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REMEDIAL INVESTIGATION WORK PLAN
PROPOSED 4001 4TH AVENUE REDEVELOPMENT SITE
4001-4011 4TH AVENUE
BROOKLYN, NEW YORK

by
H & A of New York Engineering and Geology LLP
New York, New York

for
4 Ave Property LLC
40 Fulton Street, Suite 2002
New York, New York 10038

File No. 0210815
May 2024

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28 May 2024
File No. 0210815

New York State Department of Environmental Conservation
Region 2 – Division of Environmental Remediation
47-40 21st Street
Long Island City, New York 11101-5401

Attention: Ms. Jane O'Connell

Subject: Draft Remedial Investigation Work Plan
4001 4th Avenue Redevelopment Site
4001-4011 4th Avenue
Brooklyn, New York

Dear Ms. O'Connell,

H & A of New York Engineering and Geology, LLP (Haley & Aldrich of New York), on behalf of 4 Ave Property LLC, is submitting for the review and approval of the New York State Department of Environmental Conservation (NYSDEC) this Draft Remedial Investigation Work Plan (RIWP) for the proposed 4001 4th Avenue Redevelopment Site located at 4001-4011 4th Avenue in Brooklyn, New York (Site). This document was submitted as part of the Brownfield Cleanup Program Application for the Site. This RIWP has been developed based on the NYSDEC's "Technical Guidance for Site Investigation and Remediation" (DER-10, dated May 2010).

Please do not hesitate to contact us if there are any questions regarding this submittal or any other aspects of the project.

Sincerely yours,
H & A OF NEW YORK ENGINEERING AND GEOLOGY, LLP

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Certification

I, Mari C. Conlon, certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Remedial Investigation Work Plan[1] *was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).*

Final will be Certified

Mari C. Conlon, P.G. *Date*

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[1] *Certification applies to remedial investigation activities conducted after the execution of a Brownfield Cleanup Agreement (BCA).*

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List of Acronyms and Abbreviations

A	
Alpha	Alpha Analytical Laboratories, Inc.
Applicant	4 Ave Property LLC
ASP	Analytical Services Protocol
ASTM	American Society for Testing and Materials
AWQS	Ambient Water Quality Standards
B	
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BER	Business Environmental Risk
bgs	Below Ground Surface
Berninger	Berninger Environmental
BTEX	Benzene, toluene, ethylbenzene, and xylenes
C	
CAMP	Community Air Monitoring Plan
Castleton	Castleton Environmental Geologic Services DPC
CFR	Code of Federal Regulations
CREC	Controlled Recognized Environmental Conditions
D	
DER-10	Division of Environmental Remediation-10 *(specifically "May 2010 NYSDEC Technical Guidance for Site Investigation and Remediation")*
DOT	Department of Transportation
DUSR	Data Usability Summary Report
E	
EA	Exposure Assessment
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Approval Program
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
F	
ft	Feet
FSP	Field Sampling Plan
G	
GCM	Grossly Contaminated Material
GPR	Ground Penetrating Radar
GPRS	Ground Penetrating Radar Systems, LLC

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List of Acronyms and Abbreviations (continued)

H	
Haley & Aldrich of New York	H & A of New York Engineering and Geology, LLP
HASP	Health and Safety Plan
HREC	Historical Recognized Environmental Condition
I	
I.S.	Intermediate School
In.	inch
L	
L/min	Liters per Minute
LEG	Lesova Environmental Group
LNAPL	Light Non-Aqueous Phase Liquid
LSDF	Low-Sulfur Diesel Fuel
LUST	Leaking Underground Storage Tank
M	
mg/kg	Milligrams per Kilogram
MTA	Metropolitan Transportation Authority
MW	Monitoring Well
N	
NAPL/GCM	Non-aqueous Phase Liquid/Grossly Contaminated Material
NTU	Nephelometric turbidity unit
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O	
OSHA	Occupational Safety and Health Administration
P	
PBS	Petroleum Bulk Storage
PCB	Polychlorinated Biphenyl
PCE	Perchloroethylene/Tetrachloroethene
PFAS	Per- and Polyfluoroalkyl Substances
PID	Photoionization Detector
PPM	Parts per Million
PVC	Polyvinyl Chloride

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List of Acronyms and Abbreviations (continued)

Q	
QA/QC	Quality Assurance/Quality Control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional
QHHEA	Qualitative Human Health Exposure Assessment
R	
RAWP	Remedial Action Work Plan
REC	Recognized Environmental Condition
RI	Remedial Investigation
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
RRSCOs	Restricted-Residential Soil Cleanup Objectives
S	
SC	Site Characterization
SCO	Soil Cleanup Objective
SISGR	Supplemental Investigation Soil and Groundwater Report
SIM	Selective Ion Monitoring
Site	The property located at 4001-4011 4th Avenue, Brooklyn, New York
Sq Ft	Square Feet
SRIR	Supplemental Remedial Investigation Report
SVOC	Semi-Volatile Organic Compound
T	
TAL	Target Analyte List
TCL	Target Compound List
TOGS 1.1.1	Technical and Operational Guidance Series 1.1.1 *(Specifically "June 1998 NYSDEC Division of Water Technical and Operational Guidance Series 1.1.1 Ambient Water Quality Standards and Guidance Values, Class GA for the protection of a source of drinking water modified per the April 2000 addendum")*
U	
µg/L	Micrograms per Liter
UST	Underground Storage Tank
UUSCOs	Unrestricted Use Soil Cleanup Objectives
V	
VEFR	Vacuum Enhanced Fluid Recovery
VOCs	Volatile Organic Compounds

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1. Introduction

On behalf of the Applicant, 4 Ave Property LLC, H & A of New York Engineering and Geology LLP (Haley & Aldrich of New York) has prepared this Remedial Investigation Work Plan (RIWP) for the proposed 4001 4th Avenue Redevelopment Site, located at 4001-4011 4th Avenue (see Figure 1) in the Sunset Park neighborhood of Brooklyn, New York (Site). This RIWP was prepared in accordance with the regulations and guidance applicable to the Brownfield Cleanup Program (BCP).

The Site is identified as Block 714, Lot 6 on the New York City tax map. The Site is approximately 10,017 square feet (sq ft) (0.23 acres) and is currently improved with a retail petroleum station with a one-story convenience store and associated parking lot. The Site is bound by 40th Street followed by mixed-use commercial and residential buildings to the north, a commercial car wash and auto repair shop to the south, residential apartment buildings to the east, and 4th Avenue followed by Intermediate School (I.S.) 136 to the west. The Site location is shown on Figure 1. Existing Site features are shown on Figure 2.

To facilitate the implementation of the RIWP proposed herein, the existing one-story convenience store, above-grade product dispensers, and canopy will require demolition. Further details regarding the anticipated building demolition are discussed in Section 3.1.

The Site is located within a residential and commercial zoning district (R7-A and C2-4) with the intended post-development use as a school which will include one cellar level requiring excavation to approximately 12 feet (ft) below ground surface (bgs).

1.1 PURPOSE

The objective of the Remedial Investigation (RI) is to characterize the nature and extent of environmental impacts at the Site and to provide sufficient information to evaluate remedial alternatives, as required. Based on the current and former use of the Site, and previous investigations conducted, volatile organic compounds (VOCs) are the anticipated contaminants of concern. RIs were performed between 2019 and 2021 to further investigate and delineate the petroleum-related contamination in soil and groundwater at the Site. This RI revealed elevated VOC concentrations in soil samples collected throughout the Site and in groundwater from the one monitoring well installed at the Site. Additionally, light non-aqueous phase liquid (LNAPL) has been observed within the monitoring well installed at the Site. During monthly monitoring, LNAPL was observed at this monitoring well ranging from 0.5 ft to 12 ft in thickness between December 2023 and February 2024. A summary of the historical soil and groundwater analytical data collected at the Site is further detailed in Section 2.5 and displayed in Figure 4 and Figure 5.

Previous investigations did not comprehensively delineate the extent of soil and groundwater contamination on the Site. An RI will be performed upon approval of this RIWP. Results of the additional sample analyses will be used to confirm the results of the previous Site characterization activities, delineate any on-Site source(s), and determine a course for remedial action.

2. Background

2.1 CURRENT LAND USE

The Site is currently active, and the retail petroleum station operations are anticipated to cease in June 2024. The Site is improved with a one-story structure utilized as a convenience store, located in the eastern portion of the Site; petroleum pump islands, located beneath an overhead canopy in the central portion of the Site; four underground storage tanks (USTs), containing gasoline/ethanol or diesel, and associated fill ports, located south of the overhead canopy; and paved parking areas.

2.2 SITE HISTORY

Based on the findings of the March 2024 Phase I Environmental Site Assessment (ESA) prepared by Lesova Environmental Group (LEG), the Site was comprised of one tax lot developed with a one-story concrete structure and a gasoline filling/auto service station with one UST circa 1926 and a second lot which was vacant. The 1942 Sanborn map depicted the Site merged as one lot with previous use similar to the 1926 map with a garage to the south of the lot. The Site was operated as an automotive service station, including lubrication and minor repair services, with office use and a parking area until at least August 1965. The configuration of the Site changed and was identified with a cement brick one-story structure with a gasoline filling station circa 1970. A historical City Directory search indicated that the Site was operated as a gasoline filling station circa 1928, as an auto service station circa 1940 to 2000, and as a gasoline filling station again circa 2010 to 2024.

2.3 SURROUNDING LAND USE

The Site is located within an urban area of the Sunset Park neighborhood of Brooklyn, New York, characterized by low-rise commercial buildings, multi-story mixed-use commercial and residential buildings, and one- and two-family homes. The Metropolitan Transportation Authority (MTA) subway Q line is located approximately 0.4 miles east of the Site. Prospect Park is located approximately 0.3 miles north of the Site. There are two sensitive receptors within a 500-ft radius of the Site as listed below and shown in Figure 3:

1) Middle School (I.S.) 136 – Charles O. Dewey, 4004 4th Avenue, Brooklyn, New York 11232, listed as a prep school and middle school.
2) Family Day Care Graciela's Little Angels – 432 41st Street, Brooklyn, New York 11232, listed as a daycare.
3) Sunset Park Group Family – 338 42nd Street, Brooklyn, New York 11232, listed as a daycare.

Properties immediately surrounding the Site are zoned as the following: R7A residential with C2-4 commercial overlays for the north- and south-adjacent properties; R1-2 residential for the east-adjacent property; and C8-2 commercial/OP special purpose district (Ocean Parkway) for the west-adjacent property, across Coney Island Avenue.

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2.4 SURROUNDING LAND USE HISTORY

Upgradient adjoining properties surrounding the Site to the south have historically operated as filling stations and/or auto-related facilities from as early as the late 1920s until the early 2000s. The property adjoining the Site to the south currently operates as a car wash and auto repair shop. The southern property is listed in the Leaking Underground Storage Tank (LUST) and Spills databases for past releases of petroleum and/or hazardous materials. Of note, the southern adjoining site is referred to as the "Sunset Car Care Site" under New York State Department of Environmental Conservation (NYSDEC) No. 224244 which identified perchloroethylene (PCE) in groundwater above standard.

2.5 PREVIOUS INVESTIGATIONS

The following previous investigations and reports were prepared for the Site:

- 25 January 2019, Phase II ESA, prepared by Castleton Environmental Geologic Services DPC (Castleton)
- 17 June 2020, Supplemental Remedial Investigation Report (SRIR), prepared by Berninger Environmental (Berninger)
- 8 October 2021, Supplemental Investigation Soil and Groundwater Report (SISGR), prepared by Berninger
- 27 February 2024, Monitoring Report, prepared by Berninger
- 12 March 2024, Phase I ESA, prepared by LEG

A summary of environmental findings of these investigations is provided below.

January 2019 Phase II ESA Prepared by Castleton

A Phase II ESA report dated 25 January 2019, prepared by Castleton was available for review. Castleton conducted the Phase II ESA to evaluate the findings of a Phase I ESA dated 7 January 2019, prepared by Merritt Environmental Consulting Corp. (unavailable for review), with the goal of evaluating the impact of historic and current use of the Site as a gasoline filling station on subsurface conditions. The scope of work included geophysical investigation using ground penetrating radar (GPR) to search for subsurface anomalies indicative of USTs and to clear underground utilities, and soil sampling to characterize the Site soil and evaluate impacts pertaining to gasoline filling station operations.

The GPR survey identified nine suspected former USTs at the Site. Four suspect USTs were reportedly located under the canopy between the dispensers and five suspect USTs were reportedly located on the western portion of the Site. Currently, there are four 4,000-gallon active USTs which consist of three gasoline USTs and one diesel UST on the Site registered under Petroleum Bulk Storage (PBS) ID No. 2-349399 with a registration expiration date of 8 September 2028.

Six soil borings were advanced in the potential areas of USTs identified during the GPR survey. Petroleum-related VOCs exceeding the Restricted Residential Soil Cleanup Objectives (RRSCOs) were identified in three of six soil samples all located in the southwestern portion of the Site. Elevated VOCs included 1,2,4-trimethylbenzene (maximum concentration 1,200 milligrams per kilogram [mg/kg]),

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1,3,5-trimethylbenzene (maximum concentration 860 mg/kg), benzene (maximum concentration 20 mg/kg), ethyl benzene (maximum concentration 1,100 mg/kg), n-propylbenzene (maximum concentration 170 mg/kg), toluene (maximum concentration 1,500 mg/kg) and total xylenes (maximum concentration 2,300 mg/kg). Based on these findings, a spill was reported on 5 February 2019, and Spill No. 1811146 was assigned to the Site.

June 2020 SRIR Prepared by Berninger

An SRIR, dated 25 June 2020 and prepared by Berninger Berninger, was available for review. Berninger performed supplemental investigation work in April 2020 to vertically delineate the contamination discovered at previous sample locations advanced by Castleton and to attempt to locate the groundwater interface. In addition, Berninger installed test pits in the suspected UST areas to confirm the results of the 2019 GPR survey.

Berninger installed five test pits in the areas of the suspected USTs (B-1, B-2, B-3, B-6, and B-7), two soil borings including B-4 (located at former location SB-06) and B-5 (located between former locations SB-04 and SB-05), and one soil boring downgradient (B-8). While advancing the borings in the suspected UST area, a consistent refusal was achieved at 2.5 ft at all the test pit locations indicating the tanks were abandoned in place.

B-4 was installed to 30 ft bgs until refusal was encountered. Photoionization detector (PID) readings from 15 to 25 ft bgs averaged approximately 4,500 parts per million (ppm) and decreased at 30 ft bgs to 190 ppm. A soil sample was collected at 27.5 to 30 ft bgs and analyzed for VOCs. Benzene, toluene, ethylbenzene, and xylenes (BTEX) were identified above the NYSDEC New York Codes, Rules and Regulations (NYCRR) Part 375 Unrestricted Use Soil Cleanup Objectives (UUSCOs) but not exceeding RRSCOs. B-5 was installed to 32.5 ft bgs until refusal was encountered. A soil sample was collected at 30 to 32.5 ft bgs and analyzed for VOCs. VOCs were not detected above the NYSDEC NYCRR Part 375 UUSCOs.

B-8 was installed downgradient from B-4 and B-5 to 34 ft bgs until refusal was encountered. PID readings from 10 to 20 ft bgs ranged from 1,500 to 2,500 ppm and decreased to 25 ppm at 34 ft bgs.

Groundwater was not encountered during this investigation and Berninger assumed the groundwater interface to be approximately 50 ft bgs or more.

Berninger concluded that the results of the supplemental investigation indicated the need for remedial actions in soils specifically from 10 to 25 bgs.

October 2021 SISGR Prepared by Berninger

An SISGR dated October 2021, prepared by Berninger was available for review. The supplemental investigation aimed to analyze groundwater conditions in the area of highest soil contamination levels at boring location B-4 as reported in the June 2020 SRIR. On 10 June 2021, a monitoring well (MW-1) was installed to 50 ft below grade via air rotary and screened from 30 to 50 ft bgs with 2-inch (in.) PVC slot screen. Soil was reportedly observed saturated at 30 to 40 ft bgs but dry from 40 to 65 ft bgs.

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MW-1 was developed after installation and sampled for VOCs. Multiple VOCs were detected above the Technical and Operational Guidance Series 1.1.1 (TOGS 1.1.1) Ambient Water Quality Standards (AWQS) including 1,2,4,5-trimethylbenzene (39 micrograms per liter [µg/L]), 1,2,4-trimethylbenzene (790 µg/L), 1,2, dibromoethane (7 µg/L), 1,2-dichloroethane (2 µg/L), 1,2-dichloropropane (3 µg/L), 1,3,5-trimethylbenzene (240 µg/L), acetone (110 µg/L), benzene (12,000 µg/L), chloroform (34 µg/L), ethylbenzene (1,100 µg/L), isopropylbenzene (58 µg/L), m,p-xylene (4,100 µg/L), methyl tert butyl ether (170 µg/L), methylene chloride (11 µg/L), n-propylbenzene (120 µg/L), naphthalene (160 µg/L), o-xylene (12,000 µg/L), sec-butylbenzene (11 µg/L), toluene (21,000 µg/L), and trans-1,3-dichloropropene (1 µg/L).

At this location, soil was also logged to 65 ft bgs. Berninger reported that soil mainly consisted of semi-tight, brown, silty sand, with a perched water layer observed at approximately 30 ft bgs followed by clayey soils at 30 to 35 ft bgs, silty sands from 35 to 50 ft bgs, and silty loam at 50 to 65 ft bgs. PID readings were reported highest at 30 to 32.5 ft bgs reaching 1,000 ppm and steadily decreasing until found non-detect at 50 to 65 ft bgs. A soil sample was collected from 45 to 50 ft bgs and analyzed for VOCs. Analytical results did not detect VOCs above the UUSCOs.

February 2024 Monitoring Report Prepared by Berninger

A spill monitoring report dated 27 February 2024, prepared by Berninger, was available for review. Berninger performed monitoring activities associated with Spill No. 1811146 including monitoring MW-1 for depth to groundwater and presence of free phase product on a monthly basis. As part of the scope of work, Berninger bailed product as necessary and checked the Site for any spills from the pump island, tanks, or drains.

Product was bailed via vacuum-enhanced fluid recovery (VEFR) until the monitoring well was found dry. Berninger reported the recharge rate at 1 to 1.5 gallons per 30 minutes but noted recharge rates varied between events which impacted the volume of product/water mixture recovered each month. For the three months included in this monitoring report (December 2023 through February 2024), Berninger reported the following findings and actions:

Date	Depth To Water (ft bgs)	Depth To Product (ft bgs)	Product Thickness (ft)	VEFR Total Volume Purged (gallons)
28 December 2023	21.37	20.87	0.5	23
15 January 2024	24.10	22.80	1.3	15
27 February 2024	33.4	21.08	12	5

March 2024 Phase I ESA Prepared by LEG

A Phase I ESA report dated March 12, 2024, prepared by LEG in accordance with American Society for Testing and Materials (ASTM) E1527-13 and E1527-21, was available for review. This Phase I was completed to identify current or past Recognized Environmental Conditions (RECs), Historically Recognized Environmental Conditions (HRECs), Controlled Recognized Environmental Conditions (CRECs), Business Environmental Risks (BERs), and *de minimis* conditions within or around the Site. According to Sanborn maps reviewed in the Phase I ESA, the Site was developed with a one-story concrete structure and a gasoline filling/auto service station with one gasoline tank circa 1926, and the configuration of the Site had changed and was identified with a cement brick one-story structure with a

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gasoline filling station circa 1970. A Historical City Directory search indicated that circa 1928, the Site was utilized as a gasoline filling station, circa 1940 to 2000 as an auto service station, and circa 2010 to 2024 as a gasoline filling station again. LEG identified four 4,000-gallon active USTs on the lot consistent with PBS records (PBS No. 2-349399). To the date of the Phase I ESA, the Site is an active BP gasoline filling station with a convenience store. The findings of LEG's Phase I are summarized as follows:

On-Site RECs:

- Historic use of the Site and adjacent areas as gasoline filling stations, an auto repair shop, and a car wash, indicated by impacted subsurface conditions;
- Suspected presence of nine out-of-service USTs in the western section of the lot, with subsurface impact; and,
- Metallic anomaly was detected during the geophysical investigation, possibly a buried hydraulic lift due to historic use as an auto service station.

Off-Site RECs:

- A spill was recorded on the adjacent property along 4th Avenue with no remediation conducted, and the case was closed due to lack of response from the owner.

De Minimis Condition:

- One damaged drum near the dumpsters requiring legal disposal from the Site.

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3. Remedial Investigation

This section describes the field activities to be conducted during the RI and provides the sampling scope, objectives, methods, anticipated number of samples, and sample locations. A summary of the sampling and analysis plan is provided in Table 1 and Figure 2. The following activities will be conducted to fill data gaps and determine the nature and extent of contamination at the Site.

3.1 BUILDING DEMOLITION

The existing structures prohibit the implementation of a comprehensive RI due to the configuration of the interior structural walls, low ceilings, and the depth to the water table (estimated at 30 to 40 ft bgs). Limited building demolition will facilitate investigation and the implementation of a Site-wide GPR scan to evaluate the potential presence of historical tanks as detailed below in Section 3.2. Prior to the commencement of building demolition, 4 Ave Property LLC will obtain the required permits to perform the work.

3.2 UTILITY MARKOUT

A GPR scan will be performed following building demolition and prior to the commencement of any ground-intrusive activities. The GPR scan will potentially identify any underground structures including, but not limited to, utilities and USTs in preparation for the proposed sampling work. It is noted that borings may be adjusted based on the results of the GPR scan and any adjustments to the locations presented below will be communicated to the NYSDEC. Field personnel will mobilize to the Site to mark-out (with flagging or paint) the proposed soil sample locations. Prior to mobilization, 811-Dig Safe New York will be contacted to mark public underground utilities. If necessary, the adjacent property owners and/or private vendors will be contacted for assistance with marking out of utilities. Once the utilities are marked, field equipment and personnel will be mobilized to the Site.

3.3 SOIL SAMPLING

To further characterize soil conditions, additional on-Site soil samples will be collected to meet NYSDEC Division of Environmental Remediation (DER)-10 requirements for RIs. To characterize the potential for contamination migrating to or from the Site, off-Site soil samples will also be collected. The sampling and analysis plan is summarized in Table 1. Proposed sample locations are presented on Figure 2.

As part of this RI, a total of 15 soil borings will be installed to 35 ft bgs (or 5 ft into the water table, whichever is deeper, if soil boring is converted to a monitoring well) by a track-mounted direct-push drill rig (Geoprobe®), or other drilling technology as needed, operated by a licensed operator. Soil samples will be collected from dedicated liners using stainless-steel macrocores, casings, or sampling spoons. Samples will be collected using laboratory-provided clean bottle ware. VOC grab samples will be collected using terra cores or encores.

Soils will be logged continuously by a geologist or engineer using the Modified Burmister Soil Classification System. The presence of staining, odors, and PID readings will be noted. Sampling methods are described in the Field Sampling Plan (FSP) provided in Appendix A. A Quality Assurance Project Plan (QAPP) is provided in Appendix B. Laboratory data will be reported in Analytical Services Protocols (ASP) Category B deliverable format.

Soil samples representative of Site conditions will be collected at 12 locations widely distributed across the Site and at three off-Site locations within the sidewalk to the west of the Site, as shown on Figure 2. Up to four grab samples will be collected from each soil boring. One surface sample will be collected from the top 0 to 2 ft immediately beneath the impervious Site cover (i.e., surface soils). A second sample will be collected at the bottom of the observed fill layer, estimated at 5 to 7 ft bgs but subject to field observation. A third sample will be collected from development depth at 15 to 17 ft bgs, and a fourth sample will be collected from the 2-ft interval above the groundwater interface, estimated to be encountered between 20 to 30 ft bgs but subject to field observation. The number of samples collected during the RI may vary based on field conditions.

Soil samples will be analyzed for:

- Target Compound List (TCL) VOCs using U.S. Environmental Protection Agency (EPA) Method 8260B;
- TCL Semi-Volatile Organic Compounds (SVOCs) using EPA Method 8270C;
- Total Analyte List (TAL) Metals using EPA Method 6010;
- Polychlorinated Biphenyls (PCBs) using EPA Method 8082;
- TCL Pesticides using EPA Method 8081B;
- Per- and polyfluoroalkyl substances (PFAS) using EPA Method 1633; and,
- 1,4-dioxane using EPA Method 8270.

Samples to be analyzed for PFAS will be collected and analyzed in accordance with the NYSDEC-issued April 2023 “Sampling, Analysis, and Assessment of PFAS Under NYSDEC’s Part 375 Remedial Programs.” As needed, additional samples may be collected to satisfy waste characterization analytical needs for facilities located in neighboring states.

3.3.1 Grossly Contaminated Material/LNAPL Delineation

Previous investigations identified grossly contaminated material (GCM) and LNAPL in groundwater monitoring well MW-1 installed in the southwestern portion of the Site. In addition to the soil boring investigation and sampling plan described above, additional borings will be installed in the southwest portion of the Site to horizontally and vertically delineate the presence of LNAPL. Soil borings will be observed for visual and olfactory evidence of gross contamination along with screening by a PID. Shaker tests will be completed at 5-ft intervals from 15 ft bgs to 35 ft bgs to investigate the presence of LNAPL. If evidence of GCM/LNAPL is identified in intervals shallower than 15 ft, then additional shaker tests will be performed. If GCM/LNAPL is still observed at the base of the borings at 35 ft, borings will continue to be advanced and shaker tests performed in 5-ft intervals until the presence of GCM/LNAPL is no longer observed.

Shaker tests will be performed by collecting soil in a test jar, applying laboratory-provided distilled water to the test jar, agitating the soil/water within the covered test jar for 30 seconds, and allowing the test jar to sit immobile for at least 30 minutes. Upon completion of the process, the test jar will be observed for LNAPL separating from the water. The total number of shaker tests conducted during the RI may vary based on field conditions.

Upon confirmation of the extent of GCM/LNAPL, up to three additional monitoring wells may be installed as per specifications further detailed in Section 3.4 at the boundaries of the presumed LNAPL plume in order to monitor for plume migration.

3.4 GROUNDWATER SAMPLING

The purpose of the groundwater sampling is to obtain current groundwater data and analyze for additional parameters (i.e., PFAS and 1,4-dioxane) to meet NYSDEC DER-10 requirements for remedial investigations. Groundwater flow is presumed to flow from the east to the west and northwest.

Up to six 2-in. permanent monitoring wells will be installed to approximately 35 ft bgs or to at least 5 ft below the groundwater interface (if encountered at a shallower depth). Monitoring wells will have a 2-in. annular space and be installed using either #0 or #00 certified clean sand fill. Wells will be screened to straddle the groundwater interface, assumed to be encountered between approximately 25 to 35 ft bgs. The groundwater interface has been difficult to confirm from observations recorded in previous investigation reports with observations of perched groundwater at approximately 20 ft bgs. The groundwater interface depth will be evaluated during initial work on the implementation of this RI in order to establish the proper range of well screening in the field. Observations will be communicated with NYSDEC daily in field reports, further detailed in Section 8.1.

Monitoring wells will be developed by surging a pump in the well several times to pull fine-grained material from the well. Development will be completed until the water turbidity is 50 nephelometric turbidity units (NTU) or less or ten well volumes are removed, if possible. Groundwater sampling will occur at a minimum of one week after monitoring well development. The well casings will be surveyed by a New York State-licensed surveyor and gauged during a round of synoptic groundwater depth readings to facilitate the preparation of a groundwater contour map and to determine the direction of groundwater flow.

The sampling and analysis plan is summarized in Table 1. Proposed monitoring well locations are provided on Figure 2. Additional wells may be installed to monitor the presumed LNAPL plume located in the southwest portion of the Site as discussed in Section 3.3.1. Proposed locations will be dependent on field observation and will be communicated with NYSDEC in daily reporting.

The proposed six monitoring wells, as well as existing monitoring well MW-1, will be sampled and analyzed for:

- TCL VOCs using EPA Method 8260B;
- TCL SVOCs using EPA Method 8270C;
- Total Metals using EPA Methods 6010/7471;

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- Dissolved Metals using EPA Methods 6010/7471;
- PCBs using EPA Method 8082;
- TCL Pesticides using EPA Method 8081B;
- PFAS using EPA Method 1633; and,
- 1,4-dioxane using EPA Method 8270 SIM.

Samples to be analyzed for PFAS will be collected and analyzed in accordance with the NYSDEC-issued April 2023 "Sampling, Analysis and Assessment of PFAS."

Groundwater wells will be sampled using low-flow sampling methods as described in the FSP. Following the low-flow purge, samples will be collected from monitoring wells for analysis of the analytes mentioned above. Groundwater sampling will be conducted at least one week after monitoring well development.

The FSP presented in Appendix A details field procedures and protocols that will be followed during field activities. The QAPP presented in Appendix B details the analytical methods and procedures that will be used to analyze samples collected during field activities. Monitoring wells sampled for PFAS will be done following the purge and sampling method detailed in the NYSDEC guidance documents (see Appendix C).

3.5 INVESTIGATION-DERIVED WASTE

Following sample collection, boreholes that are not converted to monitoring wells will be backfilled with soil cuttings and an upper bentonite plug. Boreholes will be restored to grade with the surrounding area. If soil is identified as grossly contaminated, it will be separated and placed into a sealed and labeled New York State Department of Transportation (DOT)-approved 55-gallon drum pending characterization and off-Site disposal. Groundwater purged from the monitoring wells during development and sample collection will be placed into a DOT-approved 55-gallon drum pending off-Site disposal.

3.6 SOIL VAPOR SAMPLING

Samples will be collected in accordance with the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, October 2006). Seven soil vapor points will be installed to the 2-ft interval below the proposed development depth, approximately 15 to 17 ft bgs. In the event that groundwater is encountered at depths shallower than 15 ft bgs, soil vapor probes will be installed 1 to 2 ft above the groundwater interface. The vapor implants will be installed with a direct-push drilling rig (e.g., Geoprobe®) to advance a stainless-steel probe to the desired sample depth. Sampling will occur for the duration of two hours.

Soil vapor and ambient air samples will be collected in appropriately sized Summa® canisters that have been certified clean by the laboratory, and samples will be analyzed for VOCs by using EPA Method TO-15. Flow rates for both purging and sampling will not exceed 0.2 liters per minute (L/min). Sampling methods are described in the FSP provided in Appendix A.

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3.7 PROPOSED SAMPLING RATIONALE

Haley & Aldrich of New York has proposed the sampling plan described herein, and as shown on Figure 2, in consideration of observations reported during the March 2024 Phase I ESA and the findings and data generated from the 2019 Phase II ESA, the 2020 SRIR, the 2021 SISGR, and 2024 Monitoring Report as described in Section 2.5. Consideration was also taken regarding the Site-wide excavation to 15 ft bgs in the proposed redevelopment plans.

During the previous investigations conducted at the Site, six soil borings and one groundwater monitoring well were installed at the Site. However, the sample map from the previous investigations shows data gaps. Data gaps include the lack of full suite analysis of soil at the Site, lack of investigation of the central and eastern regions of the Site due to drilling constraints caused by the existing canopy and convenience store, lack of delineation of the horizontal and vertical extents of LNAPL at the Site, lack of soil sampling at the groundwater interface, and lack of soil vapor and groundwater sampling throughout the Site. Further investigation is also recommended to determine if the former USTs located in the western and central regions of the Site have impacted subsurface soil, groundwater, and soil vapor quality.

Sampling locations have been proposed to investigate areas of the Site with identified data gaps. Proposed sampling locations will include groundwater, soil, soil vapor, and ambient air sampling to address data gaps and confirm if there is an on-Site source of contamination or a potential off-Site source migrating onto the Site.

As groundwater flow is expected to be generally to the west and northwest, an investigation is proposed in the area off-Site and downgradient of the Site's spill case impacts to evaluate off-Site subsurface conditions. Under Volunteer status in the BCP, off-Site remediation is not required; however, preventative measures for any future contaminant migration may be considered as part of the future remedy.

The Proposed Sample Location Map (included as Figure 2) is designed to generate sufficient data to identify the source of contamination and classify subsurface conditions throughout the Site as a whole, with a particular focus on sample locations in areas of the Site that have historically revealed evidence of contamination.

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4. Green and Sustainable Remediation and Climate Resiliency

The work completed as part of this work plan will comply with all NYSDEC guidance documents, including DER-31: Green Remediation (NYSDEC, 2011). To ensure compliance with DER-31, the work will be completed using the best practices and techniques described below. Specific reporting methods relative to DER-31 are further described below.

4.1 BEST PRACTICES AND TECHNIQUES

DER-31 provides examples of best practices and techniques that could be applied during all phases of remediation (Attachment 1 of the DER-31 policy). In addition, the techniques identified below will be implemented at sites unless a site-specific evaluation demonstrates impracticability or favors an alternative green approach:

Practice/Technique	Potential Benefits[1]	Applicable to this Work Plan
Use renewable energy where possible or purchase Renewable Energy Credits	Reduce/supplement purchased energy use	
Use of remediation technologies with an intermittent energy supply (i.e., energy use during peak energy generation only)	Reduce energy use	X
Incorporate green building design	Reduce future use impacts	
Reuse existing buildings and infrastructure to reduce waste	Reduce waste and material use	
Reuse and recycle construction and demolition debris and other materials (i.e., grind waste wood and other organics for on-site use)	Reduce waste and material use	
Design cover systems to be usable (i.e., habitat or recreation)	Reduce construction impacts of future development	
Reduce vehicle idling	Reduce air emissions and fuel use	X
Use of Low-Sulfur Diesel Fuel (LSDF) or alternate fuels (i.e., biodiesel or E85) when possible	Reduce air emissions	
Sequence work to minimize double-handling of materials	Reduce construction impacts	X
Use energy-efficient systems and office equipment in the job trailer	Reduce energy use	X
[1]*Potential benefits listed are not comprehensive and will vary depending upon the site and implementation of the practice or technique.*		

In order to comply with the requirements of DER-31, the following actions will be taken:

1. All vehicles and fuel-consuming equipment on the Site will be shut off if not in use for more than three minutes;

2. Work will be sequenced, to the extent practicable, to allow the direct loading of waste containers for off-Site disposal;
3. Work will be sequenced, to the extent practicable, to limit unnecessary mobilizations to and throughout the Site; and,
4. To the extent practicable, energy-efficient systems and office equipment will be utilized.

4.2 REPORTING

All green and sustainable practices and techniques employed will be discussed in the forthcoming Remedial Investigation Report (RIR).

4.3 CLIMATE RESILIENCY EVALUATION

The Site is not located within a 100-year flood zone. The development plan is still under design but will incorporate consideration for resiliency to climate change including the design of a cover system that will mimic, rather than alter, the current setting in the vicinity of the Site and will provide pathways for surface runoff and resiliency against future flooding events. A Climate Screening Checklist is provided in Appendix D.

4.4 ENVIRONMENTAL FOOTPRINT ANALYSIS

While the remedy plan is still under development and is dependent on findings from implementing this investigation, a preliminary analysis has been performed using SiteWise™ for the investigation and baseline conceptual remedy. The conceptual remedy components included in this analysis include a 15 ft excavation, LNAPL recovery, groundwater monitoring and granular activated carbon treatment, and installation of a composite cover as an engineering control. Further refinements to the remedy, including additional engineering controls, will be incorporated into the alternatives analysis as part of a forthcoming Remedial Action Work Plan (RAWP). Results of the preliminary analysis, available in Appendix E, indicate the majority of greenhouse gas emissions, potentially exceeding 2,000 metric tons, to be the product of consumables and transportation associated with the conceptual remedy.

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5. Quality Assurance and Quality Control (QA/QC)

QA/QC procedures will be used to provide performance information with regard to the accuracy, precision, sensitivity, representation, completeness, and comparability associated with the sampling and analysis for this investigation. Field QA/QC procedures will be used (1) to document that samples are representative of actual conditions at the Site and (2) to identify possible cross-contamination from field activities or sample transit. Laboratory QA/QC procedures and analyses will be used to demonstrate whether analytical results have been biased either by interfering compounds in the sample matrix or by laboratory techniques that may have introduced systematic or random errors to the analytical process.

QA/QC procedures are defined in the QAPP included in Appendix B.

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6. Data Use

6.1 DATA SUBMITTAL

Analytical data will be supplied in ASP Category B Data Packages. If more stringent than those suggested by the EPA, the laboratory's in-house QA/QC limits will be utilized. Validated data will be submitted to the NYSDEC EQuIS database in an electronic data deliverable (EDD) package.

6.2 DATA VALIDATION

Data packages will be sent to a qualified data validation specialist to evaluate the accuracy and precision of the analytical results. A Data Usability Summary Report (DUSR) will be created to confirm the compliance of methods with the protocols described in the NYSDEC ASP. DUSRs will summarize and confirm the usability of the data for project-related decisions. Data validation will be completed in accordance with the DUSR guidelines from the NYSDEC DER. DUSRs will be included with the submittal of a RIR, further discussed in Section 8. Additional details on the DUSRs are provided in the QAPP in Appendix B.

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7. Project Organization

A project team for the Site has been created, based on qualifications and experience, with personnel suited for the successful completion of the project.

The NYSDEC-designated Case Manager, **PENDING**, will be responsible for overseeing the successful completion of the project work and adherence to the work plan on behalf of NYSDEC.

The NYSDOH-designated Case Manager, **PENDING**, will be responsible for overseeing the successful completion of the project work and adherence to the work plan on behalf of NYSDOH.

Mari C. Conlon, P.G., will be the Qualified Environmental Professional (QEP) and Principal-in-Charge for this work. In this role, Ms. Conlon will be responsible for the overall completion of each task as per the requirements outlined in this work plan and in accordance with the DER-10 guidance.

Zhan Shu, Ph.D., P.E., will be the Project Manager for this work. In this role, Ms. Shu will manage the day-to-day tasks including coordination and supervision of field engineers and scientists, adherence to the work plan, and oversight of project schedule. As the Project Manager, Ms. Shu will also be responsible for communications with the NYSDEC Case Manager regarding project status, schedule, issues, and updates for project work.

Philip DiNardo will be the field team leader for this work and will also act as the Quality Assurance Officer (QAO). The QAO will ensure the application and effectiveness of the QAPP by the analytical laboratory and the project staff, provide input to the field team as to corrective actions that may be required as a result of the above-mentioned evaluations, and prepare and/or review data validation and audit reports.

Zavier Richards will be the field person responsible for implementing the field effort for this work. Mr. Richards' responsibilities will include implementing the work plan activities and directing the subcontractors to ensure the successful completion of all field activities.

The drilling subcontractor will be Coastal Environmental Solutions, Inc. or Lakewood Environmental. In this role, Coastal Environmental Solutions, Inc. or Lakewood Environmental will provide environmental drilling to implement the scope of work outlined in this RIWP.

The geophysical survey contractor will be Ground Penetrating Radar Systems, LLC (GPRS). In this role, GPRS will conduct a geophysical survey throughout all accessible regions of the Site prior to the performance of ground-intrusive work.

The analytical laboratory will be Alpha Analytical (Alpha) of Westborough, Massachusetts, a New York Environmental Laboratory Approval Program (ELAP)-certified laboratory (No. 11148). Alpha will be responsible for analyzing samples as per the analyses and methods identified in Section 2.

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8. Health and Safety

8.1 HEALTH AND SAFETY PLAN

A Site-specific Health and Safety Plan (HASP) has been prepared in accordance with NYSDEC and NYSDOH guidelines and is provided as Appendix F of this work plan. The HASP includes a description of health and safety protocols to be followed by Haley & Aldrich of New York field staff during implementation of the RIWP, including monitoring within the work area, along with response actions should impacts be observed. The HASP has been developed in accordance with Occupational Health and Safety Administration (OSHA) 40 Code of Federal Regulations (CFR) Part 1910.120 regulatory requirements for use by Haley & Aldrich of New York field staff that will work at the Site during planned activities. Contractors or other personnel who perform work at the Site are required to develop their own HASP and procedures of comparable or higher content for their respective personnel in accordance with relevant OSHA regulatory requirements for work at hazardous waste sites as well as the general industry requirements as applicable based on the nature of work being performed.

8.2 COMMUNITY AIR MONITORING PLAN (CAMP)

The proposed investigation work will be completed outdoors at the Site. Where intrusive drilling operations with the potential to disturb the subsurface are planned, community air monitoring will be implemented to protect the downwind receptors. A Haley & Aldrich of New York representative will continually monitor the breathing air in the vicinity of the immediate work area using a hand-held PID to measure total VOCs in air at concentrations as low as 1 ppm. The air in the work zone also will be monitored for visible dust generation.

If VOC measurements above 5 ppm are sustained for 15 minutes or visible dust generation is observed, the ground-intrusive work will be temporarily halted and a more rigorous monitoring of VOCs and dust using recordable meters will be implemented in accordance with the NYSDOH Generic CAMP. During activities not disturbing the subsurface, personnel on the Site will monitor for visual dust and odors only. CAMP data will be provided to the NYSDEC in the daily reports, further detailed in Section 9. The NYSDOH CAMP guidance document is included in Appendix G.

8.3 QUALITATIVE HUMAN HEALTH EXPOSURE ASSESSMENT (QHHEA)

A comprehensive QHHEA (on Site and off Site) will be performed following the collection of all RI data. The exposure assessment will be performed in accordance with Section 3.3(c)4 of DER-10 and the NYSDOH guidance for performing a qualitative Exposure Assessment (EA) (DER-10; Appendix 3B). The results of the QHHEA will be provided in the RIR. According to Section 3.10 of DER-10, and the Fish and Wildlife Resources Impact Analysis Decision Key in DER-10, Appendix 3C, a Fish and Wildlife Exposure Assessment will be performed (if needed) based on the RI results.

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9. Reporting

9.1 DAILY REPORTING

Daily reports will be submitted to the NYSDEC and NYSDOH summarizing the Site activities completed during the RI. Daily reports will include a Site figure, a description of Site activities, a photo log, and a summary of community air monitoring performed. Daily reports will be submitted the following calendar day after Site work is completed.

9.2 REMEDIAL INVESTIGATION REPORT

Following completion of the work, a summary of the RI will be provided to the NYSDEC in an RIR to support the implementation of the proposed remedial action. The report will include:

- Summary of the RI activities;
- Figure showing sampling locations;
- Tables summarizing laboratory analytical results;
- Laboratory analytical data reports;
- Field sampling data sheets;
- Community air monitoring data;
- Findings regarding the nature and extent of contamination at the Site;
- Qualitative exposure assessment of any contamination from an on-Site source that has migrated off the Site; and,
- Conclusions and recommendations.

The RIR may be combined with the RAWP as an RIR/RAWP. The RIR/RAWP will include all data collected during the RI and adhere to the technical requirements of DER-10.

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10. Schedule

The Site owner plans to implement this RIWP promptly upon execution of a Brownfield Cleanup Agreement (BCA) and after approval of the RIWP. The below anticipated schedule highlights BCP milestones anticipated for the Site.

Anticipated RI/BCP Schedule	
BCP Application, RIWP, and 30-Day Public Comment Period (Concurrent with BCP application)	May 2024 to July 2024
Execute BCA	September 2024
NYSDEC Approval of RIWP, and Citizen Participation Plan	October 2024
RI Implementation	November 2024
RIR/RAWP Submittal and 45-Day Public Comment Period	December 2024 to February 2025
NYSDEC Approval of RIR/RAWP and issuance of Decision Document	March 2025

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References

1. Brownfield Cleanup Program Application. Proposed 4001 4th Avenue Redevelopment Site. 4001-4011 4th Avenue, Brooklyn, New York. Prepared for 4 Ave Property LLC by H & A of New York Engineering and Geology LLP for submission to the New York State Department of Environmental Conservation. Submitted in May 2024.

2. Phase II Environmental Site Assessment. 4001-4011 4th Avenue, Brooklyn, New York. Prepared by Castleton Environmental, prepared for Merritt Environmental Consulting Corp, 25 January 2019.

3. Supplemental Remedial Investigation Report. 4001-4011 4th Avenue, Brooklyn, New York. Prepared by Berninger Environmental, prepared for The Macchia Group, June 2020.

4. Supplemental Investigation Soil and Groundwater Report. 4001 4th Avenue, Brooklyn, New York. Prepared by Berninger Environmental, prepared for New York State Department of Conservation, October 2021.

5. Monitoring Report. 4001 4th Avenue, Brooklyn, New York. Prepared by Berninger Environmental, prepared for The Macchia Group, February 2024.

6. Phase I Environmental Site Assessment – 4001 4th Avenue, Brooklyn, New York. Prepared by Lesova Environmental Group, prepared for SLJ Management Group, LLC, 12 March 2024.

7. Program Policy DER-10, "Technical Guidance for Site Investigation and Remediation," New York State Department of Environmental Conservation. May 2010.

8. New York State Department of Environmental Conservation, Part 375 of Title 6 of the New York Compilation of Codes, Rules, and Regulations, Effective December 14, 2006.

9. New York State Department of Environmental Conservation, Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS), revised April 2023.

10. New York State Department of Health, Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006.

11. New York State Division of Water Technical and Operational Guidance Series (TOGS) (1.1.1) dated June 1998.

12. United States Environmental Protection Agency, Low Flow Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, EQASOP-GW 001, September 19, 2017.

TABLE

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TABLE 1
SAMPLING AND ANALYSIS PLAN
4001 4TH AVENUE
REMEDIAL INVESTIGATION WORK PLAN

Boring Number	Sample Depth	Units	Sample Rationale	Target Compound List VOCs (8260D/5035)	Target Compound List SVOCs (8270E)/(8270)	Total Analyte List Metals (6010D)/(6010)	PCBs (8082A)	Pesticides (8081B)	PFAS (1633)	1,4-Dioxane (8270)/(8270E-SIM)	Dissolved Target Analyte List Metals (6020)	VOCs (TO-15)
SOIL												
HA-SB1	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB2	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB3	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB4	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB5	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB6	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB7	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB8	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB9	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB10	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB11	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB12	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB13	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB14	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		
HA-SB15	0-0.5'	bgs	2-ft interval immediately below slab	X	X	X	X	X	X	X		
	5-7'	bgs	2-ft interval at base of observed fill layer	X	X	X	X	X	X	X		
	15-17'	bgs	Development depth	X	X	X	X	X	X	X		
	28-30'	bgs	2-ft interval above groundwater interface	X	X	X	X	X	X	X		

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TABLE 1
SAMPLING AND ANALYSIS PLAN
4001 4TH AVENUE
REMEDIAL INVESTIGATION WORK PLAN

Boring Number	Sample Depth	Units	Sample Rationale	Target Compound List VOCs (8260D/5035)	Target Compound List SVOCs (8270E)/(8270)	Total Analyte List Metals (6010D)/(6010)	PCBs (8082A)	Pesticides (8081B)	PFAS (1633)	1,4-Dioxane (8270)/(8270E-SIM)	Dissolved Target Analyte List Metals (6020)	VOCs (TO-15)
GROUNDWATER												
MW-1			Straddle water table	X	X	X	X	X	X	X	X	
MW-2			Straddle water table	X	X	X	X	X	X	X	X	
MW-3			Straddle water table	X	X	X	X	X	X	X	X	
MW-4			Straddle water table	X	X	X	X	X	X	X	X	
MW-5			Straddle water table	X	X	X	X	X	X	X	X	
MW-6			Straddle water table	X	X	X	X	X	X	X	X	
MW-7			Straddle water table	X	X	X	X	X	X	X	X	
SOIL VAPOR												
SV-1	15-17'	bgs	Development depth									X
SV-2	15-17'	bgs	Development depth									X
SV-3	15-17'	bgs	Development depth									X
SV-4	15-17'	bgs	Development depth									X
SV-5	15-17'	bgs	Development depth									X
SV-6	15-17'	bgs	Development depth									X
SV-7	15-17'	bgs	Development depth									X

Notes:
VOCs - Volatile Organic Compounds
SVOCs - Semi-volatile Organic Compounds
PCBs - Polychlorinated biphenyls
PFAS - Per- and Polyfluoroalkyl Substances
MW-1 - Existing monitoring well (installed by Berninger in October 2021)
MW-2, MW-3, MW-4, MW-5, MW-6 - Installation of new monitoring well
Samples to be collected in the 5 to 7 ft bgs range will be determined in the field and collected at base of fill layer as determined by visual logging
Sample depths may be adjusted based on visual, olfactory, and PID field screening
bgs - below grade surface

QA/QC samples include:
MS/MSD - 1 for every 20 samples
Trip Blanks - 1 per cooler per day of samples to be analyzed for VOCs
Field Blanks - 1 for every 20 samples
Duplicates - 1 for every 20 samples

Soil QA/QC Samples:
(2) Duplicates
(2) MS/MSD
(2) Field Blanks
(1) Trip Blank per day

Groundwater QA/QC Samples:
(1) Duplicate
(1) MS/MSD
(1) Field Blank
(1) Trip Blank per day

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FIGURES

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MAP SOURCE: USGS
SITE COORDINATES: 40°39'06"N, 74°00'24"W

HALEY ALDRICH

4001 4TH AVENUE
BROOKLYN, NEW YORK

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
APRIL 2024

FIGURE 1

GIS: \\haleyaldrich\share\CF\Projects\0210815\GIS\210815_4TH_AVE_BROOKLYN\210815_4TH_AVE_BROOKLYN.aprx - mmjones - 4/17/2024 9:47 AM

LEGEND

- SITE BOUNDARY
- PARCEL BOUNDARY
- APPROXIMATE LOCATION OF 4,000-GALLON UST
- LNAPL DELINEATION BORING
- SOIL BORING
- SOIL BORING/MONITORING WELL
- SOIL VAPOR POINT

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. PARCEL DATA SOURCE: KINGS COUNTY
3. AERIAL IMAGERY SOURCE: NEARMAP, 8 MARCH 2024

N

0 30 60
SCALE IN FEET

HALEY ALDRICH

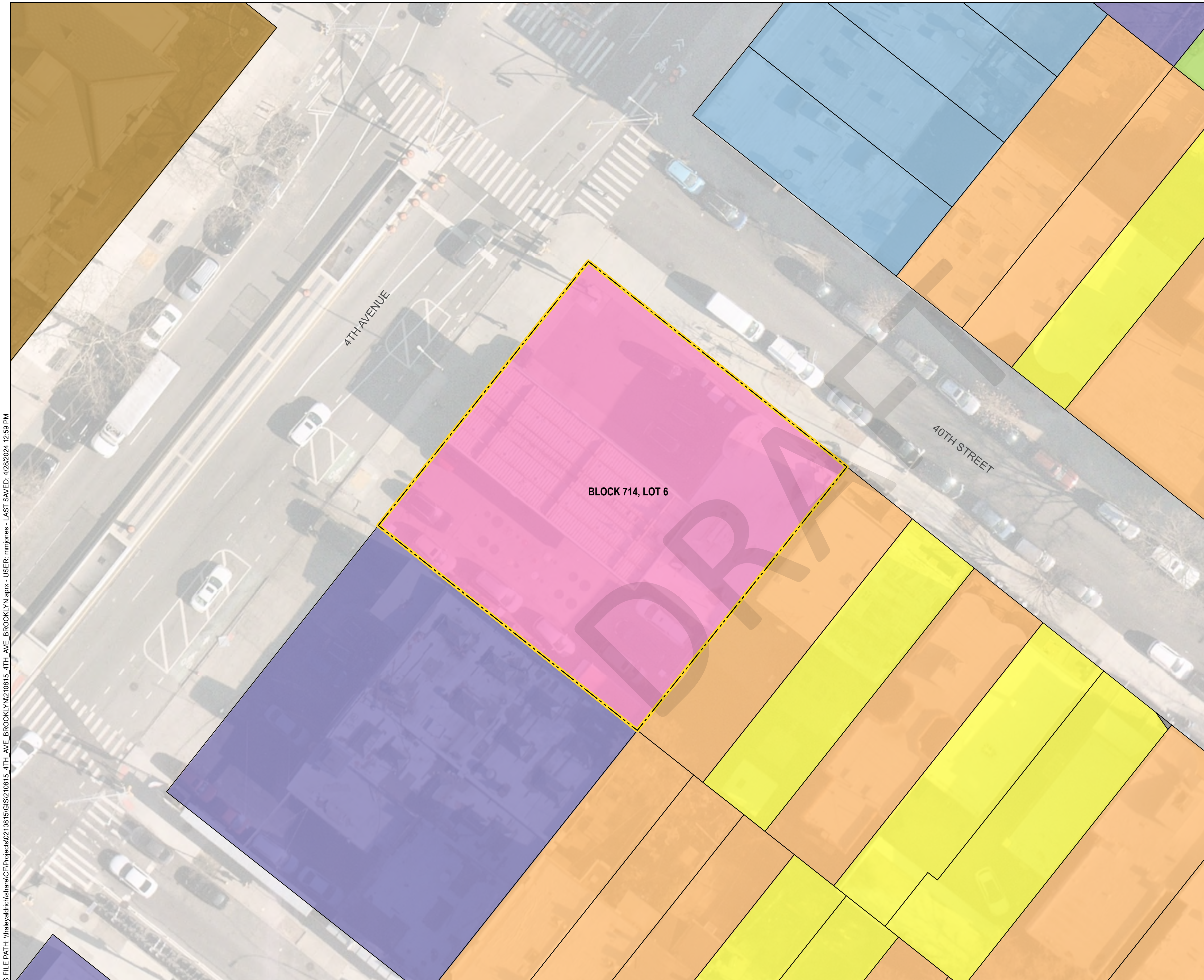
4001 4TH AVENUE
BROOKLYN, NEW YORK

PROPOSED SAMPLE LOCATION PLAN

MAY 2024

FIGURE 2

GIS FILE PATH: \\haleyaldrich\share\CF\Projects\0210815\GIS\210815_4TH_AVE_BROOKLYN\210815_4TH_AVE_BROOKLYN.aprx - USER: mmjones - LAST SAVED: 4/17/2024 1:31 PM



LEGEND

LAND USE

- ONE & TWO FAMILY BUILDINGS
- MULTI-FAMILY WALK-UP BUILDINGS
- MIXED RESIDENTIAL & COMMERCIAL
- COMMERICAL & OFFICE BUILDINGS
- INDUSTRIAL & MANUFACTURING
- TRANSPORTATION & UTILITY
- PUBLIC FACILITIES & INSTITUTIONS
- VACANT LAND
- SITE BOUNDARY
- PARCEL BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. PARCEL DATA SOURCE: KINGS COUNTY
3. AERIAL IMAGERY SOURCE: NEARMAP, 8 MARCH 2024

