

**138 BRUCKNER BOULEVARD
BRONX, NEW YORK**

Draft Remedial Investigation Work Plan

**NYSDEC BCP Site Number: TBD
AKRF Project Number: 190253**

Prepared For:

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1.0 INTRODUCTION

This Remedial Investigation Work Plan (RIWP) has been prepared by AKRF, Inc. (AKRF) on behalf of 138 Bruckner Owner LLC (the Applicant) for the property located at 138 Bruckner Boulevard and 107 Saint Ann's Avenue in the Mott Haven section of the Bronx, New York, hereafter referred to as the "Site." The Site is identified by the City of New York as Borough of the Bronx, Block 2260, Lots 10 and 19.

The Site consists of an approximately 50,625-square foot property including a one- to two-story warehouse operated by Zaro's Bakery on Lot 10 and an asphalt-paved parking lot for the adjacent bakery on Lot 19. The Site is bound to the north by Bruckner Boulevard and two multi-family residential buildings, followed by a sheet metal supply warehouse and storage yard, and mixed residential and commercial uses; to the east; by St. Ann's Avenue, followed by a warehouse and showroom for SICIS Mosaic Factory; to the south by East 132nd Street, followed by a food depot warehouse; and to the west by a gasoline station and an iron works. The Site is located in a developed area including predominantly industrial and transportation-related uses, with commercial and residential properties located further north and east. A Site Location Map is provided as Figure 1, and a Site Location Plan is provided as Figure 2.

This RIWP is being submitted concurrently with a New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) Application (BCP Site No. TBD). The Applicant plans to enter NYSDEC's BCP as a Volunteer. A July 2019 subsurface investigation conducted by Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P. (Langan) identified elevated concentrations of metals and polycyclic aromatic hydrocarbons (PAHs) in soil and metals in groundwater. A September 2019 Supplemental Subsurface (Phase II) Investigation Report prepared by AKRF for the Site concluded that there were elevated concentrations of metals and PAHs in soil.

This RIWP describes the procedures to be used to define the nature and extent of contamination at the Site. The data compiled from the Remedial Investigation (RI), as described in this RIWP, will be used to prepare an RI Report (RIR). All work will be completed in accordance with this RIWP, which includes a Quality Assurance Project Plan (QAPP) (Appendix A) and a Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) (Appendix B). The CAMP will be implemented during all subsurface investigation activities involving soil disturbance at the Site.

Contact information for the parties responsible for the work described in this RIWP are included in Table 1:

Table 1
Remedial Investigation Personnel Contact Information

Company	Individual Name	Title	Contact Number
NYSDEC	TBD	Project Manager	TBD
NYSDOH	TBD	Project Manager	TBD
AKRF	Stephen Malinowski	Project Director, QEP, NYSPG Quality Assurance/Quality Control Officer	(631) 574-3724
	Adrianna Bosco	Project Manager	(646) 388-9576
	Evan Venice	Field Team Leader/Site Safety Officer	(646) 388-9871
138 Bruckner Owner LLC	Evan Kashanian	Applicant's Representative	(212) 996-5100

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Description and Surrounding Land Use

The Site consists of an approximately 50,625-square foot property including a one- to two-story warehouse operated by Zaro's Bakery on Lot 10 and an asphalt-paved parking lot for the adjacent bakery on Lot 19. The Site is bound to the north by Bruckner Boulevard and two multi-family residential buildings, followed by a sheet metal supply warehouse and storage yard, and mixed residential and commercial uses; to the east by St. Ann's Avenue, followed by a warehouse and showroom for SICIS Mosaic Factory; to the south by East 132nd Street, followed by a food depot warehouse; and to the west by a gasoline station and an iron works. The Site is located in a developed area including predominantly industrial and transportation-related uses, with commercial and residential properties located further north and east. A Surrounding Land Use map is provided as Figure 3.

2.2 Site Geology, Hydrogeology, and Subsurface Characteristics

Based on the U.S. Geological Survey, Central Park, NY Quadrangle (2013), the Property is between 10 and 20 feet above mean sea level, with immediate surrounding area topography sloping down in a southerly to southwesterly direction toward the Bronx Kill (approximately 750 feet away), a tidal strait connecting the Harlem and East Rivers.

Based on AKRF's September 2019 Supplemental Phase II Report for the Site, subsurface materials consist of at least six feet of historical fill material consisting of sand with varying amounts of gravel, silt, and brick. No borings were advanced beyond 6 feet below grade surface.

Groundwater was not encountered during the Phase II investigation, but is anticipated at approximately 8 feet below ground surface, likely flows in a southerly direction toward the Bronx Kill. There are no surface water bodies or streams on or immediately adjacent to the Site. There are no public or private drinking water supply wells within a ½-mile radius of the Site.

2.3 Proposed Development Plan

The proposed development plan consists of a mixed-use, affordable housing project, which entails the demolition of the existing structure. Although development plans are still being prepared, the proposed project includes construction of an 18-20 story mixed-use building with approximately 250-3300 residential units and one full cellar level. Retail units will be located on the first floor. The building is anticipated to occupy the entire Site. The residential portion will contain 20-30% affordable units.

2.4 Site History

Based on the historical Sanborn Fire Insurance Maps and City Directories presented in the 2019 Phase I Environmental Site Assessment (ESA), the Site was vacant up until approximately 1908, when Lot 10 was developed with several low-rise dwellings. The warehouse on Lot 19 was constructed by 1935 and initially occupied by Vess Dry Bottling Co. on the western side of the lot and Fireproof Products Co. on the eastern side of the lot. North Eastern Bag & Burlap Co. was additionally identified in the western portion of the building between 1940 and 1947. Fireproof Products Co. occupied the entire warehouse by 1951 up until approximately 1968. Lot 19 became vacant by 1986. Operations by the current building occupant, Zaro's Bake Shop, reportedly began in 1993.

3.0 PREVIOUS ENVIRONMENTAL REPORTS

Draft Phase I Environmental Site Assessment – 138 Bruckner, Boulevard, Bronx, Bronx County, New York, Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C., April 2019

Langan prepared a draft Phase I ESA for the Site, dated April 2019. The Phase I ESA was performed in conformance with ASTM Standard E1527-13 and assessed the potential for the presence of hazardous materials, based on reconnaissance of the Site and surrounding area, review of data on geology and hydrology of the surrounding area, examination of historical Sanborn Fire Insurance maps and aerial photographs, and review of pertinent federal and state regulatory databases. The Phase I ESA identified the following recognized environmental conditions (RECs):

- The Site is registered under the NYSDEC Petroleum Bulk Storage (PBS) Database with one closed in-place 3,000-gallon No. 2 fuel oil underground storage tank (UST). The tank was installed in 1982 and reportedly closed-in-place in 2013. Based on a review of available records, Langan noted that a tank test was not completed prior to the closure and no subsurface investigation was completed after the closure. Langan concluded that there may be potential impacts or undocumented releases from this tank.
- Historical and current operations at adjacent properties included petroleum storage, reported releases, spills requiring remediation, and automotive repair. Such uses may have affected subsurface conditions beneath the Site. Historical uses of concern included a gasoline filling station, auto repair facilities with gasoline storage, gasoline tanks and a paint shop, a car wash and tire repair shop, a molding company, a metalizing company, a toy manufacturer, a locomotive railyard and turntables, and a photo marker company. The west-adjacent property historically contained over 40 petroleum storage tanks and is an active gasoline station. NYSDEC Spill No. 9405017 was reported at this facility due to free product and elevated concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) and methyl tert-butyl ether (MTBE) in groundwater.

The following Historical Recognized Environmental Condition (HREC) were identified:

- NYSDEC closed Spill No. 9804809 was reported at the Site in July 1998 due to the release of 5 gallons of No. 2 fuel oil onto concrete as a result of equipment malfunction. The spill was reportedly immediately cleaned up and was closed in November 2003.

The following Business Environmental Risks (BERs):

- Historic urban fill material is likely present beneath the Site, which will require implementation of soil handling procedures during redevelopment.
- The Site was historically occupied by various commercial and residential uses. As such, Langan determined that unknown or unregistered heating oil USTs may be located beneath the Site or adjacent sidewalks. Langan concluded that any unknown tanks encountered during redevelopment should be disposed of in accordance with state and local regulations.

Phase II Investigation – 138 Bruckner Boulevard, Bronx, NY, Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P.C., May 2019

Langan conducted a Phase II Investigation at the Site in April 2019. A full report was not issued to the Applicant; however, AKRF was provided with available figures and tables with laboratory analytical results. Langan advanced 8 soil borings with the collection and laboratory analysis of 8 soil samples, and the installation of 4 temporary groundwater monitoring wells with the collection and laboratory analysis of 4 groundwater samples. Soil and groundwater samples were analyzed for Target Compound List (TCL)

volatile organic compounds (VOCs) by EPA Method 8260, TCL semivolatile organic compounds (SVOCs) by EPA Method 8270, TCL pesticides by EPA Method 8081B, polychlorinated biphenyls (PCBs) by EPA Method 8082, Target Analyte List (TAL) metals plus mercury and hexavalent chromium by EPA Methods 6020B/7471B. The metals analysis for groundwater was conducted on both unfiltered (total) and filtered (dissolved) samples.

A summary of the soil sample analytical results is as follows:

- One VOC, acetone, was detected in one sample at a concentration of 0.057 milligrams per kilogram (mg/kg), above the NYSDEC 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objective (UUSCO) of 0.05 milligrams per kilogram (mg/kg). No VOCs were detected above the 6 NYCRR Part 375 Restricted Residential Use Soil Cleanup Objectives (RRSCOs).
- SVOCs including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene were detected above their respective RRSCOs at concentrations ranging from 0.344 mg/kg to 5 mg/kg.
- No pesticides or PCBs were detected in the soil samples at concentrations above the RRSCOs.
- Lead was detected in one sample and the associated blind duplicate at concentrations of 420 mg/kg and 878 mg/kg, respectively, above the RRSCO of 400 mg/kg. Mercury was detected in two samples at concentrations of 1.02 mg/kg and 1.51 mg/kg, above the RRSCO of 0.81 mg/kg.

A summary of the groundwater sample analytical results is as follows:

- One VOC, MTBE, was detected in one groundwater sample at a concentration of 13.9 micrograms per liter (µg/L), above its NYSDEC 6 NYCRR Part 703.5 Class GA Groundwater Quality Standards and Guidance Value (AWQSGV) of 10 µg/L. This sample was collected from the northern portion of the Site, in close proximity to the adjacent gas station.
- No SVOCs, pesticides, or PCBs were detected above the AWQSGVs in any of the groundwater samples.

Limited Soil Investigation – 138 Bruckner, Boulevard, Bronx, New York, AKRF, Inc., August 2019

AKRF conducted a limited soil investigation on Lot 10 to evaluate shallow soil conditions beneath the Site and support the BCP Application. The investigation was conducted on August 12, 2019 and included the advancement of five soil borings down to approximately six feet below grade. Two soil samples were selected for laboratory analysis from each boring: one shallow sample from the 0 to 2 foot interval (below the existing concrete slab); and one deeper sample from the 5-6-foot interval, or the interval of highest observed contamination. The soil samples were analyzed for Polycyclic Aromatic Hydrocarbons (PAHs) by EPA Method 8270D, TCL pesticides by EPA Method 8081B, TAL Metals plus Mercury by EPA Methods 6020B/7471B, and TCL VOCs by EPA Method 8260 (one sample only).

Elevated PID readings of 118 parts per million (ppm) were observed between 5 and 6 feet below grade in soil sample SB-02 located in the southwestern corner of the Site. Due to this field evidence of contamination, soil sample SB-02_5-6_20190812 was additionally analyzed for VOCs by EPA Method 8260. No other evidence of contamination [e.g., elevated photoionization detector (PID) readings, staining, or odors] was observed in the remaining soil borings.

A summary of the soil sample analytical results is as follows:

- Six VOCs were detected in sample SB-02_5-6_20190812, with the highest detection of 0.054 mg/kg of acetone. All six VOCs were detected below the NYSDEC RRSCOs.

- PAHs were detected in each of the 10 soil samples at concentrations ranging from 0.011 mg/kg to 7 mg/kg, the highest of which was detected in sample SB-02_0-2_20190812. Five PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene, were detected above their respective NYSDEC RRSCOs.
- No pesticides were detected above laboratory reporting limits.
- Metals were detected in each of the 10 soil samples at concentrations ranging from 0.16 mg/kg to 29,600 mg/kg. Three of the metals (barium, lead, and mercury) were detected above their respective NYSDEC RRSCOs.

3.1 Areas of Concern (AOCs)

Based on the Site's history and previous reports prepared for the Site, the AOCs for the RI include SVOCs and metals in soil and groundwater.

4.0 FIELD PROGRAM

The RI field program will focus on collecting soil, groundwater, and soil vapor data to further define the nature and extent of Site contamination and to assist with determining the appropriate remedial action.

4.1 Field Program Summary

The field work scope of work (SOW) includes: the performance of a geophysical survey across accessible portions of the Site; the advancement of eight soil borings with the collection of soil samples to the groundwater interface and the laboratory analysis of two soil samples from each soil boring; the installation of four permanent groundwater monitoring wells with the collection and laboratory analysis of four groundwater samples; the installation of five temporary soil vapor probes with the collection and laboratory analysis of two soil vapor samples and three sub-slab soil vapor samples. The proposed sample locations are shown on Figure 6.

The soil boring and temporary soil vapor point locations will be surveyed using a Global Positioning System (GPS) and will be measured off of fixed points in the field. The groundwater monitoring wells will be surveyed by a New York State-licensed surveyor. Any field evidence of contamination (visual, olfactory, and/or elevated PID readings) will be recorded on logs for inclusion in the RIR. All sampling equipment will be either dedicated or decontaminated between sampling locations.

The aforementioned SOW will be conducted by AKRF and its subcontractors. Qualifications for AKRF personnel are included in Section 2.0 of Attachment A. The following sections describe the methods that will be used to complete the aforementioned SOW.

4.2 Geophysical Survey

A geophysical survey, including ground-penetrating radar (GPR) and magnetometry, will be performed across the Site to investigate the presence of potential USTs and underground utilities, and to clear the proposed sampling locations. GPR uses electromagnetic wave propagation and scattering to image and identify changes in electrical and magnetic properties in the ground. Magnetometers measure irregularities in the magnetic field in a given area. Any anomalies indicative of UST(s) will be marked in the field, measure off of fixed points in the field, and surveyed using GPS.

4.3 Soil Boring Advancement and Soil Sampling

A Geoprobe™ direct-push drill rig will be used to advance soil borings RI-SB-1 through RI-SB-8 at the approximate locations shown on Figure 6. Soil cores will be collected in 4-foot long, 2-inch diameter, stainless steel macrocore piston rod samplers fitted with internal, dedicated acetate liners. Soil borings will be advanced to approximately 5 feet below the groundwater interface, expected to be encountered at approximately 10 feet below grade. Soil samples will be inspected by AKRF field personnel for evidence of contamination (e.g., odors, staining, etc.), screened for the presence of VOCs with a calibrated PID, and logged using the modified Burmister soil classification system.

At all soil boring locations, one soil sample will be collected for analysis from grade to 2 feet below grade and a second soil sample will be collected for analysis from the 2-foot interval displaying the greatest evidence of contamination. In the absence of contamination, the second sample will be collected from the 2-foot interval above the saturated zone. At each soil boring, additional samples will be collected for analysis from any additional intervals displaying field evidence of contamination (elevated PID readings, odors, staining, etc.).

Soil samples slated for laboratory analysis will be labeled and placed in laboratory-supplied containers and shipped to the laboratory via a courier with chain-of-custody (COC) documentation in accordance with appropriate United States Environmental Protection Agency (EPA) protocols to a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory.

Soil samples collected from soil borings will be analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, PCBs by EPA Method 8082, pesticides by EPA Method 8081, Target Analyte List (TAL) metals by EPA Method 6000/7000 series, and hexavalent chromium by EPA Method 7196A. Soil samples will also be analyzed for per- and polyfluorinated compounds (PFAS) by Modified EPA Method 537 and 1,4-Dioxane by EPA Method (collectively, “emerging contaminants”).

After each boring is completed, the boreholes will be filled with on-site materials (if not noticeably contaminated) in accordance with Section 3.3(e) of DER-10. Soil cuttings displaying field evidence of contamination will be containerized in properly labeled Department of Transportation (DOT)-approved 55-gallon drums for off-site disposal at a permitted facility. Boreholes that require drill cutting disposal will be filled with bentonite chips (hydrated). Disposable sampling equipment that comes in contact with environmental media will be double bagged and disposed of as municipal trash as non-hazardous refuse.

The rationale for the proposed soil sample locations is summarized in Table 2.

Table 2
Proposed Soil Sample Rationale

Sample Location	Sample Intervals For Laboratory Analysis ¹	On-Site Location	Analytical Parameters	Rationale
RI-SB-1	0-2' and 8-10'*	Northwestern	TCL List VOCs, SVOCs, PCBs, pesticides, TAL metals, hexavalent chromium, and 1,4-dioxane, PFAS	To assess soil quality in the northwestern portion of the Site
RI-SB-2	0-2' and 8-10'*	Southeastern	TCL List VOCs, SVOCs, PCBs, pesticides, TAL metals, hexavalent chromium, and 1,4-dioxane, PFAS	To assess soil quality in the southeastern portion of the Site
RI-SB-3	0-2' and 8-10'*	West-central	TCL List VOCs, SVOCs, PCBs, pesticides, TAL metals, hexavalent chromium, and 1,4-dioxane, PFAS	To determine the extent of and to assess soil quality in the west central portion of the Site
RI-SB-4	0-2' and 8-10'*	Northeast	TCL List VOCs, SVOCs, PCBs, pesticides, TAL metals, hexavalent chromium, and 1,4-dioxane, PFAS	To assess soil quality in the northeastern portion of the Site
RI-SB-5	0-2' and 8-10'*	Northern	TCL List VOCs, SVOCs, PCBs, pesticides, TAL metals, hexavalent chromium, and 1,4-dioxane, PFAS	To assess soil quality in the northern portion of the Site
RI-SB-6	0-2' and 8-10'*	Western	TCL List VOCs, SVOCs, PCBs, pesticides, TAL metals, hexavalent chromium, and 1,4-dioxane, PFAS	To assess soil quality in the western portion of the Site
RI-SB-7	0-2' and 8-10'*	Central	TCL List VOCs, SVOCs, PCBs, pesticides, TAL metals, hexavalent chromium, and 1,4-dioxane, PFAS	To assess soil quality in the central portion of the Site

Table 2
Proposed Soil Sample Rationale

Sample Location	Sample Intervals For Laboratory Analysis ¹	On-Site Location	Analytical Parameters	Rationale
RI-SB-8	0-2' and 8-10'*	South Central	TCL List VOCs, SVOCs, PCBs, pesticides, TAL metals, hexavalent chromium, and 1,4-dioxane, PFAS	To assess soil quality in the southern portion of the Site
Notes: ¹ feet below surface grade * Sample will be collected from the 2-foot interval above the saturated zone. QA/QC sampling is discussed in Section 4.8. VOCs – volatile organic compounds SVOCs – semivolatile organic compounds PCBs – polychlorinated biphenyls TAL – target analyte list PFAS – per- and polyfluorinated compounds				

4.4 Groundwater Monitoring Well Installation and Development

Four permanent monitoring wells (denoted as RI-MW-1 through RI-MW-4) will be installed using a Geoprobe DPP equipped with augers at the proposed locations shown on Figure 6. The wells will be constructed with 15 feet of 2-inch diameter 0.002-inch slotted polyvinyl chloride (PVC) well screen set approximately 10 feet into the water table and 5 feet above the water table, which is expected to be encountered between approximately 8 and 10 feet below grade, and a 2-inch diameter solid PVC riser installed to grade. A No. 2 morie sandpack will be installed from the base of the well to approximately 2 feet above the well screen. The annular space around the solid well riser above the sandpack will be sealed with approximately 2 feet of bentonite followed by a non-shrinking grout/cement mixture to approximately one foot below grade. Each of the wells will be finished with a locking j-plug and flush-mounted well cover. Well construction logs will be prepared and included as an appendix to the RIR.

Following installation, each groundwater monitoring well will be developed via pumping and surging to remove any accumulated fines and establish a hydraulic connection with the surrounding aquifer. Development will continue until turbidity within the well is less than 50 nephelometric turbidity units (NTUs) for three successive readings; and until water quality indicators have stabilized to within 10% for pH, temperature, and specific conductivity for three successive readings, or until at least three well volumes have been purged from the well. Well development details will be noted on groundwater development logs, included as an appendix to the RIR.

The rationale for the proposed soil sample locations is summarized in Table 3.

Table 3
Proposed Groundwater Sample Rationale

Groundwater Monitoring Well ID	On-Site Location	Rationale
RI-MW-1	Northwestern	To assess groundwater quality on the northwestern portion of the Site; and determine Site-specific groundwater flow direction and elevation

Groundwater Monitoring Well ID	On-Site Location	Rationale
RI-MW-2	Southeastern	To assess groundwater quality on the southeastern portion of the Site; and determine Site-specific groundwater flow direction and elevation
RI-MW-3	West-central	To assess groundwater quality on the western portion of the Site; and determine Site-specific groundwater flow direction and elevation
RI-MW-4	East-central	To assess groundwater quality on the northeastern portion of the Site; and determine Site-specific groundwater flow direction and elevation

4.5 Groundwater Elevation Survey

The groundwater monitoring wells will be surveyed by a New York State-licensed surveyor to determine their accurate location and elevation. Two elevation measurements will be taken at each well location: the at-grade elevation; and the elevation of the top of PVC casing (north side at marking), to facilitate preparation of a groundwater contour map and to determine the direction of groundwater flow. The elevation datum for the sampling points will be based on NAVD 88 Elevation Datum. The groundwater elevation survey will be included as an appendix to the RIR.

4.6 Groundwater Sampling

In accordance with EPA low-flow sampling protocols, the wells will be sampled one to two weeks following their development. Prior to sampling, an electronic interface meter will be used to measure water levels and a bailer will be used to measure any separate phase liquid. The purge water will be monitored for turbidity and water quality indicators [i.e., pH, dissolved oxygen, oxidation-reduction potential (ORP), temperature, and specific conductivity] with measurements collected approximately every five minutes. The criteria for stabilization will be three successive readings within $\pm 10\%$ for pH, temperature, and specific conductivity. Purge water displaying field evidence of contamination will be containerized in properly labeled, Department of Transportation (DOT)-approved 55-gallon drums for off-site disposal at a permitted facility.

Groundwater samples slated for laboratory analysis will be placed in laboratory-supplied containers and shipped in accordance with appropriate EPA protocols to a NYSDOH ELAP-certified laboratory. The samples will be analyzed for VOCs by EPA Method 8260, SVOCs by EPA Method 8270, PCBs by EPA Method 8082, pesticides by EPA Method 8081, and total and dissolved TAL metals by EPA Method 6000/7000 series using Category B deliverables. Filtering will occur in the field. Groundwater samples will also be analyzed for per- and polyfluorinated compounds (PFAS) by Modified EPA Method 537 and 1,4-Dioxane by EPA Method (collectively, “emerging contaminants”). Sampling for emerging contaminants will be conducted in accordance with the February 2018 NYSDEC-issued sampling protocol, with the exception that a low-density polyethylene (LDPE) bladder will be used as no industry-approved high-density polyethylene (HDPE) alternative currently exists. Well sampling details will be noted on groundwater sampling logs, included as an appendix to the RIR.

4.7 Soil Vapor and Ambient Air Sampling

Five soil vapor samples (denoted as RI-SV-1 through RI-SV-5) will be collected from five temporary vapor monitoring probes at the approximate locations shown on Figure 6. Soil vapor sampling will be performed in accordance with the guidelines provided in the NYSDOH document entitled, “Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006”. Soil vapor samples will be collected from the interval above the saturated zone.

The temporary sub-slab soil vapor points will be installed by advancing an expendable drive point using either a direct-push drilling rig or a slide hammer or hammer drill to the target sampling depth. At each monitoring point, a 6-inch stainless steel screen implant, connected to Teflon tubing will be installed by hand or through the drilling rods and threaded into the drive point. The sampling tubing will extend from the end of the screen to above grade. The push probe rods will then be removed and the boring will be backfilled with clean silica sand to 3 to 6 inches above the screen. Hydrated bentonite will be used to fill the remaining void around the sampling tubing to the ground surface. The temporary soil vapor probes will be installed by advancing an expendable drive point using a Geoprobe™ direct-push drill rig to approximately two feet above the groundwater table at each proposed sampling location. At each monitoring point, a six-inch stainless steel screen implant, connected to Teflon™ tubing will be installed through the drilling rods and threaded into the drive point. The sampling tubing will extend from the end of the screen to above grade. The push probe rods will then be removed and the boring will be backfilled with clean silica sand to approximately three to six inches above the screen. Hydrated bentonite will be used to fill the remaining void around the sampling tubing to the ground surface.

The soil vapor and ambient air samples will be collected over a two-hour time period from each monitoring point using a 6-Liter, batch-certified SUMMA® canister equipped with a vacuum gauge and flow regulator set at a maximum rate of 0.2 liter per minute. Prior to sample collection, the sampling points will be purged of three sample volumes using a GilAir air sampling pump. During purging, a shroud will be placed over the sampling point and helium gas will be introduced to saturate the atmosphere around the sample port with helium gas. Purged vapors will be collected into a Tedlar™ bag and field-screened for organic vapors using a PID. The purged air will also be monitored using a portable helium detector to check for short-circuiting of ambient air into the vapor sampling point. If the purged soil vapor contains greater than 10% helium, additional bentonite will be used to enhance the surface seal, and the point will be retested.

Following purging, a soil vapor sample will be collected using the vacuum from the SUMMA® canister. Immediately after opening the flow control valve equipped with a two-hour regulator, the initial SUMMA® canister vacuum (inches of mercury) will be noted. After two hours, the flow controller valve will be closed, the final vacuum noted, and the canister placed in a shipping carton for delivery to the laboratory. One ambient air sample (RI-AA-1) will be collected from the central portion of the Site concurrently with the soil vapor samples to establish background conditions.

