evident given the information available. Therefore, the above recommendations cannot be made. This situation most often arises for the following reasons:

a. Interfering indoor sources are identified. However, the possibility of vapor intrusion cannot be ruled out due to the concentrations of the same volatile chemicals detected in the sub-slab vapor sample. Differentiating the contribution of each source is not possible.

b. Indoor air samples were collected without concurrent outdoor air and sub-slab vapor samples. Depending upon other information that may be available (e.g., building inventory and well-characterized subsurface vapor contamination), identifying likely sources and recommending appropriate actions may not be possible.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

c. All appropriate air samples are collected. However, the indoor air quality questionnaire and building inventory forms are filled out incompletely or incorrectly. The contribution of indoor sources cannot be evaluated.

When the source(s) of volatile chemicals to indoor air cannot be identified with confidence, resampling is typically recommended with corrections made as appropriate. For example, using the three scenarios presented above:

a. resampling occurs after interferences are removed;

b. concurrent indoor air, outdoor air and sub-slab vapor samples are collected; and

c. an indoor air quality questionnaire and building inventory form is filled out completely and correctly when samples are collected.

Notes: See notes presented in Section 3.3.2.

3.3.4 Outdoor air

Outdoor air sampling results are primarily used to evaluate the extent to which outdoor air may be contributing to the levels of volatile chemicals detected in indoor air. However, people are also exposed to the outdoor air and the outdoor air results are indicative of outdoor air conditions. As such, outdoor air results are also reviewed to determine whether outdoor air conditions present a potential concern that requires further investigation.

As discussed in Sections 1.4 and 3.2.3, volatile chemicals may be present in outdoor air due to emissions from automobiles, lawn mowers, oil storage tanks, gasoline stations, and dry cleaners or other commercial and industrial facilities. To determine what extent, if any, outdoor air is affecting indoor air quality, indoor air results are compared to outdoor air results. To determine whether outdoor air conditions present a potential concern that requires further investigation, the State looks at the data set as a whole and considers the following:

a. background concentrations of volatile chemicals in outdoor air;

b. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];

c. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air; and

d. the factors described in Section 3.2.

3.4 Decision matrices

3.4.1 Overview

Decision matrices are risk management tools, developed by the NYSDOH in conjunction with other agencies, to provide guidance on a case-by-case basis about actions that should be taken to address current and potential exposures related to soil vapor intrusion. The matrices are intended to be used when evaluating the results from buildings with full slab foundations. The matrices encapsulate the data evaluation processes and actions recommended to address exposures discussed in Sections 3.3.2 and 3.3.3. The general format of a decision matrix is shown in Table 3.2.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Table 3.2 General format of a decision matrix

	Indoor Air Concentration of Volatile Chemical (mcg/m³)		
Sub-slab Vapor Concentration of Volatile Chemical (mcg/m³)	Concentration Range 1	Concentration Range 2	Concentration Range 3
Concentration Range 1	ACTION	ACTION	ACTION
Concentration Range 2	ACTION	ACTION	ACTION
Concentration Range 3	ACTION	ACTION	ACTION

Indoor air and sub-slab vapor concentration ranges in a matrix are selected based on a number of considerations in addition to health risks. For example, factors that are considered when selecting the ranges include, but are not limited to, the following:

a. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;

b. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];

c. background concentrations of volatile chemicals in air [Section 3.2.4];

d. analytical capabilities currently available; and

e. attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations).

3.4.2 Matrices

The NYSDOH has developed two matrices, which are included at the end of Section 3.4, to use as tools in making decisions when soil vapor may be entering buildings. The first decision matrix was originally developed for TCE and the second for PCE. As summarized in Table 3.3, four chemicals have been assigned to the two matrices to date.

Table 3.3 Volatile chemicals and their decision matrices

Chemical	**Soil Vapor/Indoor Air Matrix***
Carbon tetrachloride	Matrix 1
Tetrachloroethene (PCE)	Matrix 2
1,1,1-Trichloroethane (1,1,1-TCA)	Matrix 2
Trichloroethene (TCE)	Matrix 1

*The decision matrices are available at the end of Section 3.4.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Because the matrices are risk management tools and consider a number of factors, the NYSDOH intends to assign chemicals to one of these two matrices, if possible. For example, if a chemical other than those already assigned to a matrix is identified as a chemical of concern during a soil vapor intrusion investigation, assignment of that chemical into one of the existing decision matrices will be considered by the NYSDOH. Factors that will be considered in assigning a chemical to a matrix include, but are not limited to, the following:

a. human health risks, including such factors as a chemical's ability to cause cancer, reproductive, developmental, liver, kidney, nervous system, immune system or other effects, in animals and humans and the doses that may cause those effects;

b. the data gaps in its toxicologic database;

c. background concentrations of volatile chemicals in indoor air [Section 3.2.4]; and

d. analytical capabilities currently available.

If the NYSDOH determines that the assignment of the chemical into an existing matrix is inappropriate, then the NYSDOH will either modify an existing matrix or develop a new matrix.

To use the matrices appropriately as a tool in the decision-making process, the following should be considered:

a. The matrices are generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

b. Indoor air concentrations detected in samples collected from the building's basement or, if the building has a slab-on-grade foundation, from the building's lowest occupied living space should be used.

c. Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

d. When current exposures are attributed to sources other than vapor intrusion, the agencies should be provided documentation(e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix and to support assessment and follow-up by the agencies.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.4.3 Description of recommended actions

Actions recommended in the matrix are based on the relationship between sub-slab vapor concentrations and corresponding indoor air concentrations. They are intended to address both potential and current human exposures and include the following:

a. *No further action*

When the volatile chemical is not detected in the indoor air sample and the concentration detected in the corresponding sub-slab vapor sample is not expected to substantially affect indoor air quality.

b. *Take reasonable and practical actions to identify source(s) and reduce exposures*

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile chemical-containing products in places where people do not spend much time, such as a garage or shed). Resampling may also be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

d. *Monitor*

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is appropriate to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be appropriate to determine whether existing building conditions (e.g., positive pressure HVAC systems) are maintaining the desired mitigation endpoint and to determine whether changes are appropriate.

The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.

e. *Mitigate*

Mitigation is appropriate to minimize current or potential exposures associated with soil vapor intrusion. Methods to mitigate exposures related to soil vapor intrusion are described in Section 4.

f. *Monitor / Mitigate*

Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Soil Vapor/Indoor Air Matrix 1

October 2006

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 0.25	0.25 to < 1	1 to < 5.0	5.0 and above
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
5 to < 50	5. No further action	6. MONITOR	7. MONITOR	8. MITIGATE
50 to < 250	9. MONITOR	10. MONITOR / MITIGATE	11. MITIGATE	12. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE	16. MITIGATE

No further action:
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take reasonable and practical actions to identify source(s) and reduce exposures:
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

MONITOR:
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MONITOR / MITIGATE:
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

ADDITIONAL NOTES FOR MATRIX 1

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.25 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended for buildings with full slab foundations, and 1 microgram per cubic meter for buildings with less than a full slab foundation.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Soil Vapor/Indoor Air Matrix 2

October 2006

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 3	3 to < 30	30 to < 100	100 and above
< 100	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
100 to < 1,000	5. MONITOR	6. MONITOR / MITIGATE	7. MITIGATE	8. MITIGATE
1,000 and above	9. MITIGATE	10. MITIGATE	11. MITIGATE	12. MITIGATE

No further action:
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take reasonable and practical actions to identify source(s) and reduce exposures:
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

MONITOR:
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MONITOR / MITIGATE:
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

ADDITIONAL NOTES FOR MATRIX 2

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 3 micrograms per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

3.5 Emergency response

The NYSDOH's staff are responsible for recommending that residents relocate in cases where there may be health risks resulting from exposure to petroleum spills. These roles and responsibilities are outlined in Environmental Health Manual Technical Reference and Procedural Items BTSA-01. Air sampling is appropriate in some cases for demonstrating that spill cleanup and engineering controls have been effective in reducing indoor air impacts and associated health risks to residents. At a minimum, air samples are collected from the basement, first floor and from outdoors. Whether sub-slab or soil gas samples will be taken is evaluated on a case-by-case basis. Air testing data are sometimes used as the basis for ending emergency relocation financial support. For additional information, please contact the NYSDOH's Bureau of Toxic Substance Assessment by calling 1-800-458-1158.

Emergency actions not related to petroleum spills are handled on a case-by-case basis.

3.6 Parcels that are undeveloped or contain unoccupied buildings

If investigation of a parcel that is undeveloped or contains unoccupied buildings is being delayed until the site is being developed or occupied, measures should be in place that assure the State that no development or occupation will occur without addressing the exposures. Institutional controls may be used for this purpose. An institutional control is any non-physical means of enforcing a restriction on the use of real property that

a. limits human or environmental exposure,

b. provides notice to potential owners, operators or members of the public, or

c. prevents actions that would interfere with the effectiveness of remedial actions or with the effectiveness and/or integrity of operation, maintenance or monitoring activities at a site.

An institutional control that is often used is an environmental easement. An environmental easement is an enforced mechanism used for property where the remedial actions leave residual contamination that makes the property suitable for some, but not all uses, or includes engineering controls that must be maintained for the easement to be effective. The purpose of the easement is to ensure that such use restrictions or engineering controls remain in place. An environmental easement

a. can only be created by the property owner (the *grantor*) through a written instrument recorded in the appropriate county recording office. It can only be granted to the State (the *grantee*) and can only be extinguished or amended by a written instrument executed by the Commissioner of the Department of Environmental Conservation and duly recorded;

b. is binding upon all subsequent owners and occupants of the property. The deed or deeds for the property (as well as any other written instruments conveying any interest in the property) must contain a prominent notice that it is subject to an environmental easement; and

c. may be enforced in perpetuity against the *grantor*, subsequent owners of the property, lessees, and any person using the property by its grantor, by the State, or by the municipality in which the property is located.

If these actions cannot be implemented, alternative measures should be in place that assure the State that the parcel will not be developed or buildings occupied without addressing the exposure concerns. For example, arrangements should be made for the town, village or city

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
to notify the appropriate party when new construction or tenants are proposed for the parcel (e.g., permit applications and grants) or ownership of the parcel changes.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Section 4: Soil Vapor Intrusion Mitigation

As discussed in Section 1.1, soil vapor can enter a building through cracks or perforations in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation primarily because of a difference between interior and exterior pressures. This intrusion is similar to how radon gas enters buildings from the subsurface. Fortunately, given this similarity, well-established techniques for mitigating exposures to radon may also be used to mitigate exposures related to soil vapor intrusion.

Once it is determined that steps should to be taken to address exposures associated with soil vapor intrusion, they should be implemented with all due expediency. This section provides an overview of:

a. methods of mitigation,
b. installation and design of mitigation systems,
c. post-mitigation testing,
d. operation, maintenance and monitoring of mitigation systems,
e. termination of mitigation system operations, and
f. annual certification.

Mitigation is considered to be an interim measure to address exposures until contaminated environmental media are remediated, or until mitigation is no longer needed to address exposures related to soil vapor intrusion.

4.1 Methods of mitigation

The most effective mitigation methods involve sealing infiltration points and actively manipulating the pressure differential between the building's interior and exterior (on a continuous basis). As discussed in the following subsections, the appropriate method to use will largely depend upon the building's foundation design. Furthermore, buildings having more than one foundation design feature (e.g., a basement under one portion of the house and a crawl space beneath the remainder) may require a combination of mitigation methods. This section describes methods of mitigation that are expected to be the most reliable options under a wide range of circumstances. Occasionally, there are site-specific or building-specific conditions under which alternative methods (such as HVAC modification, sealing, room pressurization, passive ventilation systems, or vapor barriers) may be more appropriate. Such mitigation proposals may be considered on a case-by-case basis.

4.1.1 Buildings with a basement slab or slab-on-grade foundation

In conjunction with *sealing* potential subsurface vapor entry points, an active *sub-slab depressurization system* (SSD system) is the preferred mitigation method for buildings with a basement slab or slab-on-grade foundation. A SSD system uses a fan-powered vent and piping to draw vapors from the soil beneath the building's slab (i.e., essentially creating a vacuum beneath the slab) and discharge them to the atmosphere. This results in lower sub-slab air pressure relative to indoor air pressure, which prevents the infiltration of sub-slab vapors into the building.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

The most common approach to achieving depressurization beneath the slab is to insert the piping through the floor slab into the crushed rock or soil underneath. However, the EPA, in their "Consumer's Guide to Radon Reduction" (EPA 402-K-03-002; revised February 2003), lists the following approaches as ways to reduce radon levels in a building, either in place of the more common sub-slab suction point method or in conjunction with that method:

a. *Drain tile suction* — Some houses have drain tiles or perforated pipe to direct water away from the foundation of the house. Suction on these tiles or pipes is often effective;

b. *Sump hole suction* — If the building has a sump pump to remove unwanted water, the sump can be capped so that it can continue to drain water and serve as the location for piping. If the sump is not used as the suction or extraction point, the associated wiring and piping should be sealed and an air-tight cover should be installed to enhance the performance of the SSD system; and

c. *Block wall suction* — If the building has hollow block foundation walls, the void network within the wall may be depressurized by drawing air from inside the wall and venting it to the outside. This method is often used in combination with sub-slab depressurization.

The depressurization approach, or combination of approaches, selected for a building should be determined on a building-specific basis due to building-specific features that may be conducive to a specific depressurization approach. For example, if the contaminants are entering the building through a block wall, block wall suction in conjunction with traditional sub-slab depressurization may be more effective at minimizing exposures related to soil vapor intrusion rather than sub-slab depressurization alone.

Although sealing is not a reliable mitigation technique on its own, it can significantly improve the effectiveness of a SSD system since it limits the flow of subsurface vapors into the building. All joints, cracks and other penetrations of slabs, floor assemblies and foundation walls below or in contact with the ground surface should be sealed with materials that prevent air leakage.

If the State concurs that a SSD system is not a practicable alternative or that exposures will be mitigated concurrently by a method selected to remediate subsurface contamination, alternative mitigation methods may be considered, such as the following:

a. *HVAC modification* — a technique where the building's HVAC system is modified to avoid depressurization of the building relative to underlying and surrounding soil (i.e., to maintain a positive pressure within the building); and

b. S*oil vapor extraction (SVE) system* — a technique used to remediate contaminated subsurface soil vapor. SVE systems use high flow rates, induced vacuum or both to collect and remove contamination, while SSD systems use a minimal flow rate to effect the minimum pressure gradient (see the EPA's technical guidance documents for recommended gradients; Section 4.2.3) needed to reverse air flow across a building's foundation. Depending upon the SVE system's design, the system may also serve to mitigate exposures. For example, the SVE system's radius of influence includes the subsurface beneath affected buildings or horizontal legs of the system will be installed beneath affected buildings. However, complications can arise if the SVE system is no longer effective at remediating contaminated vapors, exposures should still be mitigated due to residual vapor contamination.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

4.1.2 Buildings with a crawl space foundation

A *soil vapor retarder* with *sub-membrane depressurization (SMD) system* is the preferred mitigation method for buildings with a crawl space foundation. A soil vapor retarder is a synthetic membrane or other comparable material that is placed on the ground in the crawl space to retard the flow of soil vapors into the building. A SMD system is similar to a SSD system. It uses a fan-powered vent and piping to draw vapors from beneath the soil vapor retarder and discharge them to the atmosphere. This results in lower air pressure beneath the membrane relative to air pressure in the crawl space, which prevents the infiltration of subsurface vapors into the building.

If the State concurs that a soil vapor retarder with a SMD system is not a practicable alternative or that exposures will be mitigated concurrently by a method selected to remediate subsurface contamination, alternative mitigation methods may be considered, such as the following:

a. *HVAC modification* — a technique where the building's HVAC system is modified to avoid depressurization of the building relative to the crawl space;

b. C*rawl space ventilation with sealing* — a technique that uses a fan to draw air out of the crawl space; and

c. *SVE system* [Section 4.1.1].

4.1.3 Buildings with dirt floor basements

Either a SSD system with a newly poured slab or a SMD system with a soil vapor retarder may be used. However, the former method is preferred.

4.1.4 Buildings with multiple foundation types

Mitigation in a building with a combination of foundations should be achieved by applying the specific methods described previously [Sections 4.1.1 through 4.1.3] to the corresponding foundation segments of the building. Special consideration should be given to the points at which different foundation types join, since additional soil vapor entry routes exist in such locations. Often, the various systems can be installed and connected to a common depressurization system and fan.

4.1.5 Undeveloped parcels

If sampling results indicate a mitigation system is recommended to address exposures in buildings that may be constructed, then a SSD system with sealing, or a SMD system with a soil vapor retarder, or a combination of these methods is recommended, as appropriate to the design of the proposed buildings.

4.1.6 Additional references

The following documents provide additional information on selecting an appropriate mitigation method:

a. *A Consumer's Guide to Radon Reduction*
EPA [EPA 402-K-03-002, revised February 2003]

This document provides assistance in selecting a qualified radon mitigation contractor to reduce the radon levels in a home, determining an appropriate radon reduction method, and maintaining a radon reduction system. It is available at the EPA's web site: http://www.epa.gov/iaq/radon/pubs/index.html; and

b. *Reducing Radon in Schools: A Team Approach*
EPA [EPA 402-R-94-008, April 1994]

This document will provide assistance in determining the best way to reduce elevated radon levels found in a school. It provides guidance on the process of confirming a radon problem, selecting the best mitigation strategy, and directing the efforts of a multidisciplinary team assembled to address elevated radon levels in a way that will contribute to the improvement of the overall indoor air quality of the school. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318.

4.2 Design and installation of mitigation systems

Once a mitigation method is selected, it should be designed and installed. The components of the design and installation of mitigation systems, the procedures for specific mitigation techniques, and references for technical guidance are provided in the following subsections.

4.2.1 General recommendations

Systems should be designed and installed by a professional engineer or environmental professional. In most areas of the state, there are contractors who have met certain requirements and are trained to identify and fix radon problems in buildings. To obtain the names of local contractors, contact the NYSDOH's Radon Program at 1-800-458-1158, extension 27556, or visit the National Radon Safety Board's web site (www.nrsb.org) or National Environmental Health Association's web site (www.neha.org).

Typically, the party responsible for remediating the site is responsible for arranging design and installation activities. If no responsible party is available, the State will arrange for the design and installation of the system. All design and installation activities should be documented and reported to the agencies. Furthermore, once a mitigation system is installed, an information package should be given to the building's owner and tenants, if applicable, to facilitate their understanding of the system's operation, maintenance and monitoring [Section 5.6].

With the exception of SVE systems, the mitigation methods introduced in Section 4.1 are not intended to remediate the source of subsurface vapors (e.g., contaminated groundwater, soil, etc.). Rather, they are designed to minimize the infiltration of subsurface vapors into a building. For consistency in implementing the techniques in residential buildings, mitigation systems should be designed and installed in accordance with the following:

a. *Standard Practice for Installing Radon Mitigation Systems in Existing Low-rise Residential Buildings* (ASTM E-2121)

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

American Society for Testing and Materials (ASTM) International [ASTM E-2121-03, February 10, 2003]

This document applies to existing buildings. The purpose of this document is to provide radon mitigation contractors with uniform standards that will ensure quality and effectiveness in the design, installation, and evaluation of radon mitigation systems in detached and attached residential buildings three stories or less in height. Information on how to obtain a copy of this standard is available in Appendix E; and

b. *Model Standards and Techniques for Control of Radon in New Residential Buildings* EPA [EPA 402-R-94-009, March 1994]

This document applies to new construction and contains information on how to incorporate radon reduction techniques and materials in residential construction. A copy of this document is provided in Appendix F.

4.2.2 System-specific recommendations

Basic design and installation recommendations for mitigation systems follow. These are based upon recommendations and requirements given by the EPA for mitigating exposures related to radon intrusion (for additional information see EPA's web site on radon at http://www.epa.gov/iaq/radon/pubs/index.html).

a. *Sealing* — To improve the effectiveness of depressurization and ventilation systems and to limit the flow of subsurface vapors into the building, materials that prevent air leakage should be used, such as elastomeric joint sealant (as defined in ASTM C920-87), compatible caulks, non-shrink mortar, grouts, expanding foam, "Dranjer" drain seals, or airtight gaskets. Some effective sealants may contain volatile organic compounds; in some situations, this may be a consideration in choosing an appropriate sealing material.

b. *Soil vapor retarder (membrane)* —

1. To retard the infiltration of subsurface vapors into the building and enhance the performance of a SMD system, a minimum 6 mil (or 3 mil cross-laminated) polyethylene or equivalent flexible sheeting material should be used.

2. The sheet should cover the entire floor area and be sealed at seams (with at least a 12 inch overlap) and penetrations, around the perimeter of interior piers and to the foundation walls.

3. Enough of the sheeting should be used so it will not be pulled away from the walls when the depressurization system is turned on and the sheet is drawn down.

4. If a membrane is installed in areas that may have future foot traffic (e.g., a dirt floor in a basement), consideration should be given to also installing a wearing surface such as sand or stone to protect the integrity of the membrane. Additionally, a layer of fine sand may be prudent beneath the membrane to protect it from penetrations by sharp objects in the dirt floor.

c. *Depressurization systems —*

1. The systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).

2. The systems should be designed to minimize soil vapor intrusion effectively while minimizing excess energy usage, to avoid compromising moisture and temperature controls and other comfort features, and to minimize noise.

3. To evaluate the potential effectiveness of a SSD before it is installed, a diagnostic test (commonly referred to as a "communication" test) should be performed to measure the ability of a suction field and air flow to extend through the material beneath the slab. This test is commonly conducted by applying suction on a centrally located hole drilled through the concrete slab and simultaneously observing the movement of smoke downward into small holes drilled in the slab at locations separated from the central suction hole. A similar quantitative evaluation may also be performed by using a digital micromanometer or comparable instrument. Depending on test results, multiple suction points may be needed to achieve the desired effectiveness of the system.

4. Passive systems (i.e., a SSD system without a vent fan) are not as effective as active systems and their performance varies depending upon ambient temperatures and wind conditions. Therefore, active systems should be used to ensure exposures are being addressed.

5. The vent fan and discharge piping should not be located in or below a livable or occupied area of the building to avoid entry of extracted subsurface vapors into the building in the event of a fan or pipe leak.

6. To avoid entry of extracted subsurface vapors into the building, the vent pipe's exhaust should be

    i. above the eave of the roof (preferably, above the highest eave of the building at least 12 inches above the surface of the roof),

    ii. at least 10 feet above ground level,

    iii. at least 10 feet away from any opening that is less than 2 feet below the exhaust point, and

    iv. 10 feet from any adjoining or adjacent buildings, or HVAC intakes or supply registers.

7. Rain caps, if used, should be installed so as not to increase the potential for extracted subsurface vapors to enter the building.

8. To avoid accidental changes to the system that could disrupt its function, the depressurization system should be labeled clearly. An example of such labeling is shown in Figure 5.1.

9. A warning device or indicator should be installed to alert building occupants if the active system stops working properly. Examples of system failure warning devices and indicators include the following: a liquid gauge (e.g., a

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

manometer), a sound alarm, a light indicator, and a dial (needle display) gauge. The warning device or indicator should be placed where it can be easily heard or seen. The party installing the system should verify the warning device or indicator is working properly. Building occupants should be made aware of the warning device or indicator (what it is, where it is located, how it works, how to read/understand it, and what to do if it indicates the system is not working properly).

d. *HVAC systems* — HVAC systems should be carefully designed, installed and operated to avoid depressurization of basements and other areas in contact with the soil.

e. *Crawl space ventilation* —

1. Ventilation systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).

2. Openings and cracks in floors above the crawl space that would permit conditioned air to pass into or out of the occupied spaces of the building, should be identified, closed and sealed.

f. *SVE systems designed to also mitigate exposures* —

1. The systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).

2. To avoid reentry of soil vapor into the building(s), the exhaust point should be located away from the openings of buildings and HVAC air intakes. Depending upon the concentrations of volatile chemicals in subsurface vapors and the expected mass removal rate, treatment (e.g., via carbon filters) of the SVE system effluent may be appropriate to minimize outdoor air effects.

3. The SVE system's radius of influence should adequately address buildings requiring mitigation, as well as subsurface sources requiring remediation. If it does not, additional actions may be appropriate. For example, if the radius of influence does not completely extend beneath a building, a complementary air monitoring program may be appropriate to confirm that exposures are being addressed adequately while the SVE system is operating.

4.2.3 Technical guidance

To address exposures effectively in larger buildings, some of the same techniques used in residential buildings can be scaled up in size, number, or performance (e.g., adjustments in the size and air movement capacity of the vent pipe fan, or installation of multiple suction points through the slab instead of a single point). The design of the techniques may also be modified (e.g., installation of horizontal pipes beneath the building instead of a single suction point).

Detailed technical guidance on designing and installing mitigation systems in residential and non-residential buildings is provided in various documents, such as the following, released by the EPA and others:

a. References provided in ASTM's E-2121 (see Appendix E for information on how to obtain a copy) and the EPA's *Model Standards and Techniques for Control of Radon in New Residential Buildings* (Appendix F);

b. *Radon Reduction Techniques for Existing Detached Houses: Technical Guidance (Third Edition) for Active Soil Depressurization Systems*
EPA [EPA 625/R-93-011, October 1993]

This technical guidance document has been prepared to serve as a comprehensive aid in the detailed selection, design, installation, and operation of indoor radon reduction measures for existing houses based on active soil depressurization techniques. It is intended for use by radon mitigation contractors, building contractors, concerned homeowners, state and local officials and other interested persons. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318;

c. *Protecting Your Home From Radon: A Step-by-Step Manual for Radon Reduction*
Kladder *et al.*, 1993

This manual is designed to provide sufficient information to a homeowner to make many of the basic repairs that can significantly reduce radon levels in the home;

d. *Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes*
EPA [EPA 402-K-01-002, April 2001]

This fully illustrated guide contains all the information needed in one place to educate home builders about radon-resistant new construction (RRNC), including the following: basic questions and detailed answers about radon and RRNC, specific planning steps before installing a system, detailed installation instructions with helpful illustrations, tips and tricks when installing a system, marketing know-how when dealing with homebuyers, and architectural drawings. This document is available at the EPA's web site: http://www.epa.gov/iaq/radon/pubs/index.html; and

e. *Radon Prevention in the Design and Construction of Schools and Other Large Buildings*
EPA [EPA 625-R-92-016, June 1994]

It is typically easier and much less expensive to design and construct a new building with radon-resistant and/or easy-to-mitigate features, than to add these features after the building is completed and occupied. Specific guidelines on how to incorporate radon prevention features in the design and construction of schools and other large buildings are detailed in this manual. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318. This document is also available on the EPA Office of Research and Development's web site: http://www.epa.gov/ORD/NRMRL/pubs/625r92016/625r92016.htm.

4.3 Post-mitigation or confirmation testing

Once a mitigation system is installed, its effectiveness and proper installation should be confirmed. The party that installed the system should conduct post-mitigation testing and for developing a post-mitigation testing plan. Minimum objectives for post-mitigation testing associated with specific mitigation methods are provided in the following

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
subsections. All post-mitigation testing activities should be documented and reported to the agencies.

4.3.1 SSD systems with sealing

a. Reasonable and practical actions should be taken to identify and fix leaks. With the depressurization system operating, smoke tubes are used to check for leaks through concrete cracks, floor joints, and at the suction point. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.

b. Once a depressurization system is installed, its operation may compete with the proper venting of fireplaces, wood stoves and other combustion or vented appliances (e.g., furnaces, clothes dryers, and water heaters), resulting in the accumulation of exhaust gases in the building and the potential for carbon monoxide poisoning. Therefore, in buildings with natural draft combustion appliances, the building should be tested for backdrafting of the appliances. Backdrafting conditions should be corrected before the depressurization system is placed in operation.

c. The distance that a pressure change is induced in the sub-slab area (i.e., a pressure field extension test) should be conducted. Analogous to a communication test, this test is commonly conducted by operating the depressurization system and simultaneously observing the movement of smoke downward into small holes (e.g., 3/8 inch) drilled through the slab at sufficient locations to demonstrate that a vacuum is being created beneath the entire slab. A similar quantitative evaluation may also be performed by using a digital micromanometer or comparable instrument. If adequate depressurization is not occurring, the reason (e.g., improper fan operation) should be identified and corrected.

d. Adequate operation of the warning device or indicator should be confirmed.

e. Except as indicated below, post-mitigation indoor and outdoor air sampling should be conducted in all buildings where pre-mitigation samples were collected and in all buildings where physical data suggest possible impediments to comprehensive sub-slab communication of the depressurization system (i.e., locations with wet or dense sub-slab soils, multiple foundations and footings, minimal pressure differentials between the interior and sub-slab). Generally, indoor and outdoor air sampling locations, protocols and analytical methods should be consistent between pre-mitigation and post-mitigation sampling, where applicable. In buildings with basements, post-mitigation indoor air sampling from the basement alone (i.e., without a concurrent indoor air sample from the first floor) is recommended in most circumstances.

   Typically, post-mitigation sampling should be conducted no sooner than 30 days after installing a depressurization system. If the system is installed outside of the heating season or at the end of a season, post-mitigation air sampling may be postponed until the heating season.

   In cases of widespread mitigation due to vapor contamination and depending upon the basis of making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination [Section 3.3.1]), a representative number of buildings from an identified study area, rather than each building, may be

sampled. Prior to implementation, this type of post-mitigation sampling approach should be approved by State agency personnel.

In newly constructed buildings, a site-specific and building-specific indoor air sampling plan is recommended due to potential interferences caused by the off-gassing of volatile chemicals in new building materials (e.g., paints, carpets, furniture, etc. [Section 1.4]). In these situations, if indoor air sampling is appropriate samples should be

i. collected while the system is operational but before potentially interfering factors are brought into the building,

ii. analyzed for a targeted list of volatile chemicals based on previous environmental sampling (e.g., groundwater, soil, soil vapor, etc.), and/or

iii. collected while the system is operational but after potentially interfering factors have had an opportunity to off-gas.

If post-mitigation sampling results do not indicate a significant decrease in the concentrations of volatile chemicals previously believed to be present in the indoor air due to soil vapor intrusion, the reason (e.g., indoor or outdoor sources, improper operation of the mitigation system, etc.) should be identified and corrected as appropriate.

4.3.2 SMD systems with soil vapor retarder

a. Reasonable and practical actions should be taken to identify and fix leaks. With the depressurization system operating, smoke tubes are used to check for leaks in the membrane at seams, edge seals and at locations where the sheet was sealed around obstructions. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.

b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].

c. Adequate operation of the warning device or indicator should be confirmed.

d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [as discussed in Section 4.3.1].

4.3.3 HVAC modifications

a. Check the building for positive pressure conditions (e.g., verify a pressure controller is maintaining the desired pressure differential and/or measure the pressure differential between the sub-slab and indoor air by using field instruments).

b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].

c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.

d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [Section 4.3.1].

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

4.3.4 Crawl space ventilation and sealing

a. Reasonable and practical actions should be taken to identify and fix leaks. With the ventilation system operating, smoke tubes are used to check for leaks in openings and cracks in floors above the crawl space that were sealed during installation of the system. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.

b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].

c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.

d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [as discussed in Section 4.3.1].

4.3.5 SVE systems designed to also mitigate exposures

a. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].

b. The distance that a pressure change is induced in the sub-slab area should be conducted. This may be done by operating the SVE system and simultaneously observing the movement of smoke downward into small holes (e.g., 3/8 inch) drilled through the building's slab at sufficient locations to demonstrate that a vacuum is being created beneath the entire slab.

c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.

d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [Section 4.3.1].

4.4 Operation, maintenance and monitoring of mitigation systems

When mitigation systems are implemented at a site, the operation, maintenance and monitoring (OM&M) protocols for the systems should be included in a site-specific site management plan (formerly referred to as operation, maintenance and monitoring plan). The party that installed the system should conduct OM&M activities and should develop the site management plan. Recommendations for minimum OM&M activities associated with specific mitigation methods are provided in the following subsections. Also included is a discussion of non-routine maintenance. All routine and non-routine OM&M activities should be documented and reported to the agencies.

4.4.1 SSD and SMD systems

Routine maintenance should commence within 18 months after the system becomes operational, and should occur every 12 to 18 months thereafter. Based upon a demonstration of the system's reliability, the State recommends that, if a different frequency is desired, a petition describing the alternative frequency and the reasons that frequency is preferred be submitted to the State. Any comments the State may have on the petition should be considered before the frequency is altered.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

During routine maintenance, the following activities (at a minimum) should be conducted:

a. a visual inspection of the complete system (e.g., vent fan, piping, warning device or indicator, labeling on systems, soil vapor retarder integrity, etc.),

b. identification and repair of leaks [Sections 4.3.1 and 4.3.2], and

c. inspection of the exhaust or discharge point to verify no air intakes have been located nearby.

As appropriate preventative maintenance (e.g., replacing vent fans), repairs and/or adjustments should be made to the system to ensure its continued effectiveness at mitigating exposures related to soil vapor intrusion. The need for preventative maintenance will depend upon the life expectancy and warranty for the specific part, as well as visual observations over time. The need for repairs and/or adjustments will depend upon the results of a specific activity compared to that obtained when system operations were initiated.

If significant changes are made to the system or when the system's performance is unacceptable, the system may need to be redesigned and restarted. Many, if not all, of the post-mitigation testing activities, as described in Sections 4.3.1 and/or 4.3, may be appropriate. The extent of such activities will primarily depend upon the reason for the changes and the documentation of sub-slab depressurization.

Generally, air monitoring is not recommended if the system has been installed properly and is maintaining a vacuum beneath the entire slab.

In addition to the routine OM&M activities described here, the building's owner and tenants are given information packages that explains the system's operation, maintenance and monitoring [Section 5.6]. Therefore, at any time during the system's operation, the building's owner or tenants may check that the system is operating properly.

4.4.2 Other mitigation systems

For other mitigation systems (e.g., HVAC modifications, crawl space ventilation, etc.), routine maintenance activities are generally comparable to post-mitigation testing activities [Section 4.3]. Activities typically include a visual inspection of the complete system, and identification and repair of leaks. System performance checks, such as air stream velocity measurements of ventilation systems, also should be performed.

As appropriate, preventative maintenance (e.g., replacing filters, cleaning lines, etc.), repairs and/or adjustments should be made to the system to ensure its continued effectiveness at mitigating exposures related to soil vapor intrusion. If significant changes are made to the system or when the system's performance is unacceptable, redesigning and restarting the system may be appropriate[Section 4.4.1].

Air monitoring, such as periodic sub-slab vapor, indoor air and outdoor air sampling, may be appropriate to determine whether existing building conditions are maintaining the desired mitigation endpoint and to determine whether changes are appropriate. The type and frequency of monitoring is determined based upon site-specific and building-specific conditions, taking into account applicable environmental data, building operating conditions, and the mitigation method employed.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

4.4.3 Non-routine maintenance

Non-routine maintenance may also be appropriate during the operation of a mitigation system. Examples of such situations include the following:

a. the building's owners or occupants report that the warning device or indicator indicates the mitigation system is not operating properly;

b. the mitigation system becomes damaged; or

c. the building has undergone renovations that may reduce the effectiveness of the mitigation system.

Activities conducted during non-routine maintenance visits will vary depending upon the reason for the visit. In general, building-related activities may include examining the building for structural or HVAC system changes, or other changes that may affect the performance of the depressurization system (e.g., new combustion appliances, deterioration of the concrete slab, or significant changes to any of the building factors listed in Table 1.2). Depressurization system-related activities may include examining the operation of the warning device or indicator and the vent fan, or the extent of sub-slab depressurization. Repairs or adjustments should be made to the system as appropriate. If appropriate, the system should be redesigned and restarted [Section 4.4.1].

4.5 Termination of mitigation system operations

Mitigation systems should not be turned off, until the State receives, and has had the opportunity to comment on, a proposal to turn off mitigation systems. The party seeking to turn off the mitigation systems should consider any comments the State may have on the proposal, except in emergency situations. Systems should remain in place and operational until they are no longer needed to address current or potential exposures related to soil vapor intrusion. This determination should be based upon several factors, including the following:

a. subsurface sources (e.g., groundwater, soil, etc.) of volatile chemical contamination in subsurface vapors have been remediated based upon an evaluation of appropriate post-remedial sampling results;

b. residual contamination, if any, in subsurface vapors is not expected to affect indoor air quality significantly based upon soil vapor and/or sub-slab vapor sampling results;

c. residual contamination, if any, in subsurface vapors is not affecting indoor air quality when active mitigation systems are turned off based upon indoor air, outdoor air and sub-slab vapor sampling results at a representative number of buildings; and

d. there is no "rebound" effect for which additional mitigation efforts would be appropriate observed when the mitigation system is turned off for prolonged periods of time. This determination should be based upon indoor air, outdoor air and/or sub-slab vapor sampling from the building over a time period, determined by site-specific conditions.

Given the prevalence of radon throughout the State of New York, consideration should be given to leaving the system in place and operating to address exposures related to radon intrusion after concurrence is reached that the system is no longer needed to mitigate exposures related to soil vapor intrusion. This action should be done only with permission of the property owner and after the property owner is aware of their responsibilities in

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
operating, monitoring and maintaining the system for this specific purpose. If the property owner declines the offer, the system should be shut down and, if requested, removed in a timely manner.

4.6 Annual certification and notification recommendations

Mitigation systems are considered engineering controls, defined as any physical barrier or method employed to

1. actively or passively contain, stabilize, or monitor hazardous waste or petroleum,
2. restrict the movement of hazardous waste or petroleum to ensure the long-term effectiveness of remedial actions, or
3. eliminate potential exposure pathways to hazardous waste or petroleum.

Therefore, depending upon the remedial program, submission of an annual certification to the State may be required. This certification must be prepared and submitted by a professional engineer or environmental professional and affirm that the engineering controls are in place, are performing properly and remain effective. This requirement of certification remains in effect until the State provides notification, in writing, that this certification is no longer needed.

If a property owner declines a mitigation system, the party responsible for arranging the design and installation of the system should renew the offer on an annual basis, unless they demonstrate environmental conditions have changed such that a system is no longer needed.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Section 5: Community Outreach

While community outreach is an essential component of the investigation and remediation of any site, it is particularly critical when evaluating soil vapor intrusion at a site due to the following:

a. a heightened awareness by environmental professionals and the general public (both nationally and state-wide) for the importance of soil vapor intrusion;

b. the relatively complicated nature of the exposure pathway (e.g., chemicals in groundwater or soil ending up in the indoor air of buildings versus contaminated groundwater entering the house through the use of a private well);

c. the unknowns associated with the evolving science of investigating, evaluating, and mitigating exposures related to soil vapor intrusion; and

d. the relatively complicated nature of mitigating the exposure pathway (e.g., the design, installation and operation of a sub-slab depressurization system in a home versus an immediate switch from using private well water to using bottled water).

When people have been or may be exposed to contamination, providing them with accurate and timely information about those exposures is extremely important. This information should include details about the types of chemicals, the levels of exposure, and possible health effects from those exposures. In addition, information should include details about the planning and progress of the investigation and remediation efforts. Techniques commonly used to inform the community about soil vapor intrusion issues are described in this section. The type, or types, of techniques selected for a site will vary depending upon the community's needs, site-specific conditions and remedial program-specific requirements.

5.1 Site contact list

A contact list contains names, addresses and telephone numbers of individuals and organizations with interest or involvement in a site. They may be affected by or interested in the site, or have information that staff needs to make effective remedial decisions. Contact lists typically include residents near the site, elected officials, appropriate federal, state, and local government contacts, local media, organized environmental groups and the responsible party, as well as local businesses, civic and recreational groups, religious facilities, school district officials, and all staff (NYSDEC, NYSDOH, county health department, EPA, etc.) involved in the site. The checklist provided in Appendix G.1 will help to identify who should be included in a particular site's contact list.

With respect to soil vapor intrusion, the site contact list is often used to

a. send a fact sheet announcing a proposed investigation in the area, a major project decision or proposal, the project's status or progress, a public meeting or availability session, or the availability of documents in the repositories;

b. contact building owners and tenants to arrange sampling dates and times and to transmit sampling results (in written form and/or verbally); and

c. provide community members with verbal updates on the project's status or progress.

The member of the project team (defined as the NYSDEC, NYSDOH, responsible party, etc.) that develops and maintains the site contact list is determined on a site-specific and/or

program-specific basis. Development and revision of the contact list are ongoing activities throughout the site's investigation and remediation. Guidance on how to create a site contact list is provided in Appendix G.1.

5.2 Project staff contact sheet

As implied by the name, this is a summary of the contact information for staff working on the site that can be handed out to the community. Often included on the sheet are the name, title, affiliation, role or area of expertise, address, telephone number, email address, facsimile number for each staff member. The contact sheet provides the community with a quick reference on whom to call with questions, comments or concerns about the site. Project staff may also use the site contact sheet to direct inquiries to the most appropriate person. This is particularly useful when there are many agencies working on the site and many issues, such as site investigation, health studies, medical outreach, etc., being addressed.

The site contact sheet should be handed out at public meetings or availability sessions, when door-to-door visits and sampling are conducted, and in conjunction with other appropriate outreach activities. The sheet should be developed early on in the process and kept up-to-date. The member of the project team that develops and maintains the staff contact sheet is determined on a site-specific and/or program-specific basis.

5.3 Fact sheets

A fact sheet is a written summary of important information about a site. It presents information in clear and concise terms for the community. Fact sheets aid consistent distribution of information and citizens' understanding of significant issues associated with site-related activities. With respect to soil vapor intrusion, fact sheets are often used to

a. announce a proposed soil vapor intrusion investigation in the area, either as a stand-alone activity or in conjunction with the site's overall investigation;

b. summarize the results of an investigation and the anticipated next steps in the process;

c. invite the public to a meeting or availability session to discuss the proposed investigation, the results of a recently completed investigation, the anticipated next steps, etc.; and

d. provide additional information on topics associated with soil vapor intrusion, such as specific air guidelines for volatile chemicals.

The member of the project team that plans, develops and distributes the fact sheet is determined on a site-specific and/or program-specific basis. Factors to consider when designating the lead include the site's remedial program, the expected content of the fact sheet, and the relationship of various team members with the community. For example, if the community strongly distrusts the responsible party and wants to know how the state is determining that their actions are appropriate, the state should be the lead. A combination of team members may also be suitable.

All team members should be included in reviewing and finalizing the fact sheet. Once the state approves the fact sheet, it may be released to the public. Timely distribution of the fact sheet is important. Sufficient time should be allowed in the development and review

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
schedule to ensure that the fact sheet is distributed — *and that it is received* — before the critical activity takes place. Specific timeframes for release include the following:

a. 2 weeks prior to a public meeting or availability session, or commencement of field activities;

b. within 24 hours of receiving a specific request for an available fact sheet from the community (e.g., members of the community that did not receive a copy of the fact sheet in the mail);

c. if applicable, before a comment period begins (otherwise a 30-day comment period becomes, in reality, a 25-day comment period); and

d. if appropriate, concurrently with letters to the community explaining sampling results.

Copies of fact sheets commonly used to supplement discussions related to soil vapor intrusion are provided in Appendix H. They are also available from the NYSDOH's soil vapor intrusion web page: http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/. Additional guidance on how to plan, develop and distribute fact sheets is provided in Appendix G.2.

5.4 Public gatherings

The following are several types of public gatherings where project staff can meet with the community:

a. Traditional Public Meetings: Project staff generally present information and answer questions. Citizens are encouraged to ask questions and provide comments;

b. Public Availability Sessions: The session is held in a casual setting, without a formal agenda and presentation. Staff generally conduct an availability session about a specific aspect of a site, which it publicizes ahead of time. The format promotes detailed individual or small group discussion between staff and the public. An availability session may be targeted to a specific subgroup of the overall community. For example, a session may be held where project staff meet with building owners and tenants to discuss their individual sampling results;

c. Public Forum: The forum is held in a casual setting, without a formal presentation. Typically, the format is one of "question and answer" — a panel of project staff (or, if applicable, outside experts) answer questions asked by community members in an open discussion; and

d. Other: Project staff may be invited to give presentations or to make themselves available for questions at community group meetings, such as community or neighborhood board meetings, school board meetings, etc.