N

0 30 60

SCALE IN FEET

HALEY ALDRICH

4001 4TH AVENUE
BROOKLYN, NEW YORK

SURROUNDING LAND USE MAP

APRIL 2024

FIGURE 3

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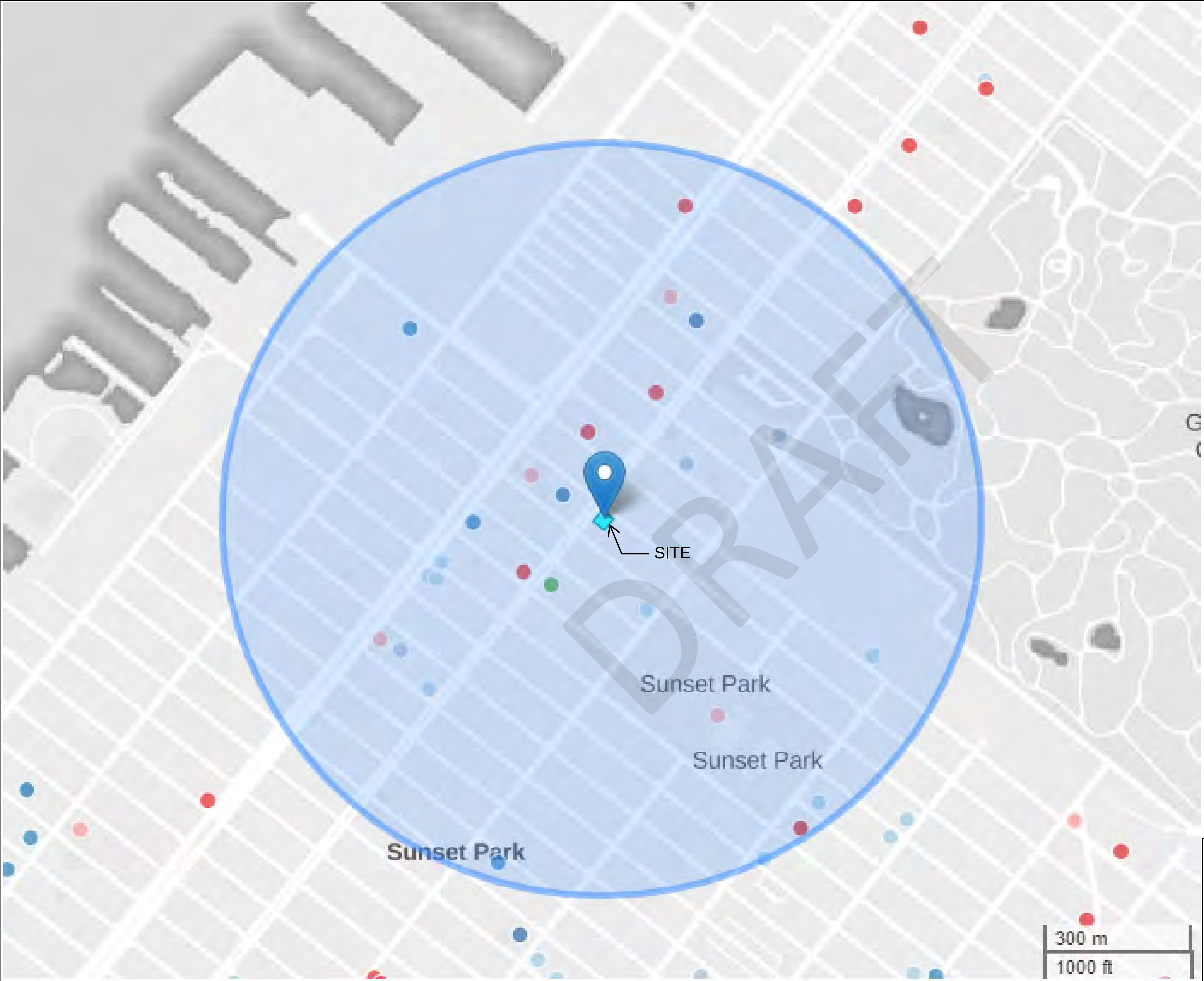

LEGEND

- ONE-HALF MILE RADIUS FROM SITE
- DAY CARE AND PRE-KINDERGARTEN
- HEALTH CARE
- HIGHER EDUCATION
- LIBRARIES
- PARKS AND PLAZAS
- SCHOOLS (K-12)

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. PARCEL DATA SOURCE: KINGS COUNTY
3. AERIAL IMAGERY SOURCE: NYC ENVIRONMENTAL COMMUNITY MAPPING PORTAL (NYC SPEED)

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4001 4TH AVENUE
BROOKLYN, NEW YORK

SURROUNDING SENSITIVE RECEPTORS MAP

MAY 2024

FIGURE 3A

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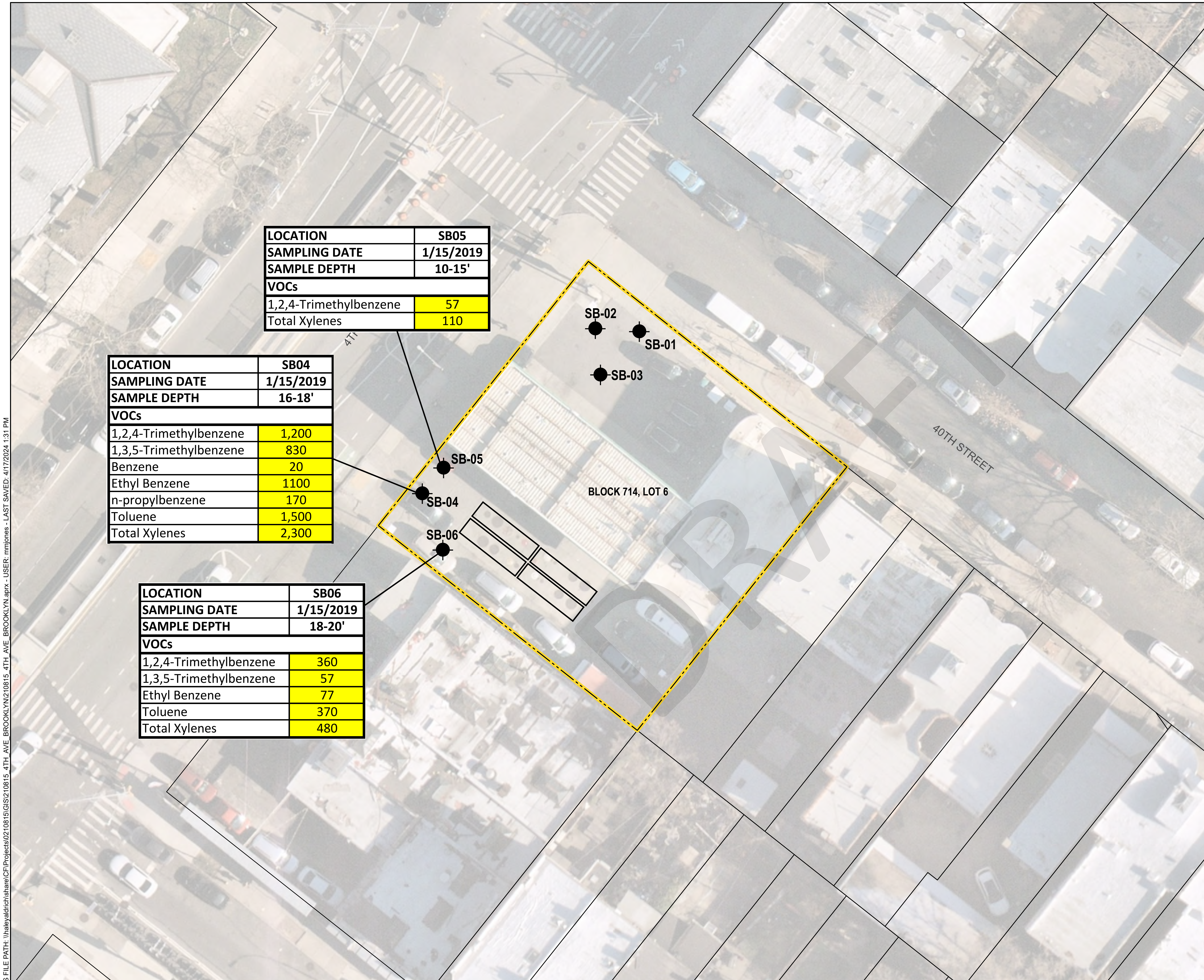

LOCATION	SB05
SAMPLING DATE	1/15/2019
SAMPLE DEPTH	10-15'
VOCs	
1,2,4-Trimethylbenzene	57
Total Xylenes	110

LOCATION	SB04
SAMPLING DATE	1/15/2019
SAMPLE DEPTH	16-18'
VOCs	
1,2,4-Trimethylbenzene	1,200
1,3,5-Trimethylbenzene	830
Benzene	20
Ethyl Benzene	1100
n-propylbenzene	170
Toluene	1,500
Total Xylenes	2,300

LOCATION	SB06
SAMPLING DATE	1/15/2019
SAMPLE DEPTH	18-20'
VOCs	
1,2,4-Trimethylbenzene	360
1,3,5-Trimethylbenzene	57
Ethyl Benzene	77
Toluene	370
Total Xylenes	480

LEGEND

- SITE BOUNDARY
- PARCEL BOUNDARY
- APPROXIMATE LOCATION OF 4,000-GALLON UST
- APPROXIMATE SOIL BORING LOCATION

Part 375 SCOs		
Analyte	NY-RESRR	Units
VOCs		
1,2,4-Trimethylbenzene	52	mg/kg
1,3,5-Trimethylbenzene	52	mg/kg
Benzene	4.8	mg/kg
Ethyl Benzene	41	mg/kg
n-Propylbenzene	100	mg/kg
Toluene	100	mg/kg
Total Xylenes	100	mg/kg

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. PARCEL DATA SOURCE: KINGS COUNTY
3. AERIAL IMAGERY SOURCE: NEARMAP, 8 MARCH 2024
4. SOIL SAMPLES COLLECTED BY CASTLETON ENVIRONMENTAL AND INCLUDED IN THE JANUARY 2019 PHASE II ENVIRONMENTAL SITE ASSESSMENT
5. EXCEEDANCES OF NYSDEC PART 375 RESTRICTED RESIDENTIAL SOIL CLEANUP OBJECTIVES SHOWN IN YELLOW

N

0 30 60
SCALE IN FEET

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4001 4TH AVENUE
BROOKLYN, NEW YORK

SOIL RESULTS EXCEEDANCES MAP

APRIL 2024

FIGURE 4

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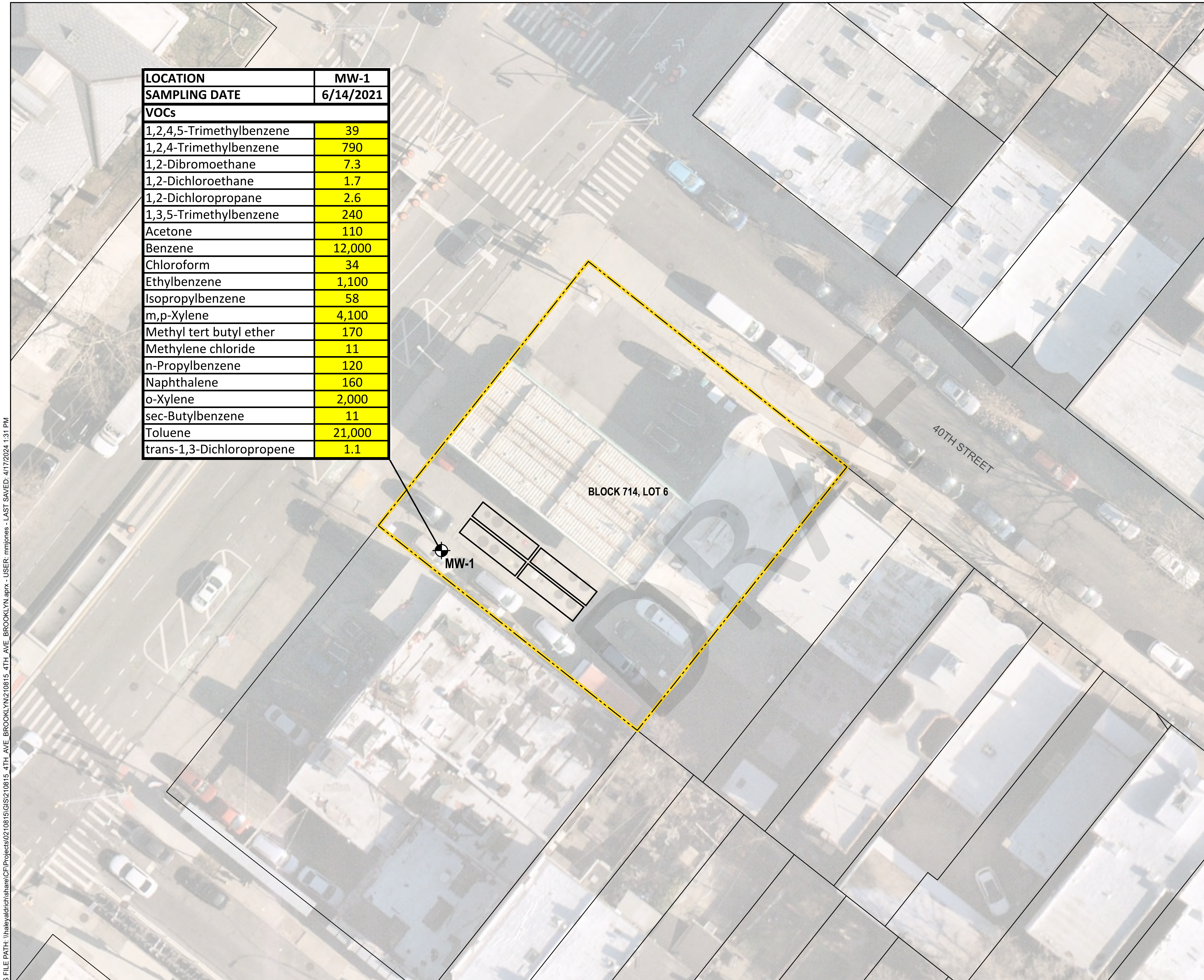

LOCATION	MW-1
SAMPLING DATE	6/14/2021
VOCs	
1,2,4,5-Trimethylbenzene	39
1,2,4-Trimethylbenzene	790
1,2-Dibromoethane	7.3
1,2-Dichloroethane	1.7
1,2-Dichloropropane	2.6
1,3,5-Trimethylbenzene	240
Acetone	110
Benzene	12,000
Chloroform	34
Ethylbenzene	1,100
Isopropylbenzene	58
m,p-Xylene	4,100
Methyl tert butyl ether	170
Methylene chloride	11
n-Propylbenzene	120
Naphthalene	160
o-Xylene	2,000
sec-Butylbenzene	11
Toluene	21,000
trans-1,3-Dichloropropene	1.1

LEGEND

- SITE BOUNDARY
- PARCEL BOUNDARY
- APPROXIMATE LOCATION OF 4,000-GALLON UST
- APPROXIMATE GROUNDWATER MONITORING WELL LOCATION

TOGS 1.1.1 AMBIENT WATER QUALITY STANDARDS		
Analyte	AWQS	Units
VOCs		
1,2,4,5-Trimethylbenzene	5	µg/L
1,2,4-Trimethylbenzene	5	µg/L
1,2-Dibromoethane	0.0006	µg/L
1,2-Dichloroethane	0.6	µg/L
1,2-Dichloropropane	1	µg/L
1,3,5-Trimethylbenzene	5	µg/L
Acetone	50	µg/L
Benzene	1	µg/L
Chloroform	7	µg/L
Ethylbenzene	5	µg/L
Isopropylbenzene	5	µg/L
m,p-Xylene	5	µg/L
Methyl tert butyl ether	10	µg/L
Methylene chloride	5	µg/L
n-Propylbenzene	5	µg/L
Naphthalene	10	µg/L
o-Xylene	5	µg/L
sec-Butylbenzene	5	µg/L
Toluene	5	µg/L
trans-1,3-Dichloropropene	0.4	µg/L

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. PARCEL DATA SOURCE: KINGS COUNTY
3. AERIAL IMAGERY SOURCE: NEARMAP, 8 MARCH 2024
4. GROUNDWATER SAMPLE COLLECTED BY BERNINGER ENVIRONMENTAL AND INCLUDED IN THE OCTOBER 2021 SUPPLEMENTAL INVESTIGATION SOIL AND GROUNDWATER REPORT
5. EXCEEDANCES OF NYSDEC TOGS 1.1.1 AMBIENT WATER QUALITY STANDARDS (AWQS) INDICATED IN YELLOW

HALEY ALDRICH

4001 4TH AVENUE
BROOKLYN, NEW YORK

GROUNDWATER RESULTS
EXCEEDANCES MAP

APRIL 2024

FIGURE 5

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APPENDIX A
Field Sampling Plan

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www.haleyaldrich.com

FIELD SAMPLING PLAN
4001 4TH AVE
BROOKLYN, NEW YORK

by
H & A of New York Engineering and Geology LLP
New York, New York

for
4th Ave Property LLC
40 Fulton Street, Suite 2002
New York, New York 10038

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File No. 0210815
May 2024

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1. Introduction

This Field Sampling Plan (FSP) has been prepared as a component of the Remedial Investigation Work Plan (RIWP) for the subject Site located at 4001 4th Avenue in Brooklyn, New York. This document was prepared to establish field procedures for field data collection to be performed in support of the RIWP for the Site.

The RIWP includes this Field Sampling Plan, a Quality Assurance Project Plan (QAPP), Health and Safety Plan (HASP), and Community Air Monitoring Plan (CAMP), which are included as part of this plan by reference.

The standard operating procedures (SOP) included as components of this plan will provide the procedures necessary to meet the project objectives. The SOPs will be used as reference for the methods to be employed for field sample collection and handling and the management of field data collected in the execution of the approved RIWP. The SOPs include numerous methods to execute the tasks of the RIWP. The Project Manager will select the appropriate method as required by field conditions and/or the objective the respective project task at the time of sample collection. Field procedures will be conducted in general accordance with the New York State Department of Conservation (NYSDEC) Technical Guidance for Site Investigation and Remediation (DER-10) and the Sampling, Analysis and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) under NYSDEC Part 375 Remedial Program when applicable.

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2. Field Program

This FSP provides the general purpose of sampling as well as procedural information. The RIWP contains the details on sampling and analysis (locations, depths, frequency, analyte lists, etc.).

The field program has been designed to acquire the necessary data to comply with the RIWP, and includes the following tasks:

- Soil sampling;
- Groundwater sampling;
- Soil vapor and ambient air sampling; and,
- Sampling of investigation of derived wastes (IDW) as needed for disposal.

Targeted Environmental Site Investigations (ESIs) have been performed at the Site between January 2019 and October 2021 to investigate the anticipated contaminants of concern identified based on the Site's current and former uses. While the limited sampling events provided preliminary site characterization data, it did not fully determine the nature and extent of soil and groundwater contamination at the Site, nor did it investigate the quality of soil vapor beneath the Site. In addition, further investigation is recommended to determine the presence of, and subsequently remove, suspected buried underground storage tanks (USTs), at the Site. The site characterization did not identify a source of contamination on the Site, therefore additional targeted soil, groundwater, and soil vapor sampling is proposed.

The SOPs presented herein may be changed as required, dependent on-site conditions, or equipment limitations, at the time of sample collection. If the procedures employed differ from the SOP, the deviations will be documented in the associated sampling report.

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3. Utility Clearance

Invasive remedial activities such as excavation or remedial construction activities require location of underground utilities prior to initiating work. Such clearance is sound practice in that it minimizes the potential for damage to underground facilities and more importantly, is protective of the health and safety of personnel. Under no circumstances will invasive activities be allowed to proceed without obtaining proper utility clearance by the appropriate public agencies and/or private entities. This clearance requirement applies to all work on both public and private properties, whether located in a dense urban area or a seemingly out-of-the-way rural location.

The drilling contractor performing the work will be responsible for obtaining utility clearance.

Utility clearance is required by law, and obtaining clearance includes contacting a public or private central clearance agency via a “one-call” telephone service and providing the proposed exploration location information. It is important to note that public utility agencies may not, and usually do not have information regarding utility locations on private property.

Before beginning subsurface work at any proposed exploration locations, it is critical that all readily available information on underground utilities and structures be obtained. This includes publicly available information as well as information in the possession of private landowners. Any drawings obtained must be reviewed in detail for information pertaining to underground utilities.

Using the information obtained, the site should be viewed in detail for physical evidence of buried lines or structures, including pavement cuts and patches, variation in or lack of vegetation, variations in grading, etc. Care must also be taken to avoid overhead utilities as well. Presence of surface elements of buried utilities should be documented, such as manholes, gas or water service valves, catch basins, monuments or other evidence.

Overhead utility lines must be considered when choosing exploration and excavation locations. Most states require a minimum of 10 ft of clearance between equipment and energized wires. Such separation requirements may also be voltage-based and may vary depending on state or municipality regulations. In evaluating clearance from overhead lines, the same restrictions may apply to “drops”, or wires on a utility pole connecting overhead and underground lines.

Using the information obtained and observations made, proposed exploration or construction locations should be marked in the field. Marking locations can be accomplished using spray paint on the ground, stakes, or other means. All markings of proposed locations should be made in white, in accordance with the generally accepted universal color code for facilities identification (AWMA 4/99):

- White: Proposed Excavation or Drilling location
- Pink: Temporary Survey Markings
- Red: Electrical Power Lines, Cables, Conduit and Lighting Cables
- Yellow: Gas, Oil, Steam, Petroleum or Gaseous Materials
- Orange: Communication, Alarm or Signal Lines, Cables or Conduits
- Blue: Potable Water
- Purple: Reclaimed Water, Irrigation and Slurry Lines
- Green: Sewers and Drain Lines

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In order to effectively evaluate the proposed locations with these entities, detailed, accurate measurements between the proposed locations and existing surface features should be obtained. Such features can be buildings, street intersections, utility poles, guardrails, etc.

Obtaining the utility clearance generally involves the designated “One-Call” underground facilities protection organization for the area and the landowner and one or both following entities:

- A third-party utility locator company will be utilized to locate underground utilities outside of the public right-of-way; and/or
- “Soft dig” excavation techniques to confirm or deny the presence of underground utilities in the area.

The proposed locations should be evaluated in light of information available for existing underground facilities. The detailed measurement information described above will be required by the “one call” agency. The owners of the applicable, participating underground utilities are obligated to mark their respective facilities at the site in the colors described above. Utility stake-out activities will typically not commence for approximately 72 hours after the initial request is made.

The public and private utility entities generally only mark the locations of their respective underground facilities within public rights-of-way. Determination of the locations of these facilities on private property will be the responsibility of the property owner or Contractor. If available information does not contain sufficient detail to locate underground facilities with a reasonable amount of confidence, alternate measures may be appropriate, as described below. In some cases, the memory of a long-time employee of a facility on private property may be the best or only source of information. It is incumbent on the Consultant or Contractor to exercise caution and use good judgement when faced with uncertainty.

Note: It is important to note that not all utilities are participants in the “one-call” agency or process. As such, inquiries must be made with the “one-call” agency to determine which entities do not participate, so they can be contacted independently.

Most utility stakeouts have a limited time period for which they remain valid, typically two to three weeks. It is critical that this time period be considered to prevent expiration of clearance prior to completion of the invasive activities, and the need to repeat the stake-out process.

Care must be exercised to document receipt of notice from the involved agencies of the presence or absence of utilities in the vicinity of the proposed locations.

Most agencies will generally provide a telephone or fax communication indicating the lack of facilities in the project area. If contact is not made by all of the agencies identified by the “one-call” process, do not assume that such utilities are not present. Re-contact the “one-call” agency to determine the status.

For complicated sites with multiple proposed locations and multiple utilities, it is advisable to arrange an on-site meeting with utility representatives. This will minimize the potential for miscommunication amongst the involved parties.

Completion of the utility stake out process is not a guarantee that underground facilities will not be encountered in excavations or boreholes; in fact, most “one-call” agencies and individual utilities do not

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offer guarantees, nor do they accept liability for damage that might occur. In areas outside the public right-of-way, a utility locating service may be utilized to locate underground utilities. It is advisable that any invasive activities proceed with extreme caution in the upper four to five feet in the event the clearance has failed to identify an existing facility. This may necessitate hand-excavation or probing to confirm potential presence of shallow utilities. If uncertainty exists for any given utility, extra activities can be initiated to solve utility clearance concerns. These options include:

- Screening the proposed work areas with utility locating devices, and/or hiring a utility locating service to perform this task.
- Hand digging, augering or probing to expose or reveal shallow utilities and confirm presence and location. In northern climates, this may require advancing to below frost line, typically at least four feet.
- Using “soft dig” techniques that utilize specialized tools and compressed air to excavate soils and locate utilities. This technique is effective in locating utilities to a depth of four to five feet.

Equipment/Materials:

- White Spray paint
- Wooden stakes, painted white or containing white flagging
- Color-code key
- Available drawings

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4. Field Data Recording

This procedure describes protocol for documenting the investigation activities in the field. Field data serves as the cornerstone for an environmental project, not only for site characterization but for additional phases of investigation or remedial design. Producing defensible data includes proper and appropriate recording of field data as it is obtained in a manner to preserve the information for future use. This procedure provides guidelines for accurate, thorough collection and preservation of written and electronic field data.

Field data to be recorded during the project generally includes, but is not limited to, the following:

- general field observations;
- numeric field measurements and instrument readings;
- quantity estimates;
- sample locations and corresponding sample numbers;
- relevant comments and details pertaining to the samples collected;
- documentation of activities, procedures and progress achieved;
- contractor pay item quantities;
- weather conditions;
- a listing of personnel involved in site-related activities;
- a log of conversations, site meetings and other communications; and,
- field decisions and pertinent information associated with the decisions.

4.1 Written Field Data

Written field data will be collected using a standardized, pre-printed field log form. In general, use of a field log form is preferable as it prompts field personnel to make appropriate observations and record data in a standardized format. This promotes completeness and consistency from one person to the next. Otherwise, electronic data collection using a handheld device produces equal completeness and consistency using a preformatted log form.

In the absence of an appropriate pre-printed form, the data should be recorded in an organized and structured manner in a dedicated project field log book. Log books must be hard cover, bound so that pages cannot be added or removed, and should be made from high-grade 50% rag paper with a water-resistant surface.

The following are guidelines for use of field log forms and log books:

1. Information must be factual and complete.
2. All entries will be made in black indelible ink with a ballpoint pen and will be written legibly. Do not use “rollerball” or felt tip-style pens, since the water-soluble ink can run or smear in the presence of moisture.
3. Field log forms should be consecutively numbered.
4. Each day’s work must start a new form/page.
5. At the end of each day, the current log book page or forms must be signed and dated by the field personnel making the entries.

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6. Make data entries immediately upon obtaining the data. Do not make temporary notes in other locations for later transfer; this only increases the potential for error or loss of data.
7. Entry errors are to be crossed out with a single line and initialed by the person making the correction.
8. Do not leave blanks on log forms, if no entry is applicable for a given data field, indicate so with "NA" or a dash ("--").
9. At the earliest practical time, photocopies or typed versions of log forms and log book pages should be made and placed in the project file as a backup in the event the book or forms are lost or damaged.
10. Log books should be dedicated to one project only, i.e., do not record data from multiple projects in one log book.

4.2 Electronic Data

Electronic data recording involves electronic measurement of field information through the use of monitoring instruments, sensors, gauges, and equipment controls. The following is a list of guidelines for proper recording and management of electronic field data:

1. Field data management should follow requirements of a project-specific data management plan (DMP), if applicable.
2. Use only instruments that have been calibrated in accordance with manufacturer's recommendations.
3. Usage of instruments, controls, and computers for the purpose of obtaining field data should only be performed by personnel properly trained and experienced in the use of the equipment and software.
4. Use only fully licensed software on personal computers and laptops.
5. Loss of electronic files may mean loss of irreplaceable data. Every effort should be made to back up electronic files obtained in the field as soon as practical. A backup file placed on the file server will minimize the potential for loss.
6. Electronic files, once transferred from field instruments or laptops to office computers, should be protected if possible, to prevent unwanted or inadvertent manipulation or modification of data. Several levels of protection are usually available for spreadsheets, including making a file "read-only" or assigning a password to access the file.
7. Protect CD disks from exposure to moisture, excessive heat or cold, magnetic fields, or other potentially damaging conditions.
8. Remote monitoring is often used to obtain stored electronic data from site environmental systems. A thorough discussion of this type of electronic field data recording is beyond the scope of this Section. Such on-site systems are generally capable of storing a limited amount of data as a comma-delimited or spreadsheet file. Users must remotely access the monitoring equipment files via modem or other access and download the data. In order to minimize the potential for loss of data, access and downloading of data should be performed frequently enough to ensure the data storage capacity of the remote equipment is not exceeded.

Equipment/Materials:

- Appropriate field log forms, or iPad® or equivalent with preformatted log forms.
- Indelible ball point pen (do not use "rollerball" or felt-tip style pens);
- Straight edge;

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- Pocket calculator; and
- Laptop computer (if required).

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5. Aquifer Characterization

This procedure describes measurement of water levels in groundwater monitoring.

A synoptic gauging round will be completed to obtain water levels in monitoring wells. Water levels will be acquired in a manner that provides accurate data that can be used to calculate vertical and horizontal hydraulic gradients and other hydrogeologic parameters. Accuracy in obtaining the measurements is critical to ensure the usability of the data.

5.1 Procedure

In order to provide reliable data, water level monitoring events should be collected over as short a period of time as practical. Barometric pressure can affect groundwater levels and, therefore, observation of significant weather changes during the period of water level measurements must be noted. Rainfall events and groundwater pumping can also affect groundwater level measurements. Personnel collecting water level data must note if any of these controls are in effect during the groundwater level collection period. Due to possible changes during the groundwater level collection period, it is imperative that the time of data collection at each station be accurately recorded. Water levels will also be collected prior to any sample collection that day.

The depth to groundwater will be measured with an electronic depth-indicating probe. Prior to obtaining a measurement, a fixed reference point on the well casing will be established for each well to be measured. Unless otherwise established, the reference point is typically established and marked on the north side of the well casing. Do not use protective casings or flush-mounted road boxes as a reference, due to the potential for damage or settlement. The elevation of the reference point shall be obtained by accepted surveying methods, to the nearest 0.01 ft.

The water level probe will be lowered into the well until the meter indicates (via indicator light or tone) the water is reached. The probe will be raised above water level and slowly lowered again until water is indicated. The cable will be held against the side of the inner protective casing at the point designated for water level measurements and a depth reading taken. This procedure will be followed three times or until a consistent value is obtained. The value will be recorded to the nearest 0.01 feet on the Groundwater Level Monitoring Report form.

Upon completion, the probe will be raised to the surface and together with the amount of cable that entered the well casing, will be decontaminated in accordance with methods described in Equipment Decontamination Procedure.

Equipment/Materials:

- Battery-operated, non-stretch electronic water level probe with permanent markings at 0.01 ft. increments, such as the Solinst Model 101 or equivalent.
- The calibrated cable on the depth indicator will be checked against a surveyor's steel tape once per quarter year. A new cable will be installed if the cable has changed by more than 0.01% (0.01 feet for a 100-foot cable). See also the Field Instruments – Use and Calibration Procedure.
- Groundwater Level Monitoring Report form.

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6. Sample Collection for Laboratory Analysis

6.1 SOIL SAMPLE COLLECTION FOR LABORATORY ANALYSIS

The following procedure is an introduction to soil sampling techniques and an outline of field staff responsibilities. All samples will be collected with dedicated sampling equipment.

6.1.1 Preparatory Requirements

Prior to the beginning of any remedial investigation or remedial measures activities, staff must attend a project briefing for the purpose of reviewing the project work plan, site and utility plans, drawings, applicable regulations, sampling location, depth, and criteria, site contacts, and other related documents. Health and safety concerns will be documented in a site-specific Health & Safety Plan.

A file folder for the field activities should be created and maintained such that all relevant documents and log forms likely to be useful for the completion of field activities by others are readily available in the event of personnel changes.

6.1.2 Soil Classification

The stratigraphic log is a factual description of the soil at the borehole location and is relied upon to interpret the soil characteristics, and their influence and significance in the subsurface environment. The accuracy of the stratigraphic log is to be verified by the person responsible for interpreting subsurface conditions. An accurate description of the soil stratigraphy is essential for a reasonable understanding of the subsurface conditions. Confirmation of the field description by examination of representative soil samples by the project geologist, hydrogeologist, or geotechnical engineer (whenever practicable) is recommended.

The ability to describe and classify soil correctly is a skill that is learned from a person with experience and by systematic training and comparison of laboratory results to field descriptions.

6.1.2.1 Data Recording

Several methods for classifying and describing soils or unconsolidated sediments are in relatively widespread use. The Unified Soil Classification System (USCS) is the most common. With the USCS, a soil is first classified according to whether it is predominantly coarse-grained or fine-grained.

The description of fill soil is similar to that of natural undisturbed soil except that it is identified as fill and not classified by USCS group, relative density, or consistency. Those logging soils must attempt to distinguish between soils that have been placed (i.e., fill) and not naturally present; or soils that have been naturally present but disturbed (i.e., disturbed native).

It is necessary to identify and group soil samples consistently to determine the subsurface pattern or changes and non-conformities in soil stratigraphy in the field at the time of drilling. The stratigraphy in each borehole during drilling is to be compared to the stratigraphy found at the previously completed

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boreholes to ensure that pattern or changes in soil stratigraphy are noted and that consistent terminology is used.

Visual examination, physical observations and manual tests (adapted from ASTM D2488, visual-manual procedures) are used to classify and group soil samples in the field and are summarized in this subsection. ASTM D2488 should be reviewed for detailed explanations of the procedures. Visual-manual procedures used for soil identification and classification include:

- visual determination of grain size, soil gradation, and percentage fines;
- dry strength, dilatancy, toughness, and plasticity (thread or ribbon test) tests for identification of inorganic fine-grained soil (e.g., CL, CH, ML, or MH); and
- soil compressive strength and consistency estimates based on thumb indent and pocket penetrometer (preferred) methods.

Soil characteristics like plasticity, strength and dilatancy should be determined using the Haley & Aldrich Soil Identification Field Form.

6.1.2.2 Field Sample Screening

Upon the collection of soil samples, the soil is screened with a photoionization detector (PID) for the presence of organic vapor. This is accomplished by running the PID across the soil sample. The highest reading and sustained readings are recorded.

Note: The PID measurement must be done upwind of the excavating equipment or any running engines so that exhaust fumes will not affect the measurements.

Another method of field screening is head space measurements. This consists of placing a portion of the soil sample in a sealable glass jar, placing aluminum foil over the jar top, and tightening the lid. Alternatively, plastic sealable bags may be utilized for field screen in lieu of glass containers. The jar should only be partially filled. Shake the jar and set aside for at least 30 minutes. After the sample has equilibrated, the lid of the jar can be opened; the foil is punctured with the PID probe and the air (headspace) above the soil sample is monitored. This headspace reading on the field form or in the field book is recorded. All head space measurements must be completed under similar conditions to allow comparability of results. Soil classification and PID readings will be recorded in the daily field report.

Equipment/Materials:

- Pocket knife or small spatula
- Small handheld lens
- Stratigraphic Log (Overburden) (Form 2001)
- Tape Measure
- When sampling for PFAS, acceptable materials for sampling include stainless steel, high density polyethylene (HDPE), PVC, silicone, acetate, and polypropylene.

6.1.3 Soil Sampling

Soil samples will be collected from acetate liners installed by a track-mounted direct push drill rig (Geoprobe®) or sonic drill rig (as necessary) operated by a licensed operator. Soil samples will be

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collected using a stainless-steel trowel or sampling spoon into laboratory provided sample containers. If it is necessary to relocate any proposed sampling location due to terrain, utilities, access, etc., the Project Manager must be notified, and an alternate location will be selected.

Prior to use and between each sampling location at an environmental site, the sampling equipment must be decontaminated. All decontamination must be conducted in accordance with the project specific plans or the methods presented in SOP 7.0.

6.1.4 Sampling Techniques

The following procedure describes typical soil sample collection methods for submission of samples to a laboratory for chemical analysis. The primary goal of soil sampling is to collect representative samples for examination and chemical analysis (if required).

Environmental soil samples obtained for chemical analyses are collected with special attention given to the rationale behind determining the precise zone to sample, the specifics of the method of soil extraction and the requisite decontamination procedures. Preservation, handling and glassware for environmental soil samples varies considerably depending upon several factors including the analytical method to be conducted, and the analytical laboratory being used.

Soil sampling for PFAS will be performed in accordance with NYSDEC, Division of Environmental Remediation, Sampling, Analysis and Assessment of PFAS under NYSDEC Part 375 Remedial Program (June 2021).

6.1.4.1 Grab Versus Composite Samples

A grab sample is collected to identify and quantify conditions at a specific location or interval. The sample is comprised of the minimum amount of soil necessary to make up the volume of sample dictated by the required sample analyses. Composite samples may be obtained from several locations or along a linear trend (in a test pit or excavation). Sampling may occur within or across stratification.

6.2 GROUNDWATER SAMPLE COLLECTION FOR LABORATORY ANALYSIS

The following section describes two techniques for groundwater sampling: "Low Stress/Low Flow Methods" and "Typical Sampling Methods."

"Low Stress/Low Flow" methods will be employed when collecting groundwater samples for the evaluation of volatile constituents (i.e., dissolved oxygen [DO]) or in fine-grained formations where sediment/colloid transport is possible. Analyses typically sensitive to colloidal transport issues include polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) and metals.

The "Typical Sampling Methods" will be employed where the collection of parameters less sensitive to turbidity/sediment issues are being collected (general chemistry, pesticides and other semi-volatile organic compounds [SVOCs]).

NOTE: If non-aqueous phase liquids (NAPL) (light or dense) are detected in a monitoring well, groundwater sample collection will not be conducted, and the Project Manager must be contacted to determine a course of action.

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6.2.1 Preparatory Requirements

- Verify well identification and location using borehole log details and location layout figures. Note the condition of the well and record any necessary repair work required.

- Prior to opening the well cap, measure the breathing space above the well casing with a handheld organic vapor analyzer to establish baseline breathing space VOC levels. Repeat this measurement once the well cap is opened. If either of these measurements exceeds the air quality criteria in the HASP, field personnel should adjust their PPE accordingly.

- Prior to commencing the groundwater purging/sampling, a water level must be obtained to determine the well volume for hydraulic purposes. In some settings, it may be necessary to allow the water level time to equilibrate. This condition exists if a watertight seal exists at the well cap and the water level has fluctuated above the top of screen; creating a vacuum or pressurized area in this air space. Three water level checks will verify static water level conditions have been achieved.

- Calculate the volume of water in the well. Typically overburden well volumes consider only the quantity of water standing in the well screen and riser; bedrock well volumes are calculated on the quantity of water within the open core hole and within the overburden casing.

6.2.2 Well Development

Well development is completed to remove fine grained materials from the well but in such a manner as to not introduce fines from the formation into the sand pack. Well development continues until the well responds to water level changes in the formation (i.e., a good hydraulic connection is established between the well and formation) and the well produces clear, sediment-free water to the extent practical.

- Attach appropriate pump and lower tubing into well.

- Gauge well and calculate one well volume. Turn on pump. If well runs dry, shut off pump and allow to recover.

- Surging will be performed by raising and lowering the pump several times to pull fine-grained material from the well. Periodically measure turbidity level using a La Motte turbidity reader.

- The second and third steps will be repeated until turbidity is less than 50 nephelometric turbidity units (NTU) or when 10 well volumes have been removed.

- All water generated during cleaning and development procedures will be collected and contained on site in 55-gallon drums for future analysis and appropriate disposal.

Equipment:

- Appropriate health and safety equipment
- Knife

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- Power source (generator)
- Field book
- Well Development Form (Form 3006)
- Well keys
- Graduated pails
- Pump and tubing
- Cleaning supplies (including non-phosphate soap, buckets, brushes, laboratory-supplied distilled/deionized water, tap water, cleaning solvent, aluminum foil, plastic sheeting, etc.)
  Water level meter

6.2.3 Well Purging and Stabilization Monitoring (Low Stress/Low Flow Method)

The preferred method for groundwater sampling will be the low stress/low flow method described below.

- Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified by the project requirements. The pump intake must be at the midpoint of the well screen to prevent disturbance and resuspension of any sediment in the screen base.

- Before starting the pump, measure the water level again with the pump in the well leaving the water level measuring device in the well when completed.

- Purge the well at 100 to a maximum of 500 milliliters per minute (mL/min). During purging, the water level should be monitored approximately every 5 minutes, or as appropriate. A steady flow rate should be maintained that results in drawdown of 0.3 feet or less. The rate of pumping should not exceed the natural flow rate conditions of the well. Care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record adjustments made to the pumping rates and water levels immediately after each adjustment.

- During the purging of the well, monitor and record the field indicator parameters (pH, temperature, conductivity, oxidation-reduction (redox) reaction potential (ORP), dissolved oxygen (DO), and turbidity) approximately every five minutes. Stabilization is considered to be achieved when the final groundwater flow rate is achieved, and three consecutive readings for each parameter are within the following limits:

  - pH: 0.1 pH units of the average value of the three readings;
  - Temperature: 3 percent of the average value of the three readings;
  - Conductivity: 0.005 milliSiemen per centimeter (mS/cm) of the average value of the three readings for conductivity <1 mS/cm and 0.01 mS/cm of the average value of the three readings for conductivity >1 mS/cm;
  - ORP: 10 millivolts (mV) of the average value of the three readings;
  - DO: 10 percent of the average value of the three readings; and
  - Turbidity: 10 percent of the average value of the three readings, or a final value of less than 50 nephelometric turbidity units (NTU).

- The pump must not be removed from the well between purging and sampling.

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6.2.4 Sampling Techniques

- If an alternate pump is utilized, the first pump discharge volumes should be discarded to allow the equipment a period of acclimation to the groundwater.

- Samples are collected directly from the pump with the groundwater being discharged directly into the appropriate sample container. Avoid handling the interior of the bottle or bottle cap and don new gloves for each well sampled to avoid contamination of the sample.

- Order of sample collection:

  - Polyfluoroalkyl substances (PFAS)
  - Volatile organic compounds (VOC)
  - 1,4-Dioxane
  - Semi-volatile organic compounds (SVOC)
  - Total Analyte List (TAL) metals
  - PCBs, pesticides, and herbicides

- 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.

- For low stress/low flow sampling, samples should be collected at a flow rate between 100 and 500 mL/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 feet.

- The pumping rate used to collect a sample for VOC should not exceed 100 mL/min. Samples should be transferred directly to the final container 40 mL glass vials completely full and topped with a Teflon cap. Once capped the vial must be inverted and tapped to check for headspace/air presence (bubbles). If air is present, the sample will be discarded, and recollected until free of air.

- Groundwater sampling for PFAS will be performed in accordance with NYSDEC, Division of Environmental Remediation, Sampling, Analysis and Assessment of PFAS under NYSDEC Part 375 Remedial Program (June 2021)

- All samples must be labeled with:

  - A unique sample number
  - Date and time
  - Parameters to be analyzed
  - Project Reference ID
  - Samplers initials

- Labels should be written in indelible ink and secured to the bottle with clear tape.

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Equipment/Materials:

- pH meter, conductivity meter, DO meter, ORP meter, nephelometer, temperature gauge
- Field filtration units (if required)
- Purging/sampling equipment
  - Peristaltic Pump
- Water level probe
- Sampling materials (containers, log book/forms, coolers, chain of custody)
- Work Plan
- Health and Safety Plan
- When sampling for PFAS, acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene.

Note: Peristaltic pump use for VOC collection is not acceptable on NYSDEC/EPA/RCRA sites; this technique has gained acceptance in select areas where it is permissible to collect VOCs using a peristaltic pump at a low flow rate (e.g. Michigan).

Note: 1,4-dioxane and PFAS purge and sample techniques will be conducted following the NYSDEC guidance documents (see Appendix D of the RIWP). Acceptable groundwater pumps include stainless steel inertia pump with HDPE tubing, peristaltic pump equipped with HDPE tubing and silicone tubing, stainless steel bailer with stainless steel ball or bladder pump (identified as PFAS-free) with HDPE tubing.

Field Notes:

- Field notes must document all the events, equipment used, and measurements collected during the sampling activities. Section 2.0 describes the data/recording procedure for field activities.
- The log book should document the following for each well sampled:
  - Identification of well
  - Well depth
  - Static water level depth and measurement technique
  - Sounded well depth
  - Presence of immiscible layers and detection/collection method
  - Well yield – high or low
  - Purge volume and pumping rate
  - Time well purged
  - Measured field parameters
  - Purge/sampling device used
  - Well sampling sequence
  - Sampling appearance
  - Sample odors
  - Sample volume
  - Types of sample containers and sample identification
  - Preservative(s) used
  - Parameters requested for analysis
  - Field analysis data and method(s)
  - Sample distribution and transporter
  - Laboratory shipped to
  - Chain of custody number for shipment to laboratory

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- Field observations on sampling event
- Name collector(s)
- Climatic conditions including air temperature
- Problems encountered and any deviations made from the established sampling protocol.

A standard log form for documentation and reporting groundwater purging and sampling events are presented on the Groundwater Sampling Record, Low Flow Groundwater Sampling Form, and Low Flow Monitored Natural Attenuation (MNA) Field Sampling Form. Refer to Appendix A for example field forms.

Groundwater/Decon Fluid Disposal:

- Groundwater disposal methods will vary on a case-by-case basis but may range from:
  - Off-site treatment at private treatment/disposal facilities or public owned treatment facilities
  - On-site treatment at Facility operated facilities
  - Direct discharge to the surrounding ground surface, allowing groundwater infiltration to the underlying subsurface regime
- Decontamination fluids should be segregated and collected separately from wash waters/groundwater containers.

6.3 SOIL VAPOR SAMPLING

The following procedure is an introduction to soil vapor sampling techniques and an outline of field staff responsibilities.

6.3.1 Preparatory Requirements

Prior to collecting the field sample, ensure the stainless-steel or polyethylene soil vapor probe has been installed to the desired depth and sealed completely to the surface using a material such as bentonite. As part of the vapor intrusion evaluation, a tracer gas should be used in accordance with NYSDOH protocols to serve as a quality assurance/quality control (QA/QC) to verify the integrity of the soil vapor probe seal. A container (box, plastic pail, etc.) will serve to keep the tracer gas in contact with the probe during testing. A portable monitoring device will be used to analyze a sample of soil vapor for the tracer gas prior to sampling. If the tracer sample results show a significant presence of the tracer, the probe seals will be adjusted to prevent infiltration. At the conclusion of the sampling round, tracer monitoring should be performed a second time to confirm the integrity of the probe seals.

6.3.2 Sampling Techniques

Samples will be collected in appropriately sized Summa canisters that have been certified clean by the laboratory and samples will be analyzed by using USEPA Method TO-15. Flow rate for both purging and sampling will not exceed 0.2 L/min. One to three implant volumes shall be purged prior to the collection of any soil-gas samples. A sample log sheet will be maintained summarizing sample identification, date and time of sample collection, sampling depth, identity of samplers, sampling methods and devices, soil vapor purge volumes, volume of the soil vapor extracted, vacuum of canisters before and after the samples are collected, apparent moisture content of the sampling zone, and chain of custody protocols.

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6.4 SAMPLE HANDLING AND SHIPPING

Sample management is the continuous care given to each sample from the point of collection to receipt at the analytical laboratory. Good sample management ensures that samples are properly recorded, properly labeled, and not lost, broken, or exposed to conditions which may affect the sample's integrity.

All sample submissions must be accompanied with a chain of custody (COC) document to record sample collection and submission. Personnel performing sampling tasks must check the sample preparation and preservation requirements to ensure compliance with the Quality Assurance Project Plan.

The following sections provide the minimum standards for sample management.

6.4.1 Sample Handling

Prior to entering the field area where sampling is to be conducted, especially at sites with defined exclusion zones, the sampler should ensure that all materials necessary to complete the sampling are on hand. If samples must be maintained at a specified temperature after collection, dedicated coolers and ice must be available for use. Conversely, when sampling in cold weather, proper protection of water samples, trip blanks, and field blanks must be considered. Sample preservation will involve pH adjustment, cooling to 4°C, and sample filtration and preservation.

6.4.2 Sample Labeling

Samples must be properly labeled immediately upon collection.

Note that the data shown on the sample label is the minimum data required. The sample label data requirements are listed below for clarity.

- Project name
- Sample name/number/unique identifier
- Sampler's initials
- Date of sample collection
- Time of sample collection
- Analysis required
- Preservatives

To ensure that samples are not confused, a clear notation should be made on the container with a permanent marker. If the containers are too soiled for marking, the container can be put into a "zip lock" bag which can then be labeled.

All sample names will be as follows:

- Sample unique identifier: Enter the sample name or number. There should be NO slashes, spaces or periods in the date.
- Date: Enter the six-digit date when the sample was collected. Note that for one-digit days, months, and/or years, add zeros so that the format is MMDDYY (050210). There should be NO slashes, dashes, or periods in the date.

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The QA/QC samples will be numbered consecutively as collected with a sample name, date and number of samples collected throughout the day (i.e., when multiple QA/QC samples are collected in one day).

Examples of this naming convention are as follows:

Sample Name:	Comments
TB-050202-0001	TRIP BLANK
TB-050202-0002	TRIP BLANK
FD-050202-0001	FIELD DUPLICATE
FD-050202-0002	FIELD DUPLICATE

NOTE: The QA/QC Sample # resets to 0001 EACH DAY, this will avoid having to look back to the previous day for the correct sequential number.

6.4.3 Field Code

The field code will be written in the 'Comments' field on the chain of custody for EVERY sample but will not be a part of the actual sample name. Enter the one/two-character code for type of sample (must be in CAPITALS):

N	Normal Field Sample
FD	Field Duplicate (note sample number (i.e. , 0001) substituted for time)
TB	Trip Blank (note sample number (i.e., 0001) substituted for time)
EB	Equipment Blank (note sample number (i.e., 0001) substituted for time)
FB	Field Blank (note sample number (i.e., 0001) substituted for time)
KD	Known Duplicate
FS	Field Spike Sample
MS	Matrix Spike Sample (note on 'Comments' field of COC – laboratory to spike matrix.
MD	Matrix Spike Duplicate Sample (note on 'Comments' field of COC – laboratory to spike matrix.
RM	Reference Material

The sample labeling – both chain and sample bottles must be EXACTLY as detailed above. In addition, the Field Sample Key for each sample collected must be filled out.

6.4.4 Packaging

Sample container preparation and packing for shipment should be completed in a well-organized and clean area, free of any potential cross contamination. The following is a list of standard guidelines which must be followed when packing samples for shipment.

- Double bag ice in "Zip Lock" bags.
- Double check to ensure trip and temperature blanks have been included for all shipments containing VOCs, or where otherwise specified in the QAPP.
- Enclose the Chain of Custody form in a "Zip Lock" bag.
- Ensure custody seals (two, minimum) are placed on each cooler. Coolers with hinged lids should have both seals placed on the opening edge of the lid. Coolers with "free" lids should have seals placed on opposite diagonal corners of the lid. Place clear tape over custody seals.

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- Containers should be wiped clean of all debris/water using paper towels (paper towels must be disposed of with other contaminated materials).
- Clear, wide packing tape should be placed over the sample label for protection.
- Do not bulk pack. Each sample must be individually padded.
- Large glass containers (1 liter and up) require much more space between containers.
- Ice is not a packing material due to the reduction in volume when it melts.

Note: Never store sterile sample containers in enclosures containing equipment which use any form of fuel or volatile petroleum-based product. When conducting sampling in freezing conditions at sites without a heated storage area (free of potential cross contaminants), unused trip blanks should be isolated from coolers immediately after receipt. Trip blanks should be double bagged and kept from freezing.

6.4.5 Chain-of-Custody Records

Chain of custody (COC) forms will be completed for all samples collected. The form documents the transfer of sample containers. The COC record, completed at the time of sampling, will contain, but not be limited to, the sample number, date and time of sampling, and the name of the sampler. The COC document will be signed and dated by the sampler when transferring the samples.

Each sample cooler being shipped to the laboratory will contain a COC form. The cooler will be sealed properly for shipment. The laboratory will maintain a copy for their records. One copy will be returned with the data deliverables package.

The following list provides guidance for the completion and handling of all COCs:

- COCs used should be a Haley & Aldrich standard form or supplied by the analytical laboratory.
- COCs must be completed in black ball point ink only.
- COCs must be completed neatly using printed text.
- If a simple mistake is made, cross out the error with a single line and initial and date the correction.
- Each separate sample entry must be sequentially numbered.
- If numerous repetitive entries must be made in the same column, place a continuous vertical arrow between the first entry and the next different entry.
- When more than one COC form is used for a single shipment, each form must be consecutively numbered using the "Page ___ of ___" format.
- If necessary, place additional instructions directly onto the COC in the Comment Section. Do not enclose separate instructions.
- Include a contact name and phone number on the COC in case there is a problem with the shipment.
- Before using an acronym on a COC, define clearly the full interpretation of your designation [i.e., polychlorinated biphenyls (PCBs)].

6.4.6 Shipment

Prior to the start of the field sampling, the carrier should be contacted to determine if pickup will be at the field site location. If pick-up is not available at the Site, the nearest pick-up or drop off location should be determined. Sample shipments must not be left at unsecured drop locations.

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Copies of all shipment manifests must be maintained in the field file.

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7. Field Instruments – Use and Calibration

A significant number of field activities involve usage of electronic instruments to monitor for environmental conditions and health and safety purposes. It is imperative the instruments are used and maintained properly to optimize their performance and minimize the potential for inaccuracies in the data obtained. This section provides guidance on the usage, maintenance and calibration of electronic field equipment.

- All monitoring equipment will be in proper working order and operated in accordance with manufacturer's recommendations.

- Field personnel will be responsible for ensuring that the equipment is maintained and calibrated in the field in accordance with manufacturer's recommendations.

- Instruments will be operated only by personnel trained in the proper usage and calibration.

- Personnel must be aware of the range of conditions such as temperature and humidity for instrument operation. Usage of instruments in conditions outside these ranges will only proceed with approval of the Project Manager and/or Health and Safety Officer as appropriate.

- Instruments that contain radioactive source material, such as x-ray fluorescence (XRF) analyzers or moisture-density gauges require specific transportation, handling and usage procedures that are generally associated with a license from the Nuclear Regulatory Commission (NRC) or an NRC-Agreement State. Under no circumstance will operation of such instruments be allowed on site unless by properly authorized and trained personnel, using the proper personal dosimetry badges or monitoring instruments.

7.1 GENERAL PROCEDURE DISCUSSION

Care must be taken to minimize the potential for transfer of contaminated materials to the ground or onto other materials. Regardless of the size or nature of the equipment being decontaminated, the process will utilize a series of steps that involve removal of gross material (dirt, grease, oil etc.), washing with a detergent, and multiple rinsing steps. In lieu of a series of washes and rinse steps, steam cleaning with low-volume, high-pressure equipment (i.e., steam cleaner) is acceptable.

Exploration equipment, and all monitoring equipment in contact with the sampling media must be decontaminated prior to initiating site activities, in between exploration locations to minimize cross-contamination, and prior to mobilizing off site after completion of site work.

The following specific decontamination procedure is recommended for sampling equipment and tools:

- Brush loose soil off equipment;
- Wash equipment with laboratory grade detergent (i.e., Alconox or equivalent);
- Rinse with tap water;
- Rinse equipment with distilled water;
- Allow water to evaporate before reusing equipment; and
- Wrap equipment in aluminum foil when not being used.

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7.2 DECONTAMINATION OF MONITORING EQUIPMENT

Because monitoring equipment is difficult to decontaminate, care should be exercised to prevent contamination. Sensitive monitoring instruments should be protected when they are at risk of exposure to contaminants. This may include enclosing them in plastic bags allowing an opening for the sample intake. Ventilation ports should not be covered.

If contamination does occur, decontamination of the equipment will be required; however, immersion in decontamination fluids is not possible. As such, care must be taken to wipe the instruments down with detergent-wetted wipes or sponges, and then with de-ionized water-wetted wipes or sponges.

7.3 DISPOSAL OF WASH SOLUTIONS AND CONTAMINATED EQUIPMENT

All contaminated wash water, rinses, solids, and materials used in the decontamination process that cannot be effectively decontaminated (such as polyethylene sheeting) will be containerized and disposed of in accordance with applicable regulations. All containers will be labeled with an indelible marker as to contents and date of placement in the container, and any appropriate stickers required (such as PCBs). Storage of decontamination wastes on site will not exceed 90 days under any circumstances.

Equipment/Materials:

Decontamination equipment and solutions are generally selected based on ease of decontamination and disposability.

- Polyethylene sheeting;
- Metal racks to hold equipment;
- Soft-bristle scrub brushes or long-handle brushes for removing gross contamination and scrubbing with wash solutions;
- Large galvanized wash tubs, stock tanks, or wading pools for wash and rinse solutions;
- Plastic buckets or garden sprayers for rinse solutions;
- Large plastic garbage cans or other similar containers lined with plastic bags can be used to store contaminated clothing;
- Contaminated liquids and solids should be segregated and containerized in DOT-approved plastic or metal drums, appropriate for offsite shipping/disposal if necessary.

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8. Investigation Derived Waste Disposal

8.1 RATIONALE/ASSUMPTIONS

This procedure applies to the disposition of investigation derived waste (IDW) including soils and/or groundwater. IDW is dealt with the following "Best Management Practices" and is not considered a listed waste due to the lack of generator knowledge concerning chemical source, chemical origin, and timing of chemical introduction to the subsurface.

