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REMEDIAL INVESTIGATION WORKPLAN
205 Park Avenue
Block 2033, Lot 50
Brooklyn, New York

PREPARED FOR:
462 Lexington, LLC
89 Bartlett St. Brooklyn, NY 11206

PREPARED BY:
Goldberg Zoino Associates of New York, P.C. d/b/a GZA GeoEnvironmental of New York
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QEP CERTIFICATION

I, David Winslow, certify that that I am a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Remedial Investigation Work Plan (RIWP), for 180 East 132nd Street, Block 2260, Lot 180, Bronx, New York, 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).

David M. Winslow, P.G.

QEP Name

QEP Signature

6/9/2021

Date

1.0 INTRODUCTION

This Remedial Investigation Workplan (RIWP) was prepared by Goldberg Zoino Associates of New York, P.C. d/b/a GZA GeoEnvironmental of New York (GZA) on behalf of 462 Lexington, LLC for submittal to the New York State Department of Environmental Conservation (NYSDEC), Division of Environmental Remediation (DER) for the property identified as 205 Park Avenue, Block 2033, Lot 50, Brooklyn, New York (Site). The Site is 12,808-square feet and is bounded by a vacant lot and residential building to the north, Park Avenue and Brooklyn Queens Expressway to the south, Vanderbilt Avenue, Vespa Brooklyn/Aprilia/Moto Guzzi and private residences to the east, and Clermont Avenue and residential buildings to the west. Pedestrian sidewalks surround the Site on the western, eastern, and southern sides. Figure 1 presents a Site Location Map and Figure 2 presents a Site Plan that shows the current configuration of the Site. On [[date]], 462 Lexington, LLC entered into a Brownfield Cleanup Agreement (BCA) as part of the Brownfield Cleanup Program (BCP) volunteer application.

The objective of this RIWP is to collect sufficient quality and quantity of data to characterize the nature and extent of the contamination present on Site. The overall objectives of the project are to prepare the Site for commercial and residential use and to remediate known and unknown environmental conditions at the Site to meet NYSDEC and New York State Department of Health (NYSDOH) requirements.

1.1 PROJECT OBJECTIVES

The objectives of this RIWP are to present an approach to:

- Delineate the extent of impacted soils on the Site;
- Evaluate the quality of groundwater on Site; and
- Evaluate potential VOC impacts detected in soil gas on-Site.

GZA prepared this RIWP for review by the NYSDEC. It is based on our current understanding of Site conditions and revisions may be appropriate as additional information becomes available.

1.2 SCOPE OF SERVICES

This RIWP was prepared by GZA for the Site in general accordance with the NYSDEC, DER *Technical Guidance for Site Investigation and Remediation (DER-10)*, dated May 2010. GZA's scope of serves consists of the following activities:

- Development of a work plan to delineate the horizontal and vertical extent of impacted soil, evaluate on-site and off-site groundwater and soil vapor;
- Development of a Site-specific health and safety plan (HASP) for the personnel undertaking the work;

- Preparation of a Quality Assurance Project Plan (QAPP) for the acquisition, handling and analysis of the samples collected;
- Implementation of this RIWP; and,
- Preparation of a Remedial Investigation Report/Remedial Action Workplan (RIR/RAWP).

This workplan has been prepared in accordance with the limitations provided in **Appendix A.**

2.0 SITE INFORMATION

The following summarizes information provided in previous site assessment and site investigation reports related to the Site. These documents should be consulted for additional information and details not presented here. Previous documents include:

- *Phase I Environmental Site Assessment,* GZA GeoEnvironmental, Inc., May 2019
- *Remedial Investigation Report,* GZA GeoEnvironmental, Inc., February 2020

Previous reports are included in **Appendix B.**

2.1 SITE LOCATION, DESCRIPTION, AND USE

The Site is located at 205 Park Avenue in the Wallabout Section in Brooklyn, New York, and is identified as Block 2033 and Lot 50 on the New York City Tax Map. The Site is vacant and unused by the current owner. A map of the Site and surrounding properties is provided as **Figure 2.**

Adjoining properties are generally residential with some commercial use. The Site is bounded by a vacant lot and residential building to the north, Vanderbilt Avenue followed by residences and a motorcycle/motor scooter repair and dealership to the east, Clermont Avenue followed by residences to the west, and Park Avenue and Brooklyn Queens Expressway followed by residences and vacant property used for parking to the south. Pedestrian sidewalks surround the Site on the western, eastern, and southern sides. Other properties not adjoining the Site are generally residential and commercial. There are four sensitive receptors present within a 500-foot radius around the Site: (1) Greene Hill School, (2) Moy Yee Kung Fu, (3) Benjamin Banneker Academy, and (4) P.S. 046 Edward c. Blum. **Figure 3** shows the surrounding land usage.

2.2 SITE HISTORY

The New York City Department of Finance website lists the following deed transfers:

Previous Owner	Contact	Address	Requestor's Relationship to Owner/Operator	Date of Ownership or Operation
462 Lexington LLC*	Bruchy Lefkowitz	44 Lorimer Street Brooklyn, NY 11206 (Prior Listed)	Owner	2/26/2007 to Present
Yeshivas Bais Limude, Hashem Jewish Center*	Not Available	430 Kent Avenue Brooklyn, NY 11211	None	12/18/2002 to 2/26/2007
Kathy Jules-Elysee*	Not Available	33-45 92nd Street Jackson Heights, NY 11372	None	11/08/2001 to 12/18/2002
Administration of General Services*	Not Available	10 Causeway Street Boston, MA 02114	None	Unknown to 11/08/2001

*Owner is presumed operator.

Historical information reviewed includes historical Sanborn Maps, aerials, topographic maps, and city directory abstracts provided by Environmental Data Resources (EDR). The Site has been developed since at least 1887 with two- and three-story dwellings and three 3-story stores. The Site has had multiple tenants and uses throughout the years, including a meat market, drug store/pharmacy, dry cleaner, auto service facility, private residences, and various other commercial establishments. All buildings on the Site were demolished in 2016 and the Site has remained vacant since. Operations involving dry cleaners and auto service garages typically utilize chemical agents, petroleum and/or hazardous materials, the discharge of which may have adversely impacted the environmental quality of the property. Therefore, the historical use of the Site as a dry cleaner and an auto service facility represented a Recognized Environmental Condition (REC).

3.0 ENVIRONMENTAL AND PHYSIOGRAPHIC SETTING

3.1 REGIONAL PHYSIOGRAPHY

Based on information of the U.S. Geological Survey topographic map for Brooklyn, NY (2013) obtained from EDR, the Site is situated at an approximate elevation of 28 to 30 feet above mean sea level. The topographic gradient near the Site slopes generally to the north. The nearest water body is the East River Navy Basin, which is located approximately 1,560 feet north of the Site.

3.2 GEOLOGIC, HYDROGEOLOGIC, AND HYDROLOGIC CONDITIONS

Based on the United States Geological Survey 1994 Bedrock and engineering geologic maps of New York County and parts of Kings and Queens Counties, bedrock near the Site consists of Middle Ordovician to Lower Cambrian interbedded units of muscovite-biotite-quartz schist, gneissic quartz-microcline-muscovite-biotite-plagioclase granite with minor garnet, quartz-biotite hornblende amphibolite, and unevenly foliated sillimanite-plagioclase-muscovite-biotite-microcline-quartz qneissic schist with minor garnet, and we anticipate bedrock to be encountered at a depth of 100 feet below ground surface. Soils observed in boring logs advanced on Site indicate that subsurface soil at the Site consisted of historic fill, which was primarily comprised of brick, concrete, asphalt and other debris in a brown silty-sand matrix. The layer of historic fill extended to a depth ranging from ground surface to approximately 17 feet below grade. Native soil consisting of brown silty sands is present below the historic fill layer. Based on information obtained from temporary wells installed on-Site, described in more detail in Section 4.0, depth to groundwater ranges from approximately 23.8 to 24.8 feet below ground surface. Based on USGS geological survey (Water-Table Altitude in Kings and Queens Counties, New York, March 1997) groundwater flow is generally from south to north although groundwater gradient on Site is relatively flat beneath the Site.

4.0 PREVIOUS SITE INVESTIGATIONS

4.1 PHASE I ENVIRONMENTAL SITE ASSESSMENT, MAY 2019

In May 2019, GZA completed a Phase I Environmental Site Assessment (ESA) for the Site in accordance with the scope and limitations of ASTM Practice E1527-13. The Phase I ESA identified the following Recognized Environmental Conditions (RECs):

- The Site is a NYC E-Designated property with environmental requirements related to air, noise, and hazardous materials that must be investigated and addressed before a building permit can be obtained for the property's redevelopment.

- The Site has been historically identified by city directories as a dry cleaner and auto service facility.

The Phase I ESA, which contains Site photos in an Appendix, is provided in **Appendix B.**

4.2 REMEDIAL INVESTIGATION REPORT, FEBRUARY 2020

In January 2020, GZA performed a Remedial Investigation (RI) to evaluate the RECs identified during the Phase I ESA. GZA performed the following scope of work:

1. Advancement of 10 soil borings at locations across the project Site, and collection of 20 soil samples for chemical analysis from the soil borings to evaluate environmental soil quality;

2. Installation of five temporary groundwater monitoring wells at locations on the Site to establish groundwater flow and collection of five groundwater samples for chemical analysis to evaluate groundwater quality; and,

3. Installation of seven soil vapor probes around the Site's perimeter and collection of seven soil vapor samples for chemical analysis.

The following is a summary of the findings of the RI:

1. Elevation of the property ranges from approximately 28.8 to 29.9 feet above mean sea level (NAVD 88).

2. Depth to groundwater, at the times measured, ranged from approximately 23.8 to 24.8 feet below ground surface at the Site.

3. Based on the USGS geological survey (Water-Table Altitude in Kings and Queens Counties, New York, March 1997), groundwater flow is generally from southeast to northwest, although groundwater gradient is relatively flat beneath the Site (Figure 4).

4. The stratigraphy of the Site, from the surface down, consists of approximately 17 feet of fine to medium/coarse sand with traces of urban fill followed by native silty sand.

5. Findings of the soil sampling included (Appendix C Figure 2):

    - Semi-volatile organic compounds (SVOCs) including benzo(a)anthracene (1.9 mg/kg), benzo(a)pyrene (1.9 mg/kg), benzo(b)fluoranthene (2.5 mg/kg), benzo(k)fluoranthene (0.9 mg/kg), chrysene (1.5 mg/kg), and indeno(1,2,3-cd)pyrene (1.3 mg/kg) were detected above their respective UUSCOs at a depth of 15.5 to 16 ft below ground surface (bgs) at soil boring location SB-5. Of these SVOCs, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3- cd)pyrene also exceeded their respective RRSCOs.

    - Copper (78.1 mg/kg) exceeded UUSCOs at 15 to 15.5 ft bgs at location SB-3.

    - Pesticides including 4,4'-DDE (0.0215 mg/kg), 4,4'-DDD (0.00938 mg/kg), and 4,4'-DDT (0.0464 mg/kg) were detected exceeding their respective UUSCOs at 5.5 to 6 ft bgs at location SB-6.

6. Findings of the groundwater sampling included (Appendix C Figure 3):

    - Tetrachloroethene (PCE) was detected above its GQS of 5 µg/L in all groundwater samples and ranged from 6 to 20 µg/L.

    - Chloroform was detected in groundwater above its GQS of 7 µg/L in two of five samples at concentrations of 34 and 38 µg/L;

- SVOCs including benzo(a)anthracene (max. of 0.39 µg/L), benzo(b)fluoranthene (max. of 0.43 µg/L), benzo(k)fluoranthene (max. of 0.15 µg/L), chrysene (max. of 0.35 µg/L), and indeno(1,2,3-cd)pyrene (max. of 0.24 µg/L) were detected above their respective GQS of 0.002 µg/L in all five samples.

- Pesticide dieldrin was detected above its GQS of 0.004 µg/L in three of the groundwater samples with the highest estimated concentration of 0.022 µg/L.

- Several total metals were detected above GQS in one or more of the groundwater samples, including aluminum, barium, beryllium, cadmium, chromium, iron, lead, magnesium, manganese, nickel, selenium, and thallium. These compounds were found in groundwater samples from across the entire Site. Concentrations of aluminum ranged from 2,960 to 29,100 ug/L, concentrations of iron ranged from 1,380 to 36,400 ug/L, concentrations of manganese ranged from 640.3 to 29,450 ug/L, above their respective GQS of 2,000 ug/L, 600 ug/L, and 600 ug/L. Barium, beryllium, cadmium, chromium, lead, magnesium, nickel, selenium, and thallium were detected at concentrations of 3,059 ug/L, 6.89 ug/L, 6.84 ug/L, 254.2 ug/L, 335.9 ug/L, 70,600 ug/L, 316.7 ug/L, 37.5 ug/L, and 0.95 ug/L, above their respective GQS of 2,000 ug/L, 3 ug/L, 10 ug/L, 100 ug/L, 50 ug/L, 35,000 ug/L, 200 ug/L, 20 ug/L, and 0.5 ug/L. Manganese was detected at a concentration of 888 µg/L exceeding its GQS of 600 µg/L in dissolved groundwater.

- The groundwater sample from (TW-1) contained perfluorooctanoic Acid (PFOA) and perfluorooctanesulfonic Acid (PFOS) at the concentrations of 93.4 nanogram per liter (ng/L) and 32.4 ng/L, above their respective screening levels of 10 ng/L under NYSDEC's Part 375 Remedial Programs. TW-1 exhibited PFOA and PFOS at the combined concentration of 126 ng/L, below its screening level of 500 ng/ under NYSDEC's Part 375 Remedial Programs.

- 1,4-Dioxane was detected in TW -1 at an estimated concentration of 0.097 µg/L.

7. Findings of the soil vapor sampling included (Appendix C Figure 3):

   - Concentrations of petroleum-related VOCs (BTEX) ranged from 16.97 µg/m^3 to 43.37 µg/m^3. Overall, the highest reported concentration was for acetone (309 µg/m^3).

   - PCE was detected in all of the soil vapor samples and ranged from 55 µg/m^3 to 209 µg/m^3.

   - Trichloroethene (TCE) was detected in 7 of 8 samples and ranged in concentration from 1.4 µg/m^3 to 23.8 µg/m^3.

   - Carbon tetrachloride (max. of 5.25 µg/m^3), cis-1,2-Dichloroethene (max. of 2.45 µg/m^3), and 1,1,1- trichloroethane (TCA) (max. of 3.13 µg/m^3) were detected in one or more of the soil vapor samples.

   - Chloroform was detected in all seven soil vapor locations at concentrations ranging from non-detectable to 288 µg/m^3.

4.3 2020 SUPPLEMENTAL REMEDIAL INVESTIGATION

In December 2020, GZA performed a supplemental investigation designed to collect additional soil data to evaluate the historic fill on the Site. Three random shallow soil samples were collected from the 2' to 2.5' bgs intervals from the Site. Results summary table, sampling location figure, and electronic copies of the laboratory reports for this investigation are provided in **Appendix B.**

The soil analytical results were compared to the UUSCOs and RRSCOs. Soil/fill analytical results showed:

- SVOCs including benzo(b)fluoranthene (1.2 mg/kg) and indeno(1,2,3-cd)pyrene (0.67 mg/kg) were detected above their respective RRSCOs at a depth of 2.5 to 3 ft bgs at soil boring location PARK AVE 5.

- Mercury (0.882 mg/kg) exceeded RRSCOs at 2.5 to 3 ft bgs at location PARK AVE 3. Although not in exceedance of RRSCOs, various metals, including nickel, lead, and zinc exceeded the UUSCOs in all the three shallow soil samples.

- Two of the three supplemental samples contained SVOC or metal concentrations above their respective RRSCOs indicating the upper 4 feet is impacted by fill material related contaminants in addition to the deeper soils documented in the January 2020 Remedial Investigation.

5.0 REMEDIAL INVESTIGATION

The proposed remedial investigation field program will focus on collecting additional data to assist in the further delineation of known Site contamination and to evaluate the potential impact of areas of concern not previously investigated. The present known Site conditions are summarized in **Appendix C.** The field-sampling scope of work consists of the following tasks:

- Advancing eight soil borings to approximate 30' bgs to the top of the groundwater table to characterize soils from 0 to 4 ft bgs intervals and soils immediately above the water table;
- Installing four permanent monitoring wells to characterize groundwater quality on-Site, three of which will be converted from three of the above-mentioned soil borings;
- Installing two off-site permanent monitoring wells to characterize potential off site migration of cVOCs; and
- Collecting two additional soil gas to complete delineation of impacted soil gas on-Site.

The following sections describe the methods that will be used to complete the scope of work summarized above. Sampling will be performed in accordance with the Quality Assurance/Quality Control Project Plan (QAPP) presented in **Appendix D**.

5.1 SOIL INVESTIGATION

The proposed remedial investigation will include eight (8) soil borings advanced to 30' bgs to further characterize soil. The following text describes the action, rationale and proposed sampling schedule for soil investigation activities.

5.1.1 Soil Borings

Eight (8) soil borings will be advanced using a direct-push drilling rig (i.e., Geoprobe) or hollow stem auger (HSA) drill rig to 30' bgs, or refusal, to characterize soils on-Site. Soils will be characterized every 2' to the end depth of 30' bgs or refusal. The proposed soil boring locations are presented in **Figure 5**.

5.1.2 Soil Sampling and Logging Methodology

A GZA scientist/engineer will be present to observe the subsurface explorations, classify soil samples and prepare soil boring logs. Descriptive information concerning soil from each sampling location will be recorded in a field notebook and classified using a modified Burmister classification system. The soil samples will be logged based on appearance, texture, moisture content and odor. The boring log will also include the sample designation, sample collection date and depth, total depth of the boring, depth and apparent thickness of identified layers of contaminated soil, and recovery percentages. Olfactory and visual evidence of impacted soils will also be noted on the boring log. Soil cores will be screened using a PID for VOCs, the results of which will be presented on the boring log.

Two soil samples per boring will be collected; One will be collected within 0 to 4 ft bgs interval to characterize shallow fill material and the other will be collected just above the water table. If elevated PID reading are encountered between 4 ft bgs to the water table, then a third sample will be collected. The samples will be collected from soil cores using dedicated sampling equipment and placed directly into the sample container.

Soil samples will be collected in laboratory provided containers and transported to a NYSDOH Environmental Laboratory Approval Program (ELAP) certified laboratory, under proper chain of custody procedures for analysis. Once the sample containers are filled, they will be immediately placed in the cooler with ice (in Ziploc plastic bags to prevent leaking) or synthetic ice packs to maintain the samples at below 4^{o}C. Samples will be shipped via courier or by an overnight delivery service.

Soil samples will be analyzed for the full NYSDEC Part 375 listed Target Compound List (TCL) and Target Analyte List (TAL) compounds and emerging contaminants including 1,4-dioxane and perfluorinated alkyl substances (PFAS). Results will be compared to the NYSDEC Part 375 Restricted Residential Use and the Unrestricted Use Soil Cleanup Objectives.

Soil cuttings from borings will be returned to the borehole. Excess soil cuttings and other investigative derived waste will be containerized, temporarily stored in a centralized location and then characterized and disposed off-Site.

5.2 GROUNDWATER INVESTIGATION

In order to evaluate the quality of groundwater beneath the Site, the remedial investigation will include a groundwater sampling program. The following text describes the action, rationale and proposed sampling schedule for groundwater investigation activities.

5.2.1 Permanent Groundwater Monitoring Well Installation

GZA will convert the three on-site soil borings described above into permanent groundwater monitoring wells using HSA drilling techniques. GZA will also install two off-site permanent groundwater monitoring wells along the sidewalk of Clermont Avenue and one onsite well at northeastern corner. The wells will be installed to approximately 35' bgs, or refusal, and will be screened from approximately 25'-35' bgs. Off-site monitoring wells will be installed downgradient of the Site. The proposed monitoring well locations are presented in **Figure 5**. The monitoring wells will be installed using a hollow stem auger drill rig and constructed with Schedule 40, two-inch diameter PVC pipe. The following is a summary of the planned well construction.

Each well will be constructed as a 2-inch diameter well with 0.010-inch machine slotted poly-vinyl chloride (PVC) screens and risers. The annular space of the wells will be filled with #2 sand extending approximately one foot above the top of the screen. A layer of bentonite will be placed above the sand pack and the boring will be sealed with cement extending to the ground surface. Each well will be completed with a flush mount and locking gripper PVC cap.

After installation, the permanent wells will be developed using a submersible pump and dedicated polyethylene tubing to remove fine materials generated during well installation activities until the groundwater is nearly free of turbidity. The development water and soil cuttings will be containerized in a 55-gallon drum and stored on-Site pending analysis and prior to disposal of off-Site.

Groundwater wells will be gauged with a water level meter, prior to purge and sampling efforts, to record a depth to groundwater reading (1/100 foot), and if necessary, an interface meter to determine the thickness of LNAPL or DNAPL. Well locations and elevations will be surveyed by a New York State licensed professional land surveyor to facilitate preparation of a groundwater contour map and determine the direction of groundwater flow.

5.2.2 Groundwater Sampling Methodology

GZA will utilize low flow sampling procedures for groundwater sampling. Prior to sampling each monitoring well, the headspace will be measured using a PID and the water level will be measured using an electronic water level meter. Before sampling, the wells will be purged utilizing a low-flow submersible stainless-steel pump with dedicated polyethylene tubing connected to a transparent flow cell. Groundwater from each well will be purged using low pumping rates so as to limit drawdown of the water level. Wells will be purged until turbidity, pH, temperature, dissolved oxygen and specific conductivity stabilize or three well volumes are extracted. Field measurements, taken from the flow cell, will be recorded in the field logbook during and after purging, and before sampling.

Samples will be collected in laboratory prepared sample bottles (pre-preserved, as appropriate), placed in ice-packed coolers maintained at approximately 4°C under proper chain of custody procedures for transportation to the laboratory. Groundwater samples will be analyzed for the full NYSDEC Part 375 listed TCL/TAL compounds and emerging contaminants including 1,4-dioxane and PFAS.

The purge water will be containerized in a 55-gallon drum and stored on-Site pending analysis and prior to disposal of off-Site.

5.3 SOIL GAS INVESTIGATION

Due to the presence of VOCs in soil gas sample, two (2) additional soil gas samples will be collected to complete delineation of impacted soil gas on-Site. Sampling will be completed in general accordance with the October 2006 NYSDOH Soil Vapor Intrusion Guidance Document. **Figure 5** presents the proposed soil gas sample locations along the northern perimeter of the Site.

Vapor samples will be collected from a depth of 20 -21 feet bgs (approximate 2 feet above the water table). The soil gas samples will be collected using a direct-push drilling rig (i.e., Geoprobe), to install a hollow rod fitted with a screened, stainless-steel, expendable drive point. After the hollow rod is advanced to the desired sampling depth, dedicated Teflon™ tubing with a threaded fitting will be connected to the sampling probe, the hollow rod will be removed, and an airtight seal will be established at the surface using hydrated bentonite. The adequacy of the bentonite seal will be tested using a 6-inch diameter PVC shroud that is placed over the borehole and sealed from the ambient air using bentonite. Helium tracer gas will be pumped into the shroud. The above grade end of the tubing will be attached to a peristaltic pump for purging. A helium gas detector will be utilized to measure helium concentrations in the above grade end of the tubing. The adequacy of the seal will be verified by direct helium readings (e.g. less than 10% of total helium in shroud). Following completion of the purging and the helium tracer test, dedicated Teflon™ tubing will be used to connect the probe to a laboratory-supplied 2.7-liter Summa canister equipped with a flow regulator. Vapor samples will be collected in Summa canisters for 2 hours. Upon completion, the tubing will be removed and the soil vapor points will be backfilled to near grade surface with the drill cuttings. The soil vapor samples will be analyzed by an ELAP certified laboratory, using EPA Method TO-15. The soil gas sample locations will be recorded in the field using a hand-held GPS device.

5.4 QUALITY ASSURANCE /QUALITY CONTROL

As part of the field investigation, GZA will also collect Quality Assurance/Quality Control (QA/QC) samples in accordance with the QAPP, presented in **Appendix D**, to ensure the usability of the data. QA/QC samples include equipment rinsate/field blanks, trip blanks, sample duplicates and matrix spike/matrix spike duplicates (MS/MSDs).

When applicable, the sample result summary tables will list the laboratory method detection limit (MDL) at which a compound was non-detectable. The laboratory results will be reported to the sample-specific practical quantitation limit (PQL), equal to the sample-specific MDL, supported by the instrument calibrations. The reliability of laboratory data is supported by compliance with sample holding times and

laboratory MDLs below cleanup criteria. Accuracy and precision of the laboratory analytical methods will be maintained by the use of calibration and calibration verification procedures, laboratory control samples, and surrogate, matrix, and analytical spikes.

5.5 DATA USABILITY

The Data Usability Summary Report (DUSR) for the samples collected will be provided during the RI. The primary objective of a DUSR is to determine whether or not data meets the site-specific criteria for data quality and data use. The DUSR provides an evaluation of analytical data without third party data validation. A summary of the findings in the DUSRs as well as the complete DUSRs will also be provided in the FER.

6.0 CHAIN OF CUSTODY AND SHIPPING

A chain-of-custody form will trace the path of sample containers from the Site to the laboratory. The project manager will notify the laboratory of upcoming field sampling events and the subsequent transfer of samples. This notification will include information concerning the number and type of samples, and the anticipated date of arrival. Insulated sample shipping containers (typically coolers) will be provided by the laboratory for shipping samples. All sample bottles within each shipping container will be individually labeled with an adhesive identification label provided by the laboratory. Project personnel receiving the sample containers from the laboratory will check each cooler for the condition and integrity of the bottles prior to field work.

The field sampler will indicate the sample designation/location number in the space provided on the chain-of-custody form for each sample. The chain of custody forms will be signed and placed in a sealed plastic Ziploc bag in the cooler. If sent via third party carrier, the shipping container will be closed for transport with nylon strapping, or a similar shipping tape, and a paper custody seals will be affixed to the lid. The seals must be broken to open the cooler and will indicate tampering if the seals are broken before receipt at the laboratory. A label may be affixed identifying the cooler as containing "Environmental Samples" and the cooler will be shipped via courier or by an overnight delivery service to the laboratory. When the laboratory receives the coolers, the custody seals will be checked and lab personnel will sign the chain-of-custody form.

The following typical Chain-Of-Custody procedures will be implemented by GZA during the soil sampling:

A. The samples are under custody of the GZA field personnel, if:
   1. they are in his/her possession,
   2. they are in view after being in possession,
   3. they are locked up or sealed securely to prevent tampering, or
   4. they are in a designated secure area.

B. The original of the chain-of-custody form must accompany the samples at all times after collection, until receipt at the analytical laboratory. A copy of the chain-of-custody form will be kept by the sampling collector until it is filed in the project file.

C. When the possession of samples is transferred, the individuals relinquishing and receiving the samples will sign, date, and note the time on the Chain-Of-Custody form.

D. When samples are shipped, the GZA personnel, or designated representative, will note the courier name, and airbill number, if applicable, on the Chain-Of-Custody form. Prior to shipping, coolers will be secured with signed custody seals so the laboratory may confirm coolers were not opened during shipping.

The chain-of-custody form will contain information to distinguish each sample from any other sample. This information will include:

A. The project name and address for which sampling is being conducted;

B. The name(s) and signature(s) of sampler(s);

C. The matrix being sampled (groundwater, soil, etc.);

D. The sampling date and time;

E. The specific sampling location in sufficient detail to allow re-sampling at the same location;

F. The number of containers and the volume of sample collected, and

G. The analytical method to be performed.

The Chain-Of-Custody record is a color-coded, four copy form. Chain-of-custody copies are distributed upon completion to the following:

1. WHITE COPY – Original accompanies samples
2. YELLOW COPY – Maintained by the laboratory
3. PINK COPY – Kept by the Sample Collector (GZA)

7.0 STORAGE AND DISPOSAL OF INVESTIGATION-DERIVED WASTE

All investigation derived waste (IDW) generated during the RI will be containerized and properly characterized and disposed of. Containers, which are USDOT approved storage containers (55-gallon drums) or a small bulk roll-off container, will be properly labeled and grouped by environmental matrix (soil, water, PPE/plastic, etc.). All drums or roll-offs will be staged in a central location on-Site prior to off-Site disposal.

If drums are used, they will be tracked as they are filled and given unique identification codes based on the following:

- A prefix indicating the drum's contents: i.e., S – Soil, W – Water, P – PPE/Plastic, and C&D – Construction Debris.

- Following the prefix and a hyphen will be the origin of the drum's contents. For example, drum SB-1, SB-2, SB-3 is a generated drum filled with soil from soil boring locations SB-1, SB-2 and SB-3; drum WMW-1 is water generated from monitoring well MW-1.
- As drums are generated, their identification code, date of generation, contents, source (i.e., drill cuttings from location x, purge water from well y), and date sampled will be entered on a tracking table.

The drums (or roll-off container) will be centrally stored on-Site. Subsequently, the waste soils and/or water will be characterized with laboratory analyses for proper disposal.

8.0 QUALITATIVE HUMAN HEALTH EXPOSURE ASSESSMENT

A Qualitative Human Health Exposure Assessment (QHHEA) will be conducted following NYSDEC guidance. The QHHEA will characterize the exposure setting, identify potentially complete exposure pathways, and qualitatively evaluate potential fate and transport of constituents from one medium to another (i.e., soil-to-air or soil-to-groundwater).

An exposure pathway is considered complete when the following five conditions are met:

1. Source identified (i.e., metals in paint on exterior building surfaces);
2. Release and transport mechanism from source to environmental media (i.e., into the subsurface or volatilization to the air of an overlying building);
3. Point of human exposure (i.e., an occupied building or surface soil);
4. A route of exposure (ingestion, dermal contact, or inhalation), and
5. A receptor population (i.e., on-site workers).

Once potentially complete exposure pathways are identified, the QHHEA will characterize Site conditions to determine whether the Site poses an existing or potential future hazard to the potentially exposed population. The evaluation will include a qualitative discussion of potential fate and transport mechanisms at the Site. The results of the QHHEA will be included as part of the RI Report.

9.0 HEALTH AND SAFETY

The work outlined above will be completed under a GZA site-specific Health and Safety Plan (HASP), attached as **Appendix E**, in accordance with OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) regulations. A photoionization detector (PID) will be used to monitor the breathing zone of workers performing investigative activities in areas where there is a potential for the presence of organic vapors (i.e. groundwater and soil vapor sampling). A dust meter will also be used to screen for dust in the breathing zone that has the potential presence of metal contamination. GZA anticipates the work will be

completed in Modified Level D personal protective equipment (PPE); however, workers will be prepared to elevate to more protective PPE based on the conditions encountered during field activities.

Prior to performing any subsurface work, a utility clearance survey will be performed in accordance with New York State Dig-Safe protocol. Sample locations will be screened using surface geophysical techniques such as electromagnetic (EM), ground penetrating radar (GPR) and/or radiofrequency (RF) techniques.

A project kick-off meeting will be held prior to initiating field work to orient field team members and subcontractors with the Site background, scope of work, potential hazards, health and safety requirements, emergency contingencies and other field procedures.

- 9.1 COMMUNITY AIR MONITORING PLAN (CAMP)

Real-time air monitoring for volatile organic compounds (VOCs) and particulate levels at the perimeter of the exclusion zone or work area will be performed in accordance with the CAMP (see **Appendix F**).

Continuous air monitoring will be required during ground intrusive activities and during the demolition of Site structures and other activities where equipment is disturbing the ground surface. Ground intrusive activities include, but are not limited to, soil/fill excavation and handling, test pitting or trenching, grading of existing Site soils and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. Periodic monitoring during sample collection would generally consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location.