If appropriate, a combination of the above may be used. The type, or combination of types, of gathering (if any) selected should be decided based on site-specific, program requirements and community-specific conditions, such as the following:

a. Is the investigation limited to on-site buildings, to a localized area of off-site buildings, or to the off-site neighborhood surrounding the site?;

b. Is the soil vapor investigation being performed as part of ongoing site investigation activities (and consequently ongoing outreach activities), or is this issue being revisited at a site where remediation was considered "complete?";

c. What type of outreach has the community favored in the past?;

d. What are the objectives of the meeting? Can one meeting type accomplish each of the objectives or are different meeting types needed on successive days (e.g., public meeting followed by an availability session)?; and

e. Who is the desired audience? Should the meeting be held in the afternoon to accommodate an elderly population and repeated in the evening for people who work during normal business hours?

The member of the project team that coordinates and implements the gathering is determined on a site-specific and/or program-specific basis. Factors to consider when designating the lead include the site's remedial program, the expected subject of the meeting, and the relationship of various team members with the community. A combination of team members may also be appropriate.

Additional guidance on how to plan and conduct a public meeting and an availability session is provided in Appendices G.3 and G.4.

5.5 Letters transmitting results

When indoor air and/or sub-slab vapor samples are collected from within or beneath a building, a letter providing the sampling results and the conclusions drawn from the data evaluation should be transmitted to the building's owner. If the building is a rental property, the transmittal letter should be sent to the tenants residing in the areas where the samples were collected and a copy to the property owner/landlord. In some cases where responsible parties are carrying out indoor air sampling, access agreements are commonly executed between such a party and the property owner. Consequently, the transmittal letter may be sent to the property owner, and where feasible by prior arrangement with the property owner and/or tenant, with a copy to the tenant.

A transmittal letter should include the following (as applicable):

a. the address of the building sampled;

b. the date samples were collected;

c. the type of samples collected (e.g., sub-slab vapor, indoor air and outdoor air);

d. indoor air sampling locations (e.g., basement, crawl space, first floor living room, etc.)

e. who collected the samples (e.g., the state, or [Consultant Name] on behalf of [Responsible Party name], etc.);

f. why samples were collected (e.g., to evaluate the potential for exposures associated with soil vapor intrusion);

g. the site name and number (usually included in the subject line);

h. the compound(s) or group of compounds of concern (e.g., trichloroethene or volatile organic compounds);

i. an overview of the sampling results (e.g., a table summarizing compounds detected in each sample and/or a figure illustrating sampling locations and corresponding results);

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

j. copies of the laboratory sheets for each sample collected and the completed building questionnaire/inventory;

k. a statement of the conclusions drawn and the next steps (e.g., soil vapor intrusion appears to be the likely source of volatile chemicals in your indoor air and we would like to install a sub-slab depressurization system to minimize exposures);

l. if applicable, what information should be shared with employees and/or patrons of the facility (e.g., the transmittal letter and enclosed fact sheets, a situation-specific fact sheet and cover memorandum, etc.);

m. contact information for project staff; and

n. fact sheets that supplement information provided in the letter.

The member of the project team that transmits the letter is typically the member that conducted the investigation. A representative of each member should be copied on each transmittal. For example, for investigations conducted by the state, letters are transmitted by the NYSDOH; state and local agencies, as well as a representative for the responsible party (or other non-agency project staff), should be copied. For investigations conducted by the responsible party, the responsible party should transmit letters that have been reviewed and approved by the state, and copy state and local agency representatives.

The level of detail provided in the letter will depend upon who transmits the letter. For example, letters written by the NYSDOH may recommend actions to reduce exposures to indoor sources (i.e., not site-related sources) of volatile chemicals, or address expected risks associated with an identified exposure. Letters transmitted by a responsible party generally focus on site-related contamination and their identified next steps. These letters generally refer the recipients to the state for questions regarding non-site-related compounds and health concerns. For additional guidance on the content of the transmittal letters, contact the NYSDOH's Bureau of Environmental Exposure Investigation at 1-800-458-1158, extension 27850.

Timely distribution of the transmittal letter is important. Generally, final (i.e., verified) sampling results from the laboratory are available 6 to 8 weeks after the samples are submitted. As soon as they are available, final results should be forwarded to the team member that is transmitting them. Sufficient time should be allowed in the development and review schedule to ensure that the letter is transmitted within 2 weeks after final results are available.

If there is significant community interest in the sampling results, reasonable attempts should be made to inform the building owners and tenants of their results verbally in addition to sending a transmittal letter. Other interested community members, such as residents, press and elected officials, may be given an overview of the investigation results and the conclusions drawn *after* each building owner and tenant has been notified.

5.6 Soil vapor intrusion mitigation information

Once a mitigation system (e.g., sub-slab depressurization system) is installed in a building, an information package should be given to the building's owner and tenants, if applicable, to facilitate their understanding of the system's operation, maintenance and monitoring. This package should include the following:

a. a description of the mitigation system installed and its basic operating principles;

b. how the owner or tenant can check that the system is operating properly;

c. how the system will be maintained and monitored and by whom;

d. a list of appropriate actions for the owner or tenant to take if the system's warning device or indicator (e.g., pressure gauge, alarm, etc.) indicates system degradation or failure; and

e. contact information (e.g., names, telephone numbers, etc.) if the owner or tenant has questions, comments or concerns.

The building's owner should also receive the following information:

a. any building permits required by local codes;

b. copies of contracts and warranties; and

c. a description of the proper operating procedures of any mechanical or electrical system installed, including manufacturer's operation and maintenance instructions and warranties.

Wherever possible, illustrations should be provided. For example, pictures of a manometer under normal operating conditions [Figure 5.1], as well as drawings or schematics showing the system at work [Figure 5.2].

The member of the project team who provides this information is the member who installed the mitigation system.



Figure 5.1
Manometer indicating the SSD system is operating properly.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

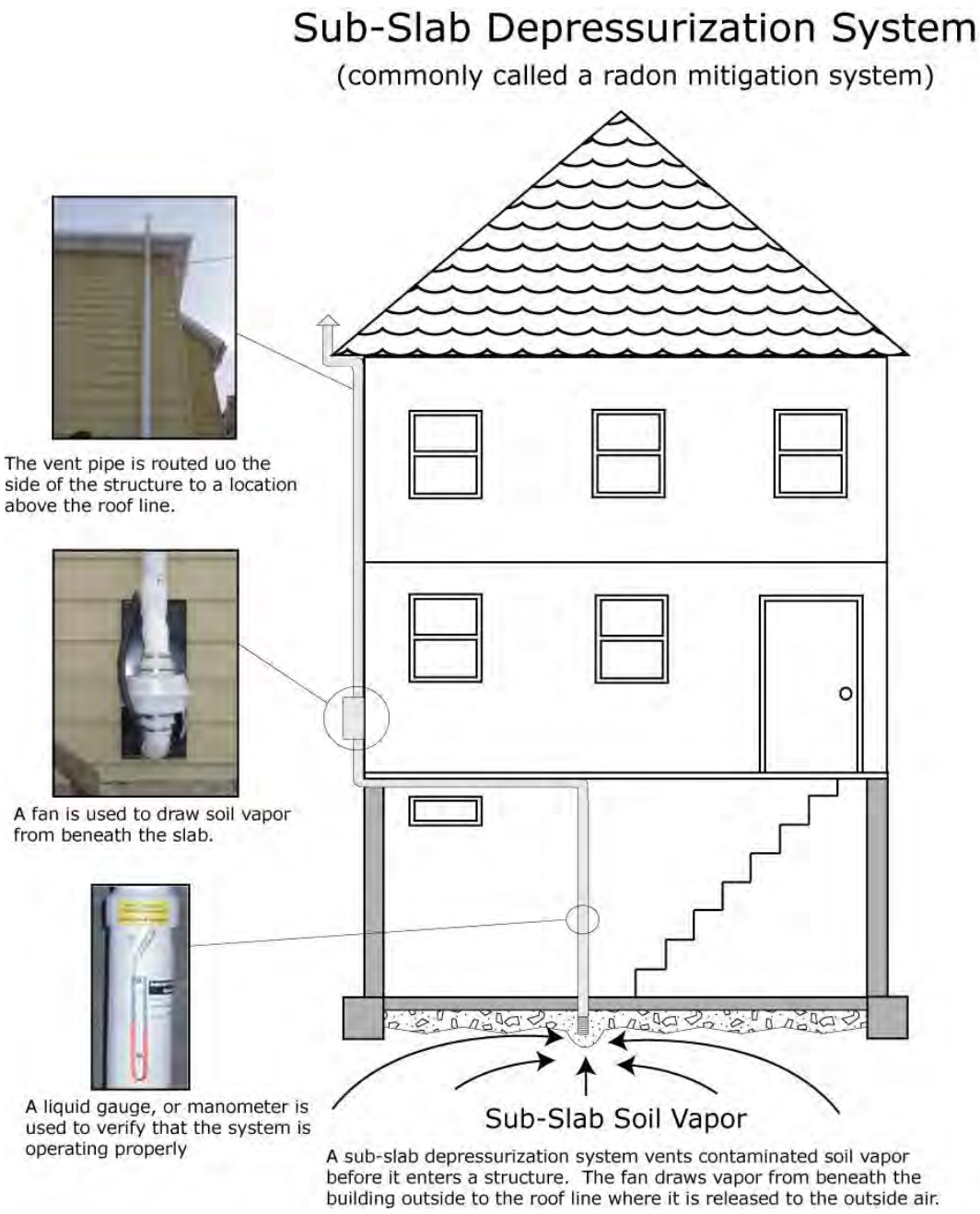


Figure 5.2
Example of an illustration showing how a SSD system works.

5.7 Toll-free "800" numbers

Toll-free information numbers provide quick, easy access for people who have questions, comments or concerns about a site. At a minimum, the NYSDOH site project manager's name and the following "800" number should be shared with the community in fact sheets and transmittal letters, at public gatherings, when samples are collected, and with other outreach techniques for their use if they have health-related questions, concerns or comments related to soil vapor intrusion at the site.

NYSDOH
Center for Environmental Health
Bureau of Environmental Exposure Investigation
Toll-free Information Line

1-800-458-1158, ext. 27850

Note: The "800" number is an *information* line — not a "*hotline*" — because callers may not receive immediate response, such as on nights or weekends.

Similarly, applicable toll-free numbers setup and maintained by other project team members should also be shared with the community whenever appropriate. Additional information on the use of toll-free "800" numbers as an outreach tool is provided in Appendix G.5.

5.8 Door-to-door visits

Door-to-door visits involve gathering or distributing site information by meeting individuals at their residences or businesses. Typically, this outreach technique is used to supplement other communication, such as telephone calls and letters. With respect to soil vapor intrusion, project staff may visit residents near a site to provide information, answer questions, or obtain permission for activities on private properties. All team members should be aware of the specifics of the door-to-door visits (e.g., who will be conducting the visits, the reason, the dates, etc.).

Additional information on conducting door-to-door visits is provided in Appendix G.6.

5.9 Document repositories

A document repository is a collection of documents and other information developed during the investigation and remediation of a site. It is located in a convenient, public facility, such as a library, so that affected and interested members of the public can easily access and review important information about the site. A repository is maintained through the site's operation and maintenance phase, or until its release from the applicable remedial program.

A site document repository helps the public review

a. documents about which the state is seeking public comment;

b. studies, reports and other information; and

c. complete versions of documents summarized in fact sheets, meeting presentations or media releases (summaries should note the locations of local repositories where the complete documents are available).

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
The member of the project team that establishes and maintains the document repository is determined on a site-specific and/or program-specific basis. Additional guidance on how to establish and maintain a document repository is provided in Appendix G.7.

5.10 Medical community outreach

Outreach to the medical community is an activity or combination of activities undertaken to assist local health care providers in caring for people who have concerns about site-specific environmental exposures. The goal of this type of outreach is to assist the individual provider by giving him/her much of the site-specific information related to the contaminants and to provide information about the site itself. This type of outreach is undertaken whenever the NYSDOH and/or other health agencies determine that the site-specific contaminants may be unfamiliar to the local medical community. Conversely, this outreach can be undertaken when community members express the concern that their health care providers may be unfamiliar with potential adverse health effects related to contaminants at the site.

The targeted audience for this type of outreach consists of specific groups of health care providers most likely to treat people with concerns about potential environmental exposures. Some examples of targeted groups of specialists could include any combination of the following: Family Practice, Internal Medicine, Preventive Medicine, Oncology, Neurology, Allergy, Pediatrics, Obstetrics, Dermatology and Emergency Medicine. Likewise, materials can be sent to medical and nursing schools, residency programs, and medical libraries if they are located nearby. Developing the targeted list of health-care providers is a cooperative effort between local and state departments of health, with input from the community as well.

The NYSDOH, in partnership with the Agency for Toxic Substance and Disease Registry (ATSDR) and the local health department, can conduct these activities, which could include any one or a combination of the following:

a. announcements made at public meetings that the NYSDOH Center for Environmental Health will mail out information packets to individual physicians at the request of any concerned citizen;

b. an article placed in a local newspaper, or, if applicable, in a newsletter periodically sent to residents, stating that the NYSDOH Center for Environmental Health will mail out packets to individual physicians at the request of any concerned citizen. The NYSDOH "800" number and two NYSDOH contact names would be given;

c. an article submitted to the newsletter of the local county medical society, stating that the NYSDOH and the ATSDR have information to help providers with questions about site-related contamination in the area of the site. The NYSDOH "800" number and two NYSDOH contact names would be given; and

d. materials sent to medical and nursing schools, residency programs, and medical libraries if they are located nearby.

Local and state departments of health, and ATSDR, have developed appropriate outreach materials. The information packets should contain a letter to the physician, site-specific fact sheets, brochures, and booklets about potential exposures and about the contaminants in the area of the site. As an example, here is a list of fact sheets and pamphlets that an information packet for a site with PCE and TCE as contaminants of concern might contain:

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

a. a letter of explanation to the provider, including the NYSDOH "800" number to call for access to more information, as well as two NYSDOH contacts with whom to speak initially;

b. a site-specific fact sheet written for the community, explaining various site-related issues;

c. a compact disc of ATSDR case studies in environmental medicine (CSEMs), with opportunities for earning many free continuing medical education (CME) credits through the Centers for Disease Control and Prevention;

d. a hard copy of both the "Trichloroethylene (TCE) Toxicity" and "Taking an Environmental Exposure History" case studies;

e. two small "quick reference guides" produced by ATSDR about evaluating environmental exposures and doing an exposure history;

f. a NYSDOH fact sheet on Trichloroethene (TCE) in indoor and outdoor air;

g. an ATSDR fact sheet on Trichloroethylene (TCE);

h. a NYSDOH fact sheet on Tetrachloroethene (PERC) in indoor and outdoor air; and

i. an ATSDR fact sheet on Tetrachloroethylene (PERC).

For additional information on this outreach tool, please contact the NYSDOH Center for Environmental Health's Outreach and Education Unit at 1-800-458-1158, extension 27530.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

References

American Society for Testing and Materials (ASTM) International. 2003. "Standard Practice for Installing Radon Mitigation Systems in Existing Low-rise Residential Buildings" (ASTM E-2121-03, February 10, 2003).

Kladder, D. L, J. F. Burkhart, and S. R. Jelinek. 1993. "Protecting Your Home from Radon: A Step-by-step Manual for Radon Reduction."

New York State Department of Environmental Conservation. "Draft DER-10 Technical Guidance for Site Investigation and Remediation." Division of Environmental Remediation. December 2002.

New York State Department of Environmental Conservation. 2006. "Program Policy DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York." Division of Environmental Remediation. October 2006.

New York State Department of Health. 2005. "Indoor Air Sampling and Analysis Guidance." February 1, 2005. Available on the NYSDOH's web site at http://www.health.state.ny.us/nysdoh/indoor/guidance.htm.

United State Environmental Protection Agency. 1993. "Radon Reduction Techniques for Existing Detached Houses: Technical Guidance (Third Edition) for Active Soil Depressurization Systems" (EPA 625/R-93-011, October 1993).

United State Environmental Protection Agency. 1994a. "Model Standards and Techniques for Control of Radon in New Residential Buildings" (EPA 402-R-94-009; March 1994).

United State Environmental Protection Agency. 1994b. "Radon Prevention in the Design and Construction of Schools and Other Large Buildings" (EPA 625-R-92-016, June 1994).

United State Environmental Protection Agency. 1994c. "Reducing Radon in Schools: A Team Approach" (EPA 402-R-94-008, April 1994).

United State Environmental Protection Agency. 2001. "Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes" (EPA 402-K-01-002, April 2001).

United State Environmental Protection Agency. 2003. "Consumer's Guide to Radon Reduction" (EPA 402-K-03-002; revised February 2003).

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix A

Highlights of document revisions

February 2005 Public Comment Draft ➔ October 2006 Final Guidance

- Throughout: Revised language to clarify that the guidance is not a rule, regulation or requirement, and to eliminate text that might create a contrary impression.
- Preface: Revised to clarify that the guidance was developed in consultation with the NYSDEC and that it represents the State's methodology and our experience. Added notes for special considerations (e.g., naturally-occurring subsurface gases).
- Section 1: Replaced image in Figure 1.1. Identified additional factors in Table 1.1. Added section on conceptual site models. Provided additional information regarding the applicability of the guidance to specific scenarios (such as residential and non-residential settings and petroleum hydrocarbon sites).
- Section 2: Revised the discussion in Section 2.2.1 to clarify the use of soil vapor samples. Included crawl space air samples. Expanded the discussion on time of year in which to sample. Revised text to emphasize the importance of selecting methods that meet the data quality objectives. Clarified which information is highly recommended to gather at the time of sampling. Included liquid tracers in the section on tracer gas. Added QA/QC considerations. Revised text on target analyte lists. Relocated guidance on applicability in non-residential settings to Section 1.7.
- Section 3: Revised text and removed summary table in Section 3.2.4 to clarify that background levels are not defined as levels within a 25^{th} to 75^{th} percentile range. Added a summary of a recently published Health Effects Institute database to the discussion on background databases. Included "resampling" as one of the potential recommended actions in Section 3.3.2 and 3.3.3. Added text to clarify who is responsible for implementing recommended actions. Revised the outdoor air evaluation section to clarify that outdoor air samples are not collected and evaluated as part of a comprehensive assessment of outdoor air.
- Matrix 1: Based on comments received on the NYSDOH's TCE Criteria Document (NYSDOH 2006), the following two revisions were made to Matrix 1: changed the boundary between the indoor air concentration ranges in Columns 2 and 3 from 2.5 to 1 mcg/m^3 and added "Monitor/Mitigate" as a recommended action in Box 10 (see memorandum from N. Kim to R. Tramontano dated October 12, 2006, provided on p. A-3 for additional information). Removed Monitor action from Box 3. Removed Mitigate and Monitor actions from Box 4. Revised the definitions of actions and the additional notes, including a definition of "Monitor/Mitigate" and a recommendation that resampling may be necessary to demonstrate the effectiveness of actions taken to reduce exposures.
- Matrix 2: Removed Monitor action from Box 3. Removed Mitigate and Monitor actions from Box 4. Added Monitor/Mitigate action to Box 6 (see memorandum from N. Kim to R. Tramontano dated October 12, 2006, provided on p. A-3 for additional information). Similar to Matrix 1, revised the definitions of actions and the additional notes.
- Section 4: Revised text to clarify that we are emphasizing preferred mitigation methods and not precluding the use of other mitigation methods. Added text to Section 4.3 about post-mitigation indoor air sampling in buildings with basements. Replaced EPA's *Radon Mitigation Standards* with ASTM E-2121. Replaced references to Operation, Maintenance and Monitoring Plans to Site Management Plans.
- Section 5: Replaced image in Figure 5.2.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

- Appendix C: Added a discussion on a recently published Health Effects Institute database. Added tables for each database with additional volatile chemicals and statistical measures of background levels.
- Appendix E: Removed EPA's *Radon Mitigation Standards*. Provided EPA's web site explaining how to get copies of the recommended ASTM E-2121.

The reader is also referred to the NYSDOH's complementary document titled "Response to Comments received on the New York State Department of Health's *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (Public comment draft dated February 2005)."

STATE OF NEW YORK - DEPARTMENT OF HEALTH
INTEROFFICE MEMORANDUM

TO: Ronald Tramontano, Director
Center for Environmental Health

FROM: Nancy K. Kim, Director
Division of Environmental Health Assessment

SUBJECT: Trichloroethene

DATE: October 12, 2006

Center for Environmental Health staff in the New York State Department of Health (DOH) have written several documents to address health concerns about exposure to trichloroethene (TCE) from soil vapor intrusion and are revising those documents in response to comments from a scientific review panel and the public. The documents and related reports are:

- Draft Report Trichloroethene Air Criteria Document (DOH, 2005)(contains the derivation of the TCE guideline),
- Comments of the Trichloroethene (TCE) Panel (letter from Henry Anderson, M.D. to Nancy K. Kim, Ph.D. dated November 1, 2005),
- Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Public Comment Draft (DOH, 2005), which includes the
  - Soil Vapor/Indoor Air Matrix 1 and Matrix 2 (both are a decision making tool for soil vapor and indoor air levels), and
  - TCE in Indoor and Outdoor Air (fact sheet), and
- Assessing the Human Health Risks of Trichloroethylene: Key Scientific Issues, a report issued by the National Research Council (NRC) of the National Academy of Sciences (July, 2006).

After reviewing these materials, I am recommending that we change Matrix 1. The 2.5 micrograms of trichloroethene per cubic meter of indoor air (2.5 mcg/m^3) in the column headings for Indoor Air Concentration of Compound in Matrix 1 should be reduced to 1.0 mcg/m^3. I am also recommending that mitigate be included as an option in Box 10 of Matrix 1 and Box 6 of Matrix 2.

Use of the Air Guideline

The purpose of the air guideline for TCE of 5 mcg/m^3 given in the fact sheet, "...is to help guide decisions about the nature of the efforts to reduce TCE exposures. Reasonable and practical actions should be taken to reduce TCE exposure when indoor air levels are above background, even when they are below the guideline of 5 mcg/m^3. The urgency to take actions increases as indoor air levels increase, especially when air

levels are above the guideline. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended action is to reduce TCE levels in indoor air to as close to background as practical." This general advice applies to all situations including the following:

an individual wants to know if he should keep a closed bottle of TCE in his house,
a school asks DOH if it has a problem with a bottle of TCE being in a shop, and
an office wants to know if it should do anything about residual exposure from past TCE use.

DOH also uses the guideline to make decisions about the need for remedial actions because of state regulated sources or sites. DOH would use this value to decide if it needs to work with the New York State Department of Environmental Conservation to reduce outdoor air levels of TCE. DOH also uses this value in Matrix 1, a decision making tool for responding to soil vapor intrusion problems; for this use, the guideline is considered to be a TCE concentration that should not be exceeded in indoor air.

Indoor Air Concentrations

Several different studies provide information about background levels of TCE in indoor air. These data differ because of a number of factors such as the criteria for choosing sampling locations, the time period of the studies, etc. Three studies give a 50^{th} percentile (less than 0.25 mcg/m^3, less than 1.4 mcg/m^3 and 0.12 mcg/m^3) and a 95^{th} percentile (less than 0.25 mcg/m^3, 1.36 mcg/m^3 and 4.2 mcg/m^3). Two studies provide a 75^{th} percentile (less than 0.25 mcg/m^3 and 1.2 mcg/m^3). One way to characterize these values is to state that background values are mostly less than 1 mcg/m^3 and frequently less than 0.25 mcg/m^3. (References: DOH 2003, USEPA 2001, and HEI, 2005)

Peer Review of the Derivation of the TCE Air Guideline

After receiving the TCE panel's comments, the Department considered changes in the guideline or Matrix 1. The TCE panel was asked to answer technical questions about the derivation of the guideline and a specific question on the guideline itself (Is the summary transparent and does it adequately justify the guideline of 5 mg/m^3?). In responding to the latter question, several panel members voiced their opinion about what they would select as a guideline. The consensus comment from the panel was "Some panel members suggested that additional consideration be given to lowering the guideline value."

The panel also commented on aspects of the guideline when answering questions about cancer risk estimates.

One of the panel's consensus comment was:

"The fact that TCE is a multi-species and multi-site carcinogen with a combination of both malignant and benign tumors should be further emphasized in the document

because these data coupled with the human data have led several authoritative bodies (EPA, NTP, & IARC) to the conclusion that TCE is on the cusp between a known and probable (likely, reasonably anticipated to be) human carcinogen. Thus, the NYSDOH should have flexibility in using risk levels of both 1 in 10^{-6} and 1 in 10^{-5}." (Part of response to question 4 of the TCE Panel's comments.)

Another consensus comment was:

"The rationale to utilize the human epidemiologic studies for weight of evidence support for the animal carcinogenicity studies rather than as the primary for the quantitative cancer risk assessment is appropriate. The weaknesses of the exposure estimates and potential confounding exposures support this decision. However, the DOH may want to consider the human studies to a greater extent when weighting the cancer evidence to establish a guideline." (Part of response to question 5 of the TCE Panel's comments)

Other, individual comments on the guideline follow.

George Lucier, Ph.D.

"Based on the available data, especially the cancer data, a guideline in the range of 1-5 mcg/m^3 could be justified. After all, a linear model cannot be rejected, for some sites acceptable risk levels are less than 5 mcg/m^3 and in some cases less than 1 mcg/m^3 and EPA has stated that TCE is highly likely to be a human carcinogen. The NYSDOH may wish to consider an acceptable risk level to be 3-5 cancers per million since TCE appears to be on the cusp between a known human carcinogen and a probable human carcinogen**."**

James Dix, Ph.D.

"The extensive review of the cancer literature in the draft document seems to indicate TCE levels giving 1×10^{-6} increased cancer risk can be in the range 0.1-1 mcg/m^3 (e.g., p. 132, 133, 141, 147, 149, and 150 of the draft document), which prima facia (sic) would support an air criterion of below 1 μ/m^3(sic). The DOH weighted these studies less. However, given the support on this scientific review panel for weighting the non-Hodgkin's lymphoma more strongly, an air criterion of less than 1 μg/m^3 might be justified."

NRC Report on Trichloroethene

In July 2006, the NRC released its report on TCE. We have reviewed that report. The approaches and methods we used to derive health-based air criteria for TCE are consistent with the recommendations of the NRC Committee. For example, both NRC and DOH identified kidney cancer, liver cancer, central nervous system effects, reproductive problems and developmental problems as human health endpoints that might be sensitive to the effects of TCE. NRC recommended that animal data, not human health data, be used to derive quantitative estimates of human cancer risks from TCE exposure and that the available human data be used only for validation. DOH used this approach in evaluating cancer risks.

Integration, Matrix 1 and Matrix 2

The attached tables compare the TCE criteria in the draft document with the revised TCE criteria in the final document. These data indicate that the guideline of 5 mcg/m^3 is below the recommended health-based criteria for non-cancer effects and that the excess lifetime cancer risks at the guideline are in the lower end of the risk range that is generally used by regulatory agencies when setting guidelines or standards. However, Matrix 1 is a major determinant for remediation in the soil vapor intrusion program, a state program addressing involuntary risks, and two revisions would help to align decisions in that program with the goals stated in the DOH TCE fact sheet and with the requirements of the Brownfields legislation.

In the current state program, mitigation is recommended when the potential for soil vapor intrusion to affect indoor air is high (sub-slab levels are equal to or greater than 250 mcg/m^3) regardless of the measured indoor air levels. However, when the potential for soil vapor intrusion to affect indoor air is moderate (sub-slab concentrations are equal to or greater than 50 mcg/m^3, but less than 250 mcg/m^3), mitigation is only recommended when an indoor air level is equal to or greater than 2.5 mcg/m^3. The excess risk levels associated with 2.5 mcg/m^3 range from 0.3 to 8 x 10^{-6}; the upper end of this range exceeds the 3 to 5 cancers per million recommended by Dr. Lucier and the 1 x 10^{-6} risk level given in the Brownfields legislation. This concentration also exceeds most background concentrations for TCE, a goal stated in the TCE fact sheet. Reducing 2.5 mcg/m^3 to 1.0 mcg/m^3 in Matrix 1 would result in recommending remediation at levels above most background levels and at risk levels of 0.1 to 3 x 10^{-6}.

In Matrix 1 of the draft soil vapor intrusion guidance, Box 10 (sub-slab vapor levels of 50 mcg/m^3 or greater to less than 250 mcg/m^3 and indoor air levels of 0.25 mcg/m^3 or greater to less than 2.5 mcg/m^3) recommends monitoring. (The recommendation in the previous paragraph would change 2.5 mcg/m^3 to 1.0 mcg/m^3.) Box 10 addresses situations where the potential for soil vapor to affect indoor air is moderate, but indoor air levels are in the range of most background levels. Recommending an option for mitigation in Box 10 when environmental factors for a specific site suggest a high potential for indoor air concentrations to increase is consistent with the goals outlined in the previous paragraph. A similar mitigation option is recommended for Box 6 of Matrix 2.

Attachments

P:\Trichloroethene\RT memo.doc

Table 1. Non-Carcinogenic Effects: Draft and Final Criteria Used in Guideline Derivation.

Organ/System/ Lifestage	Study*	Recommended TCE Air Criteria (mcg/m^3)			
		Draft		Final	
		Study	System	Study	System
CNS	Arito et al. (1994)	40	40	4 (childhood)	10
	Rasmussen et al. (1993)	40		11 (adult & childhood)	
Liver	Kjellstrand et al. (1983)	160	160	160 (adult & childhood)	160
Kidney	Kjellstrand et al. (1983)	165	165	160 (adult & childhood)	160
Reproduction	Land et al. (1981)	32	32	32	20
	DuTeaux et al. (2004)	110		110	
	Kumar et al. (2000; 2001a)	not done		20	
	NTP (1986)	not done		110	
Developmental	Dawson et al. (1993)	11	11	11 (supporting study)	20
	Healy et al. (1982)	38		38	
	Isaacson & Taylor (1989)	19		19	
	NTP (1986)	not done		22	

*References from Trichloroethene Air Criteria Document.

Table 2. Carcinogenic Effects: Draft and Final Criteria Used in Guideline Derivation.

Cancer	Recommended TCE Air Criteria (mcg/m^3)*					
	Draft			Final		
	LADE		LADD (PBPK)	LADE		LADD (PBPK)
	Unadjusted	Adjusted**		Unadjusted	Adjusted**	
Animal Data (Fukuda et al., 1983; Henschler et al., 1980; Maltoni et al., 1986)***						
liver	1.8	not done	1.4	1.8	1.1	1.4
kidney	13	not done	3100	13	7.8	3100
lymphoma	not a recommended site			0.3	not done	not done given uncertainty in appropriate internal dose & mode of action
testes (benign)	not a recommended site					
lung	not a recommended site					
Human Data (Hansen et al., 2001)***						
esophagus	0.077 – 1.2#	not done	not done	0.36 – 1.2##	not done	not done
NHL	0.062 – 0.91#	not done	not done	0.29 – 0.91##	not done	not done

*Air concentrations associated with an excess lifetime human risk of 1 x 10^{-6} are provided for comparative purposes, air concentrations associated with excess risks 1 x 10^{-5} and 1 x 10^{-4} are 10X and 100X the given concentration.

**The LADE (lifetime average daily exposure) estimates based on linear low-dose extrapolation are unadjusted and adjusted for the potential increased sensitivity of children to the early-life TCE exposures following US EPA guidance. Adjusted values were not calculated using age-specific internal dose metrics (LADD, lifetime average daily dose) because validated TCE PBPK models for children are unavailable and because of additional uncertainties associated with estimating model parameter values for children. Adjusted values were not calculated based on lymphomas because the mode-of-action for those cancers is unknown, and in such cases, the US EPA guidance recommends using unadjusted values.

***References from Trichloroethene Air Criteria Document.

Range of values based on two measures of relative risk, two occupational exposure levels, and three estimates of exposure duration.

Range of values based on two measures of relative risk, one occupational exposure level, and three estimates of exposure duration.

Soil Vapor / Indoor Air Matrix 1

WORKING DRAFT 02.23.05 SUBJECT TO CHANGE

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 0.25	0.25 to < 2.5	2.5 to < 5.0	5.0 and above
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures — and — Monitor	4. MITIGATE — or — Take reasonable and practical actions to identify source(s) and reduce exposures — and — Monitor
5 to < 50	5. No further action	6. Monitor	7. Monitor	8. MITIGATE
50 to < 250	9. Monitor	10. Monitor	11. MITIGATE	12. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE	16. MITIGATE

No further action: Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take steps to identify source(s) and reduce exposures: The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed).

Monitor as appropriate: Monitoring is needed to confirm concentrations in the indoor air have not increased due to changes in pressure gradients (e.g., deterioration of building foundation) or to evaluate temporal trends for relevant environmental data. Monitoring may also be needed to verify that existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are minimizing potential effects associated with soil vapor intrusion. The type and frequency of monitoring is determined on a site-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

See additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX 1

This matrix provides guidance on actions that should be taken to address current and potential exposures related to soil vapor intrusion. To use the matrix accurately as a tool in the decision-making process, the following must be noted:

[1] The matrix is generic. As such, it may be necessary to modify recommended actions to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or site-specific conditions (e.g., proximity of building to identified subsurface contamination) for the protection of public health. Additionally, actions more conservative than those specified within the matrix may be implemented at any time. For example, the decision to implement more conservative actions may be based on a comparison of the costs associated with resampling or monitoring to the costs associated with installation and monitoring of a mitigation system.

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude the need to investigate possible sources of vapor contamination, nor does it preclude the need to remediate contaminated soil vapors or the source of soil vapor contamination.

[3] Extreme care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples must be analyzed by methods that can achieve a minimum reporting limit of 0.25 microgram per cubic meter for indoor and outdoor air samples, and typically 1 microgram per cubic meter for subsurface vapor samples.

[4] Sub-slab vapor and indoor air samples are typically collected during the heating season since soil vapor intrusion is more likely to occur when a building's heating system is in operation and air is being drawn into the building. If samples are collected during other times of the year, it may be necessary to resample during the heating season to evaluate exposures accurately.

[5] When current exposures are attributed to sources other than vapor intrusion, the agencies must be provided documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

Soil Vapor / Indoor Air Matrix 2

WORKING DRAFT 02.23.05 SUBJECT TO CHANGE

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 3	3 to < 30	30 to < 100	100 and above
< 100	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures — and — Monitor	4. MITIGATE — or — Take reasonable and practical actions to identify source(s) and reduce exposures — and — Monitor
100 to < 1,000	5. Monitor	6. Monitor	7. MITIGATE	8. MITIGATE
1,000 and above	9. MITIGATE	10. MITIGATE	11. MITIGATE	12. MITIGATE

No further action: Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take steps to identify source(s) and reduce exposures: The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed).

Monitor: Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

Mitigate: Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is an interim measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

See additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX 2

This matrix provides guidance on actions that should be taken to address current and potential exposures related to soil vapor intrusion. To use the matrix accurately as a tool in the decision-making process, the following must be noted:

[1] The matrix is generic. As such, it may be necessary to modify recommended actions to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or site-specific conditions (e.g., proximity of building to identified subsurface contamination) for the protection of public health. Additionally, actions more conservative than those specified within the matrix may be implemented at any time. More conservative actions are often cost-based (e.g., the cost of additional sampling versus the cost of mitigation) rather than health-based.

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude the need to investigate possible sources of vapor contamination, nor does it preclude the need to remediate contaminated soil vapors or the source of soil vapor contamination.

[3] Extreme care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples must be analyzed by methods that can achieve a minimum reporting limit of 3 micrograms per cubic meter.

[4] Sub-slab vapor and indoor air samples (basement and lowest occupied living space) are typically collected during the heating season since soil vapor intrusion is more likely to occur when a building's heating system is in operation and air is being drawn into the building. If samples are collected during other times of the year, it may be necessary to resample during the heating season to evaluate exposures accurately.

[5] When current exposures are attributed to sources other than vapor intrusion, the agencies must be provided documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

Soil Vapor / Indoor Air Matrix 1

October 2006

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 0.25	0.25 to < 1	1 to < 5.0	5.0 and above
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
5 to < 50	5. No further action	6. MONITOR	7. MONITOR	8. MITIGATE
50 to < 250	9. MONITOR	10. MONITOR / MITIGATE	11. MITIGATE	12. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE	16. MITIGATE

No further action:
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take reasonable and practical actions to identify source(s) and reduce exposures:
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

MONITOR:
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MONITOR / MITIGATE:
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX 1

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.25 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended for buildings with full slab foundations, and 1 microgram per cubic meter for buildings with less than a full slab foundation.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

Soil Vapor / Indoor Air Matrix 2

October 2006

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 3	3 to < 30	30 to < 100	100 and above
< 100	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
100 to < 1,000	5. MONITOR	6. MONITOR / MITIGATE	7. MITIGATE	8. MITIGATE
1,000 and above	9. MITIGATE	10. MITIGATE	11. MITIGATE	12. MITIGATE

No further action:
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take reasonable and practical actions to identify source(s) and reduce exposures:
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

MONITOR:
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MONITOR / MITIGATE:
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

ADDITIONAL NOTES FOR MATRIX 2

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 3 micrograms per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix B

Indoor air quality questionnaire and building inventory

As discussed in Section 2.11, products in buildings should be inventoried every time indoor air is sampled to provide an accurate assessment of the potential contribution of volatile chemicals. In addition, the type of structure, floor layout and physical conditions of the building being studied should be noted to identify (and minimize) conditions that may interfere with the proposed testing.

Toward this end, a blank copy of the NYSDOH Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory is provided in this appendix. Also provided is an example that demonstrates how the form should be completed properly.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

This page is intentionally blank.

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name _____ Date/Time Prepared _____

Preparer's Affiliation _____ Phone No._____

Purpose of Investigation_____

1. OCCUPANT:

Interviewed: Y / N

Last Name: _____ First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

Number of Occupants/persons at this location _____ Age of Occupants _____

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

Last Name: _____First Name: _____

Address: _____

County: _____

Home Phone: _____ Office Phone: _____

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _____

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? _____

If the property is commercial, type?

Business Type(s) _____

Does it include residences (i.e., multi-use)? Y / N If yes, how many? _____

Other characteristics:

Number of floors_____ Building age_____

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

_____

_____

_____

Airflow near source

_____

_____

_____

Outdoor air infiltration

_____

_____

_____

Infiltration into air ducts

_____

_____

_____

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other _____
c. Basement floor:	concrete	dirt	stone	other _____
d. Basement floor:	uncovered	covered	covered with _____	
e. Concrete floor:	unsealed	sealed	sealed with _____	
f. Foundation walls:	poured	block	stone	other _____
g. Foundation walls:	unsealed	sealed	sealed with _____	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			
k. Water in sump?	Y / N / not applicable			

Basement/Lowest level depth below grade: _____(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

_____

_____

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other _____

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other_____
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

_____

_____

_____

_____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	_____
1st Floor	_____
2nd Floor	_____
3rd Floor	_____
4th Floor	_____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / NA Please specify_____

d. Has the building ever had a fire? Y / N When?_____

e. Is a kerosene or unvented gas space heater present? Y / N Where? _____

f. Is there a workshop or hobby/craft area? Y / N Where & Type? _____

g. Is there smoking in the building? Y / N How frequently? _____

h. Have cleaning products been used recently? Y / N When & Type? _____

i. Have cosmetic products been used recently? Y / N When & Type? _____

j. Has painting/staining been done in the last 6 months? Y / N Where & When? _____

k. Is there new carpet, drapes or other textiles? Y / N Where & When? _____

l. Have air fresheners been used recently? Y / N When & Type? _____

m. Is there a kitchen exhaust fan? Y / N If yes, where vented?_____

n. Is there a bathroom exhaust fan? Y / N If yes, where vented?_____

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?_____

Are there odors in the building? Y / N
If yes, please describe: _____

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? _____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No
Yes, use dry-cleaning infrequently (monthly or less) Unknown
Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: _____
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _____
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: _____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: _____

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo** Y / N

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

OSR – 3 Example 1 Correct

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name Mary Jones Date/Time Prepared 10/22/04 10:00am

Preparer's Affiliation XYZ Consulting Phone No. 518-555-1212

Purpose of Investigation Thomasville Soil Vapor Intrusion Investigation (Site#32141)

1. OCCUPANT:

Interviewed: (Y)/ N

Last Name: Smith First Name: Carol

Address: 25 Main Street Thomasville, New York 25230

County: Albany

Home Phone: 518-556-2222 Office Phone: 518-556-2400

Number of Occupants/persons at this location 2 Age of Occupants 36, 10

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y (N)

Last Name: White First Name: Frank

Address: 64 Mountain Road Bainbridge, New York 26390

County: Dutchess

Home Phone: 845-876-1301 Office Phone: 845-227-2430

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

(Residential)	School	Commercial/Multi-Use
Industrial	Church	Other: _____

Example Correct 2

If the property is residential, type? (Circle appropriate response)

(Ranch)	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_____

If multiple units, how many? NA

If the property is commercial, type?

Business Type(s) NA

Does it include residences (i.e. multi-use)? Y / N If yes, how many? _____

Other characteristics:

Number of floors 1 Building age 20 years

Is the building insulated? (Y) / N How air tight? (Tight) / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

Basement air flows up to 1st floor through plumbing waste line and domestic water line floor penetrations

Airflow near source

Yes, furnace/oil tank area open to rest of basement

Outdoor air infiltration

Outdoor air enters at loose bilco doorway openings, and at sill plate near furnace.

Infiltration into air ducts

Basement air flows into bottom of hot air unit and in loose cold air return joints.

Example Correct

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	(wood frame)	concrete	stone	brick
b. Basement type:	(full)	crawlspace	slab	other _____
c. Basement floor:	(concrete)	dirt	stone	other _____
d. Basement floor:	(uncovered)	covered	covered with _____	
e. Concrete floor:	(unsealed)	sealed	sealed with _____	
f. Foundation walls:	(poured)	block	stone	other _____
g. Foundation walls:	(unsealed)	sealed	sealed with _____	
h. The basement is:	wet	damp	(dry)	moldy
i. The basement is:	finished	(unfinished)	partially finished	
j. Sump present?	Y (N)			
k. Water in sump?	Y / N / (not applicable)			

Basement/Lowest level depth below grade: 6 (feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Floor drain in laundry area

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

(Hot air circulation)	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other _____

The primary type of fuel used is:

Natural Gas	(Fuel Oil)	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: gas

Boiler/furnace located in:	(Basement)	Outdoors	Main Floor	Other _____
Air Conditioning:	Central Air	(Window units)	Open Windows	None

Example Correct

Are there air distribution ducts present? (Y) N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

Cold air return ductwork on ceiling in basement. Cold air return joints appear loose.

7. OCCUPANCY

Basement / Is lowest level occupied? Full time Occasionally (Seldom) Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	Storage and laundry
1st Floor	living area and bedrooms
2nd Floor	
3rd Floor	
4th Floor	

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage?	(Y) / N	
b. Does the garage have a separate heating unit?	Y / (N) / NA	
c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car etc.)	(Y) / N / NA	Please specify lawnmower, car
d. Has the building ever had a fire?	Y / (N)	When?
e. Is a kerosene or unvented gas space heater present?	Y / (N)	Where?
f. Is there a workshop or hobby/craft area?	Y / (N)	Where & Type?
g. Is there smoking in the building?	Y / (N)	How frequently?
h. Have cleaning products been used recently?	(Y) N	When & Type? w/in week - windex, tilex
i. Have cosmetic products been used recently?	(Y) / N	When & Type? yesterday - hairspray

Example Correct

j. Has painting/staining been done in the last 6 months? Y / (N) Where & When? _____

k. Is there new carpet, drapes or other textiles? (Y) / N Where & When? carpet in dining room

l. Have air fresheners been used recently? Y / (N) When & Type? _____

m. Is there a kitchen exhaust fan? (Y) / N If yes, where vented? outside

n. Is there a bathroom exhaust fan? Y / (N) If yes, where vented? _____

o. Is there a clothes dryer? (Y) / N If yes, is it vented outside? (Y) / N

p. Has there been a pesticide application? Y / (N) When & Type? _____

Are there odors in the building? Y / (N)
If yes, please describe: _____

Do any of the building occupants use solvents at work? (Y) / N
(e.g., chemical manufacturing or laboratory, automechanic or autobody shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist etc.)