Consequently, waste sampling and characterization is performed to determine if the wastes exhibit a characteristic of hazardous waste. The disposal of soil cuttings, test pit soils and/or purged groundwater will be reviewed on a case-by-case basis prior to initiation of field activities. Two scenarios typically exist:

- When no information is available in the area of activity or investigation, and impacted media/soils are identified. Activities such as new construction and /or maintenance below grade may encounter environmental conditions that were unknown.
- Disposal Required/Containerization Required – When sufficient Site information regarding the investigative Site conditions warrant that all materials handled will be contained and disposed.

If a known listed hazardous and/or characteristically hazardous waste/contaminated environmental media is being handled, then handling must be performed in accordance with RCRA Subtitle C (reference 2, Part V, Section 1(a),(b),(c)).

The following outlines the waste characterization procedures to be employed when IDW disposal is required.

The following procedure describes the techniques for characterization of IDW for disposal purposes. IDW may consist of soil cuttings (augering, boring, well installation soils, test pit soils), rock core or rock flour (from coring, reaming operations), groundwater (from well development, purging and sampling activities), decontamination fluids, personal protective equipment (PPE), and disposal equipment (DE).

8.2 PROCEDURE

The procedures for handling and characterization of field activity generated wastes are:

A.) Soil Cuttings - Soils removed from boring activities will be contained within an approved container, suitable for transportation and disposal.

  - Once placed into the approved container, any free - liquids (i.e., groundwater) will be removed for disposal as waste fluids or solidified within the approved container using a solidification agent such as Speedy Dri (or equivalent).
  - Contained soils will be screened for the presence of Volatile Organic Compounds (VOCs), using a Photo ionization detector (PID); this data will be logged for future reference.
  - Once screened, full and closed; the container will be labeled and placed into the container storage area. At a minimum, the following information will be shown on each container

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label: date of filling/generation, Site name, source of soils (i.e., borehole or well), and contact.
- Prior to container closure, representative samples from the containers will be collected for waste characterization purposes and submitted to the project laboratory.
- Typically, at a location where an undetermined site-specific parameter group exists, sampling and analysis may consist of the full RCRA Waste Characterization (ignitability, corrosivity, reactivity, toxicity), or a subset of the above based upon data collected, historical information, and generator knowledge.

B.) Groundwater - purging, and sampling groundwater, which requires disposal, will be contained.

- Containment may be performed in 55-gallon drums, tanks suitable for temporary storage (i.e., Nalgene tanks 500 to 1,000 gallons) or if large volumes of groundwater are anticipated, tanker trailer (5,000 to 10,000 gallons ±), or drilling "Frac" tanks may be utilized (20,000 gallons ±). In all cases the container/tank used for groundwater storage must be clean before use such that cross contamination does not occur.

C.) Decon Waters/Decon Fluids - Decon waters and/or fluids will be segregated, contained, and disposed accordingly.

- Decon waters may be disposed of with the containerized groundwater once analytical results have been acquired.

D.) PPE/DE – A number of disposal options exists for spent PPE/DE generated from investigation tasks. The options typically employed are:

- Immediately disposed of within on-Site dumpster/municipal trash; or
- If known to be contaminated with RCRA hazardous waste, dispose off-Site at a RCRA Subtitle C facility.
- Spent Solvent/Acid Rinses - The need for sampling must be determined in consultation with the waste management organization handling the materials. If known that only the solvent and/or acids are present, then direct disposal/treatment using media specific options may be possible without sampling (i.e., incineration).
- PPE/DE – Typically not sampled and included with the disposal of the solid wastes.

Equipment/Materials:

- Sample spoons, trier, auger,
- Sample mixing bowl,
- Sampling bailer, or pump,
- Sample glassware.

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APPENDIX A

Field Forms

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EQUIPMENT CALIBRATION LOG

Project: ______________________
Location: ______________________
Model Name: ______________________
Model Number: ______________________ **Serial Number:** ______________________
Cal. Standards: ______________________

Instruments will be calibrated in accordance with manufacturer's recommendations at least once per day.

Date	Time	Calibration Satandard Solution	Calibration Result	Calibrated by

Other Comments: ______________________

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Groundwater Field Sampling Form

Location:

Job Number: ____________________
Well ID: ____________________
Field Sampling Crew: __________

Date: ________________________
Start Time: ________________________
Finished Time: ________________________

Initial Depth to Water: ____________________
Well Depth: ____________________
Depth to top of screen: ____________________
Depth to bottom of screen: ____________________
Depth of Pump Intake: ____________________

Purging Device:________________
Tubing present in well? __________
Tubing type: __________________

Time Elapsed (24 hour)	Depth to Water (from casing)	Pump Setting (ml/min or gal/min)	Purge Rate (ml/min or gal/min)	Cumulative Purge Volume (liters or gallons)	Temperature (degrees Celsius)	pH	Conductivity us/cm	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP/eH (mv)	Comments

Comments:

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SAMPLE IDENTIFICATION KEY

Page of

PROJECT
LOCATION
CLIENT
CONTRACTOR

H&A FILE NO.
PROJECT MGR.

Sample ID	Parent Sample ID	Location ID	Sample Date	Sample Time (military)	Sample Type Code	Filtered (Water Only T/D/N)	Composite Y/N	Soil Type	Depth To Top Of Sample	Depth To Bottom Of Sample	C.O.C. Number	Notes	Collected By

Notes:

Common Sample Type Codes:

N Normal Environmental Samp	WG Groundwater	WS Surface Water	SO Soil	GS Soil Gas	SE Sediment
WQ Water for Quality Control	FD Field Duplicate	EB Equipment Blank	TB Trip Blank	MS Matris Spike	MSD Matrix Spike Duplicate

see Memorandum dated 08/08/05 from Melanie Satanek "Sample Labeling for Submission to Analytical Laboratory" for less common codes

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DAILY FIELD REPORT

Page ____ of ____

Project		Report No.	
Location		Date	
Client		Page	of
Contractor		File No.	
Weather		Temperature	

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Field Representative(s)	Time on site	Report/Travel/Other	Total hours

Distribution:

Haley & Aldrich, Inc.

GEOPROBE BORING REPORT

BORING NO.
Page 1 of

PROJECT			
LOCATION		PROJECT MGR.	
CLIENT		FIELD REP.	
CONTRACTOR		DATE STARTED	
DRILLER		DATE FINISHED	

Elevation ft.	Datum	Boring Location

Item	Casing	Sampler	Core Barrel	Rig Make & Model			Hammer Type	Drilling Mud	Casing Advance
Type				☐ Truck	☐ Tripod	☐ Cat-Head	☐ Safety	☐ Bentonite	Type Method Depth
Inside Diameter (in.)				☐ ATV	☐ Geoprobe	☐ Winch	☐ Doughnut	☐ Polymer	
Hammer Weight (lb.)				☐ Track	☐ Air Track	☐ Roller Bit	☐ Automatic	☐ None	
Hammer Fall (in.)				☐ Skid	☐ ______	☐ Cutting Head	Drilling Notes:		

Depth (ft.)	Casing Blows	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft)	Elev./ Depth (ft)	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)

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Water Level Data					
			Depth in feet to:		
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water
Date					

Sample ID

O	Open End Rod
T	Thin Wall Tube
U	Undisturbed Sample
S	Split Spoon Sample
G	Geoprobe

Summary

Overburden (Linear ft.) ______
Rock Cored (Linear ft.) ______
Number of Samples ______

BORING NO.

***NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.**

NOTE: Soil descriptions based on a modified Burmister method of visual-manual identification

APPENDIX B
Quality Assurance Project Plan

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QUALITY ASSURANCE PROJECT PLAN
4001 4TH AVE
BROOKLYN, NEW YORK

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by
H & A of New York Engineering and Geology LLP
New York, New York

for
4th Ave Property LLC
40 Fulton Street, Suite 2002
New York, New York 10038

File No. 0210815
May 2024

Executive Summary

This Quality Assurance Project Plan (QAPP) outlines the scope of the quality assurance and quality control (QA/QC) activities associated with the site monitoring activities associated with the Remedial Investigation Work Plan (RIWP) for 4001 4th Avenue (Site) in Brooklyn, New York.

Protocols for sample collection, sample handling and storage, chain-of-custody procedures, and laboratory and field analyses are described herein or specifically referenced to related project documents.

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1. Project Description

This Quality Assurance Project Plan (QAPP) has been prepared as a component of the RIWP for the 4001 4th Avenue Site in Brooklyn, New York.

1.1 PROJECT OBJECTIVES

The primary objective for data collection activities is to collect sufficient data necessary to monitor the nature of any remaining groundwater and soil impacts.

1.2 SITE DESCRIPTION AND HISTORY

The general Site description and Site history is provided in the Site Description and History Summary that accompanies the RIWP appended to the Brownfield Cleanup Program application for the Site and incorporated herein by reference.

1.3 LABORATORY PARAMETERS

The laboratory parameters for soil include:

- Target Compound List volatile organic compounds (VOCs) using USEPA method 8260C/5035
- Target Compound List semi-volatile organic compounds (SVOCs) using USEPA method 8270D
- Total Analyte List (TAL) Metals (including hexavalent chromium, and cyanide) using USEPA method 6010C
- Polychlorinated biphenyls (PCBs) using USEPA method 8082A
- TCL Pesticides and Herbicides using USEPA methods 8081B and 8151A for historic fill samples, respectively
- Per- and polyfluoroalkyl substances (PFAS) using USEPA method 537.1
- 1,4-Dioxane using USEPA method 8270 SIM

The laboratory parameters for groundwater include:

- Target Compound List VOCs using USEPA method 8260B
- Target Compound List SVOCs using USEPA method 8270C
- Total Analyte List (TAL) Metals (including hexavalent chromium and cyanide) using USEPA method 6010/7471
- PCBs using USEPA method 8082
- Pesticides and herbicides by USEPA methods 8081B and 8151A, respectively
- PFAS using USEPA method 537
- 1,4-Dioxane using USEPA method 8270D SIM isotope dilution

Note: PFAS will be collected in accordance with the NYSDEC, Division of Environmental Remediation, Sampling, Analysis and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) under NYSDEC Part 375 Remedial Program, April 2023.

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During the collection of groundwater samples, pH, specific conductivity, temperature, dissolved oxygen (DO), and oxidation/reduction potential (ORP) will be measured until stabilized.
The laboratory parameter for soil vapor and ambient air includes:

- VOCs using EPA method TO-15

Laboratory parameters for disposal samples will be determined by the disposal facility after an approved facility has been determined.

1.4 SAMPLING LOCATIONS

The RIWP provides the locations of soil borings, soil vapor points, ambient air locations and groundwater monitoring wells that will be sampled.

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2. Project Organization and Responsibilities

This section defines the roles and responsibilities of the individuals who will perform the RIWP monitoring activities. A NYSDOH certified analytical laboratory will perform the analyses of environmental samples collected at the Site.

2.1 PROJECT TEAM

The following project personnel are anticipated for oversight of the RAWP implementation. Applicable Project personnel resumes are provided in Appendix G of the RAWP. Project team resumes are included in Attachment A.

NYSDEC Case Manager	Pending
NYSDOH Case Manager	Pending
Remediation Engineer	Suzanne Bell, P.E.
Project Manager/Qualified Environmental Professional	Mari Conlon, P.G.
Haley & Aldrich Health & Safety Director	Brian Fitzpatrick, CHMM
Health & Safety Officer	Brian Ferguson
Quality Assurance Officer	Philip DiNardo
Third Party Validator	Katherine Miller

2.2 MANAGEMENT RESPONSIBILITIES

The Project Manager is responsible for managing the implementation of the RIWP and monitoring and coordinating the collection of data. The Project Manager is responsible for technical quality control and project oversight. The Project Manager responsibilities include the following:

- Acquire and apply technical and corporate resources as needed to ensure performance within budget and schedule restraints;
- Review work performed to ensure quality, responsiveness, and timeliness;
- Communicate with the client point of contact concerning the progress of the monitoring activities;
- Assure corrective actions are taken for deficiencies cited during audits of RIWP monitoring activities; and
- Overall Site health and safety plan compliance.

2.3 QUALITY ASSURANCE RESPONSIBILITIES

The Quality Assurance team will consist of a Quality Assurance Officer and the Data Validation staff. Quality Assurance responsibilities are described as follows:

2.3.1 Quality Assurance (QA) Officer

The QA Officer reports directly to the Project Manager and will be responsible for overseeing the review of field and laboratory data. Additional responsibilities include the following:

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- Assure the application and effectiveness of the QAPP by the analytical laboratory and the project staff;
- Provide input to the Project Manager as to corrective actions that may be required as a result of the above-mentioned evaluations;
- Prepare and/or review data validation and audit reports.

The QA Officer will be assisted by the data validation staff in the evaluation and validation of field and laboratory generated data.

2.3.2 Data Validation Staff

The data validation staff will be independent of the laboratory and familiar with the analytical procedures performed. The validation will include a review of each validation criterion as prescribed by the guidelines presented in Section 9.2 of this document and be presented in a Data Usability Summary Report (DUSR) for submittal to the QA Officer.

2.4 LABORATORY RESPONSIBILITIES

The ELAP-approved laboratory to be used will be Alpha Analytical located in Westborough, MA. Laboratory services in support of the RAWP monitoring include the following personnel:

2.4.1 Laboratory Project Manager

The Laboratory Project Manager will report directly to the QA Officer and Project Manager and will be responsible for ensuring all resources of the laboratory are available on an as-required basis. The Laboratory Project Manager will also be responsible for the approval of the final analytical reports.

2.4.2 Laboratory Operations Manager

The Laboratory Operations Manager will report to the Laboratory Project Manager and will be responsible for coordinating laboratory analysis, supervising in-house chain-of-custody reports, scheduling sample analyses, overseeing data review and overseeing preparation of analytical reports.

2.4.3 Laboratory QA Officer

The Laboratory QA Officer will have sole responsibility for review and validation of the analytical laboratory data. The Laboratory QA Officer will provide Case Narrative descriptions of any data quality issues encountered during the analyses conducted by the laboratory. The QA Officer will also define appropriate QA procedures, overseeing QA/QC documentation.

2.4.4 Laboratory Sample Custodian

The Laboratory Sample Custodian will report to the Laboratory Operations Manager and will be responsible for the following:

- Receive and inspect the incoming sample containers;
- Record the condition of the incoming sample containers;
- Sign appropriate documents;

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- Verify chain-of-custody and its correctness;
- Notify the Project Manager and Operations Manager of sample receipt and inspection;
- Assign a unique identification number and enter each into the sample receiving log;
- Initiate transfer of samples to laboratory analytical sections; and
- Control and monitor access/storage of samples and extracts.

2.4.5 Laboratory Technical Personnel

The laboratory technical staff will have the primary responsibility in the performance of sample analysis and the execution of the QA procedures developed to determine the data quality. These activities will include the proper preparation and analysis of the project samples in accordance with the laboratory's Quality Assurance Manual (QAM) and associated Standard Operating Procedures (SOP).

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2.5 FIELD RESPONSIBILITIES

2.5.1 Field Coordinator

The Field Coordinator is responsible for the overall operation of the field team and reports directly to the Project Manager. The Field Coordinator works with the project Health & Safety Officer (HSO) to conduct operations in compliance with the project Health & Safety Plan (HASP). The Field Coordinator will facilitate communication and coordinate efforts between the Project Manager and the field team members.

Other responsibilities include the following:

- Develop and implement field-related work plans, ensuring schedule compliance, and adhering to management-developed project requirements;
- Coordinate and manage field staff;
- Perform field system audits;
- Oversee quality control for technical data provided by the field staff;
- Prepare and approve text and graphics required for field team efforts;
- Coordinate and oversee technical efforts of subcontractors assisting the field team;
- Identify problems in the field; resolve difficulties in consultation with the Project QAO, and Project Manager; implement and document corrective action procedures; and,
- Participate in preparation of the final reports.

2.5.2 Field Team Personnel

Field Team Personnel will be responsible for the following:

- Perform field activities as detailed in the RIWP and in compliance with the Field Sampling Plan (FSP) and QAPP.
- Immediately report any accidents and/or unsafe conditions to the Site Health & Safety Officer and take reasonable precautions to prevent injury.

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3. Sampling Procedures

The FSP in the NYSDEC-approved RIWP provides the SOPs for sampling required by the RAWP. Sampling will be conducted in general accordance with the New York State Department of Conservation (NYSDEC) Technical Guidance for Site Investigation and Remediation (DER-10) and the Sampling, Analysis and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) under NYSDEC Part 375 Remedial Program (April 2023) when applicable.

3.1 SAMPLE CONTAINERS

Sample containers for each sampling task will be provided by the laboratory performing the analysis. The containers will be cleaned by the manufacturer to meet or exceed the analyte specifications established in the U.S. EPA, "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers", April 1992, OSWER Directive #9240.0-0.5A. Certificates of analysis for each lot of sample containers used will be maintained by the laboratory.

The appropriate sample containers, preservation method, maximum holding times, and handling requirements for each sampling task are provided in Table I.

3.2 SAMPLE LABELING

Each sample will be labeled with a unique sample identifier that will facilitate tracking and cross-referencing of sample information. Equipment rinse blank and field duplicate samples also will be numbered with a unique sample identifier to prevent analytical bias of field QC samples.

Refer to the FSP for the sample labeling procedures.

3.3 FIELD QC SAMPLE COLLECTION

3.3.1 Field Duplicate Sample Collection

3.3.1.1 Water Samples

Field duplicate samples will be collected by filling the first sample container to the proper level and sealing and then repeated for the second set of sample container.

1. The samples are properly labeled as specified in Section 3.2.
2. Steps 1 through 4 are repeated for the bottles for each analysis. The samples are collected in order of decreasing analyte volatility as detailed in Section 3.3.1.
3. Chain-of-custody documents are executed.
4. The samples will be handled as specified in Table I.

3.3.1.2 Soil Samples

Soil field duplicates will be collected as specified in the following procedure:

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1. Soils will be sampling directly from acetate liners.
2. Soil for VOC analysis will be removed from the sampling device as specified in the FSP.
3. Soil for non-VOC analysis will be removed from the sampling device and collected into clean laboratory provided containers.

3.4 GENERAL DECONTAMINATION PROCEDURES

Care must be taken to minimize the potential for transfer of contaminated materials to the ground or onto other materials. Regardless of the size or nature of the equipment being decontaminated, the process will utilize a series of steps that involve removal of gross material (dirt, grease, oil etc.), washing with a detergent, and multiple rinsing steps. In lieu of a series of washes and rinse steps, steam cleaning with low-volume, high-pressure equipment (i.e., steam cleaner) is acceptable.

Exploration equipment, and all monitoring equipment in contact with the sampling media must be decontaminated prior to initiating site activities, in between exploration locations to minimize cross-contamination, and prior to mobilizing off site after completion of site work.

The following specific decontamination procedure is recommended for sampling equipment and tools:

- Brush loose soil off equipment;
- Wash equipment with laboratory grade detergent (i.e., Alconox or equivalent);
- Rinse with tap water;
- Rinse equipment with distilled water;
- Allow water to evaporate before reusing equipment; and
- Wrap equipment in aluminum foil when not being used.

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4. Custody Procedures

Sample custody is addressed in three parts: field sample collection, laboratory analysis and final project files. Custody of a sample begins when it is collected by or transferred to an individual and ends when that individual relinquishes or disposes of the sample.

A sample is under custody if:

1. The item is in actual possession of a person;
2. The item is in the view of the person after being in actual possession of the person;
3. The item was in actual possession and subsequently stored to prevent tampering; or
4. The item is in a designated and identified secure area.

4.1 FIELD CUSTODY PROCEDURES

Field personnel will keep written records of field activities on applicable preprinted field forms or in a bound field notebook to record data collecting activities. These records will be written legibly in ink and will contain pertinent field data and observations. Entry errors or changes will be crossed out with a single line, dated, and initialed by the person making the correction. Field forms and notebooks will be periodically reviewed by the Field Coordinator.

The beginning of each entry in the logbook or preprinted field form will contain the following information:

- Date
- Start time
- Weather
- Names of field personnel (including subcontractors)
- Level of personal protection used at the Site
- Names of all visitors and the purpose of their visit.

For each measurement and sample collected, the following information will be recorded:

- Detailed description of sample location,
- Equipment used to collect sample or make measurement and the date equipment was calibrated,
- Time sample was collected,
- Description of the sample conditions,
- Depth sample was collected (if applicable),
- Volume and number of containers filled with the sample; and,
- Sampler's identification.

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4.1.1 Field Procedures

The following procedure describes the process to maintain the integrity of the samples:

- Upon collection samples are placed in the proper containers. In general, samples collected for organic analysis will be placed in pre-cleaned glass containers and samples collected for inorganic analysis will be placed in pre-cleaned plastic (polyethylene) bottles. Refer to the FSP for sample packaging procedures.

- Samples will be assigned a unique sample number and will be affixed to a sample label. Refer to the FSP for sample labeling procedures.

- Samples will be properly and appropriately preserved by field personnel in order to minimize loss of the constituent(s) of interest due to physical, chemical or biological mechanisms.

- Appropriate volumes will be collected to ensure that the appropriate reporting limits can be successfully achieved and that the required QC sample analyses can be performed.

4.1.2 Transfer of Custody and Shipment Procedures

- A chain-of-custody (COC) record will be completed at the time of sample collection and will accompany each shipment of project samples to the laboratory. The field personnel collecting the samples will be responsible for the custody of the samples until the samples are relinquished to the laboratory. Sample transfer will require the individuals relinquishing and receiving the samples to sign, date and note the time of sample transfer on the COC record.

- Samples will be shipped or delivered in a timely fashion to the laboratory so that holding times and/or analysis times as prescribed by the methodology can be met.

- Samples will be transported in containers (coolers) which will maintain the refrigeration temperature for those parameters for which refrigeration is required in the prescribed preservation protocols.

- Samples will be placed in an upright position and limited to one layer of samples per cooler. Additional bubble wrap or packaging material will be added to fill the cooler. Shipping containers will be secured with strapping tape and custody tape for shipment to the laboratory.

- When samples are split with the NYSDEC representatives, a separate chain-of-custody will be prepared and marked to indicate with whom the samples are shared. The person relinquishing the samples will require the representative’s signature acknowledging sample receipt.

- If samples are sent by a commercial carrier, a bill of lading will be used. A copy of the bill of lading will be retained as part of the permanent record. Commercial carriers will not sign the custody record as long as the custody record is sealed inside the sample cooler and the custody tape remains intact.

- Samples will be picked up by a laboratory courier or transported to the laboratory the same day they are collected unless collected on a weekend or holiday. In these cases, the samples will be

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stored in a secure location until delivery to the laboratory. Additional ice will be added to the cooler as needed to maintain proper preservation temperatures.

4.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

A sample custodian will be designated by the laboratory and will have the responsibility to receive all incoming samples. Once received, the custodian will document if the sample is received in good condition (i.e., unbroken, cooled, etc.) and that the associated paperwork, such as chain-of-custody forms have been completed. The custodian will sign the chain-of-custody forms.

The custodian will also document if sufficient sample volume has been received to complete the analytical program. The sample custodian will then place the samples into secure, limited access storage (refrigerated storage, if required). The sample custodian will assign a unique number to each incoming sample for use in the laboratory. The unique number will then be entered into the sample-receiving log with the verified time and date of receipt also noted.

Consistent with the analyses requested on the chain-of-custody form, analyses by the laboratory's analysts will begin in accordance with the appropriate methodologies. Samples will be removed from secure storage with internal chain-of-custody sign-out procedures followed.

4.3 STORAGE OF SAMPLES

Empty sample bottles will be returned to secure and limited access storage after the available volume has been consumed by the analysis. Upon completion of the entire analytical work effort, samples will be disposed of by the sample custodian. The length of time that samples are held will be at least thirty (30) days after reports have been submitted. Disposal of remaining samples will be completed in compliance with all Federal, State, and local requirements.

4.4 FINAL PROJECT FILES CUSTODY PROCEDURES

The final project files will be the central repository for all documents with information relevant to sampling and analysis activities as described in this QAPP. The Haley & Aldrich Project Manager will be the custodian of the project file. The project files including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews will be maintained in a secured, limited access area and under custody of the Project Director or his designee.

The final project file will include the following:

- Project plans and drawings
- Field data records
- Sample identification documents and soil boring/monitoring well logs
- All chain-of-custody documentation
- Correspondence
- References, literature
- Laboratory data deliverables
- Data validation and assessment reports
- Progress reports, QA reports
- Final report

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The laboratory will be responsible for maintaining analytical logbooks, laboratory data and sample chain of custody documents. Raw laboratory data files and copies of hard copy reports will be inventoried and maintained by the laboratory for a period of six (6) years at which time the laboratory will contact the Haley & Aldrich Project Manager regarding the disposition of the project related files.

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5. Calibration Procedures and Frequency

5.1 FIELD INSTRUMENT CALIBRATION PROCEDURES

Several field instruments will be used for both on-site screening of samples and for health and safety monitoring, as described in the Health and Safety Plan (HASP). On-site air monitoring for health and safety purposes may be accomplished using a vapor detection device, such as a photoionization detector (PID).

Field instruments will be calibrated at the beginning of each day and checked during field activities to verify performance. Instrument specific calibration procedures will be performed in accordance with the instrument manufacturer's requirements.

5.2 LABORATORY INSTRUMENT CALIBRATION PROCEDURES

Reference materials of known purity and quality will be utilized for the analysis of environmental samples. The laboratory will carefully monitor the preparation and use of reference materials including solutions, standards, and reagents through well-documented procedures.

All solid chemicals and acids/bases used by the laboratory will be rated as "reagent grade" or better. All gases will be "high" purity or better. All Standard Reference Materials (SRMs) or Performance Evaluation (PE) materials will be obtained from approved vendors of the National Institute of Standards and Technology (formerly National Bureau of Standards), the U.S. EPA Environmental Monitoring Support Laboratories (EMSL), or reliable Cooperative Research and Development Agreement (CRADA) certified commercial sources.

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6. Analytical Procedures

Analytical procedures to be utilized for analysis of environmental samples will be based on referenced USEPA analytical protocols and/or project specific SOP.

6.1 FIELD ANALYTICAL PROCEDURES

Field analytical procedures include the measurement of pH, temperature, ORP, DO and specific conductivity during sampling of groundwater, and the qualitative measurement of volatile organic compounds (VOC) during the collection of soil samples.

6.2 LABORATORY ANALYTICAL PROCEDURES

Laboratory analyses will be based on the U.S. EPA methodology requirements promulgated in:

- "Test Methods for Evaluating Solid Waste," SW-846 EPA, Office of Solid Waste, and promulgated updates, 1986.

6.2.1 List of Project Target Compounds and Laboratory Detection Limits

The laboratory reporting limits (RLs) and associated method detection limits (MDLs) for the target analytes and compounds for the environmental media to be analyzed are presented in Table I. MDLs have been experimentally determined by the project laboratory using the method provided in 40 CFR, Part 136 Appendix B.

Laboratory parameters for soil samples are listed in the RIWP. Laboratory parameters for disposal samples will be determined by the disposal facility after an approved facility has been determined.

6.2.2 List of Method Specific Quality Control (QC) Criteria

The laboratory SOPs include a section that presents the minimum QC requirements for the project analyses. Section 7.0 references the frequency of the associated QC samples for each sampling effort and matrix.

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7. Internal Quality Control Checks

This section presents the internal quality control checks that will be employed for field and laboratory measurements.

7.1 FIELD QUALITY CONTROL

7.1.1 Field Blanks

Internal quality control checks will include analysis of field blanks to validate equipment cleanliness. Whenever possible, dedicated equipment will be employed to reduce the possibility of cross-contamination of samples.

7.1.2 Trip Blanks

Trip blanks samples will be prepared by the project laboratory using ASTM Type II or equivalent water placed within pre-cleaned 40 milliliter (ml) VOC vials equipped with Teflon septa. Trip blanks will accompany each sample delivery group (SDG) of environmental samples collected for analysis of VOCs.

Trip blank samples will be placed in each cooler that stores and transports project samples that are to be analyzed for VOCs.

7.2 LABORATORY PROCEDURES

Procedures which contribute to maintenance of overall laboratory quality assurance and control include appropriately cleaned sample containers, proper sample identification and logging, applicable sample preservation, storage, and analysis within prescribed holding times, and use of controlled materials.

7.2.1 Field Duplicate Samples

The precision or reproducibility of the data generated will be monitored through the use of field duplicate samples. Field duplicate analysis will be performed at a frequency of 1 in 20 project samples.

Precision will be measured in terms of the absolute value of the relative percent difference (RPD) as expressed by the following equation:

$$RPD = [|R1-R2|/[(R1+R2)/2]] \times 100\%$$

Acceptance criteria for duplicate analyses performed on solid matrices will be 100% and aqueous matrices will be 35%. RPD values outside these limits will require an evaluation of the sampling and/or analysis procedures by the project QA Officer and/or laboratory QA Director. Corrective actions may include re-analysis of additional sample aliquots and/or qualification of the data for use.

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7.2.2 Matrix Spike Samples

Ten percent of each project sample matrix for each analytical method performed will be spiked with known concentrations of the specific target compounds/analytes.

The amount of the compound recovered from the sample compared to the amount added will be expressed as a percent recovery. The percent recovery of an analyte is an indication of the accuracy of an analysis within the site-specific sample matrix. Percent recovery will be calculated for MS/MSD using the following equation.

$$\%\ Recovery = \frac{Spiked\ Sample\ \text{-}\ Background}{Known\ Value\ of\ Spike} \times 100\%$$

If the quality control value falls outside the control limits (UCL or LCL) due to sample matrix effects, the results will be reported with appropriate data qualifiers. To determine the effect a non-compliant MS recovery has on the reported results, the recovery data will be evaluated as part of the validation process.

7.2.3 Laboratory Control Sample (LCS) Analyses

The laboratory will perform LCS analyses prepared from Standard Reference Materials (SRMs). The SRMs will be supplied from an independent manufacturer and traceable to NIST materials with known concentrations of each target analyte to be determined by the analytical methods performed. In cases where an independently supplied SRM is not available, the LCS may be prepared by the laboratory from a reagent lot other than that used for instrument calibration.

The laboratory will evaluate LCS analyses in terms of percent recovery using the most recent laboratory generated control limits.

LCS recoveries that do not meet acceptance criteria will be deemed invalid. Analysis of project samples will cease until an acceptable LCS analysis has been performed. If sample analysis is performed in association with an out-of-control LCS sample analysis, the data will be deemed invalid.

Corrective actions will be initiated by the Haley & Aldrich QA Officer and/or Laboratory QA Officer to investigate the problem. After the problem has been identified and corrected, the solution will be noted in the instrument run logbook and re-analysis of project samples will be performed, if possible.

The analytical anomaly will be noted in the sample delivery group (SDG) Case Narrative and reviewed by the data validator. The data validator will confirm that appropriate corrective actions were implemented and recommend the applicable use of the affected data.

7.2.4 Surrogate Compound/Internal Standard Recoveries

For VOCs, surrogates will be added to each sample prior to analysis to establish purge and trap efficiency. Quantitation will be accomplished via internal standardization techniques.

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The recovery of surrogate compounds and internal standards will be monitored by laboratory personnel to assess possible site-specific matrix effects on instrument performance.

For semi-volatile organics analyses, surrogates will be added to the raw sample to assess extraction efficiency. Internal standards will be added to all sample extracts and instrument calibration standard immediately before analysis for quantitation via internal standardization techniques.

Method specific quality control (QC) limits are provided in the attached laboratory method SOPs. Surrogate compound/internal standard recoveries that do not fall within accepted QC limits for the analytical methodology performed will have the analytical results flagged with data qualifiers as appropriate by the laboratory and will not be noted in the laboratory report Case Narrative.

To ascertain the effect non-compliant surrogate compound/internal standard recoveries may have on the reported results, the recovery data will be evaluated as part of the validation process. The data validator will provide recommendations for corrective actions including but not limited to additional data qualification.

7.2.5 Calibration Verification Standards

Calibration verification (CV) standards will be utilized to confirm instrument calibrations and performance throughout the analytical process. CV standards will be prepared as prescribed by the respective analytical protocols. Continuing calibration will be verified by compliance with method-specific criteria prior to additional analysis of project samples.

Non-compliant analysis of CV standards will require immediate corrective action by the project laboratory QA officer and/or designated personnel. Corrective action may include re-analysis of each affected project sample, a detailed description of the problem, the corrective action undertaken, the person who performed the action, and the resolution of the problem.

7.2.6 Laboratory Method Blank Analyses

Method blank sample analysis will be performed as part of each analytical batch for each methodology performed. If target compounds are detected in the method blank samples, the reported results will be flagged by the laboratory in accordance with standard operating procedures. The data validator will provide recommendations for corrective actions including but not limited to additional data qualification.

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8. Data Quality Objectives

Sampling that will be performed as described in the RIWP is designed to produce data of the quality necessary to achieve the minimum standard requirements of the field and laboratory analytical objectives described below. These data are being obtained with the primary objective to assess levels of contaminants of concern associated with the Site.

The overall project data quality objective (DQO) is to implement procedures for field data collection, sample collection, handling, and laboratory analysis and reporting that achieve the project objectives. The following section is a general discussion of the criteria that will be used to measure achievement of the project DQO.

8.1 PRECISION

8.1.1 Definition

Precision is defined as a quantitative measure of the degree to which two or more measurements are in agreement. Precision will be determined by collecting and analyzing field duplicate samples and by creating and analyzing laboratory duplicates from one or more of the field samples. The overall precision of measurement data is a mixture of sampling and analytical factors. The analytical results from the field duplicate samples will provide data on sampling precision. The results from duplicate samples created by the laboratory will provide data on analytical precision. The measurement of precision will be stated in terms of relative percent difference (RPD).

8.1.2 Field Precision Sample Objectives

Field precision will be assessed through collection and measurement of field duplicate samples at a rate of 1 duplicate per 20 investigative samples. The RPD criteria for the project field duplicate samples will be +/- 100% for soil, +/- 35 % for groundwater for parameters of analysis detected at concentrations greater than 5 times (5X) the laboratory reporting limit (RL).

8.1.3 Laboratory Precision Sample Objectives

Laboratory precision will be assessed through the analysis of laboratory control and laboratory control duplicate samples (LCS/LCSD) and matrix spike and matrix spike duplicate (MS/MSD) samples for groundwater and soil samples and the analysis of laboratory duplicate samples for air and soil vapor samples. Air and soil vapor laboratory duplicate sample analyses will be performed by analyzing the same SUMMA canister twice. The RPD criteria for the air/soil vapor laboratory duplicate samples will be +/- 35 % for parameters of analysis detected at concentrations greater than 5 times (5X) the laboratory reporting limit (RL).

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8.2 ACCURACY

8.2.1 Definition

Accuracy relates to the bias in a measurement system. Bias is the difference between the observed and the "true" value. Sources of error are the sampling process, field contamination, preservation techniques, sample handling, sample matrix, sample preparation and analytical procedure limitations.

8.2.2 Field Accuracy Objectives

Sampling bias will be assessed by evaluating the results of field equipment rinse and trip blanks. Equipment rinse and trip blanks will be collected as appropriate based on sampling and analytical methods for each sampling effort.

If non-dedicated sampling equipment is used, equipment rinse blanks will be collected by passing ASTM Type II water over and/or through the respective sampling equipment utilized during each sampling effort. One equipment rinse blank will be collected for each type of non-dedicated sampling equipment used for the sampling effort. Equipment rinse blanks will be analyzed for each target parameter for the respective sampling effort for which environmental media have been collected. (Note: If dedicated or disposable sampling equipment is used, equipment rinse samples will not be collected as part of that field effort.)

Trip blank samples will be prepared by the laboratory and provided with each shipping container that includes containers for the collection of groundwater samples for the analysis of VOC. Trip blank samples will be analyzed for each VOC for which groundwater samples have been collected for analysis.

8.3 LABORATORY ACCURACY OBJECTIVES

Analytical bias will be assessed through the use of laboratory control samples (LCS) and Site-specific matrix spike (MS) sample analyses. LCS analyses will be performed with each analytical batch of project samples to determine the accuracy of the analytical system.

One (1) set of MS/MSD analyses will be performed with each batch of 20 project samples collected for analysis to assess the accuracy of the identification and quantification of analytes within the Site-specific sample matrices. Additional sample volume will be collected at sample locations selected for the preparation of MS/MSD samples so that the standard laboratory reporting limits (RLs) are achieved.

The accuracy of analyses that include a sample extraction procedure will be evaluated through the use of system monitoring or surrogate compounds. Surrogate compounds will be added to each sample, standard, blank, and QC sample prior to sample preparation and analysis. Surrogate compound percent recoveries will provide information on the effect of the sample matrix on the accuracy of the analyses.

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8.4 REPRESENTATIVENESS

8.4.1 Definition

Representativeness expresses the degree to which sample data represent a characteristic of a population, a parameter variation at a sampling point or an environmental condition. Representativeness is a qualitative parameter that is dependent upon the design of the sampling program. The representativeness criterion is satisfied through the proper selection of sampling locations, the quantity of samples and the use of appropriate procedures to collect and analyze the samples.

8.4.2 Measures to Ensure Representativeness of Field Data

Representativeness will be addressed by prescribing sampling techniques and the rationale used to select sampling locations. Sampling locations may be biased (based on existing data, instrument surveys, observations, etc.) or unbiased (completely random or stratified-random approaches).

8.5 COMPLETENESS

8.5.1 Definition

Completeness is a measure of the amount of valid (usable) data obtained from a measuring system compared to the total amount of the anticipated to be obtained. The completeness goal for all data uses is that a sufficient amount of valid data be generated so that determinations can be made related to the intended data use with a sufficient degree of confidence.

8.5.2 Field Completeness Objectives

Completeness is a measure of the amount of valid measurements obtained from measurements taken in this project versus the number planned. Field completeness objective for this project will be greater than (>) 90%.

8.5.3 Laboratory Completeness Objectives

Laboratory data completeness objective is a measure of the amount of valid data obtained from laboratory measurements. The evaluation of the data completeness will be performed at the conclusion of each sampling and analysis effort.

The completeness of the data generated will be determined by comparing the amount of valid data, based on independent validation, with the total laboratory data set. The completeness goal will be >90%.

8.6 COMPARABILITY

8.6.1 Definition

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another.

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8.6.2 Measures to Ensure Comparability of Laboratory Data

Comparability of laboratory data will be measured from the analysis of Standard Reference Materials (SRM) obtained from either EPA Cooperative Research and Development Agreement (CRADA) suppliers or the National Institute of Standards and Technology (NIST). The reported analytical data will also be presented in standard units of mass of contaminant within a known volume of environmental media. The standard units for various sample matrices are as follows:

- Solid Matrices – mg/kg of media (Dry Weight).
- Aqueous Matrices – ng/L for PFAS analyses, ug/L of media for organic analyses, and mg/L for inorganic analyses.

8.7 LEVEL OF QUALITY CONTROL EFFORT

If non-dedicated sampling equipment is used, equipment rinse blanks will be prepared by field personnel and submitted for analysis of target parameters. Equipment rinse blank samples will be analyzed to check for potential cross-contamination between sampling locations that may be introduced during the investigation. One (1) equipment rinse blank will be collected per sampling event to the extent that non-dedicated sampling equipment is used.

If necessary, A separate equipment rinse blank sample will be collected for PFAS using the sample collection procedure described in Section 8.1.1 of the NYSDEC-approved Avangrid Field Sampling Plan. (Note: If dedicated or disposable sampling equipment is used, equipment rinse samples will not be collected as part of that field effort.)

Trip blanks will be used to assess the potential for contamination during sample storage and shipment. Trip blanks will be provided with the sample containers to be used for the collection of groundwater samples for the analysis of VOC. Trip blanks will be preserved and handled in the same manner as the project samples. One (1) trip blank will be included along with each shipping container containing project samples to be analyzed for VOC.

Method blank samples will be prepared by the laboratory and analyzed concurrently with all project samples to assess potential contamination introduced during the analytical process.

Field duplicate samples will be collected and analyzed to determine sampling and analytical reproducibility. One (1) field duplicate will be collected for every 20 or fewer investigative samples collected for off-Site laboratory analysis.

Matrix spikes will provide information to assess the precision and accuracy of the analysis of the target parameters within the environmental media collected. One (1) matrix spike/matrix spike duplicate (MS/MSD) will be collected for every 20 or fewer investigative samples per sample matrix.

(Note: Soil MS/MSD samples require triple sample volume for VOC only. Aqueous MS/MSD samples require triple the normal sample volume for VOC analysis and double the volume for the remaining parameters.)

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9. Data Reduction, Validation and Reporting

Data generated by the laboratory operation will be reduced and validated prior to reporting in accordance with the following procedures:

9.1 DATA REDUCTION

9.1.1 Field Data Reduction Procedures

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. The pH, conductivity, temperature, turbidity, DO, ORP and breathing zone VOC readings collected in the field will be generated from direct read instruments. The data will be written into field logbooks immediately after measurements are taken. If errors are made, data will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original entry.

9.1.2 Laboratory Data Reduction Procedures

Laboratory data reduction procedures are provided by the appropriate chapter of USEPA, “Test Methods for Evaluating Solid Waste”, SW-846, Third Edition. Errors will be noted; corrections made with the original notations crossed out legibly. Analytical results for soil samples will be calculated and reported on a dry weight basis.

9.1.3 Quality Control Data

Quality control data (e.g., laboratory duplicates, surrogates, matrix spikes, and matrix spike duplicates) will be compared to the method acceptance criteria. Data determined to be acceptable will be entered into the laboratory information management system.

Unacceptable data will be appropriately qualified in the project report. Case narratives will be prepared which will include information concerning data that fell outside acceptance limits and any other anomalous conditions encountered during sample analysis.

9.2 DATA VALIDATION

Data validation procedures of the analytical data will be performed by the Haley & Aldrich QA Officer or designee using the following documents as guidance for the review process:

- "U.S. EPA National Functional Guidelines for Organic Data Review”, and the "U.S. EPA National Functional Guidelines for Inorganic Data Review".
- The specific data qualifiers used will be applied to the reported results as presented and defined in the EPA National Functional Guidelines. Validation will be performed by qualified personnel at the direction of the Haley & Aldrich QAO.

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- The completeness of each data package will be evaluated by the Data Validator. Completeness checks will be administered on all data to determine that the deliverables are consistent with the NYSDEC ASP Category A and Category B data package requirements. The validator will determine whether the required items are present and request copies of missing deliverables (if necessary) from the laboratory.

9.3 DATA REPORTING

Data reporting procedures will be carried out for field and laboratory operations as indicated below:

- Field Data Reporting: Field data reporting will be conducted principally through the transmission of report sheets containing tabulated results of measurements made in the field and documentation of field calibration activities.

- Laboratory Data Reporting: The laboratory data reporting package will enable data validation based on the protocols described above. The final laboratory data report format will include the QA/QC sample analysis deliverables to enable the development of a data usability summary report (DUSR) based on Department DER-10 Appendix 2B.

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10. Performance and System Audits

A performance audit is an independent quantitative comparison with data routinely obtained in the field or the laboratory. Performance audits include two separate, independent parts: internal and external audits.

10.1 FIELD PERFORMANCE AND SYSTEM AUDITS

10.1.1 Internal Field Audit Responsibilities

Internal audits of field activities will be initiated at the discretion of the Project Manager and will include the review of sampling and field measurements. The audits will verify that all procedures are being followed. Internal field audits will be conducted periodically during the project. The audits will include examination of the following:

- Field sampling records, screening results, instrument operating records
- Sample collection
- Handling and packaging in compliance with procedures
- Maintenance of QA procedures
- Chain-of-custody reports

10.1.2 External Field Audit Responsibilities

External audits may be conducted by the Project Coordinator at any time during the field operations. These audits may or may not be announced and are at the discretion of the NYSDEC. The external field audits can include (but are not limited to) the following:

- Sampling equipment decontamination procedures
- Sample bottle preparation procedures
- Sampling procedures
- Examination of health and safety plans
- Procedures for verification of field duplicates
- Field screening practices

10.2 LABORATORY PERFORMANCE AND SYSTEM AUDITS

10.2.1 Internal Laboratory Audit Responsibilities

The laboratory system audits are typically conducted by the laboratory QA Officer or designee on an annual basis. The system audit will include an examination of laboratory documentation including sample receiving logs, sample storage, chain-of-custody procedures, sample preparation and analysis and instrument operating records.

At the conclusion of internal system audits, reports will be provided to the laboratory's operating divisions for appropriate comment and remedial/corrective action where necessary. Records of audits and corrective actions will be maintained by the Laboratory QA Officer.

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10.2.2 External Laboratory Audit Responsibilities

External audits will be conducted as required, by the NYSDOH or designee. External audits may include any of the following:

- Review of laboratory analytical procedures
- Laboratory on-site visits
- Submission of performance evaluation samples for analysis

Failure of any of the above audit procedures can lead to laboratory de-certification. An audit may consist of but not limited to:

- Sample receipt procedures
- Custody, sample security and log-in procedures
- Review of instrument calibration logs
- Review of QA procedures
- Review of log books
- Review of analytical SOPs
- Personnel interviews

A review of a data package from samples recently analyzed by the laboratory can include (but not be limited to) the following:

- Comparison of resulting data to the SOP or method
- Verification of initial and continuing calibrations within control limits
- Verification of surrogate recoveries and instrument timing results
- Review of extended quantitation reports for comparisons of library spectra to instrument spectra, where applicable
- Assurance that samples are run within holding times

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11. Preventive Maintenance

11.1 FIELD INSTRUMENT PREVENTIVE MAINTENANCE

The field equipment preventive maintenance program is designed to ensure the effective completion of the sampling effort and to minimize equipment down time. Program implementation is concentrated in three areas:

- Maintenance responsibilities
- Maintenance schedules
- Inventory of critical spare parts and equipment

The maintenance responsibilities for field equipment will be assigned to the task leaders in charge of specific field operations. Field personnel will be responsible for daily field checks and calibrations and for reporting any problems with the equipment. The maintenance schedule will follow the manufacturer's recommendations. In addition, the field personnel will be responsible for determining that an inventory of spare parts will be maintained with the field equipment. The inventory will primarily contain parts that are subject to frequent failure, have limited useful lifetimes and/or cannot be obtained in a timely manner.

11.2 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE

Analytical instruments at the laboratory will undergo routine and/or preventive maintenance. The extent of the preventive maintenance will be a function of the complexity of the equipment.

Generally, annual preventive maintenance service will involve cleaning, adjusting, inspecting and testing procedures designed to deduce instrument failure and/or extend useful instrument life. Between visits, routine operator maintenance and cleaning will be performed according to manufacturer's specifications by laboratory personnel.

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12. Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness

12.1 FIELD MEASUREMENTS

Field generated information will be reviewed by the Field Coordinator and typically include evaluation of bound logbooks/forms, data entry and calculation checks. Field data will be assessed by the Project Coordinator who will review the field results for compliance with the established QC criteria that are specified in Section 7.0 of this QAPP. The accuracy of pH and specific conductance will be assessed using daily instrument calibration, calibration check, and blank data. Accuracy will be measured by determining the percent recovery (% R) of calibration check standards. Precision of the pH and specific conductance measurements will be assessed on the basis of the reproducibility of duplicate readings of a field sample and will be measured by determining the relative percent difference (RPD). Accuracy and precision of the soil VOC screening will be determined using duplicate readings of calibration checks. Field data completeness will be calculated using the following equation:

$$\text{Completeness} = \frac{\text{Valid (usable) Data Obtained}}{\text{Total Data Planned}} \times 100$$

12.2 LABORATORY DATA

Surrogate, internal standard and matrix spike recoveries will be used to evaluate data quality. The laboratory quality assurance/quality control program will include the following elements:

- Precision, in terms of relative percent difference (RPD), will be determined by relative sample analysis at a frequency of one duplicate analysis for each batch of ten project samples or a frequency of 10 percent (10%). RPD is defined as the absolute difference of duplicate measurements divided by the mean of these analyses normalized to percentage.

- Accuracy, in terms of percent recovery (recovery of known constituent additions or surrogate recoveries), will be determined by the analysis of spiked and unspiked samples. MS/MSD will be used to determine analytical accuracy. The frequency of MS/MSD analyses will be one project sample MS/MSD per set of 20 project samples.

- One method blank will be prepared and analyzed with each batch of project samples. The total number of method blank sample analyses will be determined by the laboratory analytical batch size.

- Standard Reference Materials (SRMs) will be used for each analysis. Sources of SRM's include the U.S. EPA, commercially available material from CRADA certified vendors and/or laboratory produced solutions. SRMs, when available and appropriate, will be processed and analyzed on a frequency of one per set of samples.

- Completeness is the evaluation of the amount of valid data generated versus the total set of data produced from a particular sampling and analysis event. Valid data is determined by independent confirmation of compliance with method-specific and project-specific data quality

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objectives. The calculation of data set completeness will be performed by the following equation.

$$\frac{Number\ of\ Valid\ Sample\ Results}{Total\ Number\ of\ Samples\ Planned}\ X\ 100 = \%\ Complete$$

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13. Quality Assurance (QA) Reports

Critically important to the successful implementation of the QA Plan is a reporting system that provides the means by which the program can be reviewed, problems identified, and programmatic changes made to improve the plan.

QA reports to management can include:

- Audit reports, internal and external audits with responses
- Performance evaluation sample results; internal and external sources
- Daily QA/QC exception reports/corrective actions

QA/QC corrective action reports will be prepared by the Haley & Aldrich QA Officer when appropriate and presented to the project and/or laboratory management personnel so that performance criteria can be monitored for all analyses from each analytical department. The updated trend/QA charts prepared by the laboratory QA personnel will be distributed and reviewed by various levels of the laboratory management.

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References

1. United States Environmental Protection Agency, (1999). EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations. EPA QA/R-5 Interim Final, November 1999.

2. United States Environmental Protection Agency (1991). Preparation Aids for the Development of Category I Quality Assurance Project Plans. U.S. EPA/600/8-91/003, Risk Reduction Engineering Laboratory, Office of Research and Development, Cincinnati, Ohio, February 1991.

3. United States Environmental Protection Agency, (1993). Data Quality Objectives Process for Superfund Interim Final Guidance. U.S. EPA/540/R-93-071, Office of Solid Waste and Emergency Response (OSWER), September 1993.

4. United States Environmental Protection Agency, (1992). Specifications and Guidance for Contaminant-Free Sample Containers. OSWER Directive 9240.0-05A, April 1992.

5. United States Environmental Protection Agency. U.S. EPA National Functional Guidelines for Organic Data Review. U.S. EPA 540/R-2017-002.

6. United States Environmental Protection Agency. U.S. EPA National Functional Guidelines for Organic Data Review. U.S. EPA 540/R-2017-001.

7. United States Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Office of Solid Waste, U.S. EPA, SW-846, November 1986, with updates.

8. New York State Department of Environmental Conservation, NYSDEC Analytical Services Protocol (ASP), Bureau of Environmental Investigation, 1991 with updates.

9. New York State Department of Environmental Conservation, NYSDEC, Division of Environmental Remediation, Technical Guidance for Site Investigation and Remediation, DER-10, May 2010.

10. New York State Department of Environmental Conservation, NYSDEC, Division of Environmental Remediation, Sampling, Analysis and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) under NYSDEC Part 375 Remedial Program, April 2023

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TABLES

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TABLE I
SUMMARY OF ANALYSIS METHOD, PRESERVATION METHOD, HOLDING TIME, SAMPLE SIZE REQUIREMENTS AND SAMPLE CONTAINERS
4001 4th Avenue
Brooklyn, NY

Analysis/Method	Sample Type	Preservation	Holding Time	Volume/Weight	Container
Volatile Organic Compounds/8260C/5035	Soil	1 - 1 Vial MeOH/2 Vial Water, Cool, 4 ± 2 °C	14 days[1]	120 mL	3 - 40ml glass vials
Semivolatile Organic Compounds/8270D	Soil	Cool, 4 ± 2 °C	14 days	250 mL	1 - 8 oz Glass
Metals/6010C	Soil	Cool, 4 ± 2 °C	180 days	60 mL	1 - 2 oz Glass
Polychlorinated Biphenyls/8082A	Soil	Cool, 4 ± 2 °C	14 days	250 mL	1 - 8 oz Glass
Pesticides (8081B)	Soil	Cool, 4 ± 2 °C	14 days	250 mL	1 - 8 oz Glass
PFAS 1633	Soil	Cool, 4 ± 2 °C	14 days	250 mL	1 - 8 oz Glass
1,4-Dioxane 8270	Soil	Cool, 4 ± 2 °C	14 days	250 mL	1 - 8 oz Glass
Volatile Organic Compounds/8260B	Groundwater	HCl, Cool, 4 ± 2 °C	14 days	120 mL	3 - 40ml glass vials
Semivolatile Organic Compounds/8270C	Groundwater	Cool, 4 ± 2 °C	7 days	500 mL	2 - 250 mL amber glass
TAL Metals 6010/7471	Groundwater	HNO_3Cool, 4 ± 2 °C	180 days	500 mL	1 - 500 mL plastic bottle
Polychlorinated Biphenyls/8082	Groundwater	Cool, 4 ± 2 °C	365 days	2000 mL	2 - 1000 mL amber glass
Pesticides & Herbicides (8081B and 8151A)	Groundwater	Cool, 4 ± 2 °C	7 days	3000 mL	2 - 500 mL amber glass 2 - 1000 mL amber glass
PFAS 1633	Groundwater	H2O Cool, 4 ± 2 °C	14 days	500 mL	2 - teflon free 250 ml plastic containers
1,4-Dioxane 8270D	Groundwater	Cool, 4 ± 2 °C	7 days	500 mL	1 - 500 mL plastic bottle
Volatile Organic Compounds/TO-15	Soil Vapor	N/A	30 days	2.7 - 6 L	1 2.7 or 6 L Summa Canister

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Notes:
1. Terracores and encores must be frozen within 48 hours of collection
2. Refer to text for additional information.

ATTACHMENT A

Project Team Resumes

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SUZANNE BELL, PE

Senior Project Manager

EDUCATION

B.S., Biosystems Engineering, University of Arizona

PROFESSIONAL REGISTRATIONS

AZ: Environmental Engineer (Reg. No. 61995)
NY: Professional Engineer (Reg No. 106301)

SPECIAL STUDIES AND COURSES

40-Hour OSHA Hazardous Waste and Operations Emergency Response Training (29 CFR 1910.120 and 40 CFR 265.16)
8-Hour HAZWOPER Refresher Course

Suzanne is a senior project manager with over 14 years of experience in the environmental consulting industry. She has worked on soil and groundwater environmental investigations, remediation projects, and prepared reports for private, industrial, and government clients. Her technical experience includes remediation systems; soil and groundwater feasibility studies; Phase I site investigations; environmental file review and historical research; stormwater assessments and SWPPP preparation; reclamation planning for the sand and gravel mining industry; air permitting; and data interpretation.

RELEVANT PROJECT EXPERIENCE

Waterfront Property Management, 89-91 Gerry Street and 93 Gerry Street, Brooklyn, New York. Suzanne served as project manager for execution of Remedial Action Work Plans at the former Just4Wheels Site and Just4Wheels Site 2 under the New York State Brownfield Cleanup Program (NYSBCP). Responsible for remedial oversight of excavation and removal of non-hazardous and hazardous soil, endpoint sample collection, air monitoring, dewatering system installation support, communication with soil brokerage firm and environmental laboratory, preparation of Daily Field Reports (DFRs and the Final Engineering Report (FER).

Multiple Clients, Remedial Investigation Work Plans and BCP Applications, New York City, New York. As project manager and engineer, Suzanne has prepared NYSBCP Applications and Remedial Investigation Work Plans for the New York State Department of Environmental Conservation (NYSDEC) for sites within the New York City boroughs.

Excavation Oversight and CAMP Monitoring, Various Sites, New York City, New York. Suzanne has served as project manager for projects under the New York City Office of Environmental Remediation (NYCOER) program and NYSBCP. Her responsibilities included managing excavation oversight, air monitoring, and logging trucks for off-site disposal.