- 9.1.1 VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) will be monitored at the Site perimeter on a continuous basis during demolition and earthwork activities unless otherwise specified in the CAMP. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. Wind direction will be evaluated using an on-site meteorological tower (RM Young sensors) that measures wind speed, direction, dry-bulb temperature and relative humidity. A central computer system will receive information from the meteorological system and compute a two-minute average wind speed and direction value. The VOC monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

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

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

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shut down until the source of the problem is identified and corrective action is taken to reduce organic vapor levels.

4. Fifteen-minute readings will be recorded and be available for State (NYSDEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

- 9.1.2 Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored at the Site perimeter and in work zones on a continuous basis during demolition and earthwork. 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 all work activities. Visible dust from the work area will trigger the initiation of dust suppression procedures. Dust suppression equipment will be on Site, functional and available at the work zone prior to commencing work.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) 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 will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work will be stopped, and a re-evaluation of

activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust migration.

3. Readings will be recorded and be available for State (NYSDEC and NYSDOH) and County Health personnel to review.

10.0 REPORTING

Upon completion of the field activities, an RI Report/Remedial Action Work Plan (RIR/RAWP) will be prepared to document the findings of the investigations performed at the Site and the proposed remedy. The RIR/RAWP will be consistent with the specifications presented in the DER-10 document and will include:

- An executive summary;
- A site description and history;
- Summary information regarding previous investigations and remedial work performed at the Site;
- Descriptions of field activities performed;
- A summary of pertinent field observations, field measurements, and laboratory analytical data summarized in tabular format - analytical results will be compared to appropriate NYSDEC guidance and standards;
- Plan view and cross-section figures presenting laboratory analytical data and field observations of surface and subsurface soil and groundwater impacts. A minimum of two profiles will be developed, one perpendicular to and one parallel with groundwater flow direction at the Site;
- A qualitative human health risk assessment which assesses the sources of impact, on and off-site human and ecological receptors, and exposure pathways;
- A data usability review and Data Usability Summary Report (DUSR) for the laboratory data collected during the RI;
- An integration of field observations and measurements with laboratory analytical data to evaluate the nature and extent of impacts and to develop a site conceptual model of potential contaminant migration;
- A Remedial Alternatives Analysis;
- A set of conclusions for the investigation; and
- Recommendations

Data collected during the RI will be submitted in the Department's Environmental Information Management System (EIMS) format for Electronic Data Delivery (EDD).

11.0 PROJECT SCHEDULE AND PROJECT PERSONNEL

Our anticipated schedule to perform the investigation activities described in this work plan is summarized below:

Description	**Estimated Time to Complete** (from NYSDEC's approval of the RIWP)
Commence Field Investigation	Week 4
Complete RIR/RAWP and submit to NYSDEC	Week 8

We note that the proposed schedule may be adjusted if unforeseen delays occur due to inclement weather, DOT permit approval, drill rig availability or other conditions that are beyond Carnegie control.

The following GZA project personnel are proposed to be involved as part of the remedial investigation activities. Qualifications of personnel are provided in **Appendix G**. Drilling and laboratory subcontractors have not yet been retained.

Personnel	**Role**	**Contact Information**
David Winslow	Qualified Environmental Professional	973-774-3307
Zhan Shu	Project Manager	973-774-3321
Lindsay Nunes	Professional Geologist	973-774-3331
Paul Benya	Environmental Scientist	973-774-3316

Tables

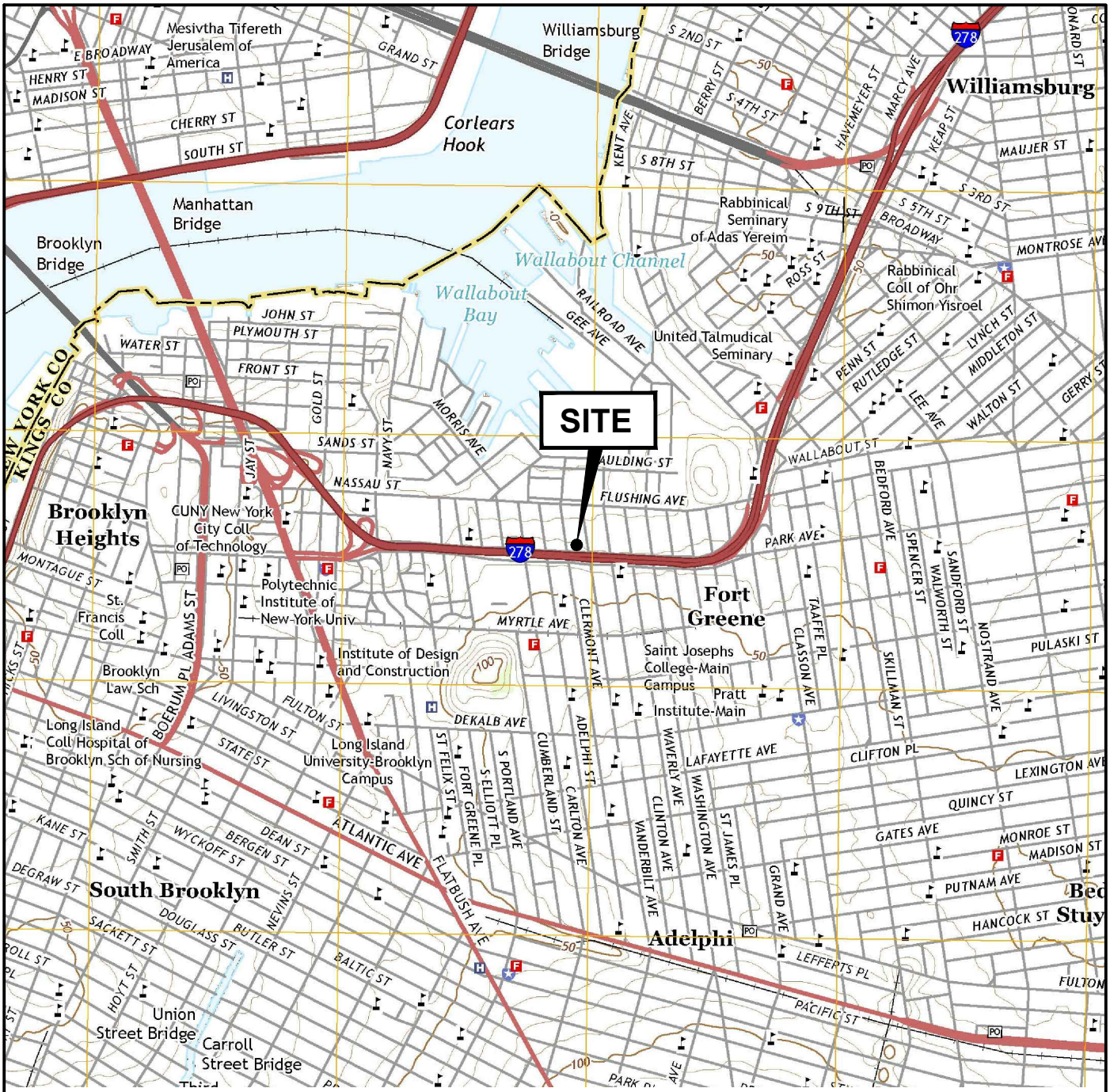
Table 1 - Summary of Sampling Program Rationale and Analysis
205 Park Avenue
Brooklyn, New York

Sample Identifier	Location	Approximate Number of Samples	Rationale for Sampling	Laboratory Analysis
Soil Boring Soils				**All Samples**
SRI-1 through SRI-8	8 locations throughout the Site	At a minimum, two soil samples will be collected from each test boring (for a total of 10 soil samples) for laboratory analysis. This includes a surface soil sample (from the 0-4 feet bgs interval) and a soil immediately above the water table. Approximately 18 samples (including 2 duplicates).	To characterize soil quality across the Site.	VOCs (EPA Method SW 846 8260); SVOCs (EPA Method SW 846 8270), pesticides/PCBs (EPA Methods SW 846 8081/8082), and Target Analyte List metals (EPA Method 6010 and 7471),1,4-Dioxane (EPA Method SW 846 8260, isotope dilution for 1-4 Dioxane), and PFAs (EPA Method SW 846 537)
Groundwater - Temporary Well Points				**All Samples**
GW-1 through GW-6	4 onsite locations and 2 off-site locations; screened across water table	7 (including one duplicate)	To characterize groundwater quality on Site	VOCs (EPA Method SW 846 8260), SVOCs (EPA Method SW 846 8270), pesticides/PCBs (EPA Methods SW 846 8081/8082), total and dissolved TAL metals (EPA Methods SW 846 6010/6020/7470), 1,4-Dioxane (EPA Method SW 846 8260, isotope dilution for 1-4 Dioxane) and PFAs (EPA Method SW 846 537)
Groundwater - Temporary Well Points				**All Samples**
SV-1 and SV-2	One onsite location along the northern perimeter of the Site. One off-site location along the western perimeter of the Site	4 samples (including one duplicate and one outdoor ambient air)	To characterize soil vapor on Site	EPA Method TO-15

Notes:

TAL = Target Analyte List
TCL = Target Compound List
VOCs + TICs = volatile organic compounds plus tentatively identified compounds
SVOCs + TICs = semi-volatile organic compounds plus tentatively identified compounds
PCBs = polychlorinated biphenyls
PFAs = perfluorinated compounds

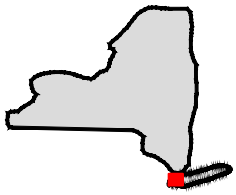
Figures



0 1000' 2000' 4000'

SCALE IN FEET 1" = 2000'

NEW YORK



QUADRANGLE LOCATION

SOURCE:

BASE MAP FROM THE FOLLOWING USGS QUADRANGLE MAP:
BROOKLYN, NY (2016)

DIGITAL TOPOGRAPHIC MAPS PROVIDED BY USGSSTORE.GOV.

CONTOUR ELEVATIONS REFERENCE NAVD 88,
CONTOURS ARE SHOWN IN FEET AT 10' INTERVALS

N W E S

205 PARK AVENUE
BROOKLYN, NEW YORK

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
PREFERRED BUILDERS

SITE LOCATION MAP

PROJ MGR: DW	REVIEWED BY: DW	CHECKED BY: DW	FIGURE
DESIGNED BY: SW	DRAWN BY: MT	SCALE: 1" = 2,000'	1
DATE: APRIL 2019	PROJECT NO. 12.0076834.00	REVISION NO.	SHEET NO.

LEGEND:

SITE BOUNDARY

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.

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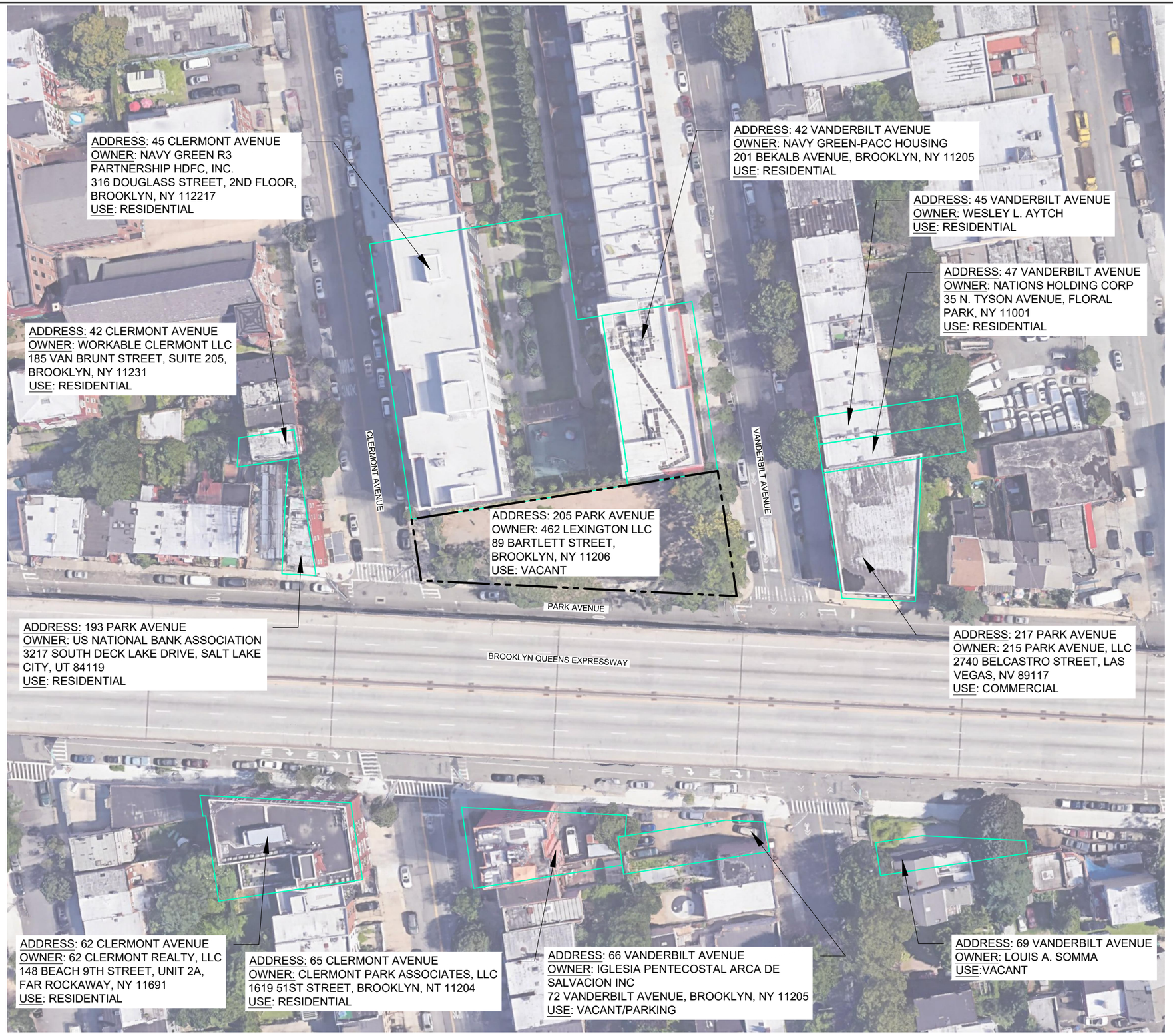
NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

SITE PLAN

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental of NY Engineers and Scientists www.gza.com		462 LEXINGTON, LLC.	
PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	FIGURE
DESIGNED BY: ZS	DRAWN BY: PB/MT	SCALE: 1" = 40'	2
DATE: JANUARY 2020	PROJECT NO. 12.0076834.10	REVISION NO.	SHEET NO.



LEGEND:

SITE BOUNDARY

ADJACENT PARCEL

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.

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SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

ADJACENT PROPERTY USE AND OWNER INFORMATION

PREPARED BY: GZA GeoEnvironmental of NY Engineers and Scientists www.gza.com		PREPARED FOR: 462 LEXINGTON, LLC.	
PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	FIGURE 3
DESIGNED BY: ZS	DRAWN BY: LN	SCALE: 1" = 40'	
DATE: JANUARY 2021	PROJECT NO. 12.0076834.10	REVISION NO.	SHEET NO.

LEGEND:

SITE BOUNDARY

SOIL BORING LOCATION CONVERTED TO TEMPORARY WELL POINT

(5.0) GROUNDWATER ELEVATION

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.

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SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

GROUNDWATER FLOW

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental of NY Engineers and Scientists www.gza.com		462 LEXINGTON, LLC.	
PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	FIGURE 4
DESIGNED BY: ZS	DRAWN BY: MT	SCALE: 1" = 40'	
DATE: JANUARY 2020	PROJECT NO. 12.0076834.10	REVISION NO.	SHEET NO.

LEGEND:

- SITE BOUNDARY
- PROPOSED PERMANENT WELL LOCATIONS
- PROPOSED PERMANENT WELL AND SOIL BORING LOCATIONS
- PROPOSED SOIL BORING LOCATIONS
- PROPOSED SOIL VAPOR LOCATION

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.

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SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

PROPOSED SAMPLE PLAN

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental of NY Engineers and Scientists www.gza.com		462 LEXINGTON, LLC.	
PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	FIGURE 5
DESIGNED BY: ZS	DRAWN BY: MT	SCALE: 1" = 40'	
DATE: MAY 2021	PROJECT NO. 12.0076834.10	REVISION NO.	SHEET NO.

Appendix A - Limitations

USE OF REPORT

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

STANDARD OF CARE

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in the Proposal for Services and/or Report and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. Conditions other than described in this report may be found at the subject location(s).

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made. Specifically, GZA does not and cannot represent that the Site contains no hazardous material, oil, or other latent condition beyond that observed by GZA during its study. Additionally, GZA makes no warranty that any response action or recommended action will achieve all of its objectives or that the findings of this study will be upheld by a local, state or federal agency.

4. In conducting our work, GZA relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

SUBSURFACE CONDITIONS

5. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs. The nature and extent of variations between these explorations may not become evident until further exploration or construction. If variations or other latent conditions then become evident, it will be necessary to reevaluate the conclusions and recommendations of this report.

6. Water level readings have been made, as described in this Report, in and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The observed water table may be other than indicated in the Report.

COMPLIANCE WITH CODES AND REGULATIONS

7. We used reasonable care in identifying and interpreting applicable codes and regulations necessary to execute our scope of work. These codes and regulations are subject to various, and possibly contradictory, interpretations. Interpretations and compliance with codes and regulations by other parties is beyond our control.

SCREENING AND ANALYTICAL TESTING

8. GZA collected environmental samples at the locations identified in the Report. These samples were analyzed for the specific parameters identified in the report. Additional constituents, for which analyses were not conducted, may be present in soil, groundwater, surface water, sediment and/or air. Future Site activities and uses may result in a requirement for additional testing.

9. Our interpretation of field screening and laboratory data is presented in the Report. Unless otherwise noted, we relied upon the laboratory's QA/QC program to validate these data.

10. Variations in the types and concentrations of contaminants observed at a given location or time may occur due to release mechanisms, disposal practices, changes in flow paths, and/or the influence of various physical, chemical, biological or radiological processes. Subsequently observed concentrations may be other than indicated in the Report.

INTERPRETATION OF DATA

11. Our opinions are based on available information as described in the Report, and on our professional judgment. Additional observations made over time, and/or space, may not support the opinions provided in the Report.

ADDITIONAL INFORMATION

12. In the event that the Client or others authorized to use this report obtain additional information on environmental or hazardous waste issues at the Site not contained in this report, such information shall be brought to GZA's attention forthwith. GZA will evaluate such information and, on the basis of this evaluation, may modify the conclusions stated in this report.

ADDITIONAL SERVICES

13. GZA recommends that we be retained to provide services during any future investigations, design, implementation activities, construction, and/or property development/ redevelopment at the Site. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

CONCEPTUAL SITE MODEL

14. Our opinions were developed, in part, based upon a comparison of site data to conditions anticipated within our Conceptual Site Model (CSM). The CSM is based on available information, and professional judgment. There are rarely sufficient data to develop a unique CSM. Therefore observations over time, and/or space, may vary from those depicted in the CSM provided in this report. In addition, the CSM should be evaluated and refined (as appropriate) whenever significant new information and/or data is obtained.

NUMERICAL MODEL

15. Actual subsurface conditions are likely more complex than indicated in the Report. Our mathematical model is, by its very nature, a simplification of actual conditions. Except as noted in the report, we did not validate the code used in the model. In constructing the model, point specific data was generalized and extrapolated across the study area. In addition, in areas where field data was not available, we used professional judgment, based on experience and regional information, to construct the model. Model assumptions are provided in **Appendix __.** Actual flow patterns, contaminant concentrations, and/or ground water discharges, and contaminant masses may be other than simulated.

As additional field data becomes available our numerical model can be modified to better reflect conditions of possible interest.

COST ESTIMATES

16. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

RISK CHARACTERIZATION

17. Our risk evaluation was performed in accordance with generally accepted practices of appropriate Federal and/or state regulatory agencies, and of other consultants undertaking similar studies at the same time, for similar purposes, and under similar circumstances. The findings of the risk evaluation are dependent on the numerous assumptions and uncertainties inherent in the risk characterization process. Sources of the uncertainty may include Site conditions; Site use; the nature, extent, concentration and distribution of contaminants; and the available toxicity and/or health/risk based regulatory information. Consequently, the findings of the risk characterization are not an absolute characterization of actual risks; but rather serve to highlight potential incremental risks associated with activities indicated in the Report. Actual risks may be other than indicated in the Report.

Appendix B Previous Reports – Digital File

Appendix C Known Site Conditions

LEGEND:

- SITE BOUNDARY
- SOIL BORING LOCATION
- SOIL VAPOR IMPLANT LOCATION
- SOIL BORING LOCATION CONVERTED TO TEMPORARY WELL POINT
- SUPPLEMENTAL SOIL BORINGS

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.

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0 20' 40' 80'

SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

SAMPLE LOCATION PLAN

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental of NY Engineers and Scientists www.gza.com		462 LEXINGTON, LLC.	
PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	FIGURE 1
DESIGNED BY: ZS	DRAWN BY: MT	SCALE: 1" = 40'	
DATE: MARCH 2021	PROJECT NO. 12.0076834.10	REVISION NO.	SHEET NO.

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-6 1/7/2020	
			5.5'-6' bgs	15.5'-16' bgs
			mg/kg	mg/kg
Organochlorine Pesticides				
4,4'-DDE	8.9	0.0033	0.0215	ND
4,4'-DDD	13	0.0033	0.00938	ND
4,4'-DDT	7.9	0.0033	0.0464	ND

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-8 1/6/2020	
			5.5'-6' bgs	15.5'-16' bgs
			mg/kg	mg/kg
Volatile Organics				
VOCs			ND	ND
Semivolatile Organics				
SVOCs			NE	NE
Pesticides				
Pesticides			ND	ND
PCBs				
PCBs			ND	ND
Metals				
Metals			NE	NE

	NYS Part 375 Restricted-Residential SCOs	NYS Part 375 Unrestricted Use SCOs	PARK AVE 8 12/11/2020
			2.5'-3' bgs
			mg/kg
Semivolatile Organics			
Lead, Total	400	63	103
Mercury, Total	0.81	0.18	0.183
Nickel, Total	310	30	33
Zinc, Total	10000	109	120

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-4 1/6/2020	
			3'-3.5' bgs	15'-15.5' bgs
			mg/kg	mg/kg
Volatile Organics				
VOCs			ND	ND
Semivolatile Organics				
SVOCs			ND	ND
Pesticides				
Pesticides			ND	ND
PCBs				
PCBs			ND	ND
Metals				
Metals			NE	NE

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-2 1/7/2020	
			3.5'-4' bgs	16'-16.5' bgs
			mg/kg	mg/kg
Volatile Organics				
VOCs			ND	ND
Semivolatile Organics				
SVOCs			ND	ND
Pesticides				
Pesticides			ND	ND
PCBs				
PCBs			ND	ND
Metals				
Metals			NE	NE

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-10 1/7/2020	
			2'-2.5' bgs	15'-15.5' bgs
			mg/kg	mg/kg
Volatile Organics				
VOCs			ND	NE
Semivolatile Organics				
SVOCs			NE	ND
Pesticides				
Pesticides			ND	ND
PCBs				
PCBs			ND	ND
Metals				
Metals			NE	NE

	NYS Part 375 Restricted-Residential SCOs	NYS Part 375 Unrestricted Use SCOs	PARK AVE 3 12/11/2020
			2.5'-3' bgs
			mg/kg
Total Metal			
Mercury, Total	0.81	0.18	0.822
Nickel, Total	310	30	31.6

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-9 1/7/2020	
			3.5'-4' bgs	15'-15.5' bgs
			mg/kg	mg/kg
Volatile Organics				
VOCs			ND	NE
Semivolatile Organics				
SVOCs			ND	ND
Pesticides				
Pesticides			ND	ND
PCBs				
PCBs			ND	ND
Metals				
Metals			NE	NE

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-1 1/6/2020	
			6.5'-7' bgs	15.5'-16' bgs
			mg/kg	mg/kg
Volatile Organics				
VOCs			ND	NE
Semivolatile Organics				
SVOCs			ND	NE
Pesticides				
Pesticides			ND	ND
PCBs				
PCBs			ND	ND
Metals				
Metals			NE	NE

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-7 1/7/2020	
			6'-6.5' bgs	15'-15.5' bgs
			mg/kg	mg/kg
Volatile Organics				
VOCs			ND	NE
Semivolatile Organics				
SVOCs			ND	NE
Pesticides				
Pesticides			ND	ND
PCBs				
PCBs			ND	NE
Metals				
Metals			NE	NE

	NYS Part 375 Restricted-Residential SCOs	NYS Part 375 Unrestricted Use SCOs	PARK AVE 5 12/11/2020
			2.5'-3' bgs
			mg/kg
Semivolatile Organics			
Benzo(b)fluoranthene	1	1	1.2
Indeno(1,2,3-cd)pyrene	0.5	0.5	0.67
Lead, Total	400	63	118
Mercury, Total	0.81	0.18	0.208
Zinc, Total	10000	109	124

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-3 1/7/2020	
			7'-7.5' bgs	15'-15.5' bgs
			mg/kg	mg/kg
Total Metals				
Copper, Total	270	50	11.2	78.1

	NYS Part 375 Restricted - Residential SCOs	NYS Part 375 Unrestricted Use SCOs	SB-5 1/6/2020	
			5.5'-6' bgs	15.5'-16' bgs
			mg/kg	mg/kg
Semivolatile Organics				
Benzo(a)anthracene	1	1	ND	1.9
Benzo(a)pyrene	1	1	ND	1.9
Benzo(b)fluoranthene	1	1	ND	2.5
Benzo(k)fluoranthene	3.9	0.8	ND	0.9
Chrysene	3.9	1	ND	1.5
Indeno(1,2,3-cd)pyrene	0.5	0.5	ND	1.3

LEGEND:

- SITE BOUNDARY
- SOIL BORING LOCATION
- SUPPLEMENTAL SOIL BORING LOCATION
- THIS VALUE EXCEEDS NYS UNRESTRICTED USE SOIL CLEANUP OBJECTIVES (SCOS)
- THIS VALUE EXCEEDS BOTH NYS UNRESTRICTED USE SOIL CLEANUP OBJECTIVES AND RESTRICTED-RESIDENTIAL SOIL CLEANUP OBJECTIVES
- bgs BELOW GROUND SURFACE
- mg/kg MILLIGRAM PER KILOGRAM
- ND NOT DETECTED AT A CONCENTRATION ABOVE SCO AND/OR LABORATORY REPORTING LIMIT
- NE NOT EXCEEDED THE SCO

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.

N W E S

0 20' 40' 80'

SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

SOIL SAMPLE EXCEEDANCES

PREPARED BY:
GZA GeoEnvironmental of NY
Engineers and Scientists
www.gza.com

PREPARED FOR:
462 LEXINGTON, LLC.

PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	FIGURE
DESIGNED BY: ZS	DRAWN BY: MT	SCALE: 1" = 40'	2
DATE: MARCH 2021	PROJECT NO. 12.0076834.10	REVISION NO.	SHEET NO.

LOCATION	NYSDEC TOGS Standards and Guidance Values-GA	TW-5
SAMPLING DATE		1/7/2020
LAB SAMPLE ID		L2000635-02
SAMPLE DEPTH (ft.)		28 ft bgs
		µg/l
Volatile Organics		
Tetrachloroethene	5	**6**
Chloroform	7	**36**
Semivolatile Organics		
Benzo(a)anthracene	0.002	**0.39**
Benzo(a)pyrene	0	**0.36**
Benzo(b)fluoranthene	0.002	**0.43**
Benzo(k)fluoranthene	0.002	**0.15**
Chrysene	0.002	**0.35**
Indeno(1,2,3-cd)pyrene	0.002	**0.24**
Total Metals		
Aluminum, Total	2000	**13,800**
Iron, Total	600	**26,800**
Lead, Total	50	**81.89**
Manganese, Total	600	**2,121**

LOCATION	NYSDEC TOGS Standards and Guidance Values-GA	TW-4
SAMPLING DATE		1/7/2020
LAB SAMPLE ID		L2000635-01
SAMPLE DEPTH (ft.)		33 ft bgs
		µg/l
Volatile Organics		
Tetrachloroethene	5	**8.7**
Chloroform	7	**34**
Semivolatile Organics		
Benzo(a)anthracene	0.002	**0.05J**
Benzo(a)pyrene	0	**0.03J**
Benzo(b)fluoranthene	0.002	**0.04J**
Benzo(k)fluoranthene	0.002	**0.02J**
Chrysene	0.002	**0.03J**
Indeno(1,2,3-cd)pyrene	0.002	**0.03J**
Total Metals		
Aluminum, Total	2000	**2,960**
Iron, Total	600	**5,320**
Manganese, Total	600	**676.8**

LOCATION	NYSDEC TOGS Standards and Guidance Values-GA	TW-3
SAMPLING DATE		1/8/2020
LAB SAMPLE ID		L2000844-03
SAMPLE DEPTH (ft.)		33 ft bgs
		µg/l
Volatile Organics		
Tetrachloroethene	5	**20**
Semivolatile Organics		
Benzo(a)anthracene	0.002	**0.1J**
Benzo(a)pyrene	0	**0.08J**
Benzo(b)fluoranthene	0.002	**0.11**
Benzo(k)fluoranthene	0.002	**0.04J**
Chrysene	0.002	**0.07J**
Indeno(1,2,3-cd)pyrene	0.002	**0.05J**
Total Metals		
Aluminum, Total	2000	**3,320**
Iron, Total	600	**6,860**
Manganese, Total	600	**917**
Thallium, Total	0.5	**0.95J**
Organochlorine Pesticides		
Dieldrin	0.004	**0.018J**

LOCATION	NYSDEC TOGS Standards and Guidance Values-GA	TW-2
SAMPLING DATE		1/8/2020
LAB SAMPLE ID		L2000844-02
SAMPLE DEPTH (ft.)		33 ft bgs
		µg/l
Volatile Organics		
Tetrachloroethene	5	**10**
Semivolatile Organics		
Benzo(a)anthracene	0.002	**0.03J**
Benzo(a)pyrene	0	**0.02J**
Benzo(b)fluoranthene	0.002	**0.03J**
Benzo(k)fluoranthene	0.002	**0.01J**
Chrysene	0.002	**0.02J**
Indeno(1,2,3-cd)pyrene	0.002	**0.02J**
Total Metals		
Iron, Total	600	**1,640**
Manganese, Total	600	**640.3**
Organochlorine Pesticides		
Dieldrin	0.004	**0.009J**

LOCATION	NYSDEC TOGS Standards and Guidance Values-GA	TW-1
SAMPLING DATE		1/6/2020, 1/8/2020
LAB SAMPLE ID		L2000844-01,L2000463-09
SAMPLE DEPTH (ft.)		28 ft bgs
		µg/l
Volatile Organics		
Tetrachloroethene	5	**18**
Semivolatile Organics		
Benzo(a)anthracene	0.002	**0.08J**
Benzo(a)pyrene	0	**0.06J**
Benzo(b)fluoranthene	0.002	**0.09J**
Benzo(k)fluoranthene	0.002	**0.04J**
Chrysene	0.002	**0.06J**
Indeno(1,2,3-cd)pyrene	0.002	**0.06J**
Total Metals		
Aluminum, Total	2000	**29,100**
Barium, Total	2000	**3,059**
Beryllium, Total	3	**6.89**
Chromium, Total	100	**254.2**
Iron, Total	600	**36,400**
Lead, Total	50	**335.9**
Magnesium, Total	35000	**70,600**
Manganese, Total	600	**29,450**
Nickel, Total	200	**316.7**
Selenium, Total	20	**37.5**
Dissolved Metals		
Manganese, Dissolved	600	**888**
Organochlorine Pesticides		
Dieldrin	0.004	**0.022J**
Perfluorinated Alkyl Acids		
Perfluorooctanoic Acid (PFOA)	0.001	**0.093**
Perfluorooctanesulfonic Acid (PFOS)	0.001	**0.032**
PFOA/PFOS, Total	0.5	0.126

LEGEND:

- SITE BOUNDARY
- SOIL BORING LOCATION TO BE CONVERTED TO TEMPORARY WELL POINT
- THIS VALUE EXCEEDS NYSDEC TOGS STANDARDS AND GUIDANCE VALUES-GA
- J INDICATES ESTIMATED VALUE
- µg/l MICROGRAMS PER LITER

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.