The soil vapor and ambient air samples will be analyzed for VOCs by EPA Method TO-15 by a NYSDOH ELAP-certified laboratory with Category B deliverables. Samples will be shipped to the laboratory with appropriate COC documentation.

The rationale for the proposed soil vapor samples is summarized in Table 4.

Table 4
Proposed Soil Vapor Sample Rationale

Vapor Point ID	Sample Location	Analytical Parameters	Rationale
RI-SV-1	Northwestern Site	VOCs	To determine concentrations of VOCs on the northwestern portion of the Site, evaluate the potential for off-site exposure to the northwest, and complete the significant threat determination.
RI-SV-2	Southeastern Site	VOCs	To determine concentrations of VOCs on the southeastern portion of the Site.

Vapor Point ID	Sample Location	Analytical Parameters	Rationale
RI-SV-3	North-central Site	VOCs	To determine concentrations of VOCs on the north-central portion of the Site, evaluate the potential for off-site exposure to the east, and complete the significant threat determination.
RI-SV-4	Southcentral Site	VOCs	To determine concentrations of VOCs on the south-central portion of the Site.
RI-SV-5	Northeastern Site	VOCs	To determine concentrations of VOCs on the northeastern portion of the Site, evaluate the potential for off-site exposure to the north, and complete the significant threat determination

4.8 Quality Assurance/Quality Control (QA/QC)

The analytical results will be reported with Category B deliverables. As required by the Category B sampling techniques, additional analysis will be included for QC measures. The QA/QC samples for soil and groundwater will include at one field blank, one trip blank, one matrix spike/matrix spike duplicate (MS/MSD), and one blind duplicate sample at a frequency of at least one sample per 20 field samples per media. The field blank, blind duplicate, and MS/MSD samples will be analyzed for the same analyte list as the accompanying samples and Category B deliverables will be requested from the laboratory. The laboratory-prepared trip blanks will be submitted for analysis of VOCs only to determine the potential for cross-contamination. QA/QC samples accompanying the groundwater samples will also be analyzed for PFAS by Modified EPA Method 537. Upon receipt of the analytical data from the laboratory, it will be reviewed by a third-party data validator, who will prepare a Data Usability summary Report (DUSR). The QAPP, included as Appendix A, describes the QA/QC protocols and procedures that will be followed during implementation of this RIWP.

4.9 Decontamination Procedures

All non-dedicated sampling equipment will be decontaminated between sampling locations using the following procedure:

1. Scrub equipment with a bristle brush using a tap water/Alconox[®] solution.
2. Rinse with tap water.
3. Scrub again with a bristle brush using a tap water/Alconox[®] solution.
4. Rinse with tap water.
5. Rinse with distilled water.
6. Air-dry the equipment.

Non-dedicated equipment used for groundwater sampling of emerging contaminants will be decontaminated with laboratory-certified PFAS-free water.

4.10 Management of Investigation-Derived Waste (IDW)

IDW that does not exhibit field evidence of contamination will be used to backfill the corresponding borehole that generated them to within 12 inches of the surface. Soil and groundwater IDW exhibiting evidence of gross contamination will be containerized in Department of Transportation (DOT)-approved 55-gallon drums. The drums will be sealed at the end of each work day and labeled with the date, the well or boring number(s), the type of waste (i.e., drill cuttings, decontamination fluids, development water, or purge water) and the name of an AKRF point-of-contact. All drums will be labeled "pending analysis" until laboratory data is available. All

boreholes will be restored after backfill. Handling of IDW and backfilling of boreholes will be conducted in accordance with Section 3.3(e) of DER-10.

5.0 REPORTING REQUIREMENTS

5.1 Remedial Investigation Report (RIR)

Upon completion of all field work and receipt of laboratory analytical results, an RIR will be prepared in compliance with Section 3.14 of DER-10 that will: document field activities; present field and laboratory data; evaluate exposure pathways in an exposure assessment; identify and characterize the source(s) of contamination; a summary of the overall nature and extent of contamination using the applicable standards, criteria, and guidance; and discuss conclusions and recommendations drawn from the results of the RI.

5.1.1 Description of Field Activities

The RIR will include a section that will describe the field methods used to characterize the Site conditions, including: sampling techniques; field screening equipment; drilling and excavation equipment; monitoring well installation procedures; and management of IDW. This section will also include descriptions of hydrogeologic factors of the Site.

5.1.2 Soil Assessment

The RIR will include a section that presents field and laboratory data for soil results. The section will include a description of soil characteristics and figures will be provided that illustrate soil boring locations. Field and laboratory analytical results will be presented in the body of the report, summarized in tables and figures, and the detected concentrations will be compared to regulatory standards and/or guidance values. Soil boring logs and laboratory analytical reports will be provided as attachments. Category B deliverables will be provided by the laboratory and a third-party DUSR will be prepared and discussed.

5.1.3 Groundwater Assessment

The RIR will include a section that presents field and laboratory data from the groundwater monitoring results. The section will include a description of groundwater characteristics and figures will be provided that illustrate monitoring well locations. Well survey data and water level measurements will be used to create a groundwater elevation contour map and determine the inferred groundwater flow direction. Field and laboratory analytical results will be presented and compared with regulatory standards and/or guidance values. Well construction, well development, and groundwater sampling logs, and laboratory analytical reports will be provided as attachments. Category B deliverables will be provided by the laboratory and a third-party DUSR will be prepared and discussed.

5.1.4 Soil Vapor Assessment

The RIR will include a section that presents field and laboratory data from the soil vapor and ambient air results. The section will include a description of soil vapor characteristics and will provide a comparison of soil vapor and ambient air sample analytical data. Figures will be provided that illustrate the soil vapor point and ambient air locations. Field and laboratory analytical results will be presented and compared with regulatory standards and/or guidance values. Soil vapor and ambient air logs and laboratory analytical reports will be provided as attachments. Category B deliverables will be provided by the laboratory and a third-party DUSR will be prepared and discussed.

5.1.5 Qualitative Human Health Exposure Assessment (QHHEA)

The RIR will include a QHHEA, which will be performed in accordance with DER-10 Section 3.3(c)4 and Appendix 3B.

6.0 PROPOSED PROJECT SCHEDULE

Table 5
Proposed Project Schedule*

Activity	Time To Complete*
BCP Pre-Application Meeting	August 2019
Submittal of BCP Application and Draft Remedial Investigation Work Plan (RIWP)	September 2019
30-day Completeness Review	October 2019
30-day Public Notice/Public Comment Period is Initiated	November 2019
BCA Execution	January 2020
Submittal and Approval of Citizen Participation Plan and Final RIWP	January 2020
Remedial Investigation	February 2020
Draft Remedial Investigation Report (RIR) and Draft Remedial Action Work Plan (RAWP) Submitted to NYSDEC	April 2020
45-day Public Comment Period for RIR and RAWP is Initiated	June 2020
Public Comment Period for RIR and RAWP Ends	July 2020
Final RIR and RAWP Submitted/DEC Approves and Issues Decision Document	August 2020
Issue Remedial/Construction Notice Fact Sheet	August 2020
Begin Redevelopment (Construction) with Implementation of RAWP	August/September 2020
Execution of Environmental Easement (if required)	July 2021
Draft Site Management Plan (SMP) Submitted to NYSDEC	August 2021
Draft Final Engineering Report and Fact Sheet	September 2021
Certificate of Completion and Fact Sheet	December 2021
Completion of Building (first occupancy)	December 2022

* Activities and dates are subject to change.

7.0 CERTIFICATION

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

Stephen Malinowski



09-13-2019

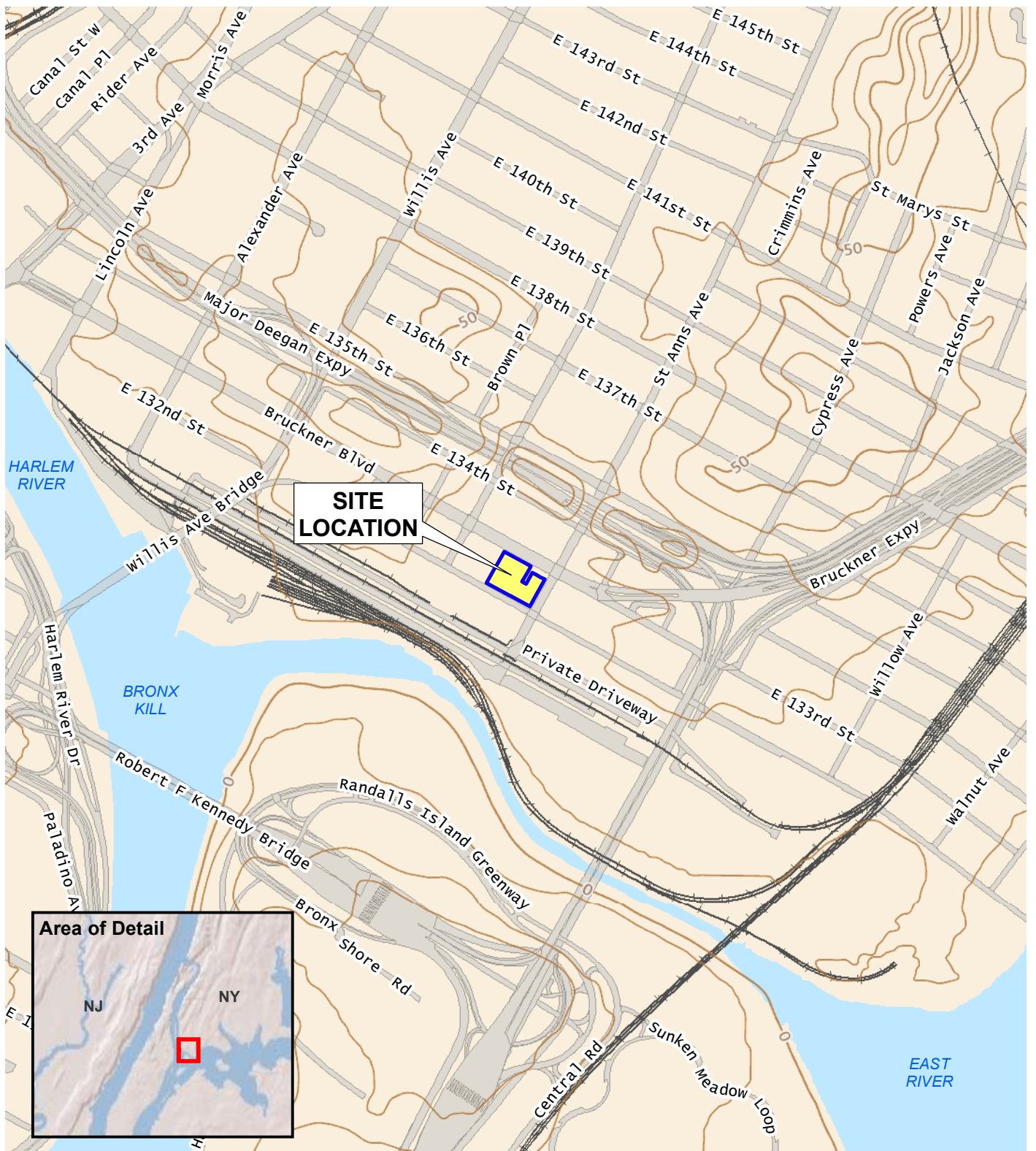
Name

Signature

Date

FIGURES

© 2019 AKRF. W:\Projects\190253 - ARTIMUS 138 BRUCKNER BLVD\Technical\GIS and Graphics\Hazmat\190253 Fig 1 site loc map.mxd 8/26/2019 3:03:52 PM mvelleux



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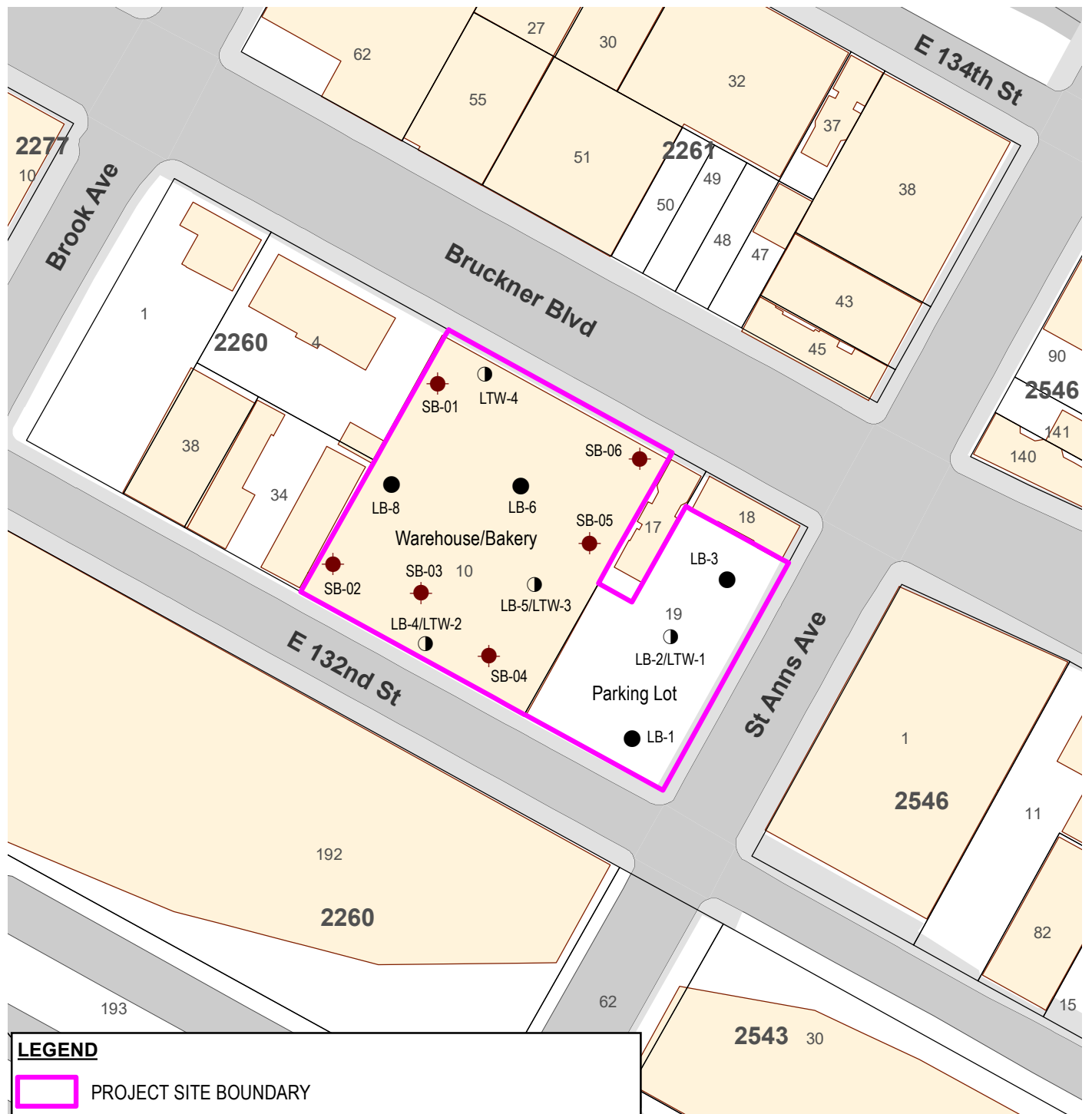


440 Park Avenue South, New York, NY 10016

138 Bruckner Boulevard
Bronx, New York

SITE LOCATION

DATE 8/26/2019
PROJECT NO. 190253
FIGURE 1



Map Source:
NYCDP (NYC Dept. of City Planning) GIS database

LEGEND

- PROJECT SITE BOUNDARY
- BUILDING
- 19 LOT BOUNDARY AND TAX LOT NUMBER
- 2260** BLOCK NUMBER
- SOIL BORING LOCATION (AUGUST 2019, AKRF)
- SOIL BORING LOCATION (APRIL 2019, LANGAN)
- ◐ SOIL BORING/TEMPORARY WELL LOCATION (APRIL 2019, LANGAN)



440 Park Avenue South, New York, NY 10016

138 Bruckner Boulevard
Bronx, New York

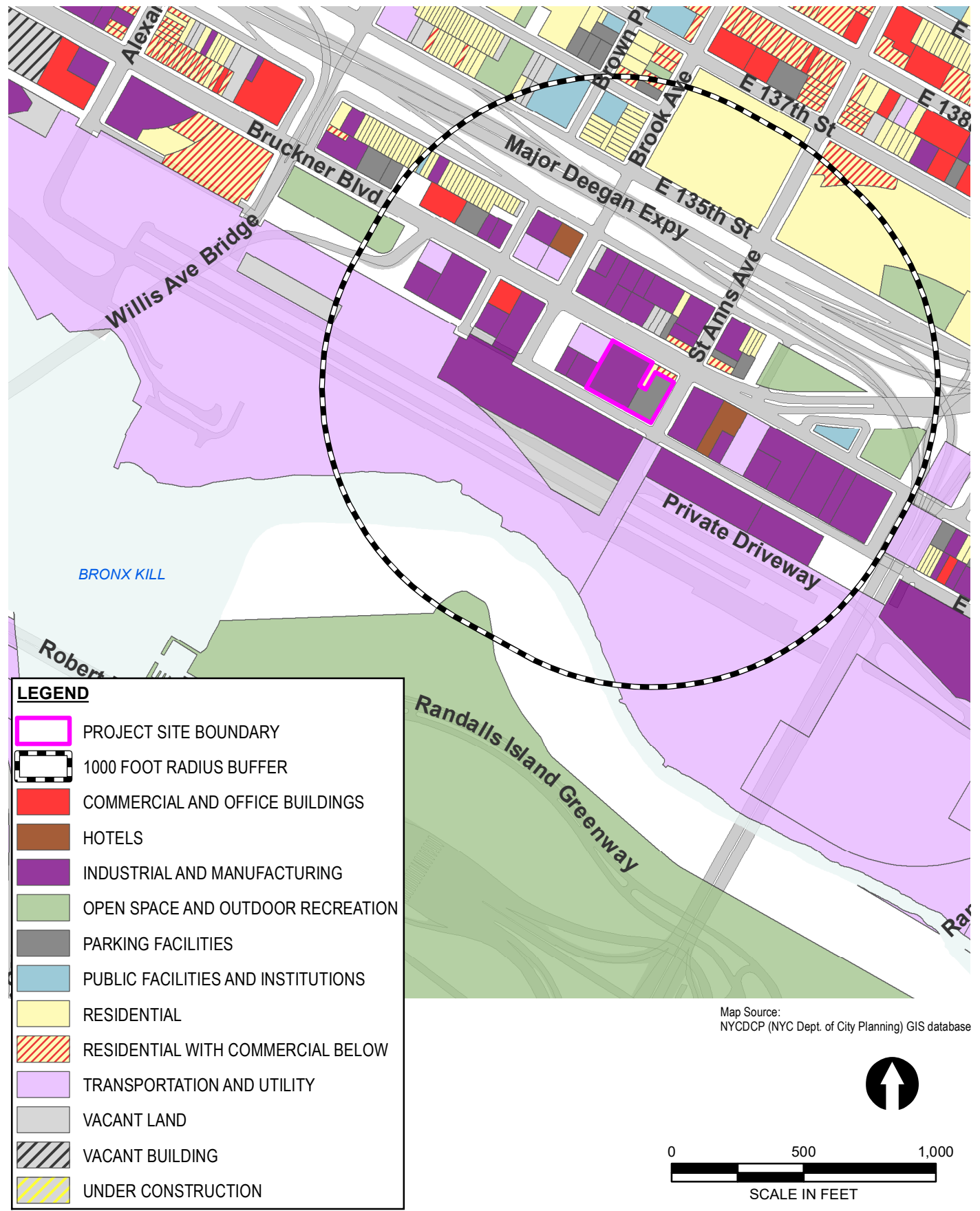
SITE AND SAMPLE LOCATION PLAN

DATE
8/29/2019

PROJECT NO.
190253

FIGURE
2

© 2019 AKRF. W:\Projects\190253 - ARTIMUS 138 BRUCKNER BLVD\Technical\GIS and Graphics\Hazard\190253 Fig 3 Surrounding Land Use map.mxd/6/2019 9:26:20 AM mveilleux



440 Park Avenue South, New York, NY 10016

138 Bruckner Boulevard
Bronx, New York

SURROUNDING LAND USE

DATE

9/6/2019

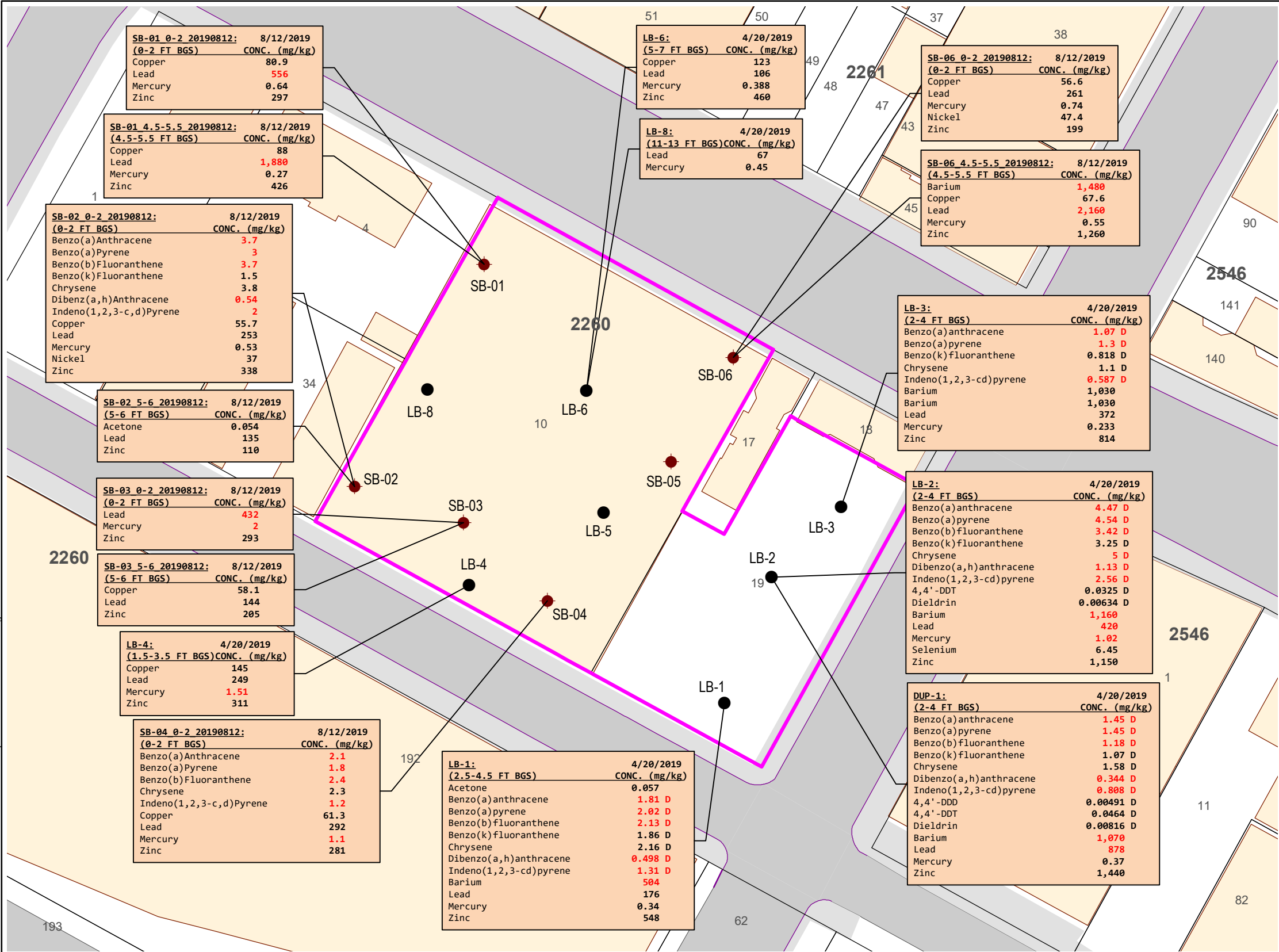
PROJECT NO.

190253

FIGURE

3

© 2019 AKRF W:\Projects\190253 - ARTIMUS 138 BRUCKNER BLVD\Technical\GIS and Graphics\Hazmat\RW\190253 Fig 4 Soil Exceedances.mxd 9/6/2019 9:27:56 AM mvelieux



Map Source:
NYCDP (NYC Dept. of City Planning) GIS database

LEGEND

- PROJECT SITE BOUNDARY
- BUILDING
- LOT BOUNDARY AND TAX LOT NUMBER
- 2260 TAX BLOCK NUMBER
- SOIL BORING LOCATION (AUGUST 2019, AKRF)
- SOIL BORING LOCATION (APRIL 2019, LANGAN)

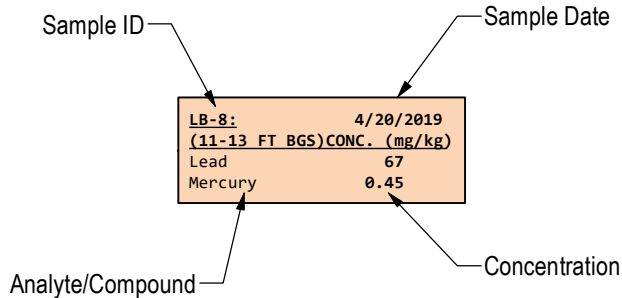
	Part 375 Restricted Residential	Part 375 Unrestricted
	mg/kg	mg/kg
Volatile Organic Compounds		
Acetone	100	0.05
Semivolatile Organic Compounds		
Benzo(a)Anthracene	1	1
Benzo(a)Pyrene	1	1
Benzo(b)Fluoranthene	1	1
Benzo(k)Fluoranthene	3.9	0.8
Chrysene	3.9	1
Dibenz(a,h)Anthracene	0.33	0.33
Indeno(1,2,3-c,d)Pyrene	0.5	0.5
Pesticides		
Dieldrin	0.2	0.005
P,P'-DDD	13	0.0033
P,P'-DDT	7.9	0.0033
Metals		
Barium	400	350
Copper	270	50
Lead	400	63
Mercury	0.81	0.18
Selenium	180	3.9
Nickel	310	30
Zinc	10,000	109

SOIL

Part 375 Soil Cleanup Objectives:
Soil Clean-up Objectives listed in NYSDEC
(New York State Department of Environmental Conservation)
"Part 375" Regulations (6 NYCRR Part 375).