Aerospace Manufacturing Facility, Feasibility Study and Remedial Action Plan, Chula Vista, CA. Suzanne co-authored feasibility studies for soil and ground water impacted by chlorinated solvents, metals, and PCBs. She screened ex-situ and in-situ remedial alternatives for effectiveness, implementability, and protectiveness of human health. She also assessed alternative cleanup levels for technical and economic feasibility of achieving background concentrations in accordance with State Water Resources Control Board Resolution 92-49. Additionally, she evaluated groundwater remedial alternatives, including bioremediation, monitored natural attenuation (MNA), pump and treat, chemical oxidation, chemical reduction, and engineered and institutional controls. Lastly, she prepared engineering cost estimates and conceptual designs. Assisted with the preparation of remedial action plans: a bioremediation remedy and MNA program for groundwater, and excavation of contaminated soil.

Aerospace Manufacturing Facility, Groundwater Remediation and Bioremediation Pilot Test, Riverside, CA. Suzanne assisted with data analysis and reporting for the bioremediation pilot test study for groundwater impacted by chlorinated solvents, hexavalent chromium, and 1,4-dioxane. She evaluated site data for trends indicative of MNA using statistical analysis.

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Goodyear Tire & Rubber Company, Phoenix Goodyear Airport South Superfund Site, Goodyear, Arizona. Suzanne prepared reports and performed data analysis related to the groundwater monitoring program and operation and maintenance of groundwater treatment systems. Currently, two groundwater extraction and remediation systems are capable of treating more than 1MGD of groundwater contaminated with trichloroethylene. The upper groundwater zone is treated with an air stripper, while the lower zone is treated with granulated activated carbon. Treated groundwater is reinjected into their respective zones.

Soil and Groundwater Remediation Systems, Arizona. Suzanne **p**erformed operation, maintenance, and sampling activities for two soil vapor extraction systems to remove tetrachloroethylene from subsurface soils at two different dry-cleaning facilities. She prepared soil vapor extraction GAC system test reports in accordance with Maricopa County Air Quality Department Permits.

ASTM Phase I Environmental Site Assessments, Arizona. Suzanne assisted with ASTM Phase I ESAs at various industrial facilities in central and southern Arizona. She evaluated site conditions and regulatory implications as they related to the owner's or potential buyer's property development plans.

Phoenix-Goodyear Airport-North Superfund Site, Focused Feasibility Study, Goodyear, Arizona. Suzanne was a member of team that prepared a source area remediation focused feasibility study report. She evaluated several technologies and alternatives to treat groundwater contaminated with trichloroethylene (TCE) and perchlorate. She analyzed remedial alternatives, including in-well air stripping, a hydraulic barrier, nano- and macro-scale zero-valent iron, anaerobic reductive dechlorination, in-situ chemical oxidation (permanganate), and electrical resistive heating. She prepared cost estimates, conceptual designs, remediation technology summaries, and sustainability evaluation of the alternatives.

Enhanced In-Situ Bioremediation (EISB) and Chemical Reduction Using a Nanoscale, Zero-Valent Metallic Alloy to Treat Co-disposed Chloroethanes and Chloroethenes in Groundwater, Manufacturing Facility, Canton, MA. Suzanne performed data analysis and prepared status reports on effectiveness of EISB in treating chlorinated solvents in shallow groundwater. She reported on the performance monitoring results for the permeable reactive barrier in deep zone groundwater.

Hayden Facilities RI/FS, ASARCO LLC, Hayden, Arizona. Suzanne served as Quality Assurance Officer for the air monitoring program at a copper smelting facility. She developed site-specific data validation procedures according EPA guidelines for several analytical methods.

Market Evaluation for Nanoscale Zero-Valent Iron, Stamford, Connecticut. Suzanne used EPA CERCLIS Public Access Database and select State databases to estimate the market size for potential use of nanoscale zero-valent iron (nZVI) as a remediation technology. She compiled competing vendor information and quotes to estimate the average cost of similar products. She utilized the U.S. Patent and Trademark Office database to analyze competing technologies.

AZPDES and NPDES Permits, Arizona. Suzanne prepared Arizona Pollutant Discharge Elimination System (AZPDES) and National Pollutant Discharge Elimination System (NPDES) permit renewal applications for a copper mining facility in Southern Arizona, which included updates to the facility's Storm Water Pollution Prevention Plan (SWPPP) and QA Manual.

Spill Prevention, Control and Countermeasure Plans, Aggregate Mining Facilities, Arizona. Suzanne assisted with a Spill Prevention, Control and Countermeasure Plans (SPCC) for aggregate mining facilities in Arizona. She performed site visit, evaluated fuel and oil tanks and secondary containment areas, assisted with calculations to verify compliance, and prepared report.

Copper Mining Facility, Miami, Arizona. Suzanne assisted with Toxic Release Inventory (TRI) and Toxic Substances Control Act (TSCA) reporting, both submitted to the EPA.

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Storm Water Pollution Prevention Plan, Franciscan Friars of California, Gila County, Arizona. Suzanne updated the SWPPP for construction activities related to the closure of a historic Gibson copper mine, authorized under the Arizona Pollutant Discharge Elimination System "General Permit for Discharge from Construction Activities to Waters of the United States." The Former Gibson Mine is a small, historic copper mine, located approximately 7 miles southwest of Miami, Arizona, in Gila County. Construction activities covered under the updated SWPPP consisted of the excavation, hauling, and removal of approximately 80,000 tons of soil cover from the Mineral Creek side of the site to mine-scarred areas on the Pinto Creek side of the site. Also included was final grading of the site, which consisted of re-contouring and re-defining any portion of the drainages that were on site; and revegetation.

Stormwater Pollution Prevention Plans, Vulcan Materials Company, Western Division, Arizona. Suzanne prepared SWPPP for 11 aggregate mining facilities in Arizona. Performed site visits, analyzed stormwater flows, prepared reports, and completed Notices of Intent for the Arizona Department of Environmental Quality under a Multi-Sector General Permit.

Uranium Enrichment Facility, Lea County, New Mexico. Suzanne prepared quarterly and annual groundwater monitoring reports, semi-annual radioactive effluent release reports, and radiological environmental monitoring program reports in accordance with New Mexico Environment Department regulations and the Nuclear Regulatory Commission. Performed quarterly data validation on a variety of matrices and analytical methods. She prepared site-specific environmental monitoring procedures, which included field sampling techniques; data collection, management and validation; and an air modeling software package.

Rocket Testing and Research Facility, Western U.S. Suzanne analyzed and evaluated groundwater quality data, prepared reports, and managed data for this Resource Conservation and Recovery Act (RCRA) site. Assisted with management of sampling, analysis, and reporting of constituents of concern for fractured sandstone bedrock aquifer impacted by chlorinated solvents and emergent chemicals 1,4-dioxane, perchlorate, and n-nitrosodimethylamine (NDMA). Performed data validation of water quality data according to U.S. EPA National Functional Guidelines. Queried data from client environmental data management system and prepared summary tables, concentration plots, and water level hydrographs using Microsoft Excel programs. She prepared a quarterly analytical schedule using an Access database application, updated the site-specific Health & Safety Plan, and participated in lean training, which reduced cost of groundwater monitoring tasks by 25 percent.

Federal Superfund Site, Eastern Massachusetts. Suzanne performed data validation and quality assurance/quality control of soil and groundwater data according to U.S. EPA National Functional Guidelines. She performed third-party database updates.

Great Western Bank, Cortaro Ranch Property, Marana, Arizona. For site characterization of undeveloped land, Suzanne performed surficial soil sampling, analytical laboratory coordination, data analysis, and report preparation.

Twin Buttes Properties, Inc., Southern Arizona. Suzanne assisted with report and analytical table preparation for the characterization and analysis of current and historical hydrologic conditions at an inactive mine site near Sahuarita, Arizona in support of regulatory compliance.

Skyworks Solutions, Inc. Site, Newbury Park, California. Suzanne assisted with report and analytical table preparation for a subsurface investigation characterizing the lateral and vertical extent of soil and groundwater impacts from known releases of TCE, 1,4-dioxane and other organic compounds.

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PUBLICATIONS

"Mixed Redox Catalytic Destruction of Chlorinated Solvents in Soils and Groundwater," with S. Gao, E. Rupp, M. Willinger, T. Foley, B. Barbaris, A.E., Saez, R.G. Arnold and E. Betterton. In Environmental Challenges In The Pacific Basin, 2008; Annals of the New York Academy of Sciences, Vol. 1140, pp 435-445. PMID: 18991945

INVITED LECTURER OR SPEAKER

"Catalytic Destruction of Perchloroethylene," with E. Betterton, R. Arnold and Eduardo Saez, Presenter - NASA Space Grant Student Symposium, Phoenix, Arizona. April 2007.

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HALEY ALDRICH

MARI C. CONLON

Project Manager

EDUCATION
M.S., Geology, Boston College
B.S., Geology with a minor in Economics and Business, Lafayette College

PROFESSIONAL REGISTRATIONS
NY: Professional Geologist (License No. 000769)

PROFESSIONAL SOCIETIES
Big Apple Brownfield Awards, Co-Chair, 2018-2019
Big Apple Brownfield Awards Nomination Committee, 2016-2017

SPECIAL STUDIES AND COURSES
40-Hour OSHA Hazardous Waste Operations and Emergency Response Training (29 CFR 1910.120)
10-Hour OSHA Construction Safety
8-Hour OSHA Supervisor of Hazardous Waste (29 CFR 1910.120 & 29 CFR 1926.65)

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Mari is a project manager with experience in soil, groundwater and soil vapor investigation and a focus on remedial design and implementation, and will focus her time at Haley & Aldrich serving the environmental and real estate markets. She is also experienced in completion of numerous Phase I Environmental Site Assessments and Phase II Environmental Site Investigations, site characterization, hazardous materials analysis, regulatory closure reports as well as remedial design and implementation.

Mari has experience in composing site closure documentation including Remedial Closure Reports and Noise Installation Reports reviewed by the Office of Environmental Remediation as well as Final Engineering Reports reviewed by the New York State Department of Environmental Conservation. Her background includes developing and complying with approved site management plans overseeing the operation and maintenance of on-site engineering controls and ensuring the protection of human health and the environment.

Mari has also worked on city rezoning proposals by performing work associated with and composing the Hazardous Materials Analysis chapter included in Final Environmental Impact Statements published by New York City Department of Planning. Analysis methods were performed in accordance with the City Environmental Quality Review (CEQR) guidelines for neighborhoods including East New York, Brooklyn, Jerome Avenue, Brooklyn, Inwood, and Manhattan.

RELEVANT PROJECT EXPERIENCE

State and City Agencies

School Construction Authority, Waste Characterization and Excavation Materials Disposal Plan, Brooklyn, New York. Project manager for consulting services for New York Public School 127. Services included composition of an Excavated Materials Disposal Plan, collection of waste characterization samples and preparation of and preparation of a findings and recommendations report.

Department of City Planning, Rezoning Environmental Impact Statement, Bronx, New York. Project lead for analysis and composing the Hazardous Materials Chapter as per City Environmental Quality Review (CEQR) Technical Manual guidelines included in the Final Environmental Impact Statement (FEIS) for an approximately 92-block area primarily along Jerome Avenue and its east-west commercial corridors in the Bronx. The review assessed the potential for the presence of hazardous materials in soil and/or groundwater at both the projected and potential development sites identified in the reasonable worst-case development scenario under the proposed East New York Rezoning Proposal. Procedures involved site inspections and review of historic Sanborn fire insurance maps, city directories and city/state regulatory databases. The assessment identified that each of the 146 projected and potential development sites has some associated concern regarding environmental conditions. As a result, the proposed zoning map actions include (E) designations (E-366) for all privately-held projected and potential development sites.

Department of City Planning, Rezoning Environmental Impact Statement, Brooklyn, New York. Project lead for performance analysis and composing the Hazardous Materials Chapter as per CEQR Technical Manual guidelines included in the FEIS for an approximately 190-block area of East New York, Cypress Hills, and Ocean Hill neighborhoods of Brooklyn, New York. The review assessed the potential for the presence of hazardous materials in soil and/or groundwater at both the projected and potential development sites identified in the reasonable worst-case development scenario under the proposed East New York Rezoning Proposal. Procedures involved site inspections and review of historic Sanborn fire insurance maps, city directories and city/state regulatory databases. The assessment identified that each of the 186 projected and potential development sites has some associated concern regarding environmental conditions. As a result, the proposed zoning map actions include (E) designations (E-366) for all privately-held projected and potential development sites.

Redevelopment and Remediation

Titan Equity Group, Hotel Redevelopment, Bronx, New York. Project manager for a hotel redevelopment in the south Bronx. The site has been assigned New York City Office of Environmental Remediation (NYC OER) E-Designation status for hazardous materials, noise and air quality. Services included completion of a remedial investigation, composition of a Remedial Investigation Report and development of Hazardous Material Remedial Action Work Plan and Air Quality/Noise Remedial Action Plan as per NYC OER requirements.

The Related Companies, Chelsea Mixed-Use Redevelopment, New York, New York. Field geologist for oversight of the remediation of a mixed-use residential and commercial building, the second of a two-building development on 30th Street. Contaminants of concern included volatile and semi-volatile organic compounds associated with historic operations and underground storage tanks (USTs) located on the Site. The Site was given an E-designation (E-142) for hazardous materials and noise as part of the Highline/West Chelsea rezoning proposal. To satisfy the requirements of the E-designation program, soil was excavated to at least 12 feet below grade and bottom endpoint collected showing no contaminants of concern exceeding the New York State Department of Environmental Conservation (NYSDEC) Unrestricted Use Soil Cleanup Objectives (SCO). By achieving Unrestricted Use SCOs, no engineering controls were necessary, although the building slab was included as part of development, and removal of the hazardous materials E-designation was requested.

Tishman Speyer, Long Island City Residential Development, Long Island City, New York. Field geologist for remedial oversight and implementation of a Community Air Monitoring Program during concurrent remediation and development of three Brownfield Cleanup Program (BCP) sites located in Long Island City, New York. The Sites were grossly contaminated with creosote, a carcinogenic chemical formed from the distillation of various tars. Remediation strategies included soil excavation and in-situ soil stabilization. To prevent migration of groundwater off-site, a temporary and later a permanent capture well system was installed on the western boundary of the property. The BCP site located on the western portion of the property left residual contamination in place requiring installation of a sub-slab depressurization system.

Queens West Development Corporation, Queens Waterfront Development, Long Island City, New York. Field geologist for performance of site management post remedial action. Services included annual groundwater monitoring, evaluation of engineering and institutional controls completion and Period Review Reports. In addition to conducting annual site management activities, responsibilities included composing a work plan to evaluate the transition from active sub-slab depressurization systems to passive. Upon NYSDEC approval, active systems were shut down for 30 days prior to a sub-slab vapor sampling event evaluation soil vapor, indoor and outdoor air conditions for potential vapor intrusion risk. As results indicated no evidence of vapor intrusion, continued pressure monitoring was conducted for from the existing monitoring ports for one year assessing whether negative pressure was held by the existing slab by stack-effect or other passive processes.

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Jim Beam Brands Co., Brownfield Cleanup Program Remediation Site, Long Island City, New York. Field geologist for oversight of the installation of an Electrical Resistive Heating (ERH) system implemented in order to remediate trichloroethylene groundwater plumes in shallow/intermediate and deep groundwater on- and off-site. The Site, a former stapler manufacturing facility, underwent various remedies, including a Soil Vapor Extraction system, air sparging, ozone injection and chemical oxidation using potassium permanganate injections, which resulted in little reduction to contamination levels and rebounding chlorinated solvents. Components of the ERH system installed included electrodes for delivery of steam, vapor recovery wells, and groundwater monitoring wells. The site is currently under remediation in the state BCP program.

Due Diligence and Site Characterization

Manufacturing Plants, Multiple Investors, Environmental and Compliance Assessment Portfolio United States. Project lead for completion of Phase I Environmental Site Assessments (ESAs) and Limited Compliance Reviews for multiple auto parts manufacturing facilities throughout the United States. Services included completion of Phase I ESAs in accordance with the American Society for Testing and Materials E1527-13 requirements and a limited review of each facility's compliance liabilities including issues pertaining to the Resource Conservation and Recovery Act, Greenhouse Gas Emission Standards and Tier II Emergency and Hazardous Chemical Inventory reporting requirements.

ARM Parking, Environmental Site Assessment and Subsurface Investigation, Brooklyn, New York. Project manager for site assessment and subsurface investigation of parking facility in Sunset Park neighborhood, Brooklyn, New York. Services included ground penetrating radar survey for former and current petroleum USTs, completion of a subsurface investigation of soils and composition of Limited Subsurface Investigation Report.

Spill Consulting

The Trump Organization, Spill Consulting Services, New York, New York. Project manager for consulting services provided after incidental release of calcium carbonate ice rink paint to the Central Park Pond from Wollman Rink. Services included liaising with NYSDEC regarding violations, consent order and required corrective action. Corrective action included designing alterations to the existing on-site drainage plans and routing all meltwater containing paint into the combined sewer system. Coordination was required with property owner, operations personnel, New York City Department of Parks and NYSDEC.

Richmond Gardens Apartments, Spill Management and Closure Services, Staten Island, New York. Project lead responsible for spill closure activities and reporting for Spill 1105661 located at the Richmond Gardens Apartment Complex in the Richmond neighborhood of Staten Island, New York. The spill was opened in 2011 when several underground storage tanks were identified adjacent to the apartments at Jersey Street and Hendricks Avenue. The tanks were cleaned and removed and impacted soils surrounding the tank area excavated to the extent possible. Excavation of all impacted material was not feasible due to the proximity of the tanks to the apartment buildings. Residual contamination in soil and groundwater remained and was monitored through 2016. Upon reviewing the groundwater monitoring data from over 12 consecutive quarters, it was apparent monitored natural attenuation was not a feasible option and an in situ chemical oxidation (ISCO) remedy was approved by NYSDEC. Due to success of the pilot test, the ISCO injection event was implemented utilizing pressure pulse technology to deliver the alkaline activated persulfate solution to the subsurface.

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BRIAN FITZPATRICK, CHMM

Corporate Director, Health and Safety

EDUCATION

M.P.A., Environmental Policy, Syracuse University
B.S., Environmental Science, University of Massachusetts-Amherst
A.S., Chemistry, Valley Forge Military Junior College
Commissioned Officer, United States Army

CERTIFICATIONS

Certified Hazardous Materials Manager (Reg. No. 13454)
Certified Department of Transportation Shipper
Certified International Air Transport Authority Shipper

PROFESSIONAL SOCIETIES

Alliance of Hazardous Materials Professionals
Academy of Certified Hazardous Materials Managers, New England Chapter

SPECIAL STUDIES AND COURSES

Department of Transportation
International Air Transport Authority
Incident Commander
Confined Space Entry and Rescue
Radiation Safety Officer
RCRA Hazardous Waste
Massachusetts Industrial Waste Water Operator Grade 2I (expired)

AWARDS

Presidents Club Award (one million hours worked without a recordable injury, Cabot Corporation
Chancellors Award for Excellence, Syracuse University

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Brian has over 25 years of experience in developing, implementing, and managing a wide range of environmental, health, and safety (EH&S) solutions for a variety of clients. Brian has served as the Health and Safety Manager and Incident Commander at several research and development sites and has managed extensive programs to maintain and clean contaminated sites under Federal and State regulatory programs. He has provided expertise in managing EH&S programs as a consultant, and has actively developed, implemented, and managed these programs as an EH&S professional for various industries.

Brian is currently working as the Chief Health and Safety Officer for Haley & Aldrich, Inc. He, and his staff, are involved in every project Haley & Aldrich, Inc. undertakes. Brian is involved on several projects, directly overseeing the health and safety on the project site of our staff, our contractors, and the public. Brian also acts as support for our on-site health and safety staff on other larger construction and remediation projects.

Through Brian's leadership our safety culture and focus extend from the top of our organization to each and every Haley & Aldrich employee as well as subconsultants and subcontractors. Utilizing a Behavior Based Safety approach, Haley & Aldrich expects every project team member to play an important role in making our projects safe and has given authority to every Haley & Aldrich employee, subconsultant, and subcontractor to stop any activity at any time for health or safety concerns. Our record illustrates that our hard work is paying off. The company has gone 4 years without a lost time injury, and our TRIR and EMR have consistently improved each of the last 3 years.

RELEVANT PROJECT EXPERIENCE

Haley & Aldrich, Inc., Burlington, Massachusetts. As Chief Health and Safety Officer, Brian has led and facilitated the development and implementation of corporate health and safety (H&S) improvement plans to enhance compliance and improve H&S performance. In Brian's time with Haley & Aldrich, Inc., the company has realized dramatic improvement on H&S goals and in Key Performance Indicators. Brian is responsible for developing a risk competence culture, where our staff are empowered to look for and engage to address risk before anyone is injured. Brian oversees the development, implementation and continuous improvement of all H&S programs for the company. Additional responsibilities include:

- Developing a safety culture through incident reporting, root cause analysis, behavior-based safety, hazard recognition and risk assessment, communication, and developing leaders;
- Monitoring proposed and existing SH&E regulations and legislation to determine their impact on operations and to ensure continued compliance;
- Overseeing the safety, industrial hygiene, and toxicology programs for over 600 staff members engaged in remediation, construction, health and safety, consulting, and general office work across 28 offices in the United States and on assignment to international project sites;
- Continuously seeks to improve H&S performance as measured by the OSHA Incident Rating (IR) and Worker's Compensation Experience Modification Rating (EMR), as well as Leading Indicators developed with the management team; and
- Participating in the corporate audit program as an auditor or lead auditor;

Energy Client, California. As Chief Health and Safety Officer, Brian led and facilitated the Alliance Partnership Safety Council in 2017, is still an active contributor to the council, and hosts routine contractor safety forums for the client. Brian is actively involved in the development and implementation of program safety, health, and environmental (SH&E) plans to ensure safe operations on project sites. Brian developed permits and Health and Safety Plans for large projects and routinely audits the site safety. Additional responsibilities include:

- Driving reporting and behavior-based safety initiatives to support our internal safety culture and developing monthly summary reports to illustrate performance to our client.
- Develop, assess and continuously improve site safety plans and practices, including specific safety protocols for working safely over and around water.
- Worked as an extension of the client's organization to provide assurance that the remedy was completed safely and consistent with client-specific requirements.
- Support on-site safety personnel in ensuring the health and safety of the general public, our staff, and our sub-contracted employees.
- Audits and visits sites to ensure compliance with our internal policies and client-specific requirements.

Energy Client, Ohio. As Chief Health and Safety Officer, Brian supports the project team in developing and executing client and project specific health and safety measures, such as a site specific Health and Safety Plan, Job Hazard Analyses, Industrial Hygiene program, and site specific training. Brian also routinely visits the site to assess current practices and condition and to ensure continuous improvement. Additional responsibilities include:

- Develop, assess, and continuously improve site safety plans and practices, including specific safety protocols to comply with supplemental EH&S requirements such as the Duke Health and Safety Handbook, Environmental Supplemental, and EHS Keys to Life.
- Develop, assess, and continuously improve site safety plans and practices to address the risks associated with the work being performed on site, as well as the environmental conditions and simultaneous operations, including trenching and excavation, hot work, work over and near water, heavy equipment, HAZWOPER, etc.
- Worked as an extension of the client's organization to provide assurance that the remedy was completed safely and consistent with client-specific requirements.
- Support on-site safety personnel in ensuring the health and safety of the general public, our staff, and our sub-contracted employees.
- Audits and visits site to ensure compliance with our internal policies and client-specific requirements.

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BRIAN A. FERGUSON

Senior Engineer

EDUCATION

M. S. Geotechnical Engineering, Tufts University, Medford, Massachusetts; 2012
B. S. Civil Engineering, State University of New York - Environmental, Science, and Forestry, Syracuse, New York; 2000
Ass. Science Degree in Applied Science and Technology (Nuclear Engineering), Thomas A. Edison State College, Trenton, New Jersey; 2000

PROFESSIONAL SOCIETIES

Order of the Engineer – 2000
Boston Society of Civil Engineers (BSCE)
American Society of Civil Engineers (ASCE)

SPECIAL STUDIES AND COURSES

American Concrete Institute – Certified Field Technician Certified Grade 1
Radiation Safety and Operations of Nuclear Testing Equipment – Troxler
40-Hour OSHA Hazardous Waste Operations Training (+ 8-Hour annual refresher)
10-Hour OSHA Construction training
Confined Space Entry Training
16-Hour Asbestos Operations and Maintenance

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Mr. Ferguson has over six years of experience serving as project engineer on a variety of real estate development projects. His project experience has included monitoring field investigations and performing construction oversight, performing due diligence and engineering analyses, performing geotechnical analyses and developing geotechnical recommendations, and preparing geotechnical reports and project specifications.

In addition to providing engineering design support, Mr. Ferguson has managed and participated in a number of field service activities. Field work has included construction monitoring and documentation of contractors' deep and shallow foundation related construction, including slurry walls, caissons, pile driving, pile cap installation, earthwork, backfilling and compaction, installation of soldier pile and wood lagging support systems, installation of tie backs, reading inclinometers, conducting in-place field unit weight tests, tie-back load testing, seismograph installation, monitoring, and evaluating, and preparation of footing bearing surfaces. Other responsibilities have included site development activities, including placement of utilities and subgrade preparation for roads; observations and testing to determine that work is completed in compliance with contract documents; on-site soil management; sampling of soil and groundwater for chemical laboratory testing and conducting in situ field screening; maintenance of job records including pile driving logs, results of field density tests, records of caisson and footing installations; preparation of daily field reports; in contact with key personnel; and resolution of field related problems.

RELEVANT PROJECT EXPERIENCE

St. Elizabeths Hostpital – West Campus Forensic Evaluations, Washington, D.C. Project Engineer for forensic evaluations on the adaptive reuse of former hospital buildings. Responsibilities included coordination of a field exploration program, including test borings and test pits to obtain subsurface information for project design and construction, overseeing multiple field personnel, subcontractors, assisting with project management, reviewing subcontractors invoices, reviewing and summarizing subsurface data and writing data reports.

TUFTS University, New Central Energy Plant, Medford, MA. Project engineer for a new Central Energy Plant that will house new co-generation steam boilers, centralized chilled water and electrical transformer switchgear that is planned to occupy approximately 20,000 square feet across two or three levels. Responsibilities included coordination of construction monitoring, observing SOE and footing installation, assisting with project management, reviewing weekly field construction reports, reviewing and responding to geotechnical design submittals and attending project meetings.

Lahey Hospital and Medical Center – Stilts Infill Project, Burlington, MA Project Engineer for an addition to the existing Stilts building on the Lahey campus. Responsibilities included coordination and overseeing geotechnical and environmental subsurface investigations, coordination of construction monitoring, observing footing installation, assisting with project management, reviewing weekly field construction reports, reviewing and responding to geotechnical design submittals and attending project meetings.

Gloucester Beauport Hotel, Gloucester, MA Project engineer for a four story hotel with a seawall constructed adjacent to tidal beach. Responsibilities included coordination and overseeing geotechnical and environmental subsurface investigations, coordination of construction monitoring, assisting with project management, reviewing weekly field construction reports, reviewing and responding to geotechnical design submittals and attending project meetings, design and implementation of a sub-slab gas mitigation system.

275 Wyman Street, New Office Building, Waltham, MA. Project engineer for a new office building and parking garage founded on a shallow foundation system. Responsibilities included preparing proposals, assisting with management and planning of a subsurface investigation program, summarizing subsurface data and reviewing geotechnical test boring logs, coordination of construction monitoring and instrumentation monitoring programs, reviewing weekly field construction reports, reviewing and responding to specialty geotechnical design submittals and RFIs by others and attending project meetings.

Suffolk University - 20 Somerset Street, Boston, MA Project engineer for design of 8-story academic building with two levels of below grade finished space. Responsibilities included coordination of construction monitoring, observing SOE and footing installation, assisting with project management, reviewing weekly field construction reports, reviewing and responding to geotechnical design submittals and attending project meetings.

Worcester State University, New Student Housing, Worcester, MA Project engineer for design and construction of a 7-story residence/dining hall with a single level basement and a major site retaining wall structure. Responsibilities included overseeing geotechnical subsurface investigations, provided foundation recommendations and specifications, and prepared a retaining wall contract document. Responsibilities included coordination of construction monitoring, excavation and construction of footings, and soil reuse and management, assisting with project management, reviewing weekly field construction reports, reviewing and responding to geotechnical design submittals and attending project meetings.

University of Massachusetts Boston, General Academic Building No.1, Boston, MA. Project engineer responsible for assisting project manager in preliminary foundation engineering recommendations and construction considerations for a new academic building on a part of Columbia Point, a historic landfill area. Assisted in design phase services that included preparing foundation support design recommendations including the use of high allowable stresses for 190-ft long end-bearing H-piles and application of Slickcoat coating to address downdrag concerns and reduce foundation costs.

Waltham Watch Factory, Waltham, MA project engineer for redevelopment of former watch factory. Responsibilities included construction oversight of new precast parking garage, utilitiy upgrades, soil remediation and management, installation of gas mitigation systems, assisting with project management, reviewing weekly field construction reports, reviewing and responding to geotechnical design submittals and attending project meetings.

Massachusetts Green High Performance Computing Center, Holyoke, MA. Project engineer for 60,000 sq. ft high level computing center and associated support utilities. Redevelopment of the site included recycling 50,000 cy of construction debris into the site fills at this historic site along the Connecticut River. Responsibilities included coordinating geotechnical and environmental field investigations, coordination of construction monitoring, seismic analysis, reviewing weekly field construction reports, reviewing and responding to geotechnical design submittals and attending project meetings.

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The Shops at Riverwood, Hyde Park, MA. The project consisted of the redevelopment of a colonial era paper mill. The multi-building complex was demolished and the concrete and brick from the previous buildings were recycled. The project involved crushing 50,000 cy of brick and concrete and placement of excavated soils and recycled brick and concrete as compacted fill materials to support proposed buildings, pavement areas, and achieve 5 to 9 ft. raises in grade. Field Representative was responsible for management and reuse of brick and concrete stockpiles, in-place density testing, coordination of test pits, installation of soldier pile and versa-lok walls, and backfilling of underground vaults. Remedial activities included: excavation of 5,000 cy of petroleum contaminated soils, on-site cement batching in a pug mill, and placement of compacted recycled materials in roadway areas; delineation, excavation and off-site disposal of TSCA-regulated PCB contaminated soils associated with historical Askarel transformers and dioxin-contaminated soils associated with historical bleaching operations; and disposition of 1,000 tons of paper mill sludge encountered within an abandoned granite-walled sluiceway structure. In addition, assisted with weekly project meetings, maintaining a record of material reuse, and providing weekly field reports.

Harvard Law School, Cambridge, MA. The Harvard Law School project is located on Massachusetts Avenue in Cambridge. The project consisted of a multistory building above ground with 5 levels below ground for a parking garage. Field Representative was responsible for overseeing the installation of slurry walls into bedrock and LBEs with three installation rigs while monitoring the removal of urban fill and transfer to several different receiving facilities from another portion of the site. The slurry walls were constructed into bedrock. Other Field Representative activities were: testing of the slurry, management of the excavated soils, and record keeping of the Contractor’s obstruction and down time of the equipment. In addition, assisted with weekly project meetings, maintaining a record of obstruction and machine time, and providing weekly field reports.

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SARAH COMMISSO

Senior Geologist

EDUCATION

B.S., Geological Sciences, State University of New York at Binghamton

Minor, Chemistry, State University of New York at Binghamton

PROFESSIONAL REGISTRATIONS

Geologist in Training (G.I.T) Certification, December 2021

SPECIAL STUDIES AND COURSES

40-Hour OSHA Hazardous Waste Operations and Emergency Response Training (29 CFR 1910.120)
8-Hour OSHA HAZWOPER Refresher Training
10-Hour OSHA Construction Safety Training
8-Hour DOT Hazmat Employee & RCRA Hazardous Waste Generator Training

Sarah is a geologist with experience in soil, groundwater, and soil vapor investigation, and preparation of technical reports. She also has extensive experience with conducting Phase I Environmental Site Assessments and Phase II Environmental Site Investigations, site characterization, and hazardous materials analysis. She has performed soil, groundwater, and soil vapor sampling events, geotechnical drilling projects, and has drafted site investigation plans and reports.

RELEVANT PROJECT EXPERIENCE

Environmental Experience

Madison Realty Capital, New York State Superfund Site, Former NuHart Plastics Site, New York State Superfund Site (NuHart West) and Brownfield Cleanup Program Site (NuHart East), Brooklyn, New York. Staff Geologist for the preparation of offsite investigation reports, RCRA (Resource Conservation and Recovery Act) Closure Work Plan, execution of the RCRA Closure, preparation of the Brownfield Cleanup Application (NuHart East), 30% Remedial Design, preparation of all BCP related work plans (NuHart East), coordination to vest the Site for 421-a and all community outreach programs for a former plasticizer facility with on- and off-site pollutant concerns. Responsible for assisting in the remedial cost and alternative analysis with the client to bring the Site to a certificate of completion. NuHart is a high-profile Site that requires coordination with the New York State Department of Environmental Conservation (NYSDEC), the New York City Office of Environmental Remediation (NYCOER), local regulatory agencies, community stakeholders and local elected officials.

The Jay Group, Speedway Portfolio, Multiple Boroughs, New York. Staff Geologist responsible for the expedited due diligence during acquisition of 5 former Speedway Sites of Phase I ESA's and Limited Phase II ESI's, preparation of the Brownfield Cleanup Program Applications, Remedial Investigation Work Plans, Interim Remedial Measure Work Plans and Air/Noise Remedial Action Work Plans (NYCOER). Four of the Sites were accepted into the NYSDEC Brownfield Cleanup program with one currently pursuing the program pending the acquisition. Remedial Investigations for compliance with the Brownfield Cleanup Program have been completed and the Remedial Investigation Reports are being drafted.

JCS Realty, 40 Bruckner Boulevard, Bronx, New York. Staff Geologist responsible for the due diligence during acquisition, preparation of the Brownfield Cleanup Program Application, Change of Use Documents, BCA Amendments, remedial investigation, and remedial action design (BCP and OER) for the former Mill Sanitary Wiping

Cloth Site under the New York State Brownfield Cleanup program and NYCOER E-Designation Programs (Air/Noise). The Site has a footprint of 45,000 SF with a planned development of a 12-story mixed use building with approximately 480 units which include affordable housing.

Toldos Yehuda, Former Techtronics Site (8 Walworth Street), Brooklyn, New York. Staff Geologist for the remedial investigation, remedial action design and remedial action implementation for the former Techtronics Site under the New York State Brownfield Cleanup program as a Participant where trichloroethene (TCE) and tetrachloroethene (PCE) were encountered in soil and groundwater. Successfully delineated the vertical and lateral extents of the plumes which were identified as an upgradient, on-site. For this Site we have designed source removal to 20'bgs, Zero Valent Iron (ZVI) Reactive Barrier Wall, in situ ZVI injections sitewide and a vertical vapor mitigation system. The Site is currently in the remedial implementation phase.

Waterfront Management of NY, 590-594 Myrtle Avenue, Brooklyn, New York. As lead field geologist, Sarah was responsible for the oversight of the excavation and remediation of the property located at 590-594 Myrtle Avenue, in Brooklyn, NY under the New York City Office of Environmental Remediation. During remediation Sarah observed and documented the excavation and proper disposal of on-site soil required for the installation of foundation elements. In addition, she oversaw the proper cleaning and removal of three underground storage tanks encountered during site wide excavation. After excavation was complete, she inspected the installation of a sub-slab vapor barrier and conducted the community air monitoring program during the course of remedial action.

Madison Realty Capital, 644 East 14th Street, New York, NY. Sarah is the lead drafter of the Remedial Investigation Work Plan and the Remedial Investigation Report for the 644 East 14th Site, which is enrolled in the NYSDEC Brownfield Cleanup Program. Sarah coordinated field staff and subcontractors for the execution of the Remedial Investigation Work Plan which included installation of soil borings, groundwater monitoring wells, and soil vapor points, and sampling of each.

Madison Realty Capital, River North, Staten Island, NY. Sarah coordinates field staff and subcontractors for the execution of the Remedial Investigation at this approximately 2-acre site enrolled in the NYSDEC Brownfield Cleanup Program. The Remedial Investigation involved the installation of approximately fifty soil borings, twenty soil vapor points, including soil borings extending to bedrock.

Oxford Property Group, Naval Yard Phase I Portfolio. Sarah conducted two of five Phase I ESAs for Oxford Property Group in the Philadelphia Naval Yard part of due diligence for potential acquisition of the properties. Each property was approximately 8-acres in size developed with active life sciences facilities. Sarah conducted site reconnaissance of the properties and reviewed historical site documentation to identify recognized environmental conditions at each site.

Target, Multiple Location in New York and New Jersey. Sarah conducted Phase I ESAs part of due diligence for potential acquisition of properties by Target in Jersey City, performed oversight of upgrades and construction at various Target stores in Brooklyn, Queens, Long Island, and Jersey City, including methane monitoring, air monitoring, collection of endpoint soil samples, and groundwater sampling. Sarah performed all oversight work in accordance with the Site-specific Soil Materials Management Plan.

Brownfield Cleanup Program Applications and Remedial Investigation Work Plans for NYSDEC. Sarah has completed writing several Brownfield Cleanup Program Applications for various clients in New York State. In writing the applications, Sarah reviews previous subsurface investigations of the site, and historical information to help get underutilized and abandoned contaminated properties into the Brownfield Cleanup Program to be remediated and redeveloped under NYSDEC. After completing the application, she prepares a Remedial Investigation Work Plan to strategically investigate site contamination so proper Remedial Action can take place.

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Excavation Oversight and CAMP Monitoring, Various Sites, Bronx and Brooklyn, New York. Sarah served as field geologist for several projects under the NYC Mayor's Office of Environmental Remediation (NYCOER) program and New York State Brownfield Cleanup Program (NYSBCP). Her responsibilities included performing excavation oversight, air monitoring, vapor barrier installation oversight, and logging trucks for off-site disposal.

Multiple Clients, Phase I ESAs and Due Diligence, Multiple Locations in New York, New Jersey, Pennsylvania and Massachusetts. Sarah conducted Phase I ESAs, for buyers on a variety of properties including commercial, industrial, and residential sites in New York, New Jersey, Pennsylvania, and Massachusetts. She has experience conducting site reconnaissance and reviewing historical site documentation to identify recognized environmental conditions at the sites.

Multiple Clients, Phase II, Multiple Locations, New York. As field geologist, Sarah conducted Phase II ESAs on a variety of different sites. She assisted with the development of sampling plans primarily based off previous environmental investigations and due diligence. Primary responsibilities for Phase II investigations included oversight of the installation of test borings and/or test pits, the installation of groundwater monitoring wells, and soil vapor points.

Geotechnical Engineering Experience

Smithsonian Institution Revitalization of the Historic Core, Washington, D.C. Sarah supported a team providing geotechnical engineering services for the renovation of several Smithsonian Institution buildings adjacent to the National Mall. Sarah was responsible for the oversight of geotechnical borings using hollow stem augur and mud rotary techniques as well as rock coring operations. Sarah classified soil samples using the Unified Soil Classification System, analyzed bedrock samples, and analyzed the geology of the Washington D.C area.

Parcel B Development, Washington, D.C. Sarah was the lead field Geologist for the geotechnical investigation for the development of the Parcel B Site adjacent to the D.C. United Stadium in Washington D.C. Sarah was responsible for the oversight of geotechnical borings using hollow stem augur and mud rotary techniques. She observed and coordinated Pressure meter testing of several borings and observed the installation of several groundwater monitoring wells to investigate impacted groundwater on the property. Additionally, based on her soil classifications in the field, she drafted boring logs and analyzed subsurface conditions at the site.

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KATHERINE R. MILLER

Project Manager

EDUCATION

B.S., Chemistry, University of Arizona

SPECIAL STUDIES AND COURSES

40-Hour OSHA Hazardous Waste Operations and Emergency Response Training (29 CFR 1910.120 and 40 CFR 265.16)
8-Hour OSHA Refresher Training (29 CFR 1910.120)
Level IV Data Validation Training

AWARDS

Pinnacle Award, 2009
Pathfinder Award, 2014

In her 10 years at Haley & Aldrich, Katherine has worked on soil and groundwater environmental investigations and the preparation of environmental reports for private, industrial, and government-based project clients. She is a qualified Data Validator capable of performing various levels of validation on laboratory water quality data according to U.S. Environmental Protection Agency (EPA) National Functional Guidelines and to U.S. Department of Energy radiochemical guidelines. She also has experience designing and maintaining databases for project-specific needs.

Project management responsibilities for a $1.5 million per year stormwater project include preparation of subcontractor bids and contracts; preparation of cost estimates, proposals, and reports; coordination of field testing programs; and interpretation of chemical testing results. She has interacted with local regulatory agencies.

RELEVANT PROJECT EXPERIENCE

Confidential Aerospace Manufacturer, Groundwater Monitoring, Western U.S. Katherine served as project manager for the comprehensive stormwater management program. Responsibilities included project finance management and data management including quality assurance/quality control (QA/QC) and interpretation of chemical testing results. Evaluated QA/QC of groundwater quality data, prepared reports and managed data for the site. Performed data validation of quarterly water quality data from over 300 locations according to EPA National Functional Guidelines and to DOE radiochemical guidelines over a six-year period. Also, responsible for updating and maintaining the integrity of over 200,000 records during that time period. Assisted with management of sampling, analysis, and reporting of constituents of concern, ensured compliance with post-closure permit monitoring and reporting requirements, Data Management Plan, QAPP, and Environmental Data Management System, and ensured and maintained 100% compliance with the QAPP and Data Management Plan. Additionally, prepared groundwater data summaries for proposed extraction wells including comparisons to site NPDES outfall limits in support of Groundwater Interim Measures planning.

Asarco Hayden Plant Site, Hayden, Arizona. Katherine assisted with field preparation, QA/QC of analytical data, and data validation as part of the Remedial Investigation/Feasibility Work Plan including soil, sediment, air, process water, surface water, and stormwater.

Former MGP Site, California. Katherine assisted with report preparation, QA/QC of soil and/or groundwater quality data, and data validation for the investigation of three large former MGP sites in an urban, residential setting; includes over 200 residential properties.

General Manufacturing, Leitchfield, Kentucky. Katherine assisted with report preparation, QA/QC of soil and/or groundwater quality data, and data validation for a soil and groundwater RCRA site. Groundwater monitoring is conducted annually at more than 50 locations for volatile organic compounds (VOCs), including 1,4-dioxane and semi-volatile organic compound (SVOCs).

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Skyworks Solutions, Inc., Newbury Park, California. Katherine assisted with report preparation, QA/QC of soil and/or groundwater quality data, and data validation at groundwater remediation site. She monitored for VOCs, including 1,4-dioxane, and inorganic chemicals, including hexavalent chromium.

Teledyne Scientific Company, Thousand Oaks, California. Katherine assisted with report preparation for this groundwater assessment site. Monitored natural attenuation has been instituted as the long-term site remedy.

Port of Redwood City, Permitting and Sediment Characterization, California. Katherine assisted with report preparation, QA/QC of sampling data, and data validation.

Kiewit Infrastructure West, Sediment Quality Study, California. Katherine assisted with report preparation, QA/QC of sampling data, and data validation.

Aeolian Yacht Harbor, Permitting, Eel Grass Conservation and Sediment Characterization, California. Katherine assisted with report preparation, QA/QC of sampling data, and data validation.

Marin County, Paradise Cay Permitting and Sediment Characterization, California. Katherine assisted with report preparation, QA/QC of sampling data, and data validation.

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APPENDIX C
NYSDEC Emerging Contaminant Field Sampling Guidance

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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

April 2023

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New York State Department of Environmental Conservation

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NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

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
Data Assessment and Application to Site Cleanup Page 3	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	3/28/2023
Water Sample Results Page 3	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.	NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These guidance values also include criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt).Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.	3/28/2023
Soil Sample Results Page 3	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values:	NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:	3/28/2023
Protection of Groundwater Page 3	PFOA (ppb) 1.1 PFOS (ppb) 3.7	PFOA (ppb) 0.8 PFOS (ppb) 1.0	3/28/2023

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Citation and Page Number	Current Text	Corrected Text	Date
Footnote 2 Page 3	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).	The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). 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).	3/28/2023
Testing for Imported Soil Page 4	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.	If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.	3/28/2023
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

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Citation and Page Number	Current Text	Corrected Text	Date
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
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

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Citation and Page Number	Current Text	Corrected Text	Date
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

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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

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Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	"In addition, further assessment of water may be warranted if either of the following screening levels are met: a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L"	Deleted	6/15/2021

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Citation and Page Number	Current Text	Corrected Text	Date
Routine Analysis, Page XX	Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP)… criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids).	Deleted	5/31/2022
Analysis and Reporting, Page XX	As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.	Deleted	5/31/2022
Routine Analysis, Page XX	LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media.	EPA Method 1633 is the procedure to use for environmental samples.	
Soil Sample Results, Page XX	Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6	
Appendix A	"Include in the text… LC-MS/MS for PFAS using methodologies based on EPA Method 537.1"	"Include in the text ….EPA Method 1633"	
Appendix A	"Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101"	Deleted	
Appendix B	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	

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Citation and Page Number	Current Text	Corrected Text	Date
Appendix C	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix D	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix G		Updated to include all forty PFAS analytes in EPA Method 533	
Appendix H		Deleted	
Appendix I	Appendix I	Appendix H	
Appendix H	"These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report."	"These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER)."	
Appendix H	"The holding time is 14 days…"	"The holding time is 28 days…"	
Appendix H, Initial Calibration	"The initial calibration should contain a minimum of five standards for linear fit…"	"The initial calibration should contain a minimum of six standards for linear fit…"	
Appendix H, Initial Calibration	Linear fit calibration curves should have an R^2 value greater than 0.990.	Deleted	
Appendix H, Initial Calibration Verification	Initial Calibration Verification Section	Deleted	
Appendix H	secondary Ion Monitoring Section	Deleted	
Appendix H	Branched and Linear Isomers Section	Deleted	

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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.

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Analysis and Reporting

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third-party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix G) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

EPA Method 1633 is the procedure to use for environmental samples. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist. Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

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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 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

NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These human health criteria should also be applied to surface water that is used as a water supply. This guidance also includes criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt). Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. 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]	0.8	1.0

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

[2] The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). 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).

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 the ambient water quality guidance values for groundwater, 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.

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Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by EPA Method 1633
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
-
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

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Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

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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.

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Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

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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.

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Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

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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.

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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).

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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.

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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

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Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonic acids	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluoropentanesulfonic acid	PFPeS	2706-91-4
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic acid	PFOS	1763-23-1
	Perfluorononanesulfonic acid	PFNS	68259-12-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
	Perfluorododecanesulfonic acid	PFDoS	79780-39-5
Perfluoroalkyl carboxylic acids	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUnA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTeDA	376-06-7
Per- and Polyfluoroether carboxylic acids	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Fluorotelomer sulfonic acids	4:2 Fluorotelomer sulfonic acid	4:2-FTS	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2-FTS	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2-FTS	39108-34-4
Fluorotelomer carboxylic acids	3:3 Fluorotelomer carboxylic acid	3:3 FTCA	356-02-5
	5:3 Fluorotelomer carboxylic acid	5:3 FTCA	914637-49-3
	7:3 Fluorotelomer carboxylic acid	7:3 FTCA	812-70-4
Perfluorooctane sulfonamides	Perfluorooctane sulfonamide	PFOSA	754-91-6
	N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8
	N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2
Perfluorooctane sulfonamidoacetic acids	N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA	2991-50-6
Perfluorooctane sulfonamide ethanols	N-methylperfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
	N-ethylperfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2

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Group	Chemical Name	Abbreviation	CAS Number
Ether sulfonic acids	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUdS	763051-92-9
	Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7

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

General

These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER). Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 28 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6°C 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.

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Initial Calibration

The initial calibration should contain a minimum of six standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

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Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

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APPENDIX D
Climate Screening Checklist

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Climate Screening Checklist

Background Information

- Project Manager: PENDING
- Site Name: 4001 4th Avenue Redevelopment Site
- Site Number: PENDING
- Site Location: 4001 4TH Avenue, Brooklyn, NY
- Site Elevation (average above sea level): 51 feet above mean sea level
- ClimAID Region (Responding Climate Change in New York State (ClimAID) - NYSERDA): Region 4
- Remedial Stage/site classification: Pending BCP Acceptance
- Contamination - Media Impacted/ Contaminants of Concern: Soil, groundwater, soil vapor
- Proposed/Current Remedy: Investigation/Design Phase
- What is the predicted timeframe of the remedy? Will components of the remedy still be in place in 10+ years?
  Remedy anticipated for completion in approximately 2 years. If required, engineering controls will remain in place, be maintained or replaced as needed for duration of requirement under future site management.
- Is the site in proximity to any sensitive receptors? (e.g. wetlands, waterbodies, residential properties, hospitals, schools, drinking water supplies, etc.)
  Yes, multiple schools, daycares, parks and medical facilities

Is the site in a disadvantaged community (DAC) or potential environmental justice area (PEJA) (Use DECinfolocator: DECinfo Locator (ny.gov))?

■ **Yes** ☐ **No**

If the site is in a DAC or PEJA, will climate impacts be magnified? If yes, list how and why.

☐ **Yes** ■ **No**

Should thresholds of concern be lowered to account for magnification of impacts? If yes, indicate how lower thresholds will be used in the screening.

☐ **Yes** ■ **No**

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Climate Screening Table*

Potential Climate Hazards	**Relevant to the Site Location** (Y/N/NA)[1]	**Projected Change** (Reference data source/Model)[3]	**Potential to Impact Remedy** (Y/N)	**Is remedy/site already resilient?** (Y/N)[4]
Precipitation	Potentially		N/A	N/A
Temperature[2] (Extreme Heat or Cold Weather Impacts)	Y	Y (Resilience Analysis and Planning Tool-RAPT)	Y	Future remedy will evaluate
Sea Level Rise	N	N/A (NOAA Relative Sea Level Trends)	N/A	N/A
Flooding	N	N/A (FEMA FloodMapper)	N/A	N/A
Storm Surge	N	N/A (NWS Storm Surge Hazard Map)	N/A	N/A
Wildfire	N	N/A (NYSDEC Fire Danger Map)	N/A	N/A
Drought	N	N/A (NYSDEC Drought Condition Map)	N/A	N/A
Storm Severity	Y	Y (Resilience Analysis and Planning Tool-RAPT)	Y	Future remedy will evaluate
Landslides	N	N	N/A	N/A
Other Hazards:	N/A	N/A	N/A	N/A

* Links to potential data sources can be found on the following page

[1] If the first column is N --> The rest of the columns will be N/A, the hazard is not applicable to the site.

[2] Extreme Heat: periods of three or more days above 90°F- Extreme Cold: Individual days with minimum temperatures at or below 0 degrees F (NYSERDA ClimAID report)

[3] List the projected change in specific terms or units e.g. inches of rain fall, feet of sea level rise, etc.

[4] If final column is Y, provide reasoning, if the final column is N --> Climate Vulnerability Assessment (CVA) required.

Required Next Steps (If no further action is required, provide justification):

Upon development of the future remedy, more robust analysis of elements needed to aid in resiliency planning for the redevelopment will be incorporated into a Climate Vulnerabiltiy Assessment.

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Potential Data Sources (not an exhaustive list)- from Superfund Climate Resilience: Vulnerability Assessment | US EPA

NYSERDA ClimAID report- Responding Climate Change in New York State (ClimAID) - NYSERDA

FEMA- National Flood Hazard Layer | FEMA.gov

NOAA- National Storm Surge Risk Maps - Version 3 (noaa.gov)

Department of Agriculture Forest Service Wildfire Risk to Communities

EPA Climate Change Indicators in the United States

EPA Climate Resilience Evaluation & Awareness Tool (CREAT) | U.S. Climate Resilience Toolkit

EPA National Stormwater Calculator

National Integrated Drought Information System U.S. Drought Portal

National Interagency Coordination Center National Interagency Fire Center

National Oceanic and Atmospheric Administration Coastal Services Digital Coast

- Resources to help communities assess coastal hazards, such as the Sea Level Rise Viewer for visualizing community-level impacts of flooding or sea level rise and downloadable LIDAR data

National Oceanic and Atmospheric Administration National Centers for Environmental Information website

National Oceanic and Atmospheric Administration Sea Level Trends

National Weather Service Climate Prediction Center

National Weather Service National Hurricane Center

National Weather Service Sea, Lake, and Overland Surges from Hurricanes (SLOSH)

National Weather Service Storm Surge Hazard Maps

U.S. Federal Government Climate Resilience Toolkit: The Climate Explorer

U.S. Army Corps of Engineers Climate Prepardness and Resilience

U.S. Geological Survey Coastal Change Hazards Portal

U.S. Geological Survey Landslide Hazards Program

U.S. Geological Survey National Ground-water Monitoring Network Data Portal

U.S. Geological Survey National Climate Change Viewer

U.S. Geological Survey National Water Dashboard

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U.S. Geological Survey StreamStats

NYS Department of State- Assess | Department of State (ny.gov)

NYSERDA NY Costal Floodplain Mapper- Home Page (ny.gov)

NYSDEC Costal Erosion Hazards- Coastal Areas Regulated By The CEHA Permit Program - NYDEC

NYSDOH Heat Index- health.ny.gov/environmental/weather/vulnerability_index/county_maps.htm

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APPENDIX E
Green Sustainable Remediation Documentation

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SITE INFORMATION	
User Name and Date	Mari Conlon 5/15/24
Site Name	4001 4th Avenue Redevelopment
Remedial Alternative Name	Preferred Alternative
Alternative File Name	Preferred Alternative-F
Choose electricity profile	NY

Component	Component Alias
Component 1	Component 1
Component 2	Component 2
Component 3	Component 3
Component 4	Component 4

Do you want to reload a previously saved remedial alternative in the SiteWise input sheet?

Yes

Refresh List

BATTELLE

Reset all input values on all worksheets to default

Reset All Values on All Sheets

-= Status =-

Reset complete.