N W E S

0 20' 40' 80'

SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

GROUNDWATER SAMPLE EXCEEDANCES

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental of NY Engineers and Scientists www.gza.com		462 LEXINGTON, LLC.	
PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	APPENDIX C FIGURE 3 SHEET NO.
DESIGNED BY: ZS	DRAWN BY: MT	SCALE: 1" = 40'	
DATE: MAY 2021	PROJECT NO. 12.0076834.10	REVISION NO.	

LOCATION	SG-8 (5-6')	SG-8 (20-21')
SAMPLING DATE	1/8/2020	1/9/2020
LAB SAMPLE ID	L2000840-06	L2001065-03
Volatile Organics in Air	ug/m3	
Dichlorodifluoromethane	1.9	2.73
1,3-Butadiene	2.57	3.85
Acetone	109	309
Trichlorofluoromethane	ND	1.98
Isopropanol	3.71	ND
Tertiary butyl Alcohol	1.69	ND
Carbon disulfide	2.98	1.42
1,1-Dichloroethane	ND	1.41
2-Butanone	5.84	9.59
Chloroform	19.8	288
Tetrahydrofuran	5.84	2.28
n-Hexane	4.72	5.57
1,1,1-Trichloroethane	2.48	2.55
Benzene	2.97	3.26
Carbon tetrachloride	3.48	5.25
Cyclohexane	0.733	0.919
Trichloroethene	1.42	11.3
Heptane	2.86	3.33
Toluene	11	12.9
2-Hexanone	ND	0.84
Tetrachloroethene	55.4	181
Ethylbenzene	2.44	3.08
p/m-Xylene	8.9	10.9
o-Xylene	2.88	3.45
1,3,5-Trimethylbenzene	0.988	ND
1,2,4-Trimethylbenzene	4.58	2.62

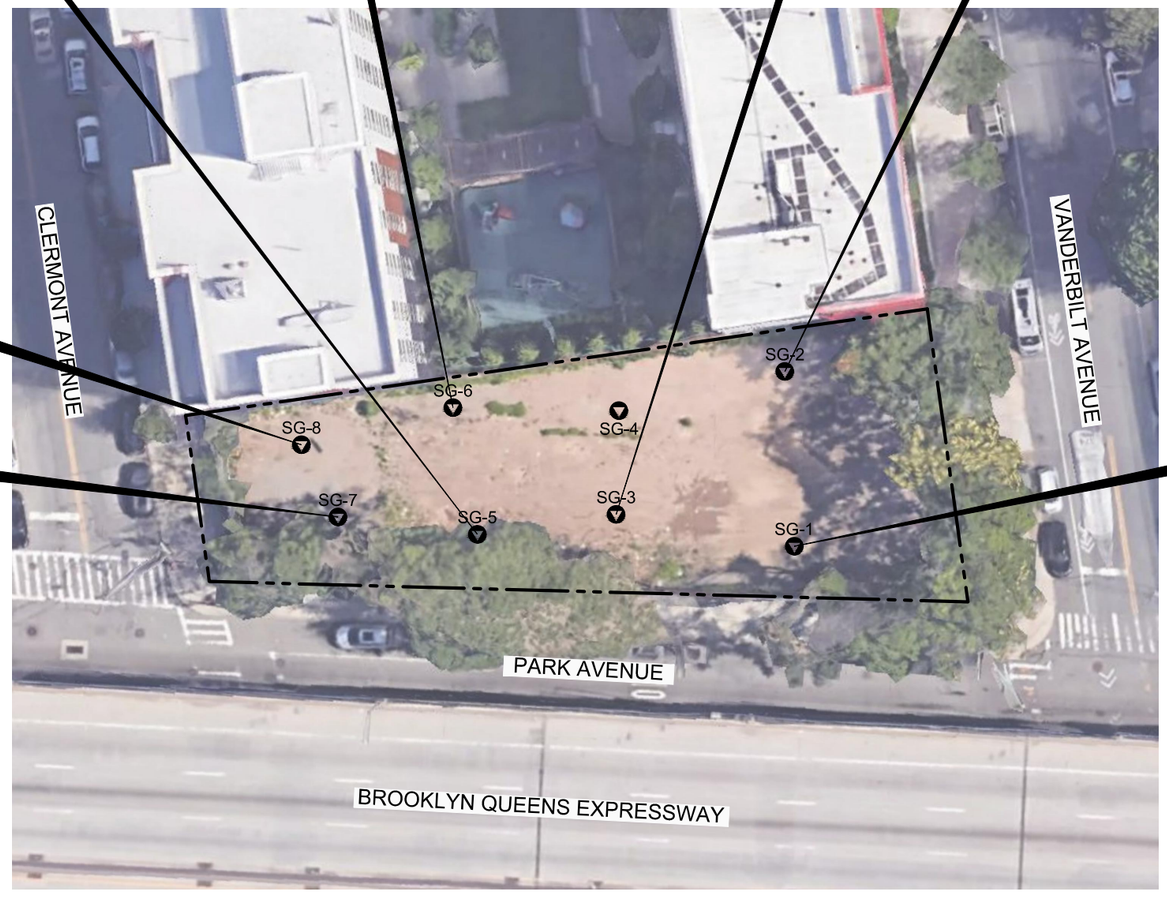
LOCATION	SG-7 (20-21')
SAMPLING DATE	1/8/2020
LAB SAMPLE ID	L2000840-05
Volatile Organics in Air	ug/m3
Dichlorodifluoromethane	1.93
1,3-Butadiene	1.05
Acetone	105
Trichlorofluoromethane	1.2
Isopropanol	3.24
Carbon disulfide	1.82
2-Butanone	6.43
Chloroform	133
Tetrahydrofuran	5.22
n-Hexane	3.48
1,1,1-Trichloroethane	1.37
Benzene	2.58
Carbon tetrachloride	2.07
Cyclohexane	1.1
Bromodichloromethane	1.45
Trichloroethene	12.6
2,2,4-Trimethylpentane	1.02
Heptane	2.7
Toluene	15.4
Tetrachloroethene	134
Ethylbenzene	3.65
p/m-Xylene	11.6
o-Xylene	3.71
1,2,4-Trimethylbenzene	4.53

LOCATION	SG-5 (20-21')
SAMPLING DATE	1/8/2020
LAB SAMPLE ID	L2000840-03
Volatile Organics in Air	ug/m3
Dichlorodifluoromethane	2.62
1,3-Butadiene	13.1
Ethanol	10.5
Acetone	59.9
Isopropanol	3.61
Tertiary butyl Alcohol	2.38
Carbon disulfide	31
2-Butanone	8.76
cis-1,2-Dichloroethene	2.45
Chloroform	54.7
Tetrahydrofuran	5.43
n-Hexane	9.13
Benzene	14.6
Carbon tetrachloride	1.43
Cyclohexane	5.47
Trichloroethene	18.3
Heptane	6.48
4-Methyl-2-pentanone	2.09
Toluene	14.7
2-Hexanone	1.05
Tetrachloroethene	174
Ethylbenzene	2.57
p/m-Xylene	8.82
o-Xylene	2.68
1,2,4-Trimethylbenzene	3.89

LOCATION	SG-6 (20-21')	SG-6 (20-21') DUP
SAMPLING DATE	1/8/2020	1/8/2020
LAB SAMPLE ID	L2000840-04	L2001065-04
Volatile Organics in Air	ug/m3	
Dichlorodifluoromethane	2.52	3.09
1,3-Butadiene	1.12	0.832
Ethanol	20.9	18.2
Acetone	138	144
Trichlorofluoromethane	1.42	2.11
Isopropanol	4.57	3
Tertiary butyl Alcohol	4.61	4.79
Carbon disulfide	1.82	1.4
2-Butanone	5.96	5.19
Chloroform	11.5	15.9
Tetrahydrofuran	6.31	4.78
n-Hexane	4.05	2.66
1,1,1-Trichloroethane	ND	1.12
Benzene	2.42	1.84
Carbon tetrachloride	ND	1.39
Cyclohexane	0.833	ND
Trichloroethene	8.6	11.4
2,2,4-Trimethylpentane	1.18	ND
Heptane	2.48	1.84
Toluene	11.4	8.89
Tetrachloroethene	88.8	209
Ethylbenzene	1.82	2.22
p/m-Xylene	6.25	7.38
o-Xylene	2.07	2.21
1,2,4-Trimethylbenzene	4.61	3.07
1,3-Dichlorobenzene	1.73	1.88

LOCATION	SG-3 (20-21')
SAMPLING DATE	1/8/2020
LAB SAMPLE ID	L2000840-02
Volatile Organics in Air	Result
Dichlorodifluoromethane	2.13
1,3-Butadiene	5.75
Acetone	76.7
Isopropanol	2.14
Carbon disulfide	10.3
2-Butanone	4.6
cis-1,2-Dichloroethene	1.8
Chloroform	58.6
Tetrahydrofuran	5.99
n-Hexane	6.45
1,1,1-Trichloroethane	3.13
Benzene	6.01
Carbon tetrachloride	2.56
Cyclohexane	1.42
Trichloroethene	23.8
Heptane	3.78
Toluene	15.9
Tetrachloroethene	182
Ethylbenzene	3.25
p/m-Xylene	11.4
o-Xylene	3.51
1,2,4-Trimethylbenzene	4

LOCATION	SG-2 (5-6')	SG-2 (20-21')
SAMPLING DATE	1/8/2020	1/9/2020
LAB SAMPLE ID	L2000840-01	L2001065-02
Volatile Organics in Air	ug/m3	
Dichlorodifluoromethane	1.65	2.24
1,3-Butadiene	ND	0.794
Ethanol	ND	9.93
Acetone	62	161
Trichlorofluoromethane	ND	1.69
Isopropanol	3.07	2.16
Tertiary butyl Alcohol	ND	3.55
Methylene chloride	1.8	ND
Carbon disulfide	ND	1.14
2-Butanone	3.13	3.86
Chloroform	ND	3.22
Tetrahydrofuran	4.36	3.51
n-Hexane	1.6	3.45
Benzene	1.11	2.06
Trichloroethene	ND	1.6
Heptane	1.08	2.03
Toluene	7.99	7.99
Tetrachloroethene	25.1	41.8
Ethylbenzene	1.84	1.27
p/m-Xylene	7.43	4.34
o-Xylene	2.42	1.31
1,2,4-Trimethylbenzene	4.51	1.9



LOCATION	SG-1 (20-21')
SAMPLING DATE	1/9/2020
LAB SAMPLE ID	L2001065-01
Volatile Organics in Air	ug/m3
Dichlorodifluoromethane	2.38
1,3-Butadiene	1.72
Acetone	94.8
Trichlorofluoromethane	1.43
Carbon disulfide	2.11
2-Butanone	2.88
Chloroform	33.2
Tetrahydrofuran	2.85
n-Hexane	3.7
Benzene	2.3
Cyclohexane	0.812
Trichloroethene	9.46
Heptane	2.25
Toluene	10.2
Tetrachloroethene	113
Ethylbenzene	2.02
p/m-Xylene	6.73
o-Xylene	1.95
1,2,4-Trimethylbenzene	1.47

LEGEND:

- SITE BOUNDARY
- SOIL VAPOR IMPLANT LOCATION
- ND — INDICATES COMPOUND ANALYZED FOR BUT NOT DETECTED
- BOLD — COMPOUND DETECTED IN SAMPLE
- ug/m3 — MICROGRAM PER CUBIC METER OF AIR

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.
2. SG-4 WAS NOT COLLECTED DUE TO ACCIDENTAL REMOVAL OF SOIL VAPOR IMPLANT BY SUBCONTRACTOR.

N W E S

0 20' 40' 80'

SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

SOIL VAPOR DETECTIONS

PREPARED BY:
GZA GeoEnvironmental of NY
Engineers and Scientists
www.gza.com

PREPARED FOR:
462 LEXINGTON, LLC.

PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	APPENDIX C
DESIGNED BY: ZS	DRAWN BY: MT	SCALE: 1" = 40'	FIGURE 4
DATE: MAY 2021	PROJECT NO. 12.0076834.10	REVISION NO.	SHEET NO.

LEGEND:

- SITE BOUNDARY
- SOIL BORING LOCATION
- SOIL VAPOR IMPLANT LOCATION
- SOIL BORING LOCATION CONVERTED TO TEMPORARY WELL POINT
- SUPPLEMENTAL SOIL BORINGS

NOTES:

1. BASE MAP DEVELOPED FROM 2019 GOOGLE EARTH PROFESSIONAL WITH AN IMAGERY DATE OF 6/15/2018.

N
W E
S

0 20' 40' 80'

SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

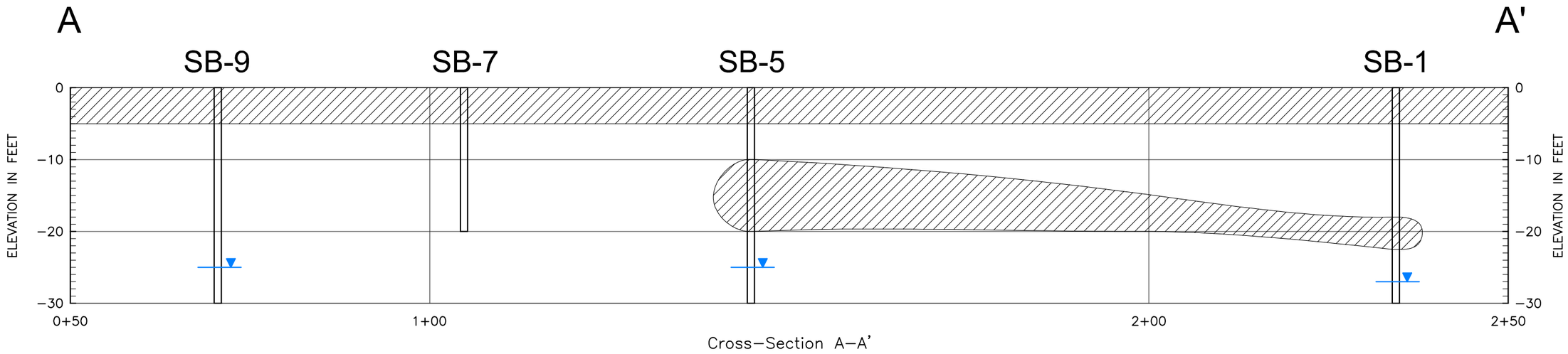
205 PARK AVENUE
BROOKLYN, NEW YORK

CROSS-SECTION LOCATIONS

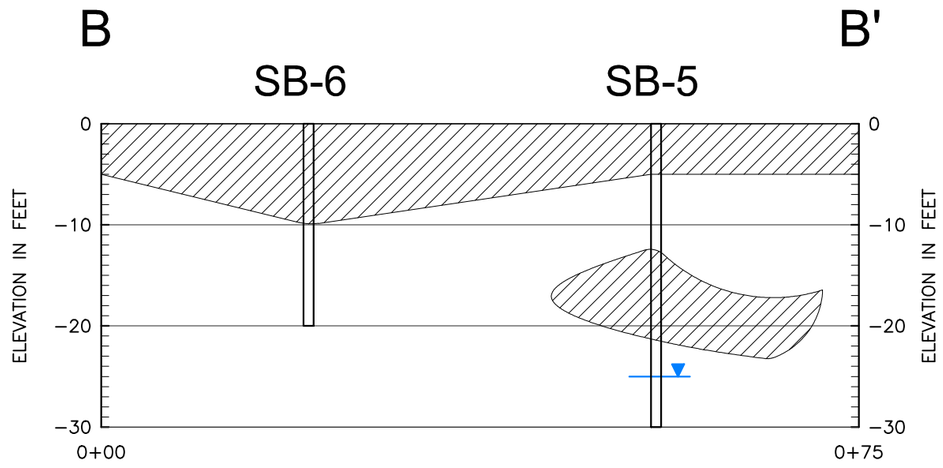
PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
462 LEXINGTON, LLC.

PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	FIGURE
DESIGNED BY: ZS	DRAWN BY: MT	SCALE: 1" = 40'	
DATE: MARCH 2021	PROJECT NO. 12.0076834.10	REVISION NO.	5
			SHEET NO.



Cross–Section A–A'



Cross–Section B–B'

LEGEND:

- FILL MATERIAL
- SAND AND GRAVEL
- GROUNDWATER TABLE

0 7.5' 15' 30'

SCALE IN FEET

NO.	ISSUE/DESCRIPTION	BY	DATE

205 PARK AVENUE
BROOKLYN, NEW YORK

CONCEPTUAL CROSS-SECTIONS

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		462 LEXINGTON, LLC.	
PROJ MGR: ZS	REVIEWED BY: ZS	CHECKED BY: DW	FIGURE 6
DESIGNED BY: ZS	DRAWN BY: CJB	SCALE: 1" = 15'	
DATE: JANUARY 2021	PROJECT NO. 12.0076834.10	REVISION NO.	SHEET NO.

Appendix D Quality Assurance Project Plan (QAPP)

Known for excellence.
Built on trust.

QUALITY ASSURANCE PROJECT PLAN

205 Park Avenue
Block 2033, Lot 50
Brooklyn, New York

May 21, 2021
File No. 12.0076834.10

PREPARED FOR:
462 Lexington Avenue, LLC
89 Bartlett Street, Brooklyn, NY 11206

PREPARED FOR:
Goldberg Zoino Associates of New York, P.C. d/b/a GZA GeoEnvironmental of New York
104 West 29th Street, 10th Floor
New York, New York 10001

31 Offices Nationwide
www.gza.com

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ATTACHMETNS

1.0 INTRODUCTION

GZA GeoEnvironmental of New York (GZA) has developed this Quality Assurance Project Plan (QAPP) to establish the procedures for sample collection, analysis and quality assurance for the Remedial Investigation (RI) to be performed at 205 Park Avenue, Brooklyn, New York (the Site). Sampling and analytical activities will be conducted in accordance with this QAPP, and the applicable requirements of the New York State Department of Environmental Conservation (NYSDEC).

1.1 PROJECT SCOPE

This QAPP describes field, analytical, and reporting standard operating procedures (SOPs) that will be utilized during the RI. The information and data collected will be utilized to assess the environmental conditions at the Site. These procedures generally apply to the following activities:

- Soil boring advancement
- Soil sample collection
- Groundwater monitoring well installation
- Monitor well gauging and sampling
- Soil gas sampling
- Laboratory analysis
- Report preparation

1.2 PROJECT OBJECTIVES

This QAPP was prepared to ensure that field sampling procedures, selected analytical methods, and chemical analytical data are of sufficient quality to meet the intended usage. As specific conditions and additional information warrant, this QAPP may be amended or revised to include Site-specific quality assurance/quality control (QA/QC) procedures. The information/data collected during the RI will be used to assist in the further delineation of known Site contamination and to evaluate the potential impact of areas of concern not previously investigated.

1.3 SAMPLE DESIGN AND RATIONALE

The RI sampling program has been designed to evaluate soil, soil gas, and groundwater conditions of the Site prior to redevelopment.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

A description of specific roles and responsibilities is provided below.

The Project Manager will be responsible for:

- Initiating project activities;
- Identifying project staff, equipment, and other resource requirements;

- Interfacing with client concerning technical matters and project progress;
- Monitoring task activities, and adjusting efforts or resources, as required to help ensure that established quality objectives are maintained;
- Internal project administration; and
- Oversight of report preparation.

The Field Team Leader/Site Supervisor will be responsible for:

- Supervising the technical performance of the project staff and field subcontractors;
- Ensuring compliance with the work plan;
- Coordinating data validation and quality assurance;
- Report preparation; and
- Working with the Project Manager in coordinating overall project quality assurance including preparation of work plans and review of data.

The field team will be comprised of various members of GZA staff based on their availability.

The Health and Safety Coordinator will be responsible for working with the Project Manager and Field Team Leader/Site Supervisor in formulation of a Site-specific Health and Safety Plan.

Quality Assurance will be accomplished through the GZA Consultant Reviewer project review process.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

3.1 DATA QUALITY PROTOCOLS

New York State Department of Health Environmental Laboratory Accreditation Program (ELAP)-certified laboratories will provide analytical services for the Monitoring program. Groundwater and soil samples will be analyzed for one or more compound classes using the following analytical methods:

- TCL Volatile Organic Compounds (VOCs) by EPA Method 8260C/D
- Semi-Volatile Organic Compounds (SVOCs) by EPA Method 8270D
- TAL Metals by EPA Method 6010D
- Pesticides by EPA Method 8081B
- Polychlorinated Biphenyls (PCBs) by EPA Method 8082A
- 1,4-Dioxane by EPA Method 8270D
- Perfluorinated Alkyl Acids by EPA Method 537
- Soil gas samples will be analyzed for VOCs via EPA Method TO-15
-

Sample containers, preservation, holding times and volumes will be in accordance with the particular EPA method.

3.2 ACCURACY

Accuracy is defined as the degree of agreement of a measurement or average of measurements with an accepted reference or true value. Accuracy will be evaluated by use of calibration and calibration verification procedures, laboratory control samples, and surrogate, matrix, and analytical spikes at the frequencies specified in **Section 4.5.** Not all accuracy checks are incorporated into each analytical method. Accuracy is defined as the degree of agreement of a measurement or average of measurements with an accepted reference or true value. Accuracy will be evaluated by use of calibration and calibration verification procedures, laboratory control samples, and surrogate, matrix, and analytical spikes at the frequencies specified in **Section 4.5**. Not all accuracy checks are incorporated into each analytical method.

3.3 PRECISION

Precision is defined as a measure of mutual agreement among individual measurements of the sample property. Precision will be evaluated by the analysis of laboratory and matrix spike duplicate samples at the rate specified in **Section 4.5**. We will also collect 5% duplicate samples in the field for comparison purposes.

3.4 DATA REPRESENTATIVENESS

Samples will be collected in a standardized manner designed to produce representative samples. This QAPP and the RI are designed so that the samples collected will present an accurate representation of actual Site conditions.

3.5 DATA COMPARABILITY

Data comparability will be ensured by control of sample collection methodology, analytical methodology, and data reporting and by the usage of USEPA-approved methodologies. The QAPP and sampling methodologies are designed so that comparability questions are minimized. Standardized sampling techniques and analytical methods will be used to attain stated project objectives. The required level of laboratory deliverables will maximize comparability of analytical results.

3.6 DATA COMPLETENESS

The number of samples to be collected is based on the need for data completeness. Data gaps will be addressed when/if they occur by systematic re-sampling and/or increasing the number of sampling points.

4.0 SAMPLING PROCEDURES

Environmental sampling will include groundwater sampling, soil sampling, and soil gas sampling. Additionally, wastes generated during well installation and development will be sampled and tested for characterization for disposal, as needed. Groundwater samples will be collected using bladder pumps, submersible pumps or bailers. Grab or composite sampling using appropriate hand-held sampling equipment will be the preferred method for waste characterization sampling.

4.1 SOIL SAMPLING (DIRECT PUSH DRILLING)

Sampling will be performed using four or five foot-long acetate sleeves that will be advanced continuously to the desired depth below the surface. Soil samples from each sleeve will be screened using a photoionization detector (PID) calibrated to 100 parts per million (ppm) isobutylene to detect possible organic vapors. Organic vapor screening will be performed by slicing open the acetate sleeve, making a small slice in the soil column with a clean knife or sampling tool, inserting the PID probe and pushing the slice closed, and monitoring the soil for approximately 5 to 10 seconds. This procedure will be repeated at intervals along the soil column at the field geologist's discretion.

The samples will be examined for staining, discoloration, odors, and debris indicative of contamination (ash, coal fragments, wood chips, cinders, petroleum staining, etc.) Samples for laboratory analysis will be collected from the six-inch interval most likely to be contaminated, based on PID readings, discoloration, staining, and the field geologist's judgment (field conditions may require a section longer than six inches to make sufficient sample; however this decision will be field-based).

The samples will be collected by cutting the soil in two places with a decontaminated steel, stainless steel, or aluminum trowel, spoon, or knife and homogenized in a decontaminated stainless-steel pan before being placed in the sample bottles. Samples collected for analysis for VOCs and total organic halides will be placed directly into the sample containers without homogenization (as per EPA sampling method 5035A). Samplers will wear phthalate-free gloves such as nitrile (no latex will be used) and will avoid contact of the gloves with the sample. Only clean metal instruments will be allowed to touch the sample. If there is insufficient soil volume in the spoon, then this will be made up by attempting a second direct push sleeve at the same depth, or by using the next immediate sample interval above or below this depth, if appropriate. If there is no recovery, then the sample depth will be skipped, and drilling will progress to the next depth interval.

Soil samples will be collected in laboratory provided containers and transported to a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified laboratory, under chain-of-custody procedures for analysis. Once the sample containers are filled, they will be immediately placed in the cooler with ice (in Ziploc plastic bags to prevent leaking) or synthetic ice packs to maintain the samples at below 4^{o}C.

Details of sampling procedures for the emerging contaminants 1,4-dioxane and per- and poly-fluoroalkyl substances (PFAS) are provided in Attachments A and B.

4.2 SOIL SAMPLING (HOLLOW-STEM AUGER)

Soil samples will be collected utilizing 2-inch-diameter by 2-foot-long split spoon samplers driven ahead of a hollow stem auger. Three-inch-diameter split spoon samplers may also be used. Augers with a minimum inside diameter of 4¼ inches will be used for drilling where wells are proposed. If soil sampling below the groundwater table is required, augers will be equipped with center plugs and/or inert "knock out" plates to control sub-water table sediments from rising inside the auger flights and hampering collection of representative soil samples.

Each split spoon sample will be screened using a PID to detect possible organic vapors. Organic vapor screening will be performed by opening the split spoon, making a small slice in the soil column with a clean knife or sampling tool, inserting the PID probe and pushing the slice closed, and monitoring the soil for approximately 5 to 10 seconds. This procedure will be repeated at intervals along the split spoon soil column at the field geologist's discretion.

The split spoons will be examined for staining, discoloration, odors, and debris indicative of contamination (ash, coal fragments, wood chips, cinders, petroleum staining, etc.). One sample will be collected from the designated six-inch

interval as per the accompanying workplan. Note that due to sample recovery or field conditions, sample intervals other than six inches may be necessary to collect sufficient sample. Additionally, sample intervals other than those designated in the accompanying workplan may be selected based on field conditions.

The samples will be collected by cutting the soil in two places with a decontaminated steel, stainless steel, or aluminum trowel, spoon, or knife and homogenizing in a decontaminated stainless steel pan before being placed in the sample bottles. Samples collected for analysis for VOCs and total organic halides samples will be placed directly into the sample containers without homogenization. Samplers will wear phthalate-free gloves such as nitrile (no latex will be used) and will avoid contact of the gloves with the sample. Only clean metal instruments will be allowed to touch the sample. If there is no recovery, then the sample depth will be skipped, and drilling will progress to the next sampling interval.

Soil samples will be collected in laboratory provided containers and transported to a NYSDOH ELAP certified laboratory, under proper chain of custody procedures for analysis. Once the sample containers are filled, they will be immediately placed in the cooler with ice (in Ziploc plastic bags to prevent leaking) or synthetic ice packs to maintain the samples at below 4°C.

Details of sampling procedures for the emerging contaminants 1,4-dioxane and per- and poly-fluoroalkyl substances (PFAS) are provided in Attachments A and B.

4.3 GROUNDWATER SAMPLING (PERMANENT WELL)

Groundwater sampling of permanent monitoring wells is described according to the following distinct phases of this work: well installation/construction, well development, well purging, and well sampling.

4.3.1 Well Installation/Construction

Groundwater monitoring wells will be constructed of threaded two-inch diameter PVC well casing and 10-slot well screen. Clean silica sand (No. 1 sand) will be placed in the annular space around the well to a minimum of one foot above the top of the well screen, two feet being optimal. Solid PVC riser, attached to the well screen, will extend to grade or above if the well is a stick-up. For a two-inch diameter well, the annular space for the filter pack should be between 2 to 4 inches thick. (The 4 ¼ inside diameter hollow stem augers will be retracted as the filter pack is installed to yield the required annular space.) A two-foot thick bentonite seal will be placed above the sand pack and moistened with potable water for a minimum of 15 minutes before backfilling the remaining space with a cement-bentonite grout. If warranted by depth, filling will be completed using a tremie pipe placed below the surface of the grout. A stick-up or flush-mount protective casing with a locking well cap will be installed and a measuring point marked on each PVC well riser. Soils will be logged utilizing a modified Bermister classification system. Boring logs/well construction diagrams will be prepared for each well.

4.3.2 Well Development

Following installation, the groundwater monitoring wells will be developed using a two-inch diameter submersible pump(s) (or equivalent) until the water is reasonably free of turbidity. Fifty nephelometric turbidity units (NTUs) or less will be the turbidity goal but not an absolute value. The wells will be developed aggressively to remove fines from the formation and sand pack. The wells will be allowed to equilibrate for 14 days prior to sampling. The volume of water removed, the well development time, and field instrument readings will be recorded in the field logbook.

4.3.3 Low-Flow Well Sampling

Upon opening each monitoring well, the headspace will be measured using PID calibrated to 100 ppm isobutylene, and water level measurements will be recorded using an electronic water level meter or oil-water interface probe, as appropriate. The depth to product (if present), depth to water, and the total depth will be measured from the top of the marked PVC casings to an accuracy of 0.01 feet. Before sampling, the wells will be purged utilizing a low-flow submersible stainless-steel pump with dedicated polyethylene tubing connected to a transparent flow cell. Very low purging rates are proposed, on the order of 100 ml/minute to 500 ml/minute, to minimize suspension of particulate matter in the well.

Groundwater from each well will be purged until turbidity, pH, temperature, dissolved oxygen, and specific conductivity have stabilized. As practical, all field measurements will be taken from the flow cell and will be recorded in the field logbook during and after purging, and before sampling.

Purging will be performed with the pump intake placed at the midpoint of the well screen or the midpoint of the water column (to be determined based on the depth and length of the screen interval) to ensure that all stagnant water in the well is removed, while not stirring up sediment that may have accumulated on the bottom of the well. Equipment will be lowered into the well very carefully to prevent suspension of bottom sediment and subsequent entrainment onto sampling equipment. Surging will be avoided. Dedicated tubing will be used for each well. Pumps will be carefully cleaned between wells according to the procedures specified in **Section 4.7.** Ideally, pumping rates will be at a rate so that no drawdown of the groundwater level occurs (i.e., pumping rate is less than recharge rate). During purging, the sampler will actively monitor and track the volume of water purged and the field parameter readings. Data will be recorded in the field logbook or well purge data sheet. Sampling personnel will wear phthalate-free gloves such as nitrile (no latex will be used) and will avoid contact of the gloves with the sample. Only clean instruments will be allowed to touch the sample.

Per- and poly-fluoroalkyl substances (PFAS), if analyzed, are to be sampled first. PFAS are very stable manmade chemicals that have properties that allow them to repel both water and oil. The water repelling properties of these substances allow them to be applied to almost any material to make it water, oil, and stain repellant. These properties were first used commercially in the 1950s, and they are used in a wide variety of consumer products, including carpets, clothing, non-stick pans, paints, polishes, waxes, cleaning products, and food packaging. Firefighters and the military use them in fire-suppressing foam. Based upon its usage it is important to prevent cross-contamination while collecting groundwater samples for PFAS analysis. A detailed sampling procedure is discussed in Attachment B. The PFAS samples should be kept in a separate and dedicated cooler and should not be placed with the other sample containers.

1, 4 Dioxane analysis: Collect groundwater samples and pour it slowly into two of the 250 ml Amber Glass vials with Teflon Lined caps.