If yes, what types of solvents are used? hair salon dyes, alcohols, peroxides, acetone

If yes, are their clothes washed at work? Y / (N)

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly) — No
(Yes, use dry-cleaning infrequently (monthly or less)) — Unknown
Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? (Y) / N Date of Installation: June 2000
Is the system active or passive? (Active) / Passive

9. WATER AND SEWAGE

Water Supply: Public Water (Drilled Well) Driven Well Dug Well Other: _____

Sewage Disposal: Public Sewer (Septic Tank) Leach Field Dry Well Other: _____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: not applicable

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

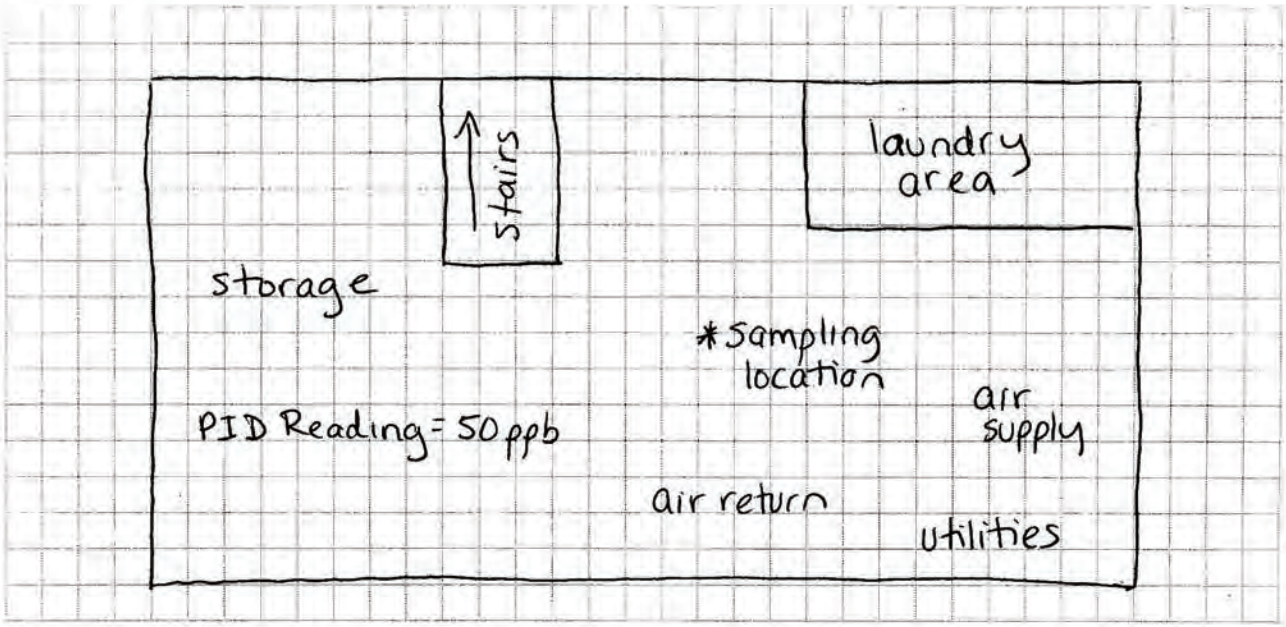
d. Relocation package provided and explained to residents? Y / N

Example Correct

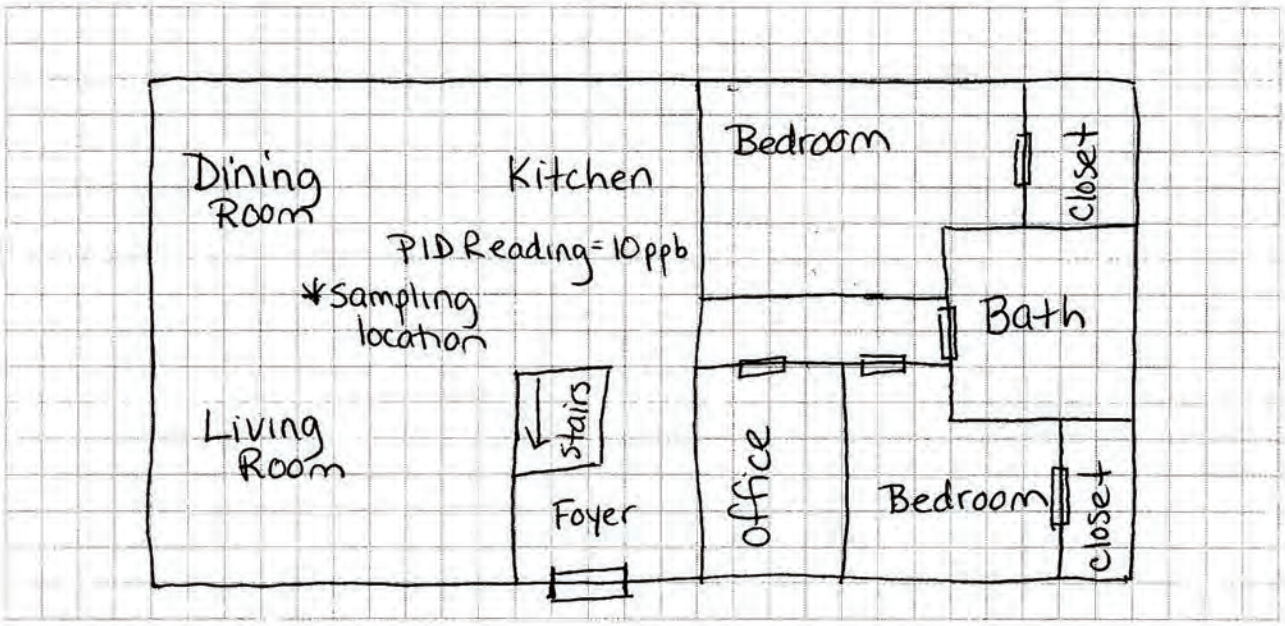
11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:



First Floor:

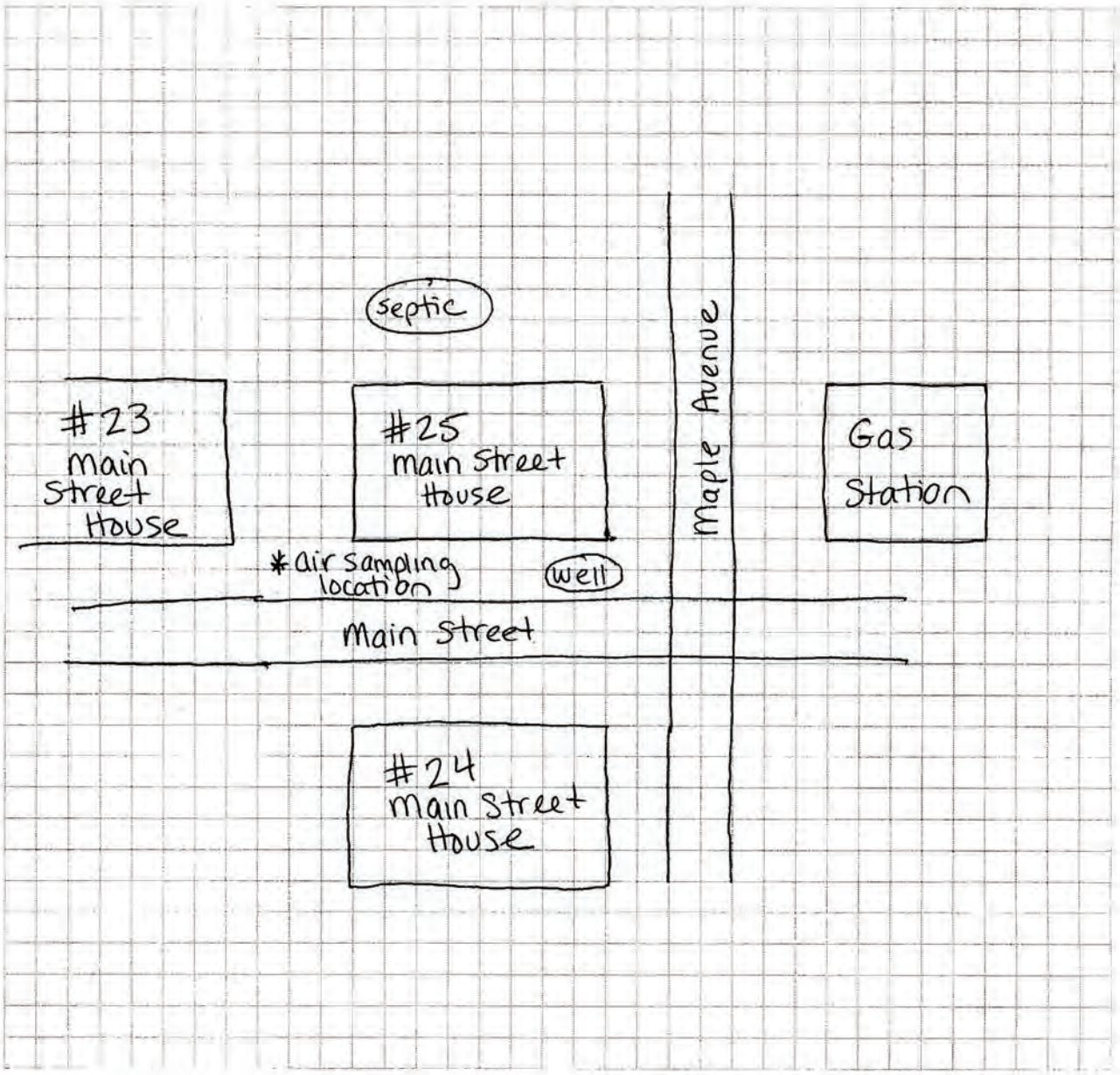


Example Correct 7

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.



N

Wind direction = NE

Example Correct

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: RAE photoionization detector

List specific products found in the residence that have the potential to affect indoor air quality.

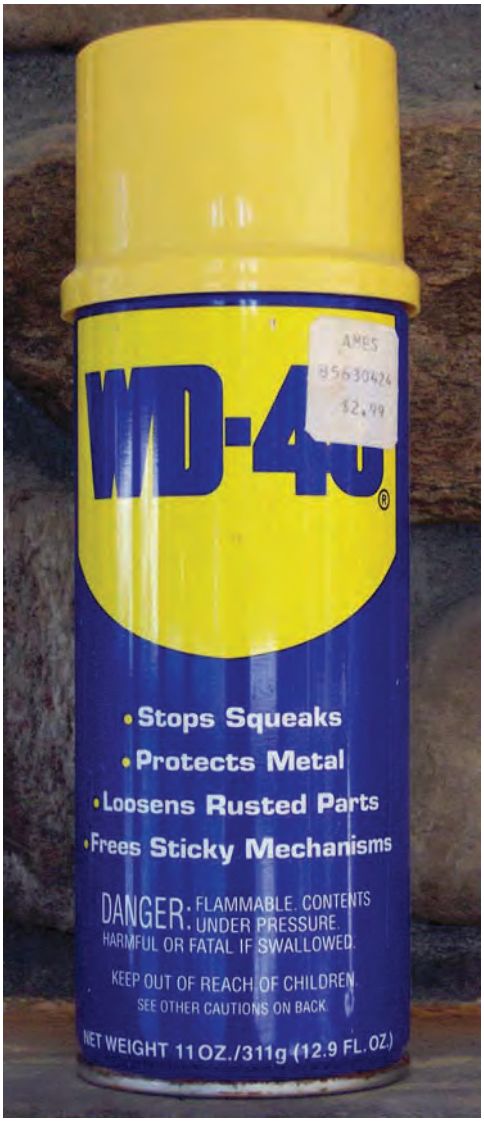
Location	Product Description	Size (oz.)	Condition*	Chemical Ingredients	Field Instrument Reading	Photo** Y / N
Kitchen	WD-40	12oz	UO	See photo	10 ppb	Y
garage	mineral spirits	24oz	U	benzene, toluene	15 ppb	N
garage	American Semi-Gloss latex paint	64oz	U	titanium dioxide, ethylene, glycol, aluminum hydroxide, 2,2,4-trimethyl 1-1,3-pentanediol isobutyrate, Vinyl acetate	2 ppb	N
garage	Krylon semi-gloss oil paint	64oz	D	butane, propane, titanium dioxide, xylene, ethylbenzene, acetone, MEK, butanol, MIK	10 ppb	N
garage	Rustoleum	12oz	U	talc, calcium carbonate, titanium dioxide, xylene, ethylbenzene, acetone, liquified petroleum gases, pentaerythritol	4 ppb	N
garage	Deep 6 Double Strength Insect Repellent	8oz	D	propane, isobutane, N,N-Diethyl-meta-toluamide	0.5 ppb	N
				Di-n-propyl isocinchomeronate		
base-ment	12 cans latex paint	128oz	U	talc, titanium dioxide, Kaolin clay, 2,24-trimethyl - 1,3 pentanediol isobutyrate, vinyl acetate	0	N

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**

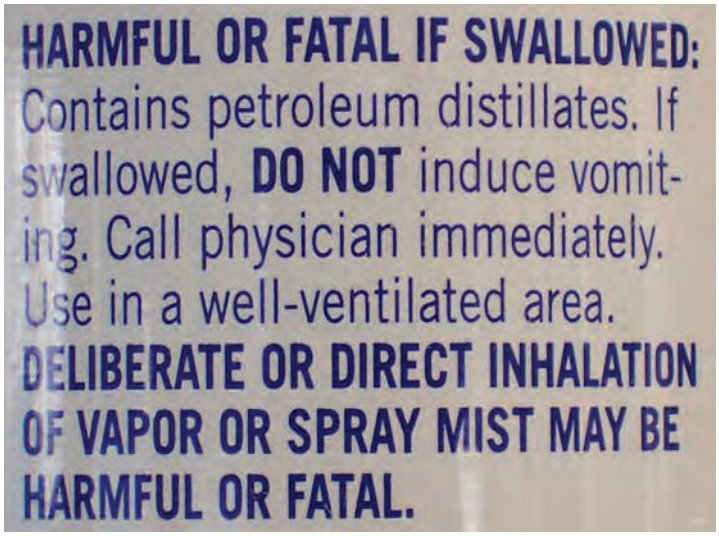
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Product Inventory Attachment — 25 Main Street, City

WD-40 FRONT



WD-40 INGREDIENTS



This page is intentionally blank.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix C

Volatile organic chemicals in air — summary of background databases

A detailed description of each background database introduced in Section 3.2.4 is provided in this appendix.

C.1 NYSDOH 2003: Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes

Between 1997 and 2003, the New York State Department of Health (NYSDOH) conducted a study of the occurrence of volatile organic chemicals (VOCs) in the indoor air of homes that heat with fuel oil. The purpose of the study was to characterize the indoor environment of fuel oil heated homes as a means of evaluating post clean-up conditions in residences affected by petroleum spills. The study included basement, living space and outdoor samples from 104 homes, tested during both heating and non-heating seasons. Most of the more than 600 samples collected in the study were analyzed for 69 individual VOCs. This summary report presents the results to help characterize commonly found concentrations of these 69 compounds in the indoor and outdoor air of residential settings heated with fuel oil.

The study is comprised of single family homes heated with fuel oil. With the exception of New York City, homes from across the state were included in the study, with the majority of the homes being near the Albany area. Prospective residences were required to have no past oil spills, no hobbies or home business that regularly use products containing VOCs, and no recent activities utilizing products that contain VOCs (e.g. painting, staining). A pre-sampling inspection was conducted in each home and included completing a building questionnaire to gather building information such as age, basement characteristics, heating and ventilation parameters, location of fuel oil tank, garage placement, etc. and an inventory of products that might be sources of indoor VOCs. When present, the products and their ingredients were listed on the inventory form. In addition, the product containers were screened with a photoionization detector (PID) to identify potential chemical interference during each sampling event and elevated readings were noted on the inventory forms. In most homes, gross sources of VOCs were not identified and containers were generally found to be sealed tightly. In some homes the PID detected elevated VOC levels associated with a product; however, the products were not removed and samples were still collected.

Sampling was performed in a manner consistent with the NYSDOH's February 1, 2005, Indoor Air Sampling and Analysis Guidance (available on the NYSDOH's web site at http://www.health.state.ny.us/nysdoh/indoor/guidance.htm). Two-hour samples were collected in 6-liter pre-cleaned, passivated, evacuated whole air canisters prepared and analyzed at the NYSDOH's Wadsworth Center laboratory. The samples were analyzed in accordance with EPA Method TO-15 utilizing a Tekmar® AutoCan® concentrator / Agilent® 6890/5973 GC/MSD analytical system. The method detection limits for all compounds except hexachlorobutadiene were 0.25 micrograms per cubic meter (mcg/m^3). The method detection limit for hexachlorobutadiene was 0.43 mcg/m^3.

The dataset exhibits a lognormal distribution typical of environmental data. Table C1 provides a summary of the indoor and outdoor air data. It contains the mean, 25^{th}, 50^{th},

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

75th, 90th percentile values and the upper fence value for each compound. The upper fence is calculated as 1.5 times the interquartile range (difference between the 25th and 75th percentile values) above the 75th percentile value. The upper fence is a boundary used for identifying the presence of outliers in the data. In cases where the 25th or 75th percentiles were below the laboratory detection limit of 0.25 mcg/m^3, randomly generated values between 0.000 and 0.250 were used in calculating the upper fence. All of the values calculated for the lower fence were negative and are not included in the table. For hexachlorobutadiene, the randomly generated values used to calculate the upper fence ranged from 0.000 to 0.430. All of the values are adjusted to two significant figures. A summary of the study can be obtained at the NYSDOH's web site: http://www.health.state.ny.us/nysdoh/indoor/fuel_oil.htm.

C.2 EPA 2001: Building Assessment and Survey Evaluation (BASE) Database

From 1994 through 1996, the EPA conducted a study of indoor air quality referred to as the Building Assessment and Survey Evaluation (BASE '94-'96). The study included measurement of VOCs, radon, formaldehyde, carbon monoxide, carbon dioxide, and particulates in indoor and outdoor air at 100 randomly selected public and commercial office buildings across the United States. Each building was sampled for a one-week period in either winter or summer. Buildings had a targeted occupancy of no less than 50 full-time employees and were served by no more than two air handling units. Physical characteristics of the buildings such as size, age, construction and heating and ventilation parameters were recorded. Ambient sources of VOCs were also characterized for the entire building and in the individual sample locations. The study excluded any buildings with highly publicized indoor air quality complaints; therefore, data from the study should be representative of conventional office buildings.

Two methods were used to measure VOC concentrations in the BASE study. Air samples were collected into passivated, evacuated whole air canisters (SUMMA®, TO-Can®, etc.) from all 100 buildings. In addition, air samples were concurrently collected on multisorbent tubes from 70 of the 100 buildings. Six-liter canister air samples were collected over a nominal nine-hour period and analyzed by gas chromatography/mass spectroscopy using EPA Method TO-14. The multisorbent tubes were filled with glass beads, Tenax TA, Ambersorb XE-340, and activated carbon and 2.5 liters of ambient air were collected over an eight-hour period. The tube samples were thermally desorbed and analyzed by gas chromatography/mass spectrometry using EPA Method TO-1. Method reporting limits ranged from 0.2 to 7.0 mcg/m^3.

BASE '94-'96 VOC data was received from the EPA in late 2001. Minimum, maximum, means and the 25th, 50th, 75th, 90th, 95th and 99th percentile values were calculated. For data analysis, all voided samples, blank samples, and samples that could not be analyzed were removed. The result for any sample or analyte that was marked as below the detection limit was assigned the value of one half the detection limit. Buildings in the BASE '94-'98 study generally had three indoor air VOC samples and one VOC outdoor sample for each method. Table C2 provides a summary of the indoor and outdoor air samples analyzed by SUMMA® canisters only. The table will be revised after EPA releases their final version of the study.

C.3 NYSDOH 1997: Control Home Database

From 1989-1996, the NYSDOH collected 228 indoor and outdoor air samples from 53 residences used as control homes in New York State investigations. Control homes were defined and selected to represent homes with neighborhood, construction, and occupancy similar to homes being investigated for VOC impacts on indoor air. Control homes also had no unusual source of VOCs, such as a past oil spill, recent refinishing or painting activities, or proximity to the VOC source being investigated.

Air samples in control homes were collected from the basement, a room considered a living space (such as a living room, dining room, or bedroom), and outdoors. An inventory of recent activities, stored household products and heating fuel type was made at the time of sampling. Air samples were collected by one of two methods: 6-liter pre-cleaned, passivated, evacuated whole air canisters (SUMMA®, TO-Can®, etc.), analyzed with Method TO-14 (EPA 1988), or Porapak adsorbent tubes, analyzed using NYSDOH method 311-6 (NYSDOH 1991). Through 1992, both methods were used about equally. After 1992, most samples were collected with Summa® canisters. About 20% of the samples were collected with a sampling time of 12 hours. The rest of the samples had sampling times of one to four hours. The NYSDOH Wadsworth Center Laboratories analyzed all samples.

The reporting limits for some compounds in samples from 1989 and 1990 were sometimes higher than 10 mcg/m^3. Analyses where compounds were reported as not detected with reporting limits greater than 10 mcg/m^3 were excluded from the database. In the 1990s reporting limits were lowered (due to improvements made in analytical equipment and methods) and some compounds were detected more frequently. Data from the later years of this study demonstrated that median levels of all compounds (except toluene) were less than 10 mcg/m^3.

The minimum, maximum, mean, median, 5th, 25th, 50th, 75th, 95th and 99th percentiles were calculated. To calculate these descriptive statistics, compounds not detected in the samples and compounds reported as present but less than the reporting limit were assigned a value equal to one half the reporting limit. Table C3 provides a summary of these data.

C.4 EPA 1988: National Ambient Volatile Organic Compounds (VOCs) Data Base Update

This database is a compilation of available air data published for the EPA in 1988. The document includes data from the original EPA database published in 1983 (Brodzinsky and Singh, 1983), which was an evaluation of 241 published reports from the years 1970 to 1980. Additional published and unpublished data for VOCs were also evaluated and included through 1987. The database covers the concentrations of more than 300 VOCs in outdoor (urban, rural, remote, source-dominated) and indoor settings. Indoor air data are limited to residential and office space, and excludes studies of emissions or sources, solely health-related studies, laboratory or modeling studies, and industrial workplace studies. Outdoor air data are limited to locations beyond the fence line of industrial and commercial facilities releasing VOCs.

Each data record includes maximum and minimum concentrations; the total number of measurements included in the average and the number of those that were below the detection limit or equal to zero. The 25th, 50th (median) and 75th percentiles were also calculated. Table C4 provides a summary of these data for a limited number of compounds reported in the publication.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

C.5 Health Effects Institute 2005: Relationship of Indoor, Outdoor and Personal Air

The Relationships of Indoor, Outdoor and Personal Air (RIOPA) study was designed to provide information in assessing the possible public health risks from air toxics and particulate matter in the urban environment for a large number of VOCs, carbonyl compounds and $PM_{2.5}$. The investigators measured indoor, outdoor and personal exposure concentrations of 16 VOCs, 10 carbonyls and PM during two 48-hour sampling periods in different seasons between the summer of 1999 and the spring of 2001. The study included 100 homes with 100 adult residents in each of three cities with different air pollution sources and weather conditions: Los Angeles, CA; Houston, TX; and Elizabeth, NJ. Children in each of the homes sampled were recruited to the best extent practical. Only 18 VOCs are summarized in this guidance document (Table C5). Refer to the original RIOPA report (Weisel *et al.*, 2005) for information about the carbonyl and particulate matter sampling and results.

The report (1) compares concentrations of the pollutants measured in indoor, outdoor and personal air, (2) examined the effects of city , season, type of home, and other variables on measured concentrations, and (3) quantified how much outdoor sources contributed to the indoor concentrations using measurements of outdoor-indoor air exchange rates.

All the VOC air samples were collected on 3M Brand Organic Vapor Monitor (OVM) badges. The badges are passive sampling devices that allow VOCs in air to pass through a diffusion membrane and are adsorbed onto carbon impregnated pads. A solvent is used to extract the VOCs from the pad and the extract is analyzed by gas chromatography/mass spectroscopy.

The published report provides descriptive summary statistics for all the tested compounds and parameters including: sample size, mean and standard deviation. Concentrations are also provided for the 1^{st}, 5^{th}, 50^{th} (median), 95^{th}, and 99^{th} percentile. Table C5 provides a summary of the indoor, outdoor, adult and child personal air data for 16 VOCs and 2 carbonyl compounds.

C.6 References

Brodzinsky, R., and H.B. Singh. 1983. "Volatile Organic Chemicals in the Atmosphere: an Assessment of Available Data" (EPA-600/3-83-027(A)). Environmental Sciences Research Laboratory, Research Triangle Park, NC.

New York State Department of Health. 1991. "Analytical Handbook. Method 311-6. Volatile Organics in Air by GC/PID/ELCD." Wadsworth Center for Laboratories and Research. Albany, NY.

New York State Department of Health. 1997. "Background Indoor/Outdoor Air Levels of Volatile Organic Compounds in Homes Sampled by the New York State Department of Health, 1989-1996." Bureau of Toxic Substance Assessment, Troy, NY.

United States Environmental Protection Agency. 1988. "Compendium Method TO-14. The Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Summa Passivated Canister Sampling and Chromatographic Analysis." Environmental Monitoring Systems Laboratory, Research Triangle Park, NC.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
United States Environmental Protection Agency. 2001. "Draft: A standard EPA protocol for characterizing indoor air quality in large buildings." Office of Air and Radiation, Washington, DC.

Weisel, C. P., J. Zhang, B. J. Turpin, M. T. Morandi, S. Colome, T. H. Stock, D. M. Spektor and Others. 2005. "Relationships of Indoor, Outdoor, and Personal Air (RIOPA)." Health Effects Institute, Boston, MA and National Urban Air Toxics Research Center, Houston, TX.

Table C1. NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR												
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max	Upper F
1,1,1-TRICHLOROETHANE	166	41.5%	400	2	<0.25	<0.25	0.3	1.1	3.1	6.9	41	110	2.5
1,1,2,2-TETRACHLOROETHANE	386	96.5%	400	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.8	2.7	0.4
1,1,2-TRICHLOROETHANE	384	96.0%	400	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1	6.2	0.4
1,1,2-TRICHLOROTRIFLUOROETHANE	178	44.5%	400	0.8	<0.25	<0.25	0.5	1.1	1.8	3.4	5.9	7.4	2.5
1,1-DICHLOROETHANE	396	99.0%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	4.4	0.4
1,1-DICHLOROETHENE	373	93.3%	400	1.4	<0.25	<0.25	<0.25	<0.25	<0.25	0.7	6.3	430	0.4
1,2,3-TRIMETHYLBENZENE	164	41.0%	400	1.2	<0.25	<0.25	0.4	1.1	2.7	5	11	37	2.5
1,2,4-TRICHLOROBENZENE	319	79.8%	400	1.3	<0.25	<0.25	<0.25	<0.25	3.4	6.3	26	37	0.5
1,2,4-TRIMETHYLBENZENE	49	12.3%	400	4.8	<0.25	0.7	1.9	4.3	9.5	18	35	260	9.8
1,2-DIBROMOETHANE	397	99.3%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1.1	0.4
1,2-DICHLOROBENZENE	315	78.8%	400	0.3	<0.25	<0.25	<0.25	<0.25	0.7	1	2.3	4.9	0.5
1,2-DICHLOROETHANE	394	98.5%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	4.9	0.4
1,2-DICHLOROPROPANE	391	97.8%	400	0.4	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	9	34	0.4
1,2-DICHLOROTETRAFLUOROETHANE	349	87.3%	400	1	<0.25	<0.25	<0.25	<0.25	0.5	1.2	23	120	0.4
1,3,5-TRIMETHYLBENZENE	100	25.0%	400	2	<0.25	0.3	0.6	1.7	3.6	6.5	25	97	3.9
1,3-DICHLOROBENZENE	316	79.0%	400	0.3	<0.25	<0.25	<0.25	<0.25	0.6	0.9	1.6	2.5	0.5
1,4-DICHLOROBENZENE	266	66.5%	400	3.7	<0.25	<0.25	<0.25	0.5	1.3	2.6	24	770	1.2
2,3-DIMETHYLPENTANE	129	32.3%	400	3.8	<0.25	<0.25	0.7	2.2	7.5	16	50	210	5.2
2,4-DIMETHYLPENTANE	143	35.8%	400	3.2	<0.25	<0.25	0.6	2	7.7	15	52	120	4.7
ACETONE	12	5.3%	227	42	<0.25	9.9	21	52	110	140	200	690	115
ALPHA-PINENE	79	19.8%	400	5.8	<0.25	0.3	1.5	4.4	14	27	63	91	10
BENZENE	28	7.0%	400	8.3	<0.25	1.1	2.1	5.9	15	29	120	460	13
BROMOMETHANE	308	77.0%	400	0.3	<0.25	<0.25	<0.25	<0.25	0.6	0.9	3.2	23	0.5
CARBON TETRACHLORIDE	201	50.3%	400	0.4	<0.25	<0.25	<0.25	0.6	0.8	1.1	3.2	4.2	1.3
CHLOROBENZENE	398	99.5%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.6	0.4
CHLOROETHANE	361	90.3%	400	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.6	0.9	4.5	0.4
CHLOROFORM	212	53.0%	400	0.9	<0.25	<0.25	<0.25	0.5	1.4	4.6	13	25	1.2
CHLOROMETHANE	184	46.0%	400	2	<0.25	<0.25	0.5	1.8	3.3	5.2	14	260	4.2
CIS-1,2-DICHLOROETHENE	364	91.0%	400	0.3	<0.25	<0.25	<0.25	<0.25	<0.25	1.2	4.6	7.4	0.4
CIS-1,3-DICHLOROPROPENE	388	97.0%	400	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	2.1	3.5	0.4
CYCLOHEPTANE	159	39.8%	400	1.2	<0.25	<0.25	0.5	1.3	3.1	5.1	11	23	2.9
CYCLOHEXANE	125	31.3%	400	6	<0.25	<0.25	0.8	2.6	8.1	19	88	510	6.3
DICHLORODIFLUOROMETHANE	215	53.8%	400	7.9	<0.25	<0.25	<0.25	4.1	15	26	180	300	10
d-LIMONENE	77	19.3%	400	8.9	<0.25	0.5	2.8	8.4	24	45	93	120	20
ETHYL ALCOHOL	3	1.3%	227	610	<0.25	27	160	540	1400	3000	6900	16000	1300
ETHYLBENZENE	58	14.5%	400	3.7	<0.25	0.4	1	2.8	7.3	13	26	340	6.4
ETHYLCYCLOHEXANE	149	37.3%	400	1.1	<0.25	<0.25	0.4	1.2	2.6	4.4	10	28	2.8

(Continued)

Table C1. NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR												
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max	Upper F
ETHYLMETHACRYLATE	215	94.7%	227	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.3	1	2.9	0.4
HEXACHLORO-1,3-BUTADIENE	304	76.0%	400	1.8	<0.25	<0.25	<0.25	<0.25	4.6	11	29	51	0.5
ISO-OCTANE	130	32.5%	400	5.5	<0.25	<0.25	0.6	2.1	6.5	14	63	870	5.0
ISOPRENE	44	11.0%	400	4.1	<0.25	0.8	2	4.3	8.8	15	43	81	9.5
ISOPROPYLBENZENE	259	64.8%	400	0.4	<0.25	<0.25	<0.25	0.4	0.9	1.3	2.7	27	0.8
M,P-XYLENE	54	13.5%	400	5.9	<0.25	0.5	1.5	4.6	12	21	46	550	11
METHYL ETHYL KETONE	20	8.8%	227	8.4	<0.25	1.4	3.4	7.3	16	39	79	180	16
METHYL ISOBUTYL KETONE	102	44.9%	227	1.2	<0.25	<0.25	0.3	0.9	2.2	5.3	16	36	1.9
METHYLCYCLOHEXANE	112	28.0%	400	4.9	<0.25	<0.25	0.7	1.9	6.4	12	32	620	4.5
METHYLENE CHLORIDE	89	22.3%	400	17	<0.25	0.3	1.4	6.6	22	45	310	2100	16
METHYLMETHACRYLATE	197	86.8%	227	0.6	<0.25	<0.25	<0.25	<0.25	0.4	1.1	5.3	66	0.4
METHYL-tert-BUTYL ETHER	69	30.4%	227	13	<0.25	<0.25	0.8	5.6	26	71	230	340	14
n-BUTYLBENZENE	222	55.5%	400	0.6	<0.25	<0.25	<0.25	0.5	1.2	2.1	4.9	33	1.1
n-DECANE	40	10.0%	400	7.7	<0.25	1.2	2.7	6.6	16	31	83	190	15
n-DODECANE	73	18.3%	400	5.6	<0.25	0.4	1.5	3.9	11	19	61	420	9.2
n-HEPTANE	19	4.8%	400	9.7	<0.25	1	2.8	7.6	19	33	72	670	18
n-HEXANE	50	12.5%	400	9.5	<0.25	0.6	1.6	5.9	18	35	93	950	14
n-NONANE	65	16.3%	400	3.8	<0.25	0.4	1.3	3.4	8.8	13	50	89	7.9
n-OCTANE	84	21.0%	400	1.9	<0.25	0.3	0.9	2.3	4.2	5.5	16	80	5.2
n-PROPYLBENZENE	206	51.5%	400	0.8	<0.25	<0.25	<0.25	0.7	1.7	2.8	8.2	41	1.5
n-UNDECANE	59	14.8%	400	5.4	<0.25	0.6	1.8	5	12	20	61	290	12
O-XYLENE	71	17.8%	400	3.8	<0.25	0.4	1.1	3.1	7.6	13	32	310	7.1
sec-BUTYLBENZENE	225	56.3%	400	0.5	<0.25	<0.25	<0.25	0.6	1.2	1.7	4.1	11	1.2
STYRENE	175	43.8%	400	0.8	<0.25	<0.25	0.3	0.6	1.3	2.3	6.2	50	1.4
tert-BUTYLBENZENE	228	57.0%	400	0.7	<0.25	<0.25	<0.25	0.6	1.6	2.8	5.3	36	1.3
TETRACHLOROETHENE	187	46.8%	400	1.3	<0.25	<0.25	0.3	1.1	2.9	4.1	20	51	2.5
TETRAHYDROFURAN	164	72.2%	227	2.1	<0.25	<0.25	<0.25	0.4	3.3	9.4	19	180	0.8
TOLUENE	25	6.3%	400	26	<0.25	3.5	9.6	25	58	110	300	510	57
TRANS-1,3-DICHLOROPROPENE	400	100.0%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
TRICHLOROETHENE	323	80.8%	400	0.4	<0.25	<0.25	<0.25	<0.25	0.5	0.8	7.4	25	0.5
TRICHLOROFLUOROMETHANE	42	10.5%	400	7.5	<0.25	1.1	2.9	5.4	17	30	95	190	12
VINYL CHLORIDE	387	96.8%	400	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.8	1	0.4

(Continued)

Table C1. NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR												
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max	Upper F
1,1,1-TRICHLOROETHANE	125	62.5%	200	0.3	<0.25	<0.25	<0.25	0.3	0.6	0.7	3.8	8.4	0.6
1,1,2,2-TETRACHLOROETHANE	199	99.5%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.5	0.4
1,1,2-TRICHLOROETHANE	199	99.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	6.3	0.3
1,1,2-TRICHLOROTRIFLUOROETHANE	97	48.5%	200	0.9	<0.25	<0.25	0.5	1.1	1.9	3.6	6	11	2.5
1,1-DICHLOROETHANE	200	100.0%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
1,1-DICHLOROETHENE	199	99.5%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1	0.4
1,2,3-TRIMETHYLBENZENE	165	82.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.4	0.6	1.4	2.5	0.5
1,2,4-TRICHLOROBENZENE	168	84.0%	200	0.8	<0.25	<0.25	<0.25	<0.25	2.3	4.8	12	21	0.4
1,2,4-TRIMETHYLBENZENE	109	54.5%	200	0.9	<0.25	<0.25	<0.25	0.8	1.7	2.5	8.2	50	1.9
1,2-DIBROMOETHANE	199	99.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	8.2	0.4
1,2-DICHLOROBENZENE	166	83.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.6	0.9	1.6	6.1	0.4
1,2-DICHLOROETHANE	199	99.5%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.3	0.4
1,2-DICHLOROPROPANE	194	97.0%	200	0.4	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	11	22	0.4
1,2-DICHLOROTETRAFLUOROETHANE	169	84.5%	200	0.3	<0.25	<0.25	<0.25	<0.25	0.6	1.3	2.4	4.5	0.5
1,3,5-TRIMETHYLBENZENE	143	71.5%	200	0.3	<0.25	<0.25	<0.25	0.3	0.7	1	2.4	2.5	0.7
1,3-DICHLOROBENZENE	170	85.0%	200	0.3	<0.25	<0.25	<0.25	<0.25	0.5	0.7	1.6	10	0.4
1,4-DICHLOROBENZENE	164	82.0%	200	0.3	<0.25	<0.25	<0.25	<0.25	0.5	0.8	1.8	7.1	0.5
2,3-DIMETHYLPENTANE	147	73.5%	200	0.5	<0.25	<0.25	<0.25	0.3	1	2	8.6	13	0.7
2,4-DIMETHYLPENTANE	139	69.5%	200	0.7	<0.25	<0.25	<0.25	0.4	0.8	1.8	14	43	0.8
ACETONE	7	6.1%	114	16	<0.25	3.4	6.4	14	44	58	170	200	30
ALPHA-PINENE	122	61.0%	200	0.9	<0.25	<0.25	<0.25	0.5	2	3.8	12	18	1.2
BENZENE	18	9.0%	200	1.9	<0.25	0.6	1.3	2.2	4.3	5.8	13	17	4.8
BROMOMETHANE	162	81.0%	200	0.4	<0.25	<0.25	<0.25	<0.25	0.5	0.9	3.1	27	0.5
CARBON TETRACHLORIDE	108	54.0%	200	0.4	<0.25	<0.25	<0.25	0.6	0.8	1	3.3	3.6	1.2
CHLOROBENZENE	200	100.0%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
CHLOROETHANE	188	94.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	0.7	1.4	0.4
CHLOROFORM	168	84.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.4	0.5	0.8	1.3	0.5
CHLOROMETHANE	96	48.0%	200	1.3	<0.25	<0.25	0.5	1.8	3.2	4.6	7.6	13	4.3
CIS-1,2-DICHLOROETHENE	193	96.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1.8	2.7	0.4
CIS-1,3-DICHLOROPROPENE	195	97.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	2.4	3.3	0.4
CYCLOHEPTANE	148	74.0%	200	0.4	<0.25	<0.25	<0.25	0.3	0.7	1.1	4.8	12	0.6
CYCLOHEXANE	137	68.5%	200	1.5	<0.25	<0.25	<0.25	0.4	1.3	3	16	170	0.9
DICHLORODIFLUOROMETHANE	108	54.0%	200	2.8	<0.25	<0.25	<0.25	4.2	7.5	11	23	38	10
d-LIMONENE	155	77.9%	199	1	<0.25	<0.25	<0.25	<0.25	0.8	1.5	24	83	0.5
ETHYL ALCOHOL	1	0.9%	114	35	<0.25	3.3	6.9	16	31	220	610	930	34
ETHYLBENZENE	107	53.5%	200	0.8	<0.25	<0.25	<0.25	0.5	1.1	1.9	19	21	1.0
ETHYLCYCLOHEXANE	164	82.0%	200	0.4	<0.25	<0.25	<0.25	<0.25	0.5	1	5.7	14	0.5

(Continued)

Table C1. NYSDOH 2003: Study of volatile organic chemicals in air of fuel oil heated homes -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR												
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max	Upper F
ETHYLMETHACRYLATE	114	100.0%	114	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
HEXACHLORO-1,3-BUTADIENE	162	81.0%	200	1.2	<0.25	<0.25	<0.25	<0.25	2.3	7	20	27	0.5
ISO-OCTANE	139	69.5%	200	0.5	<0.25	<0.25	<0.25	0.3	0.9	2	7.5	11	0.7
ISOPRENE	111	55.5%	200	1.1	<0.25	<0.25	<0.25	0.9	2.8	4.6	13	21	2.0
ISOPROPYLBENZENE	182	91.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	0.7	0.9	0.4
M,P-XYLENE	110	55.0%	200	0.8	<0.25	<0.25	<0.25	0.5	1.4	3.1	17	20	1.0
METHYL ETHYL KETONE	8	7.0%	114	6.2	<0.25	0.8	1.3	2.6	6.3	17	180	210	5.3
METHYL ISOBUTYL KETONE	86	75.4%	114	0.8	<0.25	<0.25	<0.25	<0.25	0.9	2.9	21	24	0.5
METHYLCYCLOHEXANE	141	70.5%	200	0.5	<0.25	<0.25	<0.25	0.3	0.8	1.6	4.7	23	0.7
METHYLENE CHLORIDE	101	50.5%	200	0.8	<0.25	<0.25	<0.25	0.7	1.6	2.9	12	23	1.6
METHYLMETHACRYLATE	110	96.5%	114	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1.5	2.4	0.4
n-BUTYLBENZENE	53	46.5%	114	1	<0.25	<0.25	0.3	0.9	2.1	5.9	10	14	1.9
n-DECANE	174	87.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.3	0.4	1.2	8.8	0.4
n-DODECANE	65	32.5%	200	1.3	<0.25	<0.25	0.8	2	2.6	3.6	8.5	20	4.7
n-HEPTANE	94	47.0%	200	2.2	<0.25	<0.25	0.5	1.9	4.5	7.6	27	89	4.5
n-HEXANE	57	28.5%	200	1.5	<0.25	<0.25	0.5	1	2.6	5.1	20	67	2.2
n-NONANE	79	39.5%	200	1.1	<0.25	<0.25	0.4	0.9	1.6	3.6	19	26	2.0
n-OCTANE	131	65.5%	200	0.4	<0.25	<0.25	<0.25	0.4	0.8	1.2	5.1	13	0.7
n-PROPYLBENZENE	112	56.0%	200	1	<0.25	<0.25	<0.25	0.7	1.2	2.1	8.6	90	1.5
n-UNDECANE	184	92.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	0.5	2	8	0.4
O-XYLENE	105	52.5%	200	0.6	<0.25	<0.25	<0.25	0.7	1.7	2.3	5.8	6.8	1.5
O-XYLENE	120	60.0%	200	0.7	<0.25	<0.25	<0.25	0.6	1.7	2.5	8.9	10	1.2
sec-BUTYLBENZENE	160	80.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.4	0.5	1.2	3.8	0.5
STYRENE	158	79.0%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.4	0.6	2.3	3.6	0.5
tert-BUTYLBENZENE	177	88.5%	200	0.4	<0.25	<0.25	<0.25	<0.25	0.3	0.6	2.9	31	0.4
TETRACHLOROETHENE	143	71.5%	200	0.6	<0.25	<0.25	<0.25	0.3	0.8	1.6	12	20	0.7
TETRAHYDROFURAN	108	94.7%	114	0.3	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	4	8.5	0.4
TOLUENE	12	6.0%	200	11	<0.25	0.6	1.3	2.4	5.9	21	350	640	5.1
TRANS-1,3-DICHLOROPROPENE	200	100.0%	200	0.1	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	NC
TRICHLOROETHENE	177	88.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	0.3	0.5	1	1.3	0.4
TRICHLOROFLUOROMETHANE	70	35.0%	200	1.7	<0.25	<0.25	0.8	2.2	3.6	6.1	17	20	5.1
VINYL CHLORIDE	197	98.5%	200	0.2	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.4	4.8	0.4

ND = Number of non-detects

ND (%) = Percentage of total number in sample that are non-detect

N = Total number of samples

* Non-detects were estimated at 1/2 the detection limit to calculate the mean

Min; Max = minimum and maximum value detected

Upper F = Upper Fence = The upper fence is calculated as 1.5 times the interquartile range (difference between the 25th and 75th percentile values) above the 75th percentile value.

NC = Upper Fence not calculated. Compound not detected in any sample.