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Version 3.2

Instructions

Sustainable Remediation Summary - Component 1

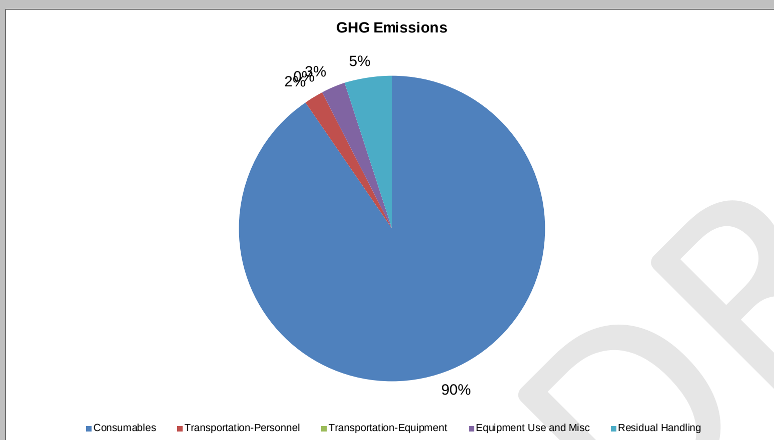
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	1,852.08	90.4	6.1E+04	94.9	NA	NA	NA	NA	NA	-	NA	-	NA	-	3.8E+00	81.9	6.8E+00	93.4	9.8E-01	37.1	NA	NA	NA	NA
Transportation-Personnel	41.30	2.0	5.4E+02	0.8	NA	NA	NA	NA	NA	-	NA	-	NA	-	1.3E-02	0.3	2.5E-04	0.0	1.3E-03	0.0	2.7E-04	55.4	2.2E-02	24.3
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Misc	52.09	2.5	7.4E+02	1.2	0.0E+00	0.0	0.0E+00	0.0	3.5E-02	100.0	7.3E-03	100.0	7.5E-03	100.0	2.6E-01	5.5	1.7E-01	2.4	2.6E-02	1.0	2.2E-04	44.6	6.8E-02	75.7
Residual Handling	102.63	5.0	2.0E+03	3.1	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	5.7E-01	12.3	3.1E-01	4.2	1.6E+00	61.9	0.0E+00	-	0.0E+00	-
Total	2,048.10	100.0	6.38E+04	100.0	0.00E+00	0.0	0.00E+00	0.0	3.50E-02	100.0	7.26E-03	100.0	7.48E-03	100.0	4.66E+00	100.0	7.24E+00	100.0	2.65E+00	100.0	4.93E-04	100.0	9.03E-02	100.0

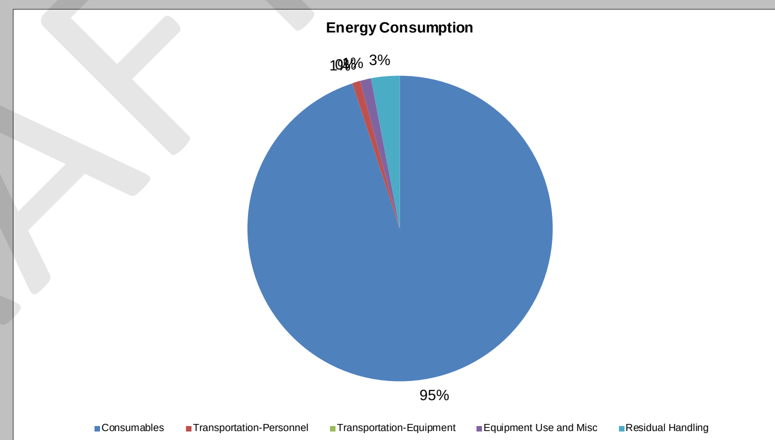
Additional Sustainability Metrics

Non-Hazardous Waste Landfill Space (tons)	8500.0
Hazardous Waste Landfill Space (tons)	500.0
Topsoil Consumption (yd^3)	400.0
Cost of Phase ($)	0.0
Lost Hours - Injury	0.7

Footprint Reduction

Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00





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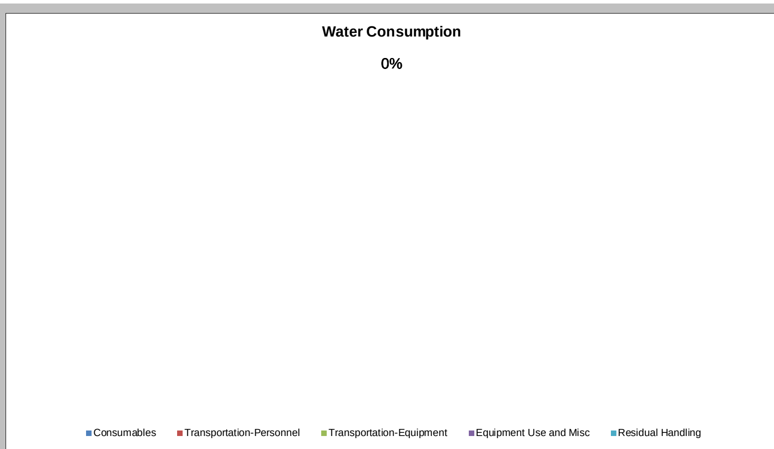
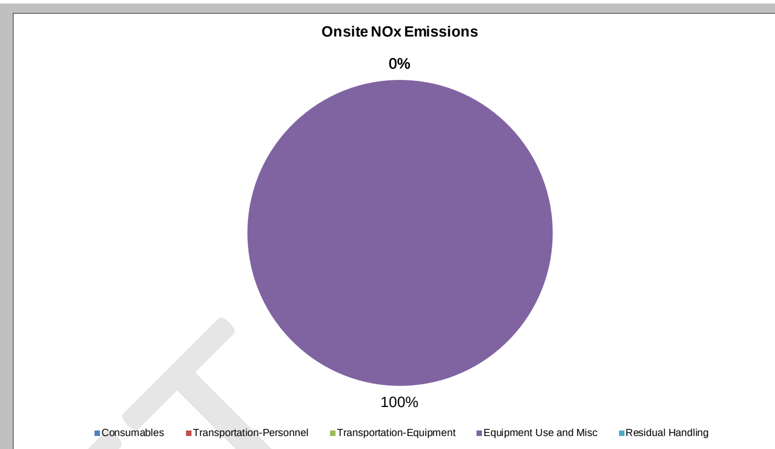
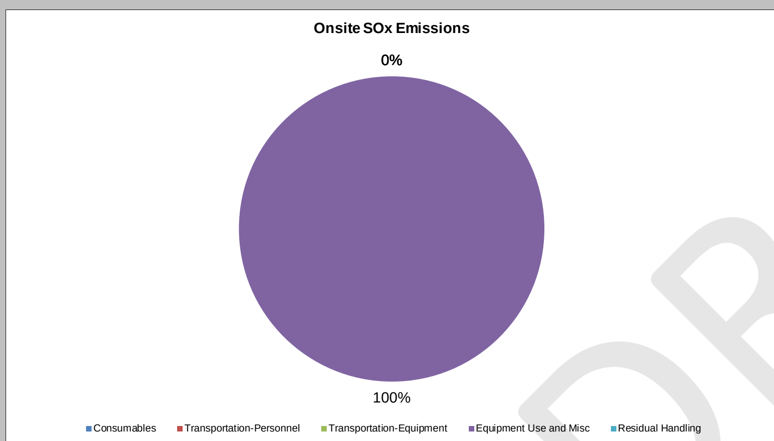
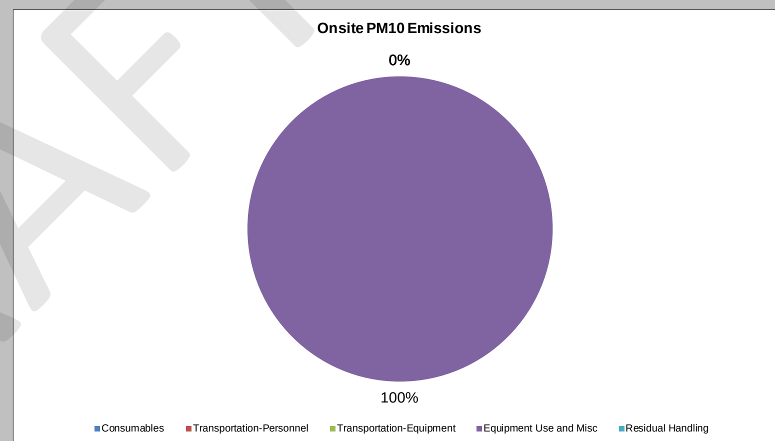

Water Consumption
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Onsite NOx Emissions
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Onsite SOx Emissions
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Onsite PM10 Emissions
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

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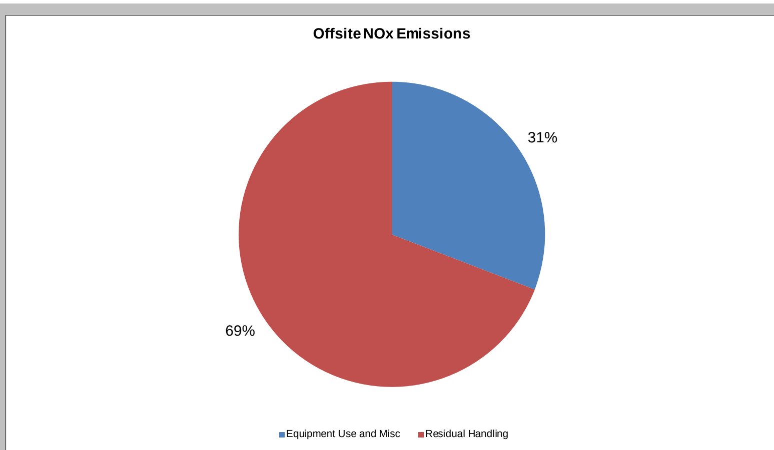
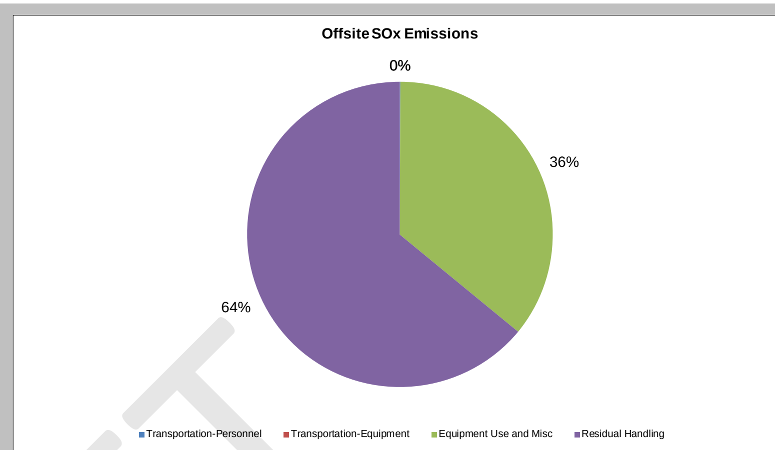
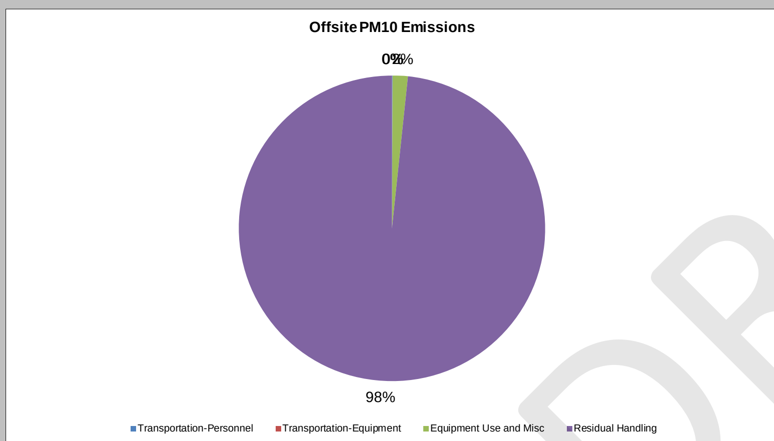
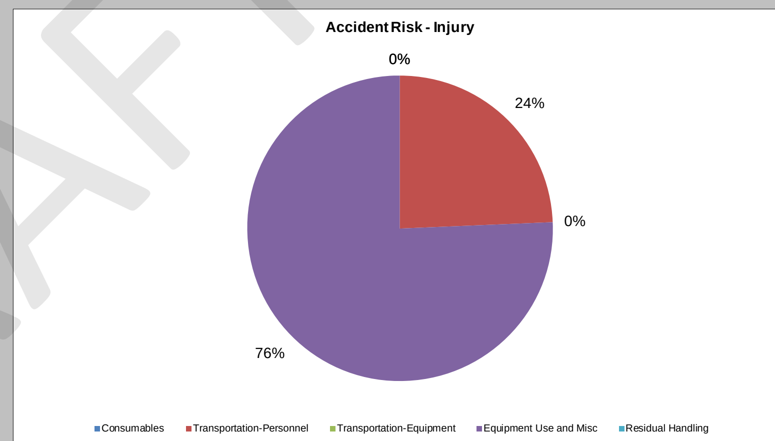

Offsite NOx Emissions
31%
69%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
36%
64%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
98%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
0%
24%
0%
76%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

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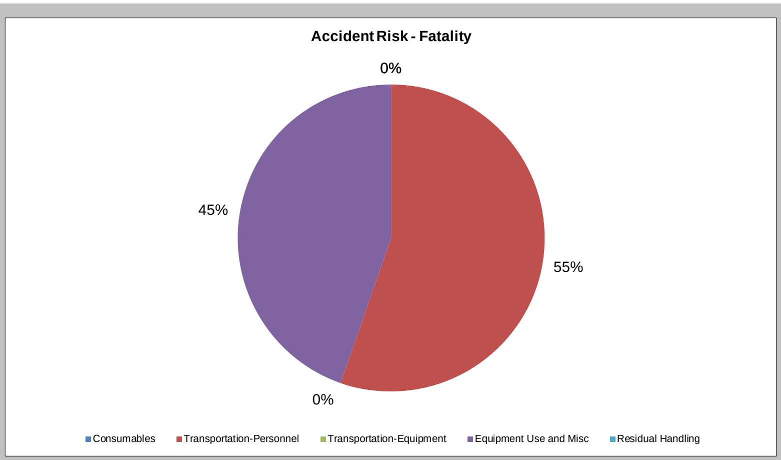
Accident Risk - Fatality
0%
45%
55%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

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This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative
Yellow cells require the user to choose an input from a drop down menu
White cells require the user to type in a value

BASELINE INFORMATION

COMPONENT 1 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10
Input number of wells	7									
Input depth of wells (ft)	50									
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)	2									
Input total quantity of Gravel (kg)	0									
Input total quantity of Bentonite (kg)	1									
Input total quantity of Typical Cement (kg)	1									
Input total quantity of General Concrete (kg)	0									
Input total quantity of Steel (kg)	0									

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10
Input number of injection points										
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)										
Input number of injections per injection point										

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10
Input weight of media used (lbs)	4,000									
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10
Choose material type from drop down menu	HDPE Liner	General Concrete	Gravel	Typical Cement	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)	30									
Input depth of material (ft)	750									

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10
Input number of wells	7									
Input depth of wells (ft)	50									
Input well diameter (in)	2.0									
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10
Input length or perimeter of silt curtain (ft)										
Input depth of silt curtain (ft)										

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity										

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Cars	Heavy Duty	Light truck	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	30	135	100							
Input number of trips taken	50	200	50							
Input number of travelers	2	1	1							
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)										

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
Input distance traveled (miles)										
Input number of travelers										
Input number of flights taken										

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)										
Input number of trips taken										
Input number of travelers										

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EQUIPMENT TRANSPORTATION - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).										
Input weight of equipment transported per truck load (tons)										

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
Input distance traveled (miles)										
Input weight of equipment transported (tons)										

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
Input distance traveled (miles)										
Input weight of equipment transported (tons)										

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
Input distance traveled (miles)										
Input weight of load (tons)										

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
Input distance traveled (mile)										
Input weight of load (tons)										

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10
Choose earthwork equipment type from drop down menu	Excavator	Loader/Backhoe	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)	5,500	2,500								
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10
Input number of drilling locations	22									
Choose drilling method from drop down menu	Sonic Drilling	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)	0.50									
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10
Choose fuel type from drop down menu	Gasoline	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	6 to 11	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)	300	150								

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)										
Choose dredge equipment size	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (	awler Crane, 25 ton, 1 (
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possibl	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)										
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)										
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (hr) (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0

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Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels										
Input operating time (hours)										
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - ELECTRICAL USAGE IS KNOWN										
Input pump electrical usage (KWh)	0	0	0	0	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN										
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN										
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region										
Electricity Region	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)										
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)										

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN										
Input equipment horsepower (hp)	0	0	0	0	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN										
Input equipment electrical usage, if known (kWh)	0	0	0	0	0	0	0	0	0	0
Region										
Electricity Region	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)	800									

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area to till (acre)										
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil

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Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)										
Input depth of tillage (in)										

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10
Choose stabilization equipment type from drop down menu	Paver	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)	10,000									
Input time available (work days)	15									

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)										
Input production rate (yd3/hr)										
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)										

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)										
Input operating hours (hr)										

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)										

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)										
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Occupation 1	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10
Choose occupation from drop-down menu	Construction laborers	Operating engineers	ntific and technical serv	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	1250.0	900.0	1000.0							

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10
Input dollars spent on laboratory analysis ($)	100,000.00									

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)										
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips										
Input number of miles per trip										

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)	8500.0	500.0								
Input landfill methane emissions (metric tons CH4)										
Region										
Electricity Region	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY

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THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input waste gas flow rate (scfm)										
Input time running (hours)										
Input waste gas inlet temperature (F)										
Input contaminant concentration (ppmV)										

*(Electric blowers are included in the analysis)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)										
Input total water disposed to wastewater treatment facility (gal)										

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)	400.0									
Input volume of groundwater or surface water lost (gal)										

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This worksheet allows the user to annotate and perform various periphery calculations in support of the primary workbooks

Yellow cells	require the user to choose an input from a drop down menu
White cells	require the user to type in a value
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

It is recommended that the calculations templates are copied/pasted into a blank section before editing

Reset All Values

WELL MATERIALS

[WELL NAME]

Input number of wells	1
Input depth of wells (ft bgs)	30
Input screen length (ft)	10
Choose specific material schedule from drop down menu	Sch 80 PVC
Choose well finish type from drop down menu	Above Ground Riser
Choose casing diameter (in) from drop down menu	4
Input borehole diameter (in)	8.25
Choose Filter Pack Material	Sand

This template calculates additional material requirements for the installation of "normal" flush-mount and above ground riser type permanent monitoring wells. Generally, temporary groundwater monitoring wells will not require any additional materials for installation. Other well types (bedrock wells, double-cased wells, etc.) may require different dimensions estimates than the defaults provided below. Concerning dimensional nomenclature: "Length" and "Depth" refer to vertical dimensions, "Outer" and "Inner" refer to the horizontal exterior and interior boundaries of the filled layer, "Dimension 1" and "Dimension 2" refer to the cross sectional sides of a rectangular object, and "Thickness" refers to the length of the most direct path between two sides of a material.

	WELL DIMENSIONS (elements arranged from bottom to top, inside to outside)						**Material**	**Volume (cubic ft)**
a	Filter Pack Base Dimenstions	**Length (ft)**	**Diameter (in)**					
	(volume between the bottom of the borehole and bottom of the casing)	0.50	8.25				**Sand**	**0.19**
b	Screened Interval Dimensions	**Length (ft)**	**Outer Diameter (in)**	**Inner Diameter (in)**				
	(volume of annular space for the length of the screened interval)	10.00	8.25	4.50			**Sand**	**2.61**
c	Filter Pack Above Screened Interval Dimensions	**Length (ft)**	**Outer Diameter (in)**	**Inner Diameter (in)**				
	(volume of annular space above the screened interval below the filter pack seal)	2.00	8.25	4.50			**Sand**	**0.52**
d	Bentonite Filter Pack Seal Dimensions	**Length (ft)**	**Outer Diameter (in)**	**Inner Diameter (in)**				
	(volume of annular space filled by the filter pack seal)	2.00	8.25	4.50			**Bentonite**	**0.52**
e	Cement Grout Dimensions	**Length (ft)**	**Top of Layer (ft bgs)**	**Outer Diameter (in)**	**Inner Diameter (in)**			
	(remaining volume of annular space)	14.00	2.00	8.25	4.50		**Typical Cement**	**3.65**
f	Flush-mount Outer Casing or Stick-up Dimensions	**Length (ft)**	**Outer Width 1 (in)**	**Outer Width 2 (in)**	**Wall Thickness (in)**	**TopThickness (in)**		
		5.00	6.00	6.00	0.25	0.75	**Steel**	**0.12**
g	Concrete or Sand Inner Fill Dimensions (between Outer Casing and Inner Casing to Surface)	**Length (ft)**	**Outer Dimension 1 (in)**	**Outer Dimension 2 (in)**	**Inner Diameter (in)**			
	(volume of annular space inside of the outer casing or stick-up)	2.00	5.75	5.75	4.50		**General Concrete**	**0.24**
h	Concrete Outer Fill Dimensions (not included in Pad)	**Length (ft)**	**Outer Diameter (in)**	**Inner Dimension 1 (in)**	**Inner Dimension 2 (in)**			
	(volume of annular space outside of the outer casing or stick-up)	2.00	8.25	6.00	6.00		**General Concrete**	**0.24**
i	Pad Dimensions (does not include Bumper Guard Concrete or Casing Outer Fill)	**Depth (in)**	**Length (ft)**	**Width (ft)**	**Inner Diameter (in)**			
	(volume of pad, minus bumper fill intended for bumper guards and fill intended for outer casing)	6.00	4.00	4.00	8.25		**General Concrete**	**7.29**
j	Bumper Guards	**Length (ft)**	**Diameter (in)**	**Thickness (in)**	**Number of Guards**			
		5.00	4.00	0.24	3.00		**Steel**	**0.29**
k	Bumper Guard Concrete (not included in Pad)	**Length (ft)**	**Outer Diameter (in)**	**Depth (ft)**				
	(volume of fill around bumpers by specified diameter from surface to depth and fill for interior of bumper)	5.00	8.00	2.00			**General Concrete**	**2.59**

RESULTS PER WELL

	Volume (cubic ft)	Volume (cubic meters)	Density (kg/cubic meter)	**Weight (kg)**
Required Sand	**3.31**	0.0939	1,850.00	**173.66**
Required Gravel	**0.00**	0.0000	1,682.00	**0.00**
Required Bentonite	**0.52**	0.0148	1,800.00	**26.58**
Required Typical Cement	**3.65**	0.1034	1,506.00	**155.69**
Required General Concrete	**10.36**	0.2933	2,371.00	**695.53**
Required Steel	**0.41**	0.0116	7,860.00	**90.85**

TOTAL WELL MATERIALS		
(kg)	**Sand**	**1.7E+02**
(kg)	**Gravel**	**0.0E+00**
(kg)	**Bentonite**	**2.7E+01**
(kg)	**Typical Cement**	**1.6E+02**
(kg)	**General Concrete**	**7.0E+02**
(kg)	**Steel**	**9.1E+01**

Well dimensions estimates are based on U.S. EPA Region 4, Science and Ecosystem Support Division, 02/18/2008, "Design and Installation of Monitoring Wells", SESDGUID-101-R0.

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CUSTOM ELECTRICITY DISTRIBUTION			
[PROFILE NAME]			
	Select State	NY	
	Input Electrical Resource Mix (as a fraction of total fuel mix):		**(Normalized)**
	Coal	0.00	0.00
	Oil	0.00	0.00
	Hydroelectric	0.00	0.00
	Natural Gas	1.00	0.00
	Biomass	0.00	0.00
	Nuclear	0.00	0.00
	Wind	0.00	0.00
	Solar	0.00	0.00
	Geothermal	0.00	0.00
	Distribution Total (if not equal to 1.00, normalized distribution will be used)	**0.00**	**0.00**
	Heat input (MMBTU) per heat output (MMBTU) by feedstock:		
	Coal		0.00
	Oil		0.00
	Hydroelectric		0.00
	Natural Gas		0.00
	Biomass		0.00
	Nuclear		0.00
	Wind		0.00
	Solar		0.00
	Geothermal		0.00
EMISSION FACTORS (lb/MWhr) [a]			
	CO2 Emission Factor	**0.0E+00**	
	N2O Emission Factor	**0.0E+00**	
	CH4 Emission Factor	**0.0E+00**	
	NOx Emission Factor	**0.0E+00**	
	SO2 Emission Factor	**0.0E+00**	
	PM10 Emission Factor	**0.0E+00**	
ENERGY PRODUCTION EFFICIENCY [b]		**0.000%**	
PERCENT OF ELECTRICAL ENERGY FROM RENEWABLE SOURCES [b]		**0.000%**	

[a] Based on User Selected Resource Mix, including Life Cycle Emissions and T&D Losses.

[b] Based on User Selected Resource Mix, including Life Cycle Energy Inputs and T&D Losses.

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Table C: Electricity use impact by region and source*

	Emission Factors for Coal, Including Life Cycle Emissions and T&D Losses						Emission Factors for Oil, Inc	
State Abbreviation	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)
AK	2.42E+03	3.32E+00	4.18E-02	4.35E+00	6.92E+00	4.75E+00	1.83E+03	2.52E+00
AL	2.21E+03	3.29E+00	3.82E-02	9.69E+00	1.99E+00	5.12E+00	2.06E+03	2.53E+00
AR	2.33E+03	3.31E+00	4.03E-02	5.96E+00	3.10E+00	4.89E+00	2.45E+03	2.55E+00
AZ	2.52E+03	3.41E+00	4.36E-02	2.14E+00	3.80E+00	4.91E+00	2.32E+03	2.61E+00
CA	2.03E+03	3.35E+00	3.52E-02	9.82E+00	1.15E+00	4.75E+00	2.21E+03	2.60E+00
CO	2.58E+03	3.42E+00	4.45E-02	3.36E+00	3.99E+00	4.88E+00	2.76E+03	2.62E+00
CT	2.15E+03	3.29E+00	3.72E-02	2.01E+00	1.36E+00	5.38E+00	2.64E+03	2.56E+00
DC	2.30E+03	3.30E+00	3.98E-02	6.87E+00	3.00E+00	6.11E+00	2.88E+03	2.57E+00
DE	2.22E+03	3.29E+00	3.84E-02	1.23E+01	3.17E+00	1.04E+01	6.62E+03	2.72E+00
FL	2.33E+03	3.31E+00	4.04E-02	6.30E+00	2.64E+00	5.69E+00	2.55E+03	2.55E+00
GA	2.29E+03	3.30E+00	3.97E-02	8.23E+00	2.07E+00	5.89E+00	1.52E+03	2.51E+00
HI	2.01E+03	3.34E+00	3.49E-02	9.07E+00	1.27E+00	5.73E+00	1.95E+03	2.58E+00
IA	2.39E+03	3.31E+00	4.14E-02	5.65E+00	2.68E+00	6.29E+00	3.51E+03	2.59E+00
ID	1.36E+03	3.27E+00	2.39E-02	1.27E+01	6.08E+00	6.27E+00	2.33E+03	2.61E+00
IL	2.43E+03	3.32E+00	4.20E-02	5.81E+00	2.03E+00	5.15E+00	2.66E+03	2.56E+00
IN	2.32E+03	3.31E+00	4.01E-02	8.33E+00	2.52E+00	7.14E+00	1.06E+03	2.49E+00
KS	2.48E+03	3.32E+00	4.29E-02	3.54E+00	3.28E+00	5.17E+00	1.26E+04	2.96E+00
KY	2.32E+03	3.31E+00	4.01E-02	6.38E+00	2.26E+00	5.19E+00	8.26E+03	2.78E+00
LA	2.36E+03	3.31E+00	4.08E-02	6.15E+00	2.48E+00	5.94E+00	3.00E+03	2.57E+00
MA	2.15E+03	3.29E+00	3.73E-02	7.77E+00	1.83E+00	4.63E+00	1.97E+03	2.53E+00
MD	2.18E+03	3.29E+00	3.78E-02	1.73E+01	1.83E+00	7.06E+00	3.25E+03	2.58E+00
ME	2.30E+03	3.30E+00	3.98E-02	6.87E+00	3.00E+00	6.11E+00	2.29E+03	2.54E+00
MI	2.35E+03	3.31E+00	4.06E-02	8.93E+00	2.89E+00	4.96E+00	1.72E+03	2.52E+00
MN	2.48E+03	3.33E+00	4.29E-02	3.92E+00	3.10E+00	6.76E+00	2.97E+03	2.57E+00
MO	2.36E+03	3.31E+00	4.08E-02	7.63E+00	1.98E+00	5.54E+00	3.45E+03	2.59E+00
MS	2.14E+03	3.29E+00	3.72E-02	4.73E+00	2.61E+00	5.03E+00	1.11E+03	2.49E+00
MT	2.59E+03	3.34E+00	4.48E-02	3.16E+00	3.20E+00	4.73E+00	2.24E+03	2.54E+00
NC	2.16E+03	3.29E+00	3.75E-02	3.87E+00	1.65E+00	7.09E+00	4.15E+03	2.62E+00
ND	2.57E+03	3.33E+00	4.43E-02	9.58E+00	4.85E+00	4.80E+00	1.37E+03	2.50E+00
NE	2.54E+03	3.33E+00	4.39E-02	7.08E+00	4.57E+00	5.24E+00	2.11E+03	2.53E+00
NH	2.18E+03	3.29E+00	3.79E-02	2.16E+01	2.53E+00	6.67E+00	2.50E+03	2.55E+00
NJ	2.39E+03	3.31E+00	4.13E-02	5.07E+00	2.34E+00	7.66E+00	2.93E+03	2.57E+00
NM	2.41E+03	3.40E+00	4.17E-02	1.63E+00	5.15E+00	4.61E+00	3.23E+03	2.64E+00
NV	2.47E+03	3.40E+00	4.27E-02	2.46E+00	3.40E+00	5.17E+00	-6.22E+02	2.49E+00
NY	2.24E+03	3.30E+00	3.89E-02	6.49E+00	2.57E+00	6.41E+00	1.87E+03	2.53E+00
OH	2.24E+03	3.30E+00	3.87E-02	1.16E+01	2.18E+00	7.82E+00	5.56E+03	2.67E+00
OK	2.34E+03	3.31E+00	4.05E-02	5.86E+00	3.86E+00	5.68E+00	2.06E+02	2.46E+00
OR	2.30E+03	3.38E+00	3.98E-02	7.72E+00	4.80E+00	6.85E+00	3.18E+03	2.64E+00
PA	2.21E+03	3.29E+00	3.83E-02	1.26E+01	2.60E+00	9.17E+00	2.19E+03	2.54E+00
RI	2.30E+03	3.30E+00	3.98E-02	6.87E+00	3.00E+00	6.11E+00	2.21E+03	2.54E+00
SC	2.28E+03	3.30E+00	3.94E-02	6.18E+00	1.66E+00	8.88E+00	1.87E+04	3.21E+00
SD	2.43E+03	3.32E+00	4.21E-02	8.05E+00	8.45E+00	4.98E+00	3.21E+03	2.58E+00
TN	2.20E+03	3.29E+00	3.82E-02	5.68E+00	1.78E+00	5.80E+00	1.92E+03	2.53E+00
TX	2.45E+03	3.39E+00	4.24E-02	7.10E+00	2.07E+00	5.53E+00	3.26E+03	2.64E+00
UT	2.34E+03	3.39E+00	4.04E-02	1.69E+00	4.17E+00	4.93E+00	2.00E+03	2.59E+00
VA	2.17E+03	3.29E+00	3.76E-02	7.31E+00	2.33E+00	5.16E+00	2.17E+03	2.54E+00
VT	2.30E+03	3.30E+00	3.98E-02	6.87E+00	3.00E+00	6.11E+00	3.23E+03	2.58E+00
WA	2.71E+03	3.43E+00	4.68E-02	1.17E+00	3.18E+00	4.98E+00	2.28E+03	2.61E+00
WI	2.41E+03	3.32E+00	4.18E-02	6.32E+00	2.21E+00	5.07E+00	2.50E+03	2.55E+00
WV	2.26E+03	3.30E+00	3.91E-02	5.72E+00	1.49E+00	7.90E+00	2.04E+03	2.53E+00
WY	2.56E+03	3.41E+00	4.42E-02	4.21E+00	3.90E+00	5.64E+00	2.10E+03	2.60E+00

*Impact factors and state electricity source distributions were calculated from several sources:

Values for regional transmission and distribution losses obtained from USEPA, eGRID 2012 Version 1.0 Year 2009 Summary Tables.

Values for plant emission factors obtained from USEPA, eGRID 2012 Version 1.0 Year 2009 Summary Tables.

Values for Coal, Oil, Gas, Other Fossil Fuels, Biomass, Nuclear, and Geothermal well-to-pump impact factors (except all PM_{10} and Biomass NOx and SO_2 impact factors) obtained from U.S. Department of Energy, Argonne National Laboratory, Transportation Technology R&D Center, GREET 1.8d.1, Fuel-Cycle model, 2010. GREET data for emis

Values for Wind, Hydroelectric, and Solar lifecycle impact factors obtained from Weisser, Daniel. 2007. A guide to life-cycle greenhouse gas (GHG) emissions from electric supply technologies *Energy* 32, 1543-1559. Values for emissions were multiplied by the eGRID 2012 subregion percent resource mix for each feedstock and added to the eGRID

Values for all lifecycle PM_{10} emission factors and Biomass lifecycle NOx and SO2 emssions factors obtained from US EPA's 2008 National Emission Inventory (NEI) Data. NEI data for NOx and SO2 emissions associated with production and delivery of nonrenewable feedstocks to the power plant were multiplied by the eGRID 2012 subregion perc

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Table D: Lifecycle electricity use efficiencies by region and source including transmission and distribution losses

	BIOMASS			COAL			GAS	
State Abbreviation	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)
AK	0	0	0	7095267.756	630591.648	2027373.607	45992197.23	3577403.159
AL	42541698.93	3414059.261	10978338.65	668211817.9	55311938.44	177862522.4	226098814.1	24500875.81
AR	21514335.94	1585550.122	5098536.627	272003133.4	24986333.29	80346709.75	101503935.2	10988377.76
AZ	2261486.507	156507.398	490520.2445	464333911	39571252.76	124022894.9	319573324.5	34588794.67
CA	101496329.9	5806045.237	18197112.5	24482004.58	2049946.888	6424874.872	1056263714	112806786.5
CO	582799.2057	56164.18	176027.8917	377654464.9	31636022.85	99152563.14	141680695.8	13693495.09
CT	28218628.2	715869.0007	2301967.165	25001691.16	2453497.463	7889530.898	88227479.19	9802101.83
DC	0	0	0	0	0	0	0	0
DE	573232.1031	40675	130795.5986	33076054.03	2848170.881	9158653.11	13584738.67	1293383.922
FL	98856826.86	4154079.331	13357966.63	609371799.8	51992807.49	167189437.7	1112013694	107624305.3
GA	25570641.66	2787499.747	8963557.417	758552479.8	68952293.54	221724806.6	180769075.2	19973249.02
HI	7992850.733	270537.862	851595.9296	13978624.3	1440062.722	4533012.656	0	0
IA	1346328.149	109630.475	352530.6355	422918288.9	37351435.69	120108257.9	9940396.299	956819.119
ID	4669459.402	477948.276	1497969.477	526094.5498	82564.779	258771.7648	14702883.44	1594320
IL	11176323.03	709180.095	2280458.144	1017429038	89780912.44	288701860.7	47622365.31	4395512.278
IN	5270353.303	301418.119	969248.0221	1191209975	108359054.6	348442222.8	32202122.91	3142263.579
KS	0	0	0	379519161.3	32243043.46	103681577.6	36387031.26	2457704.939
KY	2970276.335	363534.283	1168990.391	955746476.3	84037595.7	270233500.5	7387149.286	546707.744
LA	24499058.69	2363959.251	7601609.471	287543024.4	23065545.85	74170175.2	446117475.4	41206262.78
MA	42253394.4	1162310.652	3737556.667	94662568.48	9028109.908	29031027.4	192559430.1	20977199.01
MD	13750748.42	371930.4407	1195989.296	264358663.3	24162345.49	77697072.92	12846837.38	1268289.073
ME	48040879.2	3397572.296	10925322.73	0	0	0	66323894.16	7352830.013
MI	37443637.91	2289310.329	7361566.437	740574778.4	66679085.54	214415019.2	78130561.35	8149974.279
MN	35530105.68	1580224.476	5081411.34	350187025.2	29291121.17	94189298.75	23061366.41	2239417.099
MO	531582.1054	39151	125894.9841	795256867.3	71611239.67	230274983.6	30810747.92	3089105.096
MS	11095138.58	1424279.032	4579949.073	101027510	7966976.931	25618820.32	292875080.8	23088751.1
MT	1149987.268	94642.179	304333.8772	189681464.3	15611279.09	50200039.17	933306.8198	71261.412
NC	15437827.94	1663775.376	5350079.807	683542600.1	65048936.29	209173068.4	50761439.01	3931659.572
ND	79498.16007	11572	37211.22721	343587281.3	29606965.57	95204936.31	217.5403806	-81
NE	853512.1145	66195.441	212859.7991	278225606.4	23349780.35	75084167.1	3548830.5	262084.721
NH	17272546.68	813603.861	2616245.95	39274410.05	2885668.409	9279231.146	48295938.45	5307558.741
NJ	20159662.25	891425.594	2866491.559	61050182.9	5099868.414	16399270.85	191076436	20399657.52
NM	307216.0598	33664.004	105508.5937	324099982.2	29117308.23	91258492.15	92489183.07	8616787.96
NV	0	0	0	85439887.95	7545214.458	23647958.42	238937767.6	25880472.5
NY	44662464.12	2066500.342	6645092.788	137994231.7	12721128.87	40906396.18	448768207	41584571.66
OH	8001561.075	619296.01	1991424.519	1210357132	113472819.4	364886179	46585179.37	4606079.203
OK	2597942.927	232998.88	749237.3197	420598310.7	34059106.88	109521358.8	328659249	31378151.03
OR	10541705.23	686647.5457	2152067.738	33480124	3196901.53	10019621.69	141674622.8	16082395.38
PA	60459860.26	2237606.235	7195305.393	1130127819	105017710.1	337697707.4	267287288.9	28743809.57
RI	2191766.38	144600	464979.5588	0	0	0	70700900.89	7530357.773
SC	19813068.4	1746100.383	5614806.264	361280282.8	32758693.83	105339716.5	99287183.34	9750761.932
SD	0	0	0	37149333.27	3217352.719	10345803.93	1012142.357	77049.209
TN	7060420.249	891786.425	2867651.856	436124115.3	41525351.56	133530011.4	4719717.72	328568.592
TX	11379424.66	1078373.42	3387775.917	1566062423	139921986.5	439573460.5	1835416813	187886936.6
UT	723945.6379	47547.9249	149023.1136	388139529.3	35526126.37	111344795.3	57497017.69	6437215.506
VA	45428100.75	2376799.711	7642899.59	296068944.5	25043312.98	80529935.12	104686246.6	9669416.144
VT	7280681.518	417456.304	1342383.458	0	0	0	0	0
WA	17476334.82	1467763.673	4600215.74	100461089.8	7438653.169	23313977.6	103749383.1	11500964.9
WI	22046888.65	1250125.523	4019936.475	428708572	36982156.92	118920795.3	48895243.37	5282097.102
WV	0	0	0	727149628.2	68075112.69	218904120.8	1136180.181	66584.479
WY	0	0	0	491037953.7	41954266.35	131491656.3	4982978.929	398746.044
US TOTAL	883110530.4	52415916.69	167740445.9	19624361624	1744707650	5583727668	8767776483	885107035.7

*Impact factors and state electricity source distributions were calculated from several sources:

Values for regional transmission and distribution losses obtained from USEPA, eGRID 2012 Version 1.0 Year 2009 Summary Tables.

Values for well-to-pump energy inputs by feedstock obtained from U.S. Department of Energy, Argonne National Laboratory, Transportation Technology R&D Center, GREET 1.8d.1, Fuel-Cycle model, 2010. Values for energy input and output at plant by feedstock obtained from USEPA, eGRID 2012 Version 1.0 Year 2009 Summary Tables. Valu

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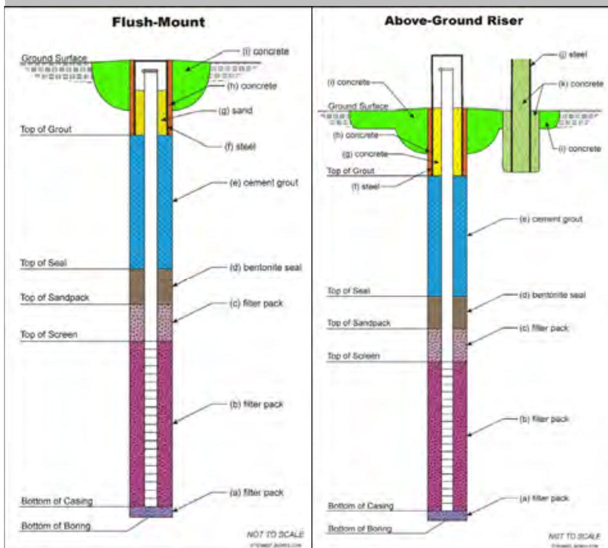

Flush-Mount
Ground Surface
(i) concrete
(h) concrete
(g) sand
Top of Grout
(f) steel
(e) cement grout
Top of Seal
(d) bentonite seal
Top of Sandpack
(c) filter pack
Top of Screen
(b) filter pack
(a) filter pack
Bottom of Casing
Bottom of Boring
NOT TO SCALE
Above-Ground Riser
(j) steel
(i) concrete
(k) concrete
Ground Surface
(h) concrete
(i) concrete
(g) concrete
Top of Grout
(f) steel
(e) cement grout
Top of Seal
(d) bentonite seal
Top of Sandpack
(c) filter pack
Top of Screen
(b) filter pack
(a) filter pack
Bottom of Casing
Bottom of Boring
NOT TO SCALE

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...cluding Life Cycle Emissions and T&D Losses				Emission Factors for Hydro, Including Life Cycle Emissions and T&D Losses						...ion Factors for Natural Gas, Including Life Cycle Emissions and T&D...						...Factors for Other Fossil Fuel, Including Life Cycle Emissions and T&D...						...sion Factors for Biomass, Including Life Cycle Emissions...				
N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)
1.83E-02	5.47E+00	1.18E+01	6.45E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E+03	3.82E+00	4.53E-03	2.77E-01	2.80E+00	1.75E-01	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	1.00E+03	7.03E-01	8.00E-02	1.60E-01	4.59E-01
2.02E-02	1.85E+00	2.83E+01	9.33E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+03	3.81E+00	3.86E-03	2.40E-01	5.84E-01	2.52E-02	1.82E+03	7.67E-02	1.53E-02	6.80E+00	1.22E+00	3.91E-01	4.01E+02	3.84E-01	4.83E-02	5.75E-02	9.68E-02
2.34E-02	2.54E+00	3.31E+01	8.48E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+03	3.81E+00	3.86E-03	3.25E-01	7.43E-01	2.78E-02	1.87E+03	7.92E-02	1.58E-02	4.04E+00	2.01E+00	7.95E+00	3.54E+02	3.75E-01	5.17E-02	5.83E-02	1.36E-01
2.23E-02	1.04E+00	2.20E+01	2.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E+03	3.91E+00	3.97E-03	2.87E-01	6.90E-01	1.41E-02	1.92E+03	8.12E-02	1.62E-02	4.75E+00	2.21E+00	4.01E-01	2.18E+02	9.17E-01	1.00E-01	5.45E-01	1.62E+00
2.15E-02	1.07E+00	2.05E+00	2.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E+03	3.91E+00	3.97E-03	2.54E-01	7.64E-01	3.75E-02	1.02E+03	4.30E-02	8.61E-03	2.26E-01	2.99E-01	1.91E+00	4.89E+02	9.43E-01	1.04E-01	1.33E-01	4.38E-01
2.59E-02	1.43E+00	1.62E+01	1.03E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E+03	3.91E+00	4.18E-03	5.08E-01	2.15E+00	7.76E-02	1.92E+03	8.12E-02	1.62E-02	4.75E+00	2.21E+00	4.01E-01	1.03E+03	7.21E-01	8.21E-02	1.64E-01	4.70E-01
2.48E-02	4.40E+00	3.63E+00	5.12E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.04E+03	3.81E+00	3.81E-03	2.68E-01	6.61E-01	1.86E-02	1.19E+03	5.03E-02	1.01E-02	5.60E-01	3.97E-01	3.92E-02	3.19E+03	1.43E+00	1.70E-01	1.60E-01	4.58E-01
2.68E-02	2.05E+01	5.98E+00	3.89E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+03	3.81E+00	4.06E-03	3.98E-01	1.34E+00	5.90E-02	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	1.00E+03	7.03E-01	8.00E-02	1.60E-01	4.58E-01
5.71E-02	1.25E+01	1.80E+01	3.18E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.61E+03	3.82E+00	4.89E-03	3.06E-01	1.55E+00	6.48E-02	1.92E+03	8.13E-02	1.63E-02	7.69E+00	2.19E+00	5.19E-01	1.00E+03	7.03E-01	8.00E-02	1.60E-01	4.58E-01
2.42E-02	5.90E+00	3.11E+00	9.09E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+03	3.81E+00	4.06E-03	9.02E-01	1.12E+00	9.13E-02	1.46E+03	6.19E-02	1.24E-02	2.44E+00	1.18E+00	5.05E-01	1.93E+03	1.02E+00	1.20E-01	1.83E-01	5.89E-01
1.58E-02	3.06E+01	5.55E+00	9.88E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E+03	3.81E+00	3.83E-03	2.48E-01	6.03E-01	3.95E-02	1.94E+03	8.22E-02	1.64E-02	6.40E+00	1.40E+00	1.49E+00	3.89E+02	3.18E-01	3.59E-02	8.14E-02	3.34E-01
1.94E-02	6.05E+00	5.30E+00	7.18E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.19E+03	3.90E+00	4.14E-03	4.06E-01	1.37E+00	6.03E-02	1.74E+03	7.35E-02	1.47E-02	5.70E+00	3.66E+00	8.59E-01	1.92E+03	1.11E+00	1.30E-01	1.64E-01	4.68E-01
3.20E-02	2.43E+00	1.89E+01	5.22E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E+03	3.82E+00	4.09E-03	2.46E-01	9.34E-01	1.48E-01	2.31E+03	9.78E-02	1.96E-02	5.33E+00	2.31E+00	5.13E+00	1.65E+02	1.89E-01	3.95E-03	1.60E-01	4.58E-01
2.25E-02	2.47E+00	3.23E+01	6.33E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E+03	3.91E+00	3.96E-03	2.48E-01	7.54E-01	6.05E-02	1.92E+03	8.12E-02	1.62E-02	4.75E+00	2.21E+00	4.01E-01	2.46E+02	4.24E-01	5.07E-02	1.64E-01	4.70E-01
2.50E-02	3.71E+00	3.48E+01	1.45E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E+03	3.81E+00	4.01E-03	5.39E-01	1.09E+00	7.63E-02	2.32E+03	9.82E-02	1.96E-02	5.39E+00	1.65E+00	5.25E+00	1.64E+02	1.89E-01	3.94E-03	5.62E-02	8.27E-02
1.21E-02	7.80E-01	1.85E+00	4.70E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.19E+03	3.82E+00	4.09E-03	2.45E-01	9.31E-01	9.57E-02	2.21E+03	9.33E-02	1.87E-02	7.77E+00	2.12E+00	1.29E-01	7.57E+02	4.12E-01	3.37E-02	1.60E-01	4.58E-01
1.06E-01	8.82E+00	1.84E+02	1.68E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E+03	3.82E+00	4.95E-03	2.49E-01	3.95E+00	8.53E-02	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	1.00E+03	7.03E-01	8.00E-02	1.60E-01	4.58E-01
7.04E-02	9.23E+00	6.88E+01	8.58E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E+03	3.82E+00	4.67E-03	2.56E-01	1.41E+00	2.29E-01	2.26E+03	9.57E-02	1.91E-02	6.16E+00	1.93E+00	5.94E-01	1.90E+02	2.89E-01	2.86E-02	5.49E-02	9.85E-02
2.78E-02	1.15E+01	3.36E+00	9.65E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+03	3.82E+00	4.06E-03	2.89E-01	1.77E+00	1.17E-01	1.55E+03	6.55E-02	1.31E-02	2.42E+00	1.62E+00	2.91E-01	4.29E+02	3.61E-01	3.74E-02	1.60E-01	4.58E-01
1.94E-02	6.04E+00	2.32E+00	7.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E+03	3.81E+00	3.84E-03	3.16E-01	6.14E-01	5.97E-02	1.30E+03	5.51E-02	1.10E-02	2.42E+00	5.65E-01	4.82E-02	3.07E+03	1.39E+00	1.64E-01	6.45E-02	3.22E-01
2.98E-02	3.10E+01	9.74E+00	3.67E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E+03	3.81E+00	4.00E-03	2.54E-01	1.04E+00	3.56E-02	2.07E+03	8.74E-02	1.75E-02	1.61E+01	1.46E+00	3.91E-01	3.36E+03	1.37E+00	1.61E-01	1.60E-01	4.58E-01
2.20E-02	9.18E+00	3.21E+00	1.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.88E+02	3.81E+00	3.72E-03	2.79E-01	6.17E-01	4.08E-02	8.81E+02	3.73E-02	7.45E-03	5.69E-01	2.64E-01	6.38E-03	5.14E+02	7.71E-01	8.78E-02	1.27E-01	1.11E+00
1.74E-02	3.88E+01	7.40E+00	2.59E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+03	3.81E+00	3.87E-03	2.79E-01	9.94E-01	2.93E-02	2.15E+03	9.08E-02	1.82E-02	7.86E+00	2.34E+00	3.70E-01	5.39E+02	6.95E-01	7.65E-02	8.45E-02	1.04E+00
2.75E-02	7.02E+00	2.72E+01	1.33E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E+03	3.81E+00	4.05E-03	3.17E-01	9.12E-01	9.67E-02	2.34E+03	9.88E-02	1.98E-02	3.48E+00	2.61E+00	1.40E-01	1.08E+03	1.06E+00	1.24E-01	5.48E-01	1.83E+00
3.14E-02	1.69E+00	1.27E+01	2.80E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+03	3.81E+00	3.99E-03	2.44E-01	8.82E-01	8.45E-02	2.26E+03	9.54E-02	1.91E-02	7.14E+00	1.61E+00	2.67E-02	1.00E+03	7.03E-01	8.00E-02	6.56E-02	1.65E-01
1.25E-02	7.87E-01	1.94E+00	1.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+03	3.81E+00	3.98E-03	2.46E-01	1.29E+00	1.03E-01	1.58E+03	6.66E-02	1.33E-02	2.36E+00	1.57E+00	3.91E-01	2.37E+02	3.47E-01	3.81E-02	1.60E-01	4.58E-01
2.17E-02	5.63E+01	1.99E+00	7.78E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E+03	3.82E+00	4.56E-03	4.00E-01	1.29E+01	1.25E-01	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	2.25E+02	5.05E-01	6.62E-02	1.60E-01	4.58E-01
3.71E-02	5.84E+00	4.32E+01	3.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E+03	3.82E+00	4.56E-03	2.63E-01	9.51E-01	6.96E-02	2.07E+03	8.75E-02	1.75E-02	3.48E+00	1.27E+00	1.05E+00	2.73E+02	4.65E-01	5.12E-02	1.48E+00	6.95E-01
1.45E-02	1.07E+00	2.58E+00	6.49E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.61E+02	3.79E+00	1.55E-03	2.28E-01	-1.67E-01	4.43E+00	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	1.00E+03	6.00E-01	5.87E-02	1.60E-01	4.58E-01
2.06E-02	1.25E+00	1.16E+01	1.66E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E+03	3.82E+00	4.69E-03	2.73E-01	1.39E+00	2.66E-01	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	1.68E+02	1.89E-01	3.95E-03	5.35E-02	7.21E-02
2.37E-02	1.17E+01	4.16E+00	4.06E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E+03	3.81E+00	3.84E-03	2.40E-01	5.58E-01	1.82E-02	1.41E+03	5.96E-02	1.19E-02	8.13E+00	9.31E-01	1.71E-01	8.00E+02	1.26E+00	1.46E-01	1.72E-01	1.31E+00
2.72E-02	1.39E+00	6.35E+00	3.16E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E+03	3.81E+00	3.89E-03	2.49E-01	7.34E-01	8.08E-02	1.25E+03	5.28E-02	1.06E-02	1.01E+00	6.22E-01	2.88E-01	2.53E+03	8.53E-01	9.26E-02	1.60E-01	4.58E-01
2.97E-02	1.52E+00	1.53E+01	1.06E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E+03	3.92E+00	4.26E-03	2.48E-01	1.08E+00	4.61E-02	1.92E+03	8.12E-02	1.62E-02	4.75E+00	2.21E+00	4.01E-01	2.82E+02	1.96E-01	4.27E-03	1.64E-01	4.70E-01
-1.46E-03	4.53E-01	-1.19E+01	1.14E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.09E+03	3.91E+00	3.96E-03	2.49E-01	9.02E-01	4.95E-02	1.30E+03	5.50E-02	1.10E-02	5.18E-01	1.01E+00	2.19E-01	1.03E+03	7.21E-01	8.21E-02	1.64E-01	4.70E-01
1.87E-02	7.20E+00	4.12E+00	7.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E+03	3.82E+00	4.12E-03	4.78E-01	9.32E-01	7.87E-02	1.35E+03	5.72E-02	1.14E-02	1.74E+00	9.09E-01	3.36E-01	1.76E+03	8.12E-01	8.82E-02	8.80E-02	3.95E-01
4.86E-02	3.01E+00	5.01E+00	1.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E+03	3.81E+00	4.04E-03	2.42E-01	6.57E-01	6.55E-02	2.14E+03	9.07E-02	1.81E-02	1.10E+01	1.79E+00	1.13E+01	5.32E+02	3.38E-01	3.47E-02	8.73E-02	2.40E-01
5.15E-03	7.05E-01	5.70E-01	4.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.19E+03	3.82E+00	4.10E-03	2.42E-01	1.57E+00	6.19E-02	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	4.32E+02	3.84E-01	3.38E-02	1.60E-01	4.58E-01
2.93E-02	8.25E+00	2.03E+01	5.88E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E+03	3.91E+00	3.85E-03	2.90E-01	6.91E-01	5.33E-02	1.14E+03	4.80E-02	9.61E-03	1.28E+00	9.05E-01	1.85E-01	6.97E+02	8.76E-01	9.76E-02	7.66E-02	6.12E-01
2.12E-02	5.68E+00	5.17E+00	5.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.07E+03	3.81E+00	3.87E-03	2.46E-01	5.91E-01	2.98E-02	1.90E+03	8.04E-02	1.61E-02	9.74E+00	1.81E+00	2.06E-02	2.14E+03	8.92E-01	1.04E-01	8.00E-02	2.86E-01
2.14E-02	8.84E-01	1.74E+01	1.02E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E+03	3.81E+00	3.89E-03	2.45E-01	6.38E-01	1.34E-02	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	1.00E+03	7.03E-01	8.00E-02	1.60E-01	4.58E-01
1.55E-01	4.45E+01	1.64E+02	1.06E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+03	3.81E+00	4.05E-03	1.17E+00	7.93E-01	5.92E-02	1.96E+03	8.29E-02	1.66E-02	4.84E+00	1.10E+00	2.37E-02	5.03E+02	3.94E-01	4.57E-02	1.60E-01	4.58E-01
2.95E-02	2.58E+00	1.77E+01	6.17E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.45E+03	3.82E+00	4.59E-03	2.42E-01	1.41E+00	5.90E-02	2.36E+03	9.97E-02	1.99E-02	7.68E+00	7.95E+00	3.91E-01	1.00E+03	7.03E-01	8.00E-02	1.60E-01	4.58E-01
1.90E-02	2.12E+00	2.62E+01	5.16E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E+03	3.83E+00	5.07E-03	3.63E-01	1.22E+00	1.87E-01	2.15E+03	9.09E-02	1.82E-02	5.46E+00	1.45E+00	9.09E+01	2.74E+02	3.15E-01	3.65E-02	5.37E-02	7.37E-02
3.00E-02	7.83E+00	4.67E+00	2.19E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.13E+03	3.90E+00	4.02E-03	2.52E-01	1.03E+00	4.77E-02	1.61E+03	6.80E-02	1.36E-02	2.96E+00	1.06E+00	2.30E-01	2.11E+02	3.25E-01	3.01E-02	1.64E-01	4.69E-01
1.98E-02	4.39E+00	2.73E+01	1.68E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+03	3.91E+00	3.89E-03	2.50E-01	8.18E-01	7.13E-02	2.08E+03	8.79E-02	1.76E-02	1.27E+00	3.30E+00	4.01E-01	7.25E+02	4.08E-01	3.27E-02	1.64E-01	4.70E-01
2.11E-02	1.93E+00	8.14E+00	1.01E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E+03	3.82E+00	4.07E-03	4.40E-01	8.61E-01	9.47E-02	1.84E+03	7.76E-02	1.55E-02	5.25E+00	1.57E+00	4.71E-01	1.27E+03	7.06E-01	8.25E-02	6.36E-02	3.05E-01
2.97E-02	3.71E+00	9.56E+00	6.17E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.17E+03	3.81E+00	4.06E-03	3.98E-01	1.34E+00	5.90E-02	1.87E+03	7.91E-02	1.58E-02	4.63E+00	2.15E+00	3.91E-01	1.87E+02	1.16E+00	1.34E-01	6.22E-02	1.56E+00
2.20E-02	3.31E+00	3.15E+01	8.12E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E+03	3.91E+00	3.88E-03	2.57E-01	7.98E-01	2.43E-02	1.63E+03	6.87E-02	1.37E-02	4.03E-01	1.32E+00	6.88E-02	6.06E+02	6.25E-01	6.99E-02	1.15E-01	6.58E-01
2.38E-02	4.80E+00	2.80E+00	1.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E+03	3.81E+00	3.86E-03	2.52E-01	6.89E-01	1.60E-01	2.19E+03	9.27E-02	1.85E-02	5.38E+00	1.68E+00	3.72E+00	8.11E+02	4.32E-01	4.46E-02	3.11E-01	1.65E-01
2.00E-02	1.01E+00	3.30E+00	2.19E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.85E+03	3.83E+00	5.34E-03	4.13E+00	2.37E+00	1.90E-01	2.21E+03	9.34E-02	1.87E-02	5.53E+00	1.16E+00	2.35E-03	1.00E+03	7.03E-01	8.00E-02	1.60E-01	4.58E-01
2.06E-02	3.10E+00	2.88E+01	8.96E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.89E+02	3.91E+00	3.58E-03	3.05E-01	2.29E+00	4.51E-02	2.48E+03	1.05E-01	2.10E-02	3.96E+00	3.53E+00	7.66E-04	1.03E+03	7.21E-01	8.21E-02	1.64E-01	4.70E-01

...sions associated with production and delivery of nonrenewable feedstocks to the power plant were multiplied by the eGRID 2012 subregion percent resource mix for each feedstock and added to the eGRID 2012 subregion emission

...) 2012 subregion emissions.