Exceedances of Part 375 Unrestricted Use SCOs (UUSCOs) are highlighted in black.
Exceedances of Part 375 Restricted Residential SCOs (RRSCOs) are highlighted in red.

mg/kg: milligrams per kilogram = parts per million (ppm)
D: Analyte concentration obtained from dilution.



138 Bruckner Boulevard
Bronx, New York



440 Park Avenue South, New York, NY 10016

SOIL SAMPLE CONCENTRATIONS ABOVE NYSDEC UUSCOs AND/OR RRSCOs

DATE

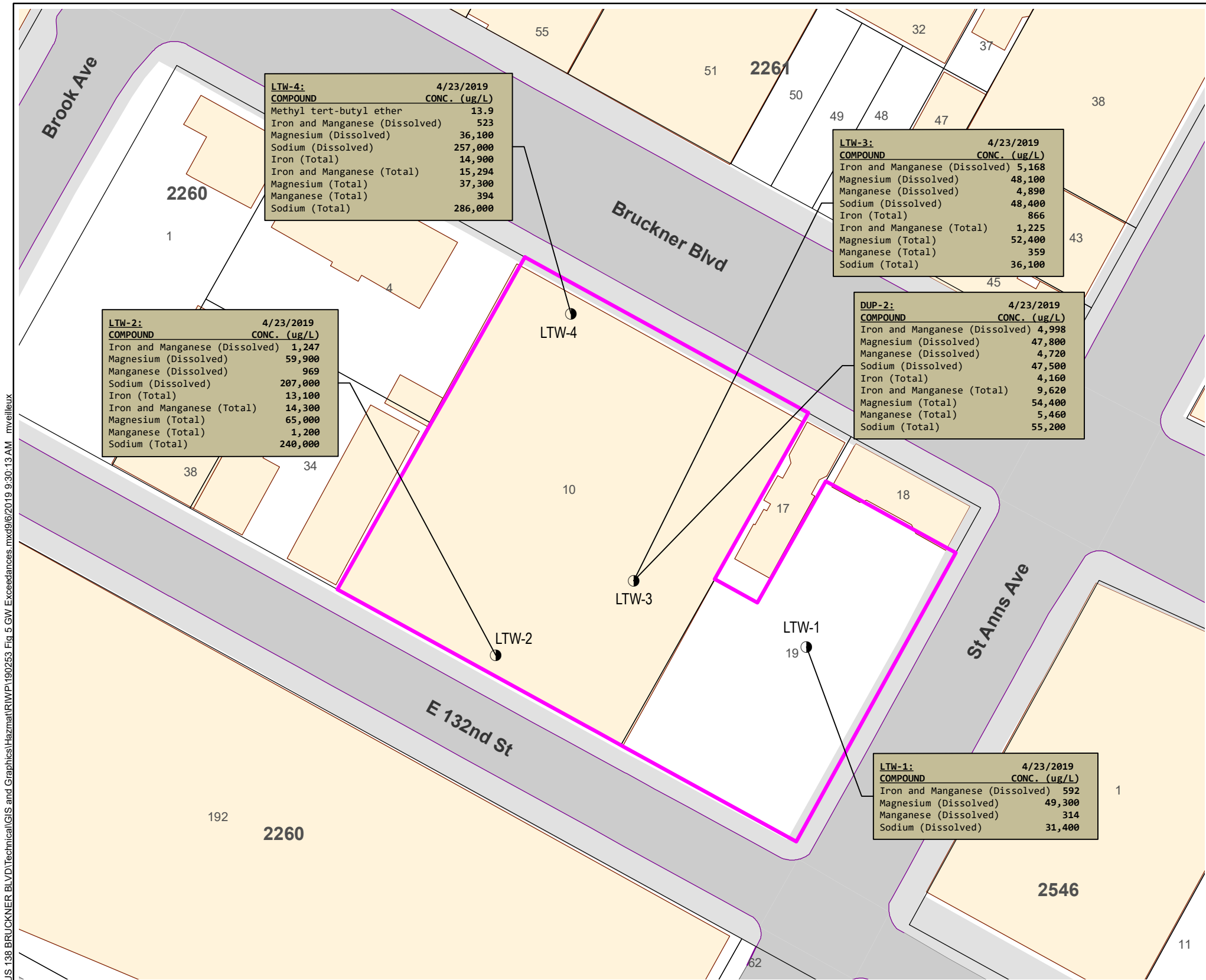
9/6/2019

PROJECT NO.

190253

FIGURE

4



© 2019 AKRF W:\Projects\190253 -ARTIMUS 138 BRUCKNER BLVD\Technical\GIS and Graphics\Harta\RW\PI\190253 Fig 5 GW Exceedances.mxd 9/6/2019 9:30:13 AM mvelieux

Map Source:
NYC DCP (NYC Dept. of City Planning) GIS database

LEGEND

- PROJECT SITE BOUNDARY
- BUILDING
- LOT BOUNDARY AND TAX LOT NUMBER
- 2260 TAX BLOCK NUMBER

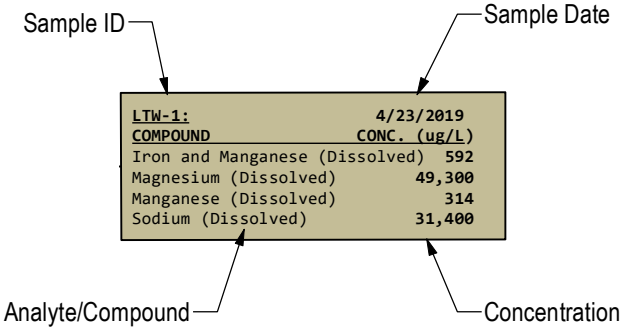
TEMPORARY WELL LOCATION (APRIL 2019, LANGAN)

NYSDEC AWQSGVs	
µg/L	
Volatile Organic Compounds	
Tert-Butyl Methyl Ether	10
Metals	
Iron	300
Magnesium	35,000
Manganese	300
Sodium	20,000

GROUNDWATER

NYSDEC TOGS Class GA Ambient Water Quality Standard and Guidance Values (AWQSGVs):
New York State Department of Environmental Conservation (NYSDEC)
Technical and Operational Guidance Series (TOGS) (1.1.1):

ug/L : micrograms per Liter = parts per billion (ppb)





440 Park Avenue South, New York, NY 10016

138 Bruckner Boulevard
Bronx, New York

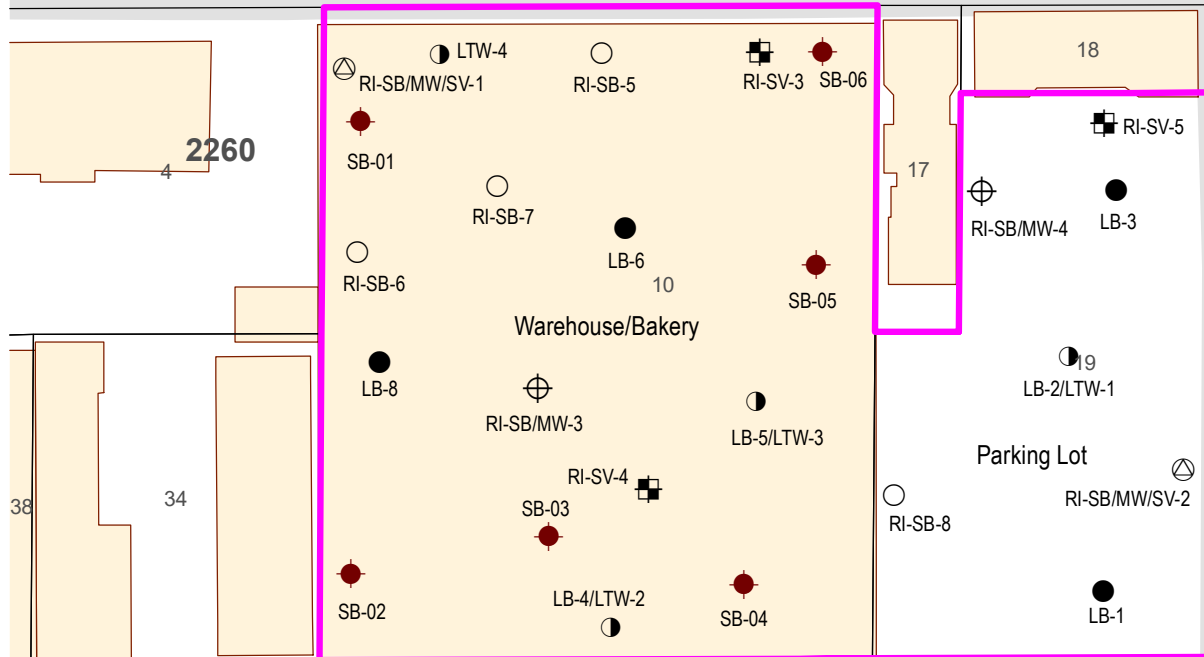
GROUNDWATER SAMPLE CONCENTRATIONS ABOVE NYSDEC AWQSGVs

DATE
9/6/2019

PROJECT NO.
190253

FIGURE
5

Bruckner Blvd



St Anns Ave

E 132nd St

LEGEND

PROJECT SITE BOUNDARY

BUILDING

LOT BOUNDARY AND TAX LOT NUMBER

2260 BLOCK NUMBER

SOIL BORING LOCATION (AUGUST 2019, AKRF)

SOIL BORING LOCATION (APRIL 2019, LANGAN)

SOIL BORING/TEMPORARY WELL LOCATION (APRIL 2019, LANGAN)

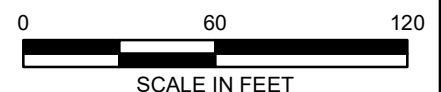
PROPOSED SOIL BORING LOCATION

PROPOSED SOIL BORING/MONITORING WELL LOCATION

PROPOSED SOIL BORING/MONITORING WELL/SOIL VAPOR POINT LOCATION

PROPOSED SOIL VAPOR POINT LOCATION

Map Source:
NYCDP (NYC Dept. of City Planning) GIS database



SCALE IN FEET



440 Park Avenue South, New York, NY 10016

138 Bruckner Boulevard
Bronx, New York

PROPOSED SAMPLE LOCATION PLAN

DATE

9/13/2019

PROJECT NO.

190253

FIGURE

6

APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

138 BRUCKNER BOULEVARD
BRONX, NEW YORK

Quality Assurance Project Plan

NYSDEC BCP Site Number: TBD
AKRF Project Number: 190253

Prepared For:

New York State Department of Environmental Conservation
Division of Environmental Remediation, Remedial Bureau B
625 Broadway, 12th Floor
Albany, New York 12233

Prepared On Behalf Of:

138 Bruckner Owner LLC
% Artimus
316 West 118th Street
New York, NY 10026

Prepared by:



AKRF, Inc.
440 Park Avenue South, 7th Floor
New York, New York 10016
212-696-0670

SEPTEMBER 2019

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2.3	Field Team Leader, Field Technician, Site Safety Officer (SSO), and Alternates	1
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Table 1 –	Laboratory Analytical Methods for Analysis Groups
Table 2 –	Sample Nomenclature

ATTACHMENTS

Attachment A – Resumes for Project Director / QA/QC Officer, Project Manager, and Field Team Leader

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) describes the protocols and procedures that will be followed during implementation of the Remedial Investigation Work Plan (RIWP) for the property located at 138 Bruckner Boulevard and 107 Saint Ann's Avenue in the Mott Haven section of the Bronx, New York, hereafter referred to as the "Site." The Site is identified by the City of New York as Borough of the Bronx, Block 2260, Lots 10 and 19. The objective of this QAPP is to provide for Quality Assurance (QA) and maintain Quality Control (QC) of environmental investigative and sampling activities conducted under the New York State Department of Environmental Conservation (NYSDEC) oversight in the Brownfield Cleanup Program (BCP) (BCP Site No. TBD). Adherence to this QAPP will ensure that defensible data will be obtained during environmental work at the Site.

2.0 PROJECT TEAM

The project team will be drawn from AKRF professional and technical personnel, and AKRF's subcontractors. All field personnel and subcontractors will have completed a 40-hour training course and updated 8-hour refresher course that meet the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR Part 1910. The following sections describe the key project personnel and their responsibilities.

2.1 Project Director / Quality Control (QA/QC) Officer

Mr. Stephen Malinowski, QEP, NYSPG will serve as the QA/QC officer and will be responsible for adherence to the QAPP. The QA/QC officer will review the procedures with all personnel prior to commencing any fieldwork and will conduct periodic Site visits to assess implementation of the procedures. The QA/QC officer will also be responsible for reviewing the Data Usability Summary Reports (DUSRs) prepared by a third-party data validator for soil, groundwater, and soil vapor analytical results. Mr. Malinowski's resume is included in Attachment A.

2.2 Project Manager

The project manager will be responsible for directing and coordinating all elements of the RIWP. The project manager will prepare reports and participate in meetings with the Site owner/Volunteer, and/or the NYSDEC. Adrianna Bosco will serve as the project manager for the RIWP. Ms. Bosco's resume is included in Attachment A.

2.3 Field Team Leader, Field Technician, Site Safety Officer (SSO), and Alternates

The field team leader will be responsible for supervising the daily sampling and health and safety activities in the field and will ensure adherence to the work plan and Health and Safety Plan (HASP), included as Appendix A of the RIWP. The field team leader will also act as the field technician and Site Safety Officer (SSO), and will report to the project manager or project manager alternate on a regular basis regarding daily progress and any deviations from the work plan. The field team leader will be a qualified and responsible person able to act professionally and promptly during environmental work at the Site. Evan Venice will be the field team leader. The field team leader alternate is Chris Puoplo of AKRF. Mr. Venice's and Mr. Puoplo's resumes are included in Attachment A.

2.4 Laboratory Quality Assurance/Quality Control (QA/QC) Officer

The laboratory QA/QC officer will be responsible for quality control procedures and checks in the laboratory and ensuring adherence to laboratory protocols. The QA/QC officer will track the movement of samples from the time they are checked in at the laboratory to the time that

analytical results are issued, and will conduct a final check on the analytical calculations and sign off on the laboratory reports. The laboratory QA/QC officer will be Carl Ambruster of TestAmerica Laboratories (TestAmerica), the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory being employed for all environmental sampling at the Site.

2.5 Thirty-Party Data Validator

The third-party data validator will be responsible for reviewing the final data packages for soil, groundwater, and soil vapor and preparing a DUSR that will provide performance information with regard to accuracy, precision, sensitivity, representation, completeness, and comparability associated with the laboratory analyses for the investigation. The third-party data validator will be Lori Beyer of L.A.B. Validation Corporation of East Northrop, New York.

3.0 STANDARD OPERATING PROCEDURES (SOPS)

The following sections describe the SOPs for the remedial activities included in the RIWP. During these activities, safety monitoring will be performed as described in the HASP, included as Appendix B of the RIWP.

3.1 Decontamination of Sampling Equipment

All sampling equipment (augers, drilling rods, split spoon samplers, probe rods, pumps, etc.) will be either dedicated or decontaminated between sampling locations. Decontamination will be conducted on plastic sheeting (or equivalent) that is bermed to prevent discharge to the ground. The decontamination procedure will be as follows:

1. Scrub using tap water/Alconox[®] mixture and bristle brush.
2. Rinse with tap water.
3. Scrub again with tap water/Alconox[®] mixture and bristle brush.
4. Rinse with tap water.
5. Rinse with distilled water.
6. Air-dry the equipment, if possible.

3.2 Management of Investigation-Derived Waste (IDW)

IDW will be containerized in New York State Department of Transportation (NYSDOT)-approved 55-gallon drums. The drums will be sealed at the end of each work day and labeled with the date, the excavation grid(s), the type of waste (i.e., drill cuttings), and the name and phone number of an AKRF point-of-contact. All IDW exhibiting field evidence of contamination will be disposed of or treated according to applicable local, state, and federal regulations.

4.0 SAMPLING AND LABORATORY PROCEDURES

4.1 Soil Sampling

Soil sampling will be conducted according to the following procedures:

- Characterize the sample according to the modified Burmister soil classification system.

- Field screen the sample for evidence of contamination (e.g., odors, staining, etc.) using visual and olfactory methods and screen for volatile organic compounds (VOCs) using a photoionization detector (PID) equipped with an 10.6 electron Volt (eV) lamp.
- Collect an aliquot of soil from each proposed sample location, place in laboratory-supplied glassware, label the sample in accordance with Section 4.6.1, and place in an ice-filled cooler for shipment to the laboratory.
- Complete the proper chain of custody (COC) paperwork and seal the cooler.
- Record sample location, sample depth, and sample observations (evidence of contamination, PID readings, soil classification, etc.) in field log book and boring log data sheet, if applicable.
- Decontaminate any soil sampling equipment between sample locations as described in Section 3.1 of this QAPP.

4.2 Groundwater Sampling

Groundwater sampling will be conducted according to the following procedures:

- Field screen the sample for evidence of contamination (e.g., odors, staining, etc.) using visual and olfactory methods and screen the well headspace for VOCs using a PID equipped with an 10.6 eV lamp.
- Collect the groundwater sample from each proposed sample location in laboratory-supplied glassware, label the sample in accordance with Section 4.6.1, and place in an ice-filled cooler for shipment to the laboratory.
- Complete the proper COC paperwork and seal the cooler.
- Record sample location, sample depth, and sample observations (evidence of contamination, PID readings, free phase liquid, etc.) in field log book and boring log data sheet, if applicable.
- Decontaminate any groundwater sampling equipment between sample locations as described in Section 3.1 of this QAPP.

4.3 Soil Vapor, Indoor Air, and Ambient Air Sampling

Soil vapor, indoor air, and ambient air sampling will be conducted according to the following procedures:

- Field screen the sample for evidence of contamination (e.g., odors, etc.) using olfactory methods and screen the purged vapors for VOCs using a PID equipped with a 10.6 eV lamp.
- Collect the soil vapor, indoor air, and ambient air samples from each proposed sample locations in laboratory-supplied SUMMA[®] canisters, label the sample in accordance with Section 4.6.1, and place in shipment container for shipment to the laboratory.
- Complete the proper COC paperwork and seal the shipment container.
- Record sample location, sample depth, and sample observations (odors, PID readings, etc.) in field log book and boring log data sheet, if applicable.

4.4 Laboratory Methods

Table 1 summarizes the laboratory methods that will be used to analyze field samples and the sample container type, preservation, and applicable holding times. TestAmerica of Edison, New Jersey, a NYSDOH ELAP-certified laboratory subcontracted to AKRF, will be used for all chemical analyses in accordance with the Division of Environmental Remediation (DER)-10 2.1(b) and 2.1(f) with Category B Deliverables.

Table 1
Laboratory Analytical Methods for Analysis Groups

Matrix	Analysis	EPA Method	Bottle Type	Preservative	Hold Time
Soil and Soil QA/QC	Volatile Organic Compounds (VOCs)	8260C	EnCore® samplers (3) and 2 oz. plastic jar	≤ 6 °C	48 hours to extract; 14 days to analyze
	Semivolatile Organic Compounds (SVOCs)	8270D	8 oz. Glass Jar	≤ 6 °C	14 days to extract; 40 days to analyze
	1,4-Dioxane	8270D plus Selective Ion Monitoring (SIM); 0.35 µg/L RL	4 oz. Glass Jar	≤ 6 °C	14 days to extract; 40 days to analyze
	Total Analyte List (TAL) Metals, and Hexavalent Chromium	6000/7000 Series, 6010C, and 7196A	8 oz. Glass Jar	≤ 6 °C	6 months holding time; Mercury 28 days holding time; Hexavalent chromium 30 days to extract, 7 days to analyze
	Pesticides	8081B	8 oz. Glass Jar	≤ 6 °C	14 days to extract; 40 days to analyze
	Polychlorinated Biphenyls (PCBs)	8082A	8 oz. Glass Jar	≤ 6 °C	14 days to extract; 40 days to analyze
	Per- and Polyfluorinated Compounds (PFAS)	Modified 537; 0.2 ng/L RL	4 oz. HDPE Plastic Container	≤ 6 °C	14 days to extract; 40 days to analyze
Groundwater and Groundwater QA/QC	VOCs	8260C	5 40 mL Glass Vials	HCl to pH < 2 and ≤ 6 °C	48 hours to extract; 14 days to analyze
	SVOCs	8270D	2,000 mL Amber Jar	≤ 6 °C	7 days to extract; 40 days to analyze
	1,4-Dioxane	8270D plus Selective Ion Monitoring (SIM); 0.35 µg/L RL	1 L Amber Jar	≤ 6 °C	7 days to extract; 40 days to analyze
	TAL Metals	6000/7000 Series	2,000 mL Amber Jar	HNO ₃ to pH < 2	6 months for metals; 28 days for mercury; 24 hours for hex. chromium
	Pesticides	8081B	2,000 mL Amber Jar	≤ 6 °C	7 days to extract; 40 days to analyze
	PCBs	8082A	2,000 mL Amber Jar	≤ 6 °C	7 days to extract; 40 days to analyze
	Per- and Polyfluorinated Compounds (PFAS)	Modified 537; 0.2 ng/L RL	3 x 250 mL Polypropylene Bottles	≤ 6 °C, Trizma	14 days to analyze
Soil Vapor and Ambient Air	VOCs	TO-15	6L SUMMA® Canister	None	14 days

Notes:

QA/QC samples will be analyzed for the same parameters as the parent sample, with the exception of the trip blank(s), which will be analyzed for VOCs by EPA Method 8260C only.

EPA – Environmental Protection Agency

Hg – Mercury

RCRA – Resource Conservation and Recovery Act

µg/L – parts per billion

ng/L – parts per trillion

4.5 Quality Control (QC) Sampling

In addition to the laboratory analysis of the soil samples, additional analysis will be included for QC measures, as required by the Category B sampling techniques. These samples will include field blank, trip blank, matrix spike/matrix spike duplicate (MS/MSD), and blind duplicate samples at a frequency of one sample per 20 field samples collected or per sample delivery group (SDG). QC samples will be analyzed for the same parameters as the accompanying samples, with the exception of any trip blanks, which will be analyzed for the VOC list only.

4.6 Sample Handling

4.6.1 Sample Identification

All samples will be consistently identified in all field documentation, chain-of-custody (COC) documents, and laboratory reports. Soil, groundwater, soil vapor, and ambient air samples collected during the RI will be identified with “RI-” and “SB-” for soil borings “MW-” for groundwater monitoring wells, “SV-” for soil vapor points, and “AA-” for ambient air samples, and the soil boring, groundwater monitoring well number, soil vapor point, or ambient air sample number. All samples will be amended with the collection date at the end of the sample name in a year, month, day (YYYYMMDD) format. Blind duplicate sample nomenclature will consist of the sample type, followed by an “X”; MS/MSD samples nomenclature will consist of the parent sample name only, but triplicate sample volume will be collected and the COC comment section will explain that the additional volume is for running the MS/MSD; and trip and field blanks will consist of “TB-” and “FB-”, respectively, followed by “S” for soil and “GW” for groundwater, and a sequential number of the trip/field blanks collected within the sample digestion group (SDG). Special characters, including primes/apostrophes (’), will not be used for sample nomenclature. Table 2 provides examples of the sampling identification scheme for samples collected during the RI.

Table 2
Remedial Investigation Sample Nomenclature

Sample Description	Sample Designation
Groundwater sample collected from groundwater monitoring well RI-MW-01 on October 15, 2019	RI-MW-01_20191015
Matrix spike/matrix spike duplicate sample of groundwater sample collected from groundwater monitoring well RI-MW-01 on October 15, 2019	RI-MW-01_20191015
Blind duplicate sample of groundwater sample collected from groundwater monitoring well RI-MW-01 on October 15, 2019	RI-MW-X01_20191015
Second field blank collected during the RI on October 15, 2019 with the soil samples	RI-FB-S-02_20191015
Soil sample collected from soil boring RI-SB-10 between 0 and 2 feet below grade on October 15, 2019	RI-SB-10_0-2_20191015
Second blind duplicate soil sample of SDG collected from soil boring RI-SB-10 between 0 and 2 feet below grade on October 15, 2019	RI-SB-X2_0-2_20191015

Sample Description	Sample Designation
Soil vapor sample collected from temporary soil vapor point RI-SV-01 on October 15, 2019	RI-SV-01_20191015
Ambient air sample collected on October 15, 2019	RI-AA-1_20191015

Sample Labeling and Shipping

All sample containers will be provided with labels containing the following information:

- Project identification, including Site name, BCP Site number, Site address
- Sample identification
- Date and time of collection
- Analysis(es) to be performed
- Sampler's initials

Once the samples are collected and labeled, they will be placed in chilled coolers and stored in a cool area away from direct sunlight to await shipment to the laboratory. All samples will be shipped to the laboratory at least twice per week. At the start and end of each workday, field personnel will add ice to the cooler(s) as needed.

The samples will be prepared for shipment by placing each sample in laboratory-supplied glassware, then wrapping each container in bubble wrap to prevent breakage, and adding freezer packs and/or fresh ice in sealable plastic bags. The COC form will be properly completed by the sampler in ink, and all sample shipment transactions will be documented with signatures, and the date and time of custody transfer. Samples will be shipped overnight (e.g., Federal Express) or transported by a laboratory courier. All coolers shipped to the laboratory will be sealed with mailing tape and a COC seal to ensure that the samples remain under strict COC protocol.