The samples will be collected in laboratory prepared sample bottles (pre-preserved, if appropriate), placed in iced coolers, and removed from light immediately after collection. In addition, all sample bottles must be filled to the top so that no aeration of the samples occurs during transport. All bottles will be filled to avoid cascading and aeration of the samples, the goal being to minimize any precipitation of colloidal matter.

4.4 SOIL GAS SAMPLING

4.4.1 Soil Gas Sampling (Direct Push)

A direct-drive rig will be utilized to drive rods with a decontaminated stainless-steel probe through six-mil plastic sheeting to the desired sample depth, which will be approximately 1.5 feet above the capillary fringe. The soil gas probe will then

be purged at a flow rate not greater than 0.2 liters/minute to evacuate one to three volumes using a photoionization detector (PID) with an integrated vacuum pump (PhotoVac 2020 or appropriate alternate). No PID readings will be taken prior to sample collection. Following the stabilization period, each probe will be connected to an evacuated laboratory-supplied SUMMA® canister. SUMMA® canisters are passivated stainless steel vessels that have been cleaned and certified contaminant-free by the contract laboratory. Each SUMMA® canister will be shipped to the sampling site under a high vacuum (30" Hg) to ensure that the canister remains free of contaminants prior to use. After connecting the SUMMA® canister to the soil gas probe, a regulator valve on the canister will be opened and the vacuum will slowly draw the sample into the canister over a period of two hours. The samples will not be drawn at greater than 0.2 liters per minute. Quantitation limits for all analytes range between 1.6 ppbV and 4.0 ppbV, depending on the compound. After collecting the soil gas sample, the valve will be closed and disconnected from the soil gas probe. The soil-gas samples will be shipped overnight to a New York ELAP certified laboratory for TO-15 analysis.

A tracer gas (e.g., helium, butane, or sulfur hexafluoride) will be utilized prior to sample collection to evaluate the potential for infiltration of outdoor air into the sample. Subsequent rounds of soil gas sampling would include the use of tracer gas only if the initial round of sampling indicates that outdoor air has the potential to influence soil gas sample results.

When soil vapor samples are collected, the following conditions that may influence the interpretation of results will be documented:

- Identification of any nearby commercial or industrial buildings that likely uses volatile organic compounds;
- A sketch of the Site, showing streets, neighboring commercial or industrial facilities (with estimated distances to the Site, and soil-gas sampling locations);
- Weather conditions (e.g., precipitation, outdoor temperature, barometric pressure, wind speed and direction); and
- Any pertinent observations, such as odors or readings from field instrumentation.

4.5 FIELD DATA COLLECTION

Data to be collected in the field may include:

- Groundwater level and/or free product level measurements via electronic water level indicator, oil/water interface probe, and or pressure-based water level data loggers;
- Pumping rates (calculated based on gallons pumped in a measured time);
- Water quality parameters including temperature, pH, oxidation-reduction potential, dissolved oxygen, specific conductivity, turbidity, etc. via water quality field meter; and,
- Volatile organic compound screening for soils and well headspace via PID.

Field data will be recorded in the field logbook, boring log forms and/or well purge datasheets.

4.6 QC SAMPLE COLLECTION

QC samples may include equipment rinsate/field blanks, trip blanks, sample duplicates and matrix spike/matrix spike duplicates (MS/MSDs).

Equipment Rinsate/Field Blanks will be used to check for potential contamination from ambient air and/or field sampling equipment. Equipment rinsate/field blanks will be collected in the field by pouring laboratory-supplied deionized water over/through decontaminated sampling equipment prior to sample collection. Equipment rinsate/field blanks will be submitted to the laboratory at a frequency of one per 20 soil samples. For groundwater samples, an equipment/rinsate blank will be collected for each sampling day when more than one groundwater sample is collected. Equipment rinsate/field blank analytical parameters will match sample analytical parameters. Equipment rinsate/field blanks will not be collected for samples associated with waste disposal.

Trip Blanks will be used to assess the potential for volatile organic compound contamination of groundwater samples due to contaminant migration during sample shipment and storage. Trip blanks will consist of laboratory-supplied deionized water. Trip blanks are never opened and travel to and from the Site with the empty and full sample bottles. Trip blanks are stored with the investigative samples and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one per cooler that contains groundwater samples for VOC analysis only.

Sample Duplicates are an additional aliquot of the same sample submitted for the same parameters as the original sample. Sample duplicates will be used to assess sampling and analytical reproducibility. Duplicate samples consist of an actual sample taken in the field that has been split into two identical aliquots and put into two separate sampling containers. Each duplicate of a soil sample (except for the VOC fraction) will be homogenized in a dedicated stainless-steel pan prior to alternately filling the sample containers. The volatile fraction for soils will be collected directly from the sampling device without homogenization. Sample duplicates will be analyzed as two separate samples and submitted at a frequency of one per 20 samples for all matrices and all parameters with the exception of parameters collected for waste characterization purposes.

MSs and MSDs are two additional aliquots of the same sample submitted for the same parameters as the original sample. However, the additional aliquots are spiked with the compounds of concern. Matrix spikes provide information about the effect of the sample matrix on the measurement methodology. MS/MSDs samples will be selected by the laboratory at a frequency of one per 20 investigative samples per matrix for organic parameters. MSs will be submitted at a frequency of one per 20 investigative samples per matrix for inorganic parameters.

4.7 SAMPLE PRESERVATION AND CONTAINERIZATION

The analytical laboratory will supply the sample containers for the applicable samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest U.S. EPA's *Specifications and Guidance for Contaminant-Free Sample Containers*. The containers will be pre-preserved, as required by the analytical method.

4.8 EQUIPMENT DECONTAMINATION

Re-usable Teflon®, Stainless steel, and aluminum sampling equipment will be cleaned between each use in the following manner:

- Wash/scrub with a biodegradable degreaser ("Simple Green") if there is oily residue on equipment surface;
- Tap water rinse;
- Wash and scrub with Alconox and water mixture;
- Tap water rinse;

- 10 percent HNO_3 rinse for non-dedicated, stainless steel groundwater sampling equipment for metals analysis only (excludes submersible pump and flow cell) and 1 percent HNO_3 rinse for non-dedicated, non-stainless steel equipment;
- Hexane rinse (optional, only if required to remove heavy petroleum coating);
- Distilled/deionized water rinse; and,
- Air dry.

Cleaned equipment will be wrapped in aluminum foil if not used immediately after air-drying.

Groundwater sampling pumps (whale pumps) will be cleaned by washing and scrubbing with an Alconox/water mixture, rinsing with tap water and irrigating with distilled/deionized water.

Bladder pumps will utilize dedicated bladders, o-rings, and grab plates. Bladder pumps will be cleaned by taking apart the pump and washing and scrubbing with an Alconox/water mixture, rinsing with tap water and irrigating with distilled/deionized water. Once the pump is clean, new dedicated parts (bladder, o-rings, and grab plate) will be installed.

Disposable, dedicated equipment (e.g. bailers, tubing, etc.) will be used to the extent feasible.

5.0 DOCUMENTATION AND CHAIN-OF-CUSTODY

5.1 SAMPLE COLLECTION DOCUMENTATION

5.1.1 Field Data Documentation/Field Logs

A system of logging pertinent data collected during sampling operations will be maintained using bound field logbooks. Each page will be numbered, dated, and initialed or signed by the person making the entry. Entries will be made in ink. Errors will be crossed out with a single line, initialed, and dated. At the completion of the day, if a page is not complete, a diagonal line will be drawn through the remainder of the page with the signature at the bottom.

Sample locations will be recorded and referenced to the Site map so that each location is permanently established. Samples will be tagged or labeled with pertinent Site information at the time of sampling. **Section 5.1.3** describes sample identification. Pertinent Site information to be supplied in the field log for each task is listed below:

- Initials or Signature of note taker
- Name and location of investigation
- Date and time of arrival and departure
- Names of all personnel on-Site and their affiliation
- Purpose of the visit
- Field instruments used, date and time of calibration and calibration checks, method of calibration, standards used
- Field measurement results
- Date, time, and location of all sampling points

- Method of sample collection
- Factors that could affect sample integrity
- Name of sampler(s)
- Sample identification and sample description
- Documentation of conversations with the client, regulatory personnel, field decisions, and approval
- Sample locations intervals
- Weather conditions
- Inventory of drum contents and storage location for each drum of waste material generated.

Field notebooks should contain only factual information entered as real-time notes, which will enable the user to recreate events on-Site. Drilling/boring logs and monitoring well construction details will be recorded in the field notebook and/or on a separate boring log/well construction form for each boring/monitoring well. Soil descriptions will be based on a modified Burmister soil classification system, where minor components and relative soil density will not be specified. Strata not sampled will be so indicated. Groundwater sampling field data will be recorded in the field notebook and/or on separate purge data sheet for each monitoring well sampled.

5.1.2 Chain-of-Custody Records

Sample custody is discussed in detail in **Sections 5.1.4 through 5.1.6** of this Plan. Chain-of-custody records are initiated by the samplers in the field. The field portion of the custody documentation should include: (1) the project name; (2) signature(s) of sampler(s); (3) the sample number, date and time of collection, and whether the sample is grab or composite; and (4) if applicable, air bill or other shipping number. Sample receipt and log-in procedures at the laboratory are described in **Section 5.1.6** of this Plan.

Samples will be transferred to the custody of the respective laboratories via third-party commercial carriers or via laboratory courier service within timeframes required by NJDEP field sampling procedures.

5.1.3 Sample Labeling

Immediately upon collection, each sample will be labeled with an adhesive label, which includes the date and time of collection, sampler's initials, tests to be performed, preservative (if applicable), and a unique identifier. The following identification scheme will be used:

A. The sample ID number will include the soil, soil gas, sediment, wastewater, or monitoring well location, along with the sample depth, sample interval, and the depth interval at which it was collected.

Example:

Sample P-9(5-5.5') indicates the sample was taken at boring location P-9, from the 6-inch interval in the spoon beginning at 5.0 feet below grade and ending at 5.5 feet below grade.

Duplicate samples will be labeled as blind duplicates by giving them sample numbers indistinguishable from a normal sample.

Blanks should be spelled out and identify the associated matrix, e.g. Field Blank

MS/MSDs will be noted in the Comments column of the COC.

B. The analysis required will be indicated for each sample.

Example: SVOC

C. Date taken will be the date the sample was collected, using the format: MM-DD-YY.

Example: 03-22-12

D. Time will be the time the sample was collected, using military time.

Example: 14:30

E. The sampler's name will be printed in the "Sampled By" section.

F. Other information relevant to the sample.

Example: Equipment Blank

A sample label will contain the following information:

Job No.

Client

Sample Number

Date/Sample Time

Sample Matrix

Grab or Composite (explain)

Preservatives

Analyses

Sampler Signature

An example sample label is presented below:

Job No: XXXXXXXXX

Client: Name

Sample No: OU1-B22(5-5.5')

Matrix: Soil
Date Taken: 3/22/12

Time Taken: 14:30

Sampler: B. Smith

Analysis: SVOC

This sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples.

5.1.4 Sample Custody

A sample is considered to be under a person's custody if:

- The item is in the actual possession of the person;
- The item is in the view of the person after being in actual possession of the person;
- The item was in the actual physical possession of the person but is locked up to prevent tampering; or,
- The item is in a designated and identified secure area.

5.1.5 Field Custody Procedures

Samples will be collected following the sampling procedures documented in **Section 4.00** of this Plan. Documentation of sample collection is described in **Section 5.1.1** of this Plan. Sample chain-of-custody and packaging procedures are summarized below. These procedures are intended to ensure that the samples will arrive at the laboratory with the chain-of-custody intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample labeling system is presented in **Section 5.1.3** of this Plan.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample label because the pen would not function in wet weather.
- Samples will be accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to the analytical laboratory courier, or to/from a secure storage location.
- All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and placed in the project files.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and/or secured to the inside top of each sample box or cooler. If using a

commercial carrier service to ship sample containers to the laboratory, the containers will be secured with strapping tape and custody seals. The custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by field personnel. The cooler will be strapped shut with strapping tape in at least two locations.

- If the samples are sent by commercial carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.

Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian or laboratory courier, and signature of the laboratory sample custodian or courier on the chain-of-custody document as receiving the samples and signature of sampler as relinquishing samples.

5.1.6 Laboratory Custody Procedures

Samples will be received and logged in by a designated sample custodian or his/her designee. Upon sample receipt, the sample custodian will:

- Examine the shipping containers to verify that the custody tape is intact, if applicable;
- Examine all sample containers for damage;
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the chain-of-custody records;
- Compare samples received against those listed on the chain-of-custody;
- Verify that sample holding times have not been exceeded;
- Examine all shipping records for accuracy and completeness;
- Determine sample pH (if applicable) and record on chain-of-custody form;
- Sign and date the chain-of-custody immediately (if shipment is accepted) and attach the air bill;
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the Laboratory Project Manager, who will be responsible for contacting GZA;
- Attach laboratory sample container labels with unique laboratory identification and test; and,
- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel.
- The Laboratory Project Manager will be notified of sample arrival.

The completed chain-of-custody, air bills, and any additional documentation will be placed in the final evidence file.

5.2 SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

No field analyses are anticipated for this program. If site conditions were to warrant field analysis, the responsible contractor will prepare an addendum establishing the field analytical procedures. Analyses of all samples will be performed by NYSDOH ELAP certified laboratories.

5.3 SAMPLE PRESERVATION

5.3.1 Soil Samples

Samples collected for non-VOC analyses will be collected in 4-oz amber glass containers. VOC samples will be collected in 5g EnCore® Samplers. All samples will be placed immediately in the sample cooler to be maintained at 4°C.

5.3.2 Groundwater Samples

Samples collected for non-VOC analyses will be collected in 1000-ml amber glass containers or 250-ml plastic containers. VOC samples will be collected in 40-ml VOA vials. All samples will be placed immediately in the sample cooler to be maintained at 4°C.

5.4 INVESTIGATION-DERIVED WASTE

Drill cuttings and purged well water will be containerized in DOT-approved or equivalent 55-gallon drums and stored on-Site pending analysis and proper off-Site disposal.

6.0 CALIBRATION/ANALYTICAL PROCEDURES

6.1 LABORATORY CALIBRATION

Calibration procedures for a specific laboratory instrument will consist of initial calibrations, initial calibration verifications, and/or continuing calibration verification. Detailed descriptions of the calibration procedures for a specific laboratory instrument are included in the laboratory's standard operating procedures (SOPs), which describe the calibration procedures, their frequency, acceptance criteria, and the conditions that will require recalibration. These procedures are as required in the respective analytical methodologies. The initial calibration associated with all analyses must contain a low-level calibration standard which is less than or equal to the quantitation limit.

6.2 LABORATORY PREVENTATIVE MAINTENANCE

Preventative maintenance and periodic maintenance will be performed as needed and documented in laboratory notebooks, instrument maintenance logbooks, or work orders as appropriate in accordance with method-specific requirements.

PID screening instruments will be calibrated daily prior to field activities according to the instrument manufacturer's specifications using certified calibration gases. Sampling personnel shall perform battery checks daily. The recorded calibration information includes date of calibration, standards used, and calibration results.

6.3 FIELD PREVENTATIVE MAINTENANCE

Field instruments will be checked prior to use in the field according to the procedures and frequencies specified by the manufacturer. GZA utilizes a commercial instrument rental company (e.g. Pine Environmental or US Environmental) to provide field instrumentation. Records of factory calibrations and instrument maintenance will be maintained by the instrument rental company. Field maintenance will be performed as needed and recorded in the field logbook.

7.0 DATA VALIDATION AND REPORTING

Laboratory deliverables will include, at a minimum:

1. A cover page, including facility name and address, laboratory name and address, laboratory certification number, date of analytical report preparation, and signature of laboratory director.
2. A contents page.
3. A non-conformance summary
3. A listing of all field sample identification numbers and corresponding laboratory sample identification numbers
3. A listing of the analytical methods used
4. Detection limits for each analyte
5. Tabulated sample results, including date of analysis
6. Method blank results
7. Chain-of-custody documents
8. Temperature of sample at receipt

TABLES

Table 1 Sampling plan with analytical method

Table 1 - Summary of Sampling Program Rationale and Analysis
205 Park Avenue
Brooklyn, New York

Sample Identifier	Location	Approximate Number of Samples	Rationale for Sampling	Laboratory Analysis
Soil Boring Soils				**All Samples**
SRI-1 through SRI-8	8 locations throughout the Site	At a minimum, two soil samples will be collected from each test boring (for a total of 10 soil samples) for laboratory analysis. This includes a surface soil sample (from the 0-4 feet bgs interval) and a soil immediately above the water table. Approximately 18 samples (including 2 duplicates).	To characterize soil quality across the Site.	VOCs (EPA Method SW 846 8260); SVOCs (EPA Method SW 846 8270), pesticides/PCBs (EPA Methods SW 846 8081/8082), and Target Analyte List metals (EPA Method 6010 and 7471),1,4-Dioxane (EPA Method SW 846 8260, isotope dilution for 1-4 Dioxane), and PFAs (EPA Method SW 846 537)
Groundwater - Temporary Well Points				**All Samples**
GW-1 through GW-6	4 onsite locations and 2 off-site locations; screened across water table	7 (including one duplicate)	To characterize groundwater quality on Site	VOCs (EPA Method SW 846 8260), SVOCs (EPA Method SW 846 8270), pesticides/PCBs (EPA Methods SW 846 8081/8082), total and dissolved TAL metals (EPA Methods SW 846 6010/6020/7470), 1,4-Dioxane (EPA Method SW 846 8260, isotope dilution for 1-4 Dioxane) and PFAs (EPA Method SW 846 537)
Groundwater - Temporary Well Points				**All Samples**
SV-1 and SV-2	One onsite location along the northern perimeter of the Site. One off-site location along the western perimeter of the Site	4 samples (including one duplicate and one outdoor ambient air)	To characterize soil vapor on Site	EPA Method TO-15

Notes:

TAL = Target Analyte List
TCL = Target Compound List
VOCs + TICs = volatile organic compounds plus tentatively identified compounds
SVOCs + TICs = semi-volatile organic compounds plus tentatively identified compounds
PCBs = polychlorinated biphenyls
PFAs = perfluorinated compounds

ATTACHMETNS

Attachment A Sampling for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances (PFAS) Under DEC's Part 375 Remedial Programs (June 2019)

June 2019

Sampling for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances (PFAS) Under DEC's Part 375 Remedial Programs

Objective

The Department of Environmental Conservation (DEC) is requiring sampling of all environmental media and subsequent analysis for the emerging contaminants 1,4-Dioxane and PFAS as part of all remedial programs implemented under 6 NYCRR Part 375, as further described in the guidance below.

Sample Planning

The number of samples required for emerging contaminant analyses is to be the same number of samples where "full TAL/TCL sampling" would typically be required in an investigation or remedial action compliance program.

Sampling of all media for ECs is required at all sites coming into or already in an investigative phase of any DER program. In other words, if the sampling outlined in the guidance hasn't already been done or isn't part of an existing work plan to be sampled for in the future, it will be necessary to go back out and perform the sampling prior to approving a SC report or issuing a decision document.

PFAS and 1,4-dioxane shall be incorporated into the investigation of potentially affected media, including soil, groundwater, surface water, and sediment as an addition to the standard "full TAL/TCL sampling." Biota sampling may be necessary based upon the potential for biota to be affected as determined pursuant to a Fish and Wildlife Impact analysis. Soil vapor sampling for PFAS and 1,4-dioxane is not required.

Upon an emerging contaminant being identified as a contaminant of concern (COC) for a site, those compounds must be assessed as part of the remedy selection process in accordance with Part 375 and DER-10 and included as part of the monitoring program upon entering the site management phase.

Special Testing Requirements for Import or Reuse of Soil: Soil imported to a site for use in a soil cap, soil cover, or as backfill must be tested for 1,4-dioxane and PFAS contamination in general conformance with DER-10, Section 5.4(e). Soil samples must be analyzed for 1,4-dioxane using EPA Method 8270, as well as the full list of PFAS compounds (currently 21) using EPA Method 537.1 (modified).

For 1,4-dioxane, soil exceeding 0.1 ppm must be rejected per DER 10: Appendix 5 - Allowable Constituent Levels for Imported Fill or Soil, Subdivision 5.4(e).

If PFOA or PFOS is detected in any sample at or above 1 ppb, then a soil sample must be tested by the Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed. If the SPLP results exceed 70 ppt combined PFOA/S, then the source of backfill must be rejected. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays.

The work plan should explicitly describe analysis and reporting requirements, including laboratory analytical procedures for modified methods discussed below.

Analysis and Reporting

Labs should provide a full category B deliverable, and a DUSR should be prepared by an independent 3rd party data validator. QA/QC samples should be collected as required in DER-10, Section 2.3(c). The electronic data submission should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

PFAS analysis and reporting: DEC has developed a *PFAS Analyte List* (below) for remedial programs. 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 compounds, the DEC project manager, in consultation with the DEC remedial program chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site.

Currently, ELAP does not offer certification for PFAS compounds in matrices other than finished drinking water. However, laboratories analyzing environmental samples (e.g., soil, sediments, and groundwater) are required by DER to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537 or ISO 25101. Labs must also adhere to the requirements and criteria set forth in the Laboratory Guidance for Analysis of PFAS in Non-Potable Water and Solids.

Modified EPA Method 537 is the preferred method to use for environmental samples due to its ability to achieve very low detection limits. Reporting limits for PFAS in groundwater and soil are to be 2 ng/L (ppt) and 1 ug/kg (ppb), respectively. If contract labs or work plans submitted by responsible parties indicate that they are not able to achieve these reporting limits for the entire list of 21 PFAS, site-specific decisions will need to be made by the DEC project manager in consultation with the DEC remedial program chemist. Note: Reporting limits for PFOA and PFOS in groundwater should not exceed 2 ng/L.

Additional laboratory methods for analysis of PFAS may be warranted at a site. These methods include Synthetic Precipitation Leaching Procedure (SPLP) by EPA Method 1312 and Total Oxidizable Precursor Assay (TOP Assay).

SPLP is a technique for determining the potential for chemicals in soil to leach to groundwater and may be helpful in determining the need for addressing PFAS-containing soils or other solid material as part of the remedy. SPLP sampling need not be considered if there are no elevated PFAS levels in groundwater. If elevated levels of PFAS are detected in water, and PFAS are also seen in soil, then an SPLP test should be considered to better understand the relationship between the PFAS in the two media.

The TOP Assay can assist in determining the potential PFAS risk at a site. For example, some polyfluoroalkyl substances may transform to form perfluoroalkyl substances, resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from the site. To conceptualize the amount and type of oxidizable perfluoroalkyl substances which could be liberated in the environment, a “TOP Assay” analysis can be performed, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized.

PFAS-containing materials can be made up of per- and polyfluoroalkyl substances that are not analyzable by routine analytical methodology (LC-MS/MS). The TOP assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by current

analytical methodology. Please note that analysis of highly contaminated samples, such as those from an AFFF site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. Please consult with a DEC remedial program chemist for assistance interpreting the results.

1,4-Dioxane analysis and reporting: The reporting limit for 1,4-dioxane in groundwater should be no higher than 0.35 µg/L (ppb) and no higher than 0.1 mg/kg (ppm) in soil. Although ELAP offers certification for both EPA Method 8260 and EPA Method 8270 for 1,4-dioxane, DER is advising the use of Method 8270 SIM for water samples and EPA Method 8270 for soil samples. EPA Method 8270 SIM is not necessary for soils if the lab can achieve the required reporting limits without the use of SIM. Note: 1,4-dioxane is currently listed as a VOC in the Part 375 SCO tables but will be moved to the SVOC table with the next update to Part 375.

Refinement of sample analyses: As with other contaminants that are analyzed for at a site, the emerging contaminant analyte list may be refined for future sampling events based on investigative findings. Initially, however, sampling using this PFAS Analyte List and 1,4-dioxane is needed to understand the nature of contamination.

PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	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	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Attachment B Sampling, Analysis, and Assessment of Per- and Poly-Fluorinated Alkyl Substances (PFAS) (January 2021)

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

January 2021

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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

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

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.

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 F) 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

Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP) does not offer certification for PFAS in matrices other than finished drinking water. However, laboratories analyzing environmental samples for PFAS (e.g., soil, sediments, and groundwater) under DER's Part 375 remedial programs need to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533. Laboratories should adhere to the guidelines and 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). 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).

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. 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.

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]

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. 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

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 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.

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

[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 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).

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.

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 LC-MS/MS for PFAS using methodologies based on EPA Method 537.1
- 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
- Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101
- 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 methodologies based on EPA Method 537.1.

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 methodologies based on EPA Method 537.1.

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 methodologies based on EPA Method 537.1.

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 sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	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	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) developed the following guidelines for laboratories analyzing environmental samples for PFAS under DER programs. If laboratories cannot adhere to the following guidelines, they should contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov prior to analysis of samples.

Isotope Dilution

Isotope dilution techniques should be utilized for the analysis of PFAS in all media.

Extraction

For water samples, the entire sample bottle should be extracted, and the sample bottle rinsed with appropriate solvent to remove any residual PFAS.

For samples with high particulates, the samples should be handled in one of the following ways:

1. Spike the entire sample bottle with isotope dilution analytes (IDAs) prior to any sample manipulation. The sample can be passed through the SPE and if it clogs, record the volume that passed through.
2. If the sample contains too much sediment to attempt passing it through the SPE cartridge, the sample should be spiked with isotope dilution analytes, centrifuged and decanted.
3. If higher reporting limits are acceptable for the project, the sample can be diluted by taking a representative aliquot of the sample. If isotope dilution analytes will be diluted out of the sample, they can be added after the dilution. The sample should be homogenized prior to taking an aliquot.

If alternate sample extraction procedures are used, please contact the DER remedial program chemist prior to employing. Any deviations in sample preparation procedures should be clearly noted in the case narrative.

Signal to Noise Ratio

For all target analyte ions used for quantification, signal to noise ratio should be 3:1 or greater.

Blanks

There should be no detections in the method blanks above the reporting limits.

Ion Transitions

The ion transitions listed below should be used for the following PFAS:

PFOA	413 > 369
PFOS	499 > 80
PFHxS	399 > 80
PFBS	299 > 80
6:2 FTS	427 > 407
8:2 FTS	527 > 507
N-EtFOSAA	584 > 419
N-MeFOSAA	570 > 419

Branched and Linear Isomers

Standards containing both branched and linear isomers should be used when standards are commercially available. Currently, quantitative standards are available for PFHxS, PFOS, NMeFOSAA, and NEtFOSAA. As more standards become available, they should be incorporated in to the method. All isomer peaks present in the standard should be integrated and the areas summed. Samples should be integrated in the same manner as the standards.

Since a quantitative standard does not exist for branched isomers of PFOA, the instrument should be calibrated using just the linear isomer and a technical (qualitative) PFOA standard should be used to identify the retention time of the branched PFOA isomers in the sample. The total response of PFOA branched and linear isomers should be integrated in the samples and quantitated using the calibration curve of the linear standard.

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated for each target analyte and the ratio compared to standards. Lab derived criteria should be used to determine if the ratios are acceptable.

Reporting

Detections below the reporting limit should be reported and qualified with a J qualifier.

The acid form of PFAS analytes should be reported. If the salt form of the PFAS was used as a stock standard, the measured mass should be corrected to report the acid form of the analyte.

Appendix I - 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 analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report. 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 14 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 five 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%. Linear fit calibration curves should have an R^2 value greater than 0.990.

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
R^2 >0.990	J flag detects and UJ non detects
Low-level calibration check <50% or >150%	J flag detects and UJ non detects
Mid-level calibration check <70% or >130%	J flag detects and UJ non detects

Initial Calibration Verification

An initial calibration verification (ICV) standard should be from a second source (if available). The ICV should be at the same concentration as the mid-level standard of the calibration curve.

ICV recovery <70% or >130%	J flag detects and 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

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated from the standards for each target analyte. Lab derived criteria should be used to determine if the ratios are acceptable. If the ratios fall outside of the laboratory criteria, qualify results as an estimated maximum concentration.

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.

Branched and Linear Isomers

Observed branched isomers in the sample that do not have a qualitative or quantitative standard should be noted and the analyte should be qualified as biased low in the final data review summary report. Note: The branched isomer peak should also be present in the secondary ion transition.

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.


GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

Appendix E Health and Safety Plan

GZA SITE-SPECIFIC HEALTH, SAFETY & ACCIDENT PREVENTION STANDARD-PLAN

1. CLIENT/SITE/PROJECT INFORMATION		
Client: 462 Lexington, LLC		
Site Address: 205 Park Avenue, Brooklyn, New York (Block 2033 Lot 50)		
Site Description (be sure to list pertinent site features, chemicals used at the facility, and other potential hazard sources): Vacant lot since 2016 and is unused by the current owner. Prior to demolition, Site was used by multiple tenants as meat market, dry-cleaners, pharmacy, auto service facility, private residencies, and other commercial establishments.		
Work Environment (active manufacturing, office, vacant site, undeveloped property, etc.): Vacant Site		
Job/Project #: 12.0076834.10	Estimated Start Date: 2/1/2021	Estimated Finish Date: 2/1/2022
Site is Covered by the Following Regulations:	OSHA HAZWOPER Standard ☒	Mine Safety and Health Administration ☐
	OSHA Construction Regulations ☒	

2. EMERGENCY INFORMATION		
Hospital Name: The Brooklyn Hospital Center		Hospital Phone: (718) 250-8000
Hospital Address: 121 Dekalb Ave, Brooklyn, NY 11201		Directions and Street Map Attached: ☒ Yes
Local Fire #: 911 or 805-458-1207	Local Ambulance #: 911	Local Police #: 911 or 718-875-6811
WorkCare Incident Intervention Services:	**For non-emergencies, if an employee becomes hurt or sick call 888-449-7787**	
Other Emergency Contact(s): Dave Winslow	Phone #'s: 347-242-7107 (cell), 973-774-3307 (Office)	
Site-Specific Emergency Preparedness/Response Procedures/Concerns: Complete daily tailgate safety meeting.		

- All EHS Events (incidents, first aid, near misses, unsafe acts/conditions, fires, chemical spills, property damage, and extraordinary safe behaviors) must be reported immediately to the Project Manager, and within 24hours to the EHS Event Reporting Portal at http://www.kelleronline.com. Username gempl1 Password 4Incidents!,
- In the event of a chemical release greater than 5 gallons, site personnel will evacuate the affected area and relocate to an upwind location. The GZA Field Safety Officer and client site representative shall be contacted immediately.
- Site work shall not be conducted during severe weather, including high winds and lightning. In the event of severe weather, stop work, lower any equipment (drill rigs), and evacuate the affected area.

3. SCOPE OF WORK	
General project description, and phase(s) or work to which this H&S Plan applies[1].	Environmental Remediation work including soil borings (Geoprobe), soil sampling, permanent monitoring well installation, and groundwater sampling.
Specific Tasks Performed by GZA:	Soil boring/ Geoprobe drill oversight, soil sampling, permanent well groundwater installation, groundwater sampling.
Concurrent Tasks to be Performed by GZA-hired Subcontractors (List Subcontractors by Name):	Soil boring and permanent well installation by driller.
Concurrent Tasks to be Performed by Others:	

Any OSHA PERMIT-REQUIRED CONFINED SPACE entry? ☐ YES ☒ NO IF YES, ADD CONFINED SPACE ENTRY PERMIT FOR THAT PORTION OF THE WORK	Any INDOOR fieldwork? ☐ YES ☒ NO IF YES, EXPLAIN:

[1] Copy from or reference proposal or applicable design plan as appropriate.