...cent resource mix for each feedstock and added to the eGRID 2012 subregion emissions; NEI data for PM10 emissions were multiplied by the eGRID 2012 subregion percent resource mix for each feedstoc

	GEOTHERMAL			HYDRO			NUCLEAR			OIL			SOLAR			WIND			COMBINED		
Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Annual net generation (MMBtu)	Total Annual heat input and Life Cycle Energy (MMBtu)	Annual net generation Less T&D Loss (MWh)	Efficiency Including T&D Losses and Life Cycle Energy
11501472.89	0	0	0	4517672.761	1323113.41	4253854.638	0	0	0	14718543.6	1140460.13	3666618.11	0	0	0	20957.7465	6138	19733.8789	72344639.1	(MMBtu)	29.7%
78785659.93	0	0	0	42801102.86	12535373	40309074.74	142744628	39716204	127712469	10531.8658	732	2353.83843	0	0	0	0	0	0	1122408593	21469053.1	38.8%
35334516.21	0	0	0	14658373.03	4293071	13804911.89	54522611.2	15169966	48780941.2	15432.8358	872	2804.02611	0	0	0	0	0	0	464217822	435650418	39.5%
108407041.7	0	0	0	22524370.47	6596825	20675547.95	110202237	30661851	96099346.4	5807.99689	360	1128.29994	21524.5412	6304	19757.7856	100879.215	29545	92598.9494	919023541	183368420	38.1%
353555251.8	43884875.8	12852783	40282761.96	95742400.89	28040555.66	87883770.31	114162783	31763804	99553050.5	25375985.1	1794008.55	5622721.5	2181807.94	638997	2002722.99	19939609.9	5839813.24	18302947	1483529511	349808836	42.6%
42917693.64	0	0	0	6067660.265	1777066	5569620.733	0	0	0	98954.9076	5054.407	15841.3531	87358.0879	25585	80187.65	10201519.2	2987769.95	9364168.5	536373452	631825214	29.3%
31519896.16	0	0	0	1758192.369	514930.59	1655824.333	59868556.3	16657382	53563915.2	3985210.35	197521.741	635156.099	0	0	0	0	0	0	207059758	157276103	47.1%
0	0	0	0	0	0	0	0	0	0	751955.272	35499	114151.517	0	0	0	0	0	0	751955.272	97566289.8	15.2%
4159039.318	0	0	0	0	0	0	0	0	0	21826.3442	426	1369.85679	0	0	0	0	0	0	47255851.2	114151.517	28.5%
346079543.4	0	0	0	710890.3116	208202	669499.8209	85288866	23730140	76307261.6	100253455	3891591.57	12513904.1	32334.6137	9470	30451.9808	0	0	0	2006527867	13449857.9	30.7%
64226504.28	0	0	0	12058628.8	3531670.91	11356533.76	113870851	31682579	101879333	4770344.12	495457.906	1593207.46	0	0	0	0	0	0	1095592021	616148065	37.4%
0	572227.0593	167591	527540.997	359829.2787	105385	331729.675	0	0	0	109405696	8284433.97	26077644.7	4746.05207	1390	4375.4258	858478.873	251427	791438.981	133172452	409743943	24.9%
3076772.696	0	0	0	3315970.977	971165	3122903.688	16816618.8	4678931	15045693.4	380002.187	15479.128	49775.0907	0	0	0	25304618.1	7411090.02	23831295.8	480022223	33117338.4	34.5%
4996864.341	259325.6509	75950	238039.946	35627021.29	10434263.86	32702720.29	0	0	0	666.58232	41	128.500827	0	0	0	1070142.55	313418	982304.197	56855593.5	165587229	71.5%
14134324.76	0	0	0	465659.411	136380	438547.1109	343144304	95473920	307008445	4003916.76	78846.762	253541.719	54.6308152	16	51.4500203	9627083.84	2819532.18	9066561.75	1433468745	40676798.5	43.4%
10104345.32	0	0	0	1719061.033	503470	1618971.359	0	0	0	4195853.31	343126.005	1103365	0	0	0	4791093.64	1403191.55	4512139.61	1239388459	621883791	29.6%
7903060.569	0	0	0	43697.8233	12798	41153.58502	31515175	8768548	28196373.3	30594.8812	600.373	1930.57519	0	0	0	9776411.61	2863266.55	9207195.14	457272072	366750292	32.6%
1758007.784	0	0	0	11327839.52	3317641	10668293.56	0	0	0	23947.0738	1174	3775.14524	0	0	0	0	0	0	977455688	149031291	29.0%
132503941.1	0	0	0	4221428.937	1236351	3975642.756	60316724.5	16782077	53964887.7	23765796.1	1471603.99	4732128.46	0	0	0	0	0	0	846463508	283832567	32.7%
67454832.23	0	0	0	2257927.375	661290.48	2126463.04	19393923.2	5396021	17351586.9	8683398.47	601103.907	1932925.52	0	0	0	19626.1204	5748	18483.4198	359830268	276948385	33.8%
4078343.663	0	0	0	6449061.886	1888769	6073575.217	52294809.5	14550119	46787744.9	553584.006	22940.79	73769.007	0	0	0	0	0	0	350253704	121652875	38.8%
23643953.36	0	0	0	13826681.49	4049489.34	13021644.31	0	0	0	3993035.41	253684.827	815755.594	0	0	0	1019626.12	298623	960259.964	133204116	135906495	37.1%
26207271.4	0	0	0	1758641.058	515062	1656246.898	78535052	21851009	70264678.6	1754497.86	103801.866	333788.007	0	0	0	1024915.24	300172.05	965241.13	939222084	49366936	34.2%
7201128.456	0	0	0	2494621.221	730612.19	2349375.752	44543402	12393425	39852623	187647.579	8494.847	27316.2532	0	0	0	15486909.8	4535728.7	14585208.4	471491078	321203812	34.6%
9933407.501	0	0	0	8137963.295	2383406	7664142.948	36829319.3	10247116	32950895.4	171588.821	1721.44	5535.50769	0	0	0	1705085.79	499377	1605809.8	873443155	163286362	32.4%
74244794.59	0	0	0	0	0	0	39529934.2	10998515	35367113.8	144100.94	18740	60260.8363	0	0	0	0	0	0	444671765	282560670	31.5%
229150.0685	0	0	0	32457328.21	9505940	30567550.4	0	0	0	5569185.79	479335	1541362.22	0	0	0	2802983.25	820923.72	2639783.88	232594256	139870939	36.8%
12642747.81	0	0	0	17803955.75	5214333.54	16767347.92	146811395	40847711	131350973	55891.7667	1989.809	6398.48209	15580.9134	4563.26	14673.7387	0	0	0	914428690	85482219.6	41.0%
-260.465728	0	0	0	5037135.297	1475251	4743855.872	0	0	0	673083.131	48304.304	155328.589	0	0	0	10234844.1	2997529.97	9638936.12	359612060	375305289	30.5%
842766.5141	0	0	0	3475977.806	1018027	3273594.366	33910990.9	9435142	30339890.5	59171.3069	2554.476	8214.24013	0	0	0	1306475.46	382634	1230407.94	321380565	109780008	34.5%
17067125.32	0	0	0	5735829.347	1679881.02	5401869.54	31688141.9	8816673	28351125.3	3823387.04	165482.302	532129.238	0	0	0	213323.09	62477	200902.683	146303577	110991900	43.4%
65597674.64	0	0	0	-579199.9659	-169633.19	-545476.9422	123378635	34327954	110385871	1769271.65	55817.171	179487.161	36558.2586	10707	34429.7105	71422.962	20918	67264.4703	396962969	63448629.2	49.1%
27006448.2	0	0	0	925183.0986	270963	849243.1585	0	0	0	953.448308	41	128.500827	0	0	0	5281154.08	1546718	4847671.75	423103672	194985012	29.3%
81113710.01	5576484.848	1633213	5118761.479	8401518.634	2460594.77	7711913.708	0	0	0	7491.77551	0	0	595165.173	174309	546313.429	0	0	0	338958316	124067492	34.9%
133720441.1	0	0	0	92513146.29	27094787.72	87126711.2	156288729	43484614	139830267	11186847.3	616612.333	1982794.82	0	0	0	7738245.39	2266338.62	7287698.01	899151871	118138657	46.4%
14811429.29	0	0	0	1801949.637	527746	1697033.902	54652423.5	15206084	48897083.2	2879678.81	93221.12	299764.282	0	0	0	48191.2079	14114	45385.3492	1324326116	417499401	32.7%
100900406.8	0	0	0	11731086.64	3435742	11048062.24	0	0	0	1237.54264	103.214	331.89765	0	0	0	9149835.25	2679758	8617100.23	772737662	432628300	29.9%
50404904.9	0	0	0	112790483.4	33033512.84	103532529.5	0	0	0	0	0	0	0	0	0	11847080.3	3469713.64	10874660.3	310334016	230836497	57.0%
92429349.17	0	0	0	6666170.141	1952354.58	6278042.678	277924642	77327686	248656939	8214249.25	384186.477	1235400.13	12162.1852	3562	11454.0608	3669784.31	1074788.08	3456116.79	1754361975	176983784	39.7%
24214816.29	0	0	0	16170.7213	4736	15229.20602	0	0	0	167008.666	10612	34124.226	0	0	0	0	0	0	73075846.7	696960314	33.8%
31354806.23	0	0	0	3879201.98	1136121.28	3653341.435	187432172	52149734	167694055	46373.0649	1773	5701.30538	0	0	0	0	0	0	671738281	24729149.3	46.7%
247761.4606	0	0	0	13139100.3	3848114	12374096.47	0	0	0	47431.2817	2154	6926.45899	0	0	0	3181695.16	931838.97	2996445.87	54529702.4	313662426	47.6%
1056553.796	0	0	0	32649184.81	9562130	30748236.44	96904548	26962001	86699718.7	35166.7213	2606.961	8383.01228	0	0	0	176686.3	51747	166399.013	577669839	25971034.2	44.2%
590258278.7	0	0	0	3512274.178	1028657.3	3231589.691	149147232	41497617	130367297	29890332	1346142.47	4228988.73	0	0	0	68128025	19952995.3	62683552.6	3663536524	255076954	33.7%
20175305.22	953037.9855	279121	874811.6888	2851923.824	835257.19	2617835.107	0	0	0	8727.93233	639	2002.7324	0	0	0	294996.159	86397	270782.583	450469179	1233730943	30.1%
31093228.58	0	0	0	490054.0845	143524.59	461521.4422	101398095	28212252	90720058.7	647067.845	41877.854	134663.528	0	0	0	0	0	0	548718508	135434556	38.4%
0	0	0	0	5073240.495	1485825.31	4777858.901	19266644.8	5360608	17237711.9	45429.3334	1645	5289.70522	0	0	0	39569.7828	11589	37265.8929	31705565.9	210582307	73.8%
36045938.97	0	0	0	249147226.8	72968994.04	228696977	23843413.1	6634014	20792104.5	6660.27989	421	1319.4841	0	0	0	12197987.4	3572485.58	11196764.4	506882095	23400509.9	64.0%
16985250.21	0	0	0	4540960	1329933.66	4276569.616	45584710.7	12683151	40784273.6	3995435.45	210417.047	676622.584	0	0	0	3591856.59	1051965	3382726.29	557363667	324647298	33.9%
214110.7999	0	0	0	5619895.86	1645927	5292686.102	0	0	0	176243.198	11865	38153.4057	0	0	0	2535002.99	742439	2387406.39	736616950	189046174	30.8%
1249736.495	0	0	0	3300288.519	966572	3029397.586	0	0	0	5450.45377	378	1184.71494	0	0	0	7601210.69	2226204.58	6977295.83	506927882	226836477	28.2%
2813389347	51245951.34	15008658	47041916.07	915824782.2	268222183.1	849597664.8	2851811566	793466848	2542793726	376614148	22245954.7	70725595.5	2987292.39	874903.26	2744418.23	251057327	73528414.7	233309957	3.3725E+10	142749271	36.5%
																				1.23E+10	

ues by feedstock for electricity delivered to site (after transmission and distribution losses) were divided by lifecycle values for energy input to determine lifecycle energy efficier

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…and T&D L…	…ssion Factors for Nuclear, Including Life Cycle Emissions and T&D L…						…ission Factors for Wind, Including Life Cycle Emissions and T&D Lo…						…ission Factors for Solar, Including Life Cycle Emissions and T&D Los…						Emission Factors for Geothermal, Including Life Cycle Emissions					
PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)	CO2 Emission Factor (lb/MWhr)	CH4 Emission Factor (lb/MWhr)	N2O Emission Factor (lb/MWhr)	SO2 Emission Factor (lb/MWhr)	NOX Emission Factor (lb/MWhr)	PM10 Emission Factor (lb/MWhr)
1.56E-01	4.59E+00	1.76E-02	9.73E-05	1.01E-03	3.39E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.31E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.95E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7.05E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.64E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.53E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9.59E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.59E-01	4.69E+00	1.80E-02	9.93E-05	1.03E-03	3.46E-02	1.10E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9.33E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9.54E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.16E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.00E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.36E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.88E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7.72E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9.44E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9.63E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.98E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.99E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.79E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.81E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.49E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.14E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.47E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9.72E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.59E-01	4.70E+00	1.80E-02	9.95E-05	1.03E-03	3.46E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.70E-02	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.07E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.38E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.86E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.56E-01	4.59E+00	1.76E-02	9.72E-05	1.01E-03	3.38E-02	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E-01	4.71E+00	1.81E-02	9.98E-05	1.03E-03	3.47E-02	1.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

DRAFT

This worksheet allows the user to calculate the life cycle environmental footprint of the materials used	
Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

WELL MATERIALS

	WELL TYPE 1	WELL TYPE 2	WELL TYPE 3	WELL TYPE 4	WELL TYPE 5	WELL TYPE 6	WELL TYPE 7	WELL TYPE 8	WELL TYPE 9	WELL TYPE 10	WELL TYPE 11	WELL TYPE 12
Number of wells	7	0	0	0	0	0	0	0	0	0	0	0
Depth of wells (ft)	50	0	0	0	0	0	0	0	0	0	0	0
Specific casing material schedule	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Well diameter from drop down menu (in)	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Total weight of Sand (kg)	2.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total weight of Gravel (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total weight of Bentonite (kg)	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total weight of Typical Cement (kg)	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total weight of General Concrete (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total weight of Steel (kg)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Casing material type	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC	PVC
Weight of casing material (lb/ft)	5.10E-02	5.10E-02	5.10E-02	5.10E-02	5.10E-02	5.10E-02	5.10E-02	5.10E-02	5.10E-02	5.10E-02	5.10E-02	5.10E-02
Total length of casing material required (ft)	350	0	0	0	0	0	0	0	0	0	0	0
Total weight of casing material required (lbs)	18	0	0	0	0	0	0	0	0	0	0	0
Total weight of casing material required (kg)	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 e emission factor (kg CO_2/kg material)	3.11E+00	3.11E+00	3.11E+00	3.11E+00	3.11E+00	3.11E+00	3.11E+00	3.11E+00	3.11E+00	3.11E+00	3.11E+00	3.11E+00
NOx emission factor (g/kg)	6.00E+00	6.00E+00	6.00E+00	6.00E+00	6.00E+00	6.00E+00	6.00E+00	6.00E+00	6.00E+00	6.00E+00	6.00E+00	6.00E+00
SOx emission factor (g/kg)	9.70E+00	9.70E+00	9.70E+00	9.70E+00	9.70E+00	9.70E+00	9.70E+00	9.70E+00	9.70E+00	9.70E+00	9.70E+00	9.70E+00
PM_{10} emission factor (g/kg)	1.40E+00	1.40E+00	1.40E+00	1.40E+00	1.40E+00	1.40E+00	1.40E+00	1.40E+00	1.40E+00	1.40E+00	1.40E+00	1.40E+00
MJ/kg material	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5	67.5
ENERGY OUTPUT												
Energy used (BTU)	1.0E+07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 e emission (metric ton)	3.5E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	6.9E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	1.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	1.5E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM WELL MATERIALS	
CO_2 e Emission (metric ton)	3.5E-02
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	6.9E-05
Offsite SOx Emission (metric ton)	1.1E-04
Offsite PM_{10} Emission (metric ton)	1.5E-05
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (BTU)	1.0E+07
Energy Used (MWh)	NA

TREATMENT CHEMICALS & MATERIALS

	TREATMENT 1	TREATMENT 2	TREATMENT 3	TREATMENT 4	TREATMENT 5	TREATMENT 6	TREATMENT 7	TREATMENT 8	TREATMENT 9	TREATMENT 10	TREATMENT 11	TREATMENT 12
Number of injection points	0	0	0	0	0	0	0	0	0	0	0	0
Material type	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Amount of material injected at each point (lbs dry mass)	0	0	0	0	0	0	0	0	0	0	0	0
Number of injections per injection point	0	0	0	0	0	0	0	0	0	0	0	0
Total weight of injected material (lbs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total weight of injected material (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 e emission factor (kg CO_2/kg material)	1.34E+00	1.34E+00	1.34E+00	1.34E+00	1.34E+00	1.34E+00	1.34E+00	1.34E+00	1.34E+00	1.34E+00	1.34E+00	1.34E+00
NOx emission factor (g/kg)	8.70E+00	8.70E+00	8.70E+00	8.70E+00	8.70E+00	8.70E+00	8.70E+00	8.70E+00	8.70E+00	8.70E+00	8.70E+00	8.70E+00
SOx emission factor (g/kg)	6.60E+00	6.60E+00	6.60E+00	6.60E+00	6.60E+00	6.60E+00	6.60E+00	6.60E+00	6.60E+00	6.60E+00	6.60E+00	6.60E+00
PM_{10} emission factor (g/kg)	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00	2.50E+00
MJ/kg material	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 e emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM TREATMENT CHEMICALS	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (BTU)	0.0E+00
Energy Used (MWh)	NA

TREATMENT MEDIA

	TREATMENT 1	TREATMENT 2	TREATMENT 3	TREATMENT 4	TREATMENT 5	TREATMENT 6	TREATMENT 7	TREATMENT 8	TREATMENT 9	TREATMENT 10	TREATMENT 11	TREATMENT 12
Weight of media used (lbs)	4,000	0	0	0	0	0	0	0	0	0	0	0
Material type	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC
Total weight of media (kg)	1814.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 e emission factor (kg CO_2/kg material)	4.50E+00	4.50E+00	4.50E+00	4.50E+00	4.50E+00	4.50E+00	4.50E+00	4.50E+00	4.50E+00	4.50E+00	4.50E+00	4.50E+00
NOx emission factor (g/kg)	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03
SOx emission factor (g/kg)	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03	9.00E-03
PM10 emission factor (g/kg)	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04
MJ/kg material	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1
ENERGY OUTPUT												
Energy used (BTU)	4.3E+07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 e emission (metric ton)	8.2E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	1.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	1.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	8.2E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM TREATMENT MEDIA PRODUCTION	
CO_2 e Emission (metric ton)	8.2E+00
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	1.6E-05
Offsite SOx Emission (metric ton)	1.6E-05
Offsite PM_{10} Emission (metric ton)	8.2E-07
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (BTU)	4.3E+07
Energy Used (MWh)	NA

CONSTRUCTION MATERIALS

	MATERIAL 1	MATERIAL 2	MATERIAL 3	MATERIAL 4	MATERIAL 5	MATERIAL 6	MATERIAL 7	MATERIAL 8	MATERIAL 9	MATERIAL 10	MATERIAL 11	MATERIAL 12
Material type	HDPE Liner	General Concrete	Gravel	Typical Cement	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Area of material (ft^2)	30	0	0	0	0	0	0	0	0	0	0	0
Depth of material (ft)	750	0	0	0	0	0	0	0	0	0	0	0
Volume of material required (ft^3)	22500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Density of material (kg/m^3)	965.0	2371.0	1682.0	1506.0	965.0	965.0	965.0	965.0	965.0	965.0	965.0	965.0
Total weight of material required (kg)	614829.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 e emission factor (kg CO_2/kg material)	3.00E+00	1.30E-01	1.70E-02	8.30E-01	3.00E+00	3.00E+00	3.00E+00	3.00E+00	3.00E+00	3.00E+00	3.00E+00	3.00E+00
NOx emission factor (g/kg)	6.20E+00	2.60E-01	6.80E-02	1.66E+00	6.20E+00	6.20E+00	6.20E+00	6.20E+00	6.20E+00	6.20E+00	6.20E+00	6.20E+00
SOx emission factor (g/kg)	1.10E+01	5.20E-01	8.50E-02	3.32E+00	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01
PM10 emission factor (g/kg)	1.60E+00	1.04E-01	3.40E-02	6.64E-01	1.60E+00	1.60E+00	1.60E+00	1.60E+00	1.60E+00	1.60E+00	1.60E+00	1.60E+00
MJ/kg material	103.9	1.0	0.3	4.6	103.9	103.9	103.9	103.9	103.9	103.9	103.9	103.9
ENERGY OUTPUT												
Energy used (BTU)	6.1E+10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 e emission (metric ton)	1.8E+03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	3.8E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	6.8E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	9.8E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM CONSTRUCTION MATERIALS	
CO_2 e Emission (metric ton)	1.8E+03
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	3.8E+00
Offsite SOx Emission (metric ton)	6.8E+00
Offsite PM_{10} Emission (metric ton)	9.8E-01
Accident Risk - Fatality	NA
Accident Risk - Injury	NA

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Water Used (gallons)	**NA**
Energy Used (BTU)	**6.1E+10**
Energy Used (MWh)	**NA**

WELL DECOMMISSIONING

	WELL TYPE 1	WELL TYPE 2	WELL TYPE 3	WELL TYPE 4	WELL TYPE 5	WELL TYPE 6	WELL TYPE 7	WELL TYPE 8	WELL TYPE 9	WELL TYPE 10	WELL TYPE 11	WELL TYPE 12
Number of wells	7	0	0	0	0	0	0	0	0	0	0	0
Depth of wells (ft)	50	0	0	0	0	0	0	0	0	0	0	0
Well diameter (in)	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volume of well (ft^3)	1.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Material	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Total volume of material required (ft^3)	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Density of material (kg/m^3)	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0	1850.0
Total weight of material required (kg)	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 e emission factor (kg CO_2/kg material)	2.30E-02	2.30E-02	2.30E-02	2.30E-02	2.30E-02	2.30E-02	2.30E-02	2.30E-02	2.30E-02	2.30E-02	2.30E-02	2.30E-02
NOx emission factor (g/kg)	9.20E-02	9.20E-02	9.20E-02	9.20E-02	9.20E-02	9.20E-02	9.20E-02	9.20E-02	9.20E-02	9.20E-02	9.20E-02	9.20E-02
SOx emission factor (g/kg)	1.15E-01	1.15E-01	1.15E-01	1.15E-01	1.15E-01	1.15E-01	1.15E-01	1.15E-01	1.15E-01	1.15E-01	1.15E-01	1.15E-01
PM10 emission factor (g/kg)	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02
MJ/kg material	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
ENERGY OUTPUT												
Energy used (BTU)	1.7E+05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 e emission (metric ton)	9.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	3.7E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	4.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	1.8E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM WELL DECOMMISSIONING	
CO_2 e Emission (metric ton)	**9.2E-03**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**3.7E-05**
Offsite SOx Emission (metric ton)	**4.6E-05**
Offsite PM_{10} Emission (metric ton)	**1.8E-05**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gallons)	**NA**
Energy Used (BTU)	**1.7E+05**
Energy Used (MWh)	**NA**

SILT CURTAIN MATERIALS

	CURTAIN 1	CURTAIN 2	CURTAIN 3	CURTAIN 4	CURTAIN 5	CURTAIN 6	CURTAIN 7	CURTAIN 8	CURTAIN 9	CURTAIN 10	CURTAIN 11	CURTAIN 12
Input length or perimeter of silt curtain (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input depth of silt curtain (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Area of material required (ft^2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 e emission factor (kg CO_2/ft^2 material)	1.76E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01	1.76E-01
NOx emission factor (g/ft^2)	3.40E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01	3.40E-01
SOx emission factor (g/ft^2)	5.50E-01	5.50E-01	5.50E-01	5.50E-01	5.50E-01	5.50E-01	5.50E-01	5.50E-01	5.50E-01	5.50E-01	5.50E-01	5.50E-01
PM10 emission factor (g/ft^2)	7.94E-02	7.94E-02	7.94E-02	7.94E-02	7.94E-02	7.94E-02	7.94E-02	7.94E-02	7.94E-02	7.94E-02	7.94E-02	7.94E-02
MJ/ft^2 material	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
CO_2 e emission factor (kg CO_2/linear ft material)	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00	1.97E+00
NOx emission factor (g/linear ft)	4.95E+00	4.95E+00	4.95E+00	4.95E+00	4.95E+00	4.95E+00	4.95E+00	4.95E+00	4.95E+00	4.95E+00	4.95E+00	4.95E+00
SOx emission factor (g/linear ft)	7.67E+00	7.67E+00	7.67E+00	7.67E+00	7.67E+00	7.67E+00	7.67E+00	7.67E+00	7.67E+00	7.67E+00	7.67E+00	7.67E+00
PM10 emission factor (g/linear ft)	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00
MJ/linear ft material	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.2	33.2
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 e emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM SILT CURTAIN MATERIALS	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gallons)	**NA**
Energy Used (BTU)	**0.0E+00**
Energy Used (MWh)	**NA**

BULK MATERIAL QUANTITIES

	MATERIAL 1	MATERIAL 2	MATERIAL 3	MATERIAL 4	MATERIAL 5	MATERIAL 6	MATERIAL 7	MATERIAL 8	MATERIAL 9	MATERIAL 10	MATERIAL 11	MATERIAL 12
Material type	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Units of quantity	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Quantity	0	0	0	0	0	0	0	0	0	0	0	0
Density of material (kg/m^3)	1050.6	1050.6	1050.6	1050.6	1050.6	1050.6	1050.6	1050.6	1050.6	1050.6	1050.6	1050.6
Total weight of material required (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO_2 e emission factor (kg CO_2/kg material)	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00
NOx emission factor (g/kg)	4.08E+00	4.08E+00	4.08E+00	4.08E+00	4.08E+00	4.08E+00	4.08E+00	4.08E+00	4.08E+00	4.08E+00	4.08E+00	4.08E+00
SOx emission factor (g/kg)	6.80E+00	6.80E+00	6.80E+00	6.80E+00	6.80E+00	6.80E+00	6.80E+00	6.80E+00	6.80E+00	6.80E+00	6.80E+00	6.80E+00
PM10 emission factor (g/kg)	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00
MJ/kg material	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 e emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM BULK MATERIALS	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gallons)	**NA**
Energy Used (BTU)	**0.0E+00**
Energy Used (MWh)	**NA**

TOTAL FROM MATERIAL PRODUCTION	
CO_2 e Emission (metric ton)	**1.9E+03**
Onsite NOx Emission (metric ton)	**NA**

DRAFT

This worksheet allows the user to calculate the environmental footprint of personnel travel	
Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

TRANSPORTATION - ROAD

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Vehicle type	Cars	Heavy Duty	Light truck	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Fuel used	Gasoline	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Distance traveled per trip (miles)	30	135	100	0	0	0	0	0	0	0	0	0
Number of trips taken	50	200	50	0	0	0	0	0	0	0	0	0
Number of travelers	2	1	1	0	0	0	0	0	0	0	0	0
Total distance traveled (miles)	1500	27000	5000	0	0	0	0	0	0	0	0	0
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Consumption rate (MPG)	29	7.4	20	29	29	29	29	29	29	29	29	29
Estimated MPG (input the default if not known)	0	0	0	0	0	0	0	0	0	0	0	0
Total fuel used (gallons)	51.7	3648.6	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	139,015	135,847	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015
CO_2 emission factor (g/mile)	3.67E+02	1.37E+03	5.32E+02	3.67E+02	3.67E+02	3.67E+02	3.67E+02	3.67E+02	3.67E+02	3.67E+02	3.67E+02	3.67E+02
N_2O emission factor (g/mile)	1.65E-02	1.54E-02	1.85E-02	1.65E-02	1.65E-02	1.65E-02	1.65E-02	1.65E-02	1.65E-02	1.65E-02	1.65E-02	1.65E-02
CH_4 emission factor (g/mile)	4.46E-01	1.54E+00	6.42E-01	4.46E-01	4.46E-01	4.46E-01	4.46E-01	4.46E-01	4.46E-01	4.46E-01	4.46E-01	4.46E-01
NOx emission factor (g/mile)	1.41E-01	4.42E-01	2.29E-01	1.41E-01	1.41E-01	1.41E-01	1.41E-01	1.41E-01	1.41E-01	1.41E-01	1.41E-01	1.41E-01
SOx emission factor (g/mile)	4.97E-03	7.82E-03	7.20E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03
PM_{10} emission factor (g/mile)	2.86E-02	3.93E-02	3.27E-02	2.86E-02	2.86E-02	2.86E-02	2.86E-02	2.86E-02	2.86E-02	2.86E-02	2.86E-02	2.86E-02
ENERGY OUTPUT												
Energy used (BTU)	7.2E+06	5.0E+08	3.5E+07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	5.5E-01	3.7E+01	2.7E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	7.7E-03	1.3E-01	2.9E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emission (metric ton CO_2 e)	1.4E-02	8.8E-01	6.7E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	2.1E-04	1.2E-02	1.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	7.5E-06	2.1E-04	3.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	4.3E-05	1.1E-03	1.6E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	2.3E-05	2.1E-04	3.9E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	1.9E-03	1.7E-02	3.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM ROAD TRANSPORTATION	
CO_2 e Emission (metric ton)	**4.1E+01**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**1.3E-02**
Offsite SOx Emission (metric ton)	**2.5E-04**
Offsite PM_{10} Emission (metric ton)	**1.3E-03**
Accident Risk - Fatality	**2.7E-04**
Accident Risk - Injury	**2.2E-02**
Water Used (gallons)	**NA**
Energy Used (BTU)	**5.4E+08**
Energy Used (MWh)	**NA**

TRANSPORTATION - AIR

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Distance traveled (miles)	0	0	0	0	0	0	0	0	0	0	0	0
Number of travelers	0	0	0	0	0	0	0	0	0	0	0	0
Number of flights taken	0	0	0	0	0	0	0	0	0	0	0	0
Total passenger miles traveled	0	0	0	0	0	0	0	0	0	0	0	0
Energy consumption rate (BTU/passenger mile)	2,843	2,843	2,843	2,843	2,843	2,843	2,843	2,843	2,843	2,843	2,843	2,843
CO_2 emission factor (kg/passenger mile)	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01	2.10E-01
N_2O emission factor (g/passenger mile)	8.50E-03	8.50E-03	8.50E-03	8.50E-03	8.50E-03	8.50E-03	8.50E-03	8.50E-03	8.50E-03	8.50E-03	8.50E-03	8.50E-03
CH_4 emission factor (g/passenger mile)	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02
NOx emission factor (g/passenger mile)	5.90E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01	5.90E-01
SO_2 emission factor (g/passenger mile)	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02	5.80E-02
PM_{10} emission factor (g/passenger mile)	3.70E-03	3.70E-03	3.70E-03	3.70E-03	3.70E-03	3.70E-03	3.70E-03	3.70E-03	3.70E-03	3.70E-03	3.70E-03	3.70E-03
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM AIR TRANSPORTATION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**0.0E+00**
Accident Risk - Injury	**0.0E+00**
Water Used (gallons)	**NA**
Energy Used (BTU)	**0.0E+00**
Energy Used (MWh)	**NA**

TRANSPORTATION - RAIL

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Type of rail used	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Distance traveled (miles)	0	0	0	0	0	0	0	0	0	0	0	0
Number of trips taken	0	0	0	0	0	0	0	0	0	0	0	0
Number of travelers	0	0	0	0	0	0	0	0	0	0	0	0
Total passenger miles traveled	0	0	0	0	0	0	0	0	0	0	0	0
Energy consumption rate (BTU/passenger mile)	1,517	1,517	1,517	1,517	1,517	1,517	1,517	1,517	1,517	1,517	1,517	1,517
CO_2 emission factor (kg/passenger mile)	1.30E-01	1.30E-01	1.30E-01	1.30E-01	1.30E-01	1.30E-01	1.30E-01	1.30E-01	1.30E-01	1.30E-01	1.30E-01	1.30E-01
N_2O emission factor (g/passenger mile)	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
CH_4 emission factor (g/passenger mile)	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03
NOx emission factor (g/passenger mile)	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02
SOx emission factor (g/passenger mile)	1.70E-01	1.70E-01	1.70E-01	1.70E-01	1.70E-01	1.70E-01	1.70E-01	1.70E-01	1.70E-01	1.70E-01	1.70E-01	1.70E-01
PM_{10} emission factor (g/passenger mile)	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03	1.80E-03
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM RAIL TRANSPORTATION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**

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Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	0.0E+00
Accident Risk - Injury	0.0E+00
Water Used (gallons)	NA
Energy Used (BTU)	0.0E+00
Energy Used (MWh)	NA

TOTAL FROM PERSONNEL TRANSPORTATION	
CO_2 e Emission (metric ton)	4.1E+01
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	1.3E-02
Offsite SOx Emission (metric ton)	2.5E-04

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This worksheet allows the user to calculate the environmental footprint of equipment and material transport	
Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

EQUIPMENT TRANSPORTATION - DEDICATED LOAD ROAD

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Vehicle	On road Truck	On road Truck	On road Truck	On road Truck	On road Truck	On road Truck	On road Truck	On road Truck	On road Truck	On road Truck	On road Truck	On road Truck
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Fuel used	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Distance travelled (mi)	0	0	0	0	0	0	0	0	0	0	0	0
Weight of equipment transported (tons)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel efficiency by weight of load (mpg)	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total fuel used (gal)	0	0	0	0	0	0	0	0	0	0	0	0
BTU per gallon fuel used	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015
CO_2 emission factor (g/gal)	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03
N_2O emission factor (g/gal)	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01
CH_4 emission factor (g/gal)	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01
NOx emission factor (g/gal)	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00
SOx emission factor (g/gal)	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01
PM_{10} emission factor (g/gal)	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM DEDICATED LOAD ROAD TRANSPORTATION	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	0.0E+00
Accident Risk - Injury	0.0E+00
Water Used (gallons)	NA
Energy Used (BTU)	0.0E+00
Energy Used (MWh)	NA

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Distance travelled (miles)	0	0	0	0	0	0	0	0	0	0	0	0
Weight of equipment transported (tons)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel efficiency (ton-mpg)	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5	42.5
Total fuel used (gal)	0	0	0	0	0	0	0	0	0	0	0	0
BTU per gallon fuel used	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847
CO_2 emission factor (g/gal)	1.01E+04	1.01E+04	1.01E+04	1.01E+04	1.01E+04	1.01E+04	1.01E+04	1.01E+04	1.01E+04	1.01E+04	1.01E+04	1.01E+04
N_2O emission factor (g/gal)	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01	1.14E-01
CH_4 emission factor (g/gal)	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01	1.14E+01
NOx emission factor (g/gal)	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00
SOx emission factor (g/gal)	5.79E-02	5.79E-02	5.79E-02	5.79E-02	5.79E-02	5.79E-02	5.79E-02	5.79E-02	5.79E-02	5.79E-02	5.79E-02	5.79E-02
PM_{10} emission factor (g/gal)	2.91E-01	2.91E-01	2.91E-01	2.91E-01	2.91E-01	2.91E-01	2.91E-01	2.91E-01	2.91E-01	2.91E-01	2.91E-01	2.91E-01
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM SHARED LOAD ROAD TRANSPORTATION	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	0.0E+00
Accident Risk - Injury	0.0E+00
Water Used (gallons)	NA
Energy Used (BTU)	0.0E+00
Energy Used (MWh)	NA

TRANSPORTATION - AIR

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Distance travelled (miles)	0	0	0	0	0	0	0	0	0	0	0	0
Weight of equipment transported (tons)	0	0	0	0	0	0	0	0	0	0	0	0
Energy consumption rate (BTU/ton mile)	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
CO_2 emission factor (kg/ton mile)	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00	1.36E+00
N_2O emission factor (g/ton mile)	4.79E-02	4.79E-02	4.79E-02	4.79E-02	4.79E-02	4.79E-02	4.79E-02	4.79E-02	4.79E-02	4.79E-02	4.79E-02	4.79E-02
CH_4 emission factor (g/ton mile)	4.17E-02	4.17E-02	4.17E-02	4.17E-02	4.17E-02	4.17E-02	4.17E-02	4.17E-02	4.17E-02	4.17E-02	4.17E-02	4.17E-02
NOx emission factor (g/ton mile)	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00
SOx emission factor (g/ton mile)	3.09E-01	3.09E-01	3.09E-01	3.09E-01	3.09E-01	3.09E-01	3.09E-01	3.09E-01	3.09E-01	3.09E-01	3.09E-01	3.09E-01
PM_{10} emission factor (g/ton mile)	3.24E-02	3.24E-02	3.24E-02	3.24E-02	3.24E-02	3.24E-02	3.24E-02	3.24E-02	3.24E-02	3.24E-02	3.24E-02	3.24E-02
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM AIR TRANSPORTATION	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (BTU)	0.0E+00
Energy Used (MWh)	NA

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TRANSPORTATION - RAIL

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Distance travelled (miles)	0	0	0	0	0	0	0	0	0	0	0	0
Weight of load (tons)	0	0	0	0	0	0	0	0	0	0	0	0
Energy consumption rate (BTU/ton mile)	3.05E+02	3.05E+02	3.05E+02	3.05E+02	3.05E+02	3.05E+02	3.05E+02	3.05E+02	3.05E+02	3.05E+02	3.05E+02	3.05E+02
CO_2 emission factor (kg/ton mile)	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02	4.00E-02
N_2O emission factor (g/ton mile)	6.00E-04	6.00E-04	6.00E-04	6.00E-04	6.00E-04	6.00E-04	6.00E-04	6.00E-04	6.00E-04	6.00E-04	6.00E-04	6.00E-04
CH_4 emission factor (g/ton mile)	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03
NOx emission factor (g/ton mile)	7.25E-01	7.25E-01	7.25E-01	7.25E-01	7.25E-01	7.25E-01	7.25E-01	7.25E-01	7.25E-01	7.25E-01	7.25E-01	7.25E-01
SOx emission factor (g/ton mile)	1.07E-01	1.07E-01	1.07E-01	1.07E-01	1.07E-01	1.07E-01	1.07E-01	1.07E-01	1.07E-01	1.07E-01	1.07E-01	1.07E-01
PM_{10} emission factor (g/ton mile)	4.45E-02	4.45E-02	4.45E-02	4.45E-02	4.45E-02	4.45E-02	4.45E-02	4.45E-02	4.45E-02	4.45E-02	4.45E-02	4.45E-02
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM RAIL TRANSPORTATION	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (BTU)	0.0E+00
Energy Used (MWh)	NA

TRANSPORTATION - WATER

	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Distance travelled (miles)	0	0	0	0	0	0	0	0	0	0	0	0
Weight of load (tons)	0	0	0	0	0	0	0	0	0	0	0	0
Energy consumption rate (BTU/ton mile)	2.78E+02	2.78E+02	2.78E+02	2.78E+02	2.78E+02	2.78E+02	2.78E+02	2.78E+02	2.78E+02	2.78E+02	2.78E+02	2.78E+02
CO_2 emission factor (kg/ton mile)	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02	4.80E-02
N_2O emission factor (g/ton mile)	2.53E-03	2.53E-03	2.53E-03	2.53E-03	2.53E-03	2.53E-03	2.53E-03	2.53E-03	2.53E-03	2.53E-03	2.53E-03	2.53E-03
CH_4 emission factor (g/ton mile)	4.89E-04	4.89E-04	4.89E-04	4.89E-04	4.89E-04	4.89E-04	4.89E-04	4.89E-04	4.89E-04	4.89E-04	4.89E-04	4.89E-04
NOx emission factor (g/ton mile)	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00	1.39E+00
SOx emission factor (g/ton mile)	2.95E-01	2.95E-01	2.95E-01	2.95E-01	2.95E-01	2.95E-01	2.95E-01	2.95E-01	2.95E-01	2.95E-01	2.95E-01	2.95E-01
PM_{10} emission factor (g/ton mile)	3.67E-02	3.67E-02	3.67E-02	3.67E-02	3.67E-02	3.67E-02	3.67E-02	3.67E-02	3.67E-02	3.67E-02	3.67E-02	3.67E-02
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM WATER TRANSPORTATION	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (BTU)	0.0E+00
Energy Used (MWh)	NA

TOTAL FROM EQUIPMENT TRANSPORTATION	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00

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This worksheet allows the user to calculate the environmental footprint of earthwork activities

Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

EARTHWORK EQUIPMENT

	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Earthwork equipment type	Excavator	Loader/Backhoe	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Fuel type	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Volume of material to be removed (yd^3)	5,500	2,500	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Approximate net power (hp)	270	80	65	65	65	65	65	65	65	65	65	65
Production rate (yd^3/hr)	239	166	0	0	0	0	0	0	0	0	0	0
Consumption rate (gal/hr)	11	2	5	5	5	5	5	5	5	5	5	5
Equipment operating hours (hr)	33.6	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel used (gal)	362.9	39.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847
CO_2 emission factor (g/hr)	9.40E+04	1.60E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04
N_2O emission factor (g/hr)	2.38E+00	3.96E-01	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00
CH_4 emission factor (g/hr)	5.40E+00	9.00E-01	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00
Onsite NOx emission factor (g/hr)	5.46E+02	1.24E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02
Onsite SOx emission factor (g/hr)	1.49E+02	2.60E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01
Onsite PM_{10} emission factor (g/hr)	4.50E+01	2.40E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01
Offsite NOx emission factor (g/hr)	6.6E+01	1.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01
Offsite SOx emission factor (g/hr)	3.5E+01	5.8E+00	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01
Offsite PM_{10} emission factor (g/hr)	1.0E+01	1.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00
ENERGY OUTPUT												
Energy used (BTU)	4.9E+07	5.4E+06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission - (metric ton)	3.2E+00	3.5E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	2.5E-02	2.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	3.8E-03	4.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	2.2E-03	2.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	1.2E-03	1.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	3.3E-04	3.7E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	1.8E-02	2.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	5.0E-03	5.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	1.5E-03	5.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	3.1E-06	2.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	7.7E-04	5.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM BACKHOE, DOZER, AND SCRAPER OPERATION	
CO_2 e Emission (metric ton)	**3.5E+00**
Onsite NOx Emission (metric ton)	**2.1E-02**
Onsite SOx Emission (metric ton)	**5.6E-03**
Onsite PM_{10} Emission (metric ton)	**2.0E-03**
Offsite NOx Emission (metric ton)	**2.5E-03**
Offsite SOx Emission (metric ton)	**1.3E-03**
Offsite PM_{10} Emission (metric ton)	**3.7E-04**
Accident Risk - Fatality	**5.1E-06**
Accident Risk - Injury	**1.3E-03**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**5.5E+01**
Energy Used (MWh)	**NA**

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WELL DRILLING EQUIPMENT

	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Number of injection and extraction points/wells	22	0	0	0	0	0	0	0	0	0	0	0
Drilling method	Sonic Drilling	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Drilling fuel consumption rate (gal/hr)	5.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Time spent drilling each injection site (hr)	0.5	0	0	0	0	0	0	0	0	0	0	0
Fuel type	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Total time drilling well (hr)	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total fuel consumption during drilling (gal)	62.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847
CO_2 emission factor (kg/gallon)	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01	1.10E+01
N_2O emission factor (g/gal)	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01	1.23E-01
CH_4 emission factor (g/gal)	1.24E+01	1.24E+01	1.24E+01	1.24E+01	1.24E+01	1.24E+01	1.24E+01	1.24E+01	1.24E+01	1.24E+01	1.24E+01	1.24E+01
NOx emission factor (g/gal)	1.14E+02	1.14E+02	1.14E+02	1.14E+02	1.14E+02	1.14E+02	1.14E+02	1.14E+02	1.14E+02	1.14E+02	1.14E+02	1.14E+02
SOx emission factor (g/gal)	1.42E+01	1.42E+01	1.42E+01	1.42E+01	1.42E+01	1.42E+01	1.42E+01	1.42E+01	1.42E+01	1.42E+01	1.42E+01	1.42E+01
PM_{10} emission factor (g/gal)	1.06E+01	1.06E+01	1.06E+01	1.06E+01	1.06E+01	1.06E+01	1.06E+01	1.06E+01	1.06E+01	1.06E+01	1.06E+01	1.06E+01
Offsite NOx emission factor (g/hr)	3.5E+01	4.9E+00	4.9E+00	4.9E+00	4.9E+00	4.9E+00	4.9E+00	4.9E+00	4.9E+00	4.9E+00	4.9E+00	4.9E+00
Offsite SOx emission factor (g/hr)	1.8E+01	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00
Offsite PM_{10} emission factor (g/hr)	5.2E+00	7.4E-01	7.4E-01	7.4E-01	7.4E-01	7.4E-01	7.4E-01	7.4E-01	7.4E-01	7.4E-01	7.4E-01	7.4E-01
ENERGY OUTPUT												
Energy used (BTU)	8.4E+06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

CO_2 OUTPUT												
CO_2 emission from drilling (metric ton)	6.8E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	2.4E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emission (metric ton CO_2 e)	1.6E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	3.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	2.0E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	5.7E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	6.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	6.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	6.0E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	1.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	2.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM WELL DRILLING	
CO_2 e Emission (metric ton)	**7.0E-01**
Onsite NOx Emission (metric ton)	**6.7E-03**
Onsite SOx Emission (metric ton)	**6.8E-04**
Onsite PM_{10} Emission (metric ton)	**6.0E-04**
Offsite NOx Emission (metric ton)	**3.8E-04**
Offsite SOx Emission (metric ton)	**2.0E-04**
Offsite PM_{10} Emission (metric ton)	**5.7E-05**
Accident Risk - Fatality	**1.0E-06**
Accident Risk - Injury	**2.5E-04**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**8.4E+00**
Energy Used (MWh)	**NA**

TRENCHING EQUIPMENT

	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Fuel type	Gasoline	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Horsepower range	1 to 3	6 to 11	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Equipment operating hours	300	150	0	0	0	0	0	0	0	0	0	0

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This worksheet allows the user to calculate the environmental footprint of earthwork activities

Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

SEDIMENT MANAGEMENT (STAGING AND DRYING)

	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Earthwork equipment type	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Fuel type	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Volume of material to be removed (yd^3)	0	0	0	0	0	0	0	0	0	0	0	0
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Actual volume of material to be removed (yd^3)	0	0	0	0	0	0	0	0	0	0	0	0
Approximate net power (hp)	175	175	175	175	175	175	175	175	175	175	175	175
Production rate (yd^3/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Consumption rate (gal/hr)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Equipment operating hours (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel used (gal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847
CO_2 emission factor (g/hr)	1.38E+05	1.38E+05	1.38E+05	1.38E+05	1.38E+05	1.38E+05	1.38E+05	1.38E+05	1.38E+05	1.38E+05	1.38E+05	1.38E+05
N_2O emission factor (g/hr)	3.52E+00	3.52E+00	3.52E+00	3.52E+00	3.52E+00	3.52E+00	3.52E+00	3.52E+00	3.52E+00	3.52E+00	3.52E+00	3.52E+00
CH_4 emission factor (g/hr)	8.00E+00	8.00E+00	8.00E+00	8.00E+00	8.00E+00	8.00E+00	8.00E+00	8.00E+00	8.00E+00	8.00E+00	8.00E+00	8.00E+00
Onsite NOx emission factor (g/hr)	9.44E+02	9.44E+02	9.44E+02	9.44E+02	9.44E+02	9.44E+02	9.44E+02	9.44E+02	9.44E+02	9.44E+02	9.44E+02	9.44E+02
Onsite SOx emission factor (g/hr)	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02	2.19E+02
Onsite PM_{10} emission factor (g/hr)	6.60E+01	6.60E+01	6.60E+01	6.60E+01	6.60E+01	6.60E+01	6.60E+01	6.60E+01	6.60E+01	6.60E+01	6.60E+01	6.60E+01
Offsite NOx emission factor (g/hr)	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01	2.0E+01
Offsite SOx emission factor (g/hr)	1.0E+01	1.0E+01	1.0E+01	1.0E+01	1.0E+01	1.0E+01	1.0E+01	1.0E+01	1.0E+01	1.0E+01	1.0E+01	1.0E+01
Offsite PM_{10} emission factor (g/hr)	3.0E+00	3.0E+00	3.0E+00	3.0E+00	3.0E+00	3.0E+00	3.0E+00	3.0E+00	3.0E+00	3.0E+00	3.0E+00	3.0E+00
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission - (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM SEDIMENT MANAGEMENT (STAGING AND DRYING)	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	0.0E+00
Onsite SOx Emission (metric ton)	0.0E+00
Onsite PM_{10} Emission (metric ton)	0.0E+00
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	0.0E+00
Accident Risk - Injury	0.0E+00
Water Used (gallons)	NA
Energy Used (MMBTU)	0.0E+00
Energy Used (MWh)	NA

DRAFT

This worksheet allows the user to calculate the environmental footprint of operating pumps on site

Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

ELECTRIC PUMP OPERATION - For each pump, select only one of the three methods to calculate energy and GHG emissior
Enter "0" for all user input values for unused pumps or unused methods

		Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Method 1 - IF ELECTRICAL USAGE IS KNOWN													
	Pump electrical usage (KWh)	0	0	0	0	0	0	0	0	0	0	0	0
Method 2 - IF PUMP HEAD IS KNOWN													
	Flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
	Total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
	Number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
	Operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
	Pump efficiency	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Pump motor efficiency	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	Pump times motor efficiency	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
	Specific gravity	1	1	1	1	1	1	1	1	1	1	1	1
	Pump horsepower (hp)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Method 3 - IF NAME PLATE SPECIFICATIONS ARE KNOWN													
	Pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
	Number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
	Operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
	Percent of maximum speed of motor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Pump load	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	Pump motor efficiency	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
SELECT REGION													
	Region	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
	CO_2 emission factor (lb/MWh)	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02
	N_2O emission factor (lb/MWh)	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03
	CH_4 emission factor (lb/MWh)	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00
	NOx emission factor (lb/MWh)	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01
	SOx emission factor (lb/MWh)	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01
	PM_{10} emission factor (lb/MWh)	5.07E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01
	Electricity production efficiency	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%
	ENERGY OUTPUT												
	Energy used (kWh)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Energy used (MWh)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	CO_2 OUTPUT												
	CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	CH_4 emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	NOx and SOx OUTPUT												
	NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM ELECTRIC PUMP OPERATION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gallons)	**0.0E+00**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**0.0E+00**

DIESEL AND GASOLINE PUMPS

		Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
	Fuel type	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
	Horsepower range	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
	Equipment operating hours (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
	Estimated fuel consumption rate (gal/hr)	0	0	0	0	0	0	0	0	0	0	0	0
	Fuel consumption rate (gal/hr)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Fuel used (gal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BTU per gallon fuel used	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015
	CO_2 emission factor (g/hr)	8.6E+02	8.6E+02	8.6E+02	8.6E+02	8.6E+02	8.6E+02	8.6E+02	8.6E+02	8.6E+02	8.6E+02	8.6E+02	8.6E+02
	N_2O emission factor (g/hr)	2.1E-02	2.1E-02	2.1E-02	2.1E-02	2.1E-02	2.1E-02	2.1E-02	2.1E-02	2.1E-02	2.1E-02	2.1E-02	2.1E-02
	CH_4 emission factor (g/hr)	4.7E-02	4.7E-02	4.7E-02	4.7E-02	4.7E-02	4.7E-02	4.7E-02	4.7E-02	4.7E-02	4.7E-02	4.7E-02	4.7E-02
	Onsite NOx emission factor (g/hr)	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
	Onsite SOx emission factor (g/hr)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Onsite PM_{10} emission factor (g/hr)	7.0E+00	7.0E+00	7.0E+00	7.0E+00	7.0E+00	7.0E+00	7.0E+00	7.0E+00	7.0E+00	7.0E+00	7.0E+00	7.0E+00
	Offsite NOx emission factor (g/hr)	5.3E-01	5.3E-01	5.3E-01	5.3E-01	5.3E-01	5.3E-01	5.3E-01	5.3E-01	5.3E-01	5.3E-01	5.3E-01	5.3E-01

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Offsite SOx emission factor (g/hr)	2.8E-01	2.8E-01	2.8E-01	2.8E-01	2.8E-01	2.8E-01	2.8E-01	2.8E-01	2.8E-01	2.8E-01	2.8E-01	2.8E-01
Offsite PM_{10} emission factor (g/hr)	8.5E-02	8.5E-02	8.5E-02	8.5E-02	8.5E-02	8.5E-02	8.5E-02	8.5E-02	8.5E-02	8.5E-02	8.5E-02	8.5E-02
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM DIESEL AND GASOLINE PUMP OPERATION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**0.0E+00**
Onsite SOx Emission (metric ton)	**0.0E+00**
Onsite PM_{10} Emission (metric ton)	**0.0E+00**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**NA**

TOTAL FROM PUMP OPERATIONS	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**0.0E+00**
Onsite SOx Emission (metric ton)	**0.0E+00**
Onsite PM_{10} Emission (metric ton)	**0.0E+00**

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This worksheet allows the user to calculate the environmental footprint of using electrical equipment	
Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

Equipment Operation - For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

		Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
	Type of equipment	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower
Method 1 - IF NAME PLATE SPECIFICATIONS ARE KNOWN													
	Equipment horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
	Number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
	Operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
	Percent of maximum speed of motor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Equipment load	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	Motor efficiency	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - IF ELECTRICAL USAGE IS KNOWN													
	Equipment electrical usage, if known (KWh)	0	0	0	0	0	0	0	0	0	0	0	0
SELECT REGION													
	Region	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
	CO_2 emission factor (lb/MWh)	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02	6.67E+02
	N_2O emission factor (lb/MWh)	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03
	CH_4 emission factor (lb/MWh)	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00	1.56E+00
	NOx emission factor (lb/MWh)	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01	6.78E-01
	SOx emission factor (lb/MWh)	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01	9.08E-01
	PM_{10} emission factor (lb/MWh)	5.07E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01	5.1E-01
	Electricity production efficiency	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%
	ENERGY OUTPUT												
	Energy used (kWh)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Energy used (MWh)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	CO_2 OUTPUT												
	CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	CH_4 emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	NOx and SOx OUTPUT												
	NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM ELECTRICAL EQUIPMENT OPERATION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gallons)	**0.0E+00**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**0.0E+00**