Sample Custody

Field personnel will be responsible for maintaining the sample coolers in a secured location until they are picked up and/or sent to the laboratory. The record of possession of samples from the time they are obtained in the field to the time they are delivered to the laboratory or shipped off-site will be documented on COC forms. The COC forms will contain the following information: project name; names of sampling personnel; sample number; date and time of collection and matrix; and signatures of individuals involved in sample transfer, and the dates and times of transfers. Laboratory personnel will note the condition of the custody seal and sample containers at sample check-in.

4.7 Field Instrumentation

Field personnel will be trained in the proper operation of all field instruments at the start of the field program. Instruction manuals for the equipment will be on file at the Site for referencing proper operation, maintenance, and calibration procedures. The equipment will be calibrated according to manufacturer specifications at the start of each day of fieldwork. If an instrument fails calibration, the project manager or QA/QC officer will be contacted immediately to obtain a replacement instrument. A calibration log will be maintained to record the date of each calibration, any failure to calibrate and corrective actions taken. The PID will be equipped with

an 10.6 eV lamp and will be calibrated each day using 100 parts per million (ppm) isobutylene standard gas in accordance with the manufacturer's standards.

4.8 Quality Assurance (QA)

All soil, groundwater, and soil vapor laboratory analytical data will be reviewed by a third-party validator and a Data Usability Summary Report (DUSR) will be prepared to document the usability and validity of the data. The Remedial Investigation Report (RIR) will include a detailed description of endpoint sampling activities, data summary tables, concentration map showing sample locations and concentrations, DUSR, and laboratory reports.

ATTACHMENT A

**RESUMES OF QA/QC OFFICER AND PROJECT DIRECTOR, PROJECT MANAGER, AND FIELD TEAM
LEADER/FIELD TECHNICIAN/SITE SAFETY OFFICER/ALTERNATE**

STEPHEN T. MALINOWSKI, QEP , NYSPG

VICE PRESIDENT

Stephen Malinowski, QEP is a Vice President with experience in assessment, investigation, and remediation of environmental contamination-related issues. Steve manages all aspects of environmental projects with multi-disciplinary teams, including public agencies, developers, property owners, architects, and construction managers to navigate regulatory programs efficiently and achieve project objectives. His projects fall under the regulatory oversight of the United States Environmental Protection Agency, New York State Department of Environmental Conservation, New York City Department of Environmental Protection and New York City Office of Environmental Remediation including the Federal and New York State Superfund, New York State Brownfield Cleanup Program (BCP) and petroleum spills, RCRA/IUC closures, New York City Voluntary Cleanup Program (VCP) and E-Designation program, and Nassau and Suffolk County regulatory programs. His proficiency in the development of custom scopes of work and accurate cost estimates coupled with his field-experience, knowledge of regulations, and excellent rapport with regulatory personnel allow him to provide turnkey environmental consulting for site assessment, investigation and remediation projects associated with development, infrastructure improvement, and coastal resiliency projects.

Mr. Malinowski's experience includes the design, implementation, and management of environmental assessment, investigation and remediation projects on Long Island and across the New York Metropolitan Area including soil groundwater investigation, monitoring, and sampling programs, Brownfield and hazardous waste site investigations; underground storage tank studies, including soil contamination delineation, classification, waste removal and disposal. He has overseen and conducted hundreds of Phase I Environmental Site Assessments (ESAs) and Phase II investigations in a variety of environmental settings ranging from industrial sites to sites in challenging urban areas, many of them in conjunction with site redevelopment and property transaction related activities. In addition, Steve has designed and implemented indoor air and soil vapor intrusion surveys at industrial, commercial, municipal, and residential properties in accordance with New York State Department of Health protocols, some requiring sub-slab depressurization or soil vapor extraction systems.

BACKGROUND

Education

B.A., Environmental Science, State University of New York at Plattsburgh

Licenses/Certifications

Qualified Environmental Professional from the Institute of Professional Environmental Practice (IPEP)

New York State Professional Geologist #000422

NYSDEC Erosion and Sediment Control Inspector -SWT#47T-120313-07

Certified Brownfield Professional by New York City Office of Environmental Remediation

Health and Safety Operations at Hazardous Materials Sites 29 CFR 1910.120

OSHA 10 Hour Occupational Construction Safety and Health

Professional Memberships

Member, Long Island Association of Professional Geologists (LIAPG)

Member, Institute of Professional Environmental Practice (IPEP)

Awards

Big Apple Brownfield Award recipient as part of the Cornerstone B1 (LaTerraza) redevelopment team 2011

Big Apple Brownfield Award recipient as part of the Flushing Commons redevelopment team 2017

Big Apple Brownfield Award recipient as part of the 3365 Third Avenue redevelopment team 2019



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VICE PRESIDENT

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Years of Experience

Year started in company: 2013

Year started in industry: 1992

RELEVANT EXPERIENCE

94th Avenue GP, LLC, Alvista Towers (94-02 148th Street), Jamaica, NY

The Remedial Investigation revealed the presence of contaminated soil and soil vapor beneath the site, and the developer entered the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) through OER's JumpStart program. The remediation consisted of soil excavation and the removal of seven underground storage tanks. The site achieved an unrestricted use Track 2 cleanup and was the first project to receive a Certificate of Completion under the post-2015 amendment BCP.

Mr. Malinowski was responsible for directing the assessment and preconstruction investigation activities for a former industrial property with an E-Designation for Hazardous Materials and Noise located within the Jamaica Brownfield Opportunity Area (BOA). Mr. Malinowski was responsible for designing the scope of the Remedial Investigation to satisfy the hazardous materials E-Designation, as well as for coordinating the pre-demolition asbestos survey and the noise survey to obtain the Notice to Proceed from the Mayor's Office of Environmental Remediation's (OER).

J2 147-07 94th Avenue LLC, Alvista Towers, Queens, NY

This historical meat refrigeration facility is enrolled in the Brownfield Cleanup Program to remediate the property and construct a 23-story affordable residential building. Although the site has an E-Designation for hazardous materials, noise, and air quality, AKRF assisted with applying for entry into the NYSDEC Brownfield Cleanup Program, due to the presence of contaminated soil and soil vapor beneath the site. AKRF is providing environmental consulting services throughout the project.

Mr. Malinowski is directing all Phases of this NYS Brownfield project located within the Jamaica BOA. Mr. Malinowski has been responsible for overseeing the implementation of a Phase I Environmental Site Assessment and asbestos survey of this former industrial property adjacent to the Long Island Rail Road tracks. Since the site had an E-Designation for hazardous materials, noise and air quality, Mr. Malinowski led a meeting with OER to coordinate all technical deliverables to satisfy the predevelopment requirements and obtain a Notice to Proceed. Additionally, he designed a scope of work for the Remedial Investigation that would satisfy both OER and the NYSDEC Brownfield Cleanup Program.

Upon the receipt of results indicating the presence of contaminated soil and soil vapor beneath the site, the client decided to apply for the NYS BCP. Mr. Malinowski was responsible for preparing and submitting the BCP Application simultaneously with the Remedial Investigation Report and a Remedial Action Work Plan (RAWP) to expedite the approval process and enable implementation of the remediation concurrently with construction. Mr. Malinowski prepared a remedial estimate for the activities required by the RAWP, allowing the client to obtain financing for construction.

Waterview at Greenpoint, LLC, NYC OER VCP, 77 Commercial Street Brooklyn, NY

AKRF provided environmental consulting services in connection with the proposed affordable housing development at 77 Commercial Street as part of ongoing revitalization of the Greenpoint waterfront. The project comprises the redevelopment of an approximately 110,000-square foot former industrial parcel into a mixed-use commercial/residential development, including a public waterfront esplanade, affordable housing, and three interconnected buildings ranging from 2 to 40 stories. The site is being remediated under the New York City Mayor's Office of Environmental Remediation (OER), and is listed with an E-Designation for Hazardous Materials, Air Quality, and Noise.



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Mr. Malinowski oversaw the preparation of a Remedial Investigation Work Plan and implementation of a Remedial Investigation (RI) which included 38 soil samples, 6 groundwater samples, and 11 soil vapor samples. Based on the results of the RI, he oversaw the preparation of a Remedial Action Work Plan (RAWP) that included excavation of approximately 90,000 tons of soil, removal of underground oil tanks, installation of a vapor barrier beneath the entire building, and design drawings for a sub-slab depressurization system. Upon approval of the RAWP, Mr. Malinowski helped enroll the project into OER's Voluntary Cleanup Program (VCP) to enable an exemption from hazardous waste disposal taxes and to capitalize on additional community involvement provided by OER. AKRF, OER, and community leaders developed proactive measures to limit the potential disturbances from construction and to help keep concerned community members informed of planned activities. He also designed and conducted an extensive in-situ testing of soil to pre-classify the material for disposal.

Mr. Malinowski managed the associated E-Designation work for Air Quality and Noise (E-138) to render the site protective of Air Quality and Noise impacts. The work included a site-specific noise study and evaluation of proposed fuel types, mechanical equipment, and emission stack locations to prepare an Air Quality and Noise Remedial Action Plan (RAP). All documents were approved by OER and the project is awaiting the start of construction.

3363-3365 Third Avenue, NYC OER VCP site, Bronx, NY

AKRF is providing environmental consulting services in connection with the proposed affordable housing development at 3363-3365 Third Avenue. The proposed project consists of a residential building with a basement and approximately 30 affordable housing units. Mr. Malinowski oversaw the preparation of Phase I ESA for due diligence purposes and to support an application to the New York City Acquisition Fund. The Phase I identified recognized environmental conditions as well as an (E) designation from the Morrisania Rezoning Action. Mr. Malinowski is assisting the client with satisfying the (E) designation and has prepared and implemented a Remedial Investigation Work Plan under the regulatory oversight of the New York City Mayor's Office of Environmental Remediation (NYCOER). The Remedial Investigation included soil, soil vapor, groundwater and ambient air sampling. AKRF also prepared a Remedial Action Work Plan (RAWP) and implemented the remediation which included the design of a sub-slab depressurization system (SSDS) and installation of a vapor barrier system to prevent potential soil vapor intrusion. AKRF conducted waste disposal testing to characterize approximately 4,500 tons of soil for off-site disposal and is currently conducting environmental monitoring during excavation of the site soils and installation of the SSDS and vapor barrier. The site is enrolled in NYCOER's Voluntary Cleanup Program and the client is anticipating receiving the maximum allowable Brownfield Incentive Grant for this affordable housing project.

New York City Department of Design and Construction, East Side Coastal Resiliency, Manhattan, NY

Mr. Malinowski leads the environmental investigation and related support for a multidisciplinary design team selected by the New York City agency partnership of DDC, DPR, and ORR for the Feasibility Study and Pre-Scoping Services for the East Side Coastal Resiliency (ESCR) project. The AKRF Team is providing design services for 100+ year storm protection and for the anticipated sea level rise along the east side of Lower Manhattan. The ESCR subsurface exploration programs involved a review of available utility plans and environmental reports concerning manufactured gas plant (MGP) and potential petroleum-related contamination along a 2.5 mile study area from Montgomery Street to East 25th Street in order to develop a Subsurface Investigation Work Plan to investigate soil and groundwater quality in areas of disturbance.

The testing program were conducted under the regulatory oversight of the NYCDEP and included both public and private utility mark-out services across vast areas of the project site containing critical infrastructure in order to enable the installation of numerous soil borings and groundwater wells. Mr. Malinowski was in charge of all aspects of management and implementation of the investigation program. As the design of the flood protection project was advanced, Mr. Malinowski designed a supplemental subsurface testing program to evaluate subsurface



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conditions for infrastructure improvements and to further define areas impacted with MPG-related wastes. He was also responsible for interpreting the wide-range of chemical parameters to evaluate critical cost and environmental impacts for the City and design team, and to prepare technical reports for submission and approval by the NYCDEP to satisfy City Environmental Quality Review (CEQR) requirements.

In addition, he continues to support the design and environmental review team by preparing the Hazmat Chapter for the Environmental Impact Statement, overseeing a hydrogeological study, developing interim remedial measures for MGP-contamination, developing estimating cost impacts to the project for design and cost recovery purposes, developing a Soil Management Plan and preparing presentations to the NYC team as well as OER, NYSDEC, and Con Edison.

Remedial Design, Gowanus Canal First Street Turning Basin, New York City Department of Design and Construction

AKRF performed professional services for the remedial design for restoration of the Filled-in Former First Street Turning Basin adjacent to the Gowanus Canal in Brooklyn, New York. The remediation is being conducted as part of an Order of Consent between the City of New York and USEPA for the Gowanus Canal Superfund Site. The remedial design will include removal of fill and sediment within the filled-in turning basin in an approximately 475-foot by 50-foot area and the creation of a wetland shelf. Design considerations include geotechnical concerns related to adjacent buildings and new and existing bulkheads; soil and water management; landscape design; and access/construction logistics. The project design is anticipated to be completed in 2020.

(From Wiles)The Environmental Protection Agency (EPA) issued an Administrative Order for the remedial design to reestablish the filled-in former First Street Turning Basin to support the design and construction of the greater Gowanus Canal project. The project consists of several field investigations, including environmental soil and groundwater sampling, geotechnical studies, topographic surveys, and marine bulkhead inspections, to support the remedial design of the former turning basin. The remediation will involve the excavation and restoration, including establishing a wetland shelf, of the former First Street Turning Basin.

Mr. Malinowski is responsible for coordination of a multidisciplinary team to evaluate existing structural and environmental conditions associated with the site and the immediate surrounding area. Mr. Malinowski is overseeing the implementation of underwater bulkhead inspections and multi-beam sounding surveys in the Gowanus Canal, as well as environmental and geotechnical investigations, surveys, structural and existing condition evaluations of nearby properties. He is responsible for all reporting and communications for the project, and is working with nearby property owners to initiate access agreements for work on their properties. Mr. Malinowski is also assisting the DDC with presentations at the Gowanus Community Action Group and is working closely with the USEPA to implement an archaeology monitoring plan during subsurface disturbance activities.

13th and 14th Street Realty, NYS Brownfield Redevelopment, New York, NY

Mr. Malinowski directed all phases of this NYS Brownfield project, including the initial investigation as well as the submittal of a BCP Application simultaneously with a Remedial Investigation Work Plan and an Interim Remedial Measures Work Plan, which enabled the investigation and remediation to be implemented concurrently with planned site redevelopment activities. The site consisted of an approximately 20,000 square foot property in Manhattan comprised of 100 year old dilapidated buildings. The presence of perchloroethene (PCE) contamination associated with a former dry cleaner prevented the property owner from selling. The developer applied to the New York State Brownfield Cleanup Program (BCP) as a "Volunteer" to eliminate off-site liability. Prior to the client securing its construction loan, all plans were approved by NYSDEC and a detailed remedial estimate was approved for financing by the client's lending institutions.

The investigation included soil and soil vapor testing as well as the installation and sampling of groundwater monitoring wells. The remediation activities included the removal of underground oil tanks, soil waste



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classification testing, and removal of approximately 15,000 tons of non-hazardous petroleum and lead contaminated soil as well as 200 tons of hazardous soil containing PCE. A water-proofing membrane was installed beneath the entire building to eliminate the exposure pathway for PCE into the new eight-story residential building. The investigation and remedial work was performed under a construction health and safety plan that included a community air monitoring program. The client received approximately \$6,000,000 in tax credits from NYS for the Track 2 cleanup of this underutilized contaminated property.

Flushing Commons Development, NYC OER VCP Site, 38-18 Union Street, Queens, NY

AKRF prepared an Environmental Impact Statement (EIS) under New York City Environmental Quality Review (CEQR) for Flushing Commons, LLC, a 2-million-square foot mixed-use, private-public development in Flushing, Queens. The project was sponsored by EDC and developed in partnership with Flushing-based TDC Development and Construction (TDC), and Rockefeller Group Development. As a result of the environmental review process, a Restrictive Declaration was assigned to the property. Due to the scale of the project, the project development was divided into two Phases. Flushing Commons Phase I included a 67,600-square foot automotive parking area at 38-18 Union Street. Mr. Malinowski prepared a Remedial Investigation Work Plan and oversaw the implementation of a Remedial Investigation (RI), which included 20 soil samples, 4 groundwater samples, and 6 soil vapor samples. Based on the results of the RI, AKRF prepared a Remedial Action Work Plan (RAWP) including excavation of approximately 178,000 tons of soil, and the installation of a vapor barrier beneath the entire building. Upon approval of the RAWP, Mr. Malinowski helped enroll the project into OER's Voluntary Cleanup Program (VCP) to enable an exemption from hazardous waste disposal taxes and to capitalize on additional community involvement provided by OER. AKRF also conducted extensive waste characterization testing of the soil to pre-classify the material for disposal.

Under Mr. Malinowski's direction, AKRF personnel initiated a Community Air Monitoring Program (CAMP) and provided construction oversight during 11 months of excavation and provided daily reports to OER. The excavation included large amounts of soil meeting the New York State Department of Environmental Conservation's Unrestricted Use criteria and the site participated in OER's Clean Soil Bank program. Approximately 14,000 cubic yards of material was exported to the Breezy Point Cooperative and Green Thumb garden. As the project neared completion, clean material and asphalt millings through OER's soil bank and asphalt bank were imported to the Site. AKRF prepared a Remedial Action Report documenting the Track 1 cleanup of the site which was approved by NYCOER.

2264-2772 Morris Avenue, NYCDEP CEQR, Bronx, NY

AKRF is providing environmental hazardous materials and consulting services in connection with the proposed affordable housing development at 2264-2272 Morris Avenue. The proposed 11-story building is expected to include 94 much-needed units of new affordable and supportive housing. Mr. Malinowski oversaw the preparation of hazardous materials reports for the project site including a Phase I ESA and Phase II site investigation for pre-purchase due diligence purposes. As part of the CEQR review, a Phase II Work Plan and Supplemental Phase II Investigation were performed under the regulatory oversight of the New York City Department of Environmental Protection (NYCDEP). Mr. Malinowski oversaw the preparation of a Remedial Action Plan (RAP) for NYCDEP approval which includes the removal of underground storage tanks (USTs), characterization and disposal of approximately 5,000 tons of soil, and the installation of a vapor barrier. AKRF is currently overseeing the implementation of the RAP and under Mr. Malinowski's direction has removed the USTs, cleaned up a petroleum spill to the satisfaction of the NYSDEC, and is conducting community air monitoring during the foundation excavation.

Site Investigation, Albanese Organization, Wyandanch, NY

AKRF performed a Phase II subsurface investigation for the Albanese Organization to support the Wyandanch Rising project located on the Long Island Rail Road (LIRR) and Town of Babylon parking areas immediately north of the Wyandanch train station. Prior to beginning the work, AKRF obtained a rail road protective liability insurance policy for the project and a Site Entry Permit from LIRR. The work consisted of the installation of soil



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and groundwater borings as well as the inspection and sampling of 13 stormwater drywells and five sanitary leaching structures under the oversight of the Suffolk County Department of Health Services (SCDHS). Based on these results, the SCDHS issued a “no further action” letter and the client was able to obtain financing for the project.

Target Rock Corp., Farmingdale, New York

The Target Rock Corp. was issued violations from the Suffolk County Department of Health Services (SCDHS) for an illegal industrial discharge of trichloroethylene (TCA) to an abandoned sanitary system and multiple bulk storage tank infractions. Under the supervision of SCDHS, Mr. Malinowski supervised dye tests of the suspect discharge as well as numerous additional floor drains to confirm their discharge outflow. Prior to beginning excavation activities, a subsurface investigation was performed to delineate soil and groundwater impacts and profile the soil for waste disposal purposes. Under his direction, approximately 300 tons of soil was excavated and transported as hazardous waste to the Stablex facility in Canada from the sanitary system and nearby area. In addition to the remediation, Mr. Malinowski worked closely with the project engineer to register and prepare plans to upgrade several chemical and petroleum bulk storage tanks to comply with SCDHS Article 12. His work also included a chemical inventory of the entire 250,000-square foot facility.



ADRIANNA BOSCO

SENIOR PROFESSIONAL

Adrianna Bosco is a Senior Professional in AKRF's Site Assessment and Remediation Department. She has experience in navigating redevelopment projects through regulatory requirements under local and state programs. Ms. Bosco has worked closely with projects enrolled in the NYSDEC Brownfield Cleanup Program, the New York City Voluntary Cleanup Program (VCP), and NYSDEC petroleum spills program, from initial stages of investigation and remediation, through site closure and post-remedial management. Ms. Bosco also has experience in preparing Phase I Environmental Site Assessments and Subsurface (Phase II) Investigations, in addition to conducting environmental/construction oversight and the associated reporting elements. Prior to joining AKRF, she worked as an Environmental Scientist for PS&S Engineering, Inc.

BACKGROUND

Education

B.S., Environmental Engineering, Manhattan College, Bronx, New York, 2011

Licenses/Certifications

40 Hour OSHA HAZWOPER Certified, September 2011

10 Hour OSHA Construction Program Certified, October 2013

Years of Experience

Date started at AKRF: July 2014

Prior industry experience: PS&S Engineering, Inc. December 2011 – July 2014 (2 years, 7 months)

RELEVANT EXPERIENCE – AKRF

147-25 94th Avenue, Queens, NY

This historical meat refrigeration facility is enrolled in the Brownfield Cleanup Program to remediate the property and construct a 23-story affordable residential building. Although the site has an E-Designation for hazardous materials, noise, and air quality, AKRF assisted with applying for entry into the NYSDEC Brownfield Cleanup Program, due to the presence of contaminated soil and soil vapor beneath the site. AKRF is providing environmental consulting services throughout the project. As the Deputy Project Manager, Ms. Bosco prepared the Brownfield Cleanup Program application and Remedial Work Plan. Ms. Bosco also managed field activities associated with the Remedial Investigation, to determine the vertical and horizontal extent of on-site contamination. Once construction begins, Ms. Bosco will also manage the on-site remediation and prepare NYSDEC-required submittals and reports.

1888 Bathgate Avenue Redevelopment Site, Bronx, NY

AKRF is providing environmental consulting services in connection to the investigation and remediation of an approximately 36,000-square foot parcel enrolled in the Brownfield Cleanup Program. This former steel door manufacturing facility is contaminated with chlorinated solvents, including tetrachloroethene. The selected remedy included site-wide excavation of soil and bedrock, continuous air monitoring, collection of post-excavation endpoint samples, and implementation of an in-situ groundwater treatment program. As the Deputy Project Manager for this project, Ms. Bosco is managing various field efforts, including a Remedial Design Investigation to develop the groundwater treatment program and implementation of the Remedial Action Work Plan. Upon



ADRIANNA BOSCO

SENIOR PROFESSIONAL

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completion of the remediation, Ms. Bosco will prepare the Final Engineering Report and Site Management Plan for submission to the NYSDEC.

East Side Coastal Resiliency, Manhattan, NY

Ms. Bosco served as an Environmental Scientist and conducted a portion of the 2016 subsurface investigation of the 2.5 mile study area from Montgomery Street to East 23rd Street. The ESCR subsurface exploration program involved a review of available utility plans and environmental reports involving manufactured gas plant (MGP) and petroleum-related contamination. Responsibilities included groundwater sampling, soil boring and temporary well installation, and compliance with the Supplemental Subsurface Investigation Work Plan.

Elton Crossing, Bronx, NY

AKRF's work includes the implementation of the NYSDEC-approved Remedial Action Work Plan for this former industrial property, including: in-situ testing, off-site transport, the closure of two petroleum spills; the registration, removal, and closure of five petroleum storage tanks encountered during excavation; and the delineation of soil contaminants, including hazardous lead, petroleum, and pesticides. As the Environmental Scientist, Ms. Bosco provided remedial oversight during soil excavation, confirmatory endpoint sampling, SSDS piping installation and inspections, vapor barrier installation, and air monitoring for particulates and volatile organic compounds (VOCs).

145 West Street, Greenpoint, Brooklyn, NY

As the Environmental Scientist and Deputy Project Manager for this project, Ms. Bosco conducted a supplemental remedial investigation, including soil and groundwater sampling, and several rounds of waste characterization soil sampling. Ms. Bosco also performed remedial oversight during activities such as soil excavation and off-site disposal, underground storage tank (UST) removal, SSDS piping installation and testing, and routine air monitoring. Ms. Bosco also aided in the preparation of the Final Engineering Report (FER) and Site Management Plan (SMP).

Former Laundry/Dry Cleaning Plant, New York, NY

Ms. Bosco served as the Environmental Scientist of the only New York State Department of Environmental Conservation's (NYSDEC) listed inactive hazardous waste (State Superfund) site in Manhattan, a former laundry/dry cleaning plant in Harlem. Remedial investigation included evaluation of soil, groundwater, soil vapor, indoor air, and building materials. Interim remediation included the removal of contaminated building materials and operation of an innovative sub-slab vapor extraction system retrofitted into the existing building. As the Environmental Scientist, Ms. Bosco performed remedial action oversight, including SSDS piping installation inspections and Health and Safety Plan (HASp) air monitoring for volatiles and particulates. Remedial action work was completed in 2014 and documented in a Final Engineering Report. NYSDEC issued Certificate of Completion in January 2015 and the site has been reclassified to a "Class 4" site (site properly closed – requires continued management). Ongoing activities continue under the NYSDEC-approved Site Management Plan, including operations, maintenance and monitoring of the SSDS and SVE system.

RELEVANT EXPERIENCE – OTHER

PS&S Engineering, Inc. (PS&S), Yonkers, NY

Before joining AKRF, Ms. Bosco was an Environmental Scientist in the Environmental Department at PS&S. She was responsible for conducting site investigations and providing construction oversight for remediation projects in New York and New Jersey. As a staff scientist, she was responsible for sampling and analysis of various media, preparing technical reports and work plans, and conducting Phase I Environmental Site Assessments.



EVAN VENICE

ENVIRONMENTAL SCIENTIST/PROFESSIONAL II

Evan Venice is an Environmental Scientist/Professional II in the AKRF, Inc. Hazardous Materials Department with experience in preparing Phase I environmental site assessments, Phase II Site Investigations, Remedial Investigations, and technical reporting.

