Remedial Investigation Work Plan

Site Name: 18 Division Place (C224211)

14-18 Division Place, 275-283 Richardson Street
Brooklyn, New York, 11222

November 29 , 2022

Prepared for:

18 Division Place Corp.
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1. INTRODUCTION

CPEngineering, PC (CPE) in conjunction with Equity Environmental Engineering, LLC (Equity) prepared this Remedial Investigation Work Plan (RIWP) on behalf of 18 Division Place Corp. (the "DPC" or the "Applicant"). The Site (referred to herein as the "Site" or "18 Division Place"), is located at 18 Division Place in the Greenpoint/East Williamsburg Industrial Area of Brooklyn, New York (see Figure 1) and is comprised of four tax parcels, Block 2849 Lots 9, 10, 21, and 24.

In this RIWP, DPC proposes to complete investigative activities pursuant to the New York State Brownfield Cleanup Program (BCP). The Site is currently used as a contractor storage yard and other commercial uses. Lot 9 is a vacant lot with no current operations. Lot 10 is occupied by various commercial tenants for use as contractor storage and offices as well as a two-story residential building. Lots 21 and 24 are occupied by NY Imports DS and NY Metal Import, respectively. There is currently no proposed post-remedial change in Site use, as the Requestor anticipates continuing the current use and occupancy of the Site.

DPC, the recent purchaser of the Site, entered the BCP as a 'Volunteer' on February 4, 2022 as per Brownfield Cleanup Agreement Index No. C224211-11-21 (the "BCA"). This RIWP was developed in accordance with the DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010 (DER-10).

2. Background

This section describes the Site, summarizes the Site operational and regulatory history, and documents the Site environmental setting.

2.1 Site Description

The 0.67-acre Site is located in the Greenpoint/East Williamsburg Industrial Area section of Kings County. The Site consists of properties with the following addresses: 14 Division Place (Block 2489, Lot 9), 18 Division Place (Block 2489, Lot 10), 275 Richardson Street (Block 2489, Lot 24), and 283 Richardson Street (Block 2489, Lot 21). All four parcels are zoned light industrial (M1-1) and are used for commercial purposes with the exception of a two-story residential house located on Lot 10. Nearly the entirety of the Site is covered by buildings, with a total of 18,900 square feet of building footprint on the four parcels, compared to a total lot size of 25,640 square feet within the four parcels collectively. The buildings were all constructed circa 1920, based on the New York City Planning Department's Zoning and Land Use Map (ZoLA). None of the commercial buildings have a cellar (2 story house has a 6' basement), and all are one-story except for a two-story building at 18 Division Place. The two-story residential building located on Lot 10 has a cellar. Only the narrow parcel at 14 Division Place and the southern third of the 275 and 283 Richardson Street properties are not covered by buildings. Where not covered by buildings, the open areas are primarily broken asphalt with partial pavement (specifically the vacant lot to the west of 14 Division Place and the asphalt yard behind the residential building at 18 Division Place