GENERATORS

		Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
	Fuel type	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
	Horsepower range	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
	Operating hours (hr)	800	0	0	0	0	0	0	0	0	0	0	0
	Consumption rate (gal/hr)	6.51E-02	6.51E-02	6.51E-02	6.51E-02	6.51E-02	6.51E-02	6.51E-02	6.51E-02	6.51E-02	6.51E-02	6.51E-02	6.51E-02
	Fuel used (gal)	52.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	BTU per gallon fuel used	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015
	CO_2 emission factor (g/hr)	7.2E+02	7.2E+02	7.2E+02	7.2E+02	7.2E+02	7.2E+02	7.2E+02	7.2E+02	7.2E+02	7.2E+02	7.2E+02	7.2E+02
	N_2O emission factor (g/hr)	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02
	CH_4 emission factor (g/hr)	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
	NOx emission factor (g/hr)	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00	1.2E+00
	SOx emission factor (g/hr)	3.4E-01	3.4E-01	3.4E-01	3.4E-01	3.4E-01	3.4E-01	3.4E-01	3.4E-01	3.4E-01	3.4E-01	3.4E-01	3.4E-01
	PM_{10} emission factor (g/hr)	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00
	Offsite NOx emission factor (g/hr)	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01
	Offsite SOx emission factor (g/hr)	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01
	Offsite PM_{10} emission factor (g/hr)	6.8E-02	6.8E-02	6.8E-02	6.8E-02	6.8E-02	6.8E-02	6.8E-02	6.8E-02	6.8E-02	6.8E-02	6.8E-02	6.8E-02
	ENERGY OUTPUT												
	Energy used (BTU)	7.2E+06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	CO_2 OUTPUT												
	CO_2 emission (metric ton)	5.7E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	N_2O emission (metric ton CO_2 e)	6.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	CH_4 emissions (metric ton CO_2 e)	1.7E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	NOx, SOx and PM_{10} OUTPUT												

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Offsite NOx emission (metric ton)	3.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	1.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	5.5E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	6.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	9.4E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	4.0E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM GENERATOR OPERATION	
CO_2 e Emission (metric ton)	**6.0E-01**
Onsite NOx Emission (metric ton)	**6.5E-04**
Onsite SOx Emission (metric ton)	**9.4E-05**
Onsite PM_{10} Emission (metric ton)	**4.0E-03**
Offsite NOx Emission (metric ton)	**3.4E-04**
Offsite SOx Emission (metric ton)	**1.8E-04**
Offsite PM_{10} Emission (metric ton)	**5.5E-05**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**7.2E+00**
Energy Used (MWh)	**NA**

TOTAL FROM ELECTRICAL EQUIPMENT OPERATIONS	
CO_2 e Emission (metric ton)	**6.0E-01**
Onsite NOx Emission (metric ton)	**6.5E-04**
Onsite SOx Emission (metric ton)	**9.4E-05**
Onsite PM_{10} Emission (metric ton)	**4.0E-03**

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This worksheet allows the user to calculate the environmental footprint of equipment use

Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

AGRICULTURAL EQUIPMENT

	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Fuel type	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Area to till (acre)	0	0	0	0	0	0	0	0	0	0	0	0
Soil condition	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Soil type	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Time available (work days)	0	0	0	0	0	0	0	0	0	0	0	0
Depth of tillage (in)	0	0	0	0	0	0	0	0	0	0	0	0
Tractor horsepower required (calculated)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tractor horsepower used	16	16	16	16	16	16	16	16	16	16	16	16
Consumption rate (gal/hr)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Actual equipment operating hours (hr), limited by tractor horsepower available	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel used (gal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015
CO_2 emission factor (g/hr)	6.4E+03	6.4E+03	6.4E+03	6.4E+03	6.4E+03	6.4E+03	6.4E+03	6.4E+03	6.4E+03	6.4E+03	6.4E+03	6.4E+03
N_2O emission factor (g/hr)	2.4E-01	2.4E-01	2.4E-01	2.4E-01	2.4E-01	2.4E-01	2.4E-01	2.4E-01	2.4E-01	2.4E-01	2.4E-01	2.4E-01
CH_4 emission factor (g/hr)	9.8E+00	9.8E+00	9.8E+00	9.8E+00	9.8E+00	9.8E+00	9.8E+00	9.8E+00	9.8E+00	9.8E+00	9.8E+00	9.8E+00
NOx emission factor (g/hr)	1.8E+01	1.8E+01	1.8E+01	1.8E+01	1.8E+01	1.8E+01	1.8E+01	1.8E+01	1.8E+01	1.8E+01	1.8E+01	1.8E+01
SOx emission factor (g/hr)	3.2E+00	3.2E+00	3.2E+00	3.2E+00	3.2E+00	3.2E+00	3.2E+00	3.2E+00	3.2E+00	3.2E+00	3.2E+00	3.2E+00
PM_{10} emission factor (g/hr)	1.7E+00	1.7E+00	1.7E+00	1.7E+00	1.7E+00	1.7E+00	1.7E+00	1.7E+00	1.7E+00	1.7E+00	1.7E+00	1.7E+00
Offsite NOx emission factor (g/hr)	4.1E+00	4.1E+00	4.1E+00	4.1E+00	4.1E+00	4.1E+00	4.1E+00	4.1E+00	4.1E+00	4.1E+00	4.1E+00	4.1E+00
Offsite SOx emission factor (g/hr)	2.2E+00	2.2E+00	2.2E+00	2.2E+00	2.2E+00	2.2E+00	2.2E+00	2.2E+00	2.2E+00	2.2E+00	2.2E+00	2.2E+00
Offsite PM_{10} emission factor (g/hr)	6.5E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM TRACTOR AND TILLER OPERATION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**0.0E+00**
Onsite SOx Emission (metric ton)	**0.0E+00**
Onsite PM_{10} Emission (metric ton)	**0.0E+00**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**0.0E+00**
Accident Risk - Injury	**0.0E+00**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**NA**

CAPPING EQUIPMENT

	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Equipment type	Paver	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Fuel type	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Area (ft^2)	10,000	0	0	0	0	0	0	0	0	0	0	0
Time available (work days)	15	0	0	0	0	0	0	0	0	0	0	0
Calculated area (ft^2)	263000	0	0	0	0	0	0	0	0	0	0	0
Actual equipment operating hours (hr), limited by machine horsepower available	64.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Machine horsepower required (calculated)	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Machine horsepower used	11	11	11	11	11	11	11	11	11	11	11	11
Consumption Rate (gal/hr)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Fuel used (gal)	46.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015
CO_2 emission factor (g/hr)	7.8E+03	6.9E+03	6.9E+03	6.9E+03	6.9E+03	6.9E+03	6.9E+03	6.9E+03	6.9E+03	6.9E+03	6.9E+03	6.9E+03
N_2O emission factor (g/hr)	1.9E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01
CH_4 emission factor (g/hr)	4.2E-01	3.8E-01	3.8E-01	3.8E-01	3.8E-01	3.8E-01	3.8E-01	3.8E-01	3.8E-01	3.8E-01	3.8E-01	3.8E-01
Onsite NOx emission factor (g/hr)	1.7E+01	1.5E+01	1.5E+01	1.5E+01	1.5E+01	1.5E+01	1.5E+01	1.5E+01	1.5E+01	1.5E+01	1.5E+01	1.5E+01
Onsite SOx emission factor (g/hr)	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

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Onsite PM_{10} emission factor (g/hr)	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
Offsite NOx emission factor (g/hr)	4.8E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00	4.3E+00
Offsite SOx emission factor (g/hr)	2.5E+00	2.3E+00	2.3E+00	2.3E+00	2.3E+00	2.3E+00	2.3E+00	2.3E+00	2.3E+00	2.3E+00	2.3E+00	2.3E+00
Offsite PM_{10} emission factor (g/hr)	7.6E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01	6.8E-01
ENERGY OUTPUT												
Energy used (BTU)	6.5E+06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	5.0E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	3.8E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	5.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	3.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	1.6E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	4.9E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	1.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	6.4E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	6.4E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	5.9E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	1.5E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM ROLLER AND PAVER OPERATION	
CO_2 e Emission (metric ton)	5.0E-01
Onsite NOx Emission (metric ton)	1.1E-03
Onsite SOx Emission (metric ton)	6.4E-05
Onsite PM_{10} Emission (metric ton)	6.4E-05
Offsite NOx Emission (metric ton)	3.1E-04
Offsite SOx Emission (metric ton)	1.6E-04
Offsite PM_{10} Emission (metric ton)	4.9E-05
Accident Risk - Fatality	5.9E-06
Accident Risk - Injury	1.5E-03
Water Used (gallons)	NA
Energy Used (MMBTU)	6.5E+00
Energy Used (MWh)	NA

MIXING EQUIPMENT

	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Fuel type	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Horsepower range	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Volume (yd^3)	0	0	0	0	0	0	0	0	0	0	0	0
Production rate (yd^3/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Estimated fuel consumption rate (gal/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel consumption rate (gal/hr)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Equipment operating hours (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel used (gal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015
CO_2 emission factor (g/hr)	2.3E+03	2.3E+03	2.3E+03	2.3E+03	2.3E+03	2.3E+03	2.3E+03	2.3E+03	2.3E+03	2.3E+03	2.3E+03	2.3E+03
N_2O emission factor (g/hr)	5.7E-02	5.7E-02	5.7E-02	5.7E-02	5.7E-02	5.7E-02	5.7E-02	5.7E-02	5.7E-02	5.7E-02	5.7E-02	5.7E-02
CH_4 emission factor (g/hr)	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01
Onsite NOx emission factor (g/hr)	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00
Onsite SOx emission factor (g/hr)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission factor (g/hr)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite NOx emission factor (g/hr)	1.5E+00	1.5E+00	1.5E+00	1.5E+00	1.5E+00	1.5E+00	1.5E+00	1.5E+00	1.5E+00	1.5E+00	1.5E+00	1.5E+00
Offsite SOx emission factor (g/hr)	7.7E-01	7.7E-01	7.7E-01	7.7E-01	7.7E-01	7.7E-01	7.7E-01	7.7E-01	7.7E-01	7.7E-01	7.7E-01	7.7E-01
Offsite PM_{10} emission factor (g/hr)	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01	2.3E-01
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM MIXER OPERATION	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	0.0E+00
Onsite SOx Emission (metric ton)	0.0E+00
Onsite PM_{10} Emission (metric ton)	0.0E+00
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00

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Accident Risk - Fatality	**0.0E+00**
Accident Risk - Injury	**0.0E+00**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**NA**

INTERNAL COMBUSTION ENGINES

	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Fuel type	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Estimated fuel consumption rate (gal or scf/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Operating hours (hr)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel used (gal or scf)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon or scf fuel used	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847
CO_2 emission factor (g/gal or scf)	1.2E+04	1.2E+04	1.2E+04	1.2E+04	1.2E+04	1.2E+04	1.2E+04	1.2E+04	1.2E+04	1.2E+04	1.2E+04	1.2E+04
N_2O emission factor (g/gal or scf)	2.9E-01	2.9E-01	2.9E-01	2.9E-01	2.9E-01	2.9E-01	2.9E-01	2.9E-01	2.9E-01	2.9E-01	2.9E-01	2.9E-01
CH_4 emission factor (g/gal or scf)	1.4E+01	1.4E+01	1.4E+01	1.4E+01	1.4E+01	1.4E+01	1.4E+01	1.4E+01	1.4E+01	1.4E+01	1.4E+01	1.4E+01
Onsite NOx emission factor (g/gal or scf)	8.8E+01	8.8E+01	8.8E+01	8.8E+01	8.8E+01	8.8E+01	8.8E+01	8.8E+01	8.8E+01	8.8E+01	8.8E+01	8.8E+01
Onsite SOx emission factor (g/gal or scf)	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00
Onsite PM_{10} emission factor (g/gal or scf)	7.9E+00	7.9E+00	7.9E+00	7.9E+00	7.9E+00	7.9E+00	7.9E+00	7.9E+00	7.9E+00	7.9E+00	7.9E+00	7.9E+00
Offsite NOx emission factor (g/hr)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission factor (g/hr)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission factor (g/hr)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM INTERNAL COMBUSTION ENGINE OPERATION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**0.0E+00**
Onsite SOx Emission (metric ton)	**0.0E+00**
Onsite PM_{10} Emission (metric ton)	**0.0E+00**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**NA**

OTHER FUELED EQUIPMENT

	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Fuel type	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Volume (scf for Natural gas, gallons for all others)	0	0	0	0	0	0	0	0	0	0	0	0
BTU per gallon or scf	983	983	983	983	983	983	983	983	983	983	983	983
CO2 emission factor (lb/MMBTU)	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02
N2O emission factor (lb/MMBTU)	3.7E-03	3.7E-03	3.7E-03	3.7E-03	3.7E-03	3.7E-03	3.7E-03	3.7E-03	3.7E-03	3.7E-03	3.7E-03	3.7E-03
CH4 emission factor (lb/MMBTU)	1.4E+00	1.4E+00	1.4E+00	1.4E+00	1.4E+00	1.4E+00	1.4E+00	1.4E+00	1.4E+00	1.4E+00	1.4E+00	1.4E+00
NOx emission factor (lb/MMBTU)	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00	2.6E+00
SOx emission factor (lb/MMBTU)	5.9E-04	5.9E-04	5.9E-04	5.9E-04	5.9E-04	5.9E-04	5.9E-04	5.9E-04	5.9E-04	5.9E-04	5.9E-04	5.9E-04
PM10 emission factor (lb/MMBTU)	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.2E-02	1.2E-02
Offsite NOx emission factor (g/gal or scf)	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01
Offsite SOx emission factor (g/gal or scf)	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02
Offsite PM_{10} emission factor (g/gal or scf)	6.0E-03	6.0E-03	6.0E-03	6.0E-03	6.0E-03	6.0E-03	6.0E-03	6.0E-03	6.0E-03	6.0E-03	6.0E-03	6.0E-03
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM OTHER FUELED EQUIPMENT	

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CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	0.0E+00
Onsite SOx Emission (metric ton)	0.0E+00
Onsite PM_{10} Emission (metric ton)	0.0E+00
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (MMBTU)	0.0E+00
Energy Used (MWh)	NA

DIESEL EQUIPMENT (PER HOUR BASIS)

	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1	65.1
Choose equipment size for Loader (HP)	65	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2	65.2
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Approximate equipment size for earthwork equipment	65	65	65	65	65	65	65	65	65	65	65	65
Approximate equipment size for other equipment	0	0	0	0	0	0	0	0	0	0	0	0
Consumption rate (gal/hr)	5	5	5	5	5	5	5	5	5	5	5	5
Corrected Equipment operating hours (hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel used (gal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847	135,847
CO_2 emission factor (g/hr)	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04	2.99E+04
N_2O emission factor (g/hr)	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00	1.12E+00
CH_4 emission factor (g/hr)	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00	2.55E+00
Onsite NOx emission factor (g/hr)	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02	1.66E+02
Onsite SOx emission factor (g/hr)	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01
Onsite PM_{10} emission factor (g/hr)	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01	2.10E+01
Offsite NOx emission factor (g/hr)	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01	3.1E+01
Offsite SOx emission factor (g/hr)	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01	1.6E+01
Offsite PM_{10} emission factor (g/hr)	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00	4.7E+00
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission - (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM DIESEL EQUIPMENT OPERATION	
CO_2 Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	0.0E+00
Onsite SOx Emission (metric ton)	0.0E+00
Onsite PM_{10} Emission (metric ton)	0.0E+00
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	0.0E+00
Accident Risk - Injury	0.0E+00
Water Used (gallons)	NA
Energy Used (MMBTU)	0.0E+00
Energy Used (MWh)	NA

OPERATOR LABOR

	Occupation 1	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Occupation	Construction laborers	Operating engineers	ntific and technical ser	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Total time worked onsite (hours)	1250.0	900.0	1000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fatality risk per labor hour	9.2E-08	5.4E-08	4.5E-09	9.2E-08	9.2E-08	9.2E-08	9.2E-08	9.2E-08	9.2E-08	9.2E-08	9.2E-08	9.2E-08

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Injury risk per labor hour	2.3E-05	2.3E-05	5.5E-06	2.3E-05	2.3E-05	2.3E-05	2.3E-05	2.3E-05	2.3E-05	2.3E-05	2.3E-05	2.3E-05
ACCIDENT RISK												
Fatality risk	1.1E-04	4.8E-05	4.5E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	2.9E-02	2.1E-02	5.5E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM OPERATOR LABOR	
CO_2 e Emission (metric ton)	**NA**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**NA**
Offsite SOx Emission (metric ton)	**NA**
Offsite PM_{10} Emission (metric ton)	**NA**
Accident Risk - Fatality	**1.7E-04**
Accident Risk - Injury	**5.5E-02**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**NA**
Energy Used (MWh)	**NA**

LABORATORY ANALYSIS

	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Dollars spent on laboratory analysis	100,000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energy used (MMBTU/$)	6.49E-03	6.49E-03	6.49E-03	6.49E-03	6.49E-03	6.49E-03	6.49E-03	6.49E-03	6.49E-03	6.49E-03	6.49E-03	6.49E-03
CO2 e emission factor (lb/$)	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
NOx emission factor (lb/$)	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03	4.80E-03

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This worksheet allows the user to calculate the environmental footprint of residual handling

The different columns allow the user to calculate and compare the emissions for different types of residue such as soil, water, and materials

Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

RESIDUE DISPOSAL/RECYCLING

	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Weight of the waste transported to landfill or recycling (tons)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fuel used	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Total number of trips	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of miles per trip	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total distance traveled (miles)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel efficiency by weight of load (mpg)	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total fuel used (gal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BTU per gallon fuel used	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015	139,015
CO_2 emission factor (g/gal)	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03	9.84E+03
N_2O emission factor (g/gal)	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01	2.09E-01
CH_4 emission factor (g/gal)	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01	1.18E+01
NOx emission factor (g/gal)	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00	3.27E+00
SOx emission factor (g/gal)	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01	1.33E-01
PM_{10} emission factor (g/gal)	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01	2.65E-01
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ACCIDENT RISK												
Fatality risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Injury risk	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM RESIDUAL HANDLING	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**0.0E+00**
Accident Risk - Injury	**0.0E+00**
Water Used (gallons)	**NA**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**NA**

LANDFILL OPERATIONS

	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6	Operation 7	Operation 8	Operation 9	Operation 10	Operation 11	Operation 12
Landfill type	Non-Hazardous	Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Region	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY	NY
Waste disposed in landfill (tons)	8500	500	0	0	0	0	0	0	0	0	0	0
Landfill methane emissions (metric tons CH_4)	0	0	0	0	0	0	0	0	0	0	0	0
Waste disposed in non-hazardous landfill (tons)	8,500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste disposed in hazardous landfill (tons)	0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy used (MMBTU/ton)	1.60E-01	1.76E-01	1.60E-01	1.60E-01	1.60E-01	1.60E-01	1.60E-01	1.60E-01	1.60E-01	1.60E-01	1.60E-01	1.60E-01
Electricity used (MWh/ton)	7.70E-03	8.50E-03	7.70E-03	7.70E-03	7.70E-03	7.70E-03	7.70E-03	7.70E-03	7.70E-03	7.70E-03	7.70E-03	7.70E-03
CO_2 e emission factor (lb/ton)	2.50E+01	2.75E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01	2.50E+01
NOx emission factor (lb/ton)	1.40E-01	1.54E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01
SOx emission factor (lb/ton)	7.50E-02	8.25E-02	7.50E-02	7.50E-02	7.50E-02	7.50E-02	7.50E-02	7.50E-02	7.50E-02	7.50E-02	7.50E-02	7.50E-02
PM_{10} emission factor (lb/ton)	4.00E-01	4.40E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01	4.00E-01
Electricity production efficiency	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%	46.43%
ENERGY OUTPUT												
Energy used (BTU)	1.8E+09	1.2E+08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	9.6E+01	6.2E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emissions (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	5.4E-01	3.5E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	2.9E-01	1.9E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	1.5E+00	1.0E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM LANDFILL OPERATIONS	
CO_2 e Emission (metric ton)	**1.0E+02**

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Onsite NOx Emission (metric ton)	NA
Onsite SOx Emission (metric ton)	NA
Onsite PM_{10} Emission (metric ton)	NA
Offsite NOx Emission (metric ton)	5.7E-01
Offsite SOx Emission (metric ton)	3.1E-01
Offsite PM_{10} Emission (metric ton)	1.6E+00
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (MMBTU)	2.0E+03
Energy Used (MWh)	NA

THERMAL/CATALYTIC OXIDIZERS

	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 7	Oxidizer 8	Oxidizer 9	Oxidizer 10	Oxidizer 11	Oxidizer 12
Oxidizer type	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Fuel type	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Waste gas flow rate (scfm)	0	0	0	0	0	0	0	0	0	0	0	0
Time running (hours)	0	0	0	0	0	0	0	0	0	0	0	0
Input waste gas inlet temperature (F)	0	0	0	0	0	0	0	0	0	0	0	0
Input contaminant concentration (ppmV)	0	0	0	0	0	0	0	0	0	0	0	0
Heat capacity at inlet (BTU/scf - F)	0.0179	0.0179	0.0179	0.0179	0.0179	0.0179	0.0179	0.0179	0.0179	0.0179	0.0179	0.0179
Combustion temperature (F)	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Heat exchanger efficiency	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Heating value for fuel (BTU/scf)	983	983	983	983	983	983	983	983	983	983	983	983
Waste inlet temp after heat exchanger (F)	0	0	0	0	0	0	0	0	0	0	0	0
Waste gas heat content (BTU/scf)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Supplemental heat required (BTU/min)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total fuel consumed (scf)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emission factor (lb/MMBTU)	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02	1.52E+02
N_2O emission factor (lb/MMBTU)	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03
CH_4 emission factor (lb/MMBTU)	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00
Onsite NOx emission factor (lb/MMBTU)	2.64E+00	2.64E+00	2.64E+00	2.64E+00	2.64E+00	2.64E+00	2.64E+00	2.64E+00	2.64E+00	2.64E+00	2.64E+00	2.64E+00
Onsite SOx emission factor (lb/MMBTU)	5.91E-04	5.91E-04	5.91E-04	5.91E-04	5.91E-04	5.91E-04	5.91E-04	5.91E-04	5.91E-04	5.91E-04	5.91E-04	5.91E-04
Onsite PM_{10} emission factor (lb/MMBTU)	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02
Offsite NOx emission factor (g/MMBTU)	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02	1.5E+02
Offsite SOx emission factor (g/MMBTU)	2.9E+01	2.9E+01	2.9E+01	2.9E+01	2.9E+01	2.9E+01	2.9E+01	2.9E+01	2.9E+01	2.9E+01	2.9E+01	2.9E+01
Offsite PM_{10} emission factor (g/MMBTU)	6.1E+00	6.1E+00	6.1E+00	6.1E+00	6.1E+00	6.1E+00	6.1E+00	6.1E+00	6.1E+00	6.1E+00	6.1E+00	6.1E+00
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
N_2O emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CH_4 emission (metric ton CO_2 e)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
Offsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Offsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Onsite PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM THERMAL OXIDIZERS	
CO_2 e Emission (metric ton)	0.0E+00
Onsite NOx Emission (metric ton)	0.0E+00
Onsite SOx Emission (metric ton)	0.0E+00
Onsite PM_{10} Emission (metric ton)	0.0E+00
Offsite NOx Emission (metric ton)	0.0E+00
Offsite SOx Emission (metric ton)	0.0E+00
Offsite PM_{10} Emission (metric ton)	0.0E+00
Accident Risk - Fatality	NA
Accident Risk - Injury	NA
Water Used (gallons)	NA
Energy Used (MMBTU)	0.0E+00
Energy Used (MWh)	NA

TOTAL FROM RESIDUAL HANDLING	
CO_2 e Emission (metric ton)	1.0E+02
Onsite NOx Emission (metric ton)	0.0E+00
Onsite SOx Emission (metric ton)	0.0E+00
Onsite PM_{10} Emission (metric ton)	0.0E+00
Offsite NOx Emission (metric ton)	5.7E-01
Offsite SOx Emission (metric ton)	3.1E-01

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This worksheet allows the user to calculate the water used and GHG emissions from onsite activities

The different columns allow the user to calculate and compare the emissions for different types of residue such as soil, water, and materials

Yellow cells	value chosen from drop down menu on input sheet
White cells	value entered on input sheet
Orange cells	provide the output of the tool
Blue Cells	tool calculations and automatic lookups

WATER CONSUMPTION

	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 7	Treatment System 8	Treatment System 9	Treatment System 10	Treatment System 11	Treatment System 12
Water consumed from municipal water treatment facility (gal)	0	0	0	0	0	0	0	0	0	0	0	0
Water disposed to wastewater treatment facility (gal)	0	0	0	0	0	0	0	0	0	0	0	0
Total water consumption (gal)	0	0	0	0	0	0	0	0	0	0	0	0
Energy consumption (Btu/gal) for water treatment	9.20E+00	9.20E+00	9.20E+00	9.20E+00	9.20E+00	9.20E+00	9.20E+00	9.20E+00	9.20E+00	9.20E+00	9.20E+00	9.20E+00
CO_2 e emission factor (kg/gal) for water treatment	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03
NOx emission factor (g/gal) for water treatment	4.40E-03	4.40E-03	4.40E-03	4.40E-03	4.40E-03	4.40E-03	4.40E-03	4.40E-03	4.40E-03	4.40E-03	4.40E-03	4.40E-03
SOx emission factor (g/gal) for water treatment	2.68E-03	2.68E-03	2.68E-03	2.68E-03	2.68E-03	2.68E-03	2.68E-03	2.68E-03	2.68E-03	2.68E-03	2.68E-03	2.68E-03
PM_{10} emission factor (g/gal) for water treatment	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03
Energy consumption (Btu/gal) for wastewater treatment	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01	1.50E+01
CO_2 e emission factor (kg/gal) for wastewater treatment	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03
NOx emission factor (g/gal) for wastewater treatment	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03	7.26E-03
SOx emission factor (g/gal) for wastewater treatment	6.80E-03	6.80E-03	6.80E-03	6.80E-03	6.80E-03	6.80E-03	6.80E-03	6.80E-03	6.80E-03	6.80E-03	6.80E-03	6.80E-03
PM10 emission factor (g/gal) for wastewater treatment	7.71E-04	7.71E-04	7.71E-04	7.71E-04	7.71E-04	7.71E-04	7.71E-04	7.71E-04	7.71E-04	7.71E-04	7.71E-04	7.71E-04
ENERGY OUTPUT												
Energy used (BTU)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
CO_2 OUTPUT												
CO_2 e emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
NOx, SOx and PM_{10} OUTPUT												
NOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
SOx emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
PM_{10} emission (metric ton)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

TOTAL FROM WATER CONSUMPTION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Used (gal)	**0.0E+00**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**NA**

ONSITE LAND AND WATER RESOURCE CONSUMPTION

	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 7	Entire Site 8	Entire Site 9	Entire Site 10	Entire Site 11	Entire Site 12
Volume of topsoil brought to site (cubic yards)	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volume of groundwater or surface water lost (gal)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TOTAL FROM ONSITE LAND AND WATER RESOURCE CONSUMPTION	
Topsoil consumption (yd^3)	**4.0E+02**
Water loss (gal)	**0.0E+00**

TOTAL FROM RESOURCE CONSUMPTION	
CO_2 e Emission (metric ton)	**0.0E+00**
Onsite NOx Emission (metric ton)	**NA**
Onsite SOx Emission (metric ton)	**NA**
Onsite PM_{10} Emission (metric ton)	**NA**
Offsite NOx Emission (metric ton)	**0.0E+00**
Offsite SOx Emission (metric ton)	**0.0E+00**
Offsite PM_{10} Emission (metric ton)	**0.0E+00**
Accident Risk - Fatality	**NA**
Accident Risk - Injury	**NA**
Water Consumption (gal)	**0.0E+00**
Energy Used (MMBTU)	**0.0E+00**
Energy Used (MWh)	**NA**

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Environmental Footprint Summary

Activities	CO_2 Emissions	Percent Total	Onsite NOx emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM_{10} Emissions	Percent Total	Total NOx emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM_{10} Emissions	Percent Total	Total Energy Used	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	MMBTU	%		%		%
Material Productions	1,852.08	90.43	NA	-	NA	-	NA	-	3.8E+00	81.9	6.8E+00	93.4	9.8E-01	37.1	6.1E+04	94.92	NA	NA	NA	NA
Transportation-Personnel	41.30	2.02	NA	-	NA	-	NA	-	1.3E-02	0.3	2.5E-04	0.0	1.3E-03	0.0	5.4E+02	0.8	2.7E-04	55.4	2.2E-02	24.3
Transportation-Equip/materials	0.00	-	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Misc	52.09	2.54	3.5E-02	100.0	7.3E-03	100.0	7.5E-03	100.0	2.6E-01	5.5	1.7E-01	2.4	2.6E-02	1.0	7.4E+02	1.2	2.2E-04	44.6	6.8E-02	75.7
Residual Handling	102.63	5.01	0.0E+00	-	0.0E+00	-	0.0E+00	-	5.7E-01	12.3	3.1E-01	4.2	1.6E+00	61.9	2.0E+03	3.1	0.0E+00	-	0.0E+00	-
Total	2,048.10	100	3.50E-02	100.0	7.26E-03	100	7.48E-03	100	4.66E+00	100	7.24E+00	100	2.65E+00	100	6.38E+04	100	4.9E-04	100	9.0E-02	100

NA: Not Available or Not Applicable

Environmental Footprint Summary continued

Activities	Water Usage	Percent Total	Electrical Usage	Lost Hours - Injury	Percent Total
	gallons	%	MWH		%
Material Productions	NA	NA	NA	NA	NA
Transportation-Personnel	NA	NA	NA	1.8E-01	24.3
Transportation-Equipment	NA	NA	NA	0.0E+00	-
Equipment Use and Misc	0.00	-	0.00E+00	5.5E-01	75.7
Residual Handling	NA	NA	NA	0.0E+00	-
Total	0.00E+00	100	0.00E+00	7.22E-01	100.0

Footprint Reduction

Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00
Water consumption reduction (gallons)	0.00E+00

Additional Sustainability Metrics

Non-Hazardous Waste Landfill Space (tons)	8500.0
Hazardous Waste Landfill Space (tons)	500.0
Topsoil Consumption (yd^3)	400.0
Cost of Phase ($)	0.0
Lost Hours - Injury	0.7

Duration of Phase

Duration (unit time)	1

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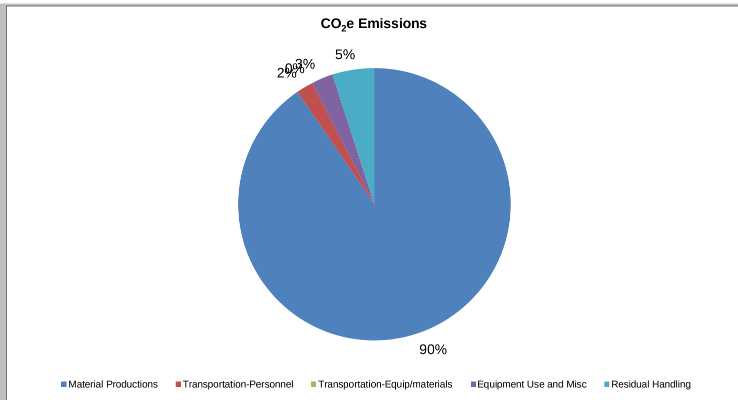
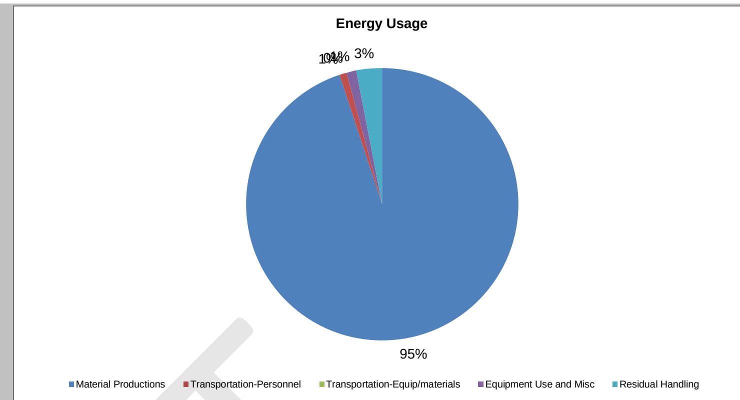
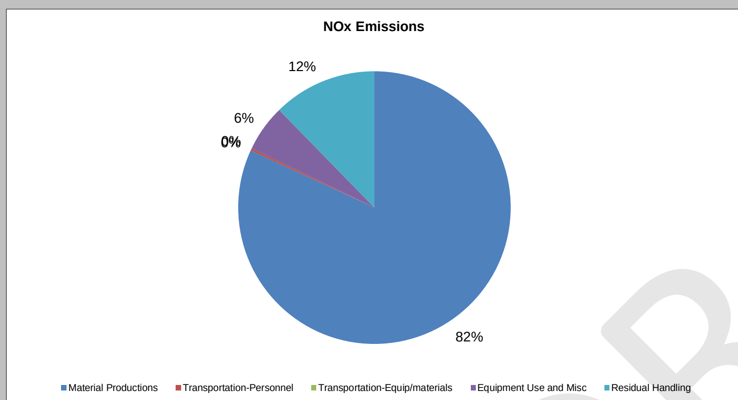
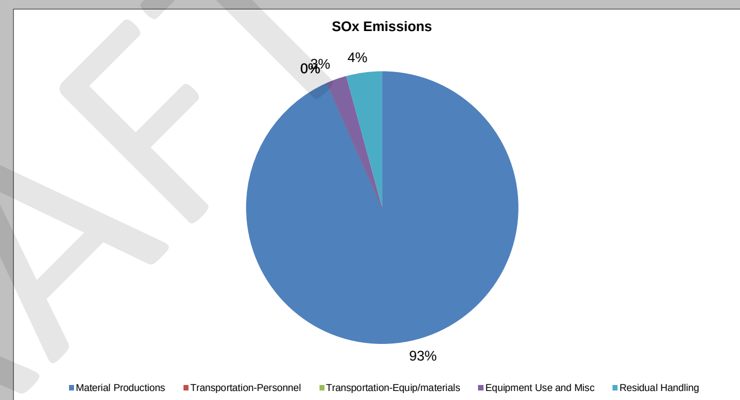
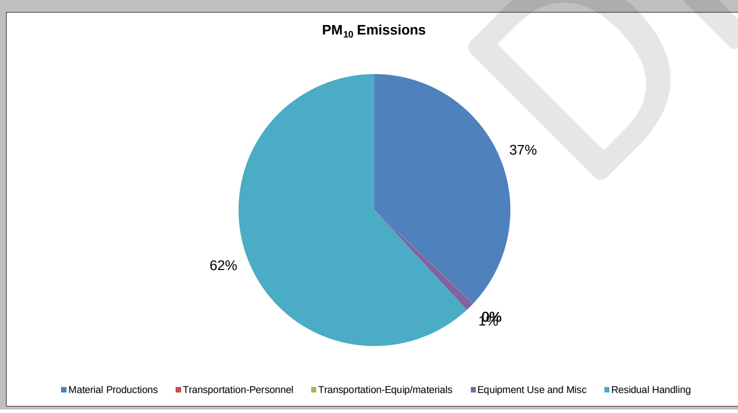
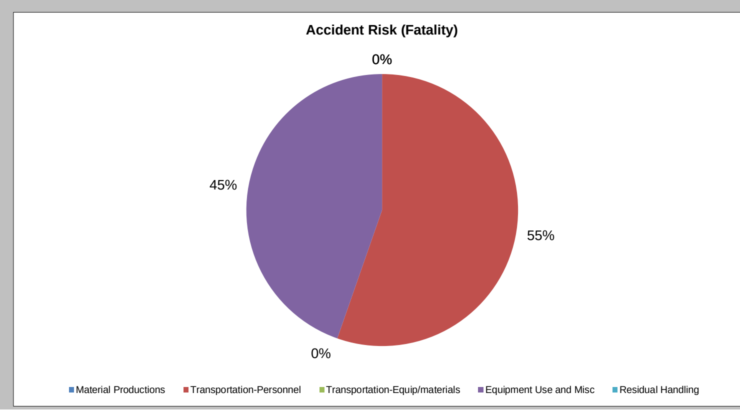

CO2e Emissions
2%
3%
5%
90%
Material Productions
Transportation-Personnel
Transportation-Equip/materials
Equipment Use and Misc
Residual Handling


Energy Usage
3%
95%
Material Productions
Transportation-Personnel
Transportation-Equip/materials
Equipment Use and Misc
Residual Handling


NOx Emissions
12%
6%
0%
82%
Material Productions
Transportation-Personnel
Transportation-Equip/materials
Equipment Use and Misc
Residual Handling


SOx Emissions
4%
93%
Material Productions
Transportation-Personnel
Transportation-Equip/materials
Equipment Use and Misc
Residual Handling


PM10 Emissions
37%
62%
Material Productions
Transportation-Personnel
Transportation-Equip/materials
Equipment Use and Misc
Residual Handling


Accident Risk (Fatality)
0%
45%
55%
0%
Material Productions
Transportation-Personnel
Transportation-Equip/materials
Equipment Use and Misc
Residual Handling

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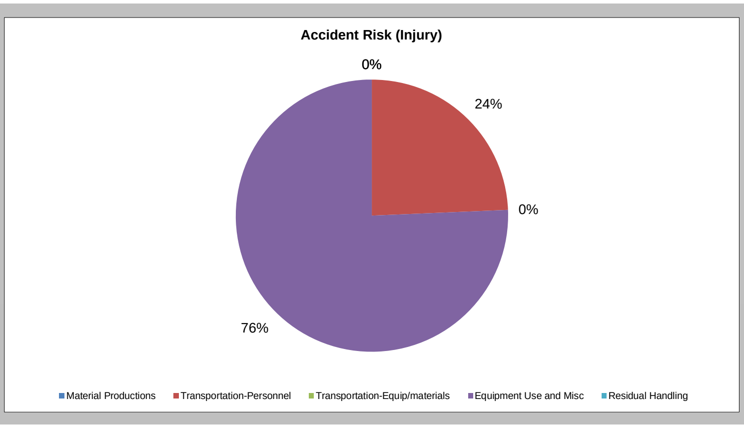
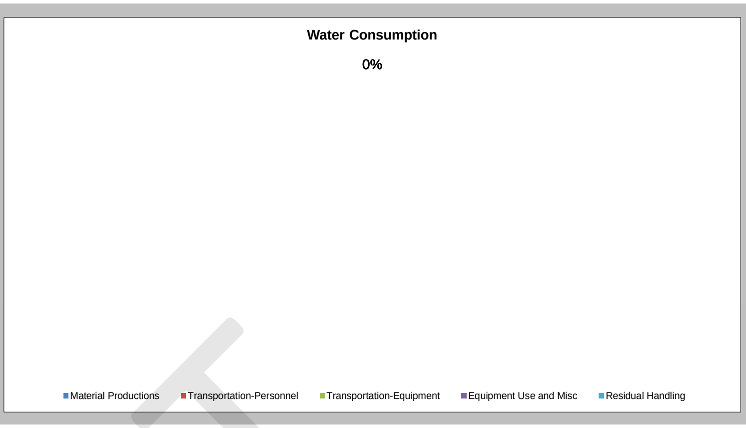

Accident Risk (Injury)
0%
24%
0%
76%
Material Productions
Transportation-Personnel
Transportation-Equip/materials
Equipment Use and Misc
Residual Handling


Water Consumption
0%
Material Productions
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

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Conversions	
3412	BTU / kWH
947.87	BTU / MJ
0.001055	MJ / BTU
1.055	kJ / BTU
0.746	kW / hp
33013	ft lbs / min hp
2.204	lb / kg
0.4537	kg / lb
2204.6	lb / metric ton
1000	kg / metric ton
3.785	L / gallon
8.34	lbs H_2O / gal

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APPENDIX F
Health and Safety Plan

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HALEY & ALDRICH, INC.
SITE-SPECIFIC SAFETY PLAN

FOR

4001 4th Avenue Redevelopment Site

4001 4th Avenue, Brooklyn, NY

Project/File No. 0210815

Gensuite EZ Scan®

BI - Developers

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Prepared By: PJ DiNardo **Date: 5/20/2024**

Approvals: The following signatures constitute approval of this Health & Safety Plan.

Project Manager: Mari Conlon **Date: 5/28/2024**

HASP Valid Through: 12/31/2024

Table of Contents

Note: This HASP has been developed for Haley & Aldrich purposes only and is not for use by others.

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Attachments

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STOP WORK AUTHORITY

In accordance with Haley & Aldrich (Haley & Aldrich) Stop Work Authority Operating Procedure (OP1035), any individual has the right to refuse to perform work that he or she believes to be unsafe without fear of retaliation. He or she also has the authority, obligation, and responsibility to stop others from working in an unsafe manner.

STOP Work Authority is the stop work policy for all personnel and subcontractors on the Site. When work has been stopped due to an unsafe condition, Haley & Aldrich site management (e.g., Project Manager [PM], Site Health & Safety Officer [SHSO], etc.) and the Haley & Aldrich Senior Project Manager (SPM) will be notified immediately.

Reasons for issuing a stop work order include, but are not limited to:

- The belief/perception that injury to personnel or accident causing significant damage to property or equipment is imminent.
- An Haley & Aldrich subcontractor is in breach of site safety requirements and/or their own site HASP.
- Identifying a substandard condition (e.g., severe weather) or activity that creates an unacceptable safety risk as determined by a qualified person.

Work will not resume until the unsafe act has been stopped OR sufficient safety precautions have been taken to remove or mitigate the risk to an acceptable degree. Stop work orders will be documented as part of an on-site stop work log, on daily field reports to include the activity/activities stopped, the duration, person stopping work, person in-charge of stopped activity/activities, and the corrective action agreed to and/or taken. Once work has been stopped, only the Haley & Aldrich SPM or SHSO can give the order to resume work. Haley & Aldrich senior management is committed to support anyone who exercises his or her "Stop Work" authority.

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ISSUANCE AND COMPLIANCE

This HASP has been prepared in accordance with Occupational Safety and Health Administration (OSHA) regulations (CFR 29, Parts 1904, 1910, and 1926) if such are applicable.

The specific requirements of this HASP include precautions for hazards that exist during this project and may be revised as new information is received or as site conditions change.

- This HASP must be signed by all Haley & Aldrich personnel involved in implementation of the SOW (Section 2 of this HASP).
- This HASP, or a current signed copy, must be retained at all times when Haley & Aldrich staff are present.
- Revisions to this HASP must be outlined within the contents of the HASP. If immediate or minor changes are necessary, the Field Safety Manager (FSM), Haley & Aldrich, SSO and/or Project Manager (PM) may use Attachment 1 (HASP Amendment Form), presented at the end of this HASP. Any revision to the HASP requires employees and subcontractors to be informed of the changes so that they understand the requirements of the change.
- Deviations from this HASP are permitted with approval from the Haley & Aldrich FSM, PM, or Senior Health & Safety Manager (SHSM). Unauthorized deviations may constitute a violation of Haley & Aldrich company procedures/policies and may result in disciplinary action.
- This HASP will be relied upon by Haley & Aldrich's subcontractors and visitors to the site. Haley & Aldrich's subcontractors must have their own HASP which will address hazards specific to their trade that is not included in this HASP. This HASP will be made available for review to Haley & Aldrich's subcontractors and other interested parties (e.g. Facility personnel and regulatory agencies) to ensure that Haley & Aldrich has properly informed our subcontractors and others of the potential hazards associated with the implementation of the SOW to the extent that Haley &Aldrich is aware.

This site-specific HASP provides only site-specific descriptions and work procedures. General safety and health compliance programs in support of this HASP (e.g., injury reporting, medical surveillance, personal protective equipment (PPE) selection, etc.) are described in detail in the Haley &Aldrich Corporate Health and Safety Program Manual and within Haley & Aldrich's Standard Operating Procedures Both the manual and SOPs can be located on the Haley & Aldrich's Company Intranet. When appropriate, users of this HASP should always refer to these resources and incorporate to the extent possible. The manual and SOPs are available to clients and regulators upon request.

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EMERGENCY EVENT PROCEDURES
1 - ASSESS THE SCENE
• STOP WORK • Review the situation and ascertain if it's safe to enter the area. • Evacuate the site if the conditions are unsafe.
2 - EVALUATE THE EMERGENCY

• **Call 911, or designated emergency number, if required.**
• **Provide first aid for the victim if qualified and safe to do so.**
  o First aid will be addressed using the onsite first aid kit. *
    ▪ If providing first aid, remember to use proper first aid universal precautions if blood or bodily fluids are present.
• **If exposure to hazardous substance is suspected, immediately vacate the contaminated area.**
  o Remove any contaminated clothing and/or equipment.
  o Wash any affected dermal/ocular area(s) with water for at least 15 minutes.
  o Seek immediate medical assistance if any exposure symptoms are present.
* *Note: Haley & Aldrich employees are not required or expected to administer first aid / CPR to any Haley & Aldrich staff member, Contractor, or Civilian personnel at any time; it is Haley & Aldrich´s position that those who do are doing so on their own behalf and not as a function of their job.*

3 - SECURE THE AREA

• **Cordon off the incident area, if possible.**
  o Notify any security personnel, if required.
  o Escort all non-essential personnel out of the area, if able.

4 - REPORT ON-SITE ACCIDENTS / INCIDENTS TO PM / SSO
• **Notify the PM and SSO as soon as it is safe to do so.**   o Assist PM and SSO in completing any additional tasks, as required.
5 - INVESTIGATE / REPORT THE INCIDENT
• **Record details of the incident for input to the Gensuite.**   o Complete any additional forms as requested by the PM and SSO.
6 - TAKE CORRECTIVE ACTION
• **Implement corrective actions per the PM following root cause analysis.**   o Complete Lessons Learned form.

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PROJECT INFORMATION AND CONTACTS	
Project Name: 4001 4th Avenue Redevelopment Site	**Haley & Aldrich File No.:** 0210815
Location: 4001 4th Avenue, Brooklyn, New York	
Client/Site Contact: Phone Number:	4th Ave Property LLC Ari Schwartz 718.408.8778
Haley & Aldrich Field Representative: Phone Number: Emergency Phone Number:	Zavier Richards 929.696.2279 332.236.9927
Haley & Aldrich Project Manager: Phone Number: Emergency Phone Number:	Mari Conlon 201.978.7871 646.277.5692
Field Safety Manager: Phone Number: Emergency Phone Number:	Ferguson, Brian 617.886.7439 617.908.2761
Nearest Hospital: Address: (see map on next page) Phone Number:	**NYU Langone Hospital – Brooklyn – Emergency Department** 5500 2nd Ave, Brooklyn, NY 11200 Brooklyn, NY 11220 718.630.7185
Nearest Occ. Health Clinic: **http://www.talispoint.com/liberty/ext/** Address: (see map on next page) Phone Number:	**CityMD Park Slope Urgent Care - Brooklyn** 420 5th Avenue Brooklyn, NY 11215 718.965.2273
Liberty Mutual Claim Policy	**WC6-Z11-254100-033**
WORKCARE Injury & Illness HOTLINE	**1-888-449-7787**
Emergency Response Number:	911
Other Local Emergency Response Number:	N/A
Other Ambulance, Fire, Police, or Environmental Emergency Resources:	911

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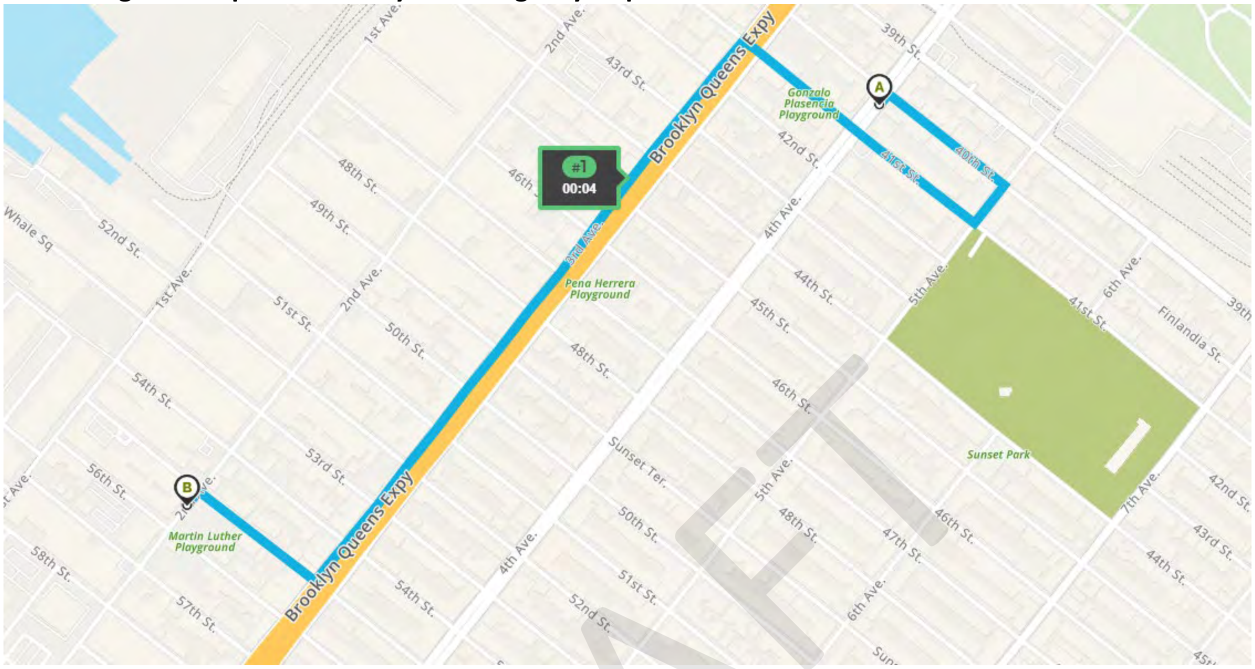
DIRECTIONS TO THE NEAREST HOSPITAL

Liberty Mutual Medical Location Directory

NYU Langone Hospital – Brooklyn – Emergency Department:



Directions to the Nearest Hospital:

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↑ Head toward 40th St on 4th Ave. Go for 79 ft.

Then 0.01 miles

↱ Turn right onto 40th St. Go for 0.1 mi.

Then 0.1 miles

↱ Turn right onto 5th Ave. Go for 256 ft.

Then 0.05 miles

↱ Turn right onto 41st St. Go for 0.3 mi.

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Then 0.3 miles

Turn left onto 3rd Ave. Go for 0.6 mi.

Then 0.6 miles

Keep right onto 3rd Ave. Go for 262 ft.

Then 0.05 miles

Turn right onto 55th St. Go for 0.1 mi.

Then 0.1 miles

Turn left onto 2nd Ave. Go for 98 ft.

Then 0.02 miles

NYU Langone Hospital Brooklyn
150 55th St, Brooklyn, NY 11220-2508

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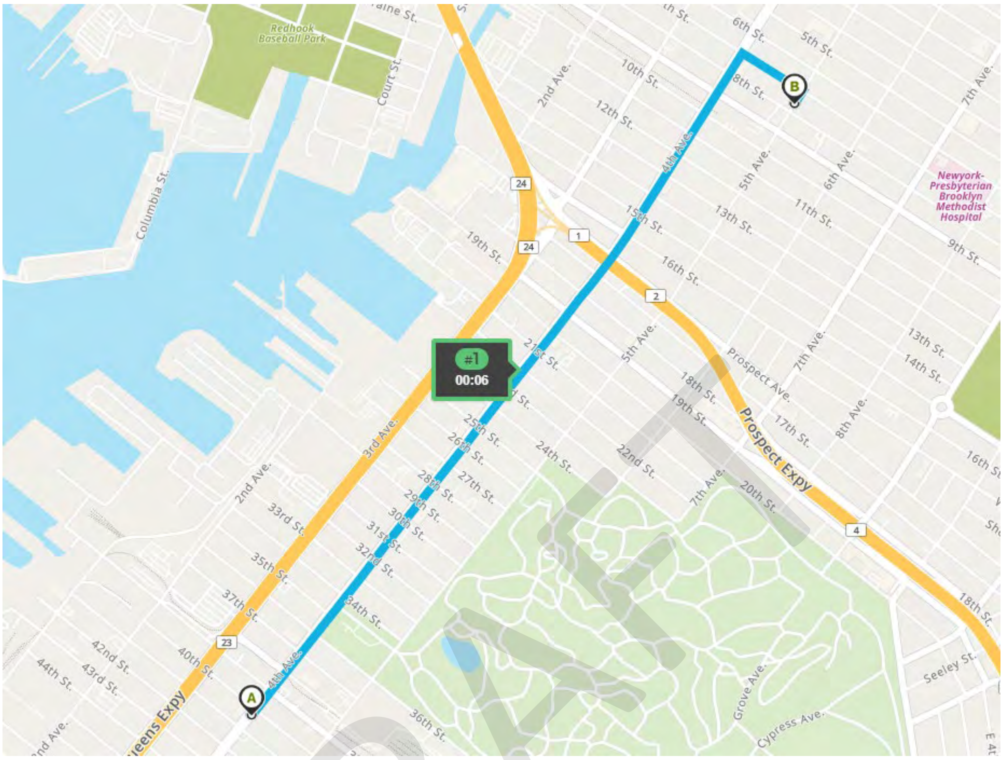
DIRECTIONS TO THE NEAREST URGENT CARE

[Liberty Mutual Medical Location Directory]



Directions to the Nearest Occupational Clinic:

Head toward 40th St on 4th Ave. Go for 1.7 mi.

Then 1.7 miles

Turn right onto 7th St. Go for 0.1 mi.

Then 0.1 miles

Turn right onto 5th Ave. Go for 171 ft.

Then 0.03 miles

Citymd
420 5th Ave, Brooklyn, NY 11211-7419

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1. WORK SCOPE

This Site-Specific Health and Safety Plan addresses the health and safety practices and procedures that will be exercised by all Haley & Aldrich employees participating in all work on the Project Site. This plan is based on an assessment of the site-specific health and safety risks available to Haley & Aldrich and Haley & Aldrich's experience with other similar project sites. The scope of work includes the following:

Geophysical Survey, Drilling, Soil, Groundwater, and Soil Vapor Sampling.

Project Task Breakdown

Task No.	Task Description	Employee(s) Assigned	Work Date(s) or Duration
1.	Geophysical Survey		1 Day
2.	Drilling & Pre-Clearing		4 Days
3.	Soil, groundwater, and soil vapor sampling		4 Days

Subcontractor(s) Tasks

Firm Name	Work Activity	Work Date(s) or Duration
Lakewood Environmental Services Corp.	Drilling	4 Days Anticipated
Projected Start Date: 6/10/2024		
Projected Completion Date: 6/14/2024		
Firm Name	**Work Activity**	**Work Date(s) or Duration**
Lakewood Environmental Services Corp.	Geophysical Survey	1 Day Anticipated
Projected Start Date: 6/10/2024		
Projected Completion Date: 6/10/2024		

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2. SITE OVERVIEW / DESCRIPTION

Site Classification

Commercial

Site Description

The Site is located in the Sunset Park neighborhood of Brooklyn and is identified as Block 714, Lot 6 on the New York City tax map. The Site is approximately 10,017 square feet (sq ft) (0.23 acres) and is currently improved with a retail petroleum station with a one-story convenience store and associated parking lot. The Site is bound by 40th Street followed by mixed-use commercial and residential buildings to the north, a commercial car wash and auto repair to the south, residential apartment buildings to the east, and 4th Avenue followed by Intermediate School (I.S.) 136 to the west.

Background and Historic Site Usage

Based on the findings of the March 2024 Phase I ESA prepared by Lesova Environmental Group (LEG), the Site was comprised of one tax lot developed with a one-story concrete structure and a gasoline filling/auto service station with one (1) UST circa 1926 and a second lot which was vacant. The 1942 Sanborn map depicted the Site merged as one (1) lot with previous use similar to the 1926 map with a garage to the south of the lot. The Site was operated as an automotive service station, lubrication, minor repair, and office use with parking area until at least August 1965. The configuration of Site changed and was identified with a cement brick one-story construction with a gasoline filling station circa 1970. A historical City Directory search indicated that the Site was previously operated as a gasoline filling station and auto service station.

Site Status

Indicate current activity status and describe operations at the site:

Active

The Site is currently operated as a BP Gas Station. Operations are planned to cease in June 2024, prior to the execution of the proposed work scope.

Site Plan

Is a site plan or sketch available? Yes

Work Areas

List and identify each specific work areas(s) on the job site and indicate its location(s) on the site plan:

Entire site

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Site Plan

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3. HAZARD ASSESSMENT

Indicate all hazards that may be present at the site and for each task. If any of these potential hazards are checked, it is the Project Manager's responsibility to determine how to eliminate / minimize the hazard to protect onsite personnel.