BACKGROUND

Role in Project

Junior Environmental Scientist

Education

B.S., Environmental Resource Management, The Pennsylvania State University, 2015

Certifications

OSHA 40-hour HAZWOPER Certified

OSHA 30-hour Construction Health & Safety

DOL Asbestos Inspector Certified, May 2019

Transportation Worker Identification Credential (TWIC), March 2016

Years of experience

Date started at AKRF: April 2019

Prior industry experience: Atlantic Environmental Solutions Inc. (AESI) – October 2015-March 2019 (3.5 years)

RELEVANT EXPERIENCE – AESI

As an Environmental Scientist at AESI, Mr. Venice performed Phase I Environmental Site Assessments for various residential, commercial, and industrial properties in the tri-state area. He performed and oversaw environmental investigation field work for Phase II and Remedial Investigations, including soil and groundwater sampling and vapor intrusion assessments. His work included supporting the project manager and other senior project staff to prepare Site/Remedial Investigation Reports, NJ Licensed Site Remediation Professional (LSRP) forms, and Remedial Action Outcome reports. While at AESI, Mr. Venice also coordinated asbestos and lead abatement projects, conducted wetland delineations, and performed air sampling for mold.

RELEVANT EXPERIENCE – AKRF

P.S. 101 (K101) - Brooklyn, NY – Training for Water Disinfection and Sampling Oversight

AKRF provided oversight of disinfection and water quality testing for the NYCSCA at P.S. 101 (K101), located at 2650 Benson Avenue in Brooklyn. Mr. Venice assisted with oversight of the disinfection and water sampling of a new 6" combined connection from 24th Avenue serving P.S. 101.



EVAN VENICE

ENVIRONMENTAL SCIENTIST | p. 2

SMJ – Y-15 - Bronx, NY – Phase I Environmental Site Assessment & Phase II Workplan Implementation

Mr. Venice prepared a Phase I ESA for a portfolio of properties in the Bronx as part of a real estate transaction and redevelopment project. As part of the assessment, Mr. Venice reviewed federal and state regulatory databases, and evaluated historical fire insurance maps and building records to identify recognized environmental conditions (RECs) and environmental concerns. Mr. Venice also prepared a Phase II Limited Subsurface Investigation Workplan based upon the recommendations of the Phase I ESA, which included performing sub-slab vapor, indoor air, and ambient air sampling.

2350 Fifth Avenue, Manhattan, NY – Groundwater Monitoring

AKRF performs quarterly groundwater monitoring and sub-slab depressurization system (SSDS) monitoring at this site which requires ongoing site management activities in accordance with the NYSDEC-approved Revised Site Management Plan (SMP), dated October 2017. Mr. Venice performed low-flow groundwater sampling as part of quarterly monitoring activities to assess the progress of the cleanup.



CHRISTOPHER PUOPLO

FIELD TECHNICIAN

Christopher Puoplo is geologist in AKRF's Hazardous Materials Department. He has experience in groundwater sampling, air monitoring, water disinfection and sampling, lead in water sampling, SWPPP inspections, phase II subsurface investigations, sturgeon monitoring, crewing and driving a motorboat, and construction oversight. Mr. Puoplo is a 2013 graduate of SUNY Oneonta, where he majored in geology.

BACKGROUND

Education

BS Geology, State University of New York, College at Oneonta, Oneonta, NY

Licenses/Certifications

40-Hour OSHA HAZWOPER Certified
10-Hour OSHA Construction Program Certified
DOL Asbestos Project Monitor, Air Technician, and Inspector Certified
SWPPP Certified
TWIC Certified

Years of experience

Year started in company: 2014
Year started in industry: 2014

RELEVANT EXPERIENCE

New York City School Construction Authority: On-Call Environmental Consulting

Under an on-call contract, AKRF provides the New York City School Construction Authority (NYCSCA) with hazardous materials consulting services. Mr. Puoplo performs environmental assessment tasks including lead in drinking water sampling and plumbing disinfection oversight tasks under the current on-call contract.

80305 NY Wheel, Staten Island, NY

Working with the New York City Department of Small Business Services (SBS) as lead agency, AKRF conducted an environmental review for the forthcoming Empire Outlets and New York Observation Wheel (NY Wheel), a mixed-use development situated on a State Voluntary Cleanup Program (VCP) site managed by the New York City Economic Development Corporation (EDC), on the northern Staten Island waterfront. The approximately 60-story NY Wheel will be one of the world's tallest Ferris wheels, while Empire Outlets will be New York City's first outlet mall. The combined project is the largest investment in the borough since the construction of the Verrazano-Narrows Bridge in the 1960s.

AKRF is also providing hazardous materials services and civil engineering services to New York Wheel LLC during construction on the NY Wheel site. Mr. Puoplo has performed construction oversight to ensure compliance with the SMP.

30141 87 Gedney Way, White Plains NY – Groundwater Sampling



CHRISTOPHER PUOPLO³⁰¹⁴¹

ENVIRONMENTAL SCIENTIST | p. 2

AKRF was hired by the City of White Plains' Department of Public Works (DPW) to prepare a Site Investigation Work Plan (SIWP) of the 22.7-acre Gedney Way Leaf and Yard Waste Compost Facility. AKRF completed the SIWP and obtained NYSDEC approval on the plan. AKRF also collected soil, groundwater, soil gas and surface water samples. Closure activities have been completed and New York State Department of Environmental Conservation (NYSDEC) closure approval is pending. As part of ongoing monitoring, Mr. Puoplo screened wells for methane, measured depth to groundwater, and collected groundwater samples from the site.

03399 Rego Park Home Depot, Queens, NY

Solvent contamination was encountered during retail development of a former industrial property in Rego Park, Queens, New York. The site work included an extensive investigation and a multi-phase remediation performed under the NYSDEC Voluntary Cleanup Program (VCP). Remediation included removal of aboveground and underground storage tanks (ASTs and USTs) and hotspot soil removal. An AS/SVE groundwater remediation system designed by AKRF was installed as part of the building construction. Mr. Puoplo performed quarterly groundwater monitoring.

all 9 storage deluxe projects? Storage Deluxe, Various Locations, NY

AKRF assists Storage Deluxe with the ongoing expansion of their self-storage facilities primarily in the five boroughs of New York City and Westchester County. AKRF provides environmental due diligence services related to their property transactions, including Phase I Environmental Site Assessments (ESAs), Phase II investigations, and geophysical surveys, remediation, as well as consulting on petroleum bulk storage tank management. Mr. Puoplo has assisted Storage Deluxe with asbestos surveys at various properties.

11259 34 Berry Street, Williamsburg, NY

AKRF was retained to prepare close-out documentation for this former industrial/warehouse facility in Williamsburg, which was remediated under the New York City Office of Environmental Remediation (OER) E-designation and NYSDEC Spills programs. The closure report, which was based on documentation provided by the environmental contractor, was prepared on an expedited basis so that the developer could obtain a Certificate of Occupancy in time for the scheduled opening of the new building. AKRF is currently providing on-going remediation monitoring services to fulfill NYSDEC Spill closure requirements. For this project, Mr. Puoplo performed monthly/quarterly groundwater monitoring.

40405 Crestwood 300-308 Columbus Avenue, Tuckahoe, NY – Environmental Monitoring

Investigation and remediation of the former gasoline filling station is being conducted under the New York State Brownfield Cleanup Program (BCP). AKRF completed a Phase I Environmental Site Assessment, Phase II Subsurface Investigation, and prepared a Remedial Action Plan (RAP) to address subsurface contamination during site redevelopment. For this project, Mr. Puoplo served as an on-site environmental monitor who performed construction oversight and conducted work zone and community air monitoring.

30141 Flushing Industrial Park, Flushing, NY

Investigation and remediation of former garage and filling station is being conducted under the New York State BCP. AKRF conducted a remedial investigation, and prepared and executed a Remedial Action Work Plan (RAWP). For this project, Mr. Puoplo served as a lead on-site environmental monitor who performed construction oversight and conducted work zone and community air monitoring.

11454 Extell Construction Oversight, Manhattan, NY

Environmental investigation and remediation of this Site is being conducted under the New York City Voluntary Cleanup Program (VCP) managed by the New York City Mayor's Office of Environmental Remediation (OER). The Site is also subject to environmental review by the NYSDEC. For this project, Mr. Puoplo performed post-remediation groundwater sampling at the site.



CHRISTOPHER PUOPLO³⁰¹⁴¹

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12146 The Crossing at Jamaica Station, Jamaica, NY

AKRF was retained to prepare close-out documentation for this former industrial/warehouse facility in Williamsburg, which was remediated under the New York City Office of Environmental Remediation (OER) E-designation and NYSDEC Spills programs. The closure report, which was based on documentation provided by the environmental contractor, was prepared on an expedited basis so that the developer could obtain a Certificate of Occupancy in time for the scheduled opening of the new building. For this project, Mr. Puoplo performed monthly/quarterly groundwater monitoring.

20434 Tappan Zee Bridge, Tarrytown, NY

AKRF was retained to perform a sturgeon monitoring program with near field monitoring during construction activities at the Tappan Zee Bridge project. For this project, Mr. Puoplo performed sturgeon monitoring and near field data collection, as well as crewing and driving a motor boat.

12546 29-39 East Fordham Road, Fordham, NY

AKRF was retained to perform a phase II subsurface investigation, create and implement a remedial action work plan for this commercial building in Fordham which had an aboveground oil storage tank spill, which was remediated under the NYSDEC Spills programs. The spill is still open today. For this project, Mr. Puoplo acted as the primary field person for construction oversight during soil remediation, installation of groundwater monitoring wells, and concrete restoration.

804001 Adelaar Resort (Formerly known as Concord Resort), Thompson, NY

Developed over several years and phases, the Adelaar Resort project will redevelop the historic Concord Resort into a variety of amenities, uses, and experiences. The Adelaar Resort will include a Resort Core with casino hotels and conference facilities, an entertainment village, a family resort area, and a residential village encompassing a total area of over 1,500 acres. AKRF was retained for engineering and remediation oversight. For this project, Mr. Puoplo conducted construction oversight, community and work zone air monitoring during remediation activities, collected soil samples, and performed stormwater pollution prevention plan (SWPPP) inspections. All activities done in accordance with the RAWP, SMP, and SWPPP.

12259 Marymount School, Manhattan, NY

AKRF was retained to perform a phase I environmental site assessment (ESA) and phase II subsurface investigation to be submitted to the NYSDEC for the athletic field at Marymount School in Manhattan, NY prior to redevelopment of the field. For this project, Mr. Puoplo performed the phase II subsurface investigation, which included soil boring oversight and logging, temporary monitoring well development, sampling, and subsequent abandonment, and installation and sampling of temporary soil vapor monitoring points.

References

Ms. Saritha Thumma
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CHRISTOPHER PUOPLO₃₀₁₄₁

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APPENDIX B
HEALTH AND SAFETY PLAN

138 BRUCKNER BOULEVARD

BRONX, NEW YORK

Health and Safety Plan & Community Air Monitoring Plan

NYSDEC BCP Site No.: TBD
AKRF Project Number: 190253

Prepared For:

New York State Department of Environmental Conservation
Division of Environmental Remediation, Remedial Bureau B
625 Broadway, 12th Floor
Albany, New York 12233

Prepared On Behalf Of:

138 Bruckner Owner LLC
% Artimus
316 West 118th Street
New York, NY 10026

Prepared by:



AKRF, Inc.
440 Park Avenue South, 7th Floor
New York, New York 10016
212-696-0670

SEPTEMBER 2019

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FIGURES

Figure 1 –Site Location Map

Figure 2 – Hospital Location Map

ATTACHMENTS

Attachment A – Potential Health Effects from On-Site Contaminants

Attachment B – Report Forms

Attachment C – Emergency Hand Signals

1.0 INTRODUCTION

This environmental Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) has been developed for the implementation of a Remedial Investigation (RI) by AKRF, Inc. (AKRF) personnel and its subcontractors at the property located at 138 Bruckner Boulevard and 107 Saint Ann's Avenue in the Mott Haven section of the Bronx, New York, hereafter referred to as the "Site." The Site is identified by the City of New York as Borough of the Bronx, Block 2260, Lots 10 and 19. The Site consists of an approximately 50,625-square foot property, including a one- to two-story warehouse operated by Zaro's Bakery on Lot 10 and an asphalt-paved parking lot for the adjacent bakery on Lot 19. The Site is bound to the north by Bruckner Boulevard and two multi-family residential buildings, followed by a sheet metal supply warehouse and storage yard, and mixed residential and commercial uses; to the east by St. Ann's Avenue, followed by a warehouse and showroom for SICIS Mosaic Factory; to the south by East 132nd Street, followed by a food depot warehouse; and to the west by a gasoline station and an iron works. The Site is located in a developed area including predominantly industrial and transportation-related uses, with commercial and residential properties located further north and east. A Site Location Map is provided as Figure 1.

A July 2019 Subsurface (Phase II) Investigation conducted by Langan Engineering, Environmental, Surveying, Landscape Architecture and Geology, D.P. (Langan) and a September 2019 Phase II investigation conducted by AKRF concluded that contaminated soil and groundwater are present at the Site. The semivolatile organic compounds (SVOCs) and metals in soil appear to be related to historic Site operations and/or filling with material of unknown origin. The Remedial Investigation (RI) will consist of the collection and laboratory analysis of soil, groundwater, and soil vapor samples to define the nature and extent of contamination in on-site soil, groundwater, and soil vapor.

This HASP and CAMP does not discuss routine health and safety issues common to general construction and excavation, including, but not, limited to slips, trips, falls, shoring, and other physical hazards. All AKRF employees are directed that all work must be performed in accordance with the AKRF's Generic HASP and all Occupation Safety and Health Administration (OSHA)-applicable regulations for the work activities required for the project. All project personnel are furthermore directed that they are not permitted to enter Permit Required Confined Spaces (as defined by OSHA). For issues unrelated to contaminated materials, all non-AKRF employees are to be bound by all applicable OSHA regulations as well as any more stringent requirements specified by their employer in their corporate HASP or otherwise. AKRF is not responsible for providing oversight for issues unrelated to contaminated materials for non-employees. This oversight shall be the responsibility of the employer of that worker or other official designated by that employer.

2.0 HEALTH AND SAFETY GUIDELINES AND PROCEDURES

2.1 Hazard Evaluation

2.1.1 Hazards of Concern

Hazards of concern include: organic and inorganic chemicals, and heat and/or cold stress.

2.1.2 Physical Characteristics

Physical characteristics of the hazards of concern include solid, aqueous, and vapor states.

2.1.3 Hazardous Materials

The Site-specific hazardous materials that may be encountered during RI implementation include: historical fill material, petroleum- and/or solvent-related VOCs, SVOCs, pesticides, petroleum, polychlorinated biphenyls (PCBs), metals, motor oil, hydraulic oil, gasoline, and/or fuel oil.

2.1.4 Chemicals of Concern

Chemicals	REL/PEL/STEL	Health Hazards
Arsenic	REL = 0.002 mg/m ³ PEL = 0.010 mg/m ³	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, [potential occupational carcinogen]
Barium	REL = 0.5 mg/m ³ PEL = 0.5 mg/m ³	Irritation of eyes, skin, upper respiratory system; skin burns; gastroenteritis; muscle spasm; slow pulse, extrasystoles; hypokalemia.
Benzene	REL = 0.1 ppm PEL = 1 ppm STEL = 5 ppm	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude, dermatitis; bone marrow depression, potential occupational carcinogen.
Carbon Disulfide	REL: 1 ppm STEL: 10 ppm PEL: 20 ppm PEL : 30 ppm; 30-min man peak: 100 ppm	Dizziness, headache, poor sleep, lassitude (weakness, exhaustion), anxiety, anorexia, weight loss; psychosis; polyneuropathy; Parkinson-like syndrome; ocular changes; coronary heart disease; gastritis; kidney, liver injury; eye, skin burns; dermatitis; reproductive effects.
Copper	REL = 1 mg/m ³ PEL = 1 mg/m ³	Irritation eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis.
Chromium	REL = 0.5 mg/m ³ PEL = 0.5 mg/m ³	Irritation eyes, skin; sensitization dermatitis; lung fibrosis (histologic)
Ethylbenzene	REL = 100 ppm PEL = 100 ppm	Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma.
Fuel Oil	REL = 350 mg/m ³ PEL = 400 ppm	Nausea, irritation – eyes, hypertension, headache, light-headedness, loss of appetite, poor coordination; long-term exposure – kidney damage, blood clotting problems; potential carcinogen.
Lead	REL = 0.1 mg/m ³ PEL = 0.05 mg/m ³	Weakness, lassitude, insomnia; facial pallor, pale eye, anorexia, low-weight, malnutrition, constipation, abdominal pain, colic; anemia; gingival lead line; tremors, paralysis wrists and ankles; encephalopathy; kidney disease; irritation eyes; hypotension.

Chemicals	REL/PEL/STEL	Health Hazards
Mercury	REL = 0.1 mg/m ³ PEL = 0.05 mg/m ³	Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria.
Naphthalene	REL = 15 ppm PEL = 10 ppm	Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage.
Nickel	REL = 0.015 mg/m ³ PEL = 1 mg/m ³	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen].
PCBs	PCB-1242: REL = 1 mg/m ³ PEL = 0.001 mg/m ³ PCB-1254: REL = 0.5 mg/m ³ PEL = 0.001 mg/m ³	Rash; anemia, liver, stomach, thyroid damage; reduced ability to fight disease; impaired reproduction.
Polycyclic Aromatic Hydrocarbons (PAHs)	PEL = 5 mg/m ³	Harmful effects to skin, bodily fluids, and ability to fight disease, reproductive problems; [potential occupational carcinogen].
Tetrachloroethylene (PCE)	PEL = 100 ppm STEL = 200 ppm	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, poor coordination; headache, drowsiness; skin erythema (skin redness); liver damage; potential occupational carcinogen.
Toluene	REL = 100 ppm PEL = 200 ppm STEL = 300 ppm	Irritation eyes, nose; lassitude, confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage.
Trichloroethylene (TCE)	PEL = 100 ppm	Lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen].
Xylenes	REL = 100 ppm PEL = 100 ppm	Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, poor coordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis.
Zinc	REL = 5 mg/m ³ (dust and fume) PEL = 5 mg/m ³ (fume) 15 mg/m ³ (total dust) 5 mg/m ³ (respirable dust)	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function.
Comments: REL = National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limit PEL = OSHA Permissible Exposure Limit STEL = OSHA Short Term Exposure Limit		

The potential health effects from these known and suspected on-site contaminants are provided in Attachment A.

2.2 Designated Personnel

AKRF will appoint one of its on-site personnel as the Site Safety Officer (SSO). This individual will be responsible for the implementation of the HASP. The SSO will work under the direction of a Qualified Environmental Professional (QEP) and will be experienced in the implementation of air monitoring and hazardous materials sampling programs. Health and safety training required for the SSO and all field personnel are outlined in Section 2.3 of this HASP.

2.3 Training

All personnel who enter the work area while intrusive activities are being performed will have completed a 40-hour training course that meets OSHA requirements of 29 CFR Part 1910, Occupational Safety and Health Standards. In addition, all personnel will have up-to-date 8-hour refresher training. The training will allow personnel to recognize and understand the potential hazards to health and safety. All field personnel must attend a training program, whose purpose is to:

- Make them aware of the potential hazards they may encounter;
- Provide the knowledge and skills necessary for them to perform the work with minimal risk to health and safety;
- Make them aware of the purpose and limitations of safety equipment; and
- Ensure that they can safely avoid or escape from emergencies.

Each member of the field crew will be instructed in these objectives before work begins. A Site safety meeting will be conducted at the start of the project work. Additional meetings shall be conducted, as necessary, for new personnel working at the Site.

2.4 Medical Surveillance Program

All AKRF and subcontractor personnel performing field work involving subsurface disturbance at the Site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). A physician's medical release for work will be confirmed by the SSO before an employee can begin Site activities. The medical release shall consider the type of work to be performed and the required personal protective equipment (PPE). The medical examination will, at a minimum, be provided annually and upon termination of hazardous waste Site work.

2.5 Site Work Zones

During any activities involving subsurface disturbance, the work area must be divided into various zones to prevent the spread of any contamination, ensure that proper PPE is donned, and provide an area for decontamination.

The Exclusion Zone is defined as the area where exposure to impacted media could be encountered. The Contamination Reduction Zone (CRZ) is the area where decontamination procedures take place and is located next to the Exclusion Zone. The Support is the zone area where support facilities such as vehicles, fire extinguisher, and first aid supplies are located. The emergency staging area (part of the Support Zone) is the area where all workers on-site would assemble in the event of an emergency. A summary of these areas is provided below. These zones may be changed by the SSO, depending on that day's activities. All field personnel will be informed of the location of these zones before work begins. The exclusion zone and CRZ are 10 and 25 feet from the drill rig during the RI, respectively. Control measures such as caution tape and/or traffic cones will be placed around the perimeter of the work area when needed.

2.6 Air Monitoring

The purpose of the air monitoring program is to identify any exposure of the field personnel and the community to potential environmental hazards in the soil and groundwater. Air Monitoring will be conducted in accordance with the New York State Department of Health (NYSDOH) and New York State Department of Environmental Conservation (NYSDEC) guidance. Results of the air monitoring will be used to determine the appropriate response action, if needed. Field personnel will be trained in the proper operation of all field instruments at the start of the field program. The equipment will be calibrated according to manufacturer specifications at the start of each day of fieldwork. If an instrument fails calibration, the project manager will be contacted immediately to obtain a replacement instrument and arrange for repairs.

2.6.1 Volatile Organic Compound (VOC) Monitoring

Continuous monitoring for VOCs will be conducted during all ground-intrusive activities, including soil boring advancement and groundwater monitoring well installation. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background concentrations. VOCs will be monitored continuously at the downwind perimeter of the exclusion zone. Monitoring will be conducted with a photoionization detector (PID) equipped with an 10.6 electron Volt (eV) lamp capable of calculating 15-minute running average concentrations. More frequent intervals of monitoring will be conducted if required as determined by the SSO. All PID readings will be recorded and available for NYSDEC and NYSDOH personnel to review. Instantaneous readings will also be recorded.

2.6.2 Airborne Particulate Monitoring

A DustTrak® or equivalent would be used to measure real-time concentrations of total particulates 10 micrometers or less (PM₁₀). Measurements for particulates will be taken prior to commencement of the work and during the work in areas where contaminated soil would be disturbed. The action levels listed in Table 1 are based on 15-minute averages of the monitoring data. The measurements will be made at the breathing height of the workers and as close to their location as practicable. The Site Safety Officer (SSO) will set up the equipment and confirm that it is working properly. His/her qualified designee may oversee the air measurements during the day. The initial measurement for the day will be performed before the start of work and will establish background levels. The final measurement for the day will be performed after the end of work. The action levels for particulates and VOCs and required responses are listed in Table 1.

Table 1
Action Levels and Required Responses

Monitoring	Action Level ¹	Response Action
Particulate	Less than 0.125 mg/m ³ above background	Level D or D-Modified (Requires coveralls and steel toe boots) (As applicable: Chemical resistant gloves, chemical resistant boot covers, hard hat, safety glasses, face shield, or escape mask)

Table 1
Action Levels and Required Responses

Monitoring	Action Level ¹	Response Action
	Between 0.125 mg/m ³ and 0.150 mg/m ³ above background	Level C (Requires full face or half face respirator, hooded chemical resistant two piece Tyvek suit or overalls, chemical resistant inner and outer gloves, chemical resistant boot covers, steel toe and shank boots) (As applicable: hard hat, face shield, or escape mask) Apply dust suppression measures. Resume work or upgrade.
	Greater than 0.150 mg/m ³ above background	Stop work. Apply additional dust suppression measures. Resume work when less than 0.150 mg/m ³ and maintain Level C.
Volatile Organic Compound (VOC)	Less than 5 ppm in breathing zone	Level D or D-Modified
	Between 5 and 50 ppm	Level C
	More than 50 ppm	Stop work. Resume work when source of vapors is abated and readings are less than 50 ppm above background.
Notes: ¹ - 15-minute time-weighted average parts per million = ppm milligrams per cubic meter = mg/m ³		

2.6.3 Major Vapor Emission Response Plan

If any organic levels greater than 5 ppm over background are identified 200 feet downwind from the work Site, or half the distance to the nearest residential or commercial property, whichever is less, all work activities must be halted or vapor controls must be implemented.

If, following the cessation of the work activities, or as the result of an emergency, organic levels persist above 5 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the exclusion zone, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 Foot Zone).

If either of the following criteria is exceeded in the 20 Foot Zone, then the Major Vapor Emission Response Plan shall automatically be implemented:

- Sustained organic vapor levels approaching 1 ppm above background for a period of more than 30 minutes; or
- Organic vapor levels greater than 5 ppm above background for any time period.

Upon activation, the following activities shall be undertaken as part of the Major Vapor Emission Response Plan:

- The NYSDEC, NYSDOH, and local police authorities will be immediately contacted by the SSO and advised of the situation;
- Frequent air monitoring will be conducted at 30-minute intervals within the 20 Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the Site Health and Safety Officer; and
- All Emergency contacts will go into effect as appropriate.

- All readings will be recorded and be available for NYSDEC and NYSDOH personnel to review.

2.7 Personal Protection Equipment (PPE)

The PPE required for various kinds of investigation tasks are based on 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, Appendix B, “General Description and Discussion of the Levels of Protection and Protective Gear.”

AKRF field personnel and other site personnel shall wear, at a minimum, Level D PPE. The protection will be based on the air monitoring described in Section 2.6.

Level D PPE includes donning of the following during drilling and sampling:

- Steel Toed Boots
- Hard Hat
- Work Gloves
- Safety Glasses
- Ear Plugs
- Nitrile Gloves
- Tyvek Suit [if non-aqueous phase liquid (NAPL) is present]

If PID readings exceed 15 ppm in the breathing zone, personnel will don Level C PPE, which includes Level D PPE and a half- or full-face respirator with a dual organic and particulate cartridge.