Table C2. EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
1,1,1-TRICHLOROETHANE	7	2.3%	298	16.2	<0.5	2.6	5.1	10.8	20.6	33.0	737.9	833.2
1,1,2-TRICHLOROETHANE	136	100.0%	136	0.6	<0.6	<1.0	<1.3	<1.4	<1.5	<1.6	<2.1	<2.3
1,1-DICHLOROETHANE	136	100.0%	136	0.2	<0.2	<0.4	<0.5	<0.5	<0.7	<0.8	<0.9	<0.9
1,1-DICHLOROETHENE	136	100.0%	136	0.5	<0.7	<0.9	<1.1	<1.2	<1.4	<1.6	<1.7	<1.8
1,2,4-TRICHLOROBENZENE	136	100.0%	136	1.1	<0.6	<0.9	<1.0	<1.2	<6.8	<7.2	<8.1	<8.2
1,2,4-TRIMETHYLBENZENE	52	17.7%	294	4.8	<0.4	1.7	2.8	5.1	9.5	13.7	39.0	91.0
1,2-DIBROMOETHANE	258	99.6%	259	0.6	<0.8	<1.1	<1.3	<1.4	<1.5	<1.6	<2.7	1.4
1,2-DICHLOROBENZENE	255	98.5%	259	0.6	<0.6	<0.8	<0.9	<1.0	<1.2	<1.3	10.5	11.2
1,2-DICHLOROETHANE	254	98.1%	259	0.9	<0.4	<0.5	<0.6	<0.7	<0.9	<1.0	24.8	84.9
1,2-DICHLOROPROPANE	136	100.0%	136	0.6	<0.5	<1.0	<1.4	<1.6	<1.6	<1.7	<2.3	<2.6
1,3,5-TRIMETHYLBENZENE	206	79.5%	259	1.6	<0.8	<1.3	<1.5	<4.6	3.7	4.6	9.0	16.6
1,3-BUTADIENE	39	100.0%	39	1.4	<2.1	<2.3	<2.5	<2.7	<3.0	<7.5	<7.9	<7.9
1,3-DICHLOROBENZENE	136	100.0%	136	0.6	<0.5	<0.7	<0.8	<1.1	<2.4	<2.5	<2.8	<2.9
1,4-DICHLOROBENZENE	212	71.1%	298	3.1	<0.5	<0.8	<1.2	1.4	5.5	12.5	80.5	87.1
1-BUTANOL	118	95.9%	123	42.7	<2.4	<3.6	<4.0	<4.3	<4.8	<7.9	35.3	4957.4
2-BUTANONE (MEK)	13	5.0%	259	6.2	<1.4	3.3	5.2	7.5	12.0	13.5	28.1	55.4
2-BUTOXYETHANOL	123	100.0%	123	4.0	<4.8	<7.2	<8.0	<8.6	<9.3	<10.4	<16.4	<16.8
2-ETHYL-1-HEXANOL	160	98.8%	162	3.2	<1.1	<5.0	<7.6	<8.4	<9.2	<9.7	8.2	8.4
2-METHYL-1-PROPANOL	30	76.9%	39	1.2	<0.9	<1.0	<1.1	<3.0	3.1	5.5	5.8	5.8
2-PROPANOL	8	20.5%	39	73.1	<1.3	6.6	30.0	56.0	250.0	475.0	580.0	580.0
3-METHYL PENTANE	125	48.3%	259	3.1	<0.9	<1.7	1.4	4.2	6.5	8.3	22.9	35.4
4-ETHYLTOLUENE	212	81.9%	259	1.7	<0.9	<1.5	<1.6	<3.1	3.6	5.9	9.8	16.4
4-METHYL-2-PENTANONE	153	59.1%	259	3.1	<0.7	<1.2	<1.5	3.0	6.0	8.1	58.4	72.5
ACETONE	0	0.0%	259	54.0	11.6	32.4	45.0	59.8	98.9	120.2	226.6	243.7
a-PINENE	238	79.9%	298	4.2	<0.5	<1.1	<1.2	<2.8	3.6	6.4	67.8	399.1
BENZENE	56	19.0%	294	4.5	<0.8	2.1	3.4	5.1	9.4	12.5	25.0	63.0
BENZYL CHLORIDE	136	100.0%	136	1.2	<0.8	<1.2	<1.4	<1.7	<6.8	<7.2	<8.1	<8.2
BROMOMETHANE	246	95.0%	259	0.6	<0.6	<0.8	<0.9	<1.1	<1.7	<2.1	3.6	4.6
BUTYL ACETATE	232	77.9%	298	2.9	<0.9	<1.5	<1.8	<5.2	4.5	15.8	35.3	50.6
CARBON DISULFIDE	134	51.7%	259	1.9	<0.5	<0.8	<1.3	2.1	4.2	6.4	14.8	24.5
CARBON TETRACHLORIDE	241	93.1%	259	0.5	<0.5	<0.8	<0.9	<1.1	<1.3	0.7	0.9	2.1
CHLOROBENZENE	255	98.5%	259	0.4	<0.4	<0.6	<0.7	<0.8	<0.9	<1.0	1.0	1.2
CHLOROETHANE	254	98.1%	259	1.1	<0.6	<0.8	<0.9	<1.0	<1.1	<1.3	47.9	56.7
CHLOROFORM	203	78.4%	259	0.5	<0.3	<0.4	<0.5	<1.2	1.1	1.4	4.8	12.1
CHLOROMETHANE	2	0.8%	259	2.9	<0.7	2.1	2.5	3.1	3.7	4.4	12.3	21.8
CIS-1,2-DICHLOROETHENE	136	100.0%	136	0.6	<0.6	<0.8	<1.0	<1.2	<1.9	<2.0	<2.2	<2.3

(Continued)

Table C2. EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
CIS-1,3-DICHLOROPROPENE	136	100.0%	136	0.9	<1.2	<1.7	<1.9	<2.0	<2.3	<2.5	<2.9	<3.2
DICHLORODIFLUOROMETHANE	18	6.9%	259	13.8	<4.8	4.8	6.7	10.5	16.5	32.9	81.3	942.3
DICHLOROTETRAFLUOROETHANE	136	100.0%	136	1.6	<1.5	<2.2	<2.5	<3.0	<6.8	<7.4	<8.2	<11.3
DIMETHYL DISULFIDE	239	92.3%	259	2.0	<1.4	<2.1	<2.4	<2.7	<3.7	3.6	32.4	70.4
d-LIMONENE	74	24.8%	298	10.8	<0.7	2.5	5.3	11.3	22.5	43.7	136.7	148.0
DODECANE	107	35.9%	298	8.2	<1.7	<4.5	5.4	9.6	15.9	22.0	92.8	110.0
ETHANOL	3	7.7%	39	89.3	<1.2	26.0	79.0	140.0	210.0	290.0	300.0	300.0
ETHYL ACETATE	163	54.7%	298	3.0	<0.6	<1.0	<2.6	3.2	5.4	9.5	59.0	64.2
ETHYLBENZENE	144	49.0%	294	2.8	<0.9	<1.6	1.4	3.4	5.7	7.6	18.5	73.6
HEXACHLOROBUTADIENE	136	100.0%	136	1.5	<1.3	<1.8	<2.1	<2.5	<6.8	<7.2	<8.1	<8.2
HEXANAL	78	63.4%	123	6.8	<2.5	<3.9	<4.6	7.8	12.0	14.7	26.2	235.1
m & p-XYLENES	53	18.0%	294	10.8	<1.5	4.1	6.9	12.2	22.2	28.5	67.6	260.8
METHYL TERTIARY-BUTYL ETHER	198	76.4%	259	3.3	<1.0	<1.5	<1.7	<6.4	11.5	16.1	30.8	34.0
METHYLENE CHLORIDE	94	31.5%	298	21.2	<1.1	<1.7	2.9	5.0	10.0	16.0	1155.6	1496.9
NAPHTHALENE	254	85.8%	296	6.6	<1.4	<2.2	<2.5	<5.2	5.1	20.9	98.0	410.0
n-DECANE	58	19.5%	298	7.4	<0.7	3.0	4.6	8.4	17.5	22.4	48.6	54.8
n-HEPTANAL	36	92.3%	39	1.7	<1.2	<1.3	<1.5	<1.6	<3.6	3.1	34.9	34.9
n-HEXANE	26	16.0%	162	6.3	<.9	1.6	3.1	6.4	10.2	15.2	120.0	130.0
NONANAL	146	90.1%	162	6.8	<1.6	<5.1	<7.8	<8.6	<16.8	30.2	88.9	106.3
NONANE	101	39.0%	259	3.7	<0.5	<1.0	1.7	3.6	7.8	12.4	45.2	53.8
n-UNDECANE	25	9.7%	259	12.6	<1.1	5.1	8.9	16.4	22.6	27.4	68.7	169.6
OCTANE	155	52.0%	298	5.5	<0.4	<0.8	<2.5	2.0	4.5	8.6	47.9	921.7
o-XYLENE	81	27.6%	294	3.8	<0.7	<2.4	2.4	4.4	7.9	11.2	20.1	90.5
PENTANAL	111	90.2%	123	3.0	<2.4	<3.7	<4.1	<4.6	<7.3	7.0	20.0	57.3
STYRENE	251	85.4%	294	1.5	<0.6	<1.6	<1.8	<2.3	1.9	4.3	15.0	40.0
TETRACHLOROETHENE	103	34.6%	298	6.0	<0.9	<1.9	3.0	5.9	15.9	25.4	55.6	65.7
TOLUENE	0	0.0%	294	25.1	3.5	10.7	15.7	25.9	43.0	70.8	348.9	390.3
TRANS-1,3-DICHLOROPROPENE	136	100.0%	136	0.5	<0.5	<0.8	<1.1	<1.2	<1.3	<1.3	<1.8	<2.0
TRICHLOROETHENE	216	72.5%	298	2.6	<0.6	<1.2	<1.4	1.2	4.2	6.5	57.0	88.5
TRICHLOROFLUOROMETHANE	107	35.9%	298	19.4	<1.7	<3.7	3.9	6.7	18.1	54.0	860.6	1015.3
TRICHLOROTRIFLUOROETHANE	217	83.8%	259	2.0	<1.1	<1.7	<1.9	<3.0	3.5	9.4	19.7	30.9
VINYL CHLORIDE	257	99.2%	259	0.5	<0.6	<0.8	<0.9	<1.0	<1.9	<2.2	<2.6	7.5

(Continued)

Table C2. EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
1,1,1-TRICHLOROETHANE	40	40.0%	100	1.3	<0.4	<0.6	0.8	1.7	2.6	3.8	8.4	8.7
1,1,2-TRICHLOROETHANE	46	100.0%	46	0.6	<0.6	<1.0	<1.2	<1.4	<1.6	<1.6	<1.8	<1.8
1,1-DICHLOROETHANE	46	100.0%	46	0.2	<0.4	<0.4	<0.4	<0.6	<0.6	<0.8	<0.8	<0.8
1,1-DICHLOROETHENE	46	100.0%	46	0.5	<0.8	<1.0	<1.0	<1.2	<1.4	<1.4	<1.6	<1.6
1,2,4-TRICHLOROBENZENE	46	100.0%	46	1.1	<0.6	<0.8	<1.0	<1.2	<6.4	<6.6	<7.8	<7.8
1,2,4-TRIMETHYLBENZENE	30	30.0%	100	2.6	<0.4	<1.6	1.8	3.1	5.8	7.1	19.1	24.2
1,2-DIBROMOETHANE	87	100.0%	87	0.6	<0.8	<1.2	<1.2	<1.4	<1.6	<1.6	<2.0	<2.0
1,2-DICHLOROBENZENE	86	98.9%	87	0.4	<0.6	<0.8	<1.0	<1.0	<1.2	<1.2	1.1	1.1
1,2-DICHLOROETHANE	86	98.9%	87	0.3	<0.4	<0.6	<0.6	<0.6	<0.8	<1.0	0.8	0.8
1,2-DICHLOROPROPANE	46	100.0%	46	0.6	<0.6	<1.2	<1.4	<1.6	<1.6	<1.8	<1.8	<1.8
1,3,5-TRIMETHYLBENZENE	69	79.3%	87	1.2	<0.8	<1.2	<1.4	<2.4	2.7	3.3	8.9	8.9
1,3-BUTADIENE	13	100.0%	13	1.5	<2.2	<2.4	<2.6	<2.8	<3.4	<7.6	<7.6	<7.6
1,3-DICHLOROBENZENE	46	100.0%	46	0.5	<0.6	<0.8	<0.8	<1.0	<2.2	<2.4	<2.8	<2.8
1,4-DICHLOROBENZENE	88	88.0%	100	0.7	<0.6	<0.8	<0.8	<1.4	1.2	1.7	5.4	6.1
1-BUTANOL	41	100.0%	41	2.0	<2.4	<3.4	<4.0	<4.4	<4.8	<5.2	<6.0	<6.0
2-BUTANONE (MEK)	5	5.7%	87	5.2	<1.2	2.2	3.7	5.7	11.3	14.8	43.1	43.1
2-BUTOXYETHANOL	41	100.0%	41	3.9	<4.6	<7.0	<8.0	<8.6	<9.6	<10.4	<11.8	<11.8
2-ETHYL-1-HEXANOL	53	98.1%	54	3.2	<1.2	<4.6	<7.2	<8.4	<9.6	<10.8	5.9	5.9
2-METHYL-1-PROPANOL	13	100.0%	13	0.6	<0.8	<1.0	<1.0	<1.2	<1.4	<3.0	<3.0	<3.0
2-PROPANOL	4	30.8%	13	6.4	<3.0	<4.2	4.7	6.6	16.5	23.5	23.5	23.5
3-METHYL PENTANE	55	63.2%	87	1.8	<1.0	<1.4	<1.6	2.0	4.4	6.6	10.5	10.5
4-ETHYLTOLUENE	75	86.2%	87	1.2	<1.0	<1.4	<1.6	<2.0	3.0	3.3	8.0	8.0
4-METHYL-2-PENTANONE	61	70.1%	87	1.3	<0.8	<1.0	<1.2	0.9	1.9	4.3	21.0	21.0
ACETONE	1	1.1%	87	26.5	<1.8	15.4	22.5	31.7	43.7	56.0	104.2	104.2
a-PINENE	92	92.0%	100	1.0	<0.6	<1.0	<1.2	<1.4	<6.2	3.7	6.8	8.1
BENZENE	22	22.0%	100	3.2	<1.2	1.2	2.7	3.7	6.6	9.6	12.6	13.0
BENZYL CHLORIDE	46	100.0%	46	1.2	<1.0	<1.2	<1.4	<1.6	<6.4	<6.6	<7.8	<7.8
BROMOMETHANE	82	94.3%	87	0.6	<0.6	<0.8	<1.0	<1.0	<1.6	1.0	4.5	4.5
BUTYL ACETATE	94	94.0%	100	1.4	<0.8	<1.4	<1.6	<1.8	<5.8	3.3	18.6	32.7
CARBON DISULFIDE	39	44.8%	87	2.1	<0.6	<0.8	0.9	2.2	3.7	8.3	22.0	22.0
CARBON TETRACHLORIDE	69	79.3%	87	0.5	<0.6	<0.8	<1.0	<1.0	0.7	0.7	1.5	1.5
CHLOROBENZENE	85	97.7%	87	0.4	<0.4	<0.6	<0.8	<0.8	<0.8	<1.0	1.1	1.1
CHLOROETHANE	84	96.6%	87	0.5	<0.6	<0.8	<0.9	<1.0	<1.2	<1.2	3.5	3.5
CHLOROFORM	77	88.5%	87	0.5	<0.2	<0.4	<0.4	<0.6	0.6	0.7	13.8	13.8
CHLOROMETHANE	0	0.0%	87	2.6	0.9	2.0	2.3	3.0	3.7	4.0	10.6	10.6
CIS-1,2-DICHLOROETHENE	45	97.8%	46	0.5	<0.6	<0.8	<1.0	<1.2	<1.8	<1.8	1.1	1.1

(Continued)

Table C2. EPA 2001: Building assessment and survey evaluation (BASE) database, SUMMA® canister method -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
CIS-1,3-DICHLOROPROPENE	46	100.0%	46	0.9	<1.4	<1.6	<1.8	<2.0	<2.2	<2.4	<2.6	<2.6
DICHLORODIFLUOROMETHANE	7	8.0%	87	7.3	<4.4	3.8	4.4	5.8	8.1	12.2	183.7	183.7
DICHLOROTETRAFLUOROETHANE	46	100.0%	46	1.6	<1.6	<2.2	<2.4	<3.0	<6.4	<6.6	<7.8	<7.8
DIMETHYL DISULFIDE	74	85.1%	87	1.7	<1.4	<2.0	<2.4	<2.8	2.4	4.5	16.4	16.4
d-LIMONENE	73	73.0%	100	1.5	<0.8	<1.0	<1.4	2.0	3.6	4.1	9.8	12.5
DODECANE	51	51.0%	100	4.6	<2.0	<2.6	<4.0	4.2	10.4	14.1	51.0	52.3
ETHANOL	0	0.0%	13	32.0	3.8	13.0	24.5	47.0	57.0	82.5	82.5	82.5
ETHYL ACETATE	89	89.0%	100	0.7	<0.6	<0.8	<1.0	<1.2	1.5	1.9	3.7	3.9
ETHYLBENZENE	59	59.0%	100	1.4	<0.8	<1.4	<1.8	1.6	3.5	4.3	7.6	7.8
HEXACHLOROBUTADIENE	46	100.0%	46	1.4	<1.4	<1.8	<2.0	<2.6	<6.4	<6.6	<7.8	<7.8
HEXANAL	30	73.2%	41	3.1	<2.4	<3.8	<4.2	2.7	3.3	3.8	36.0	36.0
m & p-XYLENES	26	26.0%	100	5.6	<1.4	<3.6	4.4	7.3	12.8	16.1	24.8	26.8
METHYL TERTIARY-BUTYL ETHER	67	77.0%	87	2.7	<1.0	<1.4	<1.8	<5.4	6.2	13.3	36.0	36.0
METHYLENE CHLORIDE	43	43.0%	100	3.7	<1.0	<1.8	1.3	3.0	6.1	10.3	63.0	78.5
NAPHTHALENE	86	86.0%	100	10.6	<1.4	<2.0	<2.4	<4.8	4.9	15.1	379.8	670.0
n-DECANE	35	35.0%	100	3.7	<0.6	<2.0	2.4	4.2	7.6	11.4	32.4	37.3
n-HEPTANAL	10	76.9%	13	3.0	<1.2	<1.5	<1.8	<2.2	2.2	26.8	26.8	26.8
n-HEXANE	16	29.6%	54	2.5	<.8	<1.2	1.4	2.7	6.4	11.4	15.3	15.3
NONANAL	41	75.9%	54	8.6	<1.6	<6.0	<7.8	<10.8	22.7	37.6	57.0	57.0
NONANE	49	56.3%	87	1.3	<0.4	<0.8	<1.0	1.7	2.8	4.0	15.3	15.3
n-UNDECANE	13	14.9%	87	7.0	<1.0	2.6	3.9	7.8	14.8	19.7	94.8	94.8
OCTANE	73	73.0%	100	0.9	<0.4	<0.6	<0.8	1.0	1.6	1.9	11.9	17.5
o-XYLENE	36	36.0%	100	2.0	<0.6	<1.4	1.4	2.6	4.6	6.0	9.6	11.1
PENTANAL	37	90.2%	41	3.5	<2.4	<3.4	<4.0	<4.4	<6.0	7.0	52.7	52.7
STYRENE	83	83.0%	100	1.7	<0.6	<1.4	<1.6	<2.0	1.3	3.6	34.1	58.0
TETRACHLOROETHENE	51	51.0%	100	2.7	<0.8	<1.4	<2.0	3.0	6.5	10.4	24.8	27.6
TOLUENE	0	0.0%	100	15.4	2.1	5.9	9.6	16.3	33.7	49.2	86.5	93.1
TRANS-1,3-DICHLOROPROPENE	46	100.0%	46	0.5	<0.6	<0.8	<1.0	<1.2	<1.4	<1.4	<1.4	<1.4
TRICHLOROETHENE	81	81.0%	100	1.0	<0.6	<1.0	<1.5	<1.6	1.3	2.6	11.2	13.5
TRICHLOROFLUOROMETHANE	41	41.0%	100	3.6	<2.0	<2.8	1.7	2.8	4.3	5.6	71.1	132.5
TRICHLOROTRIFLUOROETHANE	75	86.2%	87	1.0	<1.2	<1.6	<1.8	<2.0	1.6	1.8	5.4	5.4
VINYL CHLORIDE	87	100.0%	87	0.5	<0.6	<0.8	<1.0	<1.0	<1.8	<2.0	<2.6	<2.6

ND = Number of non-detects

ND (%) = Percentage of total number in sample that are non-detect

N = Total number of samples

* Non-detects were estimated at 1/2 the appropriate detection limit or quantification limit to calculate the mean

Min; Max = minimum and maximum value detected

Table C3. NYSDOH 1997: Control home database

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
1,1,1,2-TETRACHLOROETHANE	22	100.0	22	4.7727	<5	<10	<10	<10	<10	<10	<10	<10
1,1,1-TRICHLOROETHANE	51	38.3	133	9.17	<1	<5	4.5	6.7	14	29	180	197
1,1,2,2-TETRACHLOROETHANE	83	98.8	84	1.86	<1	<1.3	<1.6	<8.5	<10	<10	5	5
1,1,2-TRICHLOROETHANE	83	100.0	83	1.72	<1	<1	<1	<9	<10	<10	<10	<10
1,1,2-TRICHLOROTRIFLUOROETHANE (FREON-113)	45	100.0	45	0.95	<1	<1	<1	<1	<7.8	<7.8	<7.8	<7.8
1,1-DICHLOROETHANE	65	100.0	65	2.11	<1	<1	<1	<10	<10	<10	<10	<10
1,1-DICHLOROETHENE	41	100.0	41	0.68	<1	<1	<1	<1	<1	<1	<9	<9
1,1-DICHLOROPROPENE	22	100.0	22	4.77	<5	<10	<10	<10	<10	<10	<10	<10
1,2,3-TRICHLOROBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
1,2,4-TRICHLOROBENZENE	65	100.0	65	2.32	<1.6	<1.6	<1.6	<10	<10	<10	<10	<10
1,2,4-TRIMETHYLBENZENE	31	47.7	65	6.28	<1	<4.4	5	7	14	20	43	43
1,2-DIBROMOETHANE (EDB)	39	100.0	39	0.80	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
1,2-DICHLOROBENZENE	90	100.0	90	2.02	<1.6	<1.6	<2	<6	<10	<10	<10	<10
1,2-DICHLOROETHANE	63	100.0	63	2.11	<1	<1	<1	<10	<10	<10	<10	<10
1,2-DICHLOROPROPANE	63	100.0	63	2.11	<1	<1	<1	<10	<10	<10	<10	<10
1,2-DICHLOROTETRAFLUOROETHANE	39	100.0	39	0.80	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
1,3,5-TRIMETHYLBENZENE	45	69.2	65	2.99	<1	<1	<5	5	5	5	14	14
1,3-DICHLOROBENZENE	86	95.6	90	2.10	<1.6	<1.6	<2	<8	<10	<10	5	5
1,4-DICHLOROBENZENE	77	85.6	90	9.23	<1.6	<1.6	<2	<10	5	5.1	425	425
4-ISOPROPYLTOLUENE (p-Cymene)	22	84.6	26	6.25	<5	<10	<10	<10	12	13	27	27
BENZENE	69	47.9	144	4.64	<1	<3.2	2.5	5	11	14	37	50
BENZYL CHLORIDE	39	100.0	39	0.50	<1	<1	<1	<1	<1	<1	<1	<1
BROMOBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
BROMODICHLOROMETHANE	44	97.8	45	2.67	<0.6	<0.6	<5	<10	<10	<10	5	5
BROMOFORM	43	100.0	43	2.69	<1	<1	<5	<10	<10	<10	<10	<10
BROMOMETHANE	38	97.4	39	0.64	<1	<1	<1	<1	<1	<1	6	6
CARBON TETRACHLORIDE	113	85.6	132	2.17	<0.6	<1.6	<3.2	<6.2	5	5	5	5
CHLOROBENZENE	90	100.0	90	2.00	<1	<1	<2	<10	<10	<10	<10	<10
CHLOROETHANE	51	100.0	51	0.50	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROFORM	104	83.9	124	2.81	<1	<1	<4.8	<8.8	5	5	17	44
CHLOROMETHANE	63	79.7	79	1.08	<1	<1	<1	<2.6	2.5	2.7	4.5	4.5
CIS-1,2-DICHLOROETHENE	63	100.0	63	2.04	<1	<1	<1	<10	<10	<10	<10	<10
CIS-1,3-DICHLOROPROPENE	84	100.0	84	2.21	<1	<1	<5	<8.5	<10	<10	<10	<10
CYCLOPROPYLBENZENE	4	100.0	4	3.63	<5	<5.5	<7	<9	<10	<10	<10	<10

(Continued)

Table C3. NYSDOH 1997: Control home database -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	INDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
DIBROMOCHLOROMETHANE	45	100.0	45	2.66	<0.6	<0.6	<5	<10	<10	<10	<10	<10
DICHLORODIFLUOROMETHANE (FREON-12)	45	100.0	45	0.77	<1	<1	<1	<1	<5	<5	<5	<5
ETHYLBENZENE	83	63.4	131	3.21	<1	<3.4	<4.4	4.8	5	6.5	15	23
HEXACHLOROBUTADIENE (C-46)	43	100.0	43	1.24	<2	<2	<2	<2	<2	<6	<10	<10
HEXANE	51	63.8	80	3.75	<0.8	<1	<3.6	3.6	6.6	15	50	50
ISOPROPYLBENZENE (Cumene)	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
M-CHLOROTOLUENE	4	100.0	4	3.63	<5	<5.5	<7	<9	<10	<10	<10	<10
M/P-XYLENE	56	43.4	129	7.43	<1	<4.4	5	9.5	16	21	64	90
METHYLENE CHLORIDE (DICHLOROMETHANE)	76	56.3	135	13.28	<1	<3	<7	5.6	23	45	240	292
N-BUTYLBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
N-PROPYLBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	<10	<10	<10	<10
NAPHTHALENE	45	88.2	51	4.07	<2	<2	<10	<10	5	12	18	18
O-CHLOROTOLUENE	24	100.0	24	4.75	<5	<10	<10	<10	<10	<10	<10	<10
O-XYLENE	80	55.6	144	3.71	<1	<3.8	<5.2	5	6.4	7.9	18	25
P-CHLOROTOLUENE	24	100.0	24	4.75	<5	<10	<10	<10	<10	<10	<10	<10
SEC-BUTYLBENZENE	25	96.2	26	4.94	<5	<10	<10	<10	<10	<10	14	14
STYRENE	62	95.4	65	2.21	<1	<1	<1	<10	<10	<10	5	5
TERT-BUTYLBENZENE	26	100.0	26	4.60	<5	<10	<10	<10	5	5	5	5
TETRACHLOROETHENE	103	74.6	138	4.78	<0.6	<1.6	<3.8	<10	5.5	9.7	77	103
TOLUENE	16	11.0	146	18.52	<1	6.5	13	25	39	46	95	170
TRANS-1,2-DICHLOROETHENE	26	100.0	26	4.52	<4	<10	<10	<10	<10	<10	<10	<10
TRANS-1,3-DICHLOROPROPENE	84	100.0	84	2.21	<1	<1	<5	<8.5	<10	<10	<10	<10
TRICHLOROETHENE	116	92.8	125	2.17	<0.6	<1	<2.8	<5.4	<10	5	7.5	13
TRICHLOROFLUOROMETHANE (FREON-11)	40	70.2	57	2.08	<1	<1	<1	3.8	5.6	5.9	7.5	7.5
VINYL CHLORIDE	47	100.0	47	0.70	<0.6	<1	<1	<1	<2.6	<5	<5	<5

(Continued)

Table C3. NYSDOH 1997: Control home database -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
1,1,1,2-TETRACHLOROETHANE	10	100.0	10	4.75	<5	<10	<10	<10	<10	<10	<10	<10
1,1,1-TRICHLOROETHANE	45	68.2	66	2.93	<1	<2	<5.1	2.8	5	6.7	27	27
1,1,2,2-TETRACHLOROETHANE	41	100.0	41	1.75	<1	<1	<1.6	<5	<10	<10	<10	<10
1,1,2-TRICHLOROETHANE	41	100.0	41	1.61	<1	<1	<1	<5	<10	<10	<10	<10
1,1,2-TRICHLOROTRIFLUOROETHANE (FREON-113)	22	100.0	22	0.96	<1	<1	<1	<1	<7.8	<7.8	<7.8	<7.8
1,1-DICHLOROETHANE	31	100.0	31	2.02	<1	<1	<1	<10	<10	<10	<10	<10
1,1-DICHLOROETHENE	20	100.0	20	0.65	<1	<1	<1	<1	<1	<4	<7	<7
1,1-DICHLOROPROPENE	10	100.0	10	4.75	<5	<10	<10	<10	<10	<10	<10	<10
1,2,3-TRICHLOROBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
1,2,4-TRICHLOROBENZENE	32	100.0	32	2.33	<1.6	<1.6	<1.6	<10	<10	<10	<10	<10
1,2,4-TRIMETHYLBENZENE	29	90.6	32	2.24	<1	<1	<1.5	<10	<10	5	5	5
1,2-DIBROMOETHANE (EDB)	19	100.0	19	0.80	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
1,2-DICHLOROBENZENE	44	100.0	44	2.00	<1.6	<1.6	<2	<7	<10	<10	<10	<10
1,2-DICHLOROETHANE	30	100.0	30	2.02	<1	<1	<1	<10	<10	<10	<10	<10
1,2-DICHLOROPROPANE	30	100.0	30	2.02	<1	<1	<1	<10	<10	<10	<10	<10
1,2-DICHLOROTETRAFLUOROETHANE	19	100.0	19	0.80	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
1,3,5-TRIMETHYLBENZENE	31	96.9	32	2.17	<1	<1	<1	<10	<10	<10	5	5
1,3-DICHLOROBENZENE	44	100.0	44	2.00	<1.6	<1.6	<2	<7	<10	<10	<10	<10
1,4-DICHLOROBENZENE	44	100.0	44	2.00	<1.6	<1.6	<2	<7	<10	<10	<10	<10
4-ISOPROPYLTOLUENE (p-Cymene)	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
BENZENE	51	71.8	71	6.97	<1	<1.6	<3.2	5	6.6	8	242	242
BENZYL CHLORIDE	19	100.0	19	0.50	<1	<1	<1	<1	<1	<1	<1	<1
BROMOBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
BROMODICHLOROMETHANE	22	100.0	22	2.47	<0.6	<0.6	<2.8	<10	<10	<10	<10	<10
BROMOFORM	21	100.0	21	2.52	<1	<1	<1	<10	<10	<10	<10	<10
BROMOMETHANE	19	100.0	19	0.50	<1	<1	<1	<1	<1	<1	<1	<1
CARBON TETRACHLORIDE	55	84.6	65	2.25	<1.2	<1.6	<3.2	<6.2	5	5	5	5
CHLOROBENZENE	44	100.0	44	1.93	<1	<1	<2	<9	<10	<10	<10	<10
CHLOROETHANE	21	100.0	21	0.50	<1	<1	<1	<1	<1	<1	<1	<1
CHLOROFORM	66	100.0	66	1.90	<1	<1	<2.4	<4.8	<10	<10	<10	<10
CHLOROMETHANE	34	75.6	45	1.08	<1	<1	<2	<2.8	2.2	2.6	3.1	3.1
CIS-1,2-DICHLOROETHENE	30	100.0	30	1.97	<1	<1	<1	<10	<10	<10	<10	<10
CIS-1,3-DICHLOROPROPENE	41	100.0	41	2.15	<1	<1	<5	<5	<10	<10	<10	<10
CYCLOPROPYLBENZENE	3	100.0	3	4.00	<6	<6	<8	<10	<10	<10	<10	<10

(Continued)

Table C3. NYSDOH 1997: Control home database -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	OUTDOOR AIR											
	ND	ND(%)	N	Mean*	Min	25th	Median	75th	90th	95th	99th	Max
DIBROMOCHLOROMETHANE	22	100.0	22	2.47	<0.6	<0.6	<2.8	<10	<10	<10	<10	<10
DICHLORODIFLUOROMETHANE (FREON-12)	22	100.0	22	0.77	<1	<1	<1	<1	<5	<5	<5	<5
ETHYLBENZENE	63	91.3	69	2.16	<1	<1	<4.4	<5	<10	5	6.5	6.5
HEXACHLOROBUTADIENE (C-46)	22	100.0	22	1.41	<2	<2	<2	<2	<6	<8	<10	<10
HEXANE	38	86.4	44	1.79	<0.8	<1	<3.3	<3.6	3.7	5.8	9.2	9.2
ISOPROPYLBENZENE (Cumene)	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
M-CHLOROTOLUENE	3	100.0	3	4.00	<6	<6	<8	<10	<10	<10	<10	<10
M/P-XYLENE	52	76.5	68	3.63	<1	<1.4	<4.4	<10	9	13	19	19
METHYLENE CHLORIDE (DICHLOROMETHANE)	55	82.1	67	2.91	<0.8	<1	<3.4	<7.6	5	12	22	22
N-BUTYLBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
N-PROPYLBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
NAPHTHALENE	24	96.0	25	3.18	<2	<2	<7	<10	<10	<10	5	5
O-CHLOROTOLUENE	12	100.0	12	4.71	<5	<10	<10	<10	<10	<10	<10	<10
O-XYLENE	59	83.1	71	2.59	<1	<1	<4.4	<10	5.1	7.2	10	10
P-CHLOROTOLUENE	12	100.0	12	4.71	<5	<10	<10	<10	<10	<10	<10	<10
SEC-BUTYLBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
STYRENE	32	100.0	32	2.16	<1	<1	<1	<10	<10	<10	<10	<10
TERT-BUTYLBENZENE	13	100.0	13	4.58	<5	<10	<10	<10	<10	<10	<10	<10
TETRACHLOROETHENE	60	87.0	69	2.59	<0.6	<1.6	<3.8	<6.8	5	5	16	16
TOLUENE	41	57.7	71	8.47	<1	<2	<5.6	6.1	21	58	93	93
TRANS-1,2-DICHLOROETHENE	12	100.0	12	4.42	<4	<8.5	<10	<10	<10	<10	<10	<10
TRANS-1,3-DICHLOROPROPENE	41	100.0	41	2.15	<1	<1	<5	<5	<10	<10	<10	<10
TRICHLOROETHENE	63	94.0	67	2.09	<0.6	<1	<3.4	<5.4	<10	5	11	11
TRICHLOROFLUOROMETHANE (FREON-11)	22	91.7	24	1.07	<1	<1	<1	<1	<5.6	3.9	3.9	3.9
VINYL CHLORIDE	23	100.0	23	0.70	<0.6	<1	<1	<1	<2.6	<5	<5	<5

ND = Number of non-detects

ND (%) = Percentage of total number in sample that are non-detect

N = Total number of samples

* Non-detects were estimated at 1/2 the detection limit to calculate the mean

Min; Max = minimum and maximum value detected

Table C4. EPA 1988: National ambient volatile organic compounds (VOCs) data base update

All results are micrograms per cubic meter (mcg/m^3).

Compound	Indoor Air					Outdoor Air				
	N	Mean	25th	50th	75th	N	Mean	25th	50th	75th
acetaldehyde	0					175	9.2	0	2.3	9.8
acetone	4	19	11	20	27	17	16	0	2.2	6.7
benzene	2128	16	3.3	10	21	5411	8.9	2	5.3	11
benzyl chloride	0					43	0.07	0.02	0.04	0.09
bromobenzene	0					26	1.4	0	0.15	1.1
bromodichloromethane	2120	0.05	0	0	0	495	0.01	0	0	0
bromoform	2120	0	0	0	0	496	0	0	0	0
bromomethane	0					358	12	0.18	0.7	12
butane	0					888	33	12	21	34
2-butanone (MEK)	4	27	12	21	42	280	1.9	0	0	0
n-butylbenzene	0					52	0.27	0	0	0
sec-butylbenzene	0					433	2.7	0.14	0.24	0.48
carbon disulfide	0					29	0.3	0.12	0.13	0.5
carbon tetrachloride	2120	2.5	0	0	0.83	4913	1	0.43	0.76	0.81
chlorobenzene	2126	0.19	0	0	0	1491	1.5	0	0.28	1.4
chloroethane	0					190	220	0.06	0.17	1.7
chloroform	2120	4.1	0	0.51	3.4	3658	3.1	0.05	0.28	0.88
chloromethane	0					706	1.5	1.3	1.3	1.5
o-chlorotoluene	0					309	0.59	0.05	0.21	0.67
p-chlorotoluene	0					310	1.1	0.1	0.47	1.5
dibromochloromethane	2120	0	0	0	0	510	0.27	0	0	0
1,2-dibromoethane (EDB)	585	0.008	0	0	0	1980	2.5	0	0	0.08
1,2-dichlorobenzene	2121	0.44	0	0	0	1052	7.8	0	0	0.23
1,3-dichlorobenzene	2121	24	0.32	1.7	5.6	646	5.3	0	0.18	1.2
1,4-dichlorobenzene	2121	24	0.32	1.7	5.6	947	6	0	0.25	1.2
dichlorodifluoromethane (Freon 12)	0					1080	2.2	1.6	1.7	1.7
1,1-dichloroethane	0					145	0.16	0	0.04	0.2
1,2-dichloroethane	2120	0.38	0	0	0	2044	1.6	0	0	0.22
1,1-dichloroethene	2120	79	0	0	0	1275	18	0	0	0
cis-1,2-dichloroethene	0					161	1.3	0	0.15	0.45
trans-1,2-dichloroethene	0					2	3	2.2	3	3.7
1,2-dichloropropane	0					714	0.74	0.05	0.1	0.3
cis-1,3-dichloropropene	0					148	110	34	110	160
1,2-dichlorotetrafluoroethane	2					171	0.31	0.16	0.21	0.27

(Continued)

Table C4. EPA 1988: National ambient volatile organic compounds (VOCs) data base update -- Continued

All results are micrograms per cubic meter (mcg/m^3).

Compound	Indoor Air					Outdoor Air				
	N	Mean	25th	50th	75th	N	Mean	25th	50th	75th
ethylbenzene	2278	13	2	4.8	9.6	2669	20	1	2.6	5.4
formaldehyde	315	60	23	51	88	629	10	2.3	5	12
heptane	4	5.2	4.5	5	6	1064	6.6	1.4	3.2	2.5
hexachlorobutadiene (C-46)	0					72	0.38	0.01	0.03	0.06
hexane	3	2	0	2	4	894	13	2.9	5.8	10
isopropylbenzene (cumene)	103	0.84	0	0	0.84	14	0	0	0	0
4-isopropyltoluene (p-cymene)	0					132	4	0.44	2.2	5
methane	0					244	1400	1050	1080	1410
methylene chloride (dichloromethane)	0					798	5.6	1.1	2.7	6.3
naphthalene	0					67	5.2	0.2	1.2	5.7
pentane	4	3.3	1.3	2.6	5.3	886	20	5.8	11	18
n-propylbenzene	1	0.64	0	0	0	758	1	0.39	0.79	1.3
styrene	2125	6	0	1.3	2.8	1123	1.5	0	0.51	1.4
1,1,1,2-tetrachloroethane	585	0.02	0	0	0	308	0.15	0	0	0.02
1,1,2,2-tetrachloroethane	585	0.1	0	0	0	1011	0.7	0	0	0.06
tetrachloroethene	2195	21	1.7	5	11	3226	5.8	0.82	2.4	5.9
toluene	101	0	0	32	0	4074	32	0.6	7.1	20
1,2,4-trichlorobenzene	0					18	1.3	0.74	0.74	1.5
1,1,1-trichloroethane	2120	270	3	10	30	2982	5	0.7	0.89	3.3
1,1,2-trichloroethane	0					886	6	0	0	0.14
trichloroethene	2132	7.2	0	0.67	4.5	3021	2.7	0.05	0.85	2.5
trichlorofluoromethane (Freon 11)	0					1507	1.4	1.1	1.1	1.2
1,1,2-trichlorotrifluoroethane (Freon 113)	0					184	2.7	0.46	1	2.5
1,2,4-trimethylbenzene	96	2.8	0.6	1.4	4	1018	6.7	2.8	4.6	7.4
1,3,5-trimethylbenzene	178	4.5	0	1.4	5.4	585	4	0.2	1	2.5
2,2,4-trimethylpentane	0					200	9.3	1	2	4.8
vinyl chloride	0					701	32	0	0	0.78
m-xylene	103	39	4.8	16	38	3146	50	2.5	6.1	14
o-xylene	2216	12	2	4.8	9.3	3592	33	1	3	6.5
p-xylene	2305	38	6.4	14	25	3518	46	2.3	6.8	14
m/p-xylenes (weighted)			4.3		18			2		11

N - Total number of samples

Table C5. Health Effects Institute 2005: Indoor, outdoor and personal air (RIOPA) data

All results are micrograms per cubic meter (mcg/m^3).

Compound	Indoor Air							Outdoor Air						
	N	Mean	Percentiles					N	Mean	Percentiles				
			Median (50th)	1st	5th	95th	99th			Median (50th)	1st	5th	95th	99th
Acetone	398	14	8.25	0.2	1.12	45.8	128	395	9.75	4.39	0.2	0.2	19.6	55.3
Acrolein (2-propenal)	398	1.71	0.62	0.07	0.07	5.27	14.8	395	6.28	0.47	0.06	0.07	4.6	11.9
a-Pinene	554	4.87	1.22	0.04	0.07	18.1	78.6	555	0.89	0.32	0.04	0.07	1.9	16.5
Benzene	554	3.5	2.19	0.48	0.48	10	36.4	555	2.15	1.68	0.41	0.48	5.16	11.1
b-Pinene	554	4.8	1.47	0.12	0.18	20.4	62.2	555	0.53	0.18	0.1	0.12	1.43	7.35
Carbon Tetrachloride	554	0.71	0.62	0.13	0.27	1.1	2.03	555	0.71	0.64	0.13	0.34	1.0	1.58
Chloroform	554	1.86	92	0.11	0.17	6.34	14.8	554	0.32	0.17	0.08	0.09	0.76	2.35
d-Limonene	554	31	9.67	1.1	1.27	103	273	555	2.39	1.27	0.24	0.28	6.54	37.8
Ethyl Benzene	554	2.52	1.46	0.32	0.36	7.62	26.7	555	1.29	0.93	0.15	0.3	3.04	7.05
m- & p-Xylene	554	7.33	4.07	0.25	0.7	22.2	75.2	555	3.57	2.49	0.25	0.53	10	19.1
Methylene Chloride	554	2.31	0.84	0.04	0.11	7.5	33.7	555	0.95	0.84	0.04	0.07	2.46	9.32
MTBE	553	11.8	5.98	0.44	44	36	196	555	8.1	5.32	0.43	0.44	22.1	22.1
o-Xylene	554	2.48	1.46	0.17	0.36	7.24	22.6	555	1.48	0.96	0.1	0.17	3.23	7.17
p-Dichlorobenzene	554	68.9	1.44	0.19	0.29	344	1790	555	2.25	0.72	0.09	0.19	3.66	18.3
Styrene	554	1.41	0.5	0.11	0.16	5.13	23.5	555	0.48	0.17	0.07	0.11	1.29	4.15
Tetrachloroethylene	554	1.81	0.56	0.1	0.11	6.01	20.9	555	1.0	0.56	0.09	0.11	3.17	7.75
Toluene	554	15.4	10.1	2.83	3.02	39.8	122	555	7.09	5.42	1.3	2.82	19.6	32
Trichloroethylene	554	0.46	0.12	0.04	0.05	1.36	7.84	555	0.3	0.12	0.04	0.05	0.79	1.9

Compound	Adult Personal Air							Child Personal Air						
	N	Mean	Percentiles					N	Mean	Percentiles				
			Median (50th)	1st	5th	95th	99th			Median (50th)	1st	5th	95th	99th
Acetone	409	25.9	8.36	0.2	1.74	57.7	700	169	29.1	11.5	1.41	4.25	81	759
Acrolein (2-propenal)	409	12.9	0.51	0.07	0.07	5.12	11.2	169	10.9	0.87	0.06	0.07	8.04	504
a-Pinene	544	4.21	1.21	0.05	0.07	17.6	39.4	209	3.48	1.42	0.06	0.08	15.3	25.4
Benzene	545	3.64	2.39	0.48	0.48	10.7	27.4	209	4.16	2.79	0.36	0.48	12	43.6
b-Pinene	545	5.48	1.65	0.11	0.18	22.4	72.4	209	5.32	2.85	0.18	0.18	18.2	29.8
Carbon Tetrachloride	545	0.79	0.61	0.13	0.27	1.08	2.0	209	0.56	0.56	0.13	0.21	0.83	0.97
Chloroform	542	4.2	1.04	0.14	0.17	6.34	17.4	209	2.03	1.14	0.14	0.17	7.47	7.47
d-Limonene	545	41.2	11.8	1.27	1.27	112	287	209	32.1	17.4	1.27	1.27	111	168
Ethyl Benzene	545	2.79	1.68	0.36	0.36	7.48	28.8	209	3.34	1.95	0.3	0.36	10.3	54.2
m- & p-Xylene	545	8.07	4.42	0.25	0.93	22.7	75.2	209	8.87	5.15	0.43	1.38	28.2	63.1
Methylene Chloride	545	3.04	0.84	0.04	0.13	7.39	32.9	209	1.66	0.69	0.04	0.06	5.25	16.7
MTBE	544	14.8	7.14	0.44	0.94	42.7	129	209	11.7	7.03	0.44	0.56	30.2	193
o-Xylene	545	2.89	1.73	0.17	0.47	8.14	23	209	2.91	1.96	0.11	0.52	7.97	22.2
p-Dichlorobenzene	545	56.7	1.88	0.18	0.35	314	1480	209	122	4.18	0.27	0.44	979	1460
Styrene	545	1.51	0.57	0.13	0.17	5.51	21.4	209	1.69	0.67	0.14	0.16	6.89	30.6
Tetrachloroethylene	545	7.14	0.61	0.1	0.13	7.21	57.4	209	2.81	0.56	0.09	0.12	7.34	81.8
Toluene	545	19.2	12.2	2.81	3.02	50.2	138	209	18.4	12.2	1.44	2.94	57.2	220
Trichloroethylene	545	3.64	0.13	0.04	0.05	1.88	13.3	209	0.31	0.12	0.04	0.04	0.89	7.08

N - Total number of samples

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix D

NYSDOH guidelines for chemicals in air — development overview

As discussed in Section 3.2.5, the NYSDOH has developed several guidelines for chemicals in air. An overview of how the NYSDOH develops guidelines is provided in this appendix.