4. SUB-SURFACE WORK, UNDERGROUND UTILITY LOCATION

Will subsurface explorations be conducted as part of this work (drilling or excavation)?	☒ Yes ☐ No
Will GZA personnel be required to use a hand-auger as part of this work?	☐ Yes ☒ No
Site property ownership where underground explorations will be conducted on: 462 Lexington, LLC	Public Access Property ☐ Yes ☒ No Private Property ☒ Yes ☐ No
Have Necessary Underground Utility Notifications for Subsurface Work Been Made?	☐ Yes ☒ Yet to be conducted

Specify Clearance Date & Time, Dig Safe Clearance I.D. #, And Other Relevant Information: to be provided
Ticket #:to be provided

IMPORTANT! For subsurface work, prior to the initiation of ground penetrating activities, GZA personnel to assess whether the underground utility clearance (UUC) process has been completed in an manner that appears acceptable, based on participation/ confirmation by other responsible parties (utility companies, subcontractor, client, owner, etc.), for the following:

Electric:	☐ Yes	☐ No	☐ NA	☐ Other_____
Fuel (gas, petroleum, steam):	☐ Yes	☐ No	☐ NA	☐ Other_____
Communication:	☐ Yes	☐ No	☐ NA	☐ Other_____
Water:	☐ Yes	☐ No	☐ NA	☐ Other_____
Sewer:	☐ Yes	☐ No	☐ NA	☐ Other_____
Other:_____	☐ Yes	☐ No	☐ NA	☐ Other_____

Comments: Betts Environmental & Alternative Fuels & ECDI will call in the markout and will update HASP with information prior to job starting.

5. HAZARD ASSESSMENT (CHECK ALL THAT APPLY AND ADDRESS EACH HAZARD IN SECTION 6)

A. GENERAL FIELDWORK HAZARDS

☐ Confined Space Entry (Add Confined Space Entry Permit)	☐ Overhead Hazards (i.e. falling objects, overhead power lines)
☐ Abandoned or vacant building/Enclosed Spaces	☐ Portable Hand Tools or Power Tools
☒ Significant Slip/Trip/Fall Hazards	☐ Significant Lifting or Ergonomic Hazards
☐ Unsanitary/Infectious Hazards	☐ Electrical Hazards (i.e. Equipment 120 Volts or Greater, Work Inside Electrical Panels, or Maintenance of Electrical Equipment)
☐ Poisonous Plants	☐ Other Stored energy Hazards (i.e. Equipment with High Pressure or Stored Chemicals)
☐ Biting/Stinging Insects	☐ Fire and/or Explosion Hazard
☐ Feral Animal Hazards	☒ Elevated Noise Levels
☐ Water/Wetlands Hazards	☐ Excavations/Test Pits (UST Removal activities)
☐ Remote Locations/Navigation/Orientation hazards	☐ Explosives or Unexploded Ordinance/MEC
☐ Heavy Traffic or Work Alongside a Roadway	☐ Long Distance or Overnight Travel
☒ Weather-Related Hazards	☐ Personal Security or High Crime Area Hazards
☒ Motor vehicle operation Hazards	☐ Working Alone
☒ Heavy Equipment Hazards	☐ Ionizing Radiation or Non-Ionizing Radiation
☐ Structural Hazards (i.e. unsafe floors/stairways/roof)	☒ Chemical/Exposure Hazards (See Part B for Details)
☐ Demolition/Renovation	☐ Other:
☒ Presence of Pedestrians or the General Public	

B. CHEMICAL/EXPOSURE HAZARDS (CONTAMINANTS ARE CONTAINED IN SOIL, WATER, GROUNDWATER) (POTENTIAL CONTAMINANTS ON SITE, LIMITED SITE CONTAMINATION HISTORY)

☐ No chemical hazards anticipated	☐ Methane
☐ Hydrogen Sulfide (H2S)	☐ Chemicals Subject to OSHA Hazard Communication (attach Safety Data Sheet for each chemical GZA brings to the site; Alconox, HCL, Isobutylene)
☐ Cyanides, Hydrogen Cyanide (HCN)	☐ Containerized Waste, Chemicals in Piping & Process Equipment
☐ Carbon Monoxide	☐ Emissions from Gasoline-, Diesel-, Propane-fired Engine, Heater, Similar Equipment
☐ Herbicides, Pesticide, Fungicide, Animal Poisons	☐ General Work Site Airborne Dust Hazards
☐ Metals, Metal Compounds:	☒ Volatile Organic Compounds (VOCs),
☐ Corrosives, Acids, Caustics, Strong Irritants	☒ Chlorinated Organic Compounds
☐ Polychlorinated Biphenyls (PCBs)	☒ Fuel Oil, Gasoline, Petroleum Products, Waste Oil
☐ Polycyclic Aromatic Hydrocarbons (PAHs)	☐ Asbestos
☐ Compressed Gases	☐ Oxygen Deficiency, Asphyxiation Hazards
☐ Flammable/Combustible Liquids	☒ Other: Crystalline Silica (Concrete Dust, concrete coring)
☐ Radiation Hazards (i.e. radioactive sealed/open source, x-rays, ultra violet, infrared, radio-frequency, etc.)	

6. SITE-SPECIFIC OVERVIEW OF H&S HAZARDS/MITIGATIONS (NOTE: Based on Hazard Assessment, Section 5)

Describe the major hazards expected to be present at the jobsite, and describe the safety measures to be implemented for worker protection (refer to items checked in Section 5 above). Use brief abstract statements or more detailed narrative as may be appropriate.

ON-SITE HAZARDS:	HAZARD MITIGATIONS:
Task Hazard Analyses	General Outdoor Field Work, 04.4A – Excavation and Trenching (Heavy Equipment) & 04.4B – Manual Excavation and Trenching, 05.05 – AST-UST Removal, Inspection and Sampling, 04.01 – Drilling/MW Installation Observation, 04.02 – Groundwater Sampling, 20.11 – Field Sampling, 20.01 – General Outdoor Field Work
Slips, Trips, Falls	Inspect work area prior to starting work. Mark out or remove any potential hazards. Be aware and inspect area for uneven or sloped terrain, or around test pits. Wear sturdy shoes with ankle support and good tread. Look for potential natural depressions/holes/animal burrows, downed trees/limbs and other obstructions in the area of work and travel. Personnel will be wearing appropriate boots with good tread to prevent slips and falls. Maintain one free hand to break falls. Watch for equipment on ground and slippery surfaces. Keep work area clean, no running, be mindful of changing weather conditions that may change footing conditions. Maintain safe distance from open borings.
Weather-Related Hazards	Assess weather conditions prior to on-site work / examine forecast for anticipated period of work. No outside work is permitted during impeding electrical storms, tornadoes or when rain or icing creates a hazardous work environment. Dress accordingly, take breaks, keep hydrated, keep an eye on the weather and for your fellow coworkers, seek shelter as unacceptable field work conditions are not precise, but may include site specific conditions, general location, extreme weather conditions (e.g., icing, lightening, excessive cold, heat or wind), travel conditions, and other factors. Professional judgment is required, and personal assessment of safety must always be individually assessed. Bring layers of clothing for changing temperatures. Use OSHA heat stress phone app for guidance.
General Public	Be alert for pedestrians or vehicles that may approach or enter the work zone. Use cauton tape and cones to visually identify work zone as necessary and stop work immediately if unauthorized persons enter the work zone.

Motor Vehicle Operation Hazard	Check blind spots before backing up. Use a spotter when maneuvering vehicle in tight locations. Obey speed limits and wear seatbelts. No active hand-held or hands-free cell phone use while driving.
Heavy Equipment (Drilling)	Prior to mobilization to the project site, all underground utilities will be located and properly marked. All personnel working in proximity to heavy equipment will be familiarized with the location and operation of emergency kill switches prior to equipment start-up. A first aid kit and fire extinguisher (10 # class B/C, minimum) will be available at all times. No loose clothing, jewelry or unsecured long hair is permitted near the rig. Keep hands and feet AWAY from all moving parts while drilling is in progress. Persons shall not pass under or over a moving stem or auger. Watch for moving vehicles and equipment. Stay out of equipment radius while drilling is in progress. Maintain visibility and eye contact with operators when walking around trucks. Wear reflective vest to enhance visibility. Stay clear of drill rig (minimum 6 feet) while operating, and do not approach unless equipment has been stopped and eye contact/coordination is made with equipment operator for personnel to approach rig to make observations or collect samples. GZA personnel shall not climb onto rig or approach rig while operating or while drill rods are being attached or removed. GZA staff should verify that the onsite equipment has been routinely inspected. GZA staff should also maintain a safe working distance from the equipment while it is maneuvering around the Site. A fire extinguisher (with up to date inspection sticker indicating at a minimum an annual certification and monthly inspections) should be available on the machine or support truck on site. GZA staff are not authorized to operate the drill rig; however, should be familiar with the location and operation of the emergency shutoff in the event the main operator is unable to operate this control in the event of an emergency. Keep drilling equipment at least 25 feet from all overhead power lines; use spotters to assist operator in to positioning equipment when overhead power lines or other obstructions are near. Personnel are not allowed on a mast while the auger is in operation. When a drill rig is moved from one location to another, drill steel, tools and other equipment shall be secured and the mast placed in a safe position. All borings will be adequately covered and/or barricaded if left unattended for any period of time to prevent injury. Working around heavy equipment / excavators. Awareness for pinch points, rotating equipment, and winch-operated equipment. Maintain safe working distance and never walk underneath overhead projection of the equipment. Always maintain eye contact and communication with the operator. Follow GZA safe drilling and field work procedures. Keep 6 to 10 feet minimum clear distance from drill rig during operation. Be aware of rotating, falling, and mechanical hazards around drill rig. Stay aware of surroundings and wear hard hats, high visibility vests, and steel toe boots. Stay alert for potential overhead hazards (utilities lines, tree limbs) and other overhead objects that may pose hazards or may dislodge and fall during drilling operations or while drill rig is obtaining access to the next boring location. Take care maneuvering the drill rig over vegetated areas, esp after heavy rains or wet snows. Planking may be needed to prevent the drill rig from sinking into softened grounds. See attached Job Hazard Analysis – Task 4.01 Drilling observations
Chemical Hazards	Be alert for hazardous site contaminants (as indicated by odor, visual characteristics, location, and site history). Assess whether procedures and contingencies are in place for characterizing hazards and protecting workers by use of appropriate air monitoring, personal protective clothing and respiratory protection, as needed. Become familiar with hazards associated with hazardous commercial products used in drilling (fuels, silica sand, grout, cement, bentonite, etc.) and construction (fuels, cement, epoxy, paint, sealant etc.). Review Safety Data Sheets (SDSs) for such products. Wear nitrile gloves and safety glasses with side shields when sampling and during oversight of the driller. Wash hands immediately after sampling and before eating.

	Utilize PID during sampling activities to alert GZA personnel to presence of elevated VOC concentrations in breathing zone (refer to Section 7.0).
Elevated Noise Levels	Wear the appropriate hearing protection when working in loud environments (during use of Geoprobe or near loud heavy equipment). Wear appropriate hearing protection as necessary, including ear canal inserts and earmuffs.
Volatile Organic Compounds (VOCs), BTEX	BTEX COMPOUNDS. Exposure to the vapors of benzene, ethyl benzene, toluene and xylenes above their respective permissible exposure limits (PELs), as defined by the Occupational Safety and Health Administration (OSHA), may produce irritation of the mucous membranes of the upper respiratory tract, nose and mouth. Overexposure may also result in the depression of the central nervous system. Symptoms of such exposure include drowsiness, headache, fatigue and drunken-like behavior. Benzene has been determined to be carcinogenic, targeting blood-forming organs and bone marrow. The odor threshold for benzene is higher than the PEL and employees may be overexposed to benzene without sensing its presence, therefore, detector tubes must be utilized to evaluate airborne concentrations. The vapor pressures of these compounds are high enough to generate significant quantities of airborne vapor. On sites where high concentrations of these compounds are present, a potential inhalation hazard to the field team during subsurface investigations can result. However, if the site is open and the anticipated quantities of BTEX contamination are small (i.e., part per million concentrations in the soil or groundwater), overexposure potential will also be small.
Fuel Oil, Gasoline, Petroleum Products, Waste Oil	Petroleum Hydrocarbons (PHCs). Petroleum Hydrocarbons such as fuel oil are generally considered to be of low toxicity. Recommended airborne exposure limits have not been established for these vapors. However, inhalation of low concentrations of the vapor may cause mucous membrane irritation. Inhalation of high concentrations of the vapor may cause pulmonary edema. Repeated or prolonged direct skin contact with the oil may produce skin irritation as a result of defatting. Protective measures, such as the wearing of chemically resistant gloves, to minimize contact are addressed elsewhere in this plan. Because of the relatively low vapor pressures associated with PHCs, an inhalation hazard in the outdoor environment is not likely.
Hazardous Contaminants including Silica	To reduce exposure of respirable crystalline silica, GZA will implement the following safety protocols at the Site: 1) Follow the provisions of Table 1 of the silica standard (https://www.osha.gov/silica/Table1sect1926.1153.pdf); 2) Identify the tasks that involved exposure and methods used to protect workers; 3) Designate a Competent Person to implement the HASP; 4) Retrict housekeeping practices that expose workers to respirable crystalline silica; and 5) Train workers (https://gza-totara.moonami.com/course/view.php?id=153) There may be opportunities for dust generation during the excavation of soils or dumping of soils collected. Soils may contain silica which impacts the respiratory system. Contractor should follow the OSHA construction regulations for silica dust, especially while operating excavation equipment or dumping collected soils. Table 1 of the regulations covers this operation and as long as those controls are in place no air monitoring is required, but other parts of the standard (training, medical surveillance, task-specific controls) may. GZA employees should be aware of visible dust being generated and maintain a safe distance and not breathe in the dust. If respiratory protection is required due to site conditions generating significant dust, GZA employee must follow the OSHA respiratory protection standard and all its required elements before wearing a respirator.
Illness due to viral exposure_	Illness due to SARS-CoV-2 exposure Symptoms include: • Dry cough • Fever above 100°F • Shortness of breath Symptoms typically do not include:

	• Sneezing • Runny nose • Diarrhea Safety Procedures 1. Spend necessary time to think through tasks and develop ways to allow social distancing (staying 6 feet away from others) 2. Limit travel on public transit, when possible, and avoid crowds of more than 10 people. 3. Ask colleagues in personal / work vehicles "Are you feeling well today?" 4. Don't ride in the same vehicle as someone who is displaying symptoms of COVID-19. 5. Bring soap, water, hand sanitizer, disinfectant wipes, and nitrile gloves with you. 6. Wash your hands before entering a vehicle and after exiting the vehicle. 7. Before entering a vehicle, make sure it is clean and sanitized To clean and sanitize a vehicle: 1. Wash your hands before entering and exiting the vehicle 2. Sars-CoV-2 is not likely to be present on hard surfaces if the vehicle has been unoccupied for 3 days or more 3. Don nitrile gloves and safety glasses to clean the vehicle 4. Use disinfectant wipes or soapy rags to wipe all accessible surfaces (don't forget exterior door handles, cell phones, and keys) 5. If available, spray seats, carpets, and interior spaces with disinfectant (Lysol)

7. AIR MONITORING ACTION LEVELS – Make sure air monitoring instruments are in working order, calibrated before use, and 'bump-checked' periodically throughout the day and/or over multiple days of use

Is air monitoring to be performed for this project? Yes ☒ No ☐

ACTION LEVELS FOR OXYGEN DEFICIENCY AND EXPLOSIVE ATMOSPHERIC HAZARDS (Action levels apply to occupied work space in general work area)

☐ Applicable, See Below. ☒ Not Applicable (For UST prior to cleaning)

Parameter	Response Actions for Elevated Airborne Hazards
Oxygen	At 19.5% or below – Exit area, provide adequate ventilation, or proceed to Level B, or discontinue activities Verify presence of adequate oxygen (approx. 12% or more) before taking readings with LEL meter. Note: If oxygen levels are below 12%, LEL meter readings are not valid.
LEL	Less than 10% LEL – Continue working, continue to monitor LEL levels Greater than or Equal to 10% LEL – Discontinue work operations and immediately withdraw from area. Resume work activities ONLY after LEL readings have been reduced to less than 10% through passive dissipation, or through active vapor control measures.

ACTION LEVELS FOR INHALATION OF TOXIC/HAZARDOUS SUBSTANCES (Action levels are for sustained breathing zone concentrations)

☒ Applicable, See Below. ☐ Not Applicable

Air Quality Parameters (Check all that apply)	Remain in Level D or Modified D	Response Actions for Elevated Airborne Hazards
☒ VOCs	0 to 5 ppm	If PID is 5 ppm or greater sustained for 5 minutes: Ventilate, or Discontinue Activities and consult EHS Team

☐ Carbon Monoxide	0 to 35 ppm	At greater than 35 ppm, exit area, provide adequate ventilation, proceed to Level B, or discontinue activities.
☐ Hydrogen Sulfide	0 to 10 ppm	At greater than 10 ppm, exit area, provide adequate ventilation, proceed to Level B, or discontinue activities
☐ Dust	0 to mg/m^3	

SPECIAL INSTRUCTIONS/COMMENTS REGARDING AIR MONITORING (IF APPLICABLE)

8. HEALTH AND SAFETY EQUIPMENT AND CONTROLS

AIR MONITORING INSTRUMENTS

- ☒ PID Type: MiniRae Lamp Energy: 10.6 eV
- ☐ FID Type:
- ☐ Carbon Monoxide Meter
- ☐ Hydrogen Sulfide Meter
- ☐ O_2/LEL Meter (for UST Removal only) – Altair 5 – Betts Provided
- ☐ Particulate (Dust) Meter
- ☒ Calibration Gas Type 100 ppm isobutylene
- ☐ Others:

OTHER H&S EQUIPMENT & GEAR

- ☐ Fire Extinguisher 10#ABC
- ☐ Caution Tape
- ☐ Traffic Cones or Stanchions
- ☐ Warning Signs or Placards
- ☒ Decon Buckets, Brushes, etc.
- ☐ Portable Ground Fault Interrupter (GFI)
- ☐ Lockout/Tagout Equipment
- ☐ Ventilation Equipment
- ☒ Others: First Aid Kit

PERSONAL PROTECTIVE EQUIPMENT

- ☐ Respirator – Type
- ☐ Respirator - Cartridge Type:
- ☒ Hardhat for UST Removal Activities & soil borings
- ☒ Outer Gloves Type: Nitrile
- ☐ Inner Gloves Type:
- ☒ Steel-toed boots/shoes
- ☐ Coveralls – Type
- ☐ Outer Boots – Type
- ☒ Eye Protection with side shields
- ☐ Face Shield
- ☒ Traffic Vest Class/Type: III
- ☐ Personal Flotation Device (PFD)
- ☐ Fire Retardant Clothing
- ☐ EH (Electrical Hazard) Rated Boots, Gloves, etc.
- ☒ Noise/Hearing Protection For UST Removal and soil borings
- ☐ Others:

Discuss/Clarify, as Appropriate:

9. H&S TRAINING/QUALIFICATIONS FOR FIELD PERSONNEL

- ☒ Project-Specific H&S Orientation (Required for All Projects/Staff)
- ☒ OSHA 40-Hour HAZWOPER/8 Hour Refreshers
- ☒ Hazard Communication (for project-specific chemical products)
- ☒ First Aid/CPR (required for HAZWOPER for at least one individual on site)
- ☒ Current Medical Clearance Letter (required for HAZWOPER)
- ☐ OSHA 10-hour Construction Safety Training
- ☐ Fall Protection Training
- ☐ Trenching & Excavation
- ☐ Lockout/Tagout Training
- ☐ Electrical Safety Training
- ☐ Bloodborne Pathogen Training
- ☒ Soil Sampling SOP
- ☐ Drilling Safely SOP
- ☐ Safe Lifting Policy
- ☐ Respirator training, medical clearance, fit test if respirators are required
- ☐ Confined Space Training

Discuss/Clarify, as needed:

10. PERSONNEL AND EQUIPMENT DECONTAMINATION (SECTION ONLY REQUIRED FOR HAZWOPER SITES)	
Describe personnel decontamination procedures for the project site, including "dry decon" (simple removal of PPE)	Preform dry decon regularly and water/alconox/DI equipment decon between each well (for groundwater sampling)

11. PROJECT PERSONNEL - ROLES AND RESPONSIBILITIES

GZA ON-SITE PERSONNEL:

Name(s)	Project Title/Assigned Role	Telephone Numbers
Paul Benya	Site Supervisor	Work: 973-774-3316 Cell: 862-200-4640
Paul Benya	Field Safety Officer	Work: 973-774-3316 Cell: 862-200-4640
Paul Benya	First Aid Personnel	Work: 973-774-3316 Cell: 862-200-4640
To be decided	GZA Project Team Members	Work: Cell:

Site Supervisors and Project Managers (SS/PM): Responsibility for compliance with GZA Health and Safety programs, policies, procedures and applicable laws and regulations is shared by all GZA management and supervisory personnel. This includes the need for effective oversight and supervision of project staff necessary to control the Health and Safety aspects of GZA on-site activities.

Field Safety Officer (FSO): The FSO is responsible for implementation of the Site Specific Health and Safety Plan.

First Aid Personnel: At least one individual designated by GZA who has current training and certification in basic first aid and cardiopulmonary resuscitation (CPR) must be present during on-site activities involving multiple GZA personnel at HAZWOPER sites.

GZA Project Team: Follow instructions relayed by the HASP and GZA manager on-site.

OTHER PROJECT PERSONNEL:

Name	Project Title/Assigned Role	Telephone Numbers
Dave Winslow	Principal-in-Charge	Work: 973-774-3339 Cell: 973-615-8233
Zhan Shu	Project Manager	Work: 973-774-3321 Cell: 201-213-6178
Michael Bastidas	Office Safety Coordinator	Work: 973-774-3313 Cell: 201-602-3895
Richard Ecord	GZA EHS Director	Work: 781-278-3809 Cell: 404-234-2834

Principal-in-Charge: Responsible of overall project oversight, including responsibility for Health and Safety.

Project Manager: Responsible for day-to-day project management, including Health and Safety.

Health and Safety Coordinator: General Health and Safety guidance and assistance.

GZA EHS Director: H &S technical and regulatory guidance, assistance regarding GZA H&S policies and procedures.

12. PLAN ACKNOWLEDGEMENT AND APPROVALS

GZA Project Site Worker Plan Acknowledgement

I have read, understood, and agree to abide by the information set forth in this Safety and Accident Prevention Plan. I will follow guidance in this plan and in the GZA Health and Safety Program Manual. I understand the training and medical monitoring requirements covered by the work outlined in this plan and have met those requirements.

GZA Employee Name	GZA Employee Signature	Date

Subcontractor Site Worker Plan Acknowledgement

GZA has prepared this plan solely for the purpose of protecting the health and safety of GZA employees. Subcontractors, visitors, and others at the site must refer to their organization's health and safety program or site-specific HASP for their protection. Subcontractor employees may use this plan for general informational purposes only. Subcontractor firms are obligated to comply with safety regulations applicable to their work, and understand this plan covers GZA activities only.

Subcontractor Employee Name	Subcontractor Employee Signatures	Date

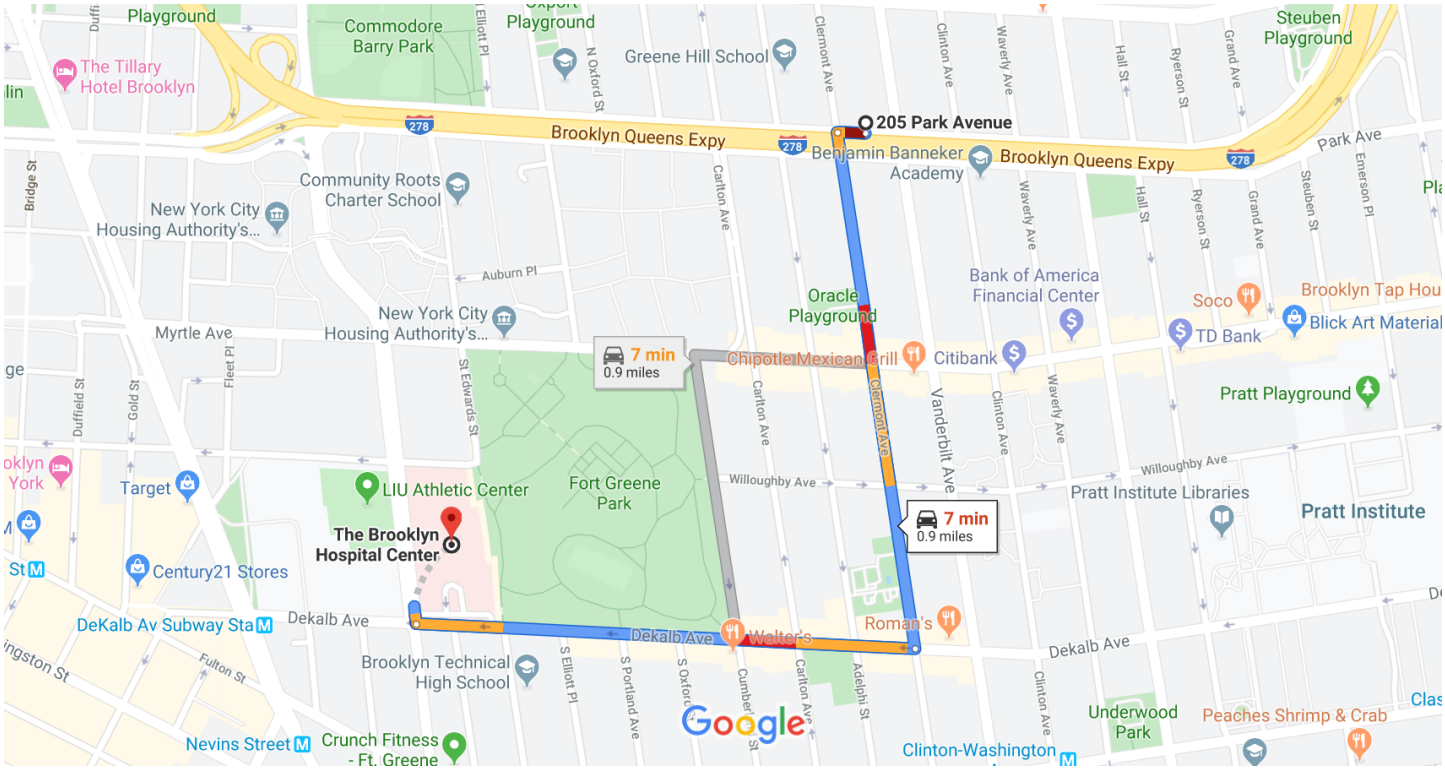
GZA HASP Approval Signatures

The following individuals indicate their acknowledgement and/or approval of the contents of this Site Specific H&S Plan based on their understanding of project work activities, associated hazards and the appropriateness of health and safety measures to be implemented. A signed copy of this document must be present at the project site at all times work is being performed.

GZA Author/Reviewer Role	Signature	Date
Paul Benya **HASP Preparer**		**12/6/2020**
EHS Reviewer		
Dave Winslow **Principal in Charge**		

205 Park Avenue, Brooklyn, NY to The Brooklyn Hospital Center

Drive 0.9 mile, 7 min



Map data ©2019 Google 200 m

205 Park Ave

Brooklyn, NY 11205

1. Head west on Park Ave toward Clermont Ave

131 ft

2. Turn left at the 1st cross street onto Clermont Ave

0.5 mi

3. Turn right onto Dekalb Ave

0.4 mi

4. Use the right lane to turn right onto Ashland Pl

Destination will be on the right

82 ft

The Brooklyn Hospital Center

121 Dekalb Ave, Brooklyn, NY 11201

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Drilling Observations, Monitoring Well Installation Observation and Soil Sampling		
Analysis By: Andrew Whitsitt	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: October 2, 2011 **Revised: June 14, 2012**	**Date: June 14, 2012**	**Date: June 26, 2012**

Task 4.1
DRILLING OBSERVATIONS, MONITORING WELL INSTALLATION OBSERVATIONS, SOIL SAMPLING

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
Review Related THA's – 21.1 – General Outdoor Field Work		
Observation of Deploying of Traffic Protection Equipment by Drilling Contractor (e.g., cones, signs, etc.)	Personal injury due to vehicle traffic, Collisions, injuries	Wear high visibility vest at all times when out of vehicle.
		Park in designated parking locations or select off-road areas that are firm and free of hazards. Directly inspect parking location on foot if necessary.
		Use emergency flashers or other appropriate vehicle warning system as appropriate to local conditions when parking personal or GZA vehicle and/or equipment.
		If parking outside of a designated parking area, demarcate vehicle with traffic cones or equivalent.
		Use emergency flashers or other appropriate vehicle warning system when placing equipment.
		Observe if police detail or other required traffic control system (if necessary) is in place.
		Stay within the confines of the work area and do not venture outside of the demarcated work area into traffic.
		If you observe that contractor may back into structures, vehicles, fences, etc., notify contractor immediately with pre-determined signals. Do not cross the path of the heavy equipment.
		Stand clear of moving Drill Rig.
Observation of Mobilizing Drill Rig To Job Site and positioning at borehole by Drilling Contractor	Struck by drill rig	Before drilling begins, confirm that drill rig has been parked properly and securely by the drilling contractor.
		Wear high visibility vests. Make sure that the driver can see you and is aware of your location at all times.
		Inform the driller if it is observed that the rig is being moved with the mast raised and/or tools and other equipment on the rig are not secured and can fall over and potentially hurt personnel.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Drilling Observations, Monitoring Well Installation Observation and Soil Sampling		
Analysis By: Andrew Whitsitt	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: October 2, 2011 **Revised: June 14, 2012**	**Date: June 14, 2012**	**Date: June 26, 2012**

Task 4.1
DRILLING OBSERVATIONS, MONITORING WELL INSTALLATION OBSERVATIONS, SOIL SAMPLING

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
	Overhead utility	Look overhead to assess if any utilities are present and confirm with driller that they are aware of the overhead utility location and to take appropriate actions to prevent contact with the overhead utilities and to minimize any arc flash hazards. Review GZA's Electrical Safe Work Practices Program 03-3003.
Observation of drilling operations and monitoring well installations	Underground utilities	Confirm that underground utility clearance procedures have been completed in accordance with GZA Policy # 04-0301 *Responsibility for Utility Clearance of Exploration Locations* for clearing utility locations prior
	Moving machinery, rotating parts, cables, ropes, etc.	Do not wear loose fitting clothing.
		All GZA personnel working in proximity to a drill rig will be familiarized with the location and operation of emergency kill switches prior to equipment start-up. Maintain safe distance from rotating auger, drill casing, rods and cathead at all times. Observe operations from a safe distance. Persons shall not pass under or over a moving stem or auger Check that "kill" switches are present and working. Confirm with driller that daily inspection of rig has been performed prior to commencing work and no conditions were noted with the rig that would affect its proper operation.
		Do not touch or operate or assist with any rig operations and maintenance work.
		Make eye contact with operator before approaching equipment.
		Be alert and take proper precautions regarding slippery ground surfaces and similar hazards near rotating auger.
		Do not engage the driller or helper when drill is in operation. Work out prearranged signals to get their attention before approaching them.
		Confirm prior to drilling operations that driller and helper communicate and coordinate their actions and movements.
		GZA personnel are not allowed to be on the drill rig or operate a rig.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Drilling Observations, Monitoring Well Installation Observation and Soil Sampling		
Analysis By: Andrew Whitsitt	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: October 2, 2011 **Revised: June 14, 2012**	**Date: June 14, 2012**	**Date: June 26, 2012**