2.8 General Work Practices

To protect the health and safety of the field personnel, field personnel will adhere to the guidelines listed below during activities involving subsurface disturbance:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited, except in designated areas on the Site. These areas will be designated by the SSO.
- Workers must wash their hands thoroughly on leaving the work area and before eating, drinking, or any other such activity.
- The workers should shower as soon as possible after leaving the Site. Contact with contaminated or suspected surfaces should be avoided.
- The buddy system should always be used; each buddy should watch for signs of fatigue, exposure, and heat/cold stress.

3.0 EMERGENCY PROCEDURES AND EMERGENCY RESPONSE PLAN

The field crew will be equipped with emergency equipment, such as a first aid kit and disposable eye washes. In the case of a medical emergency, the SSO will determine the nature of the emergency and he/she will have someone call for an ambulance, if needed. If the nature of the injury is not serious, i.e., the person can be moved without expert emergency medical personnel, he/she should be taken to a hospital by on-site personnel. Directions to the hospital are provided below, and a Hospital Location Map showing the more direct route to the hospital is included as Figure 2.

3.1 Hospital Information

Hospital Name:	Lincoln Medical Center
Phone Number:	(718) 579-5784
Address:	234 East 149 th Street, Bronx, NY 10451
Directions:	1. Turn left out of the Site, heading east toward St. Ann's Avenue. 2. Turn left onto St Ann's Avenue. 3. Turn left onto East 135th Street. 4. Merge left onto Interstate 87 North. 5. Take Exit 3 and merge onto Grand Concourse. 6. Turn right onto East 144th Street. 7. Turn left onto Park Avenue. 7. The emergency room will be on the right.

3.2 Emergency Contacts

Company	Individual Name	Title	Contact Number
AKRF	Michelle Lapin	Professional Engineer (P.E.)	(646) 388-9520
	Stephen Malinowski	Project Director, QEP, NYSPG QA/QC Officer	(631) 574-3724
	Adrianna Bosco	Project Manager	(646) 388-9576
	Evan Venice	Field Team Leader / Site Safety Officer	(646) 388-9871
	Chris Puoplo	Site Safety Officer Alternate	(914) 419-7263 (cell)
138 Bruckner Owner LLC	Evan Kashanian	Owner's Representative	(212) 996-5100
Ambulance, Fire Department & Police Department	-	-	911
NYSDEC Spill Hotline	-	-	800-457-7362

4.0 APPROVAL & ACKNOWLEDGMENTS OF HASP

4.1 Approval

Signed: _____ Date: _____
AKRF Project Manager

Signed: _____ Date: _____
AKRF Health and Safety Officer

Below is an affidavit that must be signed by all workers who enter the site. A copy of the HASP must be on-site at all times and will be kept by the SSO.

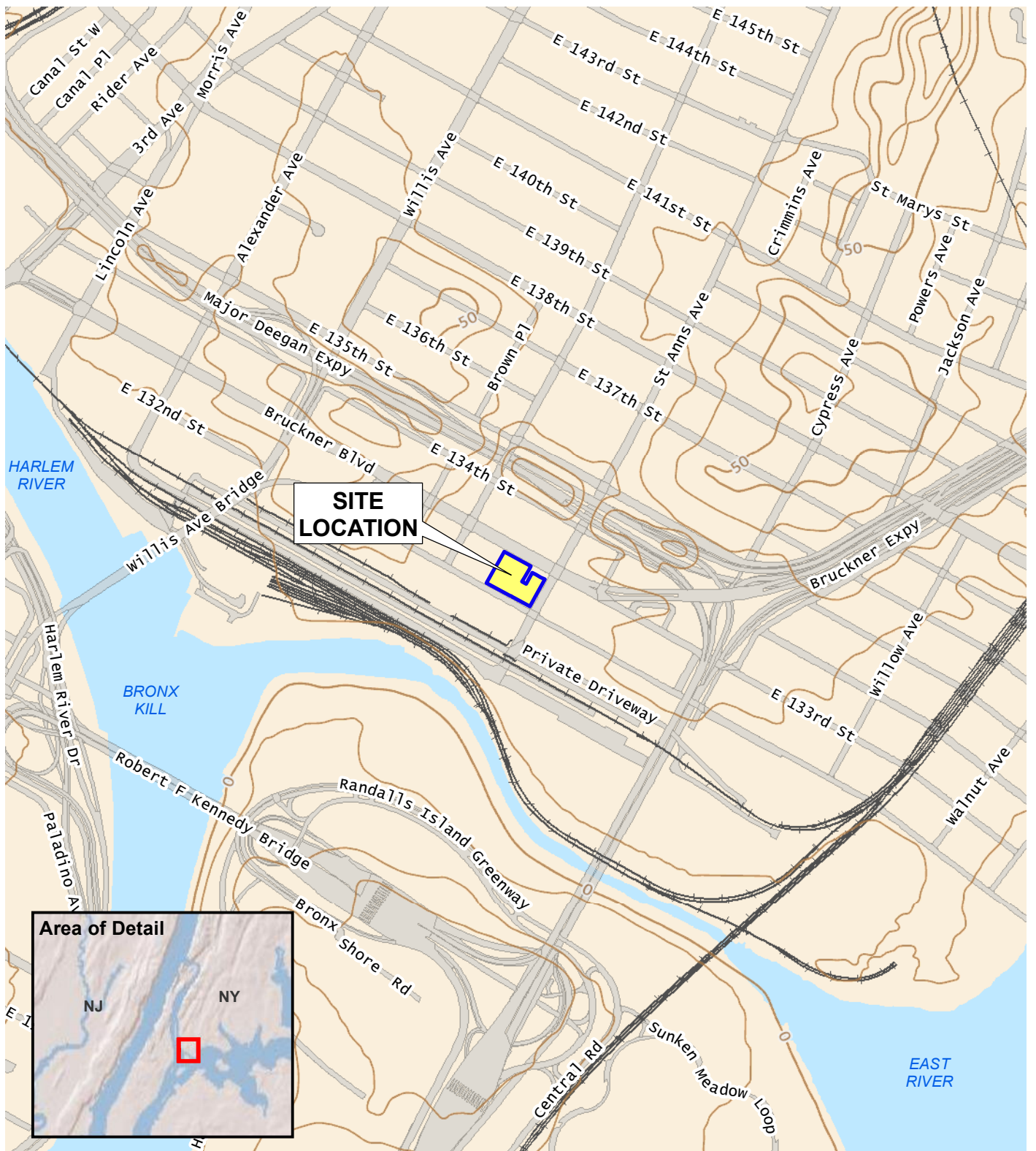
4.2 Affidavit

I have read the Health and Safety Plan (HASP) for the project located at 138 Bruckner Boulevard in the Bronx, New York. I agree to conduct all on-site work in accordance with the requirements set forth in this HASP and understand that failure to comply with this HASP could lead to my removal from the site.

Signed: _____	Company: _____	Date: _____
Signed: _____	Company: _____	Date: _____
Signed: _____	Company: _____	Date: _____
Signed: _____	Company: _____	Date: _____
Signed: _____	Company: _____	Date: _____
Signed: _____	Company: _____	Date: _____
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FIGURES

© 2019 AKRF. W:\Projects\190253 - ARTIMUS 138 BRUCKNER BLVD\Technical\GIS and Graphics\Hazmat\190253 Fig 1 site loc map.mxd 8/26/2019 3:03:52 PM mvelieux



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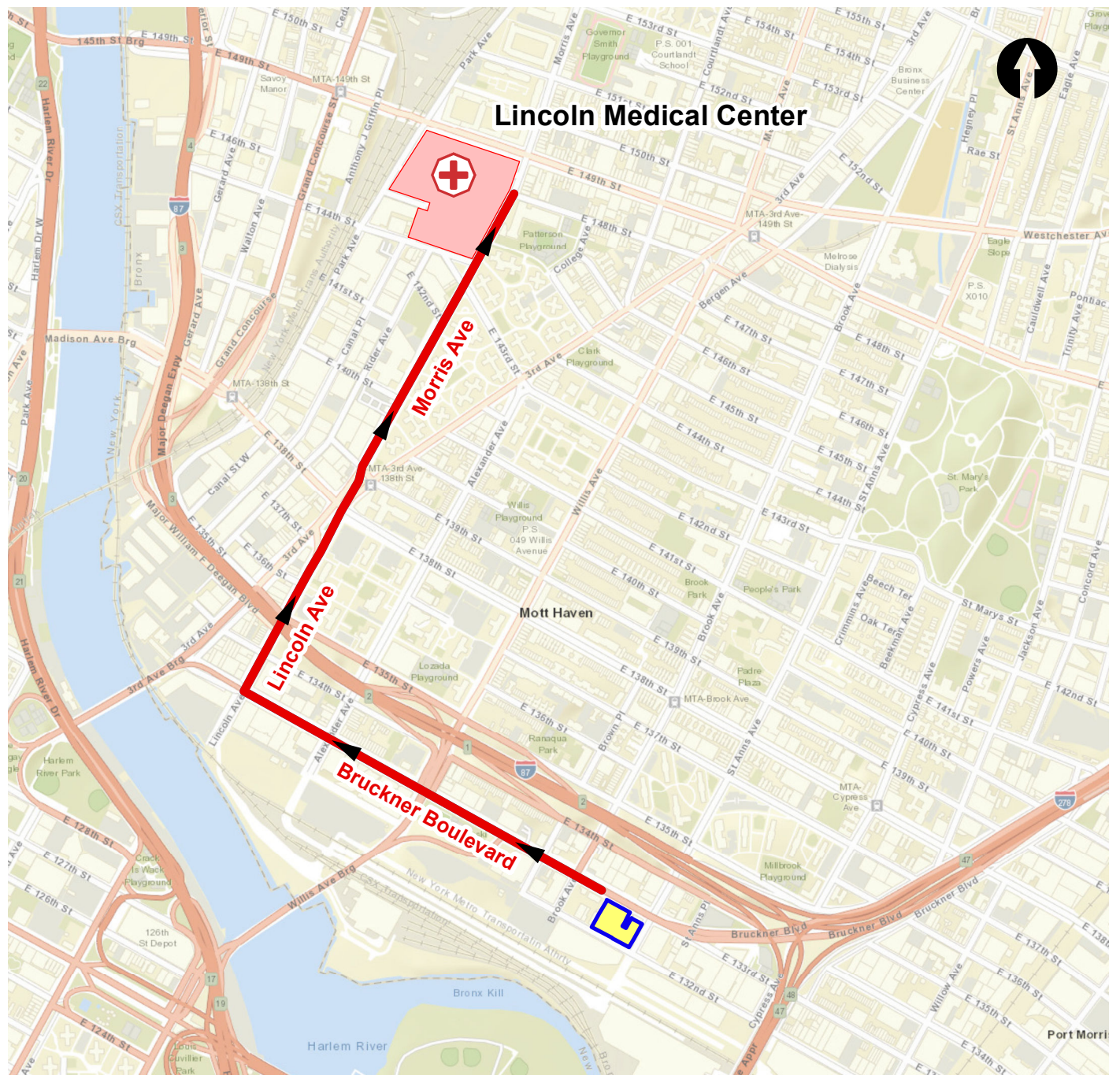


440 Park Avenue South, New York, NY 10016

138 Bruckner Boulevard
Bronx, New York

SITE LOCATION

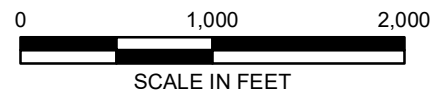
DATE 8/26/2019
PROJECT NO. 190253
FIGURE 1



Service Layer Credits: ESRI World Street Map 2019

LEGEND

-  PROJECT SITE BOUNDARY
-  ROUTE TO HOSPITAL
-  HOSPITAL LOCATION



Lincoln Medical Center
234 E. 149th Street
Bronx, NY 10451
(718) 579-5000



440 Park Avenue South, New York, NY 10016

138 Bruckner Boulevard
Bronx, New York

HOSPITAL ROUTE MAP

DATE	9/13/2019
PROJECT NO.	190253
FIGURE	2

ATTACHMENT A
POTENTIAL HEALTH EFFECTS FROM ON-SITE CONTAMINANTS

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to higher than average levels of arsenic occurs mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found at 1,014 of the 1,598 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants.

What happens to arsenic when it enters the environment?

- ☐ Arsenic cannot be destroyed in the environment. It can only change its form.
- ☐ Arsenic in air will settle to the ground or is washed out of the air by rain.
- ☐ Many arsenic compounds can dissolve in water.
- ☐ Fish and shellfish can accumulate arsenic, but the arsenic in fish is mostly in a form that is not harmful.

How might I be exposed to arsenic?

- ☐ Eating food, drinking water, or breathing air containing arsenic.
- ☐ Breathing contaminated workplace air.
- ☐ Breathing sawdust or burning smoke from wood treated with arsenic.
- ☐ Living near uncontrolled hazardous waste sites containing arsenic.
- ☐ Living in areas with unusually high natural levels of arsenic in rock.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the

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appearance of small “corns” or “warts” on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as inorganic arsenic.

How likely is arsenic to cause cancer?

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization (WHO), the Department of Health and Human Services (DHHS), and the EPA have determined that inorganic arsenic is a human carcinogen.

How can arsenic affect children?

We do not know if exposure to arsenic will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to inorganic arsenic.

It is likely that health effects seen in children exposed to high amounts of arsenic will be similar to the effects seen in adults.

How can families reduce the risk of exposure to arsenic?

- ☐ If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
- ☐ If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.

Is there a medical test to show whether I've been exposed to arsenic?

There are tests to measure the level of arsenic in blood, urine, hair, or fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels of arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict how the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or canceled many uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration has set limits of 10 µg arsenic per cubic meter of workplace air (10 µg/m³) for 8 hour shifts and 40 hour work weeks.

Source of Information

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about barium and barium compounds. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because these substances may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to barium occurs mostly in the workplace or from drinking contaminated water. Ingesting drinking water containing levels of barium above the EPA drinking water guidelines for relatively short periods of time can cause gastrointestinal disturbances and muscle weakness. Ingesting high levels for a long time can damage the kidneys. Barium and barium compounds have been found in at least 798 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is barium?

Barium is a silvery-white metal which exists in nature only in ores containing mixtures of elements. It combines with other chemicals such as sulfur or carbon and oxygen to form barium compounds.

Barium compounds are used by the oil and gas industries to make drilling muds. Drilling muds make it easier to drill through rock by keeping the drill bit lubricated. They are also used to make paint, bricks, ceramics, glass, and rubber.

Barium sulfate is sometimes used by doctors to perform medical tests and to take x-rays of the gastrointestinal tract.

What happens to barium when it enters the environment?

- ☐ Barium gets into the air during the mining, refining, and production of barium compounds, and from the burning of coal and oil.
- ☐ The length of time that barium will last in air, land, water, or sediments depends on the form of barium released.
- ☐ Barium compounds, such as barium sulfate and barium carbonate, which do not dissolve well in water, can last a long time in the environment.

☐ Barium compounds, such as barium chloride, barium nitrate, or barium hydroxide, that dissolve easily in water usually do not last in these forms for a long time in the environment. The barium in these compounds that is dissolved in water quickly combines with sulfate or carbonate that are naturally found in water and become the longer lasting forms (barium sulfate and barium carbonate).

☐ Fish and aquatic organisms can accumulate barium.

How might I be exposed to barium?

- ☐ Ingesting small amounts present in your food and water or breathing air containing very low levels of barium.
- ☐ Living in areas with unusually high natural levels of barium in the drinking water.
- ☐ Working in a job that involves barium production or use.
- ☐ Living or working near waste sites where barium has been disposed of.

How can barium affect my health?

The health effects of the different barium compounds depend on how well the compound dissolves in water or in the stomach contents. Barium compounds that do not dissolve well, such as barium sulfate, are not generally harmful.

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Barium has been found to potentially cause gastrointestinal disturbances and muscular weakness when people are exposed to it at levels above the EPA drinking water standards for relatively short periods of time. Some people who eat or drink amounts of barium above background levels found in food and water for a short period may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness. Eating or drinking very large amounts of barium compounds that easily dissolve can cause changes in heart rhythm or paralysis and possibly death. Animals that drank barium over long periods had damage to the kidneys, decreases in body weight, and some died.

How likely is barium to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified barium as to its carcinogenicity. The EPA has determined that barium is not likely to be carcinogenic to humans following ingestion and that there is insufficient information to determine whether it will be carcinogenic to humans following inhalation exposure.

How can barium affect children?

We do not know whether children will be more or less sensitive than adults to barium toxicity. A study in rats that swallowed barium found a decrease in newborn body weight; we do not know if a similar effect would be seen in humans.

How can families reduce the risks of exposure to barium?

The greatest potential source of barium exposure is through food and drinking water. However, the amount of barium in foods and drinking water are typically too low to be of concern.

Is there a medical test to determine whether I've been exposed to barium?

There is no routine medical test to determine whether you have been exposed to barium. Doctors can measure barium in body tissues and fluids, such as bones, blood, urine, and feces, using very complex instruments. These tests cannot be used to predict the extent of the exposure or potential health effects.

The geometric mean barium level measured in the U.S. general population aged 6 and older is reported by the Centers for Disease Control and Prevention (CDC) as 1.44 µg/g creatinine (measured in urine).

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2.0 milligrams of barium per liter of drinking water (2.0 mg/L), which is the same as 2 ppm.

The Occupational Safety and Health Administration (OSHA) has set Permissible Exposure Limits (PELs) of 0.5 milligrams of soluble barium compounds per cubic meter of workplace air (0.5 mg/m³) for 8 hour shifts and 40 hour work weeks. The OSHA limits for barium sulfate dust are 15 mg/m³ of total dust and 5 mg/m³ for respirable fraction.

The National Institute for Occupational Safety and Health (NIOSH) has set Recommended Exposure Limits (RELs) of 0.5 mg/m³ for soluble barium compounds. The NIOSH has set RELs of 10 mg/m³ (total dust) for barium sulfate and 5 mg/m³ (respirable fraction).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Barium and Compounds (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about benzene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 813 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is benzene?

(Pronounced bĕn'zĕn')

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities.

Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylon and synthetic fibers. Benzene is also used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke.

What happens to benzene when it enters the environment?

- ☐ Industrial processes are the main source of benzene in the environment.
- ☐ Benzene can pass into the air from water and soil.
- ☐ It reacts with other chemicals in the air and breaks down within a few days.
- ☐ Benzene in the air can attach to rain or snow and be carried back down to the ground.

- ☐ It breaks down more slowly in water and soil, and can pass through the soil into underground water.
- ☐ Benzene does not build up in plants or animals.

How might I be exposed to benzene?

- ☐ Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions.
- ☐ Indoor air generally contains higher levels of benzene from products that contain it such as glues, paints, furniture wax, and detergents.
- ☐ Air around hazardous waste sites or gas stations will contain higher levels of benzene.
- ☐ Leakage from underground storage tanks or from hazardous waste sites containing benzene can result in benzene contamination of well water.
- ☐ People working in industries that make or use benzene may be exposed to the highest levels of it.
- ☐ A major source of benzene exposures is tobacco smoke.

How can benzene affect my health?

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>

The major effect of benzene from long-term (365 days or longer) exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection.

Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men.

Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

How likely is benzene to cause cancer?

The Department of Health and Human Services (DHHS) has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

Is there a medical test to show whether I've been exposed to benzene?

Several tests can show if you have been exposed to benzene. There is test for measuring benzene in the breath; this test must be done shortly after exposure. Benzene can also be measured in the blood, however, since benzene disappears rapidly from the blood, measurements are accurate only for recent exposures.

In the body, benzene is converted to products called metabolites. Certain metabolites can be measured in the urine. However, this test must be done shortly after exposure and is not a reliable indicator of how much benzene you have been exposed to, since the metabolites may be present in urine from other sources.

Has the federal government made recommendations to protect human health?

The EPA has set the maximum permissible level of benzene in drinking water at 0.005 milligrams per liter (0.005 mg/L). The EPA requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 1 part of benzene per million parts of air (1 ppm) in the workplace during an 8-hour workday, 40-hour workweek.

Glossary

Anemia: A decreased ability of the blood to transport oxygen.

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Chromosomes: Parts of the cells responsible for the development of hereditary characteristics.

Metabolites: Breakdown products of chemicals.

Milligram (mg): One thousandth of a gram.

Pesticide: A substance that kills pests.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Benzene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about carbon disulfide. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to carbon disulfide can occur by breathing it in the air and by drinking water or eating foods that contain it. Breathing very high levels can be life threatening because of its effects on the nervous system. Breathing low levels for long periods may result in headaches, tiredness, trouble sleeping, and slight changes in the nerves. Carbon disulfide has been found in at least 210 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is carbon disulfide?

(Pronounced kär'bən dī-sŭl'fid')

Pure carbon disulfide is a colorless liquid with a pleasant odor that is like the smell of chloroform. The impure carbon disulfide that is usually used in most industrial processes is a yellowish liquid with an unpleasant odor, like that of rotting radishes.

Carbon disulfide evaporates at room temperature, and the vapor is more than twice as heavy as air. It easily explodes in air and also catches fire very easily.

In nature, small amounts of carbon disulfide are found in gases released to the earth's surface as, for example, in volcanic eruptions or over marshes. Commercial carbon disulfide is made by combining carbon and sulfur at very high temperatures.

What happens to carbon disulfide when it enters the environment?

- ☐ The amount of carbon disulfide released into the air through natural processes is difficult to judge because it is so small.

- ☐ Carbon disulfide evaporates rapidly when released to the environment.
- ☐ Most carbon disulfide in the air and surface water is from manufacturing and processing activities.
- ☐ It is found naturally in coastal and ocean waters.
- ☐ Carbon disulfide does not stay dissolved in water very long, and it also moves through soils fairly quickly.
- ☐ Carbon disulfide does not appear to be taken up in significant amounts by the organisms living in water.

How might I be exposed to carbon disulfide?

- ☐ The people most often exposed to carbon disulfide are workers in plants that use carbon disulfide in their manufacturing processes.
- ☐ People may be exposed by breathing air, drinking water, or eating foods that contain it.
- ☐ People may also be exposed through skin contact with soil, water, or other substances that contain carbon disulfide.

How can carbon disulfide affect my health?

At very high levels, carbon disulfide may be life-threatening because of its effects on the nervous system. People who

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breathed carbon disulfide near an accident involving a railroad car showed changes in breathing and some chest pains.

Some workers who breathed high levels during working hours for at least 6 months had headaches, tiredness, and trouble sleeping. However, these workers may have been exposed to other chemicals besides carbon disulfide. Among workers who breathed lower levels, some developed very slight changes in their nerves.

Studies in animals indicate that carbon disulfide can affect the normal functions of the brain, liver, and heart. After pregnant rats breathed carbon disulfide in the air, some of the newborn rats died or had birth defects.

High concentrations of carbon disulfide have caused skin burns when the chemical accidentally touched people's skin.

How likely is carbon disulfide to cause cancer?

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have not classified carbon disulfide for carcinogenicity.

There are no definitive data in humans or animals that indicate a carcinogenic potential for carbon disulfide.

Is there a medical test to show whether I've been exposed to carbon disulfide?

One chemical test using urine can be done to tell whether the levels of breakdown substances from carbon disulfide are higher than normal. However, the test is not specific for carbon disulfide exposure.

A second test based on a specific breakdown substance is more sensitive and specific. It also requires special equipment and cannot tell you exactly how much carbon disulfide you were exposed to or predict whether harmful effects will occur.

These tests aren't available at most doctors' offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA requires that spills or accidental releases into the environment of 100 pounds or more of carbon disulfide be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set a limit of 20 parts of carbon disulfide per million parts of air (20 ppm) for an 8-hour workday for a 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that workroom air levels of carbon disulfide not exceed 1 ppm for a 10-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: Ability of a substance to cause cancer.

CAS: Chemical Abstracts Service.

Dissolve: To disappear gradually.

Evaporate: To change into vapor or a gas.

References

This ToxFAQs information is taken from the 1996 Toxicological Profile for Carbon Disulfide produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html> ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about chromium. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chromium occurs from ingesting contaminated food or drinking water or breathing contaminated workplace air. Chromium(VI) at high levels can damage the nose and cause cancer. Ingesting high levels of chromium(VI) may result in anemia or damage to the stomach or intestines. Chromium(III) is an essential nutrient. Chromium has been found in at least 1,127 of the 1,669 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is chromium?

Chromium is a naturally occurring element found in rocks, animals, plants, and soil. It can exist in several different forms. Depending on the form it takes, it can be a liquid, solid, or gas. The most common forms are chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds.

The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

What happens to chromium when it enters the environment?

- ☐ Chromium can be found in air, soil, and water after release from the manufacture, use, and disposal of chromium-based products, and during the manufacturing process.
- ☐ Chromium does not usually remain in the atmosphere, but is deposited into the soil and water.
- ☐ Chromium can easily change from one form to another in water and soil, depending on the conditions present.
- ☐ Fish do not accumulate much chromium in their bodies from water.

How might I be exposed to chromium?

- ☐ Eating food containing chromium(III).

- ☐ Breathing contaminated workplace air or skin contact during use in the workplace.
- ☐ Drinking contaminated well water.
- ☐ Living near uncontrolled hazardous waste sites containing chromium or industries that use chromium.

How can chromium affect my health?

Chromium(III) is an essential nutrient that helps the body use sugar, protein, and fat.

Breathing high levels of chromium(VI) can cause irritation to the lining of the nose, nose ulcers, runny nose, and breathing problems, such as asthma, cough, shortness of breath, or wheezing. The concentrations of chromium in air that can cause these effects may be different for different types of chromium compounds, with effects occurring at much lower concentrations for chromium(VI) compared to chromium(III).

The main health problems seen in animals following ingestion of chromium(VI) compounds are irritation and ulcers in the stomach and small intestine and anemia. Chromium(III) compounds are much less toxic and do not appear to cause these problems.

Sperm damage and damage to the male reproductive system have also been seen in laboratory animals exposed to chromium(VI).

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Skin contact with certain chromium(VI) compounds can cause skin ulcers. Some people are extremely sensitive to chromium(VI) or chromium(III). Allergic reactions consisting of severe redness and swelling of the skin have been noted.