In general, the development of air guidelines starts with **toxicity assessment** and **exposure assessment**. In toxicity assessment, the scientific data on the toxicity and pharmacokinetics (i.e., the processes of absorption, distribution, metabolism and excretion) of a contaminant are evaluated to understand a chemical's potential for causing a health effect. In exposure assessment, scientific data are evaluated to determine the amount of air an individual breathes on a daily basis and how frequently and how long an individual may be exposed to a contaminant in air. Criteria based on cancer effects are generally expressed as the air concentration associated with a specific, excess lifetime cancer risk. Criteria based on non-cancer effects are generally expressed as a reference concentration, which is an air concentration that is expected to be without an appreciable risk of non-cancer health effects. These quantitative criteria are not, in themselves, guidelines or standards. They are based solely on data and scientific judgments on the relationship between the level of contaminant in air and health risk, and do not reflect consideration of other factors, such as whether the concentration can be measured or whether the concentration is above background.

The first two steps of the toxicity assessment are

1. Hazard Identification: What are the known or potential human health effects of an air contaminant? and
2. Dose-Response Assessment: What is the potency (strength) of the contaminant to cause each type of known or potential human health effect?

All the relevant data are evaluated and summarized and a weight-of-evidence analysis is used to make these determinations. These determinations are then used to estimate numerical criteria (cancer risks and reference concentrations).

These estimations are carried out under the premises that

a. studies on effects in animals can be used to estimate the likelihood of effects in humans and
b. studies of effects of high exposure levels in humans or animals can be used to estimate the effects of low exposure levels.

Uncertainties present in these estimations include the following:

a. whether or not animals are good surrogates for humans,
b. whether or not the dose-response data provide reliable data on the critical effect and its lowest dose,
c. whether or not all critical effects have been identified (no data gaps), and
d. whether or not the methods used to extrapolate from the animals to humans and from high to low doses provide plausible estimates of risk at low doses.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

In an exposure assessment for air, information is used that describes how much contaminated air a person may breathe each day. Estimations are also made about how frequently and how long people are exposed. The NYSDOH air guidelines are based on the assumption that people are continuously exposed to a contaminant in air all day, every day for as long as a lifetime.

The degree of confidence in the hazard identification and dose-response assessment is then summarized as part of the risk characterization (the last step in the risk assessment process), which describes the nature, strength of evidence, and the likelihood of adverse health effects from particular exposures.

Once criteria are derived, air guidelines are generally set using a combination of risk assessment and risk management considerations. Guidelines should be health protective; thus, the starting point in the derivation of a guideline are the criteria based on the non-cancer and cancer effects of the chemical. However, the guideline is not necessarily one of the criteria. Other factors such as uncertainties in the toxicity and exposure information, information on the nature and extent of contamination, duration of potential exposure, other sources of contaminant exposures, analytical detection limits, and background concentrations are also considered.

The following two documents are included in this appendix to illustrate the development of a guideline:

- **TCE air guideline:** NYSDOH letter from N. Kim to D. Desnoyers, Division of Environmental Remediation, NYSDEC (October 31, 2003)
- **PCE air guideline:** Tetrachloroethene Health Effects. November 6, 1991. Appendix 1 of the Tetrachloroethene Ambient Air Criteria Document. Final Report. October 1997. Albany, NY: Bureau of Toxic Substance Assessment, Center for Environmental Health, New York State Department of Health.

For additional information on NYSDOH guidelines and criteria for these and other volatile chemicals in air (Section 3), please contact the NYSDOH's Bureau of Toxic Substance Assessment by calling 1-800-458-1158, or by emailing BTSA@health.state.ny.us, or by writing to the following address:

New York State Department of Health
Bureau of Toxic Substance Assessment
Flanigan Square, 547 River Street
Troy, NY 12180-2216

STATE OF NEW YORK
DEPARTMENT OF HEALTH

Flanigan Square, 547 River Street, Troy, New York 12180-2216

Antonia C. Novello, M.D., M.P.H., Dr.P.H.
Commissioner

Dennis P. Whalen
Executive Deputy Commissioner

October 31, 2003

Dale Desnoyers, Director
Division of Environmental Remediation
NYS Department of Environmental Conservation
625 Broadway
Albany, NY 12233-1080

Dear Mr. Desnoyers:

The New York State Department of Health has derived an air guideline for trichloroethene. Trichloroethene (TCE or trichloroethylene; CAS number 79-01-6) is a chemical commonly found in the environment, including the air (outdoor and indoor) that people breathe. This letter summarizes the important toxicological and epidemiological data we used to evaluate the potential health risks associated with exposure to TCE in air. We have followed the procedures outlined by the National Academy of Sciences and federal agencies such as the United States Environmental Protection Agency (US EPA), the United States Food and Drug Administration and the Agency for Toxic Substances and Disease Registry. These procedures are most recently described in US EPA documents (1994, 2000, 2002, 2003).

Human Non-Cancer Risks Associated with Exposure to TCE in Air

For non-cancer effects, points-of-departure (no-observed-effects levels or NOELs, lowest-observed-effects levels or LOELs, benchmark doses) were identified for target organs in humans and animals. Uncertainty factors were applied to the points-of-departure to estimate criteria for long-term exposure of the general population, including subpopulations that may be more vulnerable to TCE than other groups.

Typically, several uncertainty factors (generally, each is 3 or 10) are used to derive an exposure criterion from a point-of-departure. These uncertainty factors are intended to account for:

- the variation in sensitivity among the members of the human population;
- the uncertainty in extrapolating animal data to humans;
- the uncertainty in extrapolating from data obtained in a study with less-than-lifetime exposure to lifetime exposure;
- the uncertainty in extrapolating from a LOEL rather than from a NOEL; and
- the uncertainty associated with extrapolation of results from adult humans or animals to children.

In humans, the central nervous system appears to be a sensitive indicator of TCE exposure, and there is concern that pre-natal TCE exposure may affect fetal development. In animals, TCE damages the central nervous system, liver, and kidneys of adult animals, and disrupts normal fetal development when exposure occurs during gestation. The animal data also suggest that the kidney effects generally occur at higher exposure levels than the other effects noted above.

Central Nervous System

Information on the central nervous system effects of TCE comes from studies of occupationally exposed workers and from studies of animals under controlled experimental conditions. In some occupational studies (Okawa and Bodner, 1973; Rasmussen et al., 1993; Vandervort and Polakoff, 1973), exposure to TCE is associated with effects on the central nervous system, including dizziness, headache, drowsiness, nausea and motor dyscoordination. Confidence in these studies for evaluating dose-response relationships is low because the studies did not provide adequate information on long-term TCE exposure and because the small numbers of workers who were examined were also exposed to chemicals other than TCE. Consequently, these data were not used to derive a potential criterion.

When adult male rats were exposed to TCE at 50 parts per million (ppm or 270 milligrams per cubic meter, mg/m^3) or more for eight hours per day, five days per week for six weeks, there were electroencephalographic (EEG) changes indicative of decreased wakefulness (Arito et al., 1994). The lowest exposure level in the study was an effect level. This level becomes 64 mg/m^3 after adjustment of the experimental exposure level to an equivalent level under conditions of continuous exposure (270 mg/m^3 x 8 hours/24 hours x 5 days/7 days = 64 mg/m^3). Using methods consistent with those recommended in the US EPA (1994) guidelines for deriving air

criteria[1], the human adult equivalent concentration (HEC) is 64 mg/m^3. Adjusting the adult HEC to a child's HEC using a child's inhalation rate and body weight and applying an uncertainty factor of 3,000 to the child HEC suggests a potential criterion of about 9 microgram per cubic meter (9 mcg/m^3). The uncertainty factor was selected to compensate for use of a LOEL for an effect from a subchronic study in rats, human variability, and the potential increased sensitivity of children to TCE. Alternatively, applying a larger uncertainty factor to compensate for the observed effect (and an overall uncertainty factor of 10,000) suggests a potential criterion of 3 mcg/m^3.

Liver

Trichloroethene is also toxic to the liver of laboratory animals. Increases in absolute and relative liver weights were observed in male and female mice exposed continuously to 37 ppm (200 mg/m^3) or more for 30 days (Kjellstrand et al., 1983). We modeled the dose-response data for absolute liver weights and identified 13 ppm (70 mg/m^3) as the lowest air concentration corresponding to the lower bound on a 10% increase in liver effects in either male or female mice (essentially equivalent to a LOEL). Using methods consistent with those recommended in the US EPA (1994) guideline for deriving air criteria, the adult HEC is 70 mg/m^3. Adjusting the adult HEC to a child's HEC using a child's inhalation rate and body weight and applying an uncertainty factor of 3,000 to the child HEC suggests a potential criterion of about 9 mcg/m^3. The uncertainty factor was selected to compensate for use of a LOEL from a subchronic study in mice, human variability, and the potential increased sensitivity of children to TCE.

Developmental/Reproductive Effects

An epidemiological investigation (Goldberg et al., 1990) found an association between mothers living in areas where public drinking water wells were contaminated (primarily with TCE) and an increased incidence of cardiac malformations in their children. Whether or not prenatal TCE exposure played a role in producing these cardiac effects is unclear; however, this study raises concerns that developmental effects may be an important toxicological endpoint for TCE in humans.

In animals, Dawson et al. (1990, 1993) showed that exposure to TCE in drinking water during pregnancy caused a statistically significant increase in cardiac malformations in fetal rats at doses as low as 0.2 mg/kg/day. Applying an uncertainty factor of 1,000 to the animal LOEL and assuming

[1] For extrarespiratory effects of Type 3 chemicals such as TCE, the HEC equals the animal exposure concentration x an adjustment factor, which typically is a default value of 1 (US EPA, 1994).

that the inhaled and ingested doses of TCE (as mg/kg/day) are equivalent suggests a potential criterion of about 0.7 mcg/m^3. The uncertainty factor was selected to compensate for use of a LOEL in rats and human variability in the general population. Confidence in this potential criterion is lower than for those based on other animal studies.

Human Cancer Risks Associated with Exposure to TCE in Air

TCE is an animal carcinogen via the oral and inhalation routes of exposure, and evidence from occupational studies and drinking-water studies suggests that TCE is a risk factor for several types of cancer, including kidney, liver, and cancers of the lympho-hematopoietic systems (e.g., Non-Hodgkin's lymphoma (NHL) and Hodgkin's disease) (ATSDR, 1997; US EPA, 2001; Wartenberg et al., 2000). The National Toxicology Program has classified TCE as "*reasonably anticipated to be a human carcinogen*." Similarly, the International Agency for Research on Cancer classifies TCE *"as probably carcinogenic to humans."* In both cases, the determination was based on "limited evidence" of carcinogenicity from studies in humans and "sufficient evidence" of carcinogenicity from studies in experimental animals. In short, epidemiological studies suggest, but do not conclusively prove, that TCE increases the incidence of some types of cancer in humans, animal bioassay studies show unequivocally that oral or inhaled doses of TCE cause cancer at several sites in rats and mice, and mode-of-action data suggest that the way TCE causes cancer in animals may be relevant to humans.

For cancer effects, we identified the important human and animal studies on the carcinogenicity of TCE in air, and determined the appropriateness of each study for use in estimating the human TCE air concentration associated with an excess lifetime human cancer risk of one-in-one million. In both the qualitative and quantitative evaluation, we used procedures and methods consistent with the US EPA guidelines for carcinogen risk assessment (US EPA, 2003).

We evaluated four epidemiological studies to determine their usefulness to estimate the TCE air level (mcg/m^3) associated with an excess lifetime human cancer risk of 1×10^{-6} (i.e., a TCE 1×10^{-6} air level). Three of the studies (Anttila et al., 1995; Cohn et al., 1994; Henschler et al., 1995) did not meet minimal requirements (see Hertz-Picciotto, 1995) for use in dose-response assessment, largely because each study did not characterize adequately the duration and/or magnitude of exposure to TCE. The fourth study (Hansen et al., 2001) provided estimates of TCE air levels in the workplace and of the average duration of occupational exposures and was used to derive estimates of TCE 1×10^{-6} air levels.

Using the relative risk data (from Hansen et al., 2001), exposure data from occupational studies (Hansen et al., 2001; Raaschou-Nielsen et al., 2002) and an average relative risk model recommended by the World Health Organization (WHO, 1996), our estimates of the TCE 1×10^{-6} air levels range from about 0.06 to about 1 mcg/m^3 under a standard exposure scenario (continuous exposure for 70 years, 70-kg person, and inhalation rate of 20 m^3/day), and vary with choice of cancer site, measure of relative risk, the TCE workplace air level, and years of employment. Confidence in these estimates is low because of the small number of cases, the inability to adequately control the potential influence of confounders, unavoidable uncertainties in the exposure estimates, and the lack of clear dose-response relationship. Thus, these estimates were used to check the plausibility of animal-based estimates of 1×10^{-6} TCE air level (see below).

Inhalation studies using laboratory animals provide scientifically-sound, dose-response datasets showing a statistically significant relationship between TCE exposure levels and an increased incidence of tumors (Fukuda et al., 1983; Henschler et al., 1980; Maltoni et al., 1986). These data have been used by the US EPA (1987, 2001), CA EPA (1999, 2002), WHO (1996), Health Canada (1993), and Rhomberg (2000) to derive estimates of the TCE 1×10^{-6} air level.

We evaluated published estimates and derived additional estimates based on considerations of the quality of the animal data and the use of recommended dose metrics and cross-species extrapolation factors. The estimates considered in our evaluation were based on dose-response data from rats and mice for four cancer sites (liver, lung, testes, and lymph system) using three dose metrics (lifetime average daily exposure as TCE mg/m^3; lifetime average daily metabolized TCE dose as mg TCE metabolized/kg/day; or lifetime average daily internal dose of trichloroacetic acid (TCA) in plasma or tissue as TCA-area-under-curve (mg-hr)/liter), and two cross-species scaling methods (equal risk at equal exposure or equal risk at exposure scaled by body weight$^{0.75}$). The range of estimates of the TCE 1×10^{-6} air level is about 0.2 to about 4 mcg/m^3 under a standard exposure scenario (continuous exposure for 70 years, 70-kg person, and inhalation rate of 20 m^3/day). Because there is a lack of scientific consensus on the appropriate animal surrogate and cancer sites, dose metric, and the method for scaling dose across species, no single estimate is preferred. These estimates are similar to the estimates obtained from the human data.

Summary

We have evaluated the non-cancer effects associated with TCE exposure in air, and focused our attention on those studies that identified sensitive human and animal responses to TCE exposures. Three types of effects observed in animals were used: central nervous system (Arito et al., 1994), liver (Kjellstrand et al., 1983), and developmental (Dawson et al., 1990, 1993). Using methods consistent with latest US EPA guidelines, the potential criteria range from about 1 mcg/m^3 to about 10 mcg/m^3.

In developing these potential criteria, uncertainties that limit our ability to estimate the human non-cancer effects of low-dose exposures (i.e., use of subchronic studies to evaluate chronic exposures, use of an effect level rather than a no-observed-effect level, interspecies extrapolations, and human variability) and factors necessary when considering children (respiration rate and body weight of children and the potential increased sensitivity of children to TCE exposures) were taken into account.

We have evaluated the cancer effects associated with TCE exposure in air, and focused our attention on those human and animal studies that showed significant relationships between estimated or measured TCE exposure and increased rates of cancers. We did not find any human studies strong enough to support potential criteria (i.e., TCE 1 x 10^{-6} air levels) based on cancer effects, although one study (Hansen et al., 2001) was used for checking the plausibility of criteria based on animal studies.

We derived estimates of the TCE air level associated with an excess lifetime human cancer risk of 1 x 10^{-6} using data from inhalation studies using animals (Fukuda et al., 1983; Henschler et al., 1980; Maltoni et al., 1986). Given the lack of consensus on the appropriate data, we developed estimates based on two different species, four cancer sites, three different methods of estimating dose, and two different methods for scaling dose across species. Using methods consistent with latest US EPA guidelines, the potential criteria range from about 0.2 to about 4 mcg/m^3. This range reflects the uncertainty surrounding our ability to estimate the human cancer effects of low-dose exposures. The animal-based estimates are similar to the human-based estimates.

After reviewing the data on the non-cancer and cancer effects of TCE and the potential criteria for long-term exposure of the general populations based on these effects, the New York State Department of Health has set an air guideline for TCE of 5 mcg/m^3. The margins-of-exposure between this guideline and the TCE air levels known to cause non-cancer effects in animals are consistent with recommended procedures and are adequate when

considered in conjunction with the limitations of the different studies. Similarly, the estimated increased human cancer risks associated with lifetime continuous exposure to 5 mcg/m^3 are in the risk range (1×10^{-6} to 1×10^{-4}) that is generally used by regulatory agencies when making decisions. We continue to update, review, and refine our evaluation of the potential health risks associated with TCE.

Sincerely,

Nancy K. Kim

Nancy K. Kim, Ph.D., Director
Division of Environmental Health Assessment

Enclosure
cc: R. Tramontano
C. Johnson

P:\Users\nkk01\Desnoyers (10-29-03).doc

References

Anttila, A, E Pukkala, M Sallmen, et al. 1995. Cancer incidence among Finnish workers exposed to halogenated hydrocarbons. J Environ Occup Med. 37:797–806.

Arito, H, M Takahashi, and T Ishikawa. 1994. Effects of subchronic inhalation exposure to low-level trichloroetheylene on heart rate and wakefulness-sleep in freely moving rats. Jpn. J. Ind. Health 36:1-8.

ATSDR (Agency for Toxic Substances and Disease Registry). 1997. Toxicological Profile for Trichloroethylene. Update. Atlanta, GA: Public Health Service, US Department of Health and Human Services.

CA EPA (California Environmental Protection Agency). 1999. Public Health Goal for Trichloroethylene in Drinking Water. Sacramento, CA: Office of Environmental Health Hazard Assessment, California Environmental Protection Agency.

CA EPA (California Environmental Protection Agency). 2002. Technical Support Document for Describing Available Cancer Potency Factors, December. Sacramento, CA: Office of Environmental Health Hazard Assessment, Air Toxicology and Epidemiology Section, California Environmental Protection Agency.

Cohn, P, J Klotz, F Bove, et al. 1994. Drinking water contamination and the incidence of leukemia and non-Hodgkin's lymphoma. Environ Health Perspect. 102:556–561.

Dawson, BV, PD Johnson, and SJ Goldberg. 1990. Cardiac teratogenesis of trichloroethylene and dichloroethylene in a mammalian model. J. Am. Coll. Cardiol. 16:1304-1309.

Dawson, BV, PD Johnson, SJ Goldberg, and J.B. Ulreich. 1993. Cadiac teratogenesis of halogenated hydrocarbon-contaminated drinking water. J. Am. Coll. Cardiol. 21:1466-1472.

Fukuda, K, K Takemoto, and H Tsuruta. 1983. Inhalation carcinogenicity of trichloroethylene in mice and rats. Ind Health. 21:243–254.

Goldberg, SJ, MD Lebowitz, EJ Graver, and S Hicks. 1990. An association of human congenital cardiac malformations and drinking water contaminants. J. Am. Coll. Cardiol. 16:155-164.

Hansen J, O. Raaschou-Nielsen, JM Christensen, et al. 2001. Cancer incidence among Danish workers exposed to trichloroethylene. J Occup Environ Med. 43(2):133-139.

Health Canada. 1993. Trichloroethylene. Priority Substance List Assessment Report. Ottawa: Environment Canada.

Henschler, D, W Romen, HM Elsasser, et al. 1980. Carcinogenicity study of trichloroethylene by long-term inhalation in three animal species. Arch Toxicol. 43:237–248.

Henschler, D, S Vamvakas, M Lammert, et al. 1995. Increased incidence of renal cell tumors in a cohort of cardboard workers exposed to trichloroethylene. Arch Toxicol. 69:291–299.

Hertz-Picciotto, I. 1995. Epidemiology and quantitative risk assessment: A bridge from science to policy. Am. J. Public Health. 85:484-491.

Johnson, PD, SJ Goldberg, MZ Mays, and BV Dawson. 2003. Threshold of trichloroethylene contamination in maternal drinking waters affecting fetal heart development in the rat. Env. Health Perspect. 111: 289-292.

Kjellstrand, P, B Holmquist, P Alm, et al. 1983. Trichloroethylene: Further studies of the effects on the body and organ weights and plasma butyrylcholinesterase activity in mice. Acta Pharmacol. et Toxicol. 53:375-384.

Maltoni, C, G Lefemine, and G Cotti. 1986. Experimental research on trichloroethylene carcinogenesis. In: Archives of Research on Industrial Carcinogenesis. Maltoni, C; Mehlman, MA, eds. Princeton: Princeton Scientific Publishing Co., 1–393.

Okawa, MT and A Bodner. 1973. Health Hazard Evaluation Report HHE-72-74-51, Western Electric Company, Dublin, California. Hazard Evaluation Services Branch, Cincinnati, OH: National Institute for Occupational Safety and Health.

Raaschou-Nielsen O, J Hansen, BL Thomsen, et al. 2002. Exposure of Danish workers to trichloroethylene, 1947-1989. Appl Occup Environ Hyg. 17(10):693-703.

Rasmussen, K, P Arlien-Soborg, and S Sabroe. 1993. Clinical neurological findings among metal degreasers exposed to chlorinated solvents. Acta Neurol. Scand. 87:200-204.

Rhomberg, L. 2000. Dose-response analyses of the carcinogenic effects of trichloroethylene in experimental animals. Environ Health Perspect. 108(Suppl 2):343–358

US EPA (US Environmental Protection Agency). 1987. Addendum to the Health Assessment Document for Trichloroethylene: Updated Carcinogenicity Assessment for Trichloroethylene. External Review Draft. EPA/600/8-82/006FA. Washington: Office of Health and Environmental Assessment.

US EPA (US Environmental Protection Agency). 1994. Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry. EPA/600/8-90/066F. Washington, DC: Office of Research and Development.

US EPA (US Environmental Protection Agency). 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health. Technical Support Document. Volume 1: Risk Assessment. Final. EPA-822-B-00-005. Washington, DC: Office of Science and Technology, Office of Water.

US EPA (US Environmental Protection Agency). 2001. Trichloroethylene Health Risk Assessment: Synthesis and Characterization. EPA/600/P-01/002A, External Review Draft. August. Washington, DC: National Center for Environmental Assessment, Office of Research and Development.

US EPA (US Environmental Protection Agency). 2002. A Review of the Reference Dose and Reference Concentration Process. Final Report. EPA/630/P-02/002F. Washington, DC: Risk Assessment Forum.

US EPA (US Environmental Protection Agency). 2003. Draft Final Guidelines for Carcinogen Risk Assessment. Draft Final, February. EPA/630/P-03/001A. NCEA-F-0644A Washington, DC: Risk Assessment Forum.

Vandervort, R, and PL Polakoff. 1973. Health Hazard Evaluation Report HHE-72-84-31, Dunham-Bush, Inc., West Hartford, Connecticut. Hazard Evaluation Services Branch, Cincinnati, OH: National Institute for Occupational Safety and Health.

Wartenberg D, D Reyner, and CS Scott. 2000. Trichloroethylene and cancer: Epidemiologic evidence. Environ Health Perspect. 108(Suppl 2):161-176.

WHO (World Health Organization). 1996. Air Quality Guidelines for Europe. WHO Regional Publications, European Series No. 23. Copenhagen: WHO Regional Office for Europe.

P:\Users\nkk01\Desnoyers (10-29-03) attachment.doc

FINAL REPORT

TETRACHLOROETHENE AMBIENT AIR CRITERIA DOCUMENT

OCTOBER 1997

New York State Department of Health

CENTER FOR ENVIRONMENTAL HEALTH
BUREAU OF TOXIC SUBSTANCE ASSESSMENT

2 University Place
Albany, NY 12203-3399

APPENDIX 1

TETRACHLOROETHENE
HEALTH EFFECTS

November 6, 1991

NEW YORK STATE DEPARTMENT OF HEALTH

TETRACHLOROETHENE HEALTH EFFECTS

November 6, 1991

In evaluating the health risks from tetrachloroethene exposure, the New York State Department of Health followed the procedures outlined by the National Academy of Sciences (NAS, 1977, 1987) and federal agencies such as the U.S. Food and Drug Administration, the U.S. Environmental Protection Agency, and the Agency for Toxic Substances and Disease Registry (Dourson and Stara, 1983; US EPA 1988, 1989). We've identified either no-observed-effect levels or lowest-observed-effect levels for target organs in humans and animals. When developing exposure guidelines for long-term exposure of the general population from human data, uncertainty factors are used because effect or no-effect levels can be based on studies using healthy adults (frequently only men), short exposure times, small sample sizes and limited information on exposure levels. These same limitations may exist when using animal data, but additional uncertainty is introduced when extrapolating results from animals to humans. Uncertainty factors that are usually applied include a factor of ten for a short-term study, ten for using a lowest-observed-effect level rather than a no-observed-effect level and ten in going from a limited study in adults to the general population. Consideration may also be made for the quality and quantity of the available data.

Information on central nervous system effects comes from human controlled-chamber exposures and from epidemiological studies. The controlled studies used healthy adults and short exposure times. The epidemiological studies involved longer exposure times, but the exposure levels are less certain than for the controlled studies.

In controlled exposure studies, Stewart et al. (1970) and Hake and Stewart (1977) reported central nervous system effects when adult males and females were exposed to 100 ppm (690 milligrams per cubic meter--mg/m^3) for 7 or 7.5 hours per day for five days. Effects were not detected in adults exposed to 20 ppm (140 mg/m^3) for 7.5 hours per day for 5 days.

Workers exposed to tetrachloroethene have also been evaluated for possible central nervous system effects. A study by Lauwerys et al. (1983) did not detect adverse effects on the central nervous system of Belgian workers at dry cleaning shops who were exposed to a time weighted average (TWA) tetrachloroethene level of 21 ppm (145 mg/m^3). Seeber (1989) summarized a series of studies which evaluated such endpoints as perceptual speed, digit reproduction and sensorimotor and coordination functions in German dry cleaning workers. The performance of both the high-exposed (reported TWA 360 mg/m^3) and low-exposed (reported TWA 83 mg/m^3) groups differed significantly from the control group for some tests; however, the two exposed groups did not differ from each other.

A guideline for central nervous system effects for the general population can be derived from the no-observed-effect level in controlled chamber experiments or from the worker studies. The no-observed-effect level for central nervous system effects in the controlled chamber studies is 20 ppm (140 mg/m^3). Because this study was on healthy adults and of limited duration, an uncertainty factor of 100 is applied after averaging the concentration over 24 hours. This suggests a guideline of 0.4 mg/m^3. The lowest effect level in the worker studies was 83 mg/m^3. Because effects were observed and the study was on healthy adults, an uncertainty factor of 100 is needed after averaging the concentration over 24 hours. This suggests a guideline of 0.25 mg/m^3.

The liver is also a target organ for tetrachloroethene, particularly in mice. Case reports of liver effects have also been reported in humans who were exposed to high concentrations, sometimes under severe circumstances. The lowest-observed-effect level for mice is 60 mg/m^3, when continuously exposed for 30 days (Kjellstrand et al., 1984). Liver weights were significantly elevated. Using an inhaled dose to extrapolate the results from mice to humans and applying a thousand-fold uncertainty factor would suggest a guideline of about 0.25 mg/m^3 for liver effects.

The kidney is also a target organ in rats. Effects were seen in rats exposed to 200 ppm (1,400 mg/m^3) for 6 hours per day, 5 days per week for 2 years (NTP, 1986). These effects included nucleus enlargement and tubular cell hyperplasia. Using an inhaled dose to extrapolate from rats to humans and applying a thousand-fold uncertainty factor would suggest a guideline of about 0.5 mg/m^3 for kidney effects.

Exposure to tetrachloroethene caused liver tumors in mice and mononuclear cell leukemias and kidney tumors in rats. The exact mechanisms by which these tumors were induced are not known. Because of the uncertainty, a conservative estimate of the tetrachloroethene air concentration corresponding to the upper bound on risk and associated with a one in one million excess lifetime human oncogenic risk is 0.00005 mg/m^3. This estimate is based on the assumptions that the delivered dose of the active carcinogenic agent is linearly proportional to the inhaled dose of tetrachloroethene across all doses and that surface area is the appropriate parameter for dose extrapolation. Confidence in this estimate is limited by the data which indicate that linearity across all doses does not hold for the potential oncogenic agents (tetrachloroethene or its metabolites) and by the degree to which the results of empirical observations on the toxic effects of anti-neoplastic drugs (the source of the surface area rule) are applicable to chemicals which are metabolized differently.

Correlations between the metabolic and carcinogenic data can be used to support the hypothesis that the metabolic products of the mixed function oxidase pathway for tetrachloroethene are responsible for its carcinogenicity in mice. If the available data are used with physiologically-based pharmacokinetic modeling, an estimate of the air level corresponding to the upper bound on risk and associated with a one in one million excess lifetime human carcinogenic risk is 0.0005 mg/m^3 (if humans and mice are assumed to be equally sensitive to the same delivered dose). Confidence in this estimate is limited by the validity of the initial assumptions and the accuracy of the model in compensating for non-linearity when extrapolating from high to low doses and in compensating for differences in the capacity of mice and humans to metabolize tetrachloroethene by the mixed function oxidase pathway.

Correlations using urinary excretion data for tetrachloroethene metabolites can also be used to estimate an excess human cancer risk from the mouse liver tumor data. Using this method (US EPA, 1990), the tetrachloroethene air concentration corresponding to an upper bound on risk and associated with a one in one million excess lifetime human cancer risk is 0.002 mg/m^3.

The New York State Department of Health recommends, based on an evaluation of the non-carcinogenic effects of tetrachloroethene, that the average ambient air level in a residential community not exceed 0.25 mg/m^3 for adults, considering continuous lifetime exposure. If a child's inhalation rate and body weight are used, the guideline becomes 0.1 mg/m^3. Furthermore, we recommend that the uncertainty factor not be reduced by more than an order of magnitude when considering the need to take immediate action. We also recommend that exposure to tetrachloroethene be minimized to the extent practical; e.g. regardless of the levels, solvent containers should not be left opened. The potential carcinogenic risks of tetrachloroethene will be considered further as regulations are developed for the dry cleaning industry.

REFERENCES

Dourson, M.L. and Stara, J.F. 1983. Regulatory History and Experimental Support of Uncertainty (Safety Factors). Regulatory Toxicol. Pharmacol., 3: 224-238.

Hake, C.L. and Stewart, R.D. 1977. Human Exposure to Tetrachloroethylene: Inhalation and Skin Contact. Environmental Health Perspectives, 21: 231-238.

Kjellstrand, P., Holmquist, B., Kanje, M., Alm, P., Romare, S., Jonsson, I., Mansson, L., and Bjerkemo, M. 1984. Perchloroethylene: Effects on Body and Organ Weights and Plasma Butyrylcholinesterase Activity in Mice. Acta Pharmacol. Toxicol., 54: 414-424.

Lauwerys, R., Herbrand, J., Buchet, J.P., Bernard, A., and Gaussin, J. 1983. Health Surveillance of Workers Exposed to Tetrachloroethylene in Dry-cleaning Shops. Int. Arch. Occup. Environ. Health, 52: 69-77.

National Academy of Sciences. 1977. Drinking Water and Health, Volume 1. National Academy of Sciences, Washington, D.C.

National Academy of Sciences. 1987. Drinking Water and Health, Volume 7, National Academy of Sciences, Washington, D.C.

National Toxicology Program. 1986. Toxicology and Carcinogenesis Studies of Tetrachloroethylene (Perchloroethylene) (CAS no. 127-18-4) in F344/N Rats and B6C3F$_1$ Mice (Inhalation Studies). NTP Technical Report Series No. 311. NTP, Research Triangle Park, NC. NIH Publication No. 86-2567.

Seeber, A. 1989. Neurobehavioral Toxicity of Long-Term Exposure to Tetrachloroethylene. Neurotoxicology and Teratology, 11: 579-583.

Stewart, R.D., Baretta, E.D., Dodd, H.C., Torkelson, T.R. 1970. Experimental Human Exposure to Tetrachloroethylene. Arch. Environ. Health, 20: 224-229.

U.S. Environmental Protection Agency. 1990. Health Effects Assessment Summary Tables, Fourth Quarter, FY - 1990. Environmental Criteria and Assessment Office, Cincinnati, OH. NTIS No. PB90-921104.

U.S. Environmental Protection Agency. 1989. Interim Methods for Development of Inhalation Reference Doses. EPA/600/8-88/066F. Office of Health and Environmental Assessment, Washington, D.C.

U.S. Environmental Protection Agency. 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Interim Final. EPA/540/1-89/002. Office of Emergency and Remedial Response, Washington, D.C.

97036PRO0460

EXPOSURE ASSUMPTIONS USED TO DERIVE 1991 GUIDELINES

The exposure assumptions used to derive the non-carcinogenic guidelines are provided below.

Group	Body Weight	Daily Inhalation Rate
adult	70 kg	20 m^3/day
child	20.5 kg*	14.5 m^3/day*
mouse	0.035 kg	0.039 m^3/day
rat	0.40 kg	0.24 m^3/day

*see Table 12 of Criteria Document for age-specific data

The methods and assumptions used to derive the carcinogenic guidelines based on metabolized dose are found in Table 17 of Criteria Document.

97036PRO0460

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix E

ASTM's *Standard Practice for Residential Radon Mitigation*

Reference:
EPA's web site at http://www.epa.gov/radon/pubs/mitstds.html
(Thursday, September 7th, 2006, posting)

EPA's Recommended Residential Radon Mitigation Standard of Practice

EPA recommends the ***Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings**** for residential radon mitigation. This voluntary, consensus-based standard was developed and issued by the American Society for Testing and Materials International, and is identified as **ASTM E-2121**.

The Agency first cited **ASTM E-2121** in 2003 as a national consensus standard appropriate for reducing radon in homes as far as practicable below the national action level of 4 picocuries per liter (pCi/L) in indoor air. As of May 2006, EPA no longer recommends, and will no longer distribute its own, superseded *Radon Mitigation Standards* (EPA 402-R-93-078, Revised April 1994).

- A single free copy of the **ASTM E-2121** standard is available from EPA's National Service Center for Environmental Publications - http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?OpenForm, or the Agency's IAQ-Info hotline, 1-800-438-4318.

- Copies of the standard may be purchased from ASTMI at www.astm.org/cgi-bin/SoftCart.exe/index.shtml?E+mystore, or from the American National Standards Institute (ANSI) at www.ansi.org/.

*E-2121-03 (February 10, 2003), American Society for Testing and Materials (ASTM) International; an American National Standards Institute (ANSI) approved consensus standard.

If you have questions concerning this policy, contact either Philip Jalbert jalbert.philip@epa.gov or Eugene Fisher fisher.eugene@epa.gov.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

This page is intentionally blank.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix F

EPA's *Model Standards and Techniques for Control of Radon in New Residential Buildings*

Reference:
United State Environmental Protection Agency. "Model Standards and Techniques for Control of Radon in New Residential Buildings" (EPA 402-R-94-009; March 1994).

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

This page is intentionally blank.

"Model Standards and Techniques for Control of Radon in New Residential Buildings"

U.S. Environmental Protection Agency, Air and Radiation (6604-J)
EPA 402-R-94-009, March 1994

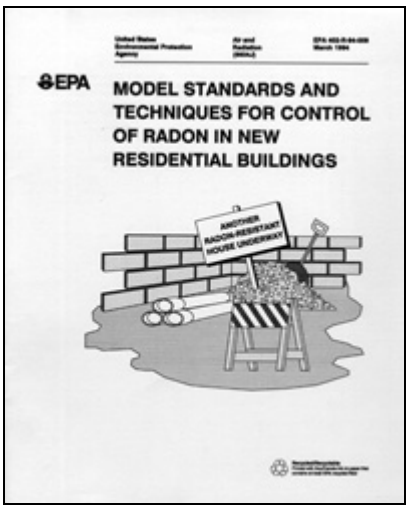


Table of Contents

1.0 Scope
2.0 Limitations
3.0 Reference Documents
4.0 Description of Terms
5.0 Principles of Construction of Radon-Resistant Residential Buildings
6.0 Summary of the Model Building Standards and Techniques
7.0 Construction Methods
8.0 Recommended Implementation Procedures
9.0 Model Building Standards and Techniques

DISCLAIMER

The U.S. Environmental Protection Agency (EPA) strives to provide accurate, complete, and useful information. However, neither EPA nor any person or organization contributing to the preparation of this document makes any warranty, expressed or implied, with respect to the usefulness or effectiveness of any information, method or process disclosed in this material. Nor does EPA assume any liability for the use of, or for damages arising from the use of, any information, methods, or process disclosed in this document.

NOTE: EPA closed its National Radon Proficiency Program on 9/30/98, see epa.gov/radon/proficiency.html for ways to find a "qualified" radon service provider.

FORWARD

This document is intended to serve as a model for use by the Model Code Organizations, States and other jurisdictions as they develop and adopt building codes, appendices to codes, or standards specifically applicable to their unique local or regional radon control requirements.

This document is responsive to the requirements set forth in Section 304 of Title III of the Toxic Substances Control Act (TSCA), 15 U.S.C. 2664, commonly referred to as the Indoor Radon Abatement Act (IRAA) of 1988. It is anticipated that future editions of this document will be prepared as additional experience is gained in constructing new radon-resistant residential buildings.

1.0 Scope

1.0.1 This document contains model building standards and techniques applicable to controlling radon levels in new construction of one- and two-family dwellings and other residential buildings three stories or less in height as defined in model codes promulgated by the respective Model Code Organizations.

1.0.2 The model building standards and techniques are also applicable when additions are made to the foundations of existing one- and two-family dwellings that result in extension of the building footprint.

1.0.3 This document is not intended to be a building code nor is it required that it be adopted verbatim as a referenced standard.

1.0.4 It is intended that the building standards and techniques contained in section 9.0 of this document, the construction method in section 7.0, and the recommended procedures for applying the standards and construction method in section 8.0, serve as a model for use by the Model Code Organizations and authorities within states or other jurisdictions that are responsible for regulating building construction as they develop and adopt building codes, appendixes to codes, or standards and implementing regulations specifically applicable to their unique local or regional radon control requirements.

1.0.5 The preferential grant assistance authorized in Section 306(d) of the Indoor Radon Abatement Act of 1988 (Title III of the Toxic Substances Control Act, TSCA, 15 U.S.C. 2666) will be applied for states where appropriate authorities who regulate building construction are taking action to adopt radon-resistant standards in their building codes.

1.0.6 Model building standards and techniques contained in this document are not intended to supersede any radon-resistant construction standards, codes or regulations previously adopted by local jurisdictions and authorities. However, jurisdictions and authorities are encouraged to review their current building standards, codes, or

regulations and their unique local or regional radon control requirements, and consider modifications, if necessary.

1.0.7 This document will be updated and revised as ongoing and future research programs suggest revisions of standards, identify ways to improve the model construction techniques, or when newly tested products or techniques prove to be equivalent to or more effective in radon control. Updates and revisions to the model building standards and techniques contained in section 9.0 will undergo appropriate peer review.

1.0.8 EPA is committed to continuing evaluation of the effectiveness of the standards and techniques contained in section 9.0 and to research programs that may identify other more effective and efficient methods.

2.0 Limitations

2.0.1 The Indoor Radon Abatement Act of 1988 (Title III of TSCA) establishes a long-term national goal of achieving radon levels inside buildings that are no higher than those found in ambient air outside of buildings. While technological, physical, and financial limitations currently preclude attaining this goal, the underlying objective of this document is to move toward achieving the lowest technologically achievable and most cost effective levels of indoor radon in new residential buildings.

2.0.2 Preliminary research indicates that the building standards and techniques contained in section 9.0 can be applied successfully in mitigating radon problems in some existing nonresidential buildings. However, their effectiveness when applied during construction of new nonresidential buildings has not yet been fully demonstrated. Therefore, it is recommended that, pending further research, these building standards and techniques not be used at this time as a basis for changing the specific sections of building codes that cover nonresidential construction.

2.0.3 Although radon levels below 4 pCi/L have been achieved in all types of residential buildings by using these model building standards and techniques, specific indoor radon levels for any given building cannot be predicted due to different site and environmental conditions, building design, construction practices, and variations in the operation of buildings.

2.0.4 These model building standards and techniques are not to be construed as the only acceptable methods for controlling radon levels, and are not intended to preempt, preclude, or restrict the application of alternative materials, systems, and construction practices approved by building officials under procedures prescribed in existing building codes.

2.0.5 Elevated indoor radon levels caused by emanation of radon from water is of potential concern, particularly in areas where there is a history of groundwater with high radon content. This document does not include model construction standards or

techniques for reducing elevated levels of indoor radon that may be caused by the presence of high levels of radon in water supplies. EPA has developed a suggested approach (see paragraph 8.3.2) that state or local jurisdictions should consider as they develop regulations concerning private wells. EPA is continuing to evaluate the issue of radon occurrence in private wells and the economic impacts of testing and remediation of wells with elevated radon levels.

2.0.6 While it is not currently possible to make a precise prediction of indoor radon potential for a specific building site, a general assessment, on a statewide, county, or grouping of counties basis, can be made by referring to EPA's Map of Radon Zones and other locally available data. It should be noted that some radon potential exists in all areas. However, EPA recognizes that based on available data, there is a lower potential for elevated indoor radon levels in some states and portions of some states, and that adoption of building codes for the prevention of radon in new construction may not be justified in these areas at this time. There is language in paragraph 8.2.3 of this document recommending that jurisdictions in these areas review all available data on local indoor radon measurements, geology, soil parameters, and housing characteristics as they consider whether adoption of new codes is appropriate.

3.0 Reference Documents

References are made to the following publications throughout this document. Some of the references do not specifically address radon. They are listed here only as relevant sources of additional information on building design, construction techniques, and good building practices that should be considered as part of a general radon reduction strategy.

3.1 "Building Foundation Design Handbook," ORNL/SUB/86-72143/1, May 1988.

3.2 "Building Radon Resistant Foundations - A Design Handbook," NCMA, 1989.

3.3 "Council of American Building Officials (CABO) Model Energy Code, 1992.

3.4 "Design and Construction of Post-Tensioned Slabs on Ground," Post Tensioning Institute Manual.

3.5 "Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings," ASHRAE Standard 90.1-1989.