Site Chemical Hazards

Is this Site impacted with chemical contamination? Yes

Source of information about contaminants: Previous Investigation

Contaminant of Concern	Location/Media	Concentration	Units
1,2,4-Trimethylbenzene	**Soil**	**1200**	**mg/kg**
Benzene	**Soil**	**20**	**mg/kg**
Ethylbenzene	**Soil**	**1100**	**mg/kg**
Naphthalene	**Soil**	**89**	**mg/kg**
Xylenes	**Soil**	**2,300**	**mg/kg**
Toluene	**Soil**	**1,500**	**mg/kg**
BTEX/VOCs	**Groundwater**	**40,200**	**ug/L**
1,2,4-Trimethylbenzene	**Groundwater**	**790**	**ug/L**
Naphthalene	**Groundwater**	**160**	**ug/L**
Choose an item.	Select Media.		Select Units
Choose an item.			Select Units
Choose an item.			
Choose an item.			
Choose an item.			
Choose an item.			
Choose an item.			
Choose an item.	Select Media.		

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Choose an item.	Select Media.		Select Units
Choose an item.	Select Media.		Select Units
Choose an item.	Select Media.		Select Units
Choose an item.	Select Media.		Select Units

VOCs: include all organic compounds (substances made up of predominantly carbon and hydrogen) with boiling temperatures in the range of 50-260 degrees C, excluding pesticides. This means that they are likely to be present as a vapor or gas in normal ambient temperatures. Substances which are included in the VOC category include aliphatic hydrocarbons (such as hexane), aldehydes, aromatic hydrocarbons (such as benzene, toluene, and the xylenes or BTEX), and oxygenated compounds (such as acetone and similar ketones). The term VOC often is used in a legal or regulatory context and in such cases the precise definition is a matter of law.

VOCs are released from oil and gasoline refining, storage and combustion as well as from a wide range of industrial processes. Processes involving fuels, solvents, paints or the use of chemicals are the most significant sources. VOCs may also be emitted from cleaning products, degreasing products, fabrics, carpets, plastic products, glues, printed material, varnishes, wax, disinfectants, and cosmetics.

Typically, VOCs are present in gas or vapor and will enter the body by breathing contaminated air. Higher concentrations of VOCs may occur in areas of poor ventilation.

1,2,4-Trimethylbenzene: is a colorless liquid chemical with a strong, pleasant scent. 1,2,4-trimethylbenzene is a major part of what is known in the petroleum industry as the 'C9 fraction.' Oil refineries produce large amounts of C9 fraction each year for use as a gasoline additive.

BTEX/VOCs: BTEX is an acronym for benzene, toluene, ethylbenzene and xylenes. These compounds are VOCs, are common in petroleum-related products (e.g., oil, gasoline, coal-tar DNAPL, etc.), and frequently co-occur at hazardous waste sites. Benzene, toluene, ethylbenzene, and xylenes have acute and chronic harmful effects on the central nervous system. Benzene is classified as a carcinogen. Short-term health effects of low-level BTEX exposure include drowsiness, dizziness, accelerated heart rate, headaches, tremors, confusion, and unconsciousness.

Naphthalene: is a colorless or white/brown solid in flake or cake form, with mothball odor. Commonly found in coal tar, gasoline, or diesel fuels. Used to make mothballs and lubricants. This is a carcinogen and should be handled with extreme caution. Is a combustible solid and when heated is a dangerous fire hazard. Finely dispersed particles can form explosive mixtures. Absorption will cause irritation or burning to skin or eyes. Inhalation will cause irritation to nose and throat. High exposures will lead to headache, fatigue, tremors, and nausea. May also cause damage to liver and kidneys. The PEL 10 ppm averaged over an 8 hour shift.

Click + Add Additional Chemical Language

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Site Hazards Checklist			
Weather			
Hot Temperatures	Cold Temperatures	High Winds	Select Hazard

Hot Temperatures

Heat stress may occur at any time work is being performed at elevated ambient temperatures. Because heat stress is one of the most common and potentially serious illnesses associated with outdoor work during hot seasons, regular monitoring and other preventative measures are vital. Site workers must learn to recognize and treat the various forms of heat stress. The best approach is preventative heat stress management.

H&A employees and their subcontractors should be aware of potential health effects and/or physical hazards of working when there are hot temperatures or a high heat index. Refer OP1015-Heat Stress for a discussion on hot weather hazards.

Cold Temperatures

Cold stress may occur at any time work is being performed at low ambient temperatures and high velocity winds. Because cold stress is common and has potentially serious illnesses associated with outdoor work during cold seasons, regular monitoring and other preventative measures are vital.

Refer to OP1003-Cold Stress for additional information and mitigation controls.

High Winds

While high winds are commonly associated with severe thunderstorms and hurricanes they may also occur as a result of differences in air pressures, such as when a cold front passes across the area. They can cause downed trees and power lines, and flying debris (such as dust or larger debris), which adds additional risks and could lead to power outages, transportation disruptions, damage to buildings and vehicles, and serious injury.

Wind Advisory are issued for sustained winds 25 to 39 mph and/or gusts to 57 mph. High Wind warnings are issued by the National Weather Service when high wind speeds may pose a hazard or is life threatening. The criteria for this warning will varies by state. The Beaufort Wind Scale is a helpful tool to when dealing with high winds.

Biological			
Mosquitoes	Stinging Insects	Large/Small Mammals	Choose an item.

Mosquitos

Work outdoors with temperatures above freezing will likely bring staff into contact with mosquitos. There are a variety of mosquito species that can transmit a range of diseases. Birds act as reservoirs for the viruses that can be collected by the mosquito and transmitted to a person. Majority of mosquitos are mainly a nuisance but staff need to take appropriate precautions to minimize the potential transmission of a virus that can result in one of the following diseases: West Nile, Eastern Equine

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Encephalitides and Western Encephalitides. Knowing some key steps that can minimize the risk of mosquito bites is, therefore, important in reducing the risks. Workers working outdoors should be aware that the use of PPE techniques is essential to preventing mosquito bites especially when working at sites where mosquitoes may be active and biting.

Use repellents containing DEET, picaridin, IR3535, and some oil of lemon eucalyptus and para-menthane-diol products provide longer-lasting protection. To optimize safety and effectiveness, repellents should be used according to the label instructions. Cover as much of your skin as possible by wearing shirts with long-sleeves, long pants, and socks whenever possible. Avoid use of perfumes and colognes when working outdoors during peak times when mosquitoes may be active; mosquitoes may be more attracted to individuals wearing perfumes and colognes.

Stinging Insects

Stinging Insects fall into two major groups: Apidae (honeybees and bumblebees) and vespids (wasps, yellow jackets, and hornets). Apidae are docile and usually do not sting unless provoked. The stinger of the honeybee has multiple barbs, which usually detach after a sting. Vespids have few barbs and can inflict multiple stings.

There are several kinds of stinging insects that might be encountered on the project site. Most stings will only result in a temporary injury. However, sometimes the effects can be more severe, even life-threatening depending on where you are stung and what allergies you have. Being stung in the throat area of the neck may cause edema (swelling caused by fluid build-up in the tissues) around the throat and may make breathing difficult.

In rare cases, a severe allergic reaction can occur. This can cause "anaphylaxis" or anaphylactic shock with symptoms appearing immediately or up to 30 minutes later. Symptoms include; Hives, itching and swelling in areas other than the sting site, swollen eyes/eyelids, wheezing, chest tightness, difficulty breathing, hoarse voice, swelling of the tongue, dizziness or sharp drop in blood pressure, shock, unconsciousness or cardiac arrest. Reactions can occur the first time you are stung or with subsequent stings. If you see any signs of reaction, or are unsure, call or have a co-worker call emergency medical services (e.g., 911) right away. Get medical help for stings near the eyes, nose or throat. Stay with the person who has been stung to monitor their reaction.

Staff who are allergic to bee stings are encouraged to inform their staff/project manager. If staff member carries an Epi-pen (i.e., epinephrine autoinjector) they are encouraged to inform their colleagues in case they are stung and are incapable of administering the injection. Examine site for any signs of activity or a hive/nest. If you see several insects flying around, see if they are entering/exiting from the same place. Most will not sting unless startled or attacked. Do not swat, let insects fly away on their own. If you must, walk away slowly or gently "blow" them away. If a nest is disturbed and you hear "wild" buzzing, protect your face with your hands and run from the area immediately. Wear long sleeves, long pants, and closed-toed boots. Wear light colored clothes such as khakis. Avoid brightly colored, patterned, or black clothing. Tie back long hair to avoid bees or wasps from entanglement. Do not wear perfumes, colognes or scented soaps as they contain fragrances that are attractive. If bee or wasp is found in your car, stop and leave windows open.

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Small Mammals

Rodents, are the most abundant order of mammals. There are hundreds of species of rats; the most common are the black and brown rat. Other rodents you may encounter are mice, beavers, squirrels, guinea pigs, capybaras and coypu.

The Brown Rat has small ears, blunt nose, and short hair. It is approximately 14-18” long (with tail). They frequently infest garbage/rubbish, slaughterhouses, domestic dwellings, warehouses, and supermarkets. They also frequent any space with an easy meal and potential nesting sites. The Black Rat is identified by its tail, that is always longer than the length from the head to the body. It is also slimmer and more agile than the Brown rat. Its size varies according to its environment and food supply.

The House Mouse has the amazing ability to adapt and can frequently be found in human dwellings. In buildings, mice will live anywhere and difficult to keep out. Mice are omnivorous, they will eat anything. Rats and mice often become a serious problem in cold winter months when they seek food and warmth inside buildings. They may suddenly appear in large numbers when excavation work disturbs their in-ground nesting locations or their food source is changed.

Some major problems caused by rats and mice are contaminating the food they eat with urine and excrement. Gnawing into materials such as paper, wood, or upholstery, to use as nest material. Also gnawing plastic, cement, soft metals such as lead and aluminum, and wiring, which may cause a fire hazard. Occasionally biting people and may kill small animals. They, or the parasites they carry, like fleas, mites and worms, spread many diseases such as salmonella, trichinosis, rat bite fever, hantavirus, Weil's disease, and bubonic plague. They damage ornamental plants by burrowing among the roots or feeding on new growth. They also eat garden vegetables, such as corn and squash. These rodents have been a problem for centuries, because of their incredible ability to survive and are so difficult to eliminate. In addition, they are extremely compatible with human behavior and needs.

Avoid contact with rodents, if possible. Avoid contact with rodent excrement. Do not eat food or water that may have encountered rodent excrement. If exposed, wash hands and avoid touching your face with your hands.

Location/Terrain			
Slip/Trip/Falls	SIMOPS	Choose an item.	Choose an item.

Slips, Trips & Falls

Slip and trip injuries are the most frequent injuries to workers. Statistics show most falls happen on the same level resulting from slips and trips. Both slips and trips result from unintended or unexpected change in the contact between the feet and the ground or walking surface. Good housekeeping, quality of walking surfaces (flooring), awareness of surroundings, selection of proper footwear, and appropriate pace of walking are critical for preventing fall accidents.

Site workers will be walking on a variety of irregular surfaces, that may affect their balance. Extra care

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must be taken to walk cautiously near rivers because the bottom of the riverbed maybe slick and may not be visible. Rocks, gradient changes, sandy bottoms, and debris may be present but not observable.

Take your time and pay attention to where you are going. Adjust your stride to a pace that is suitable for the walking surface and the tasks you are doing. Check the work area to identify hazards - beware of trip hazards such as wet floors, slippery floors, and uneven surfaces or terrain. Establish and utilize a pathway free of slip and trip hazards. Choose a safer walking route. Carry loads you can see over. Keep work areas clean and free of clutter. Communicate hazards to on-site personnel and remove hazards as appropriate.

SIMOPS

SIMOPS are described as the potential class of activities which could bring about an undesired event or set of circumstances, e.g., safety, environment, damage to assets, schedule, commercial, financial, etc. SIMOPS are defined as performing two or more operations concurrently.

SIMOPS should be identified at an early stage before operations commence to understand issues such as schedule and physical clashes, maintenance activities, failure impacts, interferences between vessels, contracts and third part interfaces and environmental impacts.

Coordinate project with site activities. Identify and understand the hazards associated with the host and client's activities. Integrate site emergency response protocols where appropriate and communicate to all project staff. Integrate site communication protocols and communicate to all project staff.

Miscellaneous			
Extended Shift	Choose an item.	Choose an item.	Choose an item.

Extended Shift

An extended shift can include extending a workday beyond eight hours. Extended or unusual work shifts may be more stressful physically, mentally, and emotionally. Non-traditional shifts and extended work hours may disrupt the body's regular schedule, leading to increased fatigue, stress, and lack of concentration. This leads to an increased risk of operator error, injuries and/or accidents. The degree to which an individual is exposed to fatigue risk factors depends upon the work schedule. As both the duration of the workday and the number of days worked increase so does the fatigue risk factors. Staff Managers need to be aware of the fatigue risk factors and ensure projects are structured to mitigate these factors. Staff Members also have a responsibility to manage the personal fatigue risk factors that they can control outside of work (e.g, duration and quality of sleep, diet, drugs, and alcohol)

Fatigue is a message to the body to rest and can be eliminated with proper rest. However, if rest is not possible, fatigue can increase and becomes distressing and eventually debilitating. Fatigue symptoms, both mental and physical, vary and depend on the person and degree of overexertion. Examples include: weariness, sleepiness, irritability, reduced alertness, lack of memory, concentration and motivation, increased susceptibility to illness, depression, headache, loss of appetite, and digestive problems.

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When possible, managers should limit use of extended shifts and increase the number of days worked. Working shifts longer than 8 hours generally result in reduced productivity and alertness. Additional breaks and meals should be provided when working extended shift periods. Tasks requiring heavy physical labor or intense concentration should be performed at the beginning of the shift if possible. This is an important consideration for pre-emergency planning.

Make efforts, when feasible, to ensure that unavoidable extended work shifts and shift changes allow affected employees time for adequate rest and recovery. Project Managers need to plan to have an adequate number of personnel available to enable workers to take breaks, eat meals, relax, and sleep.

Plan for regular and frequent breaks throughout the work shift. If at remote sites, ensure if possible, that there is a quiet, secluded area designated for rest and recuperation. In addition to formal breaks such as lunch or dinner, encourage use of micro breaks to change positions, move about, and shift concentration. Personnel should look to obtain an adequate quantity and quality of sleep.

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Task Hazard Summary

Enter any content that you want to repeat, including other content controls. You can also insert this control around table rows in order to repeat parts of a table.

Task 1 - Geophysical Survey

Surveying presents many challenges regarding safety given that the survey location is typically dynamic and can be at large construction sites, roadways, or in the woods. Before beginning a survey, determine potential hazards that might arise from the natural environment, the public, and the contractor's operations and plan the survey accordingly.

Work on a construction site will expose staff to heavy equipment, SIMOPs, and the hazards associated with the type of construction being conducted. Coordination with the site GC is critical. Work on a road way will expose staff to vehicular traffic and potentially foot traffic. The safety measures employed must be consistent with the MUTCD or equivalent state requirements. Staff need to maintain at least six feet of space between moving traffic and the work area. This includes work on shoulders as well as on the traveled way. Survey at the maximum space possible between moving traffic and the work area. Whenever feasible, each staff member must face moving traffic at all times. If it is not possible to face traffic, a lookout should be used. Work in remote areas may expose staff to wildlife, insects and poor communication. Equipment shall be carried properly so that pinch points are avoided and staff are not overloaded when moving from one location to another.

Use of proper PPE (e.g., High Visibility Vests) is an important component of conducting the work safely. Suspend survey operations when uncontrollable hazards develop. Resume work only when safe working conditions have been restored.

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Task 2 – Drilling & Pre-Clearing

Drilling is conducted for a range of services that can include but are not limited to: soil characterization, environmental investigation, well installation, and ore exploration. Familiarity with basic drilling safety is an essential component of all drilling projects. Potential hazards related to drilling operations include, but are not limited to encountering underground or overhead utilities, traffic and heavy equipment, hoisting heavy tools, steel impacts, open rotation entanglement, and the planned or unexpected encountering of toxic or hazardous substances. While staff members do not operate drilling equipment, they may work in close proximity to operating drilling equipment and may be exposed to many of the same hazards as the drilling subcontractor. It is imperative that staff are aware of emergency stops and establish communication protocols with the drillers prior to the start of work.

See OP 1002 Drilling Safety for more information.

Ground disturbance activities such as excavating or drilling have the potential to contact underground utilities and may be considered a hazardous activity and a permit to work may be required. Once the H&A Project Manager has identified the work zone and the areas designated for ground disturbance the

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PM or designee is required to delineate the area with either white paint or flags so that the appropriate agencies know which area to check for their respective utilities. Haley & Aldrich staff members must ensure that permission has been gained from the property owner to access the property prior to site entry and before marking any proposed exploration or drilling locations.

The Project Manager shall verify that the proposed dig or drill zones are adequately marked or staked prior to the locators site visit, and that the appropriate Line Location Organization/ Contractor has been notified (a minimum of 72 business hours in advance) of all planned ground disturbance activities and a request for line location has been registered with the applicable One Call or dial Before You Dig organization when applicable. Personnel that are required to mark the area need to identify and understand the hazards associated with the project area which can range from a public roadway to a greenspace in a remote location.

See OP1020 Work Near Utilities.

Task 3A – Soil Sampling

Soil sampling by H&A staff on active construction sites can be conducted in conjunction with a wide range activities such as building construction, earthwork and soil management related activities. These activities can include, but are not limited to: drill spoil characterization and management during building foundation element installation, characterization of excavated soils for management/disposal/reuse during earthwork activities, and as part of environmental remedial activities such as delineation and confirmation sampling. Familiarity with basic heavy construction safety, site conditions (geotechnical and environmental), and potential soil contaminants are essential components of soil sampling performed on active sites. Potential hazards related to soil sampling at construction sites include, but are not limited to: encountering site vehicle traffic and heavy equipment operations, manual lifting, generated waste, contact or exposure to impacted soil, and encountering unknown toxic or hazardous substances. Although soil sampling is commonly performed within active excavations, from stockpiles, or within trench excavations, sampling locations and situations will vary depending on site conditions. Care should be taken while entering and exiting excavations or trenches, and when accessing (climbing up or down) soil stockpiles, ensuring that the sampling area is not being actively accessed by construction equipment. Care should also be taken with handling of potentially environmentally impacted soil during sampling, with appropriate PPE identified and used. At no time during classification activities are personnel to reach for debris near machinery that is in operation, place any samples in their mouth, or come in contact with the soils without the use of gloves. Staff will have to carry and use a variety of sampling tools, equipment, containers, and potentially heavy sample bags. It is imperative that staff are aware of emergency / communication protocols with the Contractor prior to the start of work.

Task 3B – Soil Vapor Sampling

Soil gas sampling is employed as an indirect indicator of contamination in soil or groundwater particularly over and around landfill waste sites, or groundwater plumes. Soil gas sampling points can be installed manually using a slam bar or power driven mechanical devices (e.g., demolition hammer or

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Geoprobe) may be used based on site conditions (i.e., pavement, frozen ground, very dense clays, etc.). Soil gas samples can be drawn through the probe itself, or through Teflon tubing inserted through the probe and attached to the probe point. Samples are collected and analyzed as described below. Other field air monitoring devices, such as the Combustible Gas Indicator (CGI) and the Organic Vapor Analyzer (OVA), can also be used, depending on specific site conditions.

Because the sample is being drawn from underground, and no contamination is introduced into the breathing zone, soil gas sampling usually occurs in Level D. Nevertheless, ambient air should be constantly monitored to obtain background and breathing zone readings during the sampling procedure in the event the seal around the sampling point is breached. As long as the levels in ambient air do not rise above background, no upgrade of the level of protection is needed. Also, an underground utility search must be performed prior to sampling.

Task 3C – Water Sampling

Environmental water sampling could include activities such as groundwater sampling from permanent or temporary wells, or surface water sampling from streams, rivers, lakes, ponds, lagoons, and surface impoundments.

Sampling tasks could involve uncapping, purging (pumping water out of the well), and sampling, and/or monitoring, new or existing monitoring wells. A mechanical pump may be used to purge the wells and can be hand-, gas-, or electric-operated. Water samples taken from the wells are then placed in containers and shipped to an analytical laboratory for analysis. The physical hazards of these operations are primarily associated with the collection methods and procedures used.

When sampling bodies of water containing known or suspected hazardous substances, adequate precautions must be taken to ensure the safety of sampling personnel. The sampling team member collecting the sample should not get too close to the edge, where ground failure or slips, trips or falls may cause him/her to lose his/her balance. The person performing the sampling should have fall restraint or protection for the task. When conducting sampling from a boat in an impoundment or flowing waters, appropriate vessel safety procedures should be followed. Avoid lifting heavy coolers with back muscles; instead, use ergonomic lifting techniques, team lift or mechanical lifts. Wear proper gloves, such as when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

Inhalation and absorption of COCs are the primary routes of entry associated with water sampling, due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. During this project, several different groundwater sampling methodologies may be used based on equipment accessibility and the types of materials to be sampled. These sampling methods may include hand or mechanical bailing. The primary hazards associated with these specific sampling procedures are not potentially serious; however, other operations in the area or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with groundwater sampling procedures are generally limited to strains or sprains from hand bailing, and potential eye hazards. Exposure to water containing COCs is also possible. All tools and equipment that will be used at the site must be intrinsically safe (electronics and electrical equipment) and non-sparking or explosion-proof (hand tools).

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Task Physical Hazards Checklist				
Potential Task Hazards	**Task 1** **Geophysical Survey**	**Task 2** **Drilling & Pre-Clearing**	**Task 3** **Soil, Groundwater, and Soil Vapor Sampling**	
Heavy Equipment	☒	☒	☒	
Noise	☐	☒	☒	
Slippery Surfaces	☒	☒	☒	
Congested Area	☒	☒	☒	
Ergonomics	☒	☒	☒	
Excavation/Trenching	☐	☐	☐	
Ground Disturbance	☐	☒	☒	
Heavy Equipment	☒	☒	☒	
Line of Fire	☒	☒	☒	
Overhead Utilities	☒	☒	☐	
Underground Utilities	☒	☒	☒	
Sharp Objects	☐	☒	☒	
Other: Specify	☐	☐	☐	

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Summary of Physical Hazards & Controls

Heavy Equipment

Staff must be careful and alert when working around heavy equipment, failure or breakage and limited visibility can lead to accidents and worker injury. Heavy equipment such as cranes, drills, haul trucks, or other can fail during operation increasing chances of worker injury. Equipment of this nature shall be visually inspected and checked for proper working order prior to commencement of field work. Those operating heavy equipment must meet all requirements to operate the equipment. Haley & Aldrich, Inc. staff that supervise projects or are associated with high risk projects that involve digging or drilling should use due diligence when working with a construction firm.

See OP1052 Heavy Equipment for additional information.

Controls

- Only approach equipment once you have confirmed contact with the operator (e.g., operator places the bucket on the ground).
- Always maintain visual contact with operators and keep out of the strike zone whenever possible.

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- Always be alert to the position of the equipment around you.
- Always approach heavy equipment with an awareness of the swing radius and traffic routes of all equipment and never go beneath a hoisted load.
- Avoid fumes created by heavy equipment exhaust.

Noise

Working around heavy equipment (drill rigs, excavators, etc.) often creates excessive noise. The effects of noise include physical damage to the ear, pain, and temporary and/or permanent hearing loss. Workers can also be startled, annoyed, or distracted by noise during critical activities. Noise monitoring data that indicates that working within 25 feet of operating heavy equipment result in exposure to hazardous levels of noise (levels greater than 85 dBA).

See OP 1031 Hearing Conservation for additional information.

Controls

- Personnel are required to use hearing protection (earplugs or earmuffs) within 25 feet of any operating piece of heavy equipment.
- Limit the amount of time spent at a noise source.
- Move to a quiet area to gain relief from hazardous noise sources.
- Increase the distance from the noise source to reduce exposure.

Slippery Surfaces

Both slips and trips result from unintended or unexpected change in the contact between the feet and ground or walking surface. Good housekeeping, quality of walking surfaces, selection of proper footwear, and appropriate pace of walking are critical for preventing fall accidents. Slips happen where there is too little friction or traction between the footwear and walking surface.

Common causes of slips are wet or oily surfaces, spills, weather hazards, loose unanchored rugs or mats and flooring or other walking surfaces that do not have same degree of traction in all areas.

Weather-related slips and falls become a serious hazard as winter conditions often make for wet or icy surfaces outdoors. Even wet organic material or mud can create hazardous walking conditions. Spills and leaks can also lead to slips and falls.

Controls

- Evaluate the work area to identify any conditions that may pose a slip hazard.
- Address any spills, drips or leaks immediately.
- Mark areas where slippery conditions exist.
- Select proper footwear or enhance traction with additional PPE.
- Where conditions are uncertain or environmental conditions result in slippery surfaces walk slowly, take small steps, and slide feet on wet or slippery surfaces.

Congested Areas

Working in congested areas can expose both workers and the public to a wide range of hazards depending upon the specific activities taking place. Staff Members need to understand the work scope, work areas, equipment on-site, and internal traffic patterns to minimize or eliminate exposure potential.

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Controls

- Provide barricades, fencing, warning signs/signals and adequate lighting to protect people while working in or around congested areas.
- Vehicles and heavy equipment with restricted views to the rear should have functioning back-up alarms that are audible above the surrounding noise levels. Whenever possible, use a signaler to assist heavy equipment operators and/or drivers in backing up or maneuvering in congested areas.
- Lay out traffic control patterns to eliminate excessive congestion.
- Workers in congested areas should always wear high visibility clothing.
- Be aware of Line of Fire hazards when performing work activities in congested areas.
- Hazards associated with SIMOPs should be discussed daily at Tailgate Safety Meetings.

Ergonomics

Most Work-related Musculoskeletal Disorders (WMSDs) are caused by Ergonomic Stressors. Ergonomic Stressors are caused by poor workplace practices and/or insufficient design, which may present ergonomic risk factors. These stressors include, but not limited to, repetition, force, extreme postures, static postures, quick motions, contact pressure, vibration, and cold temperatures.

WMSDs are injuries to the musculoskeletal system, which involves bones, muscles, tendons, ligaments, and other tissues in the system. Symptoms may include numbness, tightness, tingling, swelling, pain, stiffness, fatigue, and/or redness. WMSD are usually caused by one or more Ergonomic Stressors. There may be individual differences in susceptibility and symptoms among employees performing similar tasks. Any symptoms are to be taken seriously and reported immediately.

See OP1053 Ergonomics for more information.

Controls

- Ensure workstations are ergonomically correct so bad posture is not required to complete tasks.
- Take periodic breaks over the course of the day.
- Stretch during break times.
- Break up tasks that require repetitive motion.
- Contact Corporate H&S with any ergonomic concerns

Ground Disturbance

Ground disturbance is defined as any activity disturbing the ground. Ground disturbance activities include, but are not limited to, excavating, trenching, drilling (either mechanically or by hand), digging, plowing, grading, tunneling and pounding posts or stakes.

Because of the potential hazards associated with striking an underground utility or structure, the operating procedure for underground utility clearance shall be followed prior to performing any ground disturbance activities.

See OP1020 Working Near Utilities

Controls

Prior to performing ground disturbance activities, the following requirements should be applied:

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- Confirm all approvals and agreements (as applicable) either verbal or written have been obtained.
- Request for line location has been registered with the applicable One-Call or Dial Before You Dig organization, when applicable.
    - Whenever possible, ground disturbance areas should be adequately marked or staked prior to the utility locators site visit.
- Notification to underground facility operator/owner(s) that may not be associated with any known public notification systems such as the One-Call Program regarding the intent to cause ground disturbance within the search zone.
- Notifications to landowners and/or tenant, where deemed reasonable and practicable.
- Proximity and Common Right of Way Agreements shall be checked if the line locator information is inconclusive.

Line of Fire

Line of fire refers to the path an object will travel. Examples of line of fire situations typically observed on project sites include lifting/hoisting, lines under tension, objects that can fall or roll, pressurized objects or lines, springs or stored energy, work overhead, vehicles and heavy equipment.

Controls

- Never walk under a suspended load.
- Be aware and stay clear of tensioned lines such as cable, chain and rope.
- Be cautious of torque stresses that drilling equipment and truck augers can generate. Equipment can rotate unexpectedly long after applied torque force has been stopped.
- Springs and other items can release tremendous energy if compressed and suddenly released
- Items under tension and pressure can release tremendous energy if it is suddenly released.
- Not all objects may be overhead; be especially mindful of top-heavy items and items being transported by forklift or flatbed.
- Secure objects that can roll such as tools, cylinders, and pipes.
- Stay clear of soil cuttings or soil stockpiles generated during drilling operations and excavations, be aware that chunks of soil, rocks, and debris can fall or roll.

Overhead Utilities

When work is undertaken near overhead electrical lines, the distance maintained from those lines shall also meet the minimum distances for electrical hazards as defined in Table 1 below. Note: utilities other than overhead electrical utilities need to be considered when performing work.

Table 1 Minimal Radial Clearance Distances *

Normal System Voltage Kilovolts (kV)	Required Minimal Radial Clearance Distance (feet/meters)
0 – 50	10/3.05
51 – 100	12/3.66
101 – 200	15/4.57
201 – 300	10/6.1
301 – 500	25/7.62
501 – 750	35/10.67
750 - 1000	45/13.72

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* For those locations where the utility has specified more stringent safe distances, those distances shall be observed.

Controls

- To prevent damage, guy wires shall be visibly marked and work barriers or spotters provided in those areas where work is being conducted.
    - When working around guy wires, the minimum radial clearance distances for electrical power shall be observed.
- The PM shall research and determine if the local, responsible utility or client has more restrictive requirements than those stated in Table 1.
- If equipment cannot be positioned in accordance with the requirements established in Table 1 the lines need to be de-energized.

Underground Utilities

Various forms of underground/overhead utility lines or conveyance pipes may be encountered during site activities. Prior to the start of intrusive operations, utility clearance is mandated, as well as obtaining authorization from all concerned public utility department offices. Should intrusive operations cause equipment to come into contact with utility lines, the SHSO, Project Manager, and Regional H&S Manager shall be notified immediately. Work will be suspended until the client and applicable utility agency is contacted and the appropriate actions for the situation can be addressed.

See OP1020 Work Near Utilities for complete information.

Controls

- Obtain as-built drawings for the areas being investigated from the property owner;
- Visually review each proposed soil boring locations with the property owner or knowledgeable site representative;
- Perform a geophysical survey to locate utilities;
- Hire a private line locating firm to determine location of utility lines that are present at the property;
- Identifying a no-drill or dig zone;
- Hand dig or use vacuum excavation in the proposed ground disturbance locations if insufficient data is unavailable to accurately determine the location of the utility lines.

Sharp Objects

Workers who handle sharp edged objects like sheets of steel or glass are at risk of cuts. Workers who handle sharp edged objects are also at risk of cuts. Injuries may occur to hands, fingers, or legs when they are in the way of the blade, when the blade slips, or if an open blade is handled unexpectedly. Other hazards at job sites include stepping on sharp objects (e.g. wooden boards with protruding nails, sharp work-tools, chisels, etc.) and colliding with sharp and/or protruding objects.

Controls

Always be alert when handling sharps. Never look away or become distracted while handling sharp objects. Use caution when working with tools; use right tool for the job. Keep tools sharp, dull blades are a safety hazard, requiring more force to make cuts which can lead to tool slippage. Wear appropriate PPE and do not handle sharp objects (i.e., broken glass) with bare hands. Use mechanical devices, when possible. Stay away from building debris; avoid handling site debris or placing your hand where you cannot see. Watch out for barbed wire and electrical fences; cover with a car mat or equivalent to cross

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or walk around; use the buddy system to avoid entanglement; wear gloves. Do not leave unprotected sharps unattended. Use protective shields, cases, styrofoam blocks, etc. Pass a sharp by handing it over carefully by the handle with the blade down or retracted. Fixed open blades are prohibited. Always cut away from the body, making several passes when cutting thicker materials. Make sure blades are fitted properly into the knife. Never cut items with a blade or other sharp object on your lap. Never try to catch a blade or cutting tool that is falling.

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4. PROTECTIVE MEASURES

The personal protective equipment and safety equipment (if listed) is specific to the associated task. The required PPE and equipment listed must be onsite during the task being performed. Work shall not commence unless the required PPE or Safety Equipment is present.

Required Safety & Personal Protective Equipment

Required Personal Protective Equipment (PPE)	**Task 1**	**Task 2**	**Task 3**	
	Geophysical Survey	Drilling & Pre-Clearing	Soil, Soil Vapor, and Groundwater Sampling	
Hard hat	☒	☒	☒	☐
Safety Glasses	☒	☒	☒	☐
Safety Toed Shoes	☒	☒	☒	☐
Nitrile Gloves	☒	☒	☒	☐
Cut Resistant Gloves	☒	☒	☒	☐
Tyvek Suit	☐	☐	☐	☐
Hearing Protection	☒	☒	☒	☐
Level of protection required	D	D	D	Select
Required Safety Equipment				
First Aid Kit	☒	☒	☒	☐

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5. TRAINING REQUIREMENTS

The table below lists the training requirements staff must have respective to their assigned tasks and that are required to access the Site.

Site Specific Training Requirements

HAZWOPER - 40 Hour (Initial)

HAZWOPER - 8 Hour (Annual Refresher)

Task Specific Training Requirements

Required Training Type	**Task 1**	**Task 2**	**Task 3**	
	Geophysical Survey	Drilling & Pre-Clearing	Soil, Soil Vapor, and Groundwater Sampling	
N/A	☐	☐	☐	☐

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6. AIR MONITORING PLAN AND EQUIPMENT

Exposures to airborne substances shall be fully characterized throughout project operations to ensure that exposure controls are effectively selected and modified as needed.

Is air/exposure monitoring required at this work site for personal protection? Yes

Is perimeter monitoring required for community protection? Yes

Air monitoring plan not applicable No

Air Monitoring/Screening Equipment Requirements

Aeroqual AQS 1 station with Dust Sentry and VOC sensor

Photo-Ionization Detector (PID) 10.6eV

The required equipment listed above must be on site. Work shall not commence unless the equipment is present and in working order.

Dust Suppression Techniques

Preventative measures for dust generation may include wetting site fill and soil, construction of an engineered construction entrance with gravel pad, a truck wash area, covering soils with tarps, and limiting vehicle speeds to five miles per hour.

Personal Exposure Monitoring

No asbestos, lead-based paint, or radiological hazards have been identified within the vicinity of the proposed excavation area at the Site (see Section 2.0). Therefore, personal exposure monitoring is not required during excavation.

Monitoring Plans

Select Monitoring Plan

Parameter/ Contaminant	Equipment	Action Level	Response Activity
VOCs	PID 10.6 eV	< 10 ppm	Continue work and monitoring.
		>10 ppm for 5 minutes	Clear Instrument and Re-Monitor the Area. Implement PPE upgrades
		>10 ppm for >5 minutes	Evacuate the area and call the FSM and/or PM for further guidance. Implement engineering controls.

Zone Location and Monitoring Interval

Upwind and Downwind of the Work Zone. Recorded every 15 minutes

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***If chemical does not have an action level use TLV or REL, whichever is lowest, to be used as an action level. If TLV or REL are the same as PEL, cut the PEL in half for an action level.**

7. DECONTAMINATION & DISPOSAL METHODS

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment through or over, tracking, or splashing potential or known contaminated/impacted materials.)

Personal Hygiene Safeguards

The following minimum personal hygiene safeguards shall be adhered to:

1. No smoking or tobacco products in any project work areas.
2. No eating or drinking in the exclusion zone.
3. It is required that personnel present on site wash hands before eating, smoking, taking medication, chewing gum/tobacco, using the restroom, or applying cosmetics and before leaving the site for the day.

It is recommended that personnel present on site shower or bathe at home at the end of each day of working on the site.

Decontamination Supplies

All decontamination should be conducted at the project site in designated zones or as dictated by Client requirements. Decontamination should not be performed on Haley & Aldrich owned or leased premises.

☐ Acetone	☒ Distilled Water	☐ Polyethylene Sheeting
☒ Alconox Soap	☐ Drums	☐ Pressure/Steam Cleaner
☐ Brushes	☐ Hexane	☐ Tap Water
☐ Disposal Bags	☐ Methanol	☐ Wash tubs
☐ 5 Gallon Buckets	☒ Paper Towels	☐ Other: Specify

Location of Decontamination Station

Describe/Enter location of decontamination station or refer to a figure where it is shown.

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Standard Personal Decontamination Procedures

Outer gloves and boots should be decontaminated periodically as necessary and at the end of the day. Brush off solids with a hard brush and clean with soap and water or other appropriate cleaner whenever possible. Remove inner gloves carefully by turning them inside out during removal. Wash hands and forearms frequently. It is good practice to wear work-designated clothing while on-site which can be removed as soon as possible. Non-disposable overalls and outer work clothing should be bagged onsite prior to laundering. If gross contamination is encountered on-site contact the Project Manager and Field Safety Manager to discuss proper decontamination procedures.

The steps required for decontamination will depend upon the degree and type of contamination but will generally follow the sequence below.

1. Remove and wipe clean hard hat
2. Rinse boots and gloves of gross contamination
3. Scrub boots and gloves clean
4. Rinse boots and gloves
5. Remove outer boots (if applicable)
6. Remove outer gloves (if applicable)
7. Remove Tyvek coverall (if applicable)
8. Remove respirator, wipe clean and store (if applicable)
9. Remove inner gloves (if outer gloves were used)

PPE that is not grossly contaminated can be bagged and disposed in regular trash receptacles.

Small Equipment Decontamination

Pretreatment of heavily contaminated equipment may be conducted as necessary:

1. Remove gross contamination using a brush or wiping with a paper towel
2. Soak in a solution of Alconox and water (if possible)
3. Wipe off excess contamination with a paper towel

Standard decontamination procedure:

4. Wash using a solution of Alconox and water
5. Rinse with potable water
6. Rinse with methanol (or equivalent)
7. Rinse with distilled/deionized water

Inspect the equipment for any remaining contamination and repeat as necessary.

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Disposal Methods
Procedures for disposal of contaminated materials, decontamination waste, and single use personal protective equipment shall meet applicable client, locate, State, and Federal requirements.
Disposal of Single Use Personal Protective Equipment
PPE that is not grossly contaminated can be bagged and disposed in regular trash receptacles. PPE that is grossly contaminated must be bagged (sealed and field personnel should communicate with the Project Manager to determine proper disposal.

Disposal Method for Contaminated Soil

- Contaminated soil cuttings and spoils must be containerized for disposal off-site unless otherwise specifically directed.
- Soil cuttings and spoils determined to be free of contamination through field screening can usually be returned to the boreholes or excavations from which they came.

Any additional requirements that are designated by the workplan or by client specifications should be entered here.

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8. SITE CONTROL

The overall purpose of site control is to minimize potential contamination of workers, protect the public from the site's hazards, and prevent vandalism. Site control is especially important in emergency situations. The degree of site control necessary depends on site characteristics, site size, and the surrounding community. The following information identifies the elements used to control the activities and movements of people and equipment at the project site.

Communication

Internal
Haley & Aldrich site personnel will communicate with other Haley & Aldrich staff member and/or subcontractors or contractors with:

Face to Face Communication

External
H&S site personnel will use the following means to communicate with off-site personnel or emergency services.

Cellular Phones

Visitors

Project Site
Will visitors be required to check-in prior to accessing the project site?

Yes

Visitor Access
Authorized visitors that require access to the project site need to be provided with known information with respect to the site operations and hazards as applicable to the purpose of their site visit. Authorized visitors must have the required PPE and appropriate training to access the project site.

Zoning

Work Zone
The work zone will be clearly delineated to ensure that the general public or unauthorized worker access is prevented. The following will be used:

Temporary Fencing
Cones
Flagging Tape
Barricades

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9. SITE SPECIFIC EMERGENCY RESPONSE PLAN

The Emergency Response Plan addresses potential emergencies at this site, procedures for responding to these emergencies, roles, responsibilities during emergency response, and training. This section also describes the provisions this project has made to coordinate its emergency response with other contractors onsite and with offsite emergency response organizations (as applicable).

During the development of this emergency response plan, local, state, and federal agency disaster, fire, and emergency response organizations were consulted (if required) to ensure that this plan is compatible and integrated with plans of those organizations. Documentation of the dates of these consultations are the names of individuals contacted is kept on file and available upon request.

The site has been evaluated for potential emergency occurrences, based on site hazards, and the major categories of emergencies that could occur during project work are:

- Fire(s)/Combustion
- Hazardous Material Event
- Medical Emergency
- Natural Disaster

A detailed list of emergency types and response actions are summarized in Table 9.2 below. Prior to the start of work, the SSO will update the table with any additional site-specific information regarding evacuations, muster points, or additional emergency procedures. The SSO will establish evacuation routes and assembly areas for the Site. All personnel entering the Site will be informed of these routes and assembly areas.

Pre-Emergency Planning

Before the start of field activities, the Project Manager will ensure preparation has been made in anticipation of emergencies. Preparatory actions include the following:

Meeting with the subcontractor/and or client concerning the emergency procedures in the event a person is injured. Appropriate actions for specific scenarios will be reviewed. These scenarios will be discussed, and responses determined before the sampling event commences. A form of emergency communication (i.e.; Cell phone, Air horn, etc.) between the Project Manager and subcontractor and/or client will be agreed on before the work commences.

A training session (i.e., “safety meeting”) given by the Project Manager or their designee informing all field personnel of emergency procedures, locations of emergency equipment and their use, and proper evacuation procedures.

Ensuring field personnel are aware of the existence of the emergency response HASP and ensuring a copy of the HASP accompanies the field team(s).

Onsite Emergency Response Equipment

Emergency procedures may require specialized equipment to facilitate work rescue, contamination control and reduction or post-emergency cleanup. Emergency response equipment stocked

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Table 9.1 Emergency Equipment and Emergency PPE			
Emergency Equipment	**Specific Type**	**Quantity Stocked**	**Location Stored**
First Aid Kit	Enter text	1	To be mounted on construction wall along 4th Avenue on the western edge of Site.
Emergency PPE	**Specific Type**	**Quantity Stocked**	**Location Stored**
Select	Enter text	Enter text	Enter text

EVACUATION ALARM
Will be communicated during the Onsite Kickoff Meeting
EVACUATION ROUTES
Will be given a map after site specific training
EVACUATION MUSTER POINT(S)/ SHELTER AREA(S)
Will be given a locations after site specific training
EVACUTION RESPONSE DRILLS
The Site relies on outside emergency responders and a drill is not required.

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Table 9.2 – Emergency Planning

Emergency Type	Notification	Response Action	Evacuation Plan/Route
Chemical Exposure	Report event to PM immediately	Refer to Safety Data Sheet for required actions	Remove personnel from work zone
Fire - Small	Notify PM and contact 911	Use fire extinguisher if safe and qualified to do so	Mobilize to *Muster Point*
Fire – Large/Explosion	Notify PM and contact 911	Evacuate immediately	Mobilize to *Muster Point*
Hazardous Material – Spill/Release	Notify PM; PM will contact PM to determine if additional agency notification is	If practicable don PPE and use spill kit and applicable procedures to contain the release	See Evacuation Map for route, move at least 100 ft upwind of spill location
Medical – Bloodborne Pathogen	Notify PM	If qualified dispose in container or call client or city to notify for further instruction.	None Anticipated
Medical – First Aid	Notify PM	If qualified perform first aid duties	None Anticipated
Medical – Trauma	If life threatening or transport is required call 911, immediately	Wait at site entrance for ambulance	Noe Anticipated
Security Threat	Notify PM who will call 911 as warranted	Keep all valuables out of site and work zones delineated.	None Anticipated
Weather – Earthquake/Tsunami's	STOP WORK and evacuate Site upon any earthquake	Turn off equipment and evacuate as soon as is safe to do so	Mobilize to *Shelter Location*
Weather – Lightning Storm	STOP WORK	Work may resume 30 minutes after the last observed lightning.	None Anticipated
Weather – Tornadoes/Hurricanes	Monitor weather conditions STOP WORK and evacuate the site	Evacuate to shelter location or shelter in place immediately	Mobilize to *Shelter Location*
MUSTER POINT Will be communicated during the Onsite Kickoff Meeting		*SHELTER LOCATION* Will be communicated during the Onsite Kickoff Meeting	
In case of site emergencies, site personnel shall be evacuated per this table and will not participate in emergency response activities. Site emergencies shall be reported to local, state, and federal governmental agencies as required.			

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10. HASP ACKNOWLEDGEMENT FORM

All Haley & Aldrich employees onsite must sign this form prior to entering the site.

I hereby acknowledge receipt of, and briefing on, this HASP prior to the start of on-site work. I declare that I understand and agree to follow the provisions, processes, and procedures set forth herein at all times while working on this site.

Printed Name	Signature	Date

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ATTACHMENT A
HASP AMENDMENT FORM

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HASP AMENDMENT FORM	
This form is to be used whenever there is an immediate change in the project scope that will require an amendment to the HASP. For project scope changes associated with "add-on" tasks, the changes must be made in the body of the HASP. Before changes can be made, a review of the potential hazards must be initiated by the Haley & Aldrich Project Manager. This original form must remain on site with the original HASP. If additional copies of this HASP have been distributed, it is the Project Manager's responsibility to forward a signed copy of this amendment to those who have copies.	
Amendment No.	
Site Name	
Work Assignment No.	
Date	
Type of Amendment	
Reason for Amendment	
Alternate Safeguard Procedures	
Required Changes in PPE	

Project Manager Name (Print)	Project Manager Signature	Date

Health & Safety Approver Name (Print)	Health & Safety Approver Signature	Date

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ATTACHMENT B
TRAINING REQUIREMENTS

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TRAINING REQUIREMENTS

Health and Safety Training Requirements

Personnel will not be permitted to supervise or participate in field activities until they have been trained to a level required by their job function and responsibility. Haley & Aldrich staff members, contractors, subcontractors, and consultants who have the potential to be exposed to contaminated materials or physical hazards must complete the training described in the following sections.

The Haley & Aldrich Project Manager/FSM will be responsible for maintaining and providing to the client/site manager documentation of Haley & Aldrich staff members' compliance with required training as requested. Records shall be maintained per OSHA requirements.

40-Hour Health and Safety Training

The 40-Hour Health and Safety Training course provides instruction on the nature of hazardous waste work, protective measures, proper use of personal protective equipment, recognition of signs and symptoms which might indicate exposure to hazardous substances, and decontamination procedures. It is required for all personnel working on-site, such as equipment operators, general laborers, and supervisors, who may be potentially exposed to hazardous substances, health hazards, or safety hazards consistent with 29 CFR 1910.120.

8-hour Annual Refresher Training

Personnel who complete the 40-hour health and safety training are subsequently required to attend an annual 8-hour refresher course to remain current in their training. When required, site personnel must be able to show proof of completion (i.e., certification) at an 8-hour refresher training course within the past 12 months.

8-Hour Supervisor Training

On-site managers and supervisors directly responsible for, or who supervise staff members engaged in hazardous waste operations, should have eight additional hours of Supervisor training in accordance with 29 CFR 1910.120. Supervisor Training includes, but is not limited to, accident reporting/investigation, regulatory compliance, work practice observations, auditing, and emergency response procedures.

Additional Training for Specific Projects

Haley & Aldrich personnel will ensure their personnel have received additional training on specific instrumentation, equipment, confined space entry, construction hazards, etc., as necessary to perform their duties. This specialized training will be provided to personnel before engaging in the specific work activities including:

- Client specific training or orientation
- Competent person excavations
- Confined space entry (entrant, supervisor, and attendant)
- Heavy equipment including aerial lifts and forklifts
- First aid/ CPR
- Use of fall protection
- Use of nuclear density gauges
- Asbestos awareness

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ATTACHMENT C
ROLES AND RESPONSIBILITIES

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SITE ROLES AND RESPONSIBILITIES

Haley & Aldrich Personnel

Field Safety Manager (FSM)

The Haley & Aldrich FSM is a full-time Haley & Aldrich staff member, trained as a safety and health professional, who is responsible for the interpretation and approval of this Safety Plan. Modifications to this Safety Plan cannot be undertaken by the PM or the SSO without the approval of the FSM.

Specific duties of the FSM include:

- Approving and amending the Safety Plan for this project
- Advising the PM and SHSOs on matter relating to health and safety
- Recommending appropriate personal protective equipment (PPE) and air monitoring instrumentation
- Maintaining regular contact with the PM and SSO to evaluate the conditions at the property and new information which might require modifications to the HASP and
- Reviewing and approving JSAs developed for the site-specific hazards.

Project Manager (PM)

The Haley & Aldrich PM is responsible for ensuring that the requirements of this HASP are implemented at that project location. Some of the PM´s specific responsibilities include:

- Assuring that all personnel to whom this HASP applies have received a copy of it;
- Providing the FSM with updated information regarding environmental conditions at the site and the scope of site work;
- Providing adequate authority and resources to the on-site SHSO to allow for the successful implementation of all necessary safety procedures;
- Supporting the decisions made by the SHSO;
- Maintaining regular communications with the SHSO and, if necessary, the FSM;
- Coordinating the activities of all subcontractors and ensuring that they are aware of the pertinent health and safety requirements for this project;
- Providing project scheduling and planning activities; and
- Providing guidance to field personnel in the development of appropriate Job Safety Analysis (JSA) relative to the site conditions and hazard assessment.

Site Health & Safety Officer (SHSO)

The SHSO is responsible for field implementation of this HASP and enforcement of safety rules and regulations. SHSO functions may include some or all of the following:

- Act as Haley & Aldrich´s liaison for health and safety issues with client, staff, subcontractors, and agencies.
- Verify that utility clearance has been performed by Haley & Aldrich subcontractors.
- Oversee day-to-day implementation of the Safety Plan by Haley & Aldrich personnel on site.

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- Interact with subcontractor project personnel on health and safety matters.
- Verify use of required PPE as outlined in the safety plan.
- Inspect and maintain Haley & Aldrich safety equipment, including calibration of air monitoring instrumentation used by Haley & Aldrich.
- Perform changes to HASP and document in Appendix A of the HASP as needed and notify appropriate persons of changes.
- Investigate and report on-site accidents and incidents involving Haley & Aldrich and its subcontractors.
- Verify that site personnel are familiar with site safety requirements (e.g., the hospital route and emergency contact numbers).
- Report accidents, injuries, and near misses to the Haley & Aldrich PM and FSM as needed.

The SHSO will conduct initial site safety orientations with site personnel (including subcontractors) and conduct toolbox and safety meetings thereafter with Haley & Aldrich employees and Haley & Aldrich subcontractors at regular intervals and in accordance with Haley & Aldrich policy and contractual obligations. The SHSO will track the attendance of site personnel at Haley & Aldrich orientations, toolbox talks, and safety meetings.

Field Personnel

Haley & Aldrich personnel are responsible for following the health and safety procedures specified in this HASP and for performing their work in a safe and responsible manner. Some of the specific responsibilities of the field personnel are as follows:

- Reading the HASP in its entirety prior to the start of on-site work;
- Submitting a completed Safety Plan Acceptance Form and documentation of medical surveillance and training to the SHSO prior to the start of work;
- Attending the pre-entry briefing prior to beginning on-site work;
- Bringing forth any questions or concerns regarding the content of the Safety Plan to the PM or the SHSO prior to the start of work;
- Stopping work when it is not believed it can be performed safely;
- Reporting all accidents, injuries and illnesses, regardless of their severity, to the SHSO;
- Complying with the requirements of this safety plan and the requests of the SHSO; and
- Reviewing the established JSAs for the site-specific hazards on a daily basis and prior to each shift change, if applicable.

Visitors

Authorized visitors (e.g., Client Representatives, Regulators, Haley & Aldrich management staff, etc.) requiring entry to any work location on the site will be briefed by the Site Supervisor on the hazards present at that location. Visitors will be escorted at all times at the work location and will be responsible for compliance with their employer´s health and safety policies. In addition, this safety plan specifies the minimum acceptable qualifications, training and personal protective equipment which are required for entry to any controlled work area; visitors must comply with these

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requirements at all times. Unauthorized visitors, and visitors not meeting the specified qualifications, will not be permitted within established controlled work areas.

SUBCONTRACTOR PERSONNEL

Subcontractor Site Representative

Each contractor and subcontractor shall designate a Contractor Site Representative. The Contractor Site Representative will interface directly with Insert Staff Name Here, the Subcontractor Site Safety Manager, with regards to all areas that relate to this safety plan and safety performance of work conducted by the contractor and/or subcontractor workforce. Contractor Site Representatives for this site are listed in the Contact Summary Table at the beginning of the Safety Plan.

Subcontractor Site Safety Manager

Each contractor / subcontractor will provide a qualified representative who will act as their Site Safety Manager (Sub-SSM). This person will be responsible for the planning, coordination, and safe execution of subcontractor tasks, including preparation of job hazard analyses (JHA), performing daily safety planning, and coordinating directly with the Haley & Aldrich SHSO for other site safety activities. This person will play a lead role in safety planning for Subcontractor tasks, and in ensuring that all their employees and lower tier subcontractors are in adherence with applicable local, state, and/or federal regulations, and/or industry and project specific safety standards or best management practices.

General contractors / subcontractors are responsible for preparing a site-specific HASP and/or other task specific safety documents (e.g., JHAs), which are, at a minimum, in compliance with local, state, and/or federal other regulations, and/or industry and project specific safety standards or best management practices. The contractor(s)/subcontractor(s) safety documentation will be at least as stringent as the health and safety requirements of the Haley & Aldrich Project specific HASP.

Safety requirements include, but are not limited to: legal requirements, contractual obligations and industry best practices. Contractors/subcontractors will identify a site safety representative during times when contractor/subcontractor personnel are on the Site. All contractor/subcontractor personnel will undergo a field safety orientation conducted by the Haley & Aldrich SHSO and/or PM prior to commencing site work activities. All contractors / subcontractors will participate in Haley & Aldrich site safety meetings and their personnel will be subject to training and monitoring requirements identified in this Safety Plan. If the contractors / subcontractors means and methods deviate from the scope of work described in Section 1 of this Safety Plan, the alternate means and methods must be submitted, reviewed and approved by the Haley & Aldrich SHSO and/or PM prior to the commencement of the work task. Once approved by the Haley & Aldrich SHSO and/or PM, the alternate means and methods submittal will be attached to this Safety Plan as an Addendum.

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ATTACHMENT D
JOB SAFETY ANALYSES

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4001 4TH AVENUE REDEVELOPMENT SITE

KEY TASK ENTER TASK NUMBER.: ENTER TASK NAME.

Subtask Category	Potential Hazards	Controls
Enter subtask information.	Choose category.	• Enter control(s) for each hazard.
Enter subtask information.	Choose category.	• Enter control(s) for each hazard.
Enter subtask information.	Choose category.	• Enter control(s) for each hazard.
Enter subtask information.	Choose category.	• Enter control(s) for each hazard.
Enter subtask information.	Choose category.	• Enter control(s) for each hazard.
Enter subtask information.	Choose category.	• Enter control(s) for each hazard.
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Enter subtask information.	Choose category.	• Enter control(s) for each hazard.
Enter subtask information.	Choose category.	• Enter control(s) for each hazard.
Enter subtask information.	Choose category.	• Enter control(s) for each hazard.

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Enter subtask information.	Choose category.	• Enter control(s) for each hazard.

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APPENDIX G

NYSDOH CAMP GUIDANCE Document

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Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

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

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

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

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Community Air Monitoring Plan

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

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

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

<u>VOC Monitoring, Response Levels, and Actions</u>

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.

<u>Particulate Monitoring, Response Levels, and Actions</u>

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.

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

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

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

December 2009

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Appendix 1B
Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50^{o} C (14 to 122^{o} F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

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this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m3, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m3 continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

(a) Applying water on haul roads;
(b) Wetting equipment and excavation faces;
(c) Spraying water on buckets during excavation and dumping;
(d) Hauling materials in properly tarped or watertight containers;
(e) Restricting vehicle speeds to 10 mph;
(f) Covering excavated areas and material after excavation activity ceases; and
(g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m3 action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

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