How likely is chromium to cause cancer?

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have determined that chromium(VI) compounds are known human carcinogens. In workers, inhalation of chromium(VI) has been shown to cause lung cancer. Chromium(VI) also causes lung cancer in animals. An increase in stomach tumors was observed in humans and animals exposed to chromium(VI) in drinking water.

How can chromium affect children?

It is likely that health effects seen in children exposed to high amounts of chromium will be similar to the effects seen in adults.

We do not know if exposure to chromium will result in birth defects or other developmental effects in people. Some developmental effects have been observed in animals exposed to chromium(VI).

How can families reduce the risks of exposure to chromium?

- ☐ Children should avoid playing in soils near uncontrolled hazardous waste sites where chromium may have been discarded.
- ☐ Chromium is a component of tobacco smoke. Avoid smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.
- ☐ Although chromium(III) is an essential nutrient, you should avoid excessive use of dietary supplements containing chromium.

Is there a medical test to determine whether I've been exposed to chromium?

Since chromium(III) is an essential element and naturally occurs in food, there will always be some level of chromium in your body. Chromium can be measured in hair, urine, and blood.

Higher than normal levels of chromium in blood or urine may indicate that a person has been exposed to chromium. However, increases in blood and urine chromium levels cannot be used to predict the kind of health effects that might develop from that exposure.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to chromium in drinking water at concentrations of 1 mg/L for up to 10 days is not expected to cause any adverse effects in a child.

The FDA has determined that the chromium concentration in bottled drinking water should not exceed 1 mg/L.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 0.0005 mg/m³ chromium(VI), 0.5 mg/m³ chromium(III), and 1.0 mg/m³ chromium(0) for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2008. Toxicological Profile for Chromium (Draft for Public Comment). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about copper. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Copper is a reddish metal that occurs naturally in the environment. It also occurs naturally in plants and animals. Low levels of copper are essential for maintaining good health. High levels can cause harmful effects such as irritation of the nose, mouth and eyes, vomiting, diarrhea, stomach cramps, and nausea. Copper has been found in at least 884 of the 1,613 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is copper?

Copper is a reddish metal that occurs naturally in rocks, soil, water, and air. Copper also occurs naturally in plants and animals.

Metallic copper can be easily molded or shaped. Metallic copper can be found in the U.S. penny, electrical wiring, and some water pipes. Metallic copper is also found in mixtures (called alloys) with other metals such as brass and bronze. Copper is also found as part of other compounds forming salts. Copper salts occur naturally, but are also manufactured. The most common copper salt is copper sulfate. Most copper compounds are blue-green in color. Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for wood, leather, and fabrics.

What happens to copper when it enters the environment?

- ☐ Copper can enter the environment from the mining of copper and other metals and from factories that make or use metallic copper or copper compounds.
- ☐ It can also enter the environment through domestic waste water, combustion of fossil fuels and wastes, wood production, phosphate fertilizer production, and natural sources (e.g., windblown dust from soils, volcanoes, decaying vegetation, forest fires, and sea spray).
- ☐ Copper in soil strongly attaches to organic material and minerals.

- ☐ Copper that dissolves in water becomes rapidly bound to particles suspended in the water.
- ☐ Copper does not typically enter groundwater.
- ☐ Copper carried by particles emitted from smelters and ore processing plants is carried back to the ground by gravity or in rain or snow.
- ☐ Copper does not break down in the environment.

How might I be exposed to copper?

- ☐ Breathing air, drinking water, eating food, and by skin contact with soil, water, or other copper-containing substances.
- ☐ Some copper in the environment can be taken up by plants and animals.
- ☐ Higher exposure may occur if your water is corrosive and you have copper plumbing and brass water fixtures. ☐ You may be exposed to higher amounts of copper if you drink water or swim in lakes or reservoirs recently treated with copper to control algae or receive cooling water from a power plant that may have high amounts of dissolved copper.
- ☐ Using some garden products (e.g., fungicides) to control plant diseases.
- ☐ Living near bronze and brass production facilities may expose you to higher copper levels in soil.
- ☐ You may breathe copper-containing dust or have skin contact if you work in the industry of mining copper or

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processing the ore. You may breathe high levels if you grind or weld copper metal.

How can copper affect my health?

Copper is essential for good health, but high amounts can be harmful. Long-term exposure to copper dust can irritate your nose, mouth, and eyes, and cause headaches, dizziness, nausea, and diarrhea.

Drinking water with higher than normal levels of copper may cause vomiting, diarrhea, stomach cramps, and nausea. Intentionally high intakes of copper can cause liver and kidney damage and even death.

How likely is copper to cause cancer?

We do not know whether copper can cause cancer in humans. The EPA has determined that copper is not classifiable as to carcinogenicity.

How can copper affect children?

Exposure to high levels of copper will result in the same type of effects in children and adults. Studies in animals suggest that the young children may have more severe effects than adults; we do not know if this would also be true in humans. There is a very small percentage of infants and children who are unusually sensitive to copper.

We do not know if copper can cause birth defects or other developmental effects in humans. Studies in animals suggest that ingestion of high levels of copper may cause a decrease in fetal growth.

How can families reduce the risk of exposure to copper?

- ☐ The greatest potential source of copper exposure is through drinking water, especially in water that is first drawn in the morning after sitting in copper pipes and brass faucets overnight.
- ☐ To reduce exposure, run the water for at least 15-30 seconds before using it.
- ☐ If you are exposed to copper at work, you may carry

copper home on your skin, clothes, or tools. You can avoid this by showering, and changing clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to copper?

Copper is normally found in all tissues of the body, blood, urine, feces, hair, and nails. High levels of copper in these samples can show that you have been exposed to higher than normal levels of copper. Tests to measure copper levels in the body are not routinely available at the doctor's office because they require special equipment. These tests cannot tell the extent of exposure or whether you will experience harmful effects.

Has the federal government made recommendations to protect human health?

The EPA has determined that drinking water should not contain more than 1.3 milligrams of copper per liter of water (1.3 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.1 mg per cubic meter (0.1 mg/m³) of copper fumes (vapor generated from heating copper) and 1 mg/m³ of copper dusts (fine metallic copper particles) and mists (aerosol of soluble copper) in workroom air during an 8-hour work shift, 40-hour workweek.

The Food and Nutrition Board of the Institute of Medicine recommends dietary allowances (RDAs) of 340 micrograms (340 µg) of copper per day for children aged 1-3 years, 440 µg/day for children aged 4-8 years, 700 µg/day for children aged 9-13 years, 890 µg/day for children aged 14-18 years, and 900 µg/day for adults.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2002. Toxicological Profile for Copper (Draft for Public Comment). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about ethylbenzene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Ethylbenzene is a colorless liquid found in a number of products including gasoline and paints. Breathing very high levels can cause dizziness and throat and eye irritation. Ethylbenzene has been found in at least 731 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is ethylbenzene?

(Pronounced ĕth' əl bĕn' zĕn')

Ethylbenzene is a colorless, flammable liquid that smells like gasoline. It is found in natural products such as coal tar and petroleum and is also found in manufactured products such as inks, insecticides, and paints.

Ethylbenzene is used primarily to make another chemical, styrene. Other uses include as a solvent, in fuels, and to make other chemicals.

What happens to ethylbenzene when it enters the environment?

- ☐ Ethylbenzene moves easily into the air from water and soil.
- ☐ It takes about 3 days for ethylbenzene to be broken down in air into other chemicals.
- ☐ Ethylbenzene may be released to water from industrial discharges or leaking underground storage tanks.
- ☐ In surface water, ethylbenzene breaks down by reacting with other chemicals found naturally in water.
- ☐ In soil, it is broken down by soil bacteria.

How might I be exposed to ethylbenzene?

- ☐ Breathing air containing ethylbenzene, particularly in areas near factories or highways.
- ☐ Drinking contaminated tap water.
- ☐ Working in an industry where ethylbenzene is used or made.
- ☐ Using products containing it, such as gasoline, carpet glues, varnishes, and paints.

How can ethylbenzene affect my health?

Limited information is available on the effects of ethylbenzene on people's health. The available information shows dizziness, throat and eye irritation, tightening of the chest, and a burning sensation in the eyes of people exposed to high levels of ethylbenzene in air.

Animals studies have shown effects on the nervous system, liver, kidneys, and eyes from breathing ethylbenzene in air.

How likely is ethylbenzene to cause cancer?

The EPA has determined that ethylbenzene is not classifiable as to human carcinogenicity.

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No studies in people have shown that ethylbenzene exposure can result in cancer. Two available animal studies suggest that ethylbenzene may cause tumors.

How can ethylbenzene affect children?

Children may be exposed to ethylbenzene through inhalation of consumer products, including gasoline, paints, inks, pesticides, and carpet glue. We do not know whether children are more sensitive to the effects of ethylbenzene than adults.

It is not known whether ethylbenzene can affect the development of the human fetus. Animal studies have shown that when pregnant animals were exposed to ethylbenzene in air, their babies had an increased number of birth defects.

How can families reduce the risk of exposure to ethylbenzene?

Exposure to ethylbenzene vapors from household products and newly installed carpeting can be minimized by using adequate ventilation.

Household chemicals should be stored out of reach of children to prevent accidental poisoning. Always store household chemicals in their original containers; never store them in containers children would find attractive to eat or drink from, such as old soda bottles. Gasoline should be stored in a gasoline can with a locked cap.

Sometimes older children sniff household chemicals, including ethylbenzene, in an attempt to get high. Talk with your children about the dangers of sniffing chemicals.

Is there a medical test to show whether I've been exposed to ethylbenzene?

Ethylbenzene is found in the blood, urine, breath, and

some body tissues of exposed people. The most common way to test for ethylbenzene is in the urine. This test measures substances formed by the breakdown of ethylbenzene. This test needs to be done within a few hours after exposure occurs, because the substances leave the body very quickly.

These tests can show you were exposed to ethylbenzene, but cannot predict the kind of health effects that might occur.

Has the federal government made recommendations to protect human health?

The EPA has set a maximum contaminant level of 0.7 milligrams of ethylbenzene per liter of drinking water (0.7 mg/L).

The EPA requires that spills or accidental releases into the environment of 1,000 pounds or more of ethylbenzene be reported to the EPA.

The Occupational Safety and Health Administration (OSHA) has set an occupational exposure limit of 100 parts of ethylbenzene per million parts of air (100 ppm) for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for ethylbenzene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html> ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about fuel oils. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Fuel oils are liquid mixtures produced from petroleum, and their use mostly involves burning them as fuels. Drinking or breathing fuel oils may cause nausea or nervous system effects. However, exposure under normal use conditions is not likely to be harmful. Fuel oils have been found in at least 26 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are fuel oils?

(Pronounced fyoo'əl oilz)

Fuel oils are a variety of yellowish to light brown liquid mixtures that come from crude petroleum. Some chemicals found in fuel oils may evaporate easily, while others may more easily dissolve in water.

Fuel oils are produced by different petroleum refining processes, depending on their intended uses. Fuel oils may be used as fuel for engines, lamps, heaters, furnaces, and stoves, or as solvents.

Some commonly found fuel oils include kerosene, diesel fuel, jet fuel, range oil, and home heating oil. These fuel oils differ from one another by their hydrocarbon compositions, boiling point ranges, chemical additives, and uses.

What happens to fuel oils when they enter the environment?

- ☐ Some chemicals found in fuel oils may evaporate into the air from open containers or contaminated soil or water.
- ☐ Some chemicals found in fuel oils may dissolve in water after spills to surface waters or leaks from underground storage tanks.

- ☐ Some chemicals found in fuel oils may stick to particles in water, which will eventually cause them to settle to the bottom sediment.
- ☐ Some of the chemicals found in fuel oils may be broken down slowly in air, water, and soil by sunlight or small organisms.
- ☐ Some of the chemicals found in fuel oils may build up significantly in plants and animals.

How might I be exposed to fuel oils?

- ☐ Using a home kerosene heater or stove, or using fuel oils at work.
- ☐ Breathing air in home or building basements that has been contaminated with fuel oil vapors entering from the soil.
- ☐ Drinking or swimming in water that has been contaminated with fuel oils from a spill or a leaking underground storage tank.
- ☐ Touching soil contaminated with fuel oils.
- ☐ Using fuel oils to wash paint or grease from skin or equipment.

How can fuel oils affect my health?

Little information is available about the health effects that may be caused by fuel oils. People who use kerosene

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stoves for cooking do not seem to have any health problems related to their exposure.

Breathing some fuel oils for short periods may cause nausea, eye irritation, increased blood pressure, headache, lightheadedness, loss of appetite, poor coordination, and difficulty concentrating. Breathing diesel fuel vapors for long periods may cause kidney damage and lower your blood's ability to clot.

Drinking small amounts of kerosene may cause vomiting, diarrhea, coughing, stomach swelling and cramps, drowsiness, restlessness, painful breathing, irritability, and unconsciousness. Drinking large amounts of kerosene may cause convulsions, coma, or death. Skin contact with kerosene for short periods may cause itchy, red, sore, or peeling skin.

How likely are fuel oils to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that some fuel oils (heavy) may possibly cause cancer in humans, but for other fuel oils (light) there is not enough information to make a determination. IARC has also determined that occupational exposures to fuel oils during petroleum refining are probably carcinogenic in humans.

Some studies with mice have suggested that repeated contact with fuel oils may cause liver or skin cancer. However, other mouse studies have found this not to be the case. No studies are available in other animals or in people on the carcinogenic effects of fuel oils.

Is there a medical test to show whether I've been exposed to fuel oils?

There is no medical test that shows if you have been exposed to fuel oils. Tests are available to determine if some of

the chemicals commonly found in fuel oils are in your blood. However, the presence of these chemicals in blood may not necessarily mean that you have been exposed to fuel oils.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) and the Air Force Office of Safety and Health (AFOSH) have set a permissible exposure level (PEL) of 400 parts of petroleum distillates per million parts of air (400 ppm) for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that average workplace air levels not exceed 350 milligrams of petroleum distillates per cubic meter of air (350 mg/m³) for a 40-hour workweek.

The Department of Transportation (DOT) lists fuel oils as hazardous materials and, therefore, regulates their transportation.

Glossary

Carcinogenic: Able to cause cancer.

CAS: Chemical Abstracts Service.

Evaporate: To change into a vapor or a gas.

Hydrocarbon: Any compound made up of hydrogen and carbon.

Milligram (mg): One thousandth of a gram.

ppm: Parts per million.

Sediment: Mud and debris that have settled to the bottom of a body of water.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for fuel oils. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html> ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about lead. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to lead can happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in contaminated soil. Lead can damage the nervous system, kidneys, and reproductive system. Lead has been found in at least 1,272 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is lead?

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing.

Lead has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. The use of lead as an additive to gasoline was banned in 1996 in the United States.

What happens to lead when it enters the environment?

- ☐ Lead itself does not break down, but lead compounds are changed by sunlight, air, and water.
- ☐ When lead is released to the air, it may travel long distances before settling to the ground.
- ☐ Once lead falls onto soil, it usually sticks to soil particles.
- ☐ Movement of lead from soil into groundwater will depend on the type of lead compound and the characteristics of the soil.

How might I be exposed to lead?

- ☐ Eating food or drinking water that contains lead. Water pipes in some older homes may contain lead solder. Lead can leach out into the water.

- ☐ Spending time in areas where lead-based paints have been used and are deteriorating. Deteriorating lead paint can contribute to lead dust.

- ☐ Working in a job where lead is used or engaging in certain hobbies in which lead is used, such as making stained glass.

- ☐ Using health-care products or folk remedies that contain lead.

How can lead affect my health?

The effects of lead are the same whether it enters the body through breathing or swallowing. Lead can affect almost every organ and system in your body. The main target for lead toxicity is the nervous system, both in adults and children. Long-term exposure of adults can result in decreased performance in some tests that measure functions of the nervous system. It may also cause weakness in fingers, wrists, or ankles. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people and can cause anemia. Exposure to high lead levels can severely damage the brain and kidneys in adults or children and ultimately cause death. In pregnant women, high levels of exposure to lead may cause miscarriage. High-level exposure in men can damage the organs responsible for sperm production.

How likely is lead to cause cancer?

We have no conclusive proof that lead causes cancer in humans. Kidney tumors have developed in rats and mice that had been given large doses of some kind of lead compounds. The Department of Health and Human Services

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(DHHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens and the EPA has determined that lead is a probable human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans.

How can lead affect children?

Small children can be exposed by eating lead-based paint chips, chewing on objects painted with lead-based paint, or swallowing house dust or soil that contains lead.

Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead may develop blood anemia, severe stomachache, muscle weakness, and brain damage. If a child swallows smaller amounts of lead, much less severe effects on blood and brain function may occur. Even at much lower levels of exposure, lead can affect a child's mental and physical growth.

Exposure to lead is more dangerous for young and unborn children. Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, decreased mental ability in the infant, learning difficulties, and reduced growth in young children. These effects are more common if the mother or baby was exposed to high levels of lead. Some of these effects may persist beyond childhood.

How can families reduce the risks of exposure to lead?

- ☐ Avoid exposure to sources of lead.
- ☐ Do not allow children to chew on mouth surfaces that may have been painted with lead-based paint.
- ☐ If you have a water lead problem, run or flush water that has been standing overnight before drinking or cooking with it.
- ☐ Some types of paints and pigments that are used as make-up or hair coloring contain lead. Keep these kinds of products away from children
- ☐ If your home contains lead-based paint or you live in an area contaminated with lead, wash children's hands and faces

often to remove lead dusts and soil, and regularly clean the house of dust and tracked in soil.

Is there a medical test to determine whether I've been exposed to lead?

A blood test is available to measure the amount of lead in your blood and to estimate the amount of your recent exposure to lead. Blood tests are commonly used to screen children for lead poisoning. Lead in teeth or bones can be measured by X-ray techniques, but these methods are not widely available. Exposure to lead also can be evaluated by measuring erythrocyte protoporphyrin (EP) in blood samples. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter ($\mu\text{g}/\text{dL}$). These tests usually require special analytical equipment that is not available in a doctor's office. However, your doctor can draw blood samples and send them to appropriate laboratories for analysis.

Has the federal government made recommendations to protect human health?

The Centers for Disease Control and Prevention (CDC) recommends that states test children at ages 1 and 2 years. Children should be tested at ages 3–6 years if they have never been tested for lead, if they receive services from public assistance programs for the poor such as Medicaid or the Supplemental Food Program for Women, Infants, and Children, if they live in a building or frequently visit a house built before 1950; if they visit a home (house or apartment) built before 1978 that has been recently remodeled; and/or if they have a brother, sister, or playmate who has had lead poisoning. CDC considers a blood lead level of 10 $\mu\text{g}/\text{dL}$ to be a level of concern for children.

EPA limits lead in drinking water to 15 μg per liter.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for lead (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

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This fact sheet answers the most frequently asked health questions (FAQs) about mercury. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to mercury occurs from breathing contaminated air, ingesting contaminated water and food, and having dental and medical treatments. Mercury, at high levels, may damage the brain, kidneys, and developing fetus. This chemical has been found in at least 714 of 1,467 National Priorities List sites identified by the Environmental Protection Agency.

What is mercury?

(Pronounced mŭr'kyə-rē)

Mercury is a naturally occurring metal which has several forms. The metallic mercury is a shiny, silver-white, odorless liquid. If heated, it is a colorless, odorless gas.

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make.

Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

What happens to mercury when it enters the environment?

- ☐ Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.
- ☐ It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.

- ☐ Methylmercury may be formed in water and soil by small organisms called bacteria.
- ☐ Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

How might I be exposed to mercury?

- ☐ Eating fish or shellfish contaminated with methylmercury.
- ☐ Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fuels.
- ☐ Release of mercury from dental work and medical treatments.
- ☐ Breathing contaminated workplace air or skin contact during use in the workplace (dental, health services, chemical, and other industries that use mercury).
- ☐ Practicing rituals that include mercury.

How can mercury affect my health?

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea,

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vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

How likely is mercury to cause cancer?

There are inadequate human cancer data available for all forms of mercury. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.

How can mercury affect children?

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also can pass to a nursing infant through breast milk. However, the benefits of breast feeding may be greater than the possible adverse effects of mercury in breast milk.

Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage.

How can families reduce the risk of exposure to mercury?

Carefully handle and dispose of products that contain mercury, such as thermometers or fluorescent light bulbs. Do not vacuum up spilled mercury, because it will vaporize and increase exposure. If a large amount of mercury has been spilled, contact your health department. Teach children not to play with shiny, silver liquids.

Properly dispose of older medicines that contain mercury. Keep all mercury-containing medicines away from children.

Pregnant women and children should keep away from

rooms where liquid mercury has been used.

Learn about wildlife and fish advisories in your area from your public health or natural resources department.

Is there a medical test to show whether I've been exposed to mercury?

Tests are available to measure mercury levels in the body. Blood or urine samples are used to test for exposure to metallic mercury and to inorganic forms of mercury. Mercury in whole blood or in scalp hair is measured to determine exposure to methylmercury. Your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2 parts of mercury per billion parts of drinking water (2 ppb).

The Food and Drug Administration (FDA) has set a maximum permissible level of 1 part of methylmercury in a million parts of seafood (1 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 0.1 milligram of organic mercury per cubic meter of workplace air (0.1 mg/m^3) and 0.05 mg/m^3 of metallic mercury vapor for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html> ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about nickel. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Nickel is a naturally occurring element. Pure nickel is a hard, silvery-white metal used to make stainless steel and other metal alloys. Skin effects are the most common effects in people who are sensitive to nickel. Workers who breathed very large amounts of nickel compounds developed chronic bronchitis and lung and nasal sinus cancers. Nickel has been found in at least 882 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is nickel?

Nickel is a very abundant natural element. Pure nickel is a hard, silvery-white metal. Nickel can be combined with other metals, such as iron, copper, chromium, and zinc, to form alloys. These alloys are used to make coins, jewelry, and items such as valves and heat exchangers. Most nickel is used to make stainless steel.

Nickel can combine with other elements such as chlorine, sulfur, and oxygen to form nickel compounds. Many nickel compounds dissolve fairly easy in water and have a green color. Nickel compounds are used for nickel plating, to color ceramics, to make some batteries, and as substances known as catalysts that increase the rate of chemical reactions. Nickel is found in all soil and is emitted from volcanoes. Nickel is also found in meteorites and on the ocean floor. Nickel and its compounds have no characteristic odor or taste.

What happens to nickel when it enters the environment?

- ☐ Nickel is released into the atmosphere by industries that make or use nickel, nickel alloys, or nickel compounds. It is also released into the atmosphere by oil-burning power plants, coal-burning power plants, and trash incinerators.
- ☐ In the air, it attaches to small particles of dust that settle to the ground or are taken out of the air in rain or snow; this usually takes many days.

- ☐ Nickel released in industrial waste water ends up in soil or sediment where it strongly attaches to particles containing iron or manganese.

- ☐ Nickel does not appear to accumulate in fish or in other animals used as food.

How might I be exposed to nickel?

- ☐ By eating food containing nickel, which is the major source of exposure for most people.
- ☐ By skin contact with soil, bath or shower water, or metals containing nickel, as well as by handling coins or touching jewelry containing nickel.
- ☐ By drinking water that contains small amounts of nickel.
- ☐ By breathing air or smoking tobacco containing nickel.
- ☐ Higher exposure may occur if you work in industries that process or use nickel.

How can nickel affect my health?

The most common harmful health effect of nickel in humans is an allergic reaction. Approximately 10-20% of the population is sensitive to nickel. People can become sensitive to nickel when jewelry or other things containing it are in direct contact with the skin for a long time. Once a person is sensitized to nickel, further contact with the metal may produce a reaction. The most common reaction is a skin rash at the site of contact. The skin rash may also

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occur at a site away from the site of contact. Less frequently, some people who are sensitive to nickel have asthma attacks following exposure to nickel. Some sensitized people react when they consume food or water containing nickel or breathe dust containing it.

People working in nickel refineries or nickel-processing plants have experienced chronic bronchitis and reduced lung function. These persons breathed amounts of nickel much higher than levels found normally in the environment. Workers who drank water containing high amounts of nickel had stomach ache and suffered adverse effects to their blood and kidneys.

Damage to the lung and nasal cavity has been observed in rats and mice breathing nickel compounds. Eating or drinking large amounts of nickel has caused lung disease in dogs and rats and has affected the stomach, blood, liver, kidneys, and immune system in rats and mice, as well as their reproduction and development.

How likely is nickel to cause cancer?

Cancers of the lung and nasal sinus have resulted when workers breathed dust containing high levels of nickel compounds while working in nickel refineries or nickel processing plants. The Department of Health and Human Services (DHHS) has determined that nickel metal may reasonably be anticipated to be a carcinogen and that nickel compounds are known human carcinogens. The International Agency for Research on Cancer (IARC) has determined that some nickel compounds are carcinogenic to humans and that metallic nickel may possibly be carcinogenic to humans. The EPA has determined that nickel refinery dust and nickel subsulfide are human carcinogens.

How can nickel affect children?

It is likely that the health effects seen in children exposed to nickel will be similar to those seen in adults. We do not know whether children differ from adults in their susceptibility to nickel. Human studies that examined whether nickel can harm the fetus are inconclusive. Animal studies have found increases in newborn deaths and

decreased newborn weight after ingesting very high amounts of nickel. Nickel can be transferred from the mother to an infant in breast milk and can cross the placenta.

How can families reduce the risks of exposure to nickel?

- ❑ Avoiding jewelry containing nickel will eliminate risks of exposure to this source of the metal.
- ❑ Exposures of the general population from other sources, such as foods and drinking water, are almost always too low to be of concern.

Is there a medical test to determine whether I've been exposed to nickel?

There are tests available to measure nickel in your blood, feces, and urine. More nickel was measured in the urine of workers who were exposed to nickel compounds that dissolve easily in water than in the urine of workers exposed to nickel compounds that are hard to dissolve. This means that it is easier to tell if you have been exposed to soluble nickel compounds than less-soluble compounds. The nickel measurements do not accurately predict potential health effects from exposure to nickel.

Has the federal government made recommendations to protect human health?