3.6 "Energy Efficient Design of New Low-Rise Residential Buildings," Draft ASHRAE Standard 90.2 (Under public review).

3.7 "Homebuyer's and Seller's Guide to Radon," EPA 402-R-93-003, March 1993.

3.8 "Guide to Residential Cast-in-Place Concrete Construction," ACI 332R.

3.9 "Indoor Radon and Radon Decay Product Measurement Device Protocols." EPA 402-R-92-004, July, 1992.

3.10 "Protocols For Radon and Radon Decay Product Measurements in Homes." EPA 402-R-92-003, June, 1993.

3.11 "Permanent Wood Foundation System - Basic Requirements, NFPA Technical Report No.7."

3.12 "Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings," ASTM Standard Guide, E1465-92.

3.13 "Radon Handbook for the Building Industry," NAHB-NRC, 1989.

3.14 "USEPA Map of Radon Zones," Dec. 1993. www.epa.gov/radon/zonemap.html

3.15 "Radon Reduction in New Construction, An Interim Guide." OPA-87-009, August 1987.

3.16 "Radon Reduction in Wood Floor and Wood Foundation Systems." NFPA, 1988.

3.17 "Radon Resistant Construction Techniques for New Residential Construction. Technical Guidance." EPA/625/2-91/032, February 1991.

3.18 "Radon-Resistant Residential New Construction." EPA/600/8-88/087, July 1988.

3.19 "Guide for Concrete Floor and Slab Construction," ACI 302.1R-89.

3.20 "Ventilation for Acceptable Indoor Air Quality," ASHRAE 62-1989.

4.0 Description of Terms

For this document, certain terms are defined in this section. Terms not defined herein should have their ordinary meaning within the context of their use. Ordinary meaning is as defined in "Webster's Ninth New Collegiate Dictionary."

ACTION LEVEL: A term used to identify the level of indoor radon at which remedial action is recommended. (EPA's current action level is 4 pCi/L.)

AIR PASSAGES: Openings through or within walls, through floors and ceilings, and around chimney flues and plumbing chases, that permit air to move out of the conditioned spaces of the building.

COMBINATION FOUNDATIONS: Buildings constructed with more than one foundation type; e.g., basement/crawlspace or basement/slab-on-grade.

DRAIN TILE LOOP: A continuous length of drain tile or perforated pipe extending around all or part of the internal or external perimeter of a basement or crawlspace footing.

GOVERNMENTAL: State or local organizations/agencies responsible for building code enforcement.

MAP OF RADON ZONES: A USEPA publication depicting areas of differing radon potential in both map form and in state specific booklets.

MECHANICALLY VENTILATED CRAWLSPACE SYSTEM: A system designed to increase ventilation within a crawlspace, achieve higher air pressure in the crawlspace relative to air pressure in the soil beneath the crawlspace, or achieve lower air pressure in the crawlspace relative to air pressure in the living spaces, by use of a fan.

MODEL BUILDING CODES: The building codes published by the 4 Model Code Organizations and commonly adopted by state or other jurisdictions to control local construction activity.

MODEL CODE ORGANIZATIONS: Includes the following agencies and the model building codes they promulgate:

- Building Officials and Code Administrators International, Inc. (BOCA National Building Code/1993 and BOCA National Mechanical Code/1993);
- International Conference of Building Officials (Uniform Building Code/1991 and Uniform Mechanical Code/1991);
- Southern Building Code Congress, International, Inc. (Standard Building Code/1991 and Standard Mechanical Code/1991);
- Council of American Building Officials (CABO One- and Two-Family Dwelling Code/1992 and CABO Model Energy Code/1993).

pCi/L: The abbreviation for "picocuries per liter" which is used as a radiation unit of measure for radon. The prefix "pico" means a multiplication factor of one trillionth. A Curie is a commonly used measurement of radioactivity.

SOIL GAS: The gas present in soil which may contain radon.

SOIL-GAS-RETARDER: A continuous membrane or other comparable material used to retard the flow of soil gases into a building.

STACK EFFECT: The overall upward movement of air inside a building that results from heated air rising and escaping through openings in the building super structure, thus causing an indoor pressure level lower than that in the soil gas beneath or surrounding the building foundation.

SUB-SLAB DEPRESSURIZATION SYSTEM (ACTIVE): A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab.

SUB-SLAB DEPRESSURIZATION SYSTEM (PASSIVE): A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a vent pipe routed through the conditioned space of a building and connecting the sub-slab area with outdoor air, thereby relying solely on the convective flow of air upward in the vent to draw air from beneath the slab.

SUB-MEMBRANE DEPRESSURIZATION SYSTEM: A system designed to achieve lower sub-membrane air pressure relative to crawlspace air pressure by use of a fan-powered vent drawing air from under the soil-gas-retarder membrane.

5.0 Principles for Construction of Radon-Resistant Residential Buildings

5.1 The following principles for construction of radon-resistant residential buildings underlie the specific model standards and techniques set forth in section 9.0.

5.1.1 Residential buildings should be designed and constructed to minimize the entrance of soil gas into the living space.

5.1.2 Residential buildings should be designed and constructed with features that will facilitate post-construction radon removal or further reduction of radon entry if installed prevention techniques fail to reduce radon levels below the locally prescribed action level.

5.2 As noted in the limitations section (paragraph 2.0.2), construction standards and techniques specifically applicable to new nonresidential buildings (including high-rise residential buildings), have not yet been fully demonstrated. Accordingly, the specific standards and techniques set forth in section 9.0 should not, at this time, be considered applicable to such buildings. There are, however, several general conclusions that may be drawn from the limited mitigation experience available on large nonresidential construction. These conclusions are summarized below to provide some initial factors for consideration by builders of nonresidential buildings.

5.2.1 HVAC systems should be carefully designed, installed and operated to avoid depressurization of basements and other areas in contact with the soil.

5.2.2 As a minimum, use of a coarse gravel or other permeable base material beneath slabs, and effective sealing of expansion joints and penetrations in foundations below the ground surface will facilitate post-construction installation of a sub-slab depressurization system, if necessary.

5.2.3 Limited mitigation experience has shown that some of the same radon reduction systems and techniques used in residential buildings can be scaled up in size, number, or performance to effectively reduce radon in larger buildings.

6.0 Summary of the Model Building Standards and Techniques

The model building standards and techniques listed in section 9.0 are designed primarily for control of radon in new one- and two family dwellings and other residential buildings three stories or less in height.

6.1 Basement and Slab-on-Grade Foundations.

The model building standards and techniques for radon control in new residential buildings constructed on basement and slab-ongrade foundations include a layer of permeable sub-slab material, the sealing of joints, cracks, and other penetrations of slabs, floor assemblies, and foundation walls below or in contact with the ground surface, providing a soil-gas-retarder under floors and installing either an active or passive sub-slab depressurization system (SSD). Additional radon reduction techniques are prescribed to reduce radon entry caused by the heat induced "stack effect." These include the closing of air passages (also called thermal by-passes), providing adequate makeup air for combustion and exhaust devices, and installing energy conservation features that reduce non-required airflow out of the building superstructure.

6.2 Crawlspace Foundations.

The model building standards and techniques for radon control in new residential buildings constructed on crawlspace foundations include those systems that actively or passively vent the crawlspace to outside air, that divert radon before entry into the crawlspace, and that reduce radon entry into normally occupied spaces of the building through floor openings and ductwork.

6.3 Combination Foundations.

Radon control in new residential buildings constructed on a combination of basement, slab-on-grade or crawlspace foundations is achieved by applying the appropriate construction techniques to the different foundation segments of the building. While each foundation type should be constructed using the relevant portions of these model building standards and techniques, special consideration must be given to the points at which different foundation types join, since additional soil-gas entry routes exist in such locations.

7.0 Construction Methods

The model construction standards and techniques described in section 9.0 have proved to be effective in reducing indoor radon levels when used to mitigate radon problems in existing homes and when applied in construction of new homes. In most cases,

combinations of two or more of these standards and techniques have been applied to achieve desired reductions in radon levels. Because of success achieved in reducing radon levels by applying these multiple, interdependent techniques, limited data have been collected on the singular contribution to radon reduction made by any one of the construction standards or techniques. Accordingly, there has been no attempt to classify or prioritize the individual standards and techniques as to their specific contribution to radon reduction. It is believed that use of all the standards and techniques (both passive and active) will produce the lowest achievable levels of indoor radon in new homes (levels below 2 pCi/L have been achieved in over 90 percent of new homes). It is also believed that use of only selected (passive) standards and techniques will produce indoor radon levels below the current EPA action level of 4 pCi/L in most new homes, even in areas of high radon potential.

7.1 It is recommended that all the passive standards and techniques listed in section 9.0 (including a roughed-in passive radon control system) be used in areas of high radon potential, as defined by local jurisdictions or in EPA's Map of Radon Zones. Based on more detailed analysis of locally available data, jurisdictions may choose to apply more or less restrictive construction requirements within designated portions of their areas of responsibility. To ensure that new homes are below the locally prescribed action level, in those cases where only passive radon control systems have been installed, occupants should have their homes tested to determine if passive radon control systems need to be activated. In addition, it is recommended that periodic retests be conducted to confirm continued effectiveness of the radon control system.

7.2 Any radon testing referenced in this document should be conducted in accordance with EPA Radon Testing Protocols or current EPA guidance for radon testing in real estate transactions as referenced in paragraph 3.0. It is recommended that all testing be conducted by companies listed in EPA's Radon Measurement Proficiency Program (RMP) or comparable State certification programs. [Note: EPA closed its National Radon Proficiency Program on 9/30/98, see epa.gov/radon/proficiency.html for ways to find a "qualified" radon service provider.]

7.3 The design and installation of radon control systems should be performed or supervised by individuals (i.e., builders, their representatives, or registered design professionals such as architects or engineers) who have attended an EPA-approved radon training course, or by an individual listed in the EPA Radon Contractor Proficiency Program. [Note: EPA closed its National Radon Proficiency Program on 9/30/98, see epa.gov/radon/proficiency.html for ways to find a "qualified" radon service provider.]

8.0 Recommended Implementation Procedures

The following procedures are recommended as guidelines for applying the model building standards and techniques and construction methods contained in this document. These procedures are based on the rationale that a passive radon control system and features to facilitate any necessary post-construction radon reduction

should be routinely built-in to new residential buildings in areas having a high radon potential.

8.1 State, county, or local jurisdictions that use these model building standards and techniques as a basis for developing building codes for radon resistant construction should classify their area by reference to the Zones in EPA's Map of Radon Zones or by considering other locally available data. While EPA believes that the Map of Radon Zones and accompanying state-specific booklets are useful in setting general boundaries of areas of concern, EPA recommends that state and local jurisdictions collect and analyze local indoor radon measurements, and assess geology, soil parameters and housing characteristics --in conjunction with referring to the EPA radon maps -- to determine the specific areas within their jurisdictions that should be classified as Zone 1.

8.2 State, county, or local jurisdictions that use these model building standards and techniques as a basis for developing building codes for radon-resistant construction should specify the construction methods applicable to their jurisdictional area.

8.2.1 In areas classified as Zone 1 in the Map of Radon Zones, or by local jurisdiction, application of the construction method in paragraph 7.1 is recommended.

8.2.2 In areas classified as Zone 2, home builders may apply any of the radon-resistant construction standards and techniques that contribute to reducing the incidence of elevated radon levels in new homes and that are appropriate to the unique radon potential that may exist in their local building area.

8.2.3 In those areas where state and local jurisdictions have analyzed local indoor radon measurements, geology, soil parameters, and housing characteristics and determined that there is a low potential for indoor radon, application of radon-resistant construction techniques may not be appropriate. In these areas, radon-resistant construction techniques may not be needed, or limited use of selected techniques may be sufficient.

8.3 It is recognized that specific rules, regulations, or ordinances covering implementation of construction standards or codes are developed and enforced by state or local jurisdictions. While developing the model construction standards and techniques contained in this document, EPA also developed several approaches to regulation that states or local jurisdictions may find useful and appropriate as they develop rules and regulations that meet their unique requirements. For example:

8.3.1 In areas where the recommended construction method or comparable prescriptive methods are mandated by state or local jurisdictions, regulations would need to include, as part of the inspection process, a review of the radon-resistant construction features by inspectors who have received additional training, to ensure that the radon-resistant construction features are properly installed during construction. It would also be necessary to establish requirements for those building officials who review and approve

construction plans and specifications to become proficient in identifying and approving planned radon-resistant construction features.

8.3.2 In any area where surveys have shown the existence of high levels of radon in groundwater, or in areas where elevated levels of indoor radon have been found in homes already equipped with active radon control systems, well water may be the source. In such areas, authorities responsible for water regulation should consider establishing well water testing requirements that include tests for radon.

9.0 Model Building Standards and Techniques

9.1 Foundation and Floor Assemblies. The following construction techniques are intended to resist radon entry and prepare the building for post-construction radon mitigation, if necessary. These techniques, when combined with those listed in paragraph 9.2, meet the requirements of the construction method outlined in paragraph 7.1. (See also the construction methods listed in ASTM Standard Guide, E-1465-92.)

9.1.1 A layer of gas permeable material shall be placed under all concrete slabs and other floor systems that directly contact the ground and are within the walls of the living spaces of the building, to facilitate installation of a sub-slab depressurization system, if needed. Alternatives for creating the gas permeable layer include:

a. A uniform layer of clean aggregate, a minimum of 4 inches thick. The aggregate shall consist of material that will pass through a 2-inch sieve and be retained by a 1/4-inch sieve.

b. A uniform layer of sand, a minimum of 4 inches thick, overlain by a layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.

c. Other materials, systems, or floor designs with demonstrated capability to permit depressurization across the entire subfloor area.

9.1.2 A minimum 6-mil (or 3-mil cross laminated) polyethylene or equivalent flexible sheeting material shall be placed on top of the gas permeable layer prior to pouring the slab or placing the floor assembly to serve as a soil-gas-retarder by bridging any cracks that develop in the slab or floor assembly and to prevent concrete from entering the void spaces in aggregate base material. The sheeting should cover the entire floor area, and separate sections of sheeting should be overlapped at least 12 inches. The sheeting shall fit closely around any pipe, wire or other penetrations of the material. All punctures or tears in the material shall be sealed or covered with additional sheeting.

9.1.3 To minimize the formation of cracks, all concrete floor slabs shall be designed, mixed, placed, reinforced, consolidated, finished, and cured in accordance with standards set forth in the Model Building Codes. The American Concrete Institute publications, "Guide for Concrete Floor and Slab Construction," ACI 302.1R, "Guide to Residential Cast-in-Place Concrete Construction," ACI 332R, or the Post Tensioning

Institute Manual, "Design and Construction of Post-Tensioned Slabs on Ground" are references that provide additional information on construction of concrete floor slabs.

9.1.4 Floor assemblies in contact with the soil and constructed of materials other than concrete shall be sealed to minimize soil gas transport into the conditioned spaces of the building. A soil-gas-retarder shall be installed beneath the entire floor assembly in accordance with paragraph 9.1.2.

9.1.5 To retard soil gas entry, large openings through concrete slabs, wood, and other floor assemblies in contact with the soil, such as spaces around bathtub, shower, or toilet drains, shall be filled or closed with materials that provide a permanent airtight seal such as non-shrink mortar, grouts, expanding foam, or similar materials designed for such application.

9.1.6 To retard soil gas entry, smaller gaps around all pipe, wire, or other objects that penetrate concrete slabs or other floor assemblies shall be made air tight with an elastomeric joint sealant, as defined in ASTM C920-87, and applied in accordance with the manufacturer's recommendations.

9.1.7 To retard soil gas entry, all control joints, isolation joints, construction joints, and any other joints in concrete slabs or between slabs and foundation walls shall be sealed. A continuous formed gap (for example, a "tooled edge") which allows the application of a sealant that will provide a continuous, airtight seal shall be created along all joints. When the slab has cured, the gap shall be cleared of loose material and filled with an elastomeric joint sealant, as defined in ASTM C920-97, and applied in accordance with the manufacturer's recommendations.

9.1.8 Channel type (French) drains are not recommended. However, if used, such drains shall be sealed with backer rods and an elastomeric joint sealant in a manner that retains the channel feature and does not interfere with the effectiveness of the drain as a water control system.

9.1.9 Floor drains and air conditioning condensate drains that discharge directly into the soil below the slab or into crawlspaces should be avoided. If installed, these drains shall be routed through solid pipe to daylight or through a trap approved for use in floor drains by local plumbing codes.

9.1.10 Sumps open to soil or serving as the termination point for sub-slab or exterior drain tile loops shall be covered with a gasketed or otherwise sealed lid to retard soil gas entry. (Note: If the sump is to be used as the suction point in an active sub-slab depressurization system, the lid should be designed to accommodate the vent pipe. If also intended as a floor drain, the lid shall also be equipped with a trapped inlet to handle any surface water on the slab.)

9.1.11 Concrete masonry foundation walls below the ground surface shall be constructed to minimize the transport of soil gas from the soil into the building. Hollow

block masonry walls shall be sealed at the top to prevent passage of air from the interior of the wall into the living space. At least one continuous course of solid masonry, one course of masonry grouted solid, or a poured concrete beam at or above finished ground surface level shall be used for this purpose. Where a brick veneer or other masonry ledge is installed, the course immediately below that ledge shall also be sealed.

9.1.12 Pressure treated wood foundations shall be constructed and installed as described in the National Forest Products Association (NFPA) Manual, "Permanent Wood Foundation System - Basic Requirements, Technical Report No. 7." In addition, NFPA publication, "Radon Reduction in Wood Floor and Wood Foundation Systems" provides more detailed information on construction of radon-resistant wood floors and foundations.

9.1.13 Joints, cracks, or other openings around all penetrations of both exterior and interior surfaces of masonry block or wood foundation walls below the ground surface shall be sealed with an elastomeric sealant that provides an air-tight seal. Penetrations of poured concrete walls should also be sealed on the exterior surface. This includes sealing of wall tie penetrations.

9.1.14 To resist soil gas entry, the exterior surfaces of portions of poured concrete and masonry block walls below the ground surface shall be constructed in accordance with water proofing procedures outlined in the Model Building Codes.

9.1.15 Placing air handling ducts in or beneath a concrete slab floor or in other areas below grade and exposed to earth is not recommended unless the air handling system is designed to maintain continuous positive pressure within such ducting. If ductwork does pass through a crawlspace or beneath a slab, it should be of seamless material. Where joints in such ductwork are unavoidable, they shall be sealed with materials that prevent air leakage.

9.1.16 Placing air handling units in crawlspaces, or in other areas below grade and exposed to soil-gas, is not recommended. However, if such units are installed in crawlspaces or in other areas below grade and exposed to soil gas, they shall be designed or otherwise sealed in a durable manner that prevents air surrounding the unit from being drawn into the unit.

9.1.17 To retard soil gas entry, openings around all penetrations through floors above crawlspaces shall be sealed with materials that prevent air leakage.

9.1.18 To retard soil gas entry, access doors and other openings or penetrations between basements and adjoining crawlspaces shall be closed, gasketed or otherwise sealed with materials that prevent air leakage.

9.1.19 Crawlspaces should be ventilated in conformance with locally adopted codes. In addition, vents in passively ventilated crawlspaces shall be open to the exterior and be of noncloseable design.

9.1.20 In buildings with crawlspace foundations, the following components of a passive sub-membrane depressurization system shall be installed during construction: (Exception: Where local codes permit mechanical crawlspace ventilation or other effective ventilation systems, and such systems are operated or proven to be effective year round, the sub-membrane depressurization system components are not required.)

9.1.20.1 The soil in both vented and nonvented crawlspaces shall be covered with a continuous layer of minimum 6-mil thick polyethylene sheeting or equivalent membrane material. The sheeting shall be sealed at seams and penetrations, around the perimeter of interior piers, and to the foundation walls. Following installation of underlayment, flooring, plumbing, wiring, or other construction activity in or over the crawlspace, the membrane material shall be inspected for holes, tears, or other damage, and for continued adhesion to walls and piers. Repairs shall be made as necessary.

9.1.20.2 A length of 3- or 4-inch diameter perforated pipe or a strip of geotextile drainage matting should be inserted horizontally beneath the sheeting and connected to a 3- or 4-inch diameter "T" fitting with a vertical standpipe installed through the sheeting. The standpipe shall be extended vertically through the building floors, terminate at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings.

9.1.20.3 All exposed and visible interior radon vent pipes shall be identified with at least one label on each floor level. The label shall read: "Radon Reduction System."

9.1.20.4 To facilitate installation of an active sub-membrane depressurization system, electrical junction boxes shall be installed during construction in proximity to the anticipated locations of vent pipe fans and system failure alarms.

9.1.21 In basement or slab-on-grade buildings the following components of a passive sub-slab depressurization system shall be installed during construction.

9.1.21.1 A minimum 3-inch diameter PVC or other gas-tight pipe shall be embedded vertically into the sub-slab aggregate or other permeable material before the slab is poured. A "T" fitting or other support on the bottom of the pipe shall be used to ensure that the pipe opening remains within the sub-slab permeable material. This gas tight pipe shall be extended vertically through the building floors, terminate at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings. (Note: Because of the uniform permeability of the sub-slab layer prescribed in paragraph 9.1.1, the precise positioning of the vent pipe through the slab is not critical to system

performance in most cases. However, a central location shall be used where feasible.) In buildings designed with interior footings (that is, footings located inside the overall perimeter footprint of the building) or other barriers to lateral flow of sub-slab soil gas, radon vent pipes shall be installed in each isolated, nonconnected floor area. If multiple suction points are used in nonconnected floor areas, vent pipes are permitted to be manifolded in the basement or attic into a single vent that could be activated using a single fan.

9.1.21.2 Internal sub-slab or external footing drain tile loops that terminate in a covered and sealed sump, or internal drain tile loops that are stubbed up through the slab are also permitted to provide a roughed-in passive sub- slab depressurization capability. The sump or stubbed up pipe shall be connected to a vent pipe that extends vertically through the building floors, terminates at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings.

9.1.21.3 All exposed and visible interior radon vent pipes shall be identified with at least one label on each floor level. The label shall read: "Radon Reduction System."

9.1.21.4 To facilitate installation of an active sub-slab depressurization system, electrical junction boxes shall be installed during construction in proximity to the anticipated locations of vent pipe fans and system failure alarms.

9.1.21.5 In combination basement/crawlspace or slab-on-grade/crawlspace buildings, the sub-membrane vent described in paragraph 9.1.20.2 may be tied into the sub-slab depressurization vent to permit use of a single fan for suction if activation of the system is necessary.

9.2 Stack Effect Reduction Techniques.

The following construction techniques are intended to reduce the stack effect in buildings and thus the driving force that contributes to radon entry and migration through buildings. As a basic principle, the driving force decreases as the number and size of air leaks in the upper surface of the building decrease. It should also be noted that in most cases, exhaust fans contribute to stack effect.

9.2.1 Openings around chimney flues, plumbing chases, pipes, and fixtures, ductwork, electrical wires and fixtures, elevator shafts, or other air passages that penetrate the conditioned envelope of the building shall be closed or sealed using sealant or fire resistant materials approved in local codes for such application.

9.2.2 If located in conditioned spaces, attic access stairs and other openings to the attic from the building shall be closed, gasketed, or otherwise sealed with materials that prevent air leakage.

9.2.3 Recessed ceiling lights that are designed to be sealed and that are Type IC rated shall be used when installed on top-floor ceilings or in other ceilings that connect to air passages.

9.2.4 Fireplaces, wood stoves, and other combustion or vented appliances, such as furnaces, clothes dryers, and water heaters shall be installed in compliance with locally adopted codes, or other provisions made to ensure an adequate supply of combustion and makeup air.

9.2.5 Windows and exterior doors in the building superstructure shall be weather stripped or otherwise designed in conformance with the air leakage criteria of the CABO Model Energy Code.

9.2.6 HVAC systems shall be designed and installed to avoid depressurization of the building relative to underlying and surrounding soil. Specifically, joints in air ducts and plenums passing through unconditioned spaces such as attics, crawlspaces, or garages shall be sealed.

9.3 Active Sub-Slab/Sub-Membrane Depressurization System.

When necessary, activation of the roughed-in passive sub-membrane or sub-slab depressurization systems described in paragraphs 9.1.20 and 9.1.21 shall be completed by adding an exhaust fan in the vent pipe and a prominently positioned visible or audible warning system to alert the building occupant if there is loss of pressure or air flow in the vent pipe.

9.3.1 The fan in the vent pipe and all positively pressurized portions of the vent pipe shall be located outside the habitable space of the building.

9.3.2 The fan in the vent pipe shall be installed in a vertical run of the vent pipe.

9.3.3 Radon vent pipes shall be installed in a configuration and supported in a manner that ensures that any rain water or condensation accumulating within the pipes drains downward into the ground beneath the slab or soil-gas-retarder.

9.3.4 To avoid reentry of soil gas into the building, the vent pipe shall exhaust at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings.

9.3.5 To facilitate future installation of a vent fan, if needed, the radon vent pipe shall be routed through attics in a location that will allow sufficient room to install and maintain the fan.

9.3.6 The size and air movement capacity of the vent pipe fan shall be sufficient to create and maintain a pressure field beneath the slab or crawlspace membrane that is lower than the ambient pressure above the slab or membrane.

9.3.7 Under conditions where soil is highly permeable, reversing the air flow in an active sub-slab depressurization system and forcing air beneath the slab may be effective in reducing indoor radon levels. (Note: The long-term effect of active sub-slab depressurization or pressurization on the soil beneath building foundations has not been determined. Until ongoing research produces definitive data, in areas where expansive soils or other unusual soil conditions exist, the local soils engineer shall be consulted during the design and installation of sub-slab depressurization or pressurization systems.)

This page is intentionally blank.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix G

Community outreach tools — additional information

[This appendix is a modified version of Appendix A from the New York State Department of Environmental Conservation Division of Environmental Remediation's "Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook" (June 1998).]

Additional information about several of the community outreach tools discussed in Section 5 of the guidance document is provided in this appendix. These tools are as follows:

Appendix G.1 Contact List
Appendix G.2 Fact Sheet
Appendix G.3 Public Meeting
Appendix G.4 Availability Session
Appendix G.5 Toll-free "800" Numbers
Appendix G.6 Door-to-door Visits
Appendix G.7 Document Repository

The additional information provided for each tool includes the following:

Description — Summarizes what the technique is and what it achieves.

Suggestions for Planning and Conducting — Offers basic ideas to develop and implement the technique successfully.

Benefits and Limitations — Describes specific benefits the technique can help achieve, and potential impediments to its effectiveness.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.1 Contact List

G.1.1 Description

A contact list contains names, addresses and telephone numbers of individuals and organizations with interest or involvement in the site. They may be affected by or interested in the site, or have information that staff need to make effective remedial decisions. Contact lists typically include residents near the site, elected officials, appropriate federal, state, and local government contacts, local media, organized environmental groups and responsible party, as well as local business, civic and recreational groups.

The site contact list is a critical communications tool that needs to be prepared *before* other activities can be conducted. In some ways, a site-specific citizen participation program will only be as effective as its contact list, which more or less determines who gets the project information prepared, as well as invitations to participate and provide input. Development and revision of the contact list are ongoing activities throughout the site's remediation.

It is recommended that an internal distribution list be developed while preparing the external contact list. The distribution list should include all staff (NYSDEC, NYSDOH, county health department, etc.) involved in the site. This list will help ensure that all staff involved with the project will receive the same information about all phases of the site's remediation.

Note: The checklist on page G-6 will help to identify who may need to be included in a particular site's contact list.

Contact lists are used to

- send a fact sheet announcing a major project decision or proposal, project status or progress, or a public meeting or availability session;
- issue summaries of draft/final documents and announce availability of full documents;
- send a response to public questions and comments;
- transmit a request to the public for information needed by project staff;
- send summaries of information exchanged at public meetings, forums, availability sessions and other public gatherings; and
- identify individuals, groups and organizations by affiliation, interest or geographic location to help to target communication and outreach as appropriate.

G.1.2 Suggestions for Creating an Effective Contact List

Several factors help to determine the size and make up of a site's contact list, including the following:

- the nature and size of the community, whether rural, urban, densely or sparsely populated;
- the nature of hazardous waste contamination, whether confined to an area or environmental medium or more ubiquitous (and thus involving air issues, municipal well contamination, etc.);
- real or perceived impacts of site contamination on the environment, property values, and human health;
- specifics of the proposed remedial solution, especially where there are real or perceived off-site impacts (such as dust, noise, air quality);
- the stage of the remedial process and the specific issues and audiences involved;

- characteristics of the involved audience;
- the information that needs to be exchanged; and
- program resources.

The contact list will change as a remedial program progresses. These changes reflect increasing or declining interest by different individuals, groups and organizations in various aspects of the program.

G.1.2.1 Some categories are a "given" for every contact list

Some individuals, organizations and representatives should be included in *every* contact list:

- those who are directly affected, such as residents, property owners, and commercial establishments next to the site;
- local elected officials (mayors, supervisors, council members, clerks);
- local emergency services officials;
- local media; and
- relevant business, civic, and environmental organizations.

G.1.2.2 Apply criteria to determine who else should be included

Additional individuals, groups and organizations often are included in site contact lists. The following questions about the site will help determine whether the contact list is complete:

- Who has been — or currently is — affected by site contamination, or by investigation and remediation of the site?
- Who *perceives* that he/she has been — or currently is — affected by site contamination or by investigation and remediation of the site?
- Who is likely to be affected or interested as remediation progresses?
- Who has demonstrated past interest — or currently is showing interest — in the site or the remedial process?
- Who may need information about site contamination or the remedial program who is not currently on the contact list?
- Who may have information that project staff needs who is not currently on the contact list?

G.1.2.3 Build upon existing information

For many sites, an initial list of adjacent residents and local officials is developed when the NYSDEC sends classification or reclassification letters, etc. This list can be checked for accuracy and updated as needed. It can serve as a core group for the contact list.

G.1.2.4 Include people who have shown interest

Review project files to identify people who have historically demonstrated interest in the site. Review sign-in sheets from public meetings and availability sessions; include people who have written letters about the site to the state or other party, or who have called project staff or the NYSDEC or NYSDOH's toll-free information numbers.

G.1.2.5 Ask other staff

Ask staff from the state, county or other agencies to share contacts they have had with individuals, groups and organizations affected by or interested in the site.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.1.2.6 Consult resource people and published lists

Ask municipal clerks and public works department staff (sewer or water system user lists); consult telephone or municipal directories, tax rolls and tax maps.

G.1.2.7 Ask the involved public

Ask the public with whom you are already communicating about the site to identify other individuals and organizations you should include.

G.1.2.8 Monitor media accounts

This includes newspaper, radio and television reports about the site, which often identify individuals and organizations interested in the site.

G.1.2.9 Make use of site visits

Use site visits as an opportunity to evaluate the community from the following points of view: Who is affected? Who is interested?

G.1.2.10 Organize the contact list into categories

This is particularly useful, especially when a list is large. You may need to target specific sub-groups for communication (for example, adjacent residents and local officials). Groups may be categorized based on geography (proximity to the site, political boundaries); by affiliation (unit of government, adjacent residents, environmental civic or business group) or by interest (e.g., remedial alternatives, future site use, off-site impacts, etc.).

G.1.2.11 Key contacts

Consider creating a short list of individuals and organizations likely to play an important participation role, or who need to be notified of project developments on short notice. *It is especially important to keep this list current and accurate.*

G.1.2.12 Update

Review and update the contact list regularly as changes, additions and deletions are obtained. Individuals and organizations may gain or lose interest or change roles in the program at different remedial stages. The need for information from certain members of the public at different stages may also change. A contact person for an organization may change if he or she is an elected official.

G.1.3 Benefits and Limitations

- A contact list helps to identify the affected and interested public, and their affiliations, locations and levels of interest.
- When categorized, a contact list helps project staff to deliver specific information to particular affected and interested individuals, groups and organizations and to plan specific communication activities.
- A contact list helps to inform public directly, without media and others filtering the information.
- A contact list helps to make written and telephone contact with the public systematic and efficient. It gives project staff confidence that affected/interested public is receiving important site information.
- A contact list, particularly a large one, requires staff time to create, update and maintain in useful form. An outdated or deficient contact list is worthless and erodes the effectiveness of the entire site-specific outreach program.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Checklist for Site Contact List

Adjacent/Nearby Affected Parties:

- ❑ Residents/property owners/commercial establishments
- ❑ Owners of rights-of-way (utilities, etc.)
- ❑ Neighborhood association
- ❑ Residents/property owners affected by remedial activity (truck routes, water line extensions)
- ❑ Municipal water suppliers

Local Officials, Committees and Boards:

- ❑ Mayor/supervisor
- ❑ City council/town board members
- ❑ Municipal clerk
- ❑ Planning board/zoning board
- ❑ School boards, officials, PTAs
- ❑ Municipal engineer/public works official
- ❑ Municipal attorney
- ❑ Police/fire/emergency services officials
- ❑ Conservation Advisory Committee

County/Regional Officials, Boards and Organizations:

- ❑ County Administrator
- ❑ County Legislator(s) for site's district
- ❑ County clerk
- ❑ County Health Department
- ❑ Environmental Management Council
- ❑ Soil and Water Conservation District
- ❑ Cooperative Extension
- ❑ Farm Bureau

State Official and Agencies:

- ❑ State senators and Assembly members
- ❑ NYSDEC
- ❑ NYSDOH
- ❑ NYS Department of Law
- ❑ NYS Department of State
- ❑ NYS Department of Transportation
- ❑ Governor's office

Federal Officials and Agencies:

- ❑ U.S. Senators, U.S. Representatives
- ❑ Environmental Protection Agency
- ❑ Occupational Safety and Health Adm.
- ❑ Office of Technology Assessment
- ❑ Department of Defense
- ❑ Department of Energy

Civic/Environmental/Recreational Groups:

- ❑ Outdoor/recreational groups (rod & gun clubs, hiking, biking, boating, birding interests)
- ❑ Local/regional citizens groups
- ❑ Rotary/VFW/American Legion/Lion's Club
- ❑ League of Women Voters
- ❑ Citizens Environmental Coalition, NYPIRG, Audubon, Trout Unlimited, etc.

Economic Interests:

- ❑ Responsible party
- ❑ Title 3 grant recipient
- ❑ Financial institutions/lenders
- ❑ Real estate developers/agencies
- ❑ Chamber of commerce
- ❑ Local economic development board

Local/Regional Media:

- ❑ Newspapers (daily, weekly)
- ❑ Radio and television stations

Geographic-specific Government Bodies and Subdivisions:

- ❑ Community boards established by New York City charter
- ❑ Adirondack Park Agency
- ❑ Tug Hill Plateau Commission
- ❑ New York City Department of Sanitation
- ❑ Adjacent state
- ❑ Canada
- ❑ Native American Nation

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.2 Fact Sheet

G.2.1 Description

A fact sheet is a written summary of important information about a hazardous waste site and its remedial program. It presents information in clear, concise terms for the affected and interested community. It may focus on remedial activities, legal or health issues and citizen participation opportunities.

Fact sheets ensure that site information is distributed consistently and that citizens understand the salient issues associated with the site's remedial program.

A fact sheet is a versatile tool that can be used for many purposes. It can do the following:

- announce a milestone in the site's remedial program or important site findings;
- describe major changes in the type, scope or schedule or previously announced site program activities;
- provide a "status report" during long periods of investigation or remedial construction;
- describe results or remediation efforts;
- announce availability of a document;
- publicize a public comment period or other opportunities for public input;
- announce an upcoming public meeting or availability session;
- supplement or follow up door-to-door visits; and
- complement presentations at a public meeting.

G.2.2 Suggestions for Creating a Fact Sheet

Preparation of a fact sheet can be divided into several general steps that include *planning, development and distribution*.

Note: A checklist that summarizes these major steps is on page G-12.

PLANNING THE FACT SHEET

G.2.2.1 Planning by asking questions

Before writing a fact sheet, answer the following questions to help guide your effort:

- What do readers need to know and remember? Why?
- Who is the audience for the fact sheet?
- Why should the audience read the fact sheet?
- Do you want the audience to *do* something, or *provide* something to you?
- Is the information "time-sensitive"? If so, how will this influence the way in which you distribute the fact sheet?

G.2.2.2 Identifying the message

What are the one or two *main* points that you need to communicate to the reader? These could include site findings or results, a program milestone, beginning of field work, a comment period or other opportunity for the public to provide input about the project, a public meeting, or a major change in the program. The points you identify become the focus of the fact sheet.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Besides the issues important to project staff, what issues are important to the audience? Consider acknowledging and addressing them; otherwise, the fact sheet may deter readers who will conclude that the material is irrelevant to their concerns.

In addition to the few key points you wish to emphasize, a site fact sheet always should describe

- the site's history and why it is being investigated or remediated;
- upcoming citizen participation opportunities;
- the site's document repository; and
- staff contacts and ways for readers to obtain additional information.

G.2.2.3 Defining the audience

Determine who in the affected/interested community should receive the fact sheet. Part or all of the contact list? Specific categories of people such as adjacent residents or local officials? The information contained in the fact sheet helps to identify appropriate recipients.

G.2.2.4 Distribution and logistics

Determine how to get the fact sheet into the hands of the people who need to read it. A fact sheet can be

- mailed to all or part of the site's contact list (see Appendix G.1 for a discussion about developing a site contact list);
- distributed at a public meeting or availability session;
- placed in document repositories; and
- provided to residents during door-to-door visits.

Note: The site's contact list, if you use it, should be complete and up-to-date. Be sure to include people who have attended site public meetings, or who have called or written letters about the site. Make any necessary changes based on recent local, regional or statewide elections.

During the planning stage, determine who will reproduce the fact sheet, generate labels, stuff envelopes and oversee mailing or other distribution.

G.2.2.5 Allocating responsibilities

While it is generally best to designate a point person with overall responsibility for the fact sheet, determine during planning who else needs to participate in writing, review or distribution. Be sure all necessary staff are informed and brought into the fact sheet development process in a timely way.

G.2.2.6 Timing

Does the fact sheet announce imminent remedial field work (major onsite sampling or an interim remedial action or remedial construction)? Is a major site document being made available for public review, has a public meeting been scheduled, or is a comment period about to begin?

These questions highlight cases in which timely distribution of the fact sheet is particularly important. In such situations, the fact sheet's value is twofold: a) it provides the public with information and b) invites the public's action before the important site activity begins. This means that you should build sufficient time into the fact sheet development schedule to ensure its distribution well ahead of time.

G.2.2.7 Outline

Begin writing by constructing a skeletal summary of the information, from most to least important. If it is difficult to get started, the following suggestions may help jump start the process:

- Write a summary using the *Who, What, When, Where, How, Why* method. Then add facts and details. Don't worry about writing polished text at this point;
- Try writing a headline or a simple declarative sentence proclaiming the most important fact you want to convey to the reader. For example: "State to Begin Cleanup of Hazardous Waste Contamination at Chem-Spill Site." Then begin hanging important facts on the sentence, regardless of the order in which they will ultimately appear in the text.

G.2.2.8 Selecting a format

Write clearly and concisely. Wherever possible, avoid jargon and acronyms; if they are essential to your explanation, define them clearly. This is especially important if you, for example, incorporate a test from a technical report written for specialists into a fact sheet intended for a general audience.

G.2.2.9 Capturing the reader's attention

The fact sheet must compete with all the other mail that readers have to wade through every day. Assume there are only a few seconds available to attract and hold a reader's attention to the message. Here are a few ways to do it:

- Grab the reader's attention with an informative headline.
- The lead paragraph (or at the very least the first page) of the fact sheet should contain the essence of what readers most need to know. This will help to ensure that even the most casual reader will capture the essentials of your message, even if he or she fails to turn the page or "recycles" the fact sheet after reading just the opening paragraph.
- Condense important information to essentials. If more detail is necessary, guide the reader to additional information within the fact sheet, but do not begin with background or historical information; such information, although useful, should never be the most important news for your reader. The fact sheet should lead with the most important piece of information that readers should know.
- Maps and graphics improve and increase reader understanding. The fact sheet should include a site map to help readers pinpoint the site's location, especially those who are not nearby residents. Can a simplified schematic diagram to depict the remedial technology you may be discussing be included?

G.2.2.10 Reviewing and rewriting

Make the material concise, accurate and readable, taking care to include information that should be part of every fact sheet: ways to obtain additional information, public involvement opportunities and repository information. Delete information that does not contribute to the reader's knowledge or understanding included.

Note: Staff who contributed information to the fact sheet, or who wrote portions of the fact sheet, or whose program responsibilities are described in the fact sheet, should be encouraged to review the draft before it is finalized. This includes staff from other agencies. Build enough time into the development schedule not only for reviewing and commenting, but also for incorporating important comments into the draft.

It helps to have someone not familiar with the site read the draft fact sheet for clarity and understanding. An "outsider" can provide a fresh perspective.

DISTRIBUTING THE FACT SHEET

Distribution involves the following: *who* will handle logistics, *how* distribution is conducted and *timing*.

G.2.2.11 Determining who does what

Who will handle photocopying, envelope stuffing and mailing or other distribution? Who will develop mailing labels? Don't leave these decisions until the last minute, especially if the fact sheet contains time-sensitive information. Decide during the planning stage.

G.2.2.12 Selecting method of distribution

Will all or part of the site contact list be used? If so, be sure it is up to date. Have the names from the most recent public meeting sign-in sheets been added? Did officials change after the last election?

Alternatives to mailing the fact sheet include the following: dispensing at public meetings and availability sessions, distributing during door-to-door visits, and inserting in another mailing.

G.2.2.13 Timing

The information contained in the fact sheet is time-sensitive if it announces the following:

- an upcoming public meeting (people should receive the fact sheet two weeks before the meeting so they can clear their calendars and avoid conflicts with other events);
- the start and end dates of an upcoming public comment period (the public should receive the fact sheet *before* the comment period begins; otherwise a 30-day comment period becomes, in reality, a 25-day comment period);
- imminent field investigation or construction work (e.g., workers in protective gear in the field, or a street closed or full of traffic, or the water supply to be shut off); and
- availability of an important site document for public comment, or that staff will discuss at an upcoming public meeting (people need to know in a timely way, for example, that the document is at the repository, or that it will be the focus of the public meeting).

Sufficient time should be allowed in the development and review schedule to ensure that the fact sheet is distributed, *and that it is received*, before the critical activity takes place.

G.2.3 Benefits and Limitations

- A fact sheet can effectively summarize important facts about a site's remedial program. It can also invite the public's participation in the site's decision-making process. A fact sheet often can be developed relatively quickly and distributed to a specific audience.

- Information can be provided directly to the audience without having to rely on coverage by local news media. Though local media should always be included in the intended readership, they may use some, all or none of the information contained in the fact sheet.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

- A fact sheet can supplement or emphasize information provided at meetings and other forums, or can be used as a follow-up to other activities.

- When sent to the affected community throughout a site's remedial process, fact sheets can help a community stay informed and involved and demonstrate the state's commitment to public involvement.

- Sometimes a fact sheet can take significant time to plan and develop. It often requires careful coordination among staff.

- Instead of increasing public understanding, a poorly written fact sheet may mislead and confuse. Unless the fact sheet's message is clear and immediately apparent, the reader may quickly lose interest.

- If the fact sheet does not acknowledge issues that are important to the community, readers may dismiss the information as irrelevant.

- It may be difficult to determine, short of polling the audience, how many of the read the fact sheet, and how much information they retain. The fact sheet must compete with a lot of other mail for the attention of people who have limited free time to read.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Checklist to Plan, Develop and Distribute a Fact Sheet

- ❑ Determine purpose and message of fact sheet
- ❑ Identify audience and recipients
- ❑ Determine method of distribution
  - ❑ Update contact list (if mailing)
- ❑ Develop schedule for development and distribution
- ❑ Develop outline of fact sheet
  - ❑ Coordinate with project staff
  - ❑ Collect information
  - ❑ Assemble appropriate graphics
- ❑ Write draft fact sheet. Incorporate information and graphics.
- ❑ Coordinate project staff review
- ❑ Arrange reproduction of fact sheet in appropriate quantity
- ❑ Distribute fact sheet
  - ❑ Generate mailing labels, stuff envelopes and mail **and/or**
  - ❑ Insert fact sheet in separate mailing **and/or**
  - ❑ Distribute at public meeting or availability session **and/or**
  - ❑ Hand out during door-to-door visits **and**
  - ❑ Mail to document repository(ies)
- ❑ If fact sheet contains "time-sensitive" information about field work, a comment period, release of project document or other upcoming activity, ensure distribution before the start of the activity.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.3 Public Meeting

G.3.1 Description

A public meeting brings together project staff with affected and interested citizens. Staff generally present information and answer questions, while citizens are encouraged to ask questions and provide comments.