Task 4.1
DRILLING OBSERVATIONS, MONITORING WELL INSTALLATION OBSERVATIONS, SOIL SAMPLING

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
		Wear steel toed boots, hardhat and side-shielding safety glasses/goggles.
	Falling objects, debris	Stand clear of stacked drill rods. If stack appears unstable inform driller.
	Noise	Wear appropriate hearing protection.
	Roadway/traffic hazards	Be alert at all times; never step outside traffic cones.
		Wear high visibility vests at all times.
		Be familiar with escape routes at each location.
		Follow project Traffic Control Plan. Be alert at all times and never step outside the traffic cones. Use a Police detail when necessary.
	Slips, trips and falls	Maintain clean and sanitary work area free of tripping/slipping hazards.
		All borings, excavations, or partially completed groundwater monitoring wells will be adequately covered and/or barricaded if left unattended for any period of time to prevent injury.
		Store any hand tools used for sampling in their proper storage location when not in use.
		Provide adequate space for each employee to work safely with sound footing.
		Do not perform work if adequate lighting is not available.
		Maintain an exit pathway away from the rig at all times.
	Cuts, bruises, shocks, lacerations, sprains and strains during tool use	When working with a driller, do not assist the drilling crew with their work.
		Use properly maintained tools; do not use damaged tools.
		Wear the proper Personal Protective Equipment based on the task being performed.
		Store and carry tools correctly.
		Use the correct tool for the job.
		Do not use electrical tools with damaged cords or other electrical components.
		Observe proper electrical safety practices. Do not use electrical tools in wet areas.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Drilling Observations, Monitoring Well Installation Observation and Soil Sampling		
Analysis By: Andrew Whitsitt	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: October 2, 2011 **Revised: June 14, 2012**	**Date: June 14, 2012**	**Date: June 26, 2012**

Task 4.1
DRILLING OBSERVATIONS, MONITORING WELL INSTALLATION OBSERVATIONS, SOIL SAMPLING

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
		Coordinate activities with driller. Allow driller to open sampling equipment (i.e., split spoons, Geoprobe sleeves, etc.)
	Fire hazards	Be familiar with emergency procedures and where fire extinguishers are present on site.
		Inform GZA subcontractor if you observe improper storage of used rags and unsafe storage of flammable/combustible liquids brought on site.
		GZA and its subcontractors, suppliers and vendors shall not smoke in the work area in GZA project sites. Smoking can only be in designated smoking areas away from work areas and potential fire hazard locations.
		Confirm with driller that a fire extinguisher present with rig and will be available at all times and that inspection tag is not expired.
		If driller is welding or cutting on site confirm there are no flammables or combustible materials near the vicinity of welding machines or torches (such as debris, fuels, grass/weeds, etc.). Review Site requirements for obtaining “Hot Work Permit”.
		Stand well clear of welding/cutting/burning areas.
		When drilling activities encounter the presence of gas or electric, the drill crew shall immediately curtail drilling activity, shut down the drill rig and contact the Project Manager.
	Exposure to Hazardous Substances/Chemicals	Become familiar with hazards associated with hazardous commercial products used in drilling (fuels, silica sand, grout, cement, bentonite, etc.). Review Safety Data Sheets (SDSs) for such products and participate in daily safety tailgate meetings.
		Do not handle drilling chemicals.
		Wear appropriate personal protective equipment.
		Review hazards of chemicals that may have been used or currently are being used on site.
		Refer to the site specific HASP for chemical hazards and the necessary precautions required for sampling.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Drilling Observations, Monitoring Well Installation Observation and Soil Sampling		
Analysis By: Andrew Whitsitt	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: October 2, 2011 **Revised: June 14, 2012**	**Date: June 14, 2012**	**Date: June 26, 2012**

Task 4.1
DRILLING OBSERVATIONS, MONITORING WELL INSTALLATION OBSERVATIONS, SOIL SAMPLING

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
		Be alert for hazardous site contaminants (as indicated by odor, visual characteristics, location, and site history). Assess whether procedures and contingencies are in place for characterizing hazards and protecting workers by use of appropriate air monitoring, personal protective clothing and respiratory protection, as needed. If contamination is identified at the Site only personnel trained and medically qualified to work on hazardous sites will be permitted to proceed with the work.
Sampling Soil	Exposure to chemicals	Refer to the site specific HASP for chemical hazards and the necessary precautions required for sampling.
		Understand potential hazards associated with handling sample collection preservatives.
		Review and have SDS available for chemicals being brought on site, including that of sample preservatives.
		Wear appropriate PPE identified in the HASP
		Wash hands before eating and drinking. Eating and drinking are prohibited in areas of soil contamination/work area.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Groundwater Sampling		
Analysis By: Andrew Whitsitt	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: October 2, 2011 **Revised: June 15, 2012**	**Date: June 15, 2012**	**Date: June 26, 2012**

Task 4.2
GROUNDWATER SAMPLING

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
Review Related THA's – 21.1 – General Outdoor Field Work		
Deploying Traffic Protection Equipment	Personal injury due to vehicle traffic; Collisions, injuries	GZA drivers shall be properly licensed and abide by driving safety procedures. Inspect vehicle to determine if it is in safe operating condition.
		Park in designated parking locations, or select off-road areas that are firm and without hazards. Directly observe parking location on foot if necessary.
		Use emergency flashers or other appropriate vehicle warning system as appropriate to local conditions.
		Utilize police detail (when necessary) to direct traffic while entering traffic safety zone, if applicable.
Handling Flammable Liquids	Fire Hazards	Use only approved fuel containers for fuel, heavy duty metal cans with stable base and self closing nozzle is recommended.
		Store flammable liquids in an appropriate area when not in use.
		Provide working fire extinguisher with current inspection certificate with the sampling equipment.
		Observe GZA's "no smoking" policy at all work sites.
Mobilizing Equipment	Collision; struck by	Perform a pre-operation check of the vehicle, ensuring service brakes, parking brake, steering, lights, tires, horn, wipers mirrors, and glass are in good condition. Do not drive a vehicle that is not roadworthy.
		All vehicle occupants shall wear seat belts.
		Secure loose materials in the cab or bed of the vehicle.
		Keep the windows and lights clean.
		Do not operate the vehicle if it is in an unsafe condition.
		Abide by driving safety procedures and laws.
Positioning vehicle at monitoring well	Unstable, uneven terrain and ground obstacles	Locate the vehicle on stable ground.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Groundwater Sampling		
Analysis By: Andrew Whitsitt	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: October 2, 2011 **Revised: June 15, 2012**	**Date: June 15, 2012**	**Date: June 26, 2012**

Task 4.2
GROUNDWATER SAMPLING

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
	Backing Collisions	Avoid wet areas/mud when possible.
		Assess the need for blocking/chocking wheels..
		If possible, avoid backing by taking a route that allows you to pull straight through.
		If you must back, do a complete walk around the vehicle to look for objects that could be struck or run over by the vehicle.
		Use a spotter when available to help guide the backing safely.
		Look over shoulders and glance back to make sure fenders are clearing objects. Back out slowly.
Well Sampling	Hazardous material contact	Identify wells with hazardous concentrations of contaminants.
		Sample wells in order from least to most impacted.
		Wear proper gloves specified in the project HASP when handling jars, preservatives could leak during shipment from the laboratory.
	Cuts and bruises from Sample jar	Do not over-tighten glass jars (especially VOAs); they can break, causing a laceration.
	Exposure to Hazardous Substances	Become familiar with the hazards associated with hazardous commercial products used while groundwater sampling (laboratory preservatives, decontamination solutions, etc.). Review Safety Data Sheets (SDS) for such products.
		Wear proper personal protective equipment (PPE) as specified in the Health and Safety Plan (HASP) to avoid direct contact with Site contaminants, calibration solutions, decontamination supplies, and laboratory preservatives.
		Respiratory protection as specified by the HASP must be available and used when necessary.
		Decontamination procedures as specified in the HASP must be followed.
Sampling Equipment Operation	Splashes, electrical shocks, fires, caught by	Perform an equipment observation before use; pumps, flow meters, and water quality meters must be calibrated and in good working condition.
		Use GFCI with all electrical cords.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Groundwater Sampling		
Analysis By: Andrew Whitsitt	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: October 2, 2011 **Revised: June 15, 2012**	**Date: June 15, 2012**	**Date: June 26, 2012**

Task 4.2
GROUNDWATER SAMPLING

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
		All equipment (especially generators) must be properly grounded.
		Completely shut down all equipment prior to conducting maintenance activities, fueling, servicing or repairs. Follow lock-out/tag-out procedures as needed.
	Manual lifting, equipment handling	Use proper lifting techniques when lifting equipment (generators, pumps, air compressors, tubing, etc.) Seek assistance with heavy loads.
		Use work gloves where appropriate to prevent hand injuries.
		Wear steel toed boots.
		When containerizing water, do not try to carry more than you can safely carry. It is better to make multiple trips.
	Noise	Wear appropriate hearing protection during activities that produce noise (running generators, pumps, air compressors, etc.)
	Slips, trips and falls	Maintain a clean and sanitary work area free of tripping/slipping hazards.
		Store hand tools in their proper storage location when not in use.
		Provide adequate space for each employee to work safely with sound footing.
		Provide adequate lighting.
	Tool-related hazards	Do not use electrical tools with damaged cords or other electrical components.
		Observe proper electrical safety practices.
		Properly maintain tools; do not use damaged tools.
		Wear eye protection.
		Store and carry tools correctly.
		Use the correct tool for the job.
		Protect from gouges, hammer blows, cutting tools, etc. Position your hands to prevent injury in case the tool slips while in use.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: AST/UST Removal, Inspection and Sampling		
Analysis By: Andrew Whitsitt and Joseph DiAntonio	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: November 15, 2011 **Revised: June 22, 2012**	**Date: June 22, 2012**	**Date: June 26, 2012**

Task 5.5
AST/UST Removal, Inspection and Sampling

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
Review Related THA's – 4.4A Excavation and Trenching (Heavy Equipment) 21.1 General Outdoor Field Work		
Observation of Excavation Operations and soil sampling	Various Physical hazards	Review THA for Excavation 4.4a Excavation and Trenching (Heavy Equipment).
Draining Tank and Piping of Fluids	Explosions and fires - Flammable and Combustible contents	Make sure tanks or drums are grounded.
		Monitor atmosphere and do not introduce a source of ignition.
Removal of Piping or Dispensers associated with tank	Hazardous Material Contamination or Spillage	Make sure piping has been drained prior to removal. Confirm with subcontractor that spill clean up materials are readily available if needed.
	Storage	Confirm contractor stores piping in approved (lined) containers or roll off boxes.
Testing of Atmosphere	Flammability and Combustibility	Use gas indicator to assess vapor concentrations within tank and excavation. Readings should be collected at bottom, middle and top sections of the tank.
		Do not introduce ignition source
Staging of Tank	Rolling of tank leading to physical injuries and property damage	Confirm with subcontractor that tank is being placed on level surface and chocks are used to properly to stabilize it.
Inspection of AST/UST	Struck by/crushed by	Tank must be located on stable ground and properly chocked and braced before approaching to inspect.
		DO NOT stand within swing radius of the equipment or underneath tank when it is being removed from underground or from its above ground location to observe cracks/holes on the tanks.
		DO NOT enter excavations to inspect USTs.
	Cuts and lacerations	Be aware of sharp edges from saw cut(s) while cleaning the tanks. Use gloves and approach with caution.
	Chemical Hazards	Prepare H&S Plan and review with GZA employees during daily tailgate meeting.
		Have appropriate Safety Data Sheets (SDSs) available for chemicals brought on site.
		Wear appropriate PPE as specified in the Site Health and Safety Plan (HASP).
		Be alert for site contaminants (odors, visual observations).

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: AST/UST Removal, Inspection and Sampling		
Analysis By: Andrew Whitsitt and Joseph DiAntonio	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: November 15, 2011 **Revised: June 22, 2012**	**Date: June 22, 2012**	**Date: June 26, 2012**

Task 5.5
AST/UST Removal, Inspection and Sampling

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
		Implement work practices and monitoring identified in the HASP.
Soil Sampling	Various Physical and chemical hazards	Review THA for Excavation 4.4a Excavation and Trenching (Heavy Equipment). Refer to site specific HASP for work practices and PPE to be used on site.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: Field Sampling

Analysis By: Christie Wagner	**Reviewed By: Jayanti Chatterjee, CIH**	**Approved By: Jayanti Chatterjee, CIH**
Date: November 4, 2011 **Revised: July 12, 2012**	**Date: July 12, 2012**	**Date: July 12, 2012**

Task 20.11
Field Sampling

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
Review Related THA's – 21.1 General Outdoor Field Work		
Pre work task for site visit	Adverse Weather Conditions	Assess weather conditions prior to on-site work and examine forecast for anticipated period of work.
		Dress appropriately for weather conditions (e.g., precipitation, temperature ranges over anticipated duration of field work).
		Use protective ointments such as sunscreen and chap stick, as appropriate to the field conditions.
		Be aware of the anticipated weather conditions prior to mobilization to the site. Unacceptable field work conditions are not precise, but may include site specific conditions, general location, extreme weather conditions (e.g., icing, lightening, excessive cold or wind), travel conditions, and other factors. Professional judgment is required, and personal assessment of safety must always be individually assessed.
Conduct visual inspection of site	Dangerous Terrain	Be aware of the site terrain, watch for holes and rocks that can be tripping hazards
		Learn to identify and watch for plants such as thorn bushes and poision ivy that can either scratch you or give you a rash.
Collecting sample	Muscle strain from lifting heavy objects	Use proper lifting techniques. Use appropriate mechanical assistance and tools when possible. Wear work gloves and steel toed boots.
	Exposure to unknown sample	Be sure to treat effluent samples as unknowns and wear the proper PPE.
		If there are any unusual odors/fumes coming from a sample, especially those that cause reactions in the eyes or nose, leave the area and inform a supervisor immediately.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: General Outdoor Field Work		
Analysis By: Anthony Zemba, CHMM	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: June 25, 2012	**Date: June 25, 2012**	**Date: July 12, 2012**

Task 21.1
General Outdoor Field Work

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
Pre-work preparation	Overlooking of potential hazards	Become familiar with project area and job site by reviewing available on-line mapping (USGS Topographic, NWI Wetland, NRCS Soil, etc.; and aerial photographs before visiting site. Understand related hazards through review of this and other Task Hazard Analyses and participate in daily safety tailgate meetings (where applicable).
		Communicate Task Hazard Analysis and Lessons Learned information to operator(s) prior to initiating work and throughout the project as needed.
Driving to site	Vehicle accidents/collisions/injuries	Perform pre-operation check of vehicle, verifying service brakes, parking brake, steering, lights, tires, horn, wipers mirrors and glass are in good condition. verify that the rig is roadworthy.
		Wear seat belts always when driving even on site.
		Secure loose materials in cab or bed of vehicle.
		Keep windshields, windows and lights cleans.
		Abide by safe driving procedures.
	Backing collisions	If possible avoid backing by using a route that allows you to pull through.
		If backing up from a parked area do a quality 360 walker.
Working within transportation corridors or active construction sites	Collisions injuries	Wear high visibility safety vest on site when out of personal or GZA vehicle.
		Park vehicle in designated parking locations, or select off-road area that is firm, and without hazards. Directly inspect parking location on foot if necessary.
		Use emergency flashers or other appropriate vehicle warning system as appropriate to local conditions when parking vehicle.
		Use emergency flashers or other appropriate vehicle warning system when parking outside of standard parking spaces, or to stop in right-of-
		Be alert at all times; never step outside traffic cones.

Job: General Outdoor Field Work		
Analysis By: Anthony Zemba, CHMM	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: June 25, 2012	**Date: June 25, 2012**	**Date: July 12, 2012**

Task 21.1
General Outdoor Field Work

HAZARD CONTROLS		
GZA Job Tasks	**Potential Hazards**	**Controls**
		Stand clear of moving heavy equipment and away from any overhead utility lines until equipment is safely in position and parked properly and securely by the contractor.
		Do not wear headphones or earbuds, or listen to music or talk on the phone, which may distract from work hazards.
	Crossing Automobile traffic lanes	Wear high visibility safety vests at all times when out of vehicle and working within or adjacent to the roadway.
	Crossing Airport Movement Areas (e.g., Runways, taxiways, approaches)	Learn, know, and conform to project site Airport's, Airfield's, or Airbase's protocol for crossing movement areas (whether on foot or in vehicle).
		Work within airport movement areas or safety zones must be coordinated with the Air Traffic Control Tower.
		Vehicles to have blinking or flashing lights or beacons; pedestrians to wear high visibility safety vests.
		Using protocol, maintain communication with airport security and air traffic controllers.
	Crossing Railways	Work within active railroad ROWs requires railroad safety training. No work can be done within the railroad traffic envelope without the permission of a railroad flagman.
		No equipment or vehicles can cross without the permission of a railroad flagman.
		Expect any train on any track coming from either direction at any time.
Working in Natural or Remote Areas	Slips, trips, fall	Be aware of loose ground materials such as talus, unconsolidated rock, soil, sediment, ice and other media that could cause slips, trips or falls.
		Be careful when walking in heavily vegetated areas. Mind tangles of vines, thorny branches, and slippery logs and rock surfaces. Dense vegetation and especially entangled vines present trip hazards, or can mask voids, sharp objects, or other hazards beneath.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: General Outdoor Field Work		
Analysis By: Anthony Zemba, CHMM	**Reviewed By: Guy Dalton**	**Approved By: Jayanti Chatterjee , CIH**
Date: June 25, 2012	**Date: June 25, 2012**	**Date: July 12, 2012**

Task 21.1
General Outdoor Field Work

HAZARD CONTROLS		
GZA Job Tasks	**Potential Hazards**	**Controls**
		Be vigilant for signs of cracking, shifting, fracturing, and evidence of past movement.
		Use wood mats or other stabilizing materials for equipment if soft ground conditions are present.
		Use walking stick, auger, or ski poles to steady yourself when traversing loose material or slopes.

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Task 21.1
General Outdoor Field Work

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
		Wear proper footwear for conditions.
		Store tools in their proper storage location when not in use.
		Provide adequate lighting when necessary.
	Falls into excavations/ voids	Stand away from edges of excavations and voids. Do not attempt access without proper equipment / training. Remember that some excavations or voids may constitute a confined space and may present structural stability issues.
	Cave-ins and engulfment	DO NOT enter caves, sinkholes, excavations, and other voids or concavities that are not sloped or shored properly and have not been evaluated by a competent person to be safe.
		Stand away from edges of excavations, cliffs, dug wells, and other voids.
		Watch for cracks/fissures in the ground surface in the immediate vicinity of a pit or void, which indicate imminent sidewall failure/cave-in.
		Assess if confined space entry procedures need to be implemented.
		Before entering void (if required to do so and with proper training) be aware of any hazards at the surface (boulders, equipment) which may fall into the void.
Working among hazardous biota	Plant toxins Incidental contact	Know the appearance of poison ivy and poison sumac in all seasons, and if sensitive to these toxins, carry and use special cleaning soaps/solutions when thought to be exposed. Stock first aid kit with poison ivy/sumac cleaning soaps/solutions.
	Ticks	Ticks carry risk of Lyme's and other Diseases. Tick season is basically any field day above 40 degrees F.
		Tuck pants into long socks.
		The application of DEET (or permethrin pre-treatment) to clothing in season to control exposure to ticks is recommended.
		Check clothing for ticks frequently.
		Check whole body immediately upon returning from field and shower.

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Task 21.1
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HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
	Mosquitoes	Be aware of intermittent seasonal reports of mosquito borne diseases, such as West Nile disease and Eastern Equine Encephalitis (EEE), and their locations relative to your field site. Use of DEET or other mosquito repellant is recommended.
	Stinging bees and wasps	Be aware of potential cavity, suspended or ground nesting bee/wasp/hornet nests. Avoid undue disturbance or approach with appropriate safety clothing, protection and netting.
		Take appropriate precautions if allergic to bees. Carry at least two epi-pens in first aid kit as well as anti-histamines (oral and inhalers).
		Avoid areas of heavy bee activity if allergic. Avoid perfumed soaps, shampoos, deodorants, colognes, etc. that may attract bees.
	Poisonous Snakes	Be aware of terrain likelihood of harboring poisonous snakes in your work zone. Avoid reaching or stepping into hidden areas (such as into wood pile, rock pile, debris pile, stone wall, etc.) without pre-inspection.
		Coordinate with local hospitals to verify they have proper anti-venom in stock.
		Learn first aid procedures in case of poisonous snake bite.
		Devise an action plan and include in the site-specific HASP.
	Wild Animals	Do NOT handle wildlife unless properly trained to do so.
		Beware of any wild animal that shows no sign of wariness of humans.
		Do NOT attempt to feed wild animals or to help apparently injured wild animals.
		Be aware of domestic animals that may also pose a threat such as dogs off leash, bulls out to pasture, etc.

GZA GEOENVIRONMENTAL, INC.
JOB HAZARD ANALYSIS WORKSHEET

Job: General Outdoor Field Work		
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Task 21.1
General Outdoor Field Work

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
Working in Adverse Weather Conditions	Heat / cold stress and other weather related hazards	Assess weather conditions prior to on-site work and examine forecast for anticipated period of work.
		Dress appropriately for weather conditions (e.g., precipitation, temperature ranges over anticipated duration of field work). Include clothing and the presence / absence of shade when calculating a heat index.
		Schedule work day to avoid working during hottest or coldest parts of the day, to the extent practicable.
		Keep exposed skin covered in extremely cold weather.
		Recognize signs of frostbite; use warming packs and layer clothing to maintain warmth.
		Use a wicking layer of clothing against your body to keep moisture away from skin.
		Wool clothing will continue to keep you warm after it becomes wet; cotton will not.
		Use protective ointments such as sunscreen and chap stick, as appropriate to the field conditions.
		Stay hydrated in hot weather; drink fluids regularly throughout the day, even if not thirsty.
		Recognize signs of heat stress; take frequent breaks in shade when working in direct sunlight for prolonged periods.
		Be familiar with Heat index chart - add 20 degrees to chart if fully clothed and if working in direct sunlight.
		NOTE: Unacceptable field work conditions are not precise, but may include site specific conditions, general location, extreme weather conditions (e.g., icing, lightning, excessive cold or wind), travel conditions, and other factors. Professional judgment is required, and personal assessment of safety must always be individually assessed.
	Working on Ice	Assess relative load bearing capacity of ice on lakes, ponds and other waterways. If unsure do not venture onto the ice.

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Task 21.1
General Outdoor Field Work

HAZARD CONTROLS

GZA Job Tasks	Potential Hazards	Controls
		Wear proper footwear modified for traction on ice.
	Electrical storms	If lightning is observed during drilling activities, work shall be suspended immediately and employees shall find suitable shelter (building or vehicle at minimum). Work will commence no sooner than 30 minutes after the last indications of lightning have been observed
		Seek shelter inside a walled building or your vehicle.
		Open picnic pavilions and under trees are not adequate shelters.
		Assess vulnerability to lightning strikes as soon as thunder is heard on the horizon. Open areas and higher elevations are more susceptible to strikes.
		Tall objects such as metal towers and flag poles may attract lightning.
		Consult internet weather radar tracking devices to learn of impending storm patterns proximal to your work area.
	High Winds	Avoid working at high elevations, elevated platforms, and other exposed areas during high wind conditions.
		Assess work area for equipment that may be blown down, over, or carried aloft by high winds.
Working in areas without sanitary facilities	Hygiene related hazards	Provide hand washing kits (e.g., baby wipes, hand sanitizers, paper towels, bottled water, etc.) to be used prior to eating and drinking.
		Have garbage bags handy to collect trash.
Working in remote areas	Emergency Conditions	Be familiar with onsite emergency procedures and route to nearest hospital.
		Have a first aid kit available; know its contents and how to use them.
		Carry a cell phone during all field work for emergency purposes, and confirm the nearest location of cell phone signal on site prior to start of worksite.
	Disorientation	Plan your route and anticipated progress prior to field work.

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Task 21.1
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HAZARD CONTROLS		
GZA Job Tasks	**Potential Hazards**	**Controls**
		Have multiple navigation aids (e.g., USGS Map, compass, GPS, etc.) and know how to use them before entering field. Remember to have charged batteries and battery back-ups for electronic devices.
		Share your progress plan with office staff prior to entering the field.
		Check in with office personnel periodically to update progress.
		Review and comply with GZA's Working Alone Policy 03-1009 in advance of working alone on a project site.
	Hunting	Be familiar with the various game hunting seasons. Follow rules and guidelines for remaining visible to hunters.
		Try to plan work around active hunting seasons or daily peak hunting hours as warranted.

Appendix F Community Air Monitoring Program (CAMP)

Proactive by Design

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

GZA GeoEnvironmental of NY
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10th Floor
New York, NY 10001
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Appendix F
New York State Department of Health
Generic Community Air Monitoring Plan
Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. A periodic monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

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

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

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

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

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

Particulate Monitoring, Response Levels, and Actions

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

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

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 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/m3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

Appendix G Qualification

David M. Winslow, Ph.D., P.G.

Principal

Summary of Experience

Dr. Winslow is a geologist with professional experience in bedrock, soil and groundwater investigation and remedial design. He leads GZA's Green Remediation Initiative and has presented papers on the topic at national symposiums. Dr. Winslow has also conducted, managed and implemented QA/QC practices at hundreds of Phase I and Phase II Environmental Site Assessments/Investigations. He has extensive experience in the management of on-call and term contracts for public agencies. In addition, Dr. Winslow has experience managing environmental compliance and permitting tasks associated with building and infrastructure design and construction projects, including hazardous material surveys, spill prevention and spill response. As District Office Manager of GZA's Northern New Jersey office since 2011, Dr. Winslow is responsible for the office's profit and loss, staff management, client development, and technical direction.

Education

Ph.D., 1995, Geological Sciences, Lehigh University
M.S., 1991, Geological Sciences, Virginia Polytechnic Institute & State University
B.S., 1989, Geology, State University of New York

Licenses & Registrations

Professional Geologist,
New York, #136
Professional Geologist, New Hampshire, #677
NJ DHSS - Indoor Environmental Consultant/IEHA, #392

Areas of Specialization

- Environmental Site Investigation
- Site Remediation Design
- Site Remediation
- Hydrogeologic Testing
- Hazardous Materials Surveys

Relevant Project Experience

PUBLIC PROJECTS

Principal-in-Charge, North Jersey District Water Supply Commission, Wanaque, New Jersey. GZA is providing LSRP, wetlands, and permitting services at the NJDWSC Shooting Range site in the protected New Jersey Highlands. In use as a shooting range since 1966, there has been no recovery of projectiles from the site. GZA is conducting a full site characterization to determine the extent of the contamination, detected previously by other consultants, at and adjacent to the Range, including sampling and analysis of metals in the soil, groundwater, surface water and sediments at the Range and the adjacent site. To date GZA has performed a Preliminary Assessment, initial Receptor Evaluation, field sampling and sieve analysis, permitting, surface water and sediment sampling, and groundwater investigation. GZA will also develop a bid specification package for the remediation of the site and adjacent areas and monitor remediation through final closure of the site with the New Jersey Department of Environmental Protection (NJDEP) under the LSRP program.

Principal-in-Charge, NJSDA, Demarest School Flood Vulnerability Study and Environmental Site Closure, Hoboken, New Jersey. Conducted feasibility study prior to New Jersey Schools Development Authority's commitment to renovate existing educational spaces at the school; particular focus on FEMA floodplain designations and the impact on proposed site development. GZA also prepared an Environmental Screening Report and Preliminary Assessment.

Principal-in-Charge, NJSDA, Orange High School Addition and Renovation, Orange, New Jersey. As subcontractor to architect conducting interior and exterior renovations of existing school, construction of 50,000 gross square foot addition, and pedestrian bridge, GZA provided both environmental and geotechnical engineering services. Environmental services included pre-design Site Investigation, hazardous materials services, Environmental Screening Report, and an Executive Order 215 Report. GZA expedited project and saved costs by coordinating drilling required for geotechnical and environmental tasks. Subsequently, GZA was hired directly by the NJSDA to provide LSRP services and issue RAOs for four AOCs.

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Principal

Principal-in-Charge, Bergen Community College, Paramus, New Jersey. Overseeing task-order contract in which GZA is providing environmental health and safety compliance services including an audit; employee training; stormwater compliance; chemical compliance; and radon sampling for a children's day-care center.

Principal-in-Charge, PANYNJ On-Call Asbestos Material and Lead Paint Consulting Services Contract, various locations in New York and New Jersey. GZA is responsible for numerous, on-going projects involving investigation and remediation at operating ports, airports, and river crossings in the NY metropolitan area, addressing lead and asbestos issues.

Principal-in-Charge, PANYNJ On-Call Environmental Engineering Contract, various locations in New York and New Jersey. Designed and managed site assessments, site investigations and remedial design/implementation at PANYNJ facilities in New York and New Jersey such as a Phase I ESA on a 40 acre portion of Port Elizabeth, UST removals at JFK Airport and Newark Airport, and remedial investigations and remedial design specifications at LaGuardia Airport.

Principal-in-Charge, General Service Administration (GSA)/Peter W. Rodino Federal Building Modernization, Newark, New Jersey. Responsible for GZA team providing asbestos consulting services for $146 million modernization of largest federal building in New Jersey. Scope of work includes asbestos abatement design, including preparation of drawings and specifications; inspection services, and determining worker exposure to potential airborne asbestos and lead contamination. GZA also prepared a Building Engineering Report to evaluate the feasibility of re-using pumped groundwater, in an effort to increase the sustainability of the complex.

Consultant Reviewer, Township of Teaneck, NJ/Votee Park, Teaneck, New Jersey. Investigation of contaminated public park. Initially involved preparation of a Preliminary Assessment as prerequisite for NJ DEP Green Acres program funding for the installation of an Astroturf soccer field. Team then conducted Site Investigation per NJDEP Historic Fill Guidance Document.

Principal-in-Charge, NJDEP Sandy-Blue Acres Program, Various Locations, New Jersey. Responsible for team performing pre-demolition environmental testing services (for asbestos-containing materials, lead-based paint, universal wastes, and PCBs) at single-family private homes damaged by Superstorm Sandy in 2012, acquired by the state through FEMA/NJOEM grant programs, and slated for demolition. The rapidly-paced project involves approximately 300-500 homes throughout New Jersey.

Consultant Reviewer, Lead Risk Assessment Services, New York City Economic Development Corporation (NYCEDC) Build it Back Program, various locations, New York City. Lend expertise, as needed, and review work of team conducting Lead Risk Assessments, analyzing field data (including XRF, dust wipe, and soil data) and preparing reports as part of pre-construction services to support New York City's Build it Back (BiB) Program. The purpose of the BiB Program is to assist homeowners, landlords and tenants in the five boroughs whose primary residence was damaged by Superstorm Sandy in 2012. Completed over 400 reports on an accelerated schedule; work completed to the standards of multiple grant funding sources.

Senior Project Manager, New York City Department of Housing Preservation and Development, NYSDEC Brownfield Program, Bronx, New York. Managed the remedial investigations on 11 brownfield sites undergoing redevelopment as affordable housing, known as Melrose Commons. The remedial investigations consisted of geophysical surveys, test pit excavations, soil gas surveys, soil and groundwater sampling, and monitoring well installation and sampling. Eleven remedial investigation reports/qualitative risk assessments were completed at these properties in a three month period. This data was used to produce remedial alternative analysis for each of the 11 sites.

Principal-in-Charge, New York City School Construction Authority (NYC SCA) IEH Hazardous Materials Consulting Services Contract, New York, New York. Serves as the Principal-in-Charge and Program Manager for the NYCSCA IEH Hazardous Materials Consulting Contract. Under this Contract, Dr. Winslow is responsible for client management, technical quality and financial success of work related to site assessments, site investigations and remedial design/implementation at existing and proposed New York City Schools throughout the five boroughs.

Principal-in-Charge, DASNY Environmental Contract, New York, New York. Oversaw environmental investigation, remedial design and remediation oversight projects at construction projects managed by the Dormitory Authority of the State of New York

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Principal

(DASNY) at New York City hospitals and educational facilities, including: a No. 6 fuel oil release investigation and remediation at Brooklyn College; UST upgrades and leak detection installation at Kingsborough Community College; site investigations, remedial design and remediation at Gouverneur Hospital; storm water sewer installation at Bronx Community College; and contaminated soil and dewatering management at Harlem Hospital. Responsible for coordination with DASNY Project Managers and overall quality assurance on DASNY projects.