The EPA recommends that drinking water should contain no more than 0.1 milligrams of nickel per liter of water (0.1 mg/L). To protect workers, the Occupational Safety and Health Administration (OSHA) has set a limit of 1 mg of nickel per cubic meter of air (1 mg/m³) for metallic nickel and nickel compounds in workplace air during an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Nickel (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl'ī-sī'klīk ār'ə-măt'īk hī'drə-kar'bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- ☐ PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- ☐ PAHs can occur in air attached to dust particles.
- ☐ Some PAH particles can readily evaporate into the air from soil or surface waters.
- ☐ PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.

- ☐ PAHs enter water through discharges from industrial and wastewater treatment plants.
- ☐ Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- ☐ Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- ☐ In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- ☐ PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- ☐ Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smoke-houses; and municipal trash incineration facilities.
- ☐ Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- ☐ Coming in contact with air, water, or soil near hazardous waste sites.
- ☐ Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.
- ☐ Drinking contaminated water or cow's milk.

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- ❑ Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any

health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html> ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about polychlorinated biphenyls. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to PCBs when they enter the environment?

- ❑ PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- ❑ PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- ❑ PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- ❑ PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these

aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to PCBs?

- ❑ Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
- ❑ Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
- ❑ Breathing air near hazardous waste sites and drinking contaminated well water.
- ❑ In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

How can PCBs affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects

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of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

How can PCBs affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported. In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risk of exposure to PCBs?

- ☐ You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.
- ☐ Children should be told not play with old appliances,

electrical equipment, or transformers, since they may contain PCBs.

- ☐ Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- ☐ If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to PCBs?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 404-498-0093. ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about trichloroethylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Trichloroethylene is a colorless liquid which is used as a solvent for cleaning metal parts. Drinking or breathing high levels of trichloroethylene may cause nervous system effects, liver and lung damage, abnormal heartbeat, coma, and possibly death. Trichloroethylene has been found in at least 852 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is trichloroethylene?

Trichloroethylene (TCE) is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.

Trichloroethylene is not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

What happens to trichloroethylene when it enters the environment?

- ❑ Trichloroethylene dissolves a little in water, but it can remain in ground water for a long time.
- ❑ Trichloroethylene quickly evaporates from surface water, so it is commonly found as a vapor in the air.
- ❑ Trichloroethylene evaporates less easily from the soil than from surface water. It may stick to particles and remain for a long time.
- ❑ Trichloroethylene may stick to particles in water, which will cause it to eventually settle to the bottom sediment.
- ❑ Trichloroethylene does not build up significantly in

plants and animals.

How might I be exposed to trichloroethylene?

- ❑ Breathing air in and around the home which has been contaminated with trichloroethylene vapors from shower water or household products such as spot removers and typewriter correction fluid.
- ❑ Drinking, swimming, or showering in water that has been contaminated with trichloroethylene.
- ❑ Contact with soil contaminated with trichloroethylene, such as near a hazardous waste site.
- ❑ Contact with the skin or breathing contaminated air while manufacturing trichloroethylene or using it at work to wash paint or grease from skin or equipment.

How can trichloroethylene affect my health?

Breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating.

Breathing large amounts of trichloroethylene may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage.

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Drinking large amounts of trichloroethylene may cause nausea, liver damage, unconsciousness, impaired heart function, or death.

Drinking small amounts of trichloroethylene for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear.

Skin contact with trichloroethylene for short periods may cause skin rashes.

How likely is trichloroethylene to cause cancer?

Some studies with mice and rats have suggested that high levels of trichloroethylene may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of trichloroethylene in drinking water or in workplace air have found evidence of increased cancer. Although, there are some concerns about the studies of people who were exposed to trichloroethylene, some of the effects found in people were similar to effects in animals.

In its 9th Report on Carcinogens, the National Toxicology Program (NTP) determined that trichloroethylene is “reasonably anticipated to be a human carcinogen.” The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is “probably carcinogenic to humans.”

Is there a medical test to show whether I’ve been exposed to trichloroethylene?

If you have recently been exposed to trichloroethylene, it can be detected in your breath, blood, or urine. The breath test, if it is performed soon after exposure, can tell if you have been exposed to even a small amount of trichloroethylene.

Exposure to larger amounts is assessed by blood

and urine tests, which can detect trichloroethylene and many of its breakdown products for up to a week after exposure. However, exposure to other similar chemicals can produce the same breakdown products, so their detection is not absolute proof of exposure to trichloroethylene. This test isn’t available at most doctors’ offices, but can be done at special laboratories that have the right equipment.

Has the federal government made recommendations to protect human health?

The EPA has set a maximum contaminant level for trichloroethylene in drinking water at 0.005 milligrams per liter (0.005 mg/L) or 5 parts of TCE per billion parts water.

The EPA has also developed regulations for the handling and disposal of trichloroethylene.

The Occupational Safety and Health Administration (OSHA) has set an exposure limit of 100 parts of trichloroethylene per million parts of air (100 ppm) for an 8-hour workday, 40-hour workweek.

Glossary

Carcinogenicity: The ability of a substance to cause cancer.

CAS: Chemical Abstracts Service.

Evaporate: To change into a vapor or gas.

Milligram (mg): One thousandth of a gram.

Nonflammable: Will not burn.

ppm: Parts per million.

Sediment: Mud and debris that have settled to the bottom of a body of water.

Solvent: A chemical that dissolves other substances.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Trichloroethylene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

This fact sheet answers the most frequently asked health questions (FAQs) about tetrachloroethylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Tetrachloroethylene is a manufactured chemical used for dry cleaning and metal degreasing. Exposure to very high concentrations of tetrachloroethylene can cause dizziness, headaches, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Tetrachloroethylene has been found in at least 771 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is tetrachloroethylene?

(Pronounced tět'rə-klôr' ō-ěth'ə-lēn')

Tetrachloroethylene is a manufactured chemical that is widely used for dry cleaning of fabrics and for metal-degreasing. It is also used to make other chemicals and is used in some consumer products.

Other names for tetrachloroethylene include perchloroethylene, PCE, and tetrachloroethene. It is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor. Most people can smell tetrachloroethylene when it is present in the air at a level of 1 part tetrachloroethylene per million parts of air (1 ppm) or more, although some can smell it at even lower levels.

What happens to tetrachloroethylene when it enters the environment?

- ☐ Much of the tetrachloroethylene that gets into water or soil evaporates into the air.
- ☐ Microorganisms can break down some of the tetrachloroethylene in soil or underground water.
- ☐ In the air, it is broken down by sunlight into other chemicals or brought back to the soil and water by rain.
- ☐ It does not appear to collect in fish or other animals that live in water.

How might I be exposed to tetrachloroethylene?

- ☐ When you bring clothes from the dry cleaners, they will release small amounts of tetrachloroethylene into the air.
- ☐ When you drink water containing tetrachloroethylene, you are exposed to it.

How can tetrachloroethylene affect my health?

High concentrations of tetrachloroethylene (particularly in closed, poorly ventilated areas) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death.

Irritation may result from repeated or extended skin contact with it. These symptoms occur almost entirely in work (or hobby) environments when people have been accidentally exposed to high concentrations or have intentionally used tetrachloroethylene to get a "high."

In industry, most workers are exposed to levels lower than those causing obvious nervous system effects. The health effects of breathing in air or drinking water with low levels of tetrachloroethylene are not known.

Results from some studies suggest that women who work in dry cleaning industries where exposures to tetrachloroethyl-

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ene can be quite high may have more menstrual problems and spontaneous abortions than women who are not exposed. However, it is not known if tetrachloroethylene was responsible for these problems because other possible causes were not considered.

Results of animal studies, conducted with amounts much higher than those that most people are exposed to, show that tetrachloroethylene can cause liver and kidney damage. Exposure to very high levels of tetrachloroethylene can be toxic to the unborn pups of pregnant rats and mice. Changes in behavior were observed in the offspring of rats that breathed high levels of the chemical while they were pregnant.

How likely is tetrachloroethylene to cause cancer?

The Department of Health and Human Services (DHHS) has determined that tetrachloroethylene may reasonably be anticipated to be a carcinogen. Tetrachloroethylene has been shown to cause liver tumors in mice and kidney tumors in male rats.

Is there a medical test to show whether I've been exposed to tetrachloroethylene?

One way of testing for tetrachloroethylene exposure is to measure the amount of the chemical in the breath, much the same way breath-alcohol measurements are used to determine the amount of alcohol in the blood.

Because it is stored in the body's fat and slowly released into the bloodstream, tetrachloroethylene can be detected in the breath for weeks following a heavy exposure.

Tetrachloroethylene and trichloroacetic acid (TCA), a breakdown product of tetrachloroethylene, can be detected in the blood. These tests are relatively simple to perform. These tests aren't available at most doctors' offices, but can be per-

formed at special laboratories that have the right equipment.

Because exposure to other chemicals can produce the same breakdown products in the urine and blood, the tests for breakdown products cannot determine if you have been exposed to tetrachloroethylene or the other chemicals.

Has the federal government made recommendations to protect human health?

The EPA maximum contaminant level for the amount of tetrachloroethylene that can be in drinking water is 0.005 milligrams tetrachloroethylene per liter of water (0.005 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 100 ppm for an 8-hour workday over a 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) recommends that tetrachloroethylene be handled as a potential carcinogen and recommends that levels in workplace air should be as low as possible.

Glossary

Carcinogen: A substance with the ability to cause cancer.

CAS: Chemical Abstracts Service.

Milligram (mg): One thousandth of a gram.

Nonflammable: Will not burn.

References

This ToxFAQs information is taken from the 1997 Toxicological Profile for Tetrachloroethylene (update) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services, Public Health Service in Atlanta, GA.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html> ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about toluene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to toluene occurs from breathing contaminated workplace air, in automobile exhaust, some consumer products paints, paint thinners, fingernail polish, lacquers, and adhesives. Toluene affects the nervous system. Toluene has been found at 959 of the 1,591 National Priority List sites identified by the Environmental Protection Agency

What is toluene?

Toluene is a clear, colorless liquid with a distinctive smell. Toluene occurs naturally in crude oil and in the tolu tree. It is also produced in the process of making gasoline and other fuels from crude oil and making coke from coal.

Toluene is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes.

What happens to toluene when it enters the environment?

☐ Toluene enters the environment when you use materials that contain it. It can also enter surface water and groundwater from spills of solvents and petroleum products as well as from leaking underground storage tanks at gasoline stations and other facilities.

☐ When toluene-containing products are placed in landfills or waste disposal sites, the toluene can enter the soil or water near the waste site.

☐ Toluene does not usually stay in the environment long.

☐ Toluene does not concentrate or buildup to high levels in animals.

How might I be exposed to toluene?

☐ Breathing contaminated workplace air or automobile exhaust.

☐ Working with gasoline, kerosene, heating oil, paints, and lacquers.

☐ Drinking contaminated well-water.

☐ Living near uncontrolled hazardous waste sites containing toluene products.

How can toluene affect my health?

Toluene may affect the nervous system. Low to moderate levels can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite, and

ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>

hearing and color vision loss. These symptoms usually disappear when exposure is stopped.

Inhaling High levels of toluene in a short time can make you feel light-headed, dizzy, or sleepy. It can also cause unconsciousness, and even death.

High levels of toluene may affect your kidneys.

How likely is toluene to cause cancer?

Studies in humans and animals generally indicate that toluene does not cause cancer.

The EPA has determined that the carcinogenicity of toluene can not be classified.

How can toluene affect children?

It is likely that health effects seen in children exposed to toluene will be similar to the effects seen in adults. Some studies in animals suggest that babies may be more sensitive than adults.

Breathing very high levels of toluene during pregnancy can result in children with birth defects and retard mental abilities, and growth. We do not know if toluene harms the unborn child if the mother is exposed to low levels of toluene during pregnancy.

How can families reduce the risk of exposure to toluene?

- ☐ Use toluene-containing products in well-ventilated areas.

- ☐ When not in use, toluene-containing products should be tightly covered to prevent evaporation into the air.

Is there a medical test to show whether I've been exposed to toluene?

There are tests to measure the level of toluene or its breakdown products in exhaled air, urine, and blood. To determine if you have been exposed to toluene, your urine or blood must be checked within 12 hours of exposure. Several other chemicals are also changed into the same breakdown products as toluene, so some of these tests are not specific for toluene.

Has the federal government made recommendations to protect human health?

EPA has set a limit of 1 milligram per liter of drinking water (1 mg/L).

Discharges, releases, or spills of more than 1,000 pounds of toluene must be reported to the National Response Center.

The Occupational Safety and Health Administration has set a limit of 200 parts toluene per million of workplace air (200 ppm).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Toluene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about xylene. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to xylene occurs in the workplace and when you use paint, gasoline, paint thinners and other products that contain it. People who breathe high levels may have dizziness, confusion, and a change in their sense of balance. This substance has been found in at least 658 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is xylene?

(Pronounced zī'lēn)

Xylene is a colorless, sweet-smelling liquid that catches on fire easily. It occurs naturally in petroleum and coal tar and is formed during forest fires. You can smell xylene in air at 0.08–3.7 parts of xylene per million parts of air (ppm) and begin to taste it in water at 0.53–1.8 ppm.

Chemical industries produce xylene from petroleum. It's one of the top 30 chemicals produced in the United States in terms of volume.

Xylene is used as a solvent and in the printing, rubber, and leather industries. It is also used as a cleaning agent, a thinner for paint, and in paints and varnishes. It is found in small amounts in airplane fuel and gasoline.

What happens to xylene when it enters the environment?

- ☐ Xylene has been found in waste sites and landfills when discarded as used solvent, or in varnish, paint, or paint thinners.
- ☐ It evaporates quickly from the soil and surface water into the air.

- ☐ In the air, it is broken down by sunlight into other less harmful chemicals.
- ☐ It is broken down by microorganisms in soil and water.
- ☐ Only a small amount of it builds up in fish, shellfish, plants, and animals living in xylene-contaminated water.

How might I be exposed to xylene?

- ☐ Breathing xylene in workplace air or in automobile exhaust.
- ☐ Breathing contaminated air.
- ☐ Touching gasoline, paint, paint removers, varnish, shellac, and rust preventatives that contain it.
- ☐ Breathing cigarette smoke that has small amounts of xylene in it.
- ☐ Drinking contaminated water or breathing air near waste sites and landfills that contain xylene.
- ☐ The amount of xylene in food is likely to be low.

How can xylene affect my health?

Xylene affects the brain. High levels from exposure for short periods (14 days or less) or long periods (more than 1 year) can cause headaches, lack of muscle coordination, dizziness, confusion, and changes in one's sense of balance. Exposure of

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people to high levels of xylene for short periods can also cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; problems with the lungs; delayed reaction time; memory difficulties; stomach discomfort; and possibly changes in the liver and kidneys. It can cause unconsciousness and even death at very high levels.

Studies of unborn animals indicate that high concentrations of xylene may cause increased numbers of deaths, and delayed growth and development. In many instances, these same concentrations also cause damage to the mothers. We do not know if xylene harms the unborn child if the mother is exposed to low levels of xylene during pregnancy.

How likely is xylene to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that xylene is not classifiable as to its carcinogenicity in humans.

Human and animal studies have not shown xylene to be carcinogenic, but these studies are not conclusive and do not provide enough information to conclude that xylene does not cause cancer.

Is there a medical test to show whether I've been exposed to xylene?

Laboratory tests can detect xylene or its breakdown products in exhaled air, blood, or urine. There is a high degree of agreement between the levels of exposure to xylene and the levels of xylene breakdown products in the urine. However, a urine sample must be provided very soon after exposure ends because xylene quickly leaves the body. These tests are not routinely available at your doctor's office.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 10 ppm of xylene in drinking water.

The EPA requires that spills or accidental releases of xylenes into the environment of 1,000 pounds or more must be reported.

The Occupational Safety and Health Administration (OSHA) has set a maximum level of 100 ppm xylene in workplace air for an 8-hour workday, 40-hour workweek.

The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) also recommend exposure limits of 100 ppm in workplace air.

NIOSH has recommended that 900 ppm of xylene be considered immediately dangerous to life or health. This is the exposure level of a chemical that is likely to cause permanent health problems or death.

Glossary

Evaporate: To change from a liquid into a vapor or a gas.

Carcinogenic: Having the ability to cause cancer.

CAS: Chemical Abstracts Service.

ppm: Parts per million.

Solvent: A liquid that can dissolve other substances.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for xylenes (update). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html> ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



This fact sheet answers the most frequently asked health questions (FAQs) about zinc. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Zinc is a naturally occurring element. Exposure to high levels of zinc occurs mostly from eating food, drinking water, or breathing workplace air that is contaminated. Low levels of zinc are essential for maintaining good health. Exposure to large amounts of zinc can be harmful. It can cause stomach cramps, anemia, and changes in cholesterol levels. Zinc has been found in at least 985 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

What is zinc?

Zinc is one of the most common elements in the earth's crust. It is found in air, soil, and water, and is present in all foods. Pure zinc is a bluish-white shiny metal.

Zinc has many commercial uses as coatings to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass, and bronze. A zinc and copper alloy is used to make pennies in the United States.

Zinc combines with other elements to form zinc compounds. Common zinc compounds found at hazardous waste sites include zinc chloride, zinc oxide, zinc sulfate, and zinc sulfide. Zinc compounds are widely used in industry to make paint, rubber, dyes, wood preservatives, and ointments.

What happens to zinc when it enters the environment?

- ☐ Some is released into the environment by natural processes, but most comes from human activities like mining, steel production, coal burning, and burning of waste.
- ☐ It attaches to soil, sediments, and dust particles in the air.
- ☐ Rain and snow remove zinc dust particles from the air.
- ☐ Depending on the type of soil, some zinc compounds can move into the groundwater and into lakes, streams, and rivers.
- ☐ Most of the zinc in soil stays bound to soil particles and

does not dissolve in water.

- ☐ It builds up in fish and other organisms, but it does not build up in plants.

How might I be exposed to zinc?

- ☐ Ingesting small amounts present in your food and water.
- ☐ Drinking contaminated water or a beverage that has been stored in metal containers or flows through pipes that have been coated with zinc to resist rust.
- ☐ Eating too many dietary supplements that contain zinc.
- ☐ Working on any of the following jobs: construction, painting, automobile mechanics, mining, smelting, and welding; manufacture of brass, bronze, or other zinc-containing alloys; manufacture of galvanized metals; and manufacture of machine parts, rubber, paint, linoleum, oilcloths, batteries, some kind of glass, ceramics, and dyes.

How can zinc affect my health?

Zinc is an essential element in our diet. Too little zinc can cause problems, but too much zinc is also harmful.

Harmful effects generally begin at levels 10-15 times higher than the amount needed for good health. Large doses taken by mouth even for a short time can cause stomach cramps, nausea, and vomiting. Taken longer, it can cause anemia and decrease the levels of your good cholesterol. We do not know if high levels of zinc affect reproduction in humans. Rats that were fed large amounts of zinc became infertile.

ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>

Inhaling large amounts of zinc (as dusts or fumes) can cause a specific short-term disease called metal fume fever. We do not know the long-term effects of breathing high levels of zinc.

Putting low levels of zinc acetate and zinc chloride on the skin of rabbits, guinea pigs, and mice caused skin irritation. Skin irritation will probably occur in people.

How likely is zinc to cause cancer?

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified zinc for carcinogenicity. Based on incomplete information from human and animal studies, the EPA has determined that zinc is not classifiable as to its human carcinogenicity.

How can zinc affect children?

Zinc is essential for proper growth and development of young children. It is likely that children exposed to very high levels of zinc will have similar effects as adults. We do not know whether children are more susceptible to the effects of excessive intake of zinc than the adults.

We do not know if excess zinc can cause developmental effects in humans. Animal studies have found decreased weight in the offspring of animals that ingested very high amounts of zinc.

How can families reduce the risks of exposure to zinc?

- ☐ Children living near waste sites that contain zinc may be exposed to higher levels of zinc through breathing contaminated air, drinking contaminated drinking water, touching or eating contaminated soil.
- ☐ Discourage your children from eating soil or putting their hands in their mouths and teach them to wash their hands frequently and before eating.
- ☐ If you use medicines or vitamin supplements containing

zinc, make sure you use them appropriately and keep them out of the reach of children.

Is there a medical test to determine whether I've been exposed to zinc?

There are tests available to measure zinc in your blood, urine, hair, saliva, and feces. These tests are not usually done in the doctor's office because they require special equipment. High levels of zinc in the feces can mean high recent zinc exposure. High levels of zinc in the blood can mean high zinc consumption and/or high exposure. Tests to measure zinc in hair may provide information on long-term zinc exposure; however, the relationship between levels in your hair and the amount of zinc you were exposed to is not clear.

Has the federal government made recommendations to protect human health?

The EPA recommends that drinking water should contain no more than 5 milligrams per liter of water (5 mg/L) because of taste. The EPA requires that any release of 1,000 pounds (or in some cases 5,000 pounds) into the environment be reported to the agency.

To protect workers, the Occupational Safety and Health Administration (OSHA) has set an average limit of 1 mg/m³ for zinc chloride fumes and 5 mg/m³ for zinc oxide (dusts and fumes) in workplace air during an 8-hour workday, 40-hour workweek.

Similarly, the National Institute for Occupational Safety and Health (NIOSH) has set the same standards for up to a 10-hour workday over a 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological Profile for Zinc (Update). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



ATTACHMENT B
REPORT FORMS

WEEKLY SAFETY REPORT FORM

Week Ending: _____ Project Name/Number: _____

Report Date: _____ Project Manager Name: _____

Summary of any violations of procedures occurring that week:

Summary of any job related injuries, illnesses, or near misses that week:

Summary of air monitoring data that week (include and sample analyses, action levels exceeded, and actions taken):

Comments:

Name: _____ Company: _____

Signature: _____ Title: _____

INCIDENT REPORT FORM

Date of Report: _____

Injured: _____

Employer: _____

Site: _____ Site Location: _____

Report Prepared By: _____
Signature Title

ACCIDENT/INCIDENT CATEGORY (check all that applies)

☐ Injury	☐ Illness	☐ Near Miss
☐ Property Damage	☐ Fire	☐ Chemical Exposure
☐ On-site Equipment	☐ Motor Vehicle	☐ Electrical
☐ Mechanical	☐ Spill	☐ Other

DATE AND TIME OF ACCIDENT/INCIDENT: Narrative report of Accident/Incident: Identify: 1) actions leading to or contributing to the accident/incident; 2) the accident/incident occurrence; and 3) actions following the accident/incident.

WITNESS TO ACCIDENT/INCIDENT:

Name: _____	Company: _____
Address: _____	Address: _____
Phone No.: _____	Phone No.: _____
Name: _____	Company: _____
Address: _____	Address: _____
Phone No.: _____	Phone No.: _____

INJURED - ILL:

Name: _____ SSN: _____

Address: _____ Age: _____

Length of Service: _____ Time on Present Job: _____

Time/Classification: _____

SEVERITY OF INJURY OR ILLNESS:

____ Disabling ____ Non-disabling ____ Fatality

____ Medical Treatment ____ First Aid Only

ESTIMATED NUMBER OF DAYS AWAY FROM JOB: _____**NATURE OF INJURY OR ILLNESS:** __________
_____**CLASSIFICATION OF INJURY:**

__ Abrasions	_____ Dislocations	_____ Punctures
__ Bites	_____ Faint/Dizziness	_____ Radiation Burns
__ Blisters	_____ Fractures	_____ Respiratory Allergy
__ Bruises	_____ Frostbite	_____ Sprains
__ Chemical Burns	_____ Heat Burns	_____ Toxic Resp. Exposure
__ Cold Exposure	_____ Heat Exhaustion	_____ Toxic Ingestion
__ Concussion	_____ Heat Stroke	_____ Dermal Allergy
__ Lacerations		

Part of Body Affected: _____

Degree of Disability: _____

Date Medical Care was Received: _____

Where Medical Care was Received: _____

Address (if off-site): _____

(If two or more injuries, record on separate sheets)

PROPERTY DAMAGE:

Description of Damage: _____

Cost of Damage: \$ _____

ACCIDENT/INCIDENT LOCATION: _____

ACCIDENT/INCIDENT ANALYSIS: Causative agent most directly related to accident/incident
(Object, substance, material, machinery, equipment, conditions)

Was weather a factor?: _____

Unsafe mechanical/physical/environmental condition at time of accident/incident (Be specific):

Personal factors (Attitude, knowledge or skill, reaction time, fatigue):

ON-SITE ACCIDENTS/INCIDENTS:

Level of personal protection equipment required in Site Safety Plan:

Modifications:

Was injured using required equipment?:

If not, how did actual equipment use differ from plan?:

ACTION TAKEN TO PREVENT RECURRENCE: (Be specific. What has or will be done? When will it be done? Who is the responsible party to insure that the correction is made?)

ACCIDENT/INCIDENT REPORT REVIEWED BY:

SSO Name Printed

SSO Signature

OTHERS PARTICIPATING IN INVESTIGATION:

Signature

Title

Signature

Title

Signature

Title

ACCIDENT/INCIDENT FOLLOW-UP: Date: _____

Outcome of accident/incident: _____

Physician's recommendations: _____

Date injured returned to work: _____
Follow-up performed by: _____

Signature

Title

ATTACH ANY ADDITIONAL INFORMATION TO THIS FORM

ATTACHMENT C
EMERGENCY HAND SIGNALS

EMERGENCY SIGNALS

In most cases, field personnel will carry portable radios for communication. If this is the case, a transmission that indicates an emergency will take priority over all other transmissions. All other site radios will yield the frequency to the emergency transmissions.

Where radio communications is not available, the following air-horn and/or hand signals will be used:

EMERGENCY HAND SIGNALS

OUT OF AIR, CAN'T BREATHE!



Hand gripping throat

**LEAVE AREA IMMEDIATELY,
NO DEBATE!**

(No Picture) Grip partner's wrist or place both hands around waist

NEED ASSISTANCE!



Hands on top of head

**OKAY! – I'M ALL RIGHT!
- I UNDERSTAND!**



Thumbs up

NO! - NEGATIVE!



Thumbs down