A public meeting usually is held at a milestone in a site's remedial program, or to describe progress during a lengthy remedial stage. The meeting generally has a well-defined structure, spelled out in a formal agenda. Discrete time periods generally are defined for presentations, questions and answers, and public comment.

A public meeting helps

- ensure that important information about a site's remedial program is delivered in a consistent way to a large audience;
- identify issues and concerns important to the affected/interested community;
- ask the community for information about site history and conditions before beginning major investigation activity;
- gather public comment about a specific issue; and
- demonstrate to an emotionally-charged community that environmental officials are accessible and accountable. In such cases a public meeting should be supplemented with other outreach activities designed to help work through emotion and contribute to problem-solving. A meeting should *not* be held simply to encourage the public to vent.

G.3.2 Suggestions for Planning and Conducting a Public Meeting

Note: A checklist that summarizes major steps to plan and conduct a public meeting is on page G-19.

G.3.2.1 Identifying the need for a public meeting

- Define the status of the site's overall remedial and decision making process;
- Identify, in specific terms, the needs of the project staff and the community regarding information and involvement. How do those needs relate to the site's overall remedial process? Define objectives to meet those needs.
- Is a public meeting required at this point in the site's remedial process, or is it being considered as an optional activity to supplement the public outreach effort?
- Have other kinds of outreach activities been reviewed to determine whether any of them could more effectively accomplish the objectives?

If it is determined that a public meeting is required or appropriate at this time, proceed with organizing the meeting.

G.3.2.2 Objectives and participants

Public meetings often are conducted because of a remedial milestone or to report progress during a lengthy remedial stage. Answers to questions such as the following will help to define the goals and objectives of the meeting:

- What must be accomplished at the meeting?
- What important information must be given to or gathered from attendees? Ideally, who should these attendees be?

- What issues, questions and concerns are attendees likely to raise, whether or not related to the issues and information the project staff will discuss?

Identify program staff who have appropriate expertise and knowledge to provide the information identified and to address public comments and questions. At a minimum, staff should participate who have the program responsibilities for the remedial activities that will be the focus of the meeting.

G.3.2.3 Framework and format

Project staff should develop an agenda based on the goals of the meeting. The agenda should identify presentations to be made to the audience, the major points and the presenters. Develop handouts and other necessary supporting materials; at a minimum, these should include the agenda or a summary of the main points to be discussed, as well as a fact sheet.

Other useful supporting materials include slides and overheads (transparencies), maps and charts, cutaway sketches, blueprints, photographs, tools and instruments and even samples of liner material or other remedial equipment.

Be sure each participating staff person understands which items they are responsible for, as well as the timetable for their development.

Although slides and overheads are useful support tools, they should not overwhelm the presentation. A few suggestions:

- Use only as many slides or overheads as necessary. An AV extravaganza usually detracts from your message — the audience can be worn out, confused or overwhelmed by a myriad of charts, graphs and tables.
- Focus the message. Each slide and overhead should deal with one idea or concept. Use key words, phrases, and illustrations. Avoid undefined acronyms and technical language. Avoid the temptation to pull an entire page of text or an elaborate chart of sampling results from a technical report and throw it onto a screen. Extract the most significant statistics onto a simple overhead. Every second your audience must wade through a detailed overhead is a second spent not listening to you.
- Use large size typeface. People in the back of the room need to be able to read the material.
- Consider providing attendees with paper copies of your overheads, so they can follow along from their seats.
- After you're through with a slide or overhead, turn off the projector, or remove or cover the image. Otherwise, the audience will be distracted by the image long after you have moved on to new material.

G.3.2.4 Eliciting input

The agenda should describe the methods to be used to gather public input, whether at the meeting itself or as part of a public comment period. Furthermore, the agenda should describe the kind of input desired, from comments about a proposal, to community issues and concerns, to information about a site's history or conditions.

G.3.2.5 Planning for the number of attendees

Consider the history of public involvement related to the site. How many people are affected by or interested in the issues you will discuss at the meeting? How many people have turned out for previous sessions? If this is the site's first public meeting, you can try to gauge public interest through other means, including media coverage, letters and phone calls to project staff, and political interest at the local or state level.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.3.2.6 Selecting a date, time and place

Choose a location, date and time conducive to public attendance. Check with the municipal clerk and school officials to be sure that your public meeting does not conflict with other meetings that could draw members of the community away.

The location should be an easily accessible building familiar to residents, such as a municipal hall, school, fire station or library. Local residents and officials can usually suggest an appropriate venue. Because locations may vary greatly in size, it is important to estimate attendance. It is better to overestimate when in doubt.

The facility should be accessible to people with disabilities. If you expect that most attendees will drive to the public meeting, there should be adequate parking. If the public meeting is being held in a large urban area, the facility should be reachable via public transportation.

Follow up on the arrangements made with a letter to the facility contact person, confirming the date and time of the meeting, and the subject of the session.

G.3.2.7 Publicity

Notify the community at least two weeks before the date of the public meeting. This allows interested people to clear their calendars and avoid conflicts with other events.

The public meeting may be publicized in many ways. Examples include the following:

- send a fact sheet or meeting announcement to part or all of the site contact list (be sure the contact list is up-to-date). Include the meeting agenda as well as highlights of the proposal or issues to be discussed. This is important because, even if people do not attend, they will receive information you want them to know.
- send a media release or a fact sheet to local newspapers and radio stations;
- telephone key individuals, organizations and officials;
- post notices at highly visible points in the community; and
- announce the upcoming public meeting at another forum, such as a town council or school board meeting.

Regardless of the methods you choose, emphasize the reasons for the meeting, the agenda, and the importance of public participation.

G.3.2.8 Coordinating with staff

Coordinate with participating staff before the public meeting to ensure that everyone understands the agenda and how the meeting will be conducted. Be sure that participating staff have developed their presentations and support materials.

Staff should try to rehearse their presentations ahead of time; they can benefit from a constructive critique about content and style. It is also useful to brainstorm questions and comments you are likely to hear at the public meeting, and to assess who is most qualified to address a particular question or issue, and whether there is sufficient information for a response. Remember to consider questions staff may want to ask the public.

G.3.2.9 Packing up and heading out

Remember the materials you will need for the meeting, such as

- fact sheets, agendas and other handouts (e.g., remedial program brochures);
- sign-in materials;
- directional signs;
- tape, pens, markers;
- support materials (slides, overheads, maps, charts, blueprints);
- equipment (slide projector, overhead projector, projection screen, tape recorder, flip chart stand and pad);
- extra projector bulbs; and
- extension cords (the nearest outlet may be 50 feet away).

G.3.2.10 Preparing the location

Arrive well ahead of time in order to get ready for the meeting:

- place directional signs as needed;
- establish a place for sign-in sheets and handout materials. Be sure that people sign in as they arrive, and use the information to update the site's contact list;
- set up equipment and support materials, such as projector or overhead, screen, flipchart, maps, tape recorder and other items; and
- set up podiums or platforms for speakers — move chairs and tables for presenters and audience as appropriate.

Try to greet people as they arrive, and introduce staff participants. A few pleasant words of greeting can help to set at ease those who may be uncomfortable in a public forum. Establish a climate that enables constructive communication.

G.3.2.11 Taking notes

A staff person who is not making a presentation should be selected ahead of time to take detailed notes of the meeting. Other staff should take notes as time and their responsibilities allow. Good notes help staff keep track of the public's questions and comments, as well as items for follow-up.

G.3.2.12 Beginning the meeting

Begin the meeting by welcoming the audience, and thanking them for taking the time to attend. Tell them about the purpose of the meeting and why it is important. Review the agenda with the audience (everyone should have a copy). State the ground rules up front and in simple terms.

G.3.2.13 Presenting information

In order to allow time for audience participation, especially questions and answers (Q & A), try to keep presentations as short as is possible. Be sure everyone can see the slides or overheads, and encourage people to move closer if they cannot.

G.3.2.14 Encouraging feedback

Adhering to the ground rules, facilitate public comments and questions during, between or after presentations. Everyone who wants to speak should have the opportunity. Be sure to ask if anyone has written comments.

Here are some tips for working effectively with the audience. Two dynamics operate at a public meeting: a) the issues and information to be exchanged; and b) the relationship

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
between staff and audience brought to, or forged at, the meeting. The quality of the second dynamic, the relationship, usually rules the day. The importance of the information, or the craftsmanship of your presentations, will not matter if

- the prior relationship with the public has been non-productive or non-existent;
- the public distrusts the sincerity of project staff, or their motives;
- the public doubts the ability of project staff to address issues that concern them; or
- the public brings a different agenda to the meeting, or tries to obstruct the process.

It is impossible, within the confines of a single meeting, to remedy a long-standing dysfunctional relationship with the public. However, a few steps can be taken to increase trust and improve communication:

- Write the public's questions and comments on a flip-chart. This is a simple graphic demonstration that you have heard what the audience has said.
- During Q & A restate each speaker's question or comment for the entire audience. This shows the speaker that he or she has been understood, and ensures that everyone at the meeting understands what will be responded to.
- Tell the audience how their comments and input will be considered and how their overall involvement fits in the site decision-making process.
- If someone in the audience monopolizes Q & A or the comment period to the exclusion of others, gently but firmly remind the audience of the ground rules they agreed to. If the person persists, sound out the audience; sometimes an audience is its own best enforcer.
- If the meeting becomes heated or emotional, staff may feel that they are being attacked personally. Remember that people sometimes feel the need to vent and speak their piece. They may have been living with the effects of a hazardous waste site for years; or they may perceive public agencies to be slow, uncaring or mysterious, especially if the meeting is their first contact with the agencies.
- If the answer to a question is not known, say so plainly and simply. Tell the speaker an answer will be obtained and relayed as soon as possible. Be sure to follow up back at the office!
- Always tell the audience where the site remedial process is headed: what the next steps are; when they will hear from staff again and what they can expect to be told; when the public will have another opportunity to provide input.
- If the audience is not asking questions or providing comments about the information provided or the proposal outlined, staff should have several questions ready to ask the audience. The questions should be designed to break the ice and stimulate useful discussion.
- Encourage attendees to contact staff whenever they have questions, concerns or ideas outside of the meeting. Provide contact names, telephone numbers and addresses.

G.3.2.15 After the meeting

Try to allot a few minutes after the meeting to speak informally with people who need detailed answers to questions, or who prefer to ask questions privately.

G.3.2.16 Debriefing and following up

Review the substance of the meeting with all participating staff. Follow up on the public's questions and requests for information, as well as any commitments staff made. Share information with staff involved with the project that did not participate. Consider following up with another fact sheet or a responsiveness summary, but do not limit the mailing only

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm
to those who attended the meeting. Update the site's contact list with the names on the sign-in sheet.

G.3.3 Benefits and Limitations

- Public meetings help to ensure that important site information and proposals are provided to the affected and interested public.

- Public meetings encourage direct contact and communication between the public and project decision makers.

- Public meetings help reveal issues important to the public, or elicit feedback and comments staff want about the site, the surrounding community, or staff's site efforts and proposals.

- Public meetings usually require extensive preparation time, staff and resources. Presentations and supporting materials need to be prepared. Logistics for planning, conducting and following-up a large meeting can be comprehensive and time-consuming.

- Some staff are uncomfortable making presentations before large audiences. Training and rehearsal can help to increase staff confidence and effectiveness.

- Limited personal interaction can take place at a large public meeting. The setting often is formal and impersonal. Some people are not comfortable speaking out at public meetings, so it is possible that a broad spectrum of public opinion may go unheard.

- The positions which attendees take from their real or underlying interests may be difficult to distinguish. Often people feel compelled to take firm stands, or to posture for their constituents, peers or the media.

- When staff determine that they need to reach out to the community, they often decide to conduct a large public meeting. However, many public outreach and information objectives can be achieved more effectively through activities other than large group meetings. Availability sessions, meetings targeted to specific groups or interests, and fact sheets often are effective ways to provide information or encourage public input.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Checklist to Plan and Conduct a Public Meeting

- ❑ Determine purpose (s) and subject(s): _____
- ❑ Identify location for public meeting
  - ❑ Facility name & location: _____
  - ❑ Contact person/phone number at facility: _____
  - ❑ Accessibility
    - ❑ People with disabilities and
    - ❑ Adequate parking and/or
    - ❑ Convenient to public transportation
- ❑ Choose date and time of the public meeting: _____
- ❑ Confirm arrangements with follow up letter to facility contact person
- ❑ Identify staff to participate in public meeting
- ❑ Scope information to be presented (agenda, presentations, etc.)
- ❑ Identify/prepare support materials (handouts, slides/transparencies)
- ❑ Publicize the upcoming public meeting
  - ❑ Send fact sheet to all/part of site contact list and/or
  - ❑ Send fact sheet and/or media release to local media and/or
  - ❑ Telephone key individuals, organizations, officials and/or
  - ❑ Post notices in the community and/or
  - ❑ Announce the upcoming public meeting in another forum
- ❑ Hold staff pre-meeting to finalize content and coordination

- ❑ Conduct the public meeting
  - ❑ Bring and use signs, sign-in sheets and support materials
  - ❑ Collect/record comments and questions for program use or follow-up

- ❑ Follow up activities to the public meeting
  - ❑ Provide necessary follow-up to public questions/comments
  - ❑ Update contact list with sign-in sheets
  - ❑ Consider additional follow up

G.4 Availability Session

G.4.1 Description

An availability session is a scheduled gathering of project staff with the affected/interested public. The session is held in a casual setting, without a formal agenda or presentations. Staff generally conduct an availability session about a specific aspect of a site's remedial program, which it publicizes ahead of time. The format promotes detailed individual or small group discussion between staff and the public.

An availability session is an appropriate tool

- to provide information to, and address the concerns of, the affected community about specific aspects of a site's remedial program. For example, if remedial construction is about to begin, staff may wish to discuss with community members the general construction schedule, specific on-site activities, and the effects of remedial activity on the local community, such as road closures, truck traffic, dust and noise;
- to supplement a formal public meeting or other outreach activity by providing interested members of the public additional opportunity for individual, detailed discussions about the site's remediation;
- when larger crowds would discourage certain members of the public from engaging project staff or asking questions; or
- when staff do not have time or resources needed to plan and conduct a formal, large group public meeting.

G.4.2 Suggestions for Planning and Conducting an Availability Session

Note: A checklist that summarizes major steps to plan and conduct an availability session is on page G-24.

G.4.2.1 Determining the focus of the session

Define the focus of the availability session. What must be communicated? What questions and concerns are attendees likely to raise? Identify project staff who have information needed to prepare for the availability session. Determine which project staff should participate in the session. At a minimum, project staff should attend who have responsibility for the activity that will be the focus of the session.

Availability sessions generally require fewer project staff to participate than at a formal public meeting. At a minimum, however, at least two staff should participate at the availability session. To help determine the appropriate number of staff participants, consider the kind of information likely to be discussed, the estimated number of public attendees, and available staff resources.

G.4.2.2 Planning for the number of attendees

Depending on the number of people expected to attend, two sessions may be appropriate: one in the afternoon and one in the evening. If only one session is possible, extend the evening hours or bring additional staff. The availability session is designed to foster individual and small-group discussion. Try to ensure that attendees talk to staff with minimal waiting, and that staff will talk to small groups.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.4.2.3 Selecting a date, time and location

Choose a location, date and time that encourage attendance. An evening session will accommodate people who work during normal business hours. Check with the municipal clerk and school officials to be sure the session does not conflict with other meetings that could draw members of the community away.

The location should be in an easily accessible building familiar to residents, such as a library, municipal hall, school, fire hall or local meeting room. Local residents and officials can usually suggest an appropriate venue. Because an availability session generally involves a small number of people, there is more flexibility in choosing a location than for a large, formal public meeting.

The facility should be accessible to citizens with disabilities. If it is expected that most attendees will drive to the availability session, there should be adequate parking. If the availability session is being held in a large urban area, the facility should be reachable via public transportation.

Follow up on the arrangements with a letter to the facility contact person, confirming the date, time and subject of the session.

G.4.2.4 Supporting materials

Many materials may be suitable for an availability session: maps, schematic drawings, cutaway sketches, blueprints, photographs of the pertinent remedial technology, tools and instruments, documents, sampling results — even pieces of synthetic liner material or filter fabric. All can potentially be used to help answer the public's questions and to focus discussion.

It is generally appropriate to develop a fact sheet that covers the essential points of the discussion for distribution at the availability session.

G.4.2.5 Publicity

Notify the community at least two weeks before the date of the availability session. This allows interested people to clear their calendars and avoid conflicts with other events.

The session may be publicized in many ways. Examples include the following:

- send a fact sheet or session announcement to part or all of the site contact list (be sure the contact list is up-to-date). Include the agenda as well as highlights of the proposal or issues to be discussed. This is important because, even if people do not attend, they will receive information you want them to know.
- send a media release or a fact sheet to local newspapers and radio stations;
- telephone key individuals, organizations and officials;
- post notices at highly visible points in the community; and
- announce the upcoming session at another forum, such as a town council or school board meeting.

Regardless of the methods you choose, emphasize the reasons for the session, the agenda, and the importance of public participation.

When explaining the format of an availability session, emphasize how it differs from a public meeting:

- project staff will be available for a specific time period to answer questions, address concerns and discuss aspects of the site's remediation with individuals or small groups;
- there is no set agenda or formal presentations; and
- the public can drop by anytime during the availability session.

G.4.2.6 Coordinating with staff

Coordinate with participating staff before the availability session to ensure that everyone understands the topics for discussion and how the session will be conducted. Be sure that staff have developed and reviewed their support materials.

G.4.2.7 Conducting the availability session

Arrive well ahead of time in order to get ready for the meeting:

- place directional signs as needed;
- establish a place for sign-in sheets and handout materials. Be sure that people sign in as they arrive, and use the information to update the site's contact list; and
- set up all supporting materials.

Try to greet people as they arrive, and introduce staff participants. A few pleasant words of greeting can help to set at ease those who may be uncomfortable in a public forum. Establish a climate that enables constructive communication.

Connect people with particular questions or comments and staff with the appropriate expertise. Note comments and questions that require follow-up by project staff.

G.4.2.8 Debriefing and following up

Review the substance of the session with all participating staff. Follow up on the public's questions and requests for information, as well as any commitments staff made. Share information with staff involved with the project that did not participate. Consider following up with another fact sheet or a responsiveness summary, but do not limit the mailing only to those who attended the session. Update the site's contact list with the names on the sign-in sheet.

G.4.3 Benefits and Limitations

- A face-to-face discussion is perhaps the most efficacious form of public outreach. It encourages an exchange of information with people directly affected by site contamination, investigation activities, or remediation. The individual and small-group dialogue can help build mutual credibility between the affected community and project staff —credibility that is more difficult to achieve in other settings.

- Availability sessions stretch limited program resources. They do not require prepared presentations and are significantly faster, easier and less resource-intensive to plan and conduct than formal public meetings.

- Quicker and easier planning and implementation create flexibility to conduct an availability session in locations and for reasons that other public outreach activities could not accommodate.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

- An availability session often attracts a small audience, but attendees usually bring intense rather than casual interest in a site's remediation. This heightened interest and modest attendance actually enhances direct dialogue between the public and project staff.

- When held within a day or two of a formal public meeting, an availability session can offer the public an additional forum to interact with project staff. As a result, people attending the formal public meeting may not feel pressed to compete for limited opportunities for input in a forum that must accommodate formal presentations, a large audience, and many levels of interest and understanding.

- An availability session encourages those who might be intimidated or uncomfortable in a large group setting to talk to project staff in a more intimate setting.

- After the availability session, follow-up activities may require widely varying amounts of time and resources.

- Some community members may express suspicion that availability sessions are designed to divide and conquer the affected public, and prevent the community from demonstrating unity and resolve. In such circumstances consider using the availability session to supplement other outreach activities that promote interaction with the affected community.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Checklist to Plan and Conduct an Availability Session

- ❑ Determine purpose (s) and subject(s): _____
- ❑ Identify location for availability session
  - ❑ Facility name & location: _____
  - ❑ Contact person/phone number at facility: _____
  - ❑ Accessibility
    - ❑ People with disabilities and
    - ❑ Adequate parking and/or
    - ❑ Convenient to public transportation
- ❑ Choose date and time of the availability session: _____
- ❑ Confirm arrangements with follow up letter to facility contact person
- ❑ Identify staff to participate in public meeting
- ❑ Review information to be discussed with the public
- ❑ Identify/prepare support materials (maps, blueprints, handouts, etc.)
- ❑ Publicize the upcoming public meeting
  - ❑ Send fact sheet to all/part of site contact list and/or
  - ❑ Send fact sheet and/or media release to local media and/or
  - ❑ Telephone key individuals, organizations, officials and/or
  - ❑ Post notices in the community and/or
  - ❑ Announce the upcoming public meeting in another forum
- ❑ Conduct the availability session
  - ❑ Bring and use signs, sign-in sheets and support materials
  - ❑ Record comments and questions for program use or follow-up
- ❑ Follow up activities to the availability session
  - ❑ Provide necessary follow-up to public questions/comments
  - ❑ Update contact list with sign-in sheets
  - ❑ Consider additional follow up

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.5 Toll-free "800" Numbers

G.5.1 Description

Toll-free information numbers are a convenient means for people with questions, comments or concerns about a hazardous waste site to obtain information, particularly those who cannot or will not participate in other outreach activities. In addition to building credibility with the public, toll-free numbers can address minor problems and concerns before they escalate into larger ones that demand greater expenditures of time and resources.

G.5.2 Suggestions for Using Toll-free "800" Numbers

G.5.2.1 Publicizing "800" numbers

Use fact sheets, media releases, public meetings, availability sessions, letters and other public contact information to announce the project's toll-free number(s). Encourage interested people to use the toll-free number(s) to contact project staff with questions or concerns at any time during the remedial process.

Publicize the NYSDEC (for central office-lead sites) and NYSDOH toll-free numbers for site-related and health-related questions, concerns and comments:

NYSDEC	**NYSDOH**
Division of Environmental Remediation Toll-free Information Line 1-800-342-9296	Bureau of Environmental Exposure Investigation Toll-free Information Line 1-800-458-1158, ext. 27850

NOTE: "800" numbers are typically information lines — not a "hotline" — because weeknight and weekend callers may not receive immediate responses. Avoid public misunderstanding: identify the number as an "information-only" line when it is publicized.

G.5.2.2 Managing toll-free number(s)

Whenever the "800" numbers are publicized in a fact sheet, meeting announcement or newsletter, be sure that a copy of the material has been provided to staff managing to "800" numbers. This helps to prevent staff from being blindsided: with the publicity material site in hand, they can often answer calls directly, or immediately know to which staff members to forward calls.

G.5.2.3 Following up

It may be appropriate to follow up a toll-free call by sending a letter or other written material to satisfy a caller's more detailed questions.

G.5.2.4 Involving project staff

To provide a complete answer to a caller's questions or information requests, all appropriate staff should be involved in reviewing the response.

G.5.2.5 Sharing information

As appropriate, be sure to share with other staff involved with the site the questions and concerns being received from the toll-free number(s). This information may assist other staff as they communicate with the public about the site.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.5.3 Benefits and Limitations

- Can be an effective way to interact with many people to gather comments and answer questions.

- Helps to build and maintain credibility by improving public access to project staff and information.

- Timely response to calls is important. Delayed or inadequate response can damage credibility and increase public frustration or cynicism.

- Despite all the best efforts, some people may believe the toll-free information number is a "hotline" and may expect immediate response.

- The NYSDEC toll-free number can only be called from within New York State, so care should be used when publicizing it at a site that may border an adjacent state or Canada.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.6 Door-to-door Visits

G.6.1 Description

Door-to-door visits involve gathering or distributing site information by meeting individuals at their residences or businesses. Project staff visit residents near a site to provide information, answer questions or obtain permissions for activities on private properties.

Door-to-door visits may be appropriate when

- on-site investigation or remediation activity is imminent, and there is not enough time for mailings or public meetings (for example, an impending emergency removal action or a time-sensitive interim remedial measure);
- there is a need to reach a particular group of people for a particular purpose, such as obtaining signatures to allow access to properties near the site;
- public concern about site contamination or other site-related issues is extremely high; and
- personal contact could effectively supplement other outreach efforts.

G.6.2 Suggestions for Conducting Door-to-door Visits

Door-to-door visits require specialized techniques applied within well-defined circumstances, such as those listed above. When planned and conducted properly, visits can be extremely effective in reaching their designated audience.

G.6.2.1 Preparation

Identify as specifically as possible the information that needs to be provided or gathered. What site issues or activities are driving these needs? Establish the time-frame for the visits, especially when there is a deadline. Be sure that door-to-door visits are the appropriate method of outreach.

G.6.2.2 Identifying the area and audience

Determine the residences and businesses that need to be visited (this is influenced largely by the site issues or activities and whom they affect). Be sure that there are sufficient staff and resources to cover the designated area.

G.6.2.3 Planning with project staff

Defining the information that needs to be provided or gathered will indicate which remedial, health or consultant staff should participate in the door-to-door visits. If these staff are unavailable, they should still help plan the visits and brief other staff with answers to anticipated questions.

Be sure all participating staff clearly understand the information to be discussed with the public, so that they provide consistent, accurate information throughout the area to be visited.

G.6.2.4 Reviewing the message

The information provided or gathered during door-to-door visits should be

- specific — pertinent to a particular issue or activity of the site;
- timely —involving a situation or activity soon to occur or which has already begun; and
- clear — staff should know what is needed from the residents, while residents should understand what staff need to tell them.

G.6.2.5 Written summaries

Develop a written summary (essentially a short fact sheet) that encapsulates the information to be provided or requested during the door-to-door visits. Distribute this summary to the occupants, even when no one is present.

Be sure the written material meets the standards of specificity, timeliness, and clarity, and lists ways for residents to contact staff with questions or comments.

G.6.2.6 Conducting the visits

Allow sufficient time to cover the designated area and to account for lengthy discussions that may occur. Staff should always

- wear or carry identification;
- tell residents why they are conducting the visits;
- present and request information consistently at all addresses called upon;
- distribute the written summary at all addresses visited;
- note all information provided by residents;
- note areas covered; and
- note names and addresses of people who have requested additional information.

Based on the particulars of the site and the area being visited, it may be advisable for staff to pair up when conducting visits. This will help to ensure that staff with varied expertise are available to answer a range of questions.

G.6.2.7 Following up

Staff participants should meet after the visits to discuss their experiences and compare notes. Be sure to respond promptly to requests for information that was not provided during the visits. Consider sending a follow-up letter or fact sheet to all residents in the designated area.

G.6.3 Benefits and Limitations

- Project staff can meet directly with the people that they need to communicate with about specific issues or activities.

- Door-to-door visits help to distribute information quickly, when time is of the essence and when other activities such as mailing cannot accomplish the task during the identified time frame.

- Door-to-door visits demonstrate a commitment to the community when other, less direct outreach seems insufficient to deal with community concerns effectively.

- Despite best intentions, door-to-door visits can foster unfavorable cliches (e.g., "We're from the government and we're here to help.")

- Door-to-door visits can be time-consuming. In addition, some project staff may not be comfortable with the technique or have appropriate training to conduct the activity effectively. As a result, the technique should be used only if other outreach cannot be used or will likely be ineffectual.

- If there are concerns for the safety and security of staff, even more resources may be required to conduct visits than usual.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.7 Document Repository

G.7.1 Description

A document repository is a collection of documents and other information developed during the investigation and remediation of a waste site. It is located in a convenient public facility, such as a library, so that interested members of the public can easily access and review important information about the site and the site's remedial program. A repository is maintained through the site's operation and maintenance phase, or until its release from the applicable remedial program.

A site document repository is helps the public review

- documents about which the state is seeking public comment;
- studies, reports and other information;
- complete versions of documents summarized in fact sheets, meeting presentations or media releases (summaries should note the location(s) of a local repository where the complete documents are available).

G.7.2 Suggestions for Establishing a Document Repository

The appropriate regional NYSDEC office often generates or receives documents developed during a site's investigation and remediation. However, most people don't live near a regional office. The selection of a local repository becomes very important.

G.7.2.1 Determining the location

The repository should be located near the site and the affected and interested community. Residents, municipal clerks, local officials and school officials can to help identify a suitable location.

If possible, a location should be selected to can accommodate people who work during normal business hours. In addition, the availability of public transportation in locations where parking or automobile travel is inconvenient should be considered. Access for disabled people and the availability of photocopying should be determined.

A local public library usually is a suitable location. Alternatives include municipal offices, public health offices and schools.

G.7.2.2 Contact the potential repository

Be sure to contact the potential repository *before* sending documents. Most librarians and municipal clerks are more than willing to help make documents available to the public. They don't appreciate receiving a box full of reports with an explanatory letter out of the blue.

When calling a library, the reference librarian is a good first contact. Explain that you would like to have site program documents maintained in an accessible spot for public review and copying. Because space may be limited, the librarian may ask for an estimate of the total volume of documents you will be sending over a given time.

Follow up the conversation with a courtesy letter confirming the agreed-upon terms and conditions for the repository. Be sure to restate your understanding of who the repository contact person will be and where the documents will be maintained.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

G.7.2.3 Depositing documents and other information

Send studies, reports, information sheets and other suitable materials to the repository. Consider providing several copies of documents that are likely to be of great interest to the public.

G.7.2.4 Accommodating the repository host

When sending a document to the repository, transmit it with a cover letter that describes what the document is, why it was produced and which briefly summarizes its contents. This will help the host maintain an ordered file and will help the public locate documents of interest. For documents about which the state is seeking public comment, provide information about how the public is to comment, such as the length of the comment period, and where to send comments.

G.7.2.5 Publicizing the repository and its contents

It is important to remind the public about the repository as often as possible. Take advantage of the public contact tools you use during the public outreach program. Use fact sheets, media releases, public meetings, availability sessions, door-to-door visits, letters and telephone calls to tell people about the repository, its contents, and why public review is important. Provide the repository's location, days and hours of operation and the repository contact person.

G.7.2.6 Special consideration for time-sensitive documents

Some documents are placed in a repository for public review during a prescribed comment period. Be sure that documents for public comment are in the repository when the comment period starts. This affords the public maximum opportunity for review and comment.

G.7.2.7 Updating the repository

Send materials as soon as possible after they are developed. Remove/replace outdated materials. Provide finalized and revised versions of documents.

G.7.2.8 Consider providing additional copies of documents

As mentioned earlier, consider sending additional copies of documents to a repository when sustained public interest is anticipated. In addition, consider providing copies of appropriate documents to local officials, involved organizations and others who have demonstrated a keen interest in the site and its remedial program.

G.7.3 Benefits and Limitations

- A repository makes detailed, timely information available to residents, officials and others in the community affected by or interested in the site and the remedial program. In particular, the repository serves community members interested in additional details beyond summaries provided in fact sheets and public meeting presentations.
- A repository should be maintained to ensure timely availability of current information. It should be checked occasionally to ensure that materials are available.
- Even when a local repository is established to improve access to project information, most people do not read complete documents.
- A repository supports — but cannot substitute for — two-way communication between project staff and the community.

NOTE: Updates to this final guidance are available at http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

This page is intentionally blank.

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

Appendix H

NYSDOH fact sheets related to soil vapor intrusion

As introduced in Section 5, fact sheets are often used to share information with the public in a variety of ways: mailed to all or part of the site's contact list, distributed at a public meeting or availability session, placed in document repositories, provided to residents during door-to-door visits, and/or included in letters transmitting sampling results.

Copies of the following fact sheets, which are commonly used to supplement discussions related to soil vapor intrusion, are provided in this appendix:

What is exposure? Information Sheet

- describes how a person may come into contact with chemicals in the environment

Soil Vapor Intrusion: Frequently Asked Questions Sheet

- describes the process referred to as "soil vapor intrusion"

PCE Fact Sheet

- provides information on tetrachloroethene (PCE) and the NYSDOH guideline for PCE in air

TCE Fact Sheet

- provides information on trichloroethene (TCE) and the NYSDOH guideline for TCE in air

Radon: Frequently Asked Questions Sheet

- provides information on this gas, commonly found in many areas of New York State, that may also migrate into buildings from the subsurface

NOTE: Updates to this final guidance are available at
http://health.ny.gov/environmental/indoors/vapor_intrusion/update.htm

This page is intentionally blank.

New York State Department of Health

What is Exposure?

Exposure is contact. No matter how dangerous a substance or activity, without exposure, it cannot harm you.

Information Sheet



Amount of exposure:

Over 400 years ago, a scientist said "...nothing [is] without poisonous qualities. It is only the dose that makes a thing poison." The **dose** is the amount of a substance that enters or contacts a person. An important factor to consider in evaluating a dose is body weight. If a child is exposed to the same amount of chemical as an adult, the child (who weighs less) can be affected more than the adult. For example, children are given smaller amounts of aspirin than adults because an adult dose is too large for a child's body weight.

The greater the amount of a substance a person is exposed to, the more likely that health effects will occur. Large amounts of a relatively harmless substance can be toxic. For example, two aspirin tablets can help to relieve a headache, but taking an entire bottle of aspirin can cause stomach pain, nausea, vomiting, headache, convulsions or death.



Routes of exposure:

There are three major means by which a toxic substance can come into contact with or enter the body. These are called routes of exposure.

Inhalation (breathing) of gases, vapors, dusts or mists is a common route of exposure. Chemicals can enter and irritate the nose, air passages and lungs. They can become deposited in the airways or be absorbed through the lungs into the bloodstream. The blood can then carry these substances to the rest of the body.

Direct contact (touching) with the skin or eyes is also a route of exposure. Some substances are absorbed through the skin and enter the bloodstream. Broken, cut or cracked skin will allow substances to enter the body more easily.

Ingestion (swallowing) of food, drink, or other substances is another route of exposure. Chemicals that get in or on food, cigarettes, utensils or hands can be swallowed. Children are at greater risk of ingesting substances found in dust or soil because they often put their fingers or other objects in their mouths. Lead in paint chips is a good example. Substances can be absorbed into the blood and then transported to the rest of the body.
The route of exposure can determine whether or not the toxic substance has an effect. For example, breathing or swallowing lead can result in health effects, but touching lead is not usually harmful because lead is not absorbed particularly well through the skin.



Length of exposure:

Short-term exposure is called **acute exposure**. Long-term exposure is called **chronic exposure**. Either may cause health effects that are immediate or health effects that occur days or years later.

Acute exposure is a short contact with a chemical. It may last a few seconds or a few hours. For example, it might take a few minutes to clean windows with ammonia, use nail polish remover or spray a can of paint. The fumes someone might inhale during these activities are examples of acute exposures.

Chronic exposure is continuous or repeated contact with a toxic substance over a long period of time (months or years). If a chemical is used every day on the job, the exposure would be chronic. Over time, some chemicals, such as PCBs and lead, can build up in the body and cause long-term health effects.

Chronic exposures can also occur at home. Some chemicals in household furniture, carpeting or cleaners can be sources of chronic exposure.



Sensitivity:

All people are not equally **sensitive** to chemicals, and are not affected by them in the same way. There are many reasons for this.

- People's bodies vary in their ability to absorb and break down or eliminate certain chemicals due to **genetic differences.**

- People may become **allergic** to a chemical after being exposed. Then they may react to very low levels of the chemical and have different or more serious health effects than nonallergic people exposed to the same amount. People who are allergic to bee venom, for example, have a more serious reaction to a bee sting than people who are not.

- Factors such as **age, illness, diet, alcohol use, pregnancy and medical or nonmedical drug use** can also affect a person's sensitivity to a chemical. Young children are often more sensitive to chemicals for a number of reasons. Their bodies are still developing and they cannot get rid of some chemicals as well as adults. Also, children absorb greater amounts of some chemicals (such as lead) into their blood than adults.

For more information:

New York State Department of Health
Center for Environmental Health
Flanigan Square
547 River Street, Room 316
Troy, NY 12180-2218
1-800-458-1158 (ext. 2-7530)

March 2001

NEW YORK STATE
DEPARTMENT OF HEALTH

SOIL VAPOR INTRUSION

Frequently Asked Questions

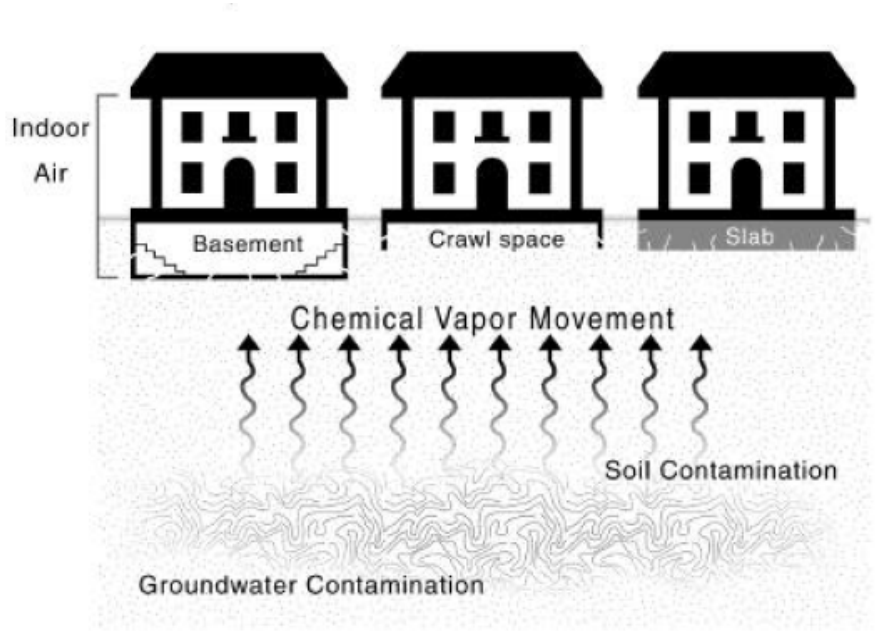
What is soil vapor intrusion?

The phrase "soil vapor intrusion" refers to the process by which volatile chemicals move from a subsurface source into the indoor air of overlying buildings.

Soil vapor, or soil gas, is the air found in the pore spaces between soil particles. Because of a difference in pressure, soil vapor enters buildings through cracks in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation. Heating, ventilation or air-conditioning systems may create a negative pressure that can draw soil vapor into the building. This intrusion is similar to how radon gas seeps into buildings.

Soil vapor can become contaminated when chemicals evaporate from subsurface sources and enter the soil vapor. Chemicals that readily evaporate are called "volatile chemicals." Volatile chemicals include volatile organic compounds (VOCs). Subsurface sources of volatile chemicals may include contaminated soil and groundwater, or buried wastes. If soil vapor is contaminated, and enters a building as described above, indoor air quality may be affected.

When contaminated vapors are present in the zone directly next to or under the foundation of the building, vapor intrusion is possible. Soil vapor can enter a building whether it is old or new, or whether it has a basement, a crawl space, or is on a slab (as illustrated in the figure).



[Source: United States Environmental Protection Agency, Region 3]

How am I exposed to chemicals through soil vapor intrusion?

Humans can be exposed to soil vapor contaminated with volatile chemicals when vapors from beneath a building are drawn through cracks and openings in the foundation and mix with the indoor air. Inhalation is the route of exposure, or the manner in which the volatile chemicals actually enter the body, once in the indoor air.

Current exposures are when vapor intrusion is documented in an occupied building. *Potential* exposures are when volatile chemicals are present, or are accumulating, in the vapor phase beneath a building, but have not affected indoor air quality. Potential exposures also exist when there is a chance that contaminated soil vapors may move to existing buildings not currently affected or when there is a chance that new buildings can be built over existing subsurface vapor contamination. Both current and potential exposures are considered when evaluating soil vapor intrusion at a site that has documented subsurface sources of volatile chemicals.

In general, exposure to a volatile chemical does not necessarily mean that health effects will occur. Whether or not a person experiences health effects depends on several factors, including inhalation exposure, the length of exposure (short-term or acute versus long-term or chronic), the frequency of exposure, the toxicity of the volatile chemical, and the individual's sensitivity to the chemical.

What types of chemicals associated with environmental contamination may be entering my home via soil vapor intrusion?

Volatile organic compounds, or VOCs, are the most likely group of chemicals found in soil vapor, and which can move through the soil and enter buildings. Solvents used for dry cleaning, degreasing and other industrial purposes (e.g., tetrachloroethene, trichloroethene, 1,1,1-trichloroethane and Freon 113) are examples of VOCs. Examples of petroleum-related VOCs from petroleum spills are benzene, toluene, ethyl benzene, xylenes, styrene, hexane and trimethylbenzenes.

Is contaminated soil vapor the only source of volatile chemicals in my indoor air?

No. Volatile chemicals are also found in many household products. Paints, paint strippers and thinners, mineral spirits, glues, solvents, cigarette smoke, aerosol sprays, mothballs, air fresheners, new carpeting or furniture, hobby supplies, lubricants, stored fuels, refrigerants and recently dry-cleaned clothing all contain VOCs. Household products are often more of a source of VOCs in indoor air in homes than contaminated soil vapor.

Indoor air may also become affected when outdoor air containing volatile chemicals enters your home. Volatile chemicals are present in outdoor air due to their widespread use. Gasoline stations, dry cleaners, and other commercial/industrial facilities are important sources of VOCs to outdoor air.

What should I expect if soil vapor intrusion is a concern near my home?

If you live near a site that has documented soil, groundwater and/or soil vapor contaminated with volatile chemicals, you should expect that the potential for vapor intrusion is being, or has been, investigated. You may be contacted by the site owner or others working on the cleanup with information about the project. Your cooperation and consent would be requested before any testing/sampling would be done on your property. You may ask the person contacting you any questions about the work being done. You can also contact the NYSDOH's project manager for the site at 1-800-458-1158 (extension 2-7850) for additional information.

How is soil vapor intrusion investigated at sites contaminated with volatile chemicals?

The process of investigating soil vapor intrusion typically requires more than one set of samples to determine the extent of vapor contamination. Furthermore, four types of environmental samples are collected: soil vapor samples, sub-slab vapor samples, indoor air samples and outdoor air (sometimes referred to as "ambient air") samples.

Soil vapor samples are collected to characterize the nature and extent of vapor contamination in the soil in a given area. They are often collected before sub-slab vapor and/or indoor air samples to help identify buildings or groups of buildings that need to be sampled. Soil vapor samples are used to determine the *potential* for human exposures. *Soil vapor* samples are not the same as *soil* samples.

Sub-slab vapor samples are collected to characterize the nature and extent of vapor contamination in the soil immediately beneath a building with basement foundations or a slab. Sub-slab vapor results are used to determine the potential for *current* and *future* human exposures. For example, an exposure could occur in the future if cracks develop in the building's foundation or changes in the operation of the building's heating, ventilation or air-conditioning system are made that make the movement of contaminated soil vapor into the building possible.

Indoor air samples are collected to characterize the nature and extent of air contamination within a building. Indoor air sample results help to evaluate whether there are *current* human exposures. They are also compared to sub-slab vapor and outdoor air results to help determine where volatile chemicals may be coming from (indoor sources, outdoor sources, and/or beneath the building).

Outdoor air samples are collected to characterize site-specific background air conditions. Outdoor air results are used to evaluate the extent to which outdoor sources, such as automobiles, lawn mowers, oil storage tanks, gasoline stations, commercial/industrial facilities, and so forth, may be affecting indoor air quality.

What should I expect if indoor air samples are collected in my home?

You should expect the following:

- Indoor air samples are generally collected from the lowest-level space in a building, typically a basement, during the heating season. Indoor air samples may also be collected from the first floor of living space. Indoor air is believed to represent the greatest exposure potential with respect to soil vapor intrusion.
- Sub-slab vapor and outdoor air samples are usually collected at the same time as indoor air samples to help determine where volatile chemicals may be coming from (indoor sources, outdoor sources, and/or beneath the building).
- More limited sampling may be performed outside of the heating season. For example, sub-slab vapor samples without indoor air or outdoor air samples may be collected to identify buildings and areas where comprehensive sampling is needed during the heating season.
- An indoor air quality questionnaire and building inventory will be completed. The questionnaire includes a summary of the building's construction characteristics; the building's heating, ventilation and air-conditioning system operations; and potential indoor and outdoor sources of volatile chemicals. The building inventory describes products present in the building that might contain volatile chemicals. In addition, we take monitoring readings from a real-time organic vapor meter (also known as a photoionization detector or PID). The PID is an instrument that detects many VOCs in the air. When indoor air samples are collected, the PID is used to help determine whether

products containing VOCs might be contributing to levels that are detected in the indoor air.