Senior Project Manager, NYCDDC, Corridor Investigations, Five Boroughs. As part of the Environmental Term Contract with the New York City Department of Design and Construction (NYCDDC), designed and implemented subsurface investigations at areas targeted for infrastructure (storm water and sanitary sewers) improvement and installation. Designed and managed Corridor Assessments and Investigation to identify potential environmentally impacted soil and groundwater as part of the design-phase of the infrastructure project. The results of the investigations were incorporated into the design bid specifications. Helped develop the NYCDDC's approach toward Corridor Investigations within the City of New York as well as the NYCDDC's standard contaminated materials handling, transportation and disposal specification package. Dr. Winslow managed more than 20 Corridor Investigations on behalf of the NYCDDC.

Principal-in-Charge, Fort Washington Park EIS (with Stantec), New York, New York. As part of the NYC Environmental Quality Review (CEQR) Act, oversaw the hazardous materials assessment portion of the Environmental Impact Assessment for the 160-acre Fort Washington Park. This NYC Department of Parks and Recreation parkland is located adjacent to the east bank of the Hudson River on the far Upper West Side of Manhattan from 135th Street in the south to Spuyten Duyvil in the north. Evaluated the potential for contaminated materials in the soil, groundwater or building materials to be disturbed during reconstruction and excavation activities. The preliminary contaminated materials assessment identified 73 potential sources of contamination and recommended additional investigations at 14 of these areas. Designed and oversaw the subsurface investigations to assess the potential sources of contamination in areas associated with proposed construction. The contamination was found to be consistent with urban fill; a combination of existing vegetative caps and proposed impervious caps were recommended as the remedial strategy.

Principal-in-Charge, Soundview Park (with MKW Architects), Bronx, New York. Responsible for the subsurface investigation of the areas of park that would be impacted by a proposed bicycle and pedestrian greenway path, connecting inland areas to the Greenway Path Project along the Bronx River's edge. Previous environmental assessments and investigations within Soundview Park, which is built on a former landfill, indicated the presence of contaminated soils and buried wastes. Dr. Winslow designed and oversaw the investigation of shallow soils that would be impacted by the project, evaluating composite soils samples for assessment of health and safety concerns for workers, the community and for disposal purposes during construction. Discreet interval shallow soil samples were collected to evaluate impacts to public health associated with soils to remain in place. As part of the investigation, the suitability of the existing vegetative cover was evaluated as a potential soil cap. Soils contamination was found to be consistent with urban fill and construction and demolition material. Recommendations were provided concerning handling, management, disposal, and capping of this material during construction.

Principal-in-Charge, NYCSCA- PS-312 (with Leon d DeMatteis Construction Corp.), Queens, New York. Managed construction support services related to soil management and community air monitoring associated with the construction of a New York City school complex and associated utility corridors on a high-profile NYSDEC Brownfield Site. The site had a long industrial history, was contaminated with petroleum products and historic fill, and the redevelopment was being closely scrutinized by the community and NYSDEC. GZA prepared Excavated Material Disposal Plans, reviewed potential disposal facilities, conducted waste characterization soil sampling, prepared a Community Air Monitoring Plan, and conducted community air monitoring using three stations that continuously monitored volatile organic compounds and particulates.

Principal-in-Charge, NYCSCA- Metropolitan High School (with Leon d DeMatteis Construction Corp.), New York, New York. Managed construction support services related to soil management and community air monitoring associated with the construction of a New York City school complex and associated utility corridors. The site was a former Inactive Hazardous Waste Site contaminated with chlorinated solvents and historic fill. GZA prepared Excavated Material Disposal Plans, reviewed potential

David M. Winslow, Ph.D., P.G.
Principal

disposal facilities, conducted waste characterization soil sampling, prepared a Community Air Monitoring Plan, and conducted community air monitoring using three stations that continuously monitored volatile organic compounds and particulates.

Senior Project Manager, NYCDEP- Catskill Delaware Ultra Violet Light Disinfection Facility Site Preparation Contract (Granite Halmar). As part of one of the largest Water Treatment construction projects in the country, Dr. Winslow managed the environmental and compliance portions of the project for the contractor. The projected involved the excavation of a shaft to a depth of 90 feet below ground surface in order to access the Catskill Aqueduct. GZA's services included preparation and implementation of an In-Situ Soil Sampling and Analysis Plan, preparation of an Excavation, Transportation and Disposal Plan, preparation of a Storm Water Pollution Prevention Plan and Erosion Control Plan, and preparation of a Construction Waste Management Plan.

Senior Project Manager, The General Consulate of the People's Republic of China, New York, New York. Performed a review of past investigations and remediation conducted by the NYSDEC in relation to a No. 6 Fuel Oil Release at the site of the Chinese Consulate; determined that previous remedial efforts had reached a point of diminishing returns. Designed an investigation to determine if any additional source of product remained beneath the slab of the building; based on results, prepared a Site Investigation Report and Exposure Assessment for submittal to the NYSDEC. The report recommended that all remedial efforts be suspended and the site be monitored for one year to assess product rebound. If product levels remained similar, GZA would recommend no further action. The NYSDEC accepted the proposal.

Senior Project Manager, United States Postal Service, Farley Building, New York, New York. Assisted in a hazardous materials survey and soil characterization project associated with the proposed redevelopment of the Farley Building as the new Pennsylvania Station. The survey consisted of multiple reconnaissance of the portions of Amtrak located below the Farley Building which would be impacted by proposed renovations. The survey identified PCB bearing equipment, mercury bearing equipment, asbestos containing materials, lead-based paint, miscellaneous chemicals and petroleum products, as well as non-hazardous-materials-contaminated soils. The information was utilized to prepare demolition specifications and a soil management plan.

Project Geologist, NYSDEC, Region I and II, various locations throughout New York State. Supervised construction and operation of several groundwater remediation systems at petroleum-contaminated gasoline service stations. These remediation systems included technologies such as pump and treat, air sparging, vapor extraction, vacuum enhanced recovery, and bioremediation using the injection of proprietary bacteria and nutrient solutions. Conducted and assessed remedial selection investigations including slug tests, pump tests, sparge tests, vapor extraction tests and enhanced fluid recovery tests.

BROWNFIELDS EXPERIENCE

Principal-in-Charge, JPMorgan Chase, Brownfields Redevelopment, Orangeburg, New York. Principal-in-charge (PIC) for $3M+ investigation/remediation oversight project at a 90+ year old State hospital campus slated for redevelopment as a database center. The 61-acre Site consists of 32 abandoned and derelict buildings, walkways, roads and significantly overgrown landscape areas. Initial project work included preparation of a New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) application and design and implementation of a fast-track, comprehensive remedial investigation. Upon completion of RI, GZA prepared an Interim Remedial Measures (IRM) Workplan to allow Site remediation/ development to begin prior to development of a site-wide remedial action. A site-wide Remedial Action Workplan (RAWP) was then developed and is currently in the NYSDEC review/public comment period. GZA is currently performing IRM remediation oversight, clearing sources for soil import and facilities for soil disposal, and perimeter air monitoring at the Site. Daily and monthly field reports and air monitoring reports submitted to NYSDEC. Upon approval of the site-wide RAWP, GZA will continue these tasks during the site-wide remedial action. GZA's PIC, Project Manager and field staff participate in frequent communications with the NYSDEC field inspector and the NYSDEC project manager

Principal-in-Charge, Former Nuhart Plastics Site, New York State Superfund Site, Brooklyn, New York. GZA was retained to conduct a feasibility study and remedial planning for this former plasticizer facility with on-site and off-site pollutant concerns.

David M. Winslow, Ph.D., P.G.

Principal

Initial site investigations were conducted by others. Project is a high-profile New York State Superfund Site and requires regulatory compliance with NYSDEC, NYCOER, as well as close coordination with local government bodies.

Principal-in-Charge, Former Cascade Laundry, Brownfield Redevelopment, Brooklyn, New York. Responsible for environmental and construction management services required to successfully navigate seven-building redevelopment project through the New York City Office of Environmental Remediation's (NYCOER's) E-Designation and Voluntary Cleanup Programs, as well as the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP). Project included site investigation, design, remediation, and construction.

Principal-in-Charge, Former BH Aircraft Site, Brownfield Redevelopment, Farmingdale, New York. Prepared NYSDEC Brownfield Cleanup Application (BCA), conducted remedial investigation for chlorinated solvents and metals in soil and groundwater, conducted soil gas and soil vapor investigations, closed out sanitary and industrial leaching pools; prepared remedial investigation and remedial action work plan. Constructed soil vapor extraction system. Prepared FER and SMP.

Principal-in-Charge, National Resources Brownfield Development, Edgewater, New Jersey. Provided environmental consulting services during the purchase and redevelopment of a brownfield site contaminated with coal tar and arsenic. The site was the former location of Unilever, Inc.'s research and development facility and had housed industrial operations since 1910. It was found to be contaminated with tar, deposited on site by an adjacent roofing tar manufacturer. Designed and implemented a Phase I ESA, prepared a site conceptual model, and developed a remedial cost estimate in order to secure cost cap insurance and financing. Following the real estate transaction, GZA completed remediation of the site under NJ's Industrial Site Recovery Act (ISRA). Prepared and submitted a Remedial Investigation and Interim Remedial Measures Plan for review by the NJDEP.

The site was found to be impacted by coal tar derived roofing tar and fill material containing significantly elevated concentrations of arsenic. The main chemicals of concern were benzene and arsenic. Arsenic in soils was detected at concentrations as great as 30,000 ppm and 20,000 ppb in groundwater.

GZA negotiated site-specific cleanup standards for arsenic and for pitch material. Pitch material remediation was limited to soft fractions of pitch that were impacting groundwater. The arsenic standard of 600 ppm was derived imperially by comparing soil concentrations to groundwater. The approved remedial strategy consisted of institutional and engineered controls to limit exposure to contaminants, excavation and off-site removal of arsenic-impacted soils greater than 600 ppm, in-situ solidification and stabilization of pitch impacting groundwater, installation of a groundwater barrier wall to protect the Hudson River, and stabilization of a rip rap embankment to prevent pitch accumulation on the shore line.

Principal-in-Charge, Bay Park Brownfield Redevelopment, Coney Island, New York. Providing environmental services during rehabilitation and expansion of 1970s-era mixed use complex, which covers an area equivalent to three city blocks. GZA facilitated the Brownfield Cleanup Program (BCP) applications for two adjacent parcels within the complex: the first for an existing retail space formerly occupied by a dry cleaner; the second application is for an adjacent "historic" dry cleaner lot that had been razed as part of urban renewal in the 1960s. Previous site investigations had documented the presence of tetrachlorethene (PCE) in soil gas; GZA's Remedial Investigation Work Plan (RIWP) outlined work required to delineate the vertical and horizontal extent of the impacted soils, soil vapor and groundwater at both BCP sites. A Remedial Action Work Plan was developed to address contaminated media. A subslab depressurization system was designed to protect residential and retail tenants, in conjunction with source area treatments.

Senior Project Manager, City of Schenectady, Brownfield Pilot Assessment Program, Schenectady, New York. Dr. Winslow prepared a proposal to perform Brownfield Assessment Services for the City of Schenectady. The work was awarded in May 2000. The services were as follows: create a forum for the expanded and interactive community involvement in the Brownfield initiative; review existing planning information, community needs, and private interests for the site; review ownership and site use histories to identify potential environmental concerns; secure all necessary permits and file appropriate applications; determine all sources of alternative funding and apply for grants; and conduct environmental investigations and create remedial action plans.

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Senior Project Manager, New York City Department Housing Preservation and Development, NYSDEC Brownfield Program, New York, New York. Dr. Winslow managed the remedial investigations on eleven brownfield sites undergoing redevelopment as affordable housing. The remedial investigations consisted of geophysical surveys, test pit excavations, soil gas surveys, soil and groundwater sampling, and monitoring well installation and sampling. Eleven remedial investigation reports/qualitative risk assessments were completed at these properties in a three month period. This data was used to produce remedial alternative analysis for each of the eleven sites.

Principal-in-Charge, Silver Star Mercedes Brownfield Redevelopment, LIC, New York. Member of design team for the redevelopment of a former automobile services station/car dealership. Six-story building will house a Mercedes dealership, parking and affordable housing. Dr. Winslow consulted with the owner and design team regarding the (E) Designation and the feasibility of enrolling the Site in either the NYSDEC or the NYCOER Brownfield Program. Based upon the results of the Site Investigation the site was enrolled in the NYCOER Brownfield Program. A Remedial Action Plan was submitted to the NYCOER to remove impacted soils and install a vapor barrier liner.

Senior Project Manager, Meridian Development Partners, LLC, Former Ideal Forging, Southington, Connecticut. Designed and managed the investigation, conceptual remedial approach, and remedial cost estimate for a former forging plant, adjacent to a municipal drinking water well, to be redeveloped as a mixed-use residential and retail complex. The site's soil and groundwater were impacted by fuel oil and cutting oil releases. In addition, a portion of the site was located within the floodplain and a large retention basin was required in order to develop the site. Due to the large amount of earthwork required to accommodate civil engineering designs, the site civil construction and the remedial construction were combined to eliminate issues related to handling contaminated material. The remedial approach consisted of a combination of excavation, on-site treatment of soils, placing contaminated soils under building pads and roads to render them inaccessible, using treated soils as asphalt road-base, constructing a retaining wall that would also act as a barrier to free product migration, capping, installation of sub-slab depressurization systems beneath new buildings, and monitored natural attenuation. Assisted client with presentations to the planning board and wetlands commission.

Senior Project Manager, Nine Mall Investors, LLC – Nine Mall Plaza – Dry Cleaner, Wappingers Falls, New York. Designed and managed the investigation and remediation of tetrachloroethylene-impacted soils and groundwater associated with a dry cleaner. Performed due diligence investigations, prepared a NYSDEC Brownfield Cleanup Program (BCP) application, and aided the developer in successfully completing the BCP application process. Following some additional assessment, negotiated with the NYSDEC to submit a Remedial Investigation Report/Remedial Action Plan, thereby saving time and money associated with preparation and public comment related to a remedial investigation work plan. In addition, a remedial approach of enhanced bioremediation was proposed to complete the remedial actions already undertaken at the site, realizing further cost savings for client.

Senior Project Manager, National Resources, Brownfields, Various Locations Nationwide. As Client Manager, assisted the development team in assessment, investigation and remediation planning at several Brownfield properties throughout the United States. Projects included due diligence services, document reviews, conceptual remedial plans and cost estimates for properties formerly operated as Manufactured Gas Plant Sites, Unilever Cosmetics and Edible Oils plant, IBM's Fishkill West Campus, former pharmaceutical sites, and former dry cleaning sites. Designed and implemented Site Investigations, Site Assessments, and remediation projects. Oversaw the design, operation, monitoring, and maintenance of a total fluids and air sparging remediation system targeted to remediate a chlorinated solvent plume at the former Smith Industry property in Grand Rapids, Michigan.

Senior Project Manager, Meridian Development Partners, LLC, Brownfields, North Carolina. Provided environmental consulting services during a proposed property transaction of a former electronics manufacturing site utilized by Channel Master to produce satellite dishes. GZA's services consisted of reviewing previous environmental reports, conducting a Phase II Environmental Site Investigation, conducting a Supplemental Phase II Environmental Site Investigation, and preparing remedial cost estimates to be used by the client during contract negotiation.

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During the course of the document review it became apparent that the site had been impacted by releases of chlorinated solvents. While previous consultants had indicated that the release had resulted in minor impacts to soil and groundwater, review of available documents and local hydrogeologic conditions indicated that borings had not been properly located. Therefore, GZA recommended a Phase II Site Investigation.

The results of the investigation indicated that chlorinated solvent-impacted soil and groundwater were present in the vicinity of a former spill containment UST associated with a flammable liquids storage area. The solvents had impacted both the overburden and bedrock water bearing units. The initial investigation indicated that the contamination was not migrating off-site; however, the vertical and horizontal extent of contamination was unknown.

Dr. Winslow designed a rapid turnaround and cost effective study to assess the vertical and horizontal extent of contamination within the timeframe of the due diligence period in order to apply cost certainty to estimated remediation figures. GZA mobilized a Geoprobe direct push drill rig, field instruments, and an air rotary drill rig to complete the investigation within a two week period. The results of the investigation indicated that the bedrock water bearing unit had only minor impacts and the horizontal extent of the overburden contamination was limited to the area around the former spill containment UST. With this knowledge Dr. Winslow was able to design a conceptual approach to remediation and apply realistic cost estimates in order for the Client to make an informed decision regarding purchase of the brownfield site.

Project Manager, National Auto Parts Retailer, Brooklyn, New York. Designed and oversaw the remediation of gasoline impacted soil and groundwater during redevelopment of site that was entered into the NYSDEC Voluntary Cleanup Program. The remediation consisted of the removal of eight 550-gallon gasoline USTs, the excavation of 2,200 tons of petroleum impacted soils, performance of high vacuum dual phase extraction, and the injection of Oxygen Release Compound (ORC) to accelerate attenuation following source area treatment. The remedial efforts resulted in a decrease of dissolved-phase contamination and expected closure of the case with the NYSDEC.

TRANSPORTATION / INFRASTRUCTURE

Lead Scientist/Environmental, Tappan Zee Bridge Replacement, Tarrytown and South Nyack, New York. As a specialty subcontractor to the lead bridge designer, HDR, providing environmental consulting services related to demolition of existing three-mile-long span and construction of new Hudson River crossing. Environmental services include preparation of environmental compliance plans; soil and groundwater characterization for disposal; pre-demolition hazardous materials investigation; hazardous materials abatement design and oversight; remedial action plans; and underground storage tank (UST) removal oversight.

Principal-in-Charge, Beacon Station Transit Oriented Development (with AECOM), Beacon, New York. Designed and oversaw the environmental assessment, site investigations and conceptual remedial approach in support of the proposed Transit Oriented Development (TOD) at Metro-North Railroad's (MNR) Beacon Station. MNR was preparing a preliminary design for a TOD for inclusion in a request for proposals to developers. Dr. Winslow designed a Site Assessment program to identify and quantify the environmental liabilities associated with the development. The study included compilation of existing environmental data on five parcels (including a coal tar impacted parcel), a Phase I Environmental Site Assessment on five parcels, a Site Investigation to evaluate data gaps, preparation of a conceptual remedial approach, and preparation of remedial cost estimates. The information was designed to be used in the RFP process to reduce uncertainties in the development proposal process.

Senior Project Manager, NJTA - TransHudson Express Tunnel-Manhattan Segments (Judlau-Halcrow Joint Venture), Civil Construction Support Services, New York, New York. As part of the design-build project for the Manhattan Tunnels Project, designed and oversaw the soil and rock characterization of the soils and rock within the shaft and starter tunnels at 29th Street and 12th Avenue. The project involved the excavation of a shaft to a depth of 130 feet below ground surface in order to allow access by the tunnel boring machine. GZA's services included preparation of an In-Situ Soil Sampling and Analysis Plan, a Field Sampling Plan, collection of 190 composite soils samples representing 500 cubic yard cells at five foot lifts, preparation of a field summary report, and recommendations to the contractor on materials disposal.

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INDUSTRIAL / COMMERCIAL

Principal-in-Charge, Steel Craft, Newark, New Jersey. Designed and conducted a pilot test to evaluate the feasibility of soil vapor extraction (SVE) to remediate unsaturated soils impacted with chlorinated volatile organic compounds (cVOCs) using horizontal well network. Airflow in the treatment zone is subject to induced pressure gradient, driving contaminant mass toward a vacuum recovery system.

Principal-in-Charge, Chrysler Corporation, various sites in New Jersey and New York. As part of a long-standing environmental consulting contract, provide a range of services, often conducted in support of dealership expansion or property transactions, including compliance activities, site assessment and hazardous materials building services, as well as storage tank management and remediation.

Principal-in-Charge, Preferred Freezer-Bayway, Elizabeth, New Jersey. GZA has provided varied services at this 20-acre brownfield site including Phase I ESA, Brownfield Designation services, site/civil work, a redevelopment plan, extensive permitting with numerous entities, geotechnical investigation and review, wetlands survey, a pre-demolition asbestos-containing material survey and hazardous waste inventory, and UST removal. After project owner opted into NJDEP LSRP program, GZA's LSRP obtained soil remediation permit and Restricted RAO for site. Groundwater monitoring is ongoing with a CEA expected before 2014. At additional Preferred Freezer sites in Bayonne, Jersey City and Newark, GZA is also responsible for annual inspection and biennial certification of Deed Notices.

Principal-in-Charge, Kelley Drye & Warren, LLC/Historic Residence, Peapack-Gladstone New Jersey. In support of a real estate transaction, designed and managed the closure of a 1,000-gallon gasoline tank and 550-gallon fuel oil tank located on a residential property estate. The tanks were located beneath a retaining wall supporting a slope and adjacent to a gas line; therefore, they were closed in place.

Principal-in-Charge, New York Life Investment Management, Various Properties, New Jersey. Designed and managed a due diligence program for the client who was acquiring a portfolio of nine industrial/warehouse properties. Provided advice regarding environmental liability and risk associated with each property. Prepared remedial cost estimates and prepared a program to take several sites into New Jersey's LSRP program.

Principal-in-Charge, New Brunswick Properties, LLC, New Brunswick, New Jersey. Assisted a trucking company with the acquisition of a truck depot. A previously undetected UST was located and removed. Soils were found to be contaminated with historic fill and trichloroethene (TCE) above impact to groundwater standards. The site was entered into New Jersey's LSRP program and historic fill was addressed through capping and a deed notice; no CEA was required. A groundwater investigation found that the TCE had not impacted groundwater and no further action was necessary.

Senior Project Manager, U-Haul, Edison, New Jersey. Conducted a remedial investigation on a U-Haul site characterized by MTBE and gasoline-contaminated groundwater. The contamination was commingled with two other properties' contaminant plumes. Using natural attenuation modeling, demonstrated that U-Haul's component of the contamination had only migrated 90 feet downgradient and would attenuate with time. Designed, permitted and constructed a dual phase high vacuum extraction system, installed under budget, to remediate the source of contamination on the U-Haul property.

Senior Project Manager, ConocoPhillips, various projects in New York and New Jersey. Prime contract under which GZA provided environmental consulting services for the operation and maintenance of remediation systems, groundwater monitoring and reporting, site investigation and remedial design service, as well as closure and upgrades of stations and fueling systems.

Senior Project Manager, Hertz Rent-A-Car, LaGuardia Airport, Queens, New York. Designed and implemented a Site Investigation to delineate the extent and magnitude of separate-phase product, petroleum vapors and dissolved-phase petroleum contamination/MTBE emanating from the current and former fueling operations at the Hertz facility. Following characterization, designed a cost-effective, receptor-based remediation system to mitigate separate-phase product and control petroleum vapors.

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Senior Project Manager, U-Haul, Bronx, New York. Designed and implemented the remediation of a U-Haul Moving Center in the Kingsbridge section of the Bronx. The site formerly contained three separate fueling areas. Two of the fueling areas contained low levels of dissolved phase contamination; the NYSDEC closed these areas of concern based upon natural attenuation modeling and a risk based approach. The third area of fueling was characterized by free-phase product. The area of saturated soils was excavated and transported off-site for treatment. The excavation was then lined with oxygen release compound (ORC) prior to backfilling. ORC was then injected into dissolved contamination plume to promote biodegradation downgradient of the former tank pit. The leading edge of the plume was allowed to attenuate following source removal. The NYSDEC closed the case within one year of the commencement of remedial action and the project was completed under budget.

Senior Project Manager, U-Haul, Staten Island, New York. Conducted a Site Investigation at the U-Haul facility located on Bay Street in Staten Island, New York. The results of the Site Investigation indicated that soil and groundwater in the vicinity of the former UST area and fuel dispensers were contaminated with gasoline compounds. Conducted a Remedial Investigation and prepared a Remedial Action Plan for submittal to the NYSDEC. Due to fluctuations of seasonal water table elevations and a thick zone of adsorbed-phase contamination, a total fluid extraction system was recommended and installed to address dissolved phase and adsorbed phase contamination.

Senior Project Manager, Mystic Transportation Inc., Mount Vernon, New York. Designed and supervised the construction of a No. 4 fuel oil recovery system at a residential building where, due to an overfill, a 5,000-gallon AST had ruptured and spilled 6,600-gallons of fuel oil. Eight hundred gallons of fuel oil were released into the groundwater beneath the building and into the Bronx River. Following emergency response and cleanup of fuel oil in the basement of the building, a product recovery system and water treatment system were installed. Total fluids were recovered from each recovery trench and routed to an oil/water separator and carbon treatment system housed in the basement of the building. In addition, several sumps were impacted by the fuel oil release. The effluent water from these sumps was also routed to the treatment system prior to discharge to the municipal storm water system. Within approximately eight months, product levels had decreased to trace amounts in all but one well.

HEALTHCARE PROJECTS

Principal-in-Charge, Holy Name Hospital, Teaneck, New Jersey. Oversee asbestos management and lead-based paint evaluation services at a variety of buildings on the hospital campus.

Principal-in-Charge, St. Joseph's Hospital, Paterson, New Jersey. Completed various projects, including a lead and asbestos investigation to aid in the hospital's day care center license renewal and asbestos investigations at multiple vacant houses prior to their complete demolition as part of hospital expansion.

Senior Project Manager, New York Presbyterian Hospital, New York, New York. Conducted assessment of a PCB-bearing transformer to be removed as part of a construction project. The transformer was found to have leaked, resulting in impacts to the concrete pad and soils. Designed and oversaw a remediation program to remove the transformer, concrete pad and impacted soils. The case was closed with the NYSDEC.

Senior Project Manager, Memorial Sloan Kettering Cancer Center (with Granary Associates), New York. Designed and coordinated a pre-demolition laboratory and hazardous material survey. The survey included an evaluation and inventory of all hazardous chemicals, waste and biohazards associated with each laboratory. Once the hazard assessment was completed, a survey was designed to determine impacts from use of building materials in light of planned demolition activities. Areas such as storage cabinets, duct work, fume hoods, bench tops and plumbing were evaluated for presence of hazardous substances. In addition, a lead-based paint survey and a universal waste survey were conducted. Laboratory decontamination and hazardous material specifications were created and a contractor was selected. GZA personnel coordinated and oversaw the decommissioning and abatement.

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ENERGY PROJECTS

Principal-in-Charge, TransCanada – Ravenswood Power Generating Station, L.I.C., New York. Designed and oversaw the spill response investigation following the discovery of a 25,000 gallon kerosene release from an underground fuel oil line connecting a gas turbine generator with the 6,000,000 gallon aboveground storage tank. Within one week of notification of the release, GZA was on-site conducting a subsurface investigation to delineate the vertical and horizontal extent of kerosene associated with the release. In addition, GZA installed several recovery sumps to initiate product recovery during the investigation period. Dr. Winslow developed a Conceptual Site Model (CSM) that was continuously revised and updated as data became available. The initial CSM projected that kerosene would migrate vertically to the water table and then flow west towards the East River. However, once investigative activities and data review commenced it became evident that anthropogenic features (old foundation elements and utility conduits) were complicating kerosene migration. In addition, shallow bedrock at the release area resulted in migration of kerosene to the north, south, and west from the release area. The investigation IRM was completed within three months of mobilization to the Site and included the installation of over 30 soil borings, 14 monitoring wells and four recovery sumps, and design of an interim product recovery system. Within the first four months of the release 5,000 gallons of kerosene were recovered. A product recovery system was designed and installed to continue product recovery past the emergency response stage. In a subsequent project at the site, oversaw team responsible for asbestos surveys and sampling of suspect materials throughout the power plant, including the 10-story boilers and roof.

Senior Project Manager, Enercon Inc. – Indian Point Energy Center, Buchanan, New York. Designed and implemented a site investigation to delineate and determine the source of tritium, strontium and cesium detected in groundwater as a result of a leak in spent fuel storage pool and process piping at the Indian Point Nuclear Plant. The investigation consisted of a thorough review of construction drawings, historic hydrogeologic data and historic groundwater chemistry data to prepare a conceptual site model for the release. In order to verify the conceptual site model, GZA advanced 42 bedrock and overburden borings at the site to supplement the site's existing 18 groundwater monitoring wells. The borings were advanced using a combination of drive and wash techniques and rotary coring techniques. Rock cores were characterized for the presence of water bearing fractures as well as lithology. All bedrock borings were subject to downhole geophysical borehole logging consisting of acoustic televiewer, optical televiewer, temperature, conductivity, and heat pulse flow meter. Hydraulic conductivity was evaluated using a combination of extraction packer testing and sustain yield pump tests. Wells were completed using multilevel sampling systems resulting in 127 sample intervals. GZA then completed an organic dye tracer test to confirm contaminant flow paths and groundwater velocities. GZA was able to delineate the extent of horizontal and vertical groundwater contamination, determine the sources of the contamination and the post release flow paths. GZA then recommended a long term monitoring plan to be implemented at the site to assess long term plume reductions as well as monitor potential releases from other SSCs.

Senior Project Manager, Hudson High Voltage Direct Current (HVDC) Converter Station/Siemens AG, Ridgefield, New Jersey. Evaluated the impacts to construction associated with contaminated soils and groundwater at the site in order for Siemens to determine that the developer completed all necessary environmental remediation in accordance with NJDEP regulations prior to construction of the facility. The site is being developed as part of a transmission project intended to convert the power between New Jersey's Public Service Electric & Gas (PSEG) 230 kV grid and New York's Con Edison 345 kVgrid.

Principal-in-Charge, SUEZ Energy Generation NA, LLC, Astoria, New York. Designed and managed an environmental investigation to characterize soils and groundwater as part of the pre-construction design phase of the Astoria Energy Phase II project. The proposed power plant was situated on a former major oil storage facility and was characterized by approximately 10 feet of historic fill material and petroleum contaminated soils and groundwater. The investigation consisted of collecting soils samples in a grid fashion in areas proposed for grubbing, excavation of structures and overhead and subsurface transmission lines in order to characterize soils for proper handling and disposal. In addition, groundwater samples were collected to evaluate the necessity for treatment of dewatering effluent. Then prepared a Site Investigation Report and a Construction Contaminant Management Plan to be used by the contractor for proper health and safety, handling, transportation and disposal of contaminated media. During construction, GZA conducted waste characterization soil sampling for disposal of contaminated material.

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VAPOR INTRUSION

Principal-in-Charge, Bay Park Brownfield Redevelopment, Coney Island, New York. As part of brownfield redevelopment, GZA's Remedial Investigation Work Plan (RIWP) outlined work required to delineate the vertical and horizontal extent of the impacted soils, soil vapor and groundwater at both BCP sites. A Remedial Action Work Plan was developed to address contaminated media. A subslab depressurization system was designed to protect residential and retail tenants, in conjunction with source area treatments.

Principal-in-Charge, POKO Management, LLC, Brooklyn, New York. Provided environmental due diligence services during real estate transaction and renovation. The Phase I ESA identified a former dry cleaning operation at the site. Initial investigations found no soil contamination, however, groundwater downgradient of the dry cleaner was found to be impacted. Additional investigations found that groundwater was only marginally impacted, however, subslab soil gas PCE concentrations were as high as 11,000 ug/m3. GZA proposed a remedy consisting of a subslab depressurization system to address potential vapor intrusion and monitored natural attenuation to address the groundwater condition. Dr. Winslow prepared design specifications for construction of SSDS at the site.

Principal-in-Charge, i.park Edgewater, LLC, Edgewater, New Jersey. As part of this mixed use Brownfield development project, Dr. Winslow, conducted a Vapor Intrusion Study at the site which resulted in the requirement for all existing buildings and new construction to incorporate passive subslab depressurization systems with the ability to be converted to active systems. Designed systems for 10 separate buildings. In addition, developed a program to evaluate the effectiveness of each passive system to determine if active depressurization would be required. The program was accepted by the NJDEP.

NEW YORK CITY (E) DESIGNATED SITES

Principal-in-Charge, Highline Development Corp, West 29th Street, New York, New York. Managed CEQR (E) designated site requirements associated with the redevelopment of seven parcels with industrial histories for use as a hotel and residential building, all under a tight time schedule. Following NYCDEP's acceptance of the Site Investigation Work Plan, GZA advanced 32 soil borings, collected 64 soil samples, and installed 15 groundwater monitoring wells; a Site Investigation Report was submitted in combination with a Remedial Action Plan in order to save time for the client. The site was found to be contaminated with chlorinated solvents. GZA proposed a remedial action which coincided with the proposed redevelopment of the parcels. The remedial design consisted of excavation of soils to bedrock to accommodate the foundation design of the proposed building. Soil samples were collected in a grid across the site at multiple depths to further characterize VOC-contaminated soils, historic fill material and native soils, for disposal purposes. This identification of "cells" of soil that could be transported to different facilities resulted in significant cost savings to the client. In addition, GZA recommended a soil vapor barrier and post excavation groundwater monitoring. Both the NYCDEP and the NYSDEC approved the work plans.

Senior Project Manager, Horrigan Development Partners, North 9th Street, Williamsburg, New York. Managed CEQR (E) designated site requirements associated with the redevelopment of a former industrial building for reuse as a residential building. Following NYCDEP's acceptance of Site Investigation Work Plan, conducted a Site Investigation and submitted a Site Investigation Report combined with a Remedial Action Plan in order to save time for the client. When the site was found to be contaminated with chlorinated solvents, proposed a remedial action which coincided with the proposed redevelopment of the parcels. The remedial design consisted of excavation of soils to bedrock to accommodate the foundation design of the proposed building. Soil samples were collected in a grid across the site at multiple depths to further characterize VOC contaminated soils, historic fill material and native soils, for disposal purposes. This identification of "cells" of soil that could be transported to different facilities resulted in significant cost savings to the client. In addition, GZA recommended a soil vapor barrier and post excavation groundwater monitoring. Both the NYCDEP and the NYSDEC approved the work plans.

MANUFACTURED GAS PLANTS (MGP) AND COAL TAR SITES

Project Manager, National Autoparts Retailer, Former MGP Site Redevelopment, Staten Island, New York. Conducted environmental due diligence studies on a former natural gas storage site targeted for redevelopment for commercial interests. A

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Phase I Environmental Site Assessment and a Phase II Site Investigation were performed prior to purchase of the property. The site had previously been utilized by Brooklyn Union Natural Gas as a natural gas storage site; the site had been listed as a potential MGP site operating in the late 1800s and early 1900s. Performed a remedial investigation under the supervision of the NYSDEC, including a remedial investigation work plan, the advancement of 20 soil borings, the installation of 10 temporary well points, regulatory interfacing, laboratory services, and a remedial action plan. It was determined that a concrete vault housing piping had been filled with condensate-contaminated debris during site closure. All contaminated material was confined to within the concrete vault. No other contaminants were detected above applicable guidance values. The contaminated material was excavated from the concrete vault; no groundwater had been impacted by the presence of the contaminated material. The NYSDEC granted a no further action letter, and the site was developed as a retail autoparts store.

Senior Project Manager, National RE/Sources, Former MGP Site Redevelopment, Tarrytown, New York. Prepared a conceptual remedial action plan and provided cost estimates to remediate a site that had operated as an MGP until the 1930s. The site had two areas of MGP-contaminated soil and groundwater as well as three areas of diesel-contaminated soil and groundwater. The conceptual remedial action consisted of a combination of containment, encapsulation, excavation, on-site thermal treatment, and product recovery. Land use restrictions were incorporated into the conceptual remedial action plan to allow for less stringent cleanup standards. Dr. Winslow provided cost estimates for the remedial actions, which were used by the developer to determine the feasibility of implementing the remediation.

RELEVANT GEOLOGIC EXPERIENCE

Dr. Winslow has conducted structural geologic field mapping to evaluate locations of folding, faulting and lithologic contacts in both the western and eastern United States, as well as overseas in the Pakistan Himalaya. The results of the geologic mapping have been used to assess regional scale tectonic relationships as well as local scale mineral resources. In the Pakistan Himalaya, Dr. Winslow was able to map an active tectonic fault which accommodated kilometers of uplift in one of the most tectonically active areas of the world.

Dr. Winslow has utilized remote sensing, photo lineament analysis, and structural/petrographic techniques to evaluate the pressure, temperature and time history of rocks associated with tectonic faulting. This information has included field scale structural analysis, petrographic thin section analysis, fluid inclusion analysis, major cation (thermobarometric analysis) chemistry, and thermochronological analysis of rocks from several tectonic complexes. This information has been used to evaluate the movement and uplift history along major tectonic faults.

EXPERT TESTIMONY

Principal, New York State Attorney General's Office, Soundview Avenue, Bronx, New York. Provided expert testimony with regards to contaminant fate and transport of MTBE and hydrogeology for a case involving a commingled MTBE Plume remediated under the NYSDEC Spill Fund.

Principal, Avis Budget Car Rental, JFK International Airport, Queens, New York. Provided expert testimony with regards to an underground utility damaged during replacement of an underground storage tank when a contractor drove sheeting through an 18-inch sewer line located 18 feet bgs. Provided an opinion on whether proper procedures had been followed to identify utilities during design and construction.

Senior Project Manager, New York City School Construction Authority (NYC SCA), Corona, Queens, New York. Provided expert testimony in a condemnation case regarding impacts to the site from lead contamination associated with historic fill at the site. In some instances, lead concentrations were sufficient to classify soils as hazardous waste. Provided testimony concerning the nature and extent of the contamination, as well as typical remedial solutions to this issue and costs associated with the remediation. Remediation costs were estimated for residential usage vs. usage as a public school in order to determine what the environmental remediation costs would be under the highest and best use of the site.

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Senior Project Manager, Medi-Ray Inc., Tuckahoe, New York. Provided expert testimony concerning contaminant fate transport of lead in the environment in conjunction with a "whistle blower" case. The former employee charged that he was fired because he intended to report to the authorities the mismanagement and dumping of lead into the environment. Dr. Winslow provided testimony concerning background concentration of lead in the environment, contaminant fate and transport properties of lead, the potential to create a substantial and material threat to public health and the environment, and critique of the conclusions of the opposing witnesses.

Senior Project Manager, Toys-R-Us, Yonkers, New York. Provided factual testimony concerning site investigation and remediation efforts during the development of a Babies "R" Us store on a site that had been previously filled in the 1950s. During excavation to construct the store, evidence of commercial and industrial waste was detected in the fill material. This included fill with chemical odors, buried drums, and cinders. Once this material was identified it could no longer be disposed of as construction and demolition debris. Laboratory analysis indicated that the fill material contained metals and organic compounds above standards. Babies "R" Us sent the site owner a bill for the remedial efforts. The site owner disputed whether the fill material required special handling and whether the remediation was conducted in accordance with industry standards and state regulations.

Ph.D. Dissertation

Pressure Temperature Time History of Nanga Parbat-Haramosh Massif, Pakistan Himalaya. Lehigh University, 1995.

Publications and Presentations

Winslow, D. M., Zeitler, P.K., Chamberlain, C.P., and Williams, I.S., 1996, Geochronologic Constraints on Syntaxial development in the Nanga Parbat Region, Pakistan, Tectonics.

Winslow, D.M., Chamberlain, C. Page, Zeitler, P.K. 1995, Metamorphism and Melting of the Lithosphere Due to Rapid Denudation, Nanga Parbat Massif Himalaya, Journal of Geology.

Winslow, D.M., Zeitler, P.K., Chamberlain, C. Page, Hollister, L.S., 1994, Direct Evidence of a Steep Geotherm Under Conditions of Rapid Denudation, Western Himalaya, Pakistan, Geology.

Craw, D., Koons, P.O., Winslow, D., Chamberlain, C.P., Zeitler, P.K., 1994, Boiling Fluids in a Region of Rapid Uplift, Nanga Parbat Massif, Pakistan, Earth and Planetary Science Letters.

Winslow, D.M., Bodnar, R.J., Tracy, R.J., 1993, Fluid Inclusion Evidence for a Counterclockwise P-T Path in CMT of Central Massachusetts. Journal of Metamorphic Geology.

Rapid Vapor Intrusion Assessment and Mitigation at a Hurricane Sandy-Impacted Brownfield Site, Battelle Chlorinated Conference, Monterey, California, May, 2014

Arsenic Speciation, Mobility and Treatability at a Former Industrial Site in Edgewater, New Jersey, Environmental Services Association of Alberta (ESAA)/Remediation Technologies Symposium 2013 (RemTech 2013), Banff, Alberta, October, 2013

Arsenic Speciation, Mobility and Treatability at a Former Industrial Site in Edgewater, New Jersey, 29th Annual International Conference on Soils, Sediments, Water, and Energy/Association for Environmental Health and Sciences (AEHS) Foundation, University of Massachusetts, Amherst, Massachusetts, October, 2013.

Bench Scale In-situ Solidification/Stabilization Treatability Tests Using ANSI 16.1., Environmental Services Association of Alberta (ESAA)/Remediation Technologies Symposium 2012 (RemTech 2012), Banff, Alberta, October, 2012

Green Remediation at a LEED Silver Brownfield Site, The Environmental Institute, Green Remediation Conference, Amherst, MA, June 2010

Characterization of Tritium and Strontium Releases and Hydrogeology at the Indian Point Nuclear Power Plant, Buchanan, New York, Northeast Geological Society of America, March 2007

Integration of Investigative Methods to Assess a Porous Media vs. Fracture Flow Approach in Fractured Bedrock Systems, 2007, U.S. EPA/NGWA Fractured Rock Conference, September 2007

David M. Winslow, Ph.D., P.G.

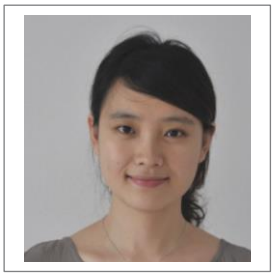
Principal

Certifications/Training

- OSHA 40-hour Health and Safety Training Certification – 1995
- 8-hour Site Supervisor Certification - 1995
- OSHA Confined Space Entry Training Certification - May 1995
- ASTM Risk Based Corrective Action for Petroleum Contaminated Sites – 1998

Affiliations/Memberships

- Program Committee Member, Urban Land Institute (ULI)/Northern New Jersey Chapter
- Member, National Groundwater Association



Zhan Shu, Ph. D., P.E.

Project Manager

Summary of Experience

Dr. Shu has broad experience in the fate and transport of contaminants in the environment. Specialties include site investigation and remediation, statistical analysis, contaminant attenuation and mobility, mechanistic and transport modeling, environmental chemistry, physical and chemical processes, and environmental risk assessment. Prior to joining GZA, Dr. Shu had collaborated with the New York State Department of Transportation (NYSDOT) and DuPont to investigate and address the transport and migration of contaminants on-site. Dr. Shu has been managing multiple projects in NY and NJ area.

o Developing and managing all phases of project including phase I ESAs, remedial investigations, conceptual site models, feasibility studies, remedial design, and long-term operations and maintenance of remedial systems in accordance with NJDEP, NYSDEC, NYCDEP, and other relevant regulations;
o Experience with strategic soil management and remediation as part of site redevelopment and building construction preferred;
o Working with client during due diligence, property redevelopment, and acquisition processes;
o Coordinating meetings and following-ups with NJDEP, NYSDEC, NYCOER, and Client for NY Brownfield Cleanup Program (BCP), Voluntary Cleanup Program (VCP), NYC E-Designation Program, and superfund Sites;
o Preparing/reviewing environmental permitting and regulatory compliance (air, flood hazard areas, discharge to surface water and groundwater, hazardous waste, etc.); and
o Directing junior staff, field work, and executing day to day activities of projects.

Education

Ph.D., 2013, Environmental Engineering, New Jersey Institute of Technology (NJIT), Newark, NJ
B.S & M.S., 2008, Environmental Engineering, National Hua Chiao University, China

Licenses & Registrations

Professional Engineer, New Jersey, 24GE05424500

Areas of Specialization

- Site Investigation
- Site Remediation
- Geochemistry
- Contaminant Fate and Transport Modeling
- Statistical Analysis

Relevant Project Expérience

Project Manager/ Environmental Engineer, Bay Park Brownfield Redevelopment, Coney Island, Brooklyn, New York. For this BCP, Site investigations performed had documented the presence of PCE in soil gas and was delineated over three separate structural slabs in commercial and residential space utilizing a mobile laboratory. Two sub-slab depressurization systems were designed and installed. The sub-slab depressurization system (SSDS) system was designed with below slab suction pits, remote sensing vacuum monitoring points, and a variable frequency drive blower tied into the monitoring points for optimization and power savings. Reviewed shop drawings and oversaw installation of SSDS. Set up each quarterly sampling event, prepared the Final Engineering Report (FER) and Site Management Plan (SMP) for the property; analyzed the effluent data by using AERSCREEN computer program for the Control of Toxic Ambient Air Contaminant; and prepared the quarterly O&M report.

Project Manager, Former Cascade Laundry, Brownfield Redevelopment, Brooklyn, New York. For this BCP, conducted remedial investigation to delineate the vertical and horizontal extent of petroleum contamination in soil. Designed a vapor barrier and

Zhan Shu, Ph.D., P.E.

Project Manager

passive sub-slab depressurization (SSDS) system. Prepared the BCP required documents including monthly report, Noise/Air Remedial Action Plan, Site management Plan, and Final Engineering Report.

Assistant Project Manager/ Environmental Engineer, Rockland County Psychiatric Center- Core Area Site, Orangetown, New York. GZA facilitated the Brownfield Cleanup Program (BCP) applications. Conducted site investigation, prepared Remedial Investigation Work Plan (RIWP) and Brownfield cleanup program application package; addressed the NYSDEC comments, and prepared the logistics for the sampling event.

Assistant Project Manager/ Environmental Engineer, Former Nuhart Plastics Site, New York State Superfund Site, Brooklyn, New York. This Site is a New York State Superfund Site that requires compliance with NYSDEC, NYCOER, and local regulatory agencies. The current work includes monthly monitoring well gauging for product presence and thickness within the 5,000 square foot plume in a mixed use residential/commercial neighborhood. Conducted a feasibility study and researched remedial alternatives for this former plasticizer facility with on-site and off-site pollutant concerns; Addressed the comments from NYSDEC; Prepared the RIR and RAWP for the NYCOER VCP Site.

Assistant Project Manager/ Environmental Engineer, 11 Spencer Street, Brooklyn, New York. For this Brownfield Cleanup Program (BCP), previous remedial investigations had documented the presence of tetrachlorethene (PCE) in groundwater, soil, and soil gas; We performed supplemental investigation to delineate the onsite PCE plumes, developed the Remedial Investigation Report (RIR), conducted soil vapor extraction (SVE) and air sparging (AS) pilot study, and developed the interim remedial measure work plan to address the contaminants.

Environmental Engineer, Junior High School 226 Queens (I.S. 226), Queens, New York. Managed construction support services related to soil management associated with the construction of a New York City school complex and associated utility corridors. Prepared Excavated Material Disposal Plans, reviewed potential disposal facilities, and conducted waste characterization soil sampling.

Environmental Engineer, 599 Valley Health Plaza, SSDS, Paramus, New Jersey. GZA provided environmental services including a Phase I ESA, Vapor Encroachment Assessment, Phase II ESA, Remedial Action Plan, and Construction Health and Safety Plan. For active sub-slab depressurization system (SSDS), designed and prepared bid specifications.

Environmental Engineer, 2581 & 2587 Atlantic Avenue, 40-44 Georgia Avenue, Brooklyn, New York. GZA provided environmental services including a Phase I ESA, Vapor Encroachment Assessment, Phase II ESA, Remedial Action Plan, and Construction Health and Safety Plan. Designed the active and passive SSDS systems; and prepared bid specifications.

Environmental Engineer, Steel Craft, Newark, New Jersey. Conducted groundwater sampling; delineate and differentiate the onsite and offsite PCE and TCE plumes.

Former Pesticide Manufacturing Facility, Site Investigation and Remediation, Middlesex, New Jersey. The 57-acre Site is composed of multiple properties that is impacted by former manufacturing activities involving arsenic compounds and other chemicals used as pesticide ingredients. A groundwater remediation system pumps and treats arsenic, pesticides, and VOCs impacted groundwater in accordance with NJDEP and POTW permits. Performed a wide variety of tasks related to site investigation and remediation for this project. This includes:

- Collected and assessed multimedia environmental data; delineated contaminant plumes; completed geologic mapping, and geophysical logging and interpretation;
- Prepared technical reports (RIR, RASR, RAW, and RAR) for clients and NJDEP;
- Statistically developed surface water background threshold values (BTV) to evaluate effectiveness of engineering controls; statistically evaluated remedial alternatives to ensure environmental compliance;
- Assisted in groundwater treatment plant modification projects and feasibility studies; evaluated pilot study results and assessed feasibility of scaling up operations; prepared associated engineering cost estimate; and
- Prepared engineering design, bid package, and assisted in permit application

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Project Manager

Former Dry Cleaner Facility Remediation, Toms River, New Jersey. Assisted in site remediation project involving PCE vapor intrusion. Soil vapor extraction (SVE) and air sparging (AS), along with groundwater monitored natural attenuation (MNA) were applied to reduce contaminant residuals. Conceptually designed intuitional controls --Deed Notice and Classification Exception Area (CEA)--to address on-site residual soil and groundwater contamination.

Active Waste Oil Recycling Facility, Elizabeth, New Jersey. Delineated previous and current LNAPL contaminant plume in the groundwater system. Updated facility's Storm Water Pollution Prevention Plan (SPPP) according to NJPDES permit conditions.

Oil Spill Risk Assessment, BP and National Oceanic and Atmospheric Administration (NOAA), Gulf of Mexico. Performed risk assessment for oil spill contamination. Statistically evaluated the data obtained from the site. Reviewed reports and conducting associated research.

Soil Geobiochemistry Study at DuPont Chambers Works Site (CWKs), Deepwater, New Jersey. As an external consultant for the DuPont Geobiochemistry group, developed protocols for collecting and processing soil core samples in an anaerobic condition; and analyzing the collected data to support the refinement of the site-wide conceptual site model (CSM). Assisted in understanding the interactions and mechanisms at the interface as well as in explaining groundwater chemistry, redox conditions, Fe speciation, S speciation, and abiotic/biotic processes.

Contaminant Mobility in Paint Waste during Bridge Rehabilitation, New York State Department of Transportation, New York State. Collaborated with NYSDOT to investigate the transport and mitigation of the heavy metal contamination from lead-based paint during bridge rehabilitation. Developed mathematical model using a variety of statistical approaches to rapidly characterize paint waste during bridge rehabilitation. Nine task deliverables were submitted and presented to NYSDOT.

Impact Study on Effects of Superstorm Sandy, National Science Foundation (NSF), Raritan Bay, New Jersey. Investigated water quality, trace metals, Nitrogen, Phosphate, and related contaminants in the groundwater and sediment in the shorelines along Raritan Bay in NJ. Evaluated coastal ecosystem recovery and resilience potential after Superstorm Sandy.

Bio-remediation of Tannery Sludge, China. Conducted bio-remediation using indigenous sulfur-oxidizing bacteria present in the tannery sludge to reduce elevated hexavalent chromium in tannery sludge. Chromium removal rate of 90% was achieved.

Fujian Petrochemical Industrial Group Co., Compliance Services, China. Supported lead engineer in preparation of planning documents and completion of regulatory permit applications. Assisted lead scientist to modify related EHS programs and procedures to ensure compliance.

Ph.D Dissertation

Field Methods for Rapidly Characterizing Paint Waste during Bridge Rehabilitation, New Jersey Institute of Technology (NJIT), 2014.

Publications and Presentations

Shu, Z., Axe, L. Jahan, K. Ramanujachary, K. V., Field Methods for Rapidly Characterizing Paint Waste during Bridge Rehabilitation, Chemosphere, 134 (2015):598-605.

Shu, Z., Axe, L. Jahan, K. Ramanujachary, K. V., Metal Leaching from the Bridge Paint Waste in the Presence of Steel Grit, Chemosphere, 119 (2015) 1105–1112.

Shu, Z., Axe, L. Jahan, K. Ramanujachary, K. V., Kochersbergerd, C. Metal Concentrations and Distribution in Paint Waste Generated during Bridge Rehabilitation in New York State, Science of the Total Environment, 526 (2015): 262-270.

Personna, Y. R. Geng, X., Saleh, F., Shu, Z., Jackson, N., Weinstein, M., Boufadel, M., Monitoring Changes in Salinity and Metal Concentrations in New Jersey (USA) Coastal Ecosystems Post-Hurricane Sandy, Environ Earth Science, 2015, 73(3): 1169-1177.

Zhan Shu, Ph.D., P.E.

Project Manager

Shu, Z., Axe, L. Jahan, K. Ramanujachary, K. V., Trace metal leaching from bridge paint waste in the presence of iron oxide surfaces, Division of Colloid and Surface Chemistry, 246th American Chemical Society (ACS) National Meeting, Indianapolis, Indiana, September 8-12, 2013 (Oral presentation).

Shu, Z., Axe, L. Jahan, K. Ramanujachary, K. V., Leaching behavior of lead and chromium from bridge paint waste in the presence of steel grit, Session of Steel Bridges Committee, Transportation Research Board 92nd Annual Meeting, Washington, D.C., January 13-17, 2013.

Shu, Z., Axe, L. Jahan, K. Ramanujachary, K. V., Leaching behavior of lead and other metals in the presence of steel grit, Session of Environmental Chemistry for Fe-Oxides and Fe-Hydroxides, 244th American Chemical Society (ACS) National Meeting, Philadelphia, Pennsylvania, August 19-23, 2012.

Shu, Z., Axe, L. Jahan, K. Ramanujachary, K. V., Field methods for rapidly characterizing paint waste during bridge rehabilitation, Session of Environmental chemistry for a sustainable world, 243rd American Chemical Society (ACS) National Meeting, San Diego, California, March 25-29, 2012.

Nine task deliverables submitted and presented to NYSDOT

https://www.dot.ny.gov/divisions/engineering/technical-services/trans-r-and-d-repository/C-08-19%20%20Final%20Report_12-2013_0.pdf

Zhan Shu, Ph.D., P.E.

Project Manager

Certifications/Training

- OSHA - Hazardous Waste Operations and Emergency Response (OSHA 40-Hour HAZWOPER)
- 8 Hour OSHA Annual HAZWOPER Refresher
- Application of Risk Assessment as a Decision Making Tool for Contaminated Sites

Affiliations/Memberships

- American Society of Civil Engineering
- American Chemical Society
- New Jersey Society of Women Environmental Professionals
- Reviewer, Journal of Environmental Engineering Science
- Reviewer, Journal of Science of Total Environment
- Reviewer, Journal of Environmental Engineering

Lindsay A. Nunes, PG

Assistant Project Manager

Summary of Experience

Ms. Nunes is licensed Professional Geologist in New York State and has extensive experience with remediation projects in the NY/NJ area. She is experienced with database management and data analysis and technical report writing in compliance with regulatory agencies. Ms. Nunes is proficient in EQuIS and AutoCAD Civil 3D.

Relevant Project Experience

INDUSTRIAL/COMMERCIAL PROJECTS

Assistant Project Manager, GATX Corporation, Middlesex, New Jersey. Assists the Project Manager/Case LSRP and manages 20+ years-worth of soil and groundwater data in an EQuIS database. Soil and groundwater contamination includes metals, PCBs, PAHs, CVOCs and petroleum. Assisted the client with completing a Remedial Action Selection Report and quarterly groundwater monitoring reports.

Assistant Project Manager, McWilliams Forge, Rockleigh, New Jersey. Completed a Remedial Action Workplan for future site remedial activities. Developed and manages the soil and groundwater project database in EQuIS.

Assistant Project Manager, Former Reichold Chemical Facility, Linden, New Jersey. Developed and manages the sediment project database in EQuIS. Assisted the Project Manager with developing the technical report and statistics for a background sediment study.

DUE DILIGENCE/REAL ESTATE PROJECTS

Assistant Project Manager, Various New York State Sites. Performed third-party reviews of historical reports to advise the client on the status and completion of environmental conditions for pending real estate transactions.

Experience Prior to GZA

Database Manager/Associate Project Manager, Former Pharmaceutical Manufacturer, Nutley, New Jersey. Managed the tracking and organization of all field data regarding site-wide groundwater remedial investigations. Contributed to the preparation of technical reports for remedial investigations and annual progress reports. Generated maps with CAD. Key Contributions:

- Produced maps, RFA summaries and CSARS to facilitate project functions and processing.
- Established monitoring networks that met compliance regulations through the review of groundwater monitoring data.

Task Manager/Associate Project Manager, Confidential University, Newark, New Jersey. Oversaw all aspects of remedial investigation such as data analysis, CEA biennial certification, and project management. Key Contributions:

- Organized, reviewed and updated the well search and table, maps, GIS files and certification forms.

Education

B.S., 2011, Geology, Rutgers – The State University of NJ, Newark, NJ

Licenses & Registrations

Professional Geologist, New York, #001116

Areas of Specialization

- Remedial Investigations
- Remediation
- Data Management
- Data Analysis and Technical Report Writing
- EQuIS
- AutoCAD Civil3D
- Grapher
- ArcGIS

Lindsay A. Nunes, PG

Assistant Project Manager

- Contributed to preparation of work plans and project budgets in addition to managing expenditures and purchase orders.

Task Manager/Geologist, Dry Cleaning Facility, Flemington, New Jersey. Supervised the preparation and negotiation of bid documents for a wide range of projects and services. Key Contribution:

- Established pricing and scheduling for projects such as delineation soil borings, the removal and disposal of contaminated soil and holding pits, the on-site monitoring of well installations and the off-site monitoring of well cluster installations.

Graphics Manager/Geologist, Confidential Shopping Center, Park Ridge, New Jersey. Prepared and enhanced technical reports through the design and utilization of graphics packages. Key Contribution:

- Collaborated with the Licensed Site Remediation Professional (LSRP) to create and analyze potentiometric surface maps, contaminant isopleths, geologic cross-sections for remedial investigation and classification exception areas (CEA).

Database Manager/Geologist, Chemical Distribution Terminal, Carteret, New Jersey. Directed the logistics and management of the database associated with quarterly soil and ground water sampling. Built data tables and reports with an emphasis on soil and ground water quality and hydraulic gradients. Key Contributions:

- Optimized CAD tools to create maps that accurately illustrate soil and ground water data collected from field operations.
- Crafted and updated isopleth, potentiometric surface and cross section maps.

Database Manager/Geologist, Spectra Expansion Project, Multiple Locations, New York and New Jersey. Executed the sampling of soil and groundwater for characterization within the Spectra pipeline. Coalesced the collected data from linear project to expedite analysis and strategy development. Resolved sampling plans for the soil disposal facility. Key Contributions:

- Administered the installation of wells and soil borings.
- Wrote multiple sections of the Linear Construction Project Reports within both New Jersey and New York.

Certifications/Training

- 40-Hour OSHA HAZWOPER Training, including 8-hour Refresher
- 10-Hour OSHA Construction Training
- Practical Applications in Hydrogeology, Rutgers University

RESUME

Casey McGuffy

Scientist I

Education

M.S., 2017, Geophysics, University of Wyoming
B.S., 2014, Geology, Rutgers University - Newark

Areas of Specialization

- Phase I Site Assessments
- Soil & Groundwater Sampling
- Data Analysis and Report Preparation
- Geophysical Work

Summary of Experience

Casey McGuffy's field experience includes site/remedial investigations and remedial actions. She has completed soil, groundwater and air sampling; she has also contributed to research, data analysis and reporting efforts.

Prior to her work at GZA, she worked as a geologist for a Delaware-based engineering firm. She has a strong background working in outdoor conditions, including field work in New Mexico and Wyoming for her Master's thesis, as well as a two-week field project in sub-zero temperatures in the Norwegian arctic.

Relevant Project Experience

INDUSTRIAL/COMMERCIAL PROJECTS

Environmental Scientist, Gulton, Metuchen, New Jersey. Member of GZA team providing large-scale site investigation at a site where historic operations included alkaline battery and thermal printhead manufacturing. Field activities were intended to delineate extent of contamination by hazardous materials on site, including petroleum products, diluted acids, metal solutions, and chlorinated solvents. Field activities have included site-wide groundwater and soil sampling. Oversaw Membrane Interface Probe (MIP) data collection. Assisted with data analysis and Permit-By-Rule Monitoring report preparation.

Environmental Scientist, Asbury Park, New Jersey. Assisted GZA's LSRP with a soil and groundwater investigation at a site with gasoline-related contamination at a site with two former underground storage tanks (USTs). Oversaw removal of USTs, called in a spill to the NJDEP, oversaw the installation of monitoring wells and temporary wells, collected soil and groundwater samples.

Environmental Scientist, FEMA-funded Preliminary Assessments, Little Falls, New Jersey. Completed Preliminary Assessments on multiple residences located within a flood plain near the Passaic River. Flood prone homes will be demolished in effort to reclaim flood zone and reduce future flooding risk. Project was completed for the Township of Little Falls under a grant from FEMA. Conducted Phase II investigation at several homes revealing areas of concern (AOCs) that needed further investigation.

Environmental Scientist, 180 East 132nd Street, Bronx, New York. Prepared Phase I Environmental Site Assessment. Compiled Phase II workplan and completed Phase II field activities, including oversight of temporary well installation, oversight of soil vapor probe installation, groundwater sampling, soil sampling, and soil vapor sampling. Compiled Remedial Investigation Report (RIR) for NYC Office of Environmental Remediation (OER). Assisted with Brownfields Cleanup Program (BCP) application for the Site.

Environmental Scientist, UGI, Catasauqua, Pennsylvania. Assisted with Initial Investigation report preparation on a Manufactured Gas Plant (MGP) site.

Environmental Scientist, McWilliams Forge, Rockaway, New Jersey. Assisted with Passive Diffusion Bag (PDB) deployment and sampling, low-flow groundwater sampling, and stream sediment sampling

Casey McGuffy

Scientist I

Environmental Scientist, GATX, Middlesex, New Jersey. Participated in a large remedial investigation effort at a salvage yard in Middlesex County. The site was identified historically to operate as a rail car operation facility. Performed multiple rounds of low flow groundwater sampling of an on-site and off-site well network.

Environmental Scientist, Steel Craft, Newark, New Jersey. Member of GZA team providing environmental investigation and remediation services for a former industrial site. Conducted well gauging and baseline groundwater sampling prior to startup of groundwater remediation system. Sampled off-site monitoring wells via low flow sampling methods for volatile organic compounds (VOCs).

Environmental Scientist, PQ Corporation Remedial Investigation/Remediation, Rahway, New Jersey. Conducted quarterly well gauging and low-flow groundwater sampling for ongoing groundwater investigation.

Environmental Scientist, HOPES Daycare, Hoboken, New Jersey. Compiled Vapor Intrusion and Site Investigation reports for a daycare site at which GZA is providing multiple environmental services.

Environmental Scientist, Gerry Street Brownfield Redevelopment, Brooklyn, New York. Assisted with Long Island Well Permit Application for anticipated dewatering activities required at this brownfield site, which is enrolled in the NYSDEC Voluntary Clean-up Program. Contamination includes chlorinated solvent impacts to groundwater and soil vapor, and historic-fill-impacted soils.

Environmental Scientist, State and City Environmental Quality Reviews (SEQR/CEQR), Bronx, New York. Conducted SEQR/CEQRs for several properties in the Bronx, New York.

Environmental Scientist, Phase I Environmental Site Assessments. Completed many Phase I Environmental Site Assessments for properties located in New Jersey, New York, and Michigan.

Certifications/Training

- 40-Hour OSHA HAZWOPER

GZA GeoEnvironmental, Inc.