What happens if soil vapor contamination or soil vapor intrusion is identified during investigation of a site?

Depending on the investigation results, additional sampling, monitoring or mitigation actions may be recommended. Additional sampling may be performed to determine the extent of soil vapor contamination and to verify questionable results. Monitoring (sampling on a recurring basis) is typically conducted if there is a significant potential for vapor intrusion to occur should building conditions change. Mitigation steps are taken to minimize exposures associated with soil vapor intrusion. Mitigation may include sealing cracks in the building's foundation, adjusting the building's heating, ventilation and air-conditioning system to maintain a positive pressure to prevent infiltration of subsurface vapors, or installing a sub-slab depressurization system beneath the building.

What is a sub-slab depressurization system?

A sub-slab depressurization system, much like a radon mitigation system, essentially prevents vapors beneath a slab from entering a building. A low amount of suction is applied below the foundation of the building and the vapors are vented to the outside (see illustration). The system uses minimal electricity and should not noticeably affect heating and cooling efficiency. This mitigation system also essentially prevents radon from entering a building, an added health benefit. The party responsible for cleaning up the source of the soil vapor contamination is usually responsible for paying for the installation of this system. If no responsible party is available, New York State will install the system. Once the contamination is cleaned up, the system should no longer be needed. In areas where radon is a problem, the NYSDOH recommends that these systems remain in place permanently.

What else can I do to improve my indoor air quality?

Household products and other factors, such as mold growth, carbon monoxide, and radon, can degrade the quality of air in your home. Consider the following tips to improve indoor air quality:

- Be aware of household products that contain VOCs. Do not buy more chemicals than you need at a time.
- Store unused chemicals in tightly-sealed containers in a well-ventilated location, preferably away from the living space in your home.
- Keep your home properly ventilated. Keeping it too air-tight may promote build up of chemicals in the air, as well as mold growth due to the build up of moisture.
- Fix all leaks promptly, as well as other moisture problems that encourage mold growth.
- Make sure your heating system, hot water, dryer and fireplaces are properly vented and in good condition. Have your furnace or boiler checked annually by a professional.
- Test your home for radon; take actions to reduce radon levels if needed.
- Install carbon monoxide detectors in your home; take immediate actions to reduce carbon monoxide levels if needed.

Where can I get more information?

For additional information about soil vapor intrusion, contact the NYSDOH's Bureau of Environmental Exposure Investigation at 1-800-458-1158 (extension 2-7850).

Sub-Slab Depressurization System

(commonly called a radon mitigation system)



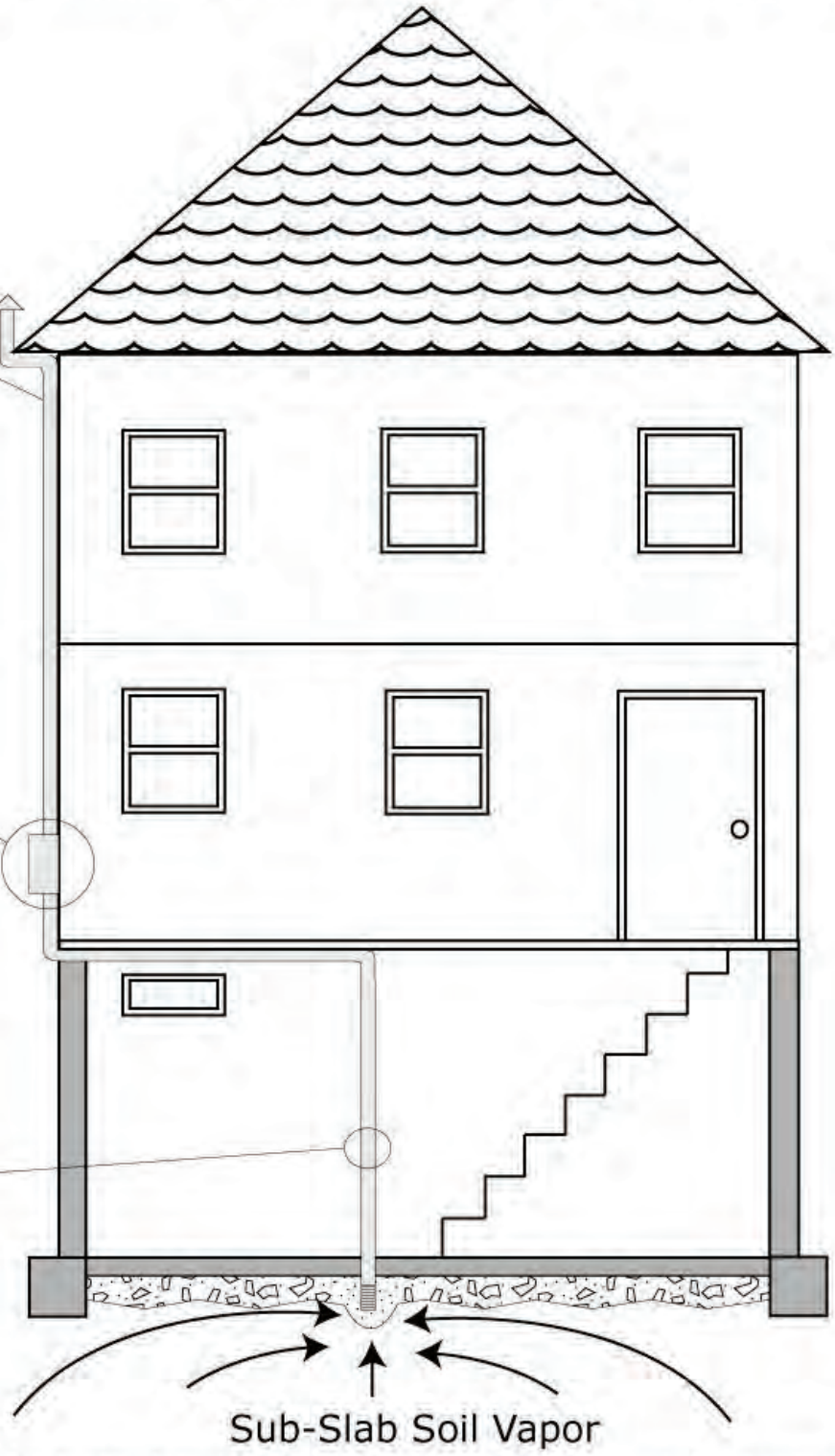
The vent pipe is routed up the side of the structure to a location above the roof line.



A fan is used to draw soil vapor from beneath the slab.



A liquid gauge, or manometer is used to verify that the system is operating properly



A sub-slab depressurization system vents contaminated soil vapor before it enters a structure. The fan draws vapor from beneath the building outside to the roof line where it is released to the outside air.

FACT SHEET

TETRACHLOROETHENE (PERC) IN INDOOR AND OUTDOOR AIR

MAY, 2003

This fact sheet answers a few questions about a chemical called tetrachloroethene (PERC), which is widely used to dry-clean clothes. It provides information on health effects seen in humans and animals exposed to PERC in air. It also provides information about the New York State Department of Health (NYSDOH) guideline of 100 micrograms of PERC per cubic meter of air (100 mcg/m^3) or 0.1 milligrams of PERC per cubic meter of air (0.1 mg/m^3). The fact sheet focuses on the health risks from air exposures because most of the PERC released into the environment goes into air.

Prepared by

New York State Department of Health

1. WHAT IS TETRACHLOROETHENE (PERC)?

Tetrachloroethene is a manufactured chemical that is widely used in the dry-cleaning of fabrics, including clothes. It is also used for degreasing metal parts and in manufacturing other chemicals. Tetrachloroethene is found in consumer products, including some paint and spot removers, water repellents, brake and wood cleaners, glues, and suede protectors. Other names for tetrachloroethene include PERC, tetrachloroethylene, perchloroethylene, and PCE. PERC is a commonly used name and will be used in the rest of the fact sheet.

PERC is a nonflammable, colorless liquid at room temperature. It readily evaporates into air and has an ether-like odor. Because most people stop noticing the odor of PERC in air after a short time, odor is not a reliable warning signal of PERC exposure.

2. HOW CAN I BE EXPOSED TO PERC?

People are exposed to PERC in air, water, and food. Exposure can also occur when PERC or material containing PERC (for example, soil) gets on the skin. For most people, almost all exposure is from PERC in air.

PERC gets into outdoor and indoor air by evaporation from industrial or dry-cleaning operations and from areas where chemical wastes are stored or disposed. Groundwater near these areas may become contaminated if PERC is improperly dumped or leaks into the ground. People may be exposed if they drink the contaminated water. They may also be exposed if PERC evaporates from contaminated drinking water into indoor air during cooking and washing. PERC may evaporate from contaminated groundwater and soil and into the indoor air of buildings above the contaminated area. PERC also may evaporate from dry-cleaned clothes and into indoor air or may get into indoor air after PERC-products, such as spot removers, are used. Indoor air PERC levels may get high if PERC-products are used in poorly ventilated areas.

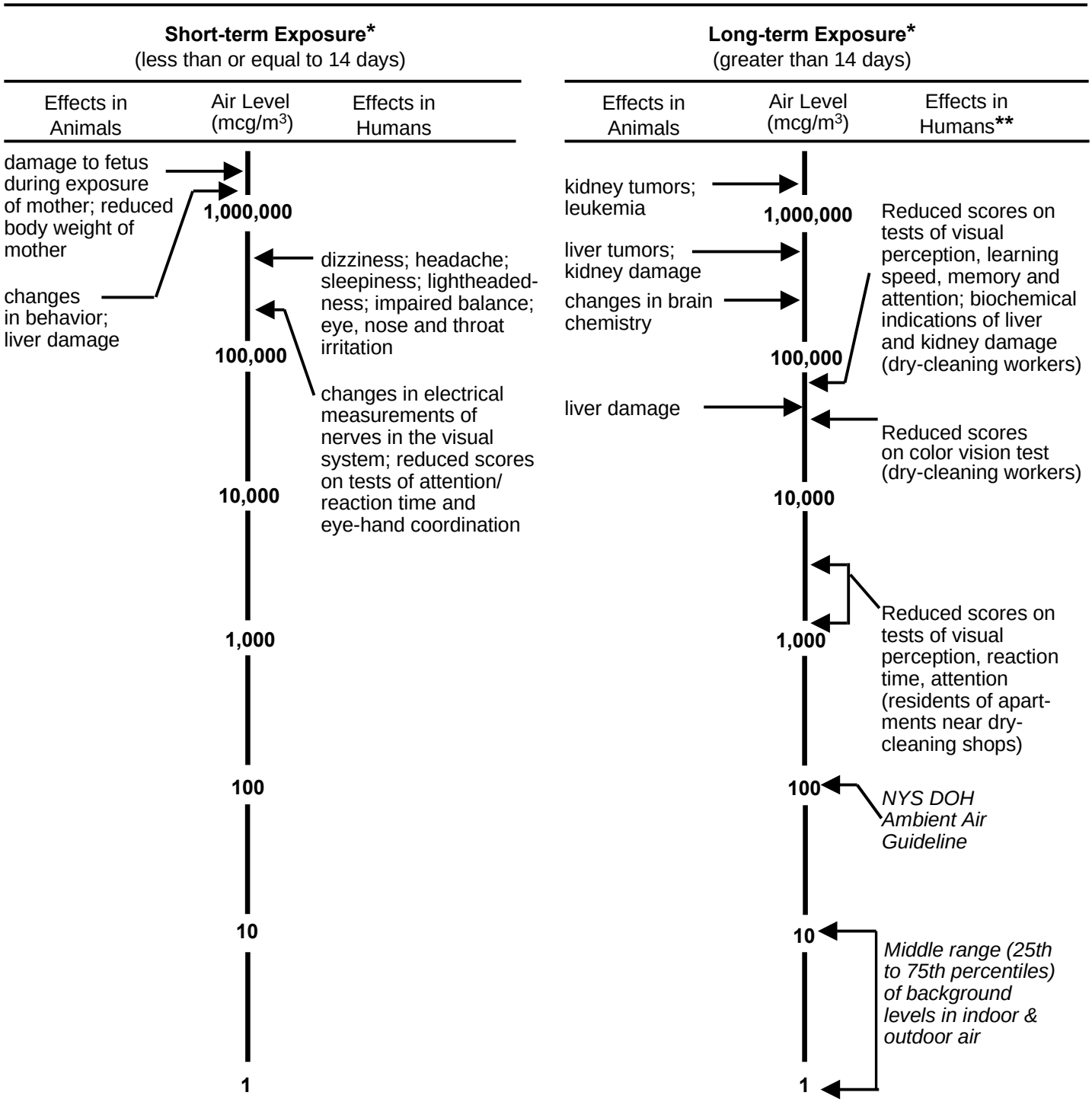
3. HOW DOES PERC ENTER AND LEAVE MY BODY?

When people breathe air containing PERC, the PERC is taken into the body through the lungs and passed into the blood, which carries it to all parts of the body. A large fraction of this PERC is breathed out, unchanged, through the lungs into the air. Some of this PERC is stored in the body (for example, in fat, liver, and brain) and some is broken down in the liver to other compounds and eliminated in urine. PERC can also be found in breastmilk. Once exposure stops, most of the PERC and its breakdown products leave the body in several days. However, it may take several weeks for all of the PERC and its breakdown products to leave the body.

4. WHAT KINDS OF HEALTH EFFECTS CAN BE CAUSED BY EXPOSURE TO PERC IN AIR?

In humans and animals, the major effects of PERC exposure are on the central nervous system, kidney, liver, and possibly the reproductive system. These effects vary with the level and length of exposure. Figure 1 shows the types of health effects seen in humans and animals and the lowest levels of PERC in air at which the effects were seen. The diagram on the right side of the figure shows the effects of long-term exposures in humans and animals whereas the diagram on the left side shows the same information for short-term exposures. Because there is a

Figure 1. Health Effects from Breathing Tetrachloroethene (PERC). The diagram shows the effects observed in humans and animals exposed to measured levels of PERC in air. The diagram contains information on the effects observed after short-term and long-term exposure. Also shown are background levels in indoor and outdoor air.



*Effects are listed at the lowest level (micrograms per cubic meter of air, mcg/m^3) at which they were first observed. They and other effects may also be seen at higher levels. 100 mcg/m^3 = 0.1 mg/m^3 (milligrams per cubic meter of air) = 15 ppb (parts per billion) = 0.015 ppm (parts per million).

**Studies have shown that workplace exposure to PERC is associated with an increased risk of cancer and spontaneous abortion, but studies did not provide good quantitative data on exposure levels.

large amount of information on the human effects of PERC, the rest of the fact sheet will discuss only the human data.

The human effects shown in Figure 1 represent the average response of a group of individuals at an estimated level of exposure (typically, the average of the measured air levels). Because data for individual people are not usually reported, some people (those sensitive to the effects of PERC) may have experienced effects at air levels below the average air level, whereas other people (those resistant to the effects of PERC) may not have experienced effects at air levels above the average air level. The difference in how people respond to the same or similar exposure levels is due, in part, to the individual differences among people. People, for example, differ in age, sex, diet, family traits, lifestyle, genetic background, the presence of other chemicals in their body (e.g., alcohol, prescription drugs), and state of health. These differences can affect how people will respond to a given exposure. One person may feel fine during and after an exposure while another person may become sick. This is known as sensitivity. Differences in sensitivity should be kept in mind when reading the following information on the human health effects of PERC.

Short-Term Exposure - Studies with volunteers show that exposures of 8-hours or less to 700,000 micrograms per cubic meter of air (mcg/m^3) cause central nervous system symptoms such as dizziness, headache, sleepiness, lightheadedness, and poor balance (Figure 1). Exposures to 350,000 mcg/m^3 for 4 hours affected the nerves of the visual system and reduced scores on certain behavioral tests (which, for example, measure the speed and accuracy of a person's response to something they see on a computer screen). These effects were mild and disappeared soon after exposure ended.

Long-Term Exposure – Numerous studies of dry-cleaning workers indicate that long-term exposure (9 to 20 years, for example) to workplace air levels averaging about 50,000 mcg/m^3 to 80,000 mcg/m^3 reduces scores on behavioral tests and causes biochemical changes in blood and urine (Figure 1). The effects were mild and hard to detect. How long these effects would last if exposure ended is not known.

One study reported reduced scores on behavioral tests in 14 healthy adults living (for 10.6 years, on average) in apartments near dry-cleaning shops. The effects were small; the average test scores of the residents were slightly lower than the average score of unexposed people. The range of measured air levels in 13 apartments was 7.6 mcg/m^3 to 23,000 mcg/m^3; one air level was below 100 mcg/m^3, five values were between 100 and 1,000 mcg/m^3, and seven values were above 1,000 mcg/m^3. The average air level in all apartments was 5,000 mcg/m^3 and the median value was about 1,400 mcg/m^3 (that is, half the measured air levels were above 1,400 mcg/m^3 and half were below it). As with the long-term occupational studies, how long these effects would last if exposure ended is not known. Confidence in the understanding of exposure in this study is less than that in the occupational studies.

Some studies show a slightly increased risk of some types of cancer and reproductive effects among workers, including dry-cleaning workers, exposed to PERC and other chemicals. Cancers associated with exposures include cancers of the esophagus, bladder, and non-Hodgkin's

lymphoma. Cancers less clearly associated with exposures include cancers of the cervix, tongue, and lung. The reproductive effects associated with exposure included increased risks of spontaneous abortion, menstrual and sperm disorders, and reduced fertility. The data suggest, but do not prove, that the effects were caused by PERC and not by some other factor or factors.

Data on the workplace air levels in these studies ranged from none (reproductive studies) to some (cancer studies); however, workplace air levels during the times these studies were conducted were considerably higher than those found in indoor or outdoor air (see next question).

5. WHAT ARE BACKGROUND LEVELS FOR PERC IN INDOOR AND OUTDOOR AIR IN AREAS THAT ARE NOT NEAR A KNOWN SOURCE OF PERC?

The United States Environmental Protection Agency (US EPA) has collected and analyzed information on PERC levels in indoor and outdoor air. Table 1 contains the results from air samples collected inside and outside of buildings that were not near known sources of PERC and other chemicals (for example, a home not known to be near a chemical spill, a hazardous waste site, a dry-cleaner, or a factory). The middle half (25^{th} to 75^{th} percentile) of PERC levels in indoor and outdoor air samples is about 1 to 10 mcg/m^3. A similar result was found for NYS homes not near known PERC sources. NYSDOH sampled 138 homes between 1989 and 1996 and the level of PERC in the indoor air was below 10 mcg/m^3 in 95% of the homes. Collectively, these data show that background levels of PERC in air are seldom above 10 mcg/m^3.

Table 1.

Sample	PERC Air Levels (mcg/m^3)[A]			Sample Size
	25^{th} Percentile	50^{th} Percentile (Median)	75^{th} Percentile	
Homes & Offices: Nationwide 1970 – 1988[B]				
Indoor	1.7	5.0	11	2,195
Outdoor	0.82	2.4	5.9	3,226
Offices: Nationwide 1994 – 1996[C]				
Indoor	not detected*	3.0	5.9	298
Outdoor		not detected*	3.0	100

[A] These databases contain air-testing results from studies where there were no known sources of chemicals or chemical spills. Outdoor samples were taken at the same time as indoor samples and at a location close to the building sampled.

[B] The US EPA Volatile Organic Compounds Database was published in March 1988.

[C] From 1994 through 1996, US EPA measured volatile organic compounds in indoor and outdoor air at 100 randomly selected public and private office buildings across the US.

* Not detected means that the amount of PERC in the air sample was less than the smallest amount of PERC that could be accurately measured (that is, the level was less than the detection limit); in these studies, the detection limit ranged from 1.4 to 2.0 mcg/m^3.

6. WHAT IS THE NEW YORK STATE DEPARTMENT OF HEALTH'S (NYSDOH) GUIDELINE FOR PERC IN AIR?

NYSDOH recommends that the average air level in a residential community not exceed 100 micrograms of PERC per cubic meter of air (100 mcg/m^3), considering continuous lifetime exposure and sensitive people. Three other ways of expressing the guideline are 0.1 milligrams per cubic meter of air (0.1 mg/m^3), 15 parts per billion (ppb) or 0.015 parts per million (ppm).

The purpose of the guideline is to help guide decisions about the nature of efforts to reduce PERC exposure. Reasonable and practical actions should be taken to reduce PERC exposure when indoor air levels are above background, even when they are below the guideline of 100 mcg/m^3. The urgency to take actions increases as indoor air levels increase, especially when air levels are above the guideline. Finally, NYSDOH recommends taking immediate action to reduce exposure when an air level is ten-times or more higher than the guideline (that is, when the air level is 1,000 mcg/m^3 or higher). In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce PERC levels in indoor air to as close to background as practical.

7. SHOULD I BE CONCERNED ABOUT HEALTH EFFECTS IF I AM EXPOSED TO AN AIR LEVEL SLIGHTLY ABOVE THE GUIDELINE?

The guideline is lower than the air levels that caused either non-cancer or cancer effects (Figure 1); thus, the possibility of health effects is low even at air levels slightly above the guideline. In addition, the guideline is based on the assumption that people are continuously exposed to PERC in air all day, every day for as long as a lifetime. This is rarely true for most people, who are more likely to be exposed for a part of the day and part of their lifetime.

8. WHEN SHOULD MY CHILDREN OR I SEE A PHYSICIAN?

If you believe you or your children have symptoms that you think are caused by PERC exposure, you and your children should see a physician. You should tell the physician about the symptoms and about when, how, and for how long you think you and/or your children were exposed to PERC.

9. WHERE CAN I GET MORE INFORMATION?

If you have any questions about the information in this fact sheet or would like to know more about PERC, please call the New York State Department of Health at 1-518-402-7800 or 1-800-458-1158 (extension 2-7800) or write to the following address.

New York State Department of Health
Bureau of Toxic Substance Assessment
Flanigan Square, 547 River Street
Troy, NY 12180-2216

NEW YORK STATE
DEPARTMENT OF HEALTH

Trichloroethene (TCE) in Indoor and Outdoor Air

FACT SHEET
February 2005

What is trichloroethene?

Trichloroethene is a manufactured, volatile organic chemical. It has been used as a solvent to remove grease from metal. Trichloroethene has also been used as a paint stripper, adhesive solvent, as an ingredient in paints and varnishes, and in the manufacture of other organic chemicals. Other names for trichloroethene include TCE and trichloroethylene. TCE is a common name for trichloroethene and will be used for the rest of this fact sheet.

TCE is a clear, colorless liquid, and has a somewhat sweet odor. It is non-flammable at room temperature and will evaporate into the air.

How can I be exposed to TCE?

People can be exposed to TCE in air, water and food. Exposure can also occur when TCE, or material containing TCE, gets on the skin.

TCE gets into the air by evaporation when it is used. TCE can also enter air and groundwater if it is improperly disposed or leaks into the ground. People can be exposed to TCE if they drink groundwater contaminated with TCE, and if the TCE evaporates from the contaminated drinking water into indoor air during cooking and washing. They may also be exposed if TCE evaporates from the groundwater, enters soil vapor (air spaces between soil particles), and migrates through building foundations into the building's indoor air. This process is called "soil vapor intrusion."

How can TCE enter and leave my body?

If people breathe air containing TCE, some of the TCE is exhaled unchanged from the lungs and back into the air. Much of the TCE gets taken into the body through the lungs and is passed into the blood, which carries it to other parts of the body. The liver changes most of the TCE taken into the blood into other compounds, called breakdown products, which are excreted in the urine in a day or so. However, some of the TCE and its breakdown products can be stored in the fat or the liver, and it may take a few weeks for them to leave the body after exposure stops.

What kinds of health effects are caused by exposure to TCE in air?

In humans, long term exposure to workplace air containing high levels of TCE (generally greater than about 40,000 micrograms of TCE per cubic meter of air (mcg TCE/m^3)) is linked to effects on the central nervous system (reduced scores on tests evaluating motor coordination, nausea, headaches, dizziness) and irritation of the mucous membranes. Exposure to higher levels (generally greater than 300,000 mcg TCE/m^3) for short periods of time can irritate the eyes and respiratory tract, and can cause effects on the central nervous system, including dizziness, headache, sleepiness, nausea, confusion, blurred vision and fatigue. In laboratory animals, exposure to high levels of TCE has damaged the central

nervous system, liver and kidneys, and adversely affected reproduction and development of offspring. Lifetime exposure to high levels of TCE has caused cancer in laboratory animals.

Some studies of people exposed for long periods of time to high levels of TCE in workplace air, or elevated levels of TCE in drinking water, show an association between exposure to TCE and increased risks for certain types of cancer, including cancers of the kidney, liver and esophagus, and non-Hodgkin's lymphoma. One study showed an association between elevated levels of TCE in drinking water and effects on fetal development. Other studies suggest an association between workplace TCE exposure and reproductive effects (alterations in sperm counts) in men. We do not know if the effects observed in these studies are due to TCE or some other possible factor (for example, exposure to other chemicals, smoking, alcohol consumption, socioeconomic status, lifestyle choices). Because all of these studies have limitations, they only suggest, but do not prove, that exposure to TCE can cause cancer in humans and can cause developmental and reproductive effects as well.

What are background levels of TCE for indoor and outdoor air?

The exact meaning of background depends on how a study selected sampling locations and conditions. Generally, sampling locations are selected to be not near known sources of volatile chemicals (for example, a home not near a chemical spill, a hazardous waste site, a dry cleaner, or a factory). In some studies, the criteria for sampling indoor air may require checking containers of volatile chemicals to make sure they are tightly closed or removing those products before samples are taken. The New York State Department of Health (NYSDOH) has used several sources of information on background levels of TCE in indoor and outdoor air. One NYSDOH study of residences heated by fuel oil found that background concentrations of TCE in indoor and outdoor air are less than 1 mcg/m^3 in most cases. In this study, most homes did not have obvious sources of volatile organic compounds (VOCs). In those homes with VOC sources, samples were taken and the data are included in the study.

What are sources of TCE in air in homes?

TCE is found in some household products, such as glues, adhesives, paint removers, spot removers, rug cleaning fluids, paints, metal cleaners and typewriter correction fluid. These and other products could be potential sources for TCE in indoor air.

Another source of TCE in indoor air is contaminated groundwater that is used for household purposes. Common use of water, such as washing dishes or clothing, showering, or bathing, can introduce TCE into indoor air through volatilization from the water.

TCE may also enter homes through vapor intrusion as described on page 1 in the question "How can I be exposed to TCE?".

What is the level of TCE that people can smell in the air?

The reported odor threshold (the air concentration at which a chemical can be smelled) for TCE in air is about 540,000 mcg TCE/m^3. At this level, most people would likely be able to start smelling TCE in air. However, odor thresholds vary from person to person. Some people may be able to detect TCE at levels lower than the reported odor threshold and some people may only detect it at concentrations higher than the reported odor threshold.

If I can't smell TCE in the air, am I being exposed?

Just because you can't smell TCE doesn't mean there is no exposure. Sampling and testing is the best way to know if TCE is present.

What is the NYSDOH's guideline for TCE in air?

After a review of the toxicological literature on TCE, the NYSDOH set a guideline of 5 mcg/m^3 for TCE in air. This level is lower than the levels that have caused health effects in animals and humans. In setting this level, the NYSDOH also considered the possibility that certain members of the population (infants, children, the elderly, and those with pre-existing health conditions) may be especially sensitive to the effects of TCE.

The guideline is not a bright line between air levels that cause health effects and those that do not. The purpose of the guideline is to help guide decisions about the nature of the efforts to reduce TCE exposure. Reasonable and practical actions should be taken to reduce TCE exposure when indoor air levels are above background, even when they are below the guideline of 5 mcg/m^3. The urgency to take actions increases as indoor air levels increase, especially when air levels are above the guideline. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce TCE levels in indoor air to as close to background as practical.

Should I be concerned about health effects if I am exposed to air levels slightly above the guideline? Below the guideline?

The possibility of health effects occurring is low even at air levels slightly above the guideline. In addition, the guideline is based on the assumption that people are continuously exposed to TCE in air all day, every day for as long as a lifetime. This is rarely true for most people who are likely to be exposed for only part of the day and part of their lifetime.

How can I limit my exposure to TCE?

TCE can get into indoor air through household sources (for example, commercial products that contain TCE), from contaminated drinking water, or by vapor intrusion. As with any indoor air contaminant, removing household sources of TCE will help reduce indoor air levels of the chemical. Maintaining adequate ventilation will also help reduce the indoor air levels of TCE. If TCE is in the indoor air as a result of vapor intrusion, a sub-slab depressurization system, much like a radon mitigation system, will reduce exposures by minimizing the movement of vapors that are beneath a slab into a building. If TCE is in the water supply of a house, a carbon filter on the water supply to remove the TCE will minimize ingestion and inhalation exposures.

Is there a medical test that can tell me whether I have been exposed to TCE?

TCE can be measured in people's breath soon after they are exposed. TCE and some of its breakdown products can be measured in the urine and blood. These tests are not routinely available at a doctor's office. Urine and blood tests can indicate that you may have recently (within the last few days) been exposed to a large amount of the chemical. However, they cannot tell you the source of the exposure. Some of the breakdown products of TCE can also be formed from other chemicals.

When should my children or I see a physician?

If you believe you or your children have symptoms that you think are caused by TCE exposure, you or your children should see a physician. You should tell the physician about the symptoms and about when, how and for how long you think you and/or your children were exposed to TCE.

What is the NYSDOH doing to educate physicians about TCE?

The NYSDOH maintains an Infoline (1-800-458-1158) that physicians or the public can call when they have questions related to various types of chemical exposures. A certified occupational and environmental health nurse is available to triage physicians' questions and to direct their inquiries to the appropriate staff member.

The NYSDOH also works closely with the federal Agency for Toxic Substances and Disease Registry (ATSDR), making their educational materials available to physicians upon request. One of these items is an environmental medicine case study entitled "Trichloroethylene (TCE) Toxicity," which provides the opportunity for physicians to earn continuing medical education credits from the Centers for Disease Control and Prevention. Physicians who would like to complete this training are encouraged to contact the NYSDOH for more information. A printed copy can be mailed to the physician or it can be accessed on-line at the following web site http://www.atsdr.cdc.gov/HEC/CSEM/tce/index.html.

Where can I get more information?

If you have any questions about the information in this fact sheet or would like to know more about TCE, please call the NYSDOH at 1-800-458-1158 or write to the following address:

New York State Department of Health
Bureau of Toxic Substance Assessment
Flanigan Square, 547 River Street
Troy, NY 12180-2216

NEW YORK STATE
DEPARTMENT OF HEALTH

RADON

Frequently Asked Questions

What is radon and where does it come from?

Radon is a gas that comes from the radioactive decay of radium in the soil. Radon is a colorless, tasteless and odorless gas that can only be measured through the use of proper test procedures.

Radon is constantly being generated by the decay of radium. Radium is the decay product of uranium, which is commonly found in rocks and soils present in the earth's crust. The concentration of radon gas in the soil will be related to the amount of uranium present. However, this is not a good indicator of the level of radon that may be in an individual home. The radon concentration in a home is dependent on many factors, including the types and properties of the soil that the home is built on and the individual features of the building.

Radon can also be dissolved in ground water and can be introduced into the indoor air through the aeration of well water during its use in washing machines, showers, and so forth. However, in New York State, with a few exceptions, this component is usually relatively small compared to the amount of radon entering the home from the soil.

What are the health effects of radon?

Based on data provided by the United States Environmental Protection Agency (EPA), the Surgeon General has warned that radon is the second leading cause of lung cancer in the United States, resulting in an estimated 22,000 lung cancer deaths annually. Many homes contain radon concentrations that are high enough to give their occupants lifetime exposures that could increase their risk of developing lung cancer. As one inhales, radon decay products in the inhaled air are deposited in the lungs. Radon and its decay products emit alpha and beta particles and gamma photons. The alpha particles are very damaging if emitted from radioactive material within the body. The alpha particles can strike sensitive lung tissue causing damage to the cells in the lungs and increase the risk of lung cancer. The risk associated with exposure to radon is thought to increase along with increasing radon concentration, so the higher the average radon level is in a house, and the longer the exposure period, the greater the risk to the occupants.

In addition, if you are a smoker, radon greatly increases your risk of lung cancer.

RADON RISK*

Radon Level**	If 1,000 people who smoked were exposed to this level over a lifetime…	If 1,000 people who never smoked were exposed to this level over a lifetime…
20 pCi/L	About 135 people could get lung cancer	About 8 people could get lung cancer
4 pCi/L	About 29 people could get lung cancer	About 2 people could get lung cancer
0.4 pCi/L	About 3 people could get lung cancer	Less than 1 person could get lung cancer

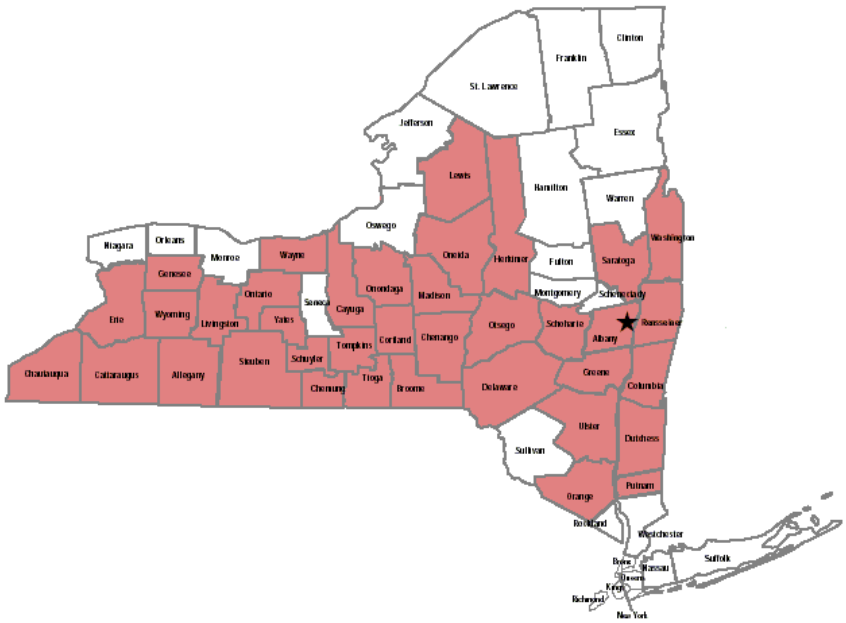
* The risk of exposure to radon in addition to other causes.

** Radon concentration in air is measured in units of "picoCuries per Liter (pCi/L)." The picoCurie (pCi) is a unit of radioactivity which represents one trillionth of a Curie or 2.22 nuclear-transformations per minute.

Do I live in an area designated as a "high radon risk area" by the United States Environmental Protection Agency and New York State?

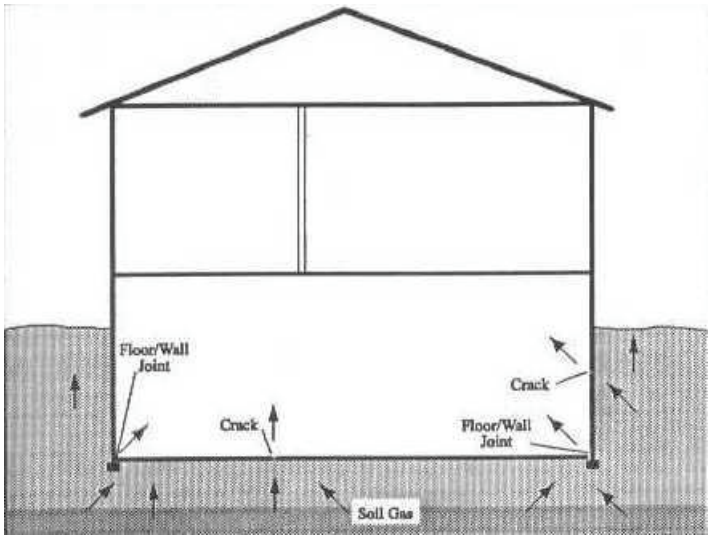
Thirty-seven (37) counties in the state have been designated as "high radon risk areas" by the EPA and New York State. They are as follows (shaded on the map):

Albany
Allegany
Broome
Cattaraugus
Cayuga
Chautauqua
Chemung
Chenango
Columbia
Cortland
Delaware
Dutchess
Erie
Genesee
Greene
Herkimer
Lewis
Livingston
Madison
Oneida
Onondaga
Ontario
Orange
Otsego
Putnam
Rensselaer
Saratoga
Schoharie
Schuyler
Steuben
Tioga
Tompkins
Ulster
Washington
Wayne
Wyoming
Yates



How can radon enter my home?

Radon can enter a home whether it is old or new, or whether it has a basement or is on a slab. Radon enters homes through cracks in slabs or basement floors and walls, and through openings around sump pumps because of a difference in pressure. Heating, ventilation or air-conditioning systems may create a negative pressure that can draw radon into the building. The major routes of entry into a home in New York State are illustrated in the figure.



How can I test the radon levels in my home?

Testing for radon is simple and inexpensive. You can test your home any time, although it's better to do so during the heating season when the home is less ventilated. Remember that the longer you wait, the longer you and your family may be exposed to radon.

Test kits can be purchased in many hardware stores, the hardware sections of discount outlets, from local health departments, or from the New York State Department of Health (NYSDOH). The kits should display the phrase "Meets EPA or National Radon Proficiency Requirements."

There are two categories of detectors: long-term (90 days to one year) and short-term (less than 90 days, typically 2 to 7 days). The length of testing varies depending on the type of radon information you are interested in. Short-term tests are useful for screening and for situations

where results are needed quickly. A long-term test will usually be a better indicator of the radon level in your home. Since the long-term test occurs over a longer period of time, the influence of daily and seasonal fluctuations in your home's radon level will be reduced. A long-term test will provide a true annual average. "Alpha track" and "electret" detectors are commonly used for this type of testing. Long-term test kits cost about $30, and are accurate to within plus or minus 25%.

The most commonly used device for making short-term radon measurements in homes is the charcoal canister. These devices are fairly quick, inexpensive, and easy to use. Their accuracy is about plus or minus 20%. Since short term tests can be affected by daily and seasonal fluctuations in your home's radon level, the NYSDOH recommends that the average of two charcoal canister measurements be used before making a decision to take appropriate corrective action. Short-term charcoal canisters are available from the NYSDOH at a cost of $6.75 per detector ordered (New York State Residents ONLY). To obtain an order form, please visit the NYSDOH website at http://www.health.state.ny.us/nysdoh/radon/detector.pdf or call 1-800-458-1158, ext. 2-7556.

Continuous electronic radon monitors may also be used for short-term measurements (often for real estate transactions). They should only be used by certified professional radon testing firms. Tests using these monitors are more expensive (about $100). To obtain the names of certified professional radon testing firms, contact the NYSDOH's Radon Program, the National Radon Safety Board's web site (NRSB; www.nrsb.org), the National Environmental Health Association's web site (NEHA; www.neha.org), or the NYSDOH's Environmental Laboratory Approval Program web site (www.wadsworth.org/labcert/elap/radon.html).

What is the recommended action level for radon?

The NYSDOH and the EPA use 4 pCi/L as a recommended action level. When testing indicates that the radon level in the lowest primary living area of the home is above this action level, the NYSDOH recommends that the homeowner take appropriate corrective action.

How can I reduce the radon levels in an existing house?

Radon levels in a house can be reduced. This can be done by several methods, including sealing cracks in floors and walls. One of the most widely used methods is the active sub-slab depressurization system. This technique will reroute the radon gas from the soil away from the house, by using a fan to create a pressure that will move the soil gas from beneath the basement to a point above the roof. This technique is very effective and will typically cost between $1,000 and $1,500 to install. There are contractors in most areas of the state who have met certain requirements and are trained to identify and fix radon problems in your home. To obtain the names of local contractors, contact the NYSDOH's Radon Program at 1-800-458-1158, extension 2-7556, or visit the NRSB's web site or NEHA's web site.

What types of radon reduction techniques are available for new construction?

If you are building in an area known to have a high probability of elevated radon levels, there are certain steps that can be taken during construction that will reduce the radon levels. EPA's *Model Standards and Techniques for Control of Radon in New Residential Buildings* and *Building Radon Out: A Step-by-step Guide on How to Build Radon Resistant Homes* (both available on EPA's web site) contains information on how to incorporate these techniques and materials in residential construction. Essentially this will consist of a layer of semi-permeable material, such as sand or gravel, under the foundation, a 6 mil or thicker layer of plastic between the gravel under the foundation and the concrete, a 4" PVC pipe through the foundation floor and extending through the roof, a roughed in electrical box in the attic or loft near the PVC pipe, and sealing and caulking of all openings in the concrete floor.

Where can I get more information?

For more information about radon or radon testing, or to obtain the names of local contractors, contact the NYSDOH's Radon Program at 1-800-458-1158, extension 2-7556.

Email:
radon@health.state.ny.us

Web sites:
http://www.health.state.ny.us/nysdoh/radon/radonhom.htm
http://www.wadsworth.org/labcert/elap/radon.html
http://www.epa.gov/iaq/radon
http://www.nrsb.org
http://www.neha.org

APPENDIX N - RESPONSIBILITIES OF OWNER AND REMEDIAL PARTY

Responsibilities

The responsibilities for implementing the Site Management Plan ("SMP") for the Carol Cleaners, Staten Island Mall site (the "site"), number 243020 are divided between the site owner(s) and a Remedial Party, as defined below. The owner(s) is/are currently listed as: General Growth Properties, Josh Ryals, 350 N Orleans Street, Suite 300, Chicago, IL 60654 (the "owner").

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:
GGP Staten Island Mall, LLC, Josh Ryals, 350 N Orleans Street, Suite 300, Chicago, IL 60654

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.

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 an 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. If 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) If 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 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 1.3 of the SMP. A change of use includes, but is not limited to, any activity that may increase direct human or environmental exposure (e.g., day care, school or park). A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html.

8) Until such time as the NYSDEC deems the vapor mitigation system unnecessary, the owner shall operate the system, pay for the utilities for the system's operation, and report any maintenance issues to the RP and the NYSDEC.

9) In accordance with the tenant notification law, within 15 days of receipt, the owner must supply a copy of any vapor intrusion data, that is produced with respect to structures and that exceeds NYSDOH or OSHA guidelines on the site, whether produced by the NYSDEC, RP, or owner, to the tenants on the property. The owner must otherwise comply with the tenant and occupant notification provisions of Environmental Conservation Law Article 27, Title 24.

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) The RP is responsible for the proper maintenance of any installed vapor intrusion mitigation systems associated with the site, as required in Section 5.3 (Operation, Monitoring and Maintenance Manual) of the SMP.

8) 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.

9) 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 NYSDEC project manager 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 O - REMEDIAL SYSTEM OPTIMIZATION OUTLINE

REMEDIAL SYSTEM OPTIMIZATION OUTLINE
FORMER CAROL CLEANERS SITE

Table of contents

1.0 Introduction

1.1 Site overview

1.2 Project objectives and scope of work

1.3 Report overview

2.0 Remedial action description

2.1 Site location and history

2.2 Regulatory history and requirements

2.3 Clean-up goals and site closure criteria

2.4 Previous remedial actions

2.5 Description of existing remedy

2.5.1 System goals and objectives

2.5.2 System description

2.5.3 Operation and maintenance program

3.0 Findings and observations

3.1 Subsurface performance

3.2 Treatment system performance

3.3 Regulatory compliance

3.4 Major cost components or processes

3.5 Safety record

4.0 Recommendations

4.1 Recommendations to achieve or accelerate site closure

4.1.1 Source reduction/treatment

4.1.2 Sampling

4.1.3 Conceptual site model (risk assessment)

4.2 Recommendations to improve performance

4.2.1 Maintenance improvements

4.2.2 Monitoring improvements

4.2.3 Process modifications

4.3 Recommendations to reduce costs
4.3.1 Supply management
4.3.2 Process improvements or changes
4.3.3 Optimize monitoring program
4.3.4 Maintenance and repairs
4.4 Recommendations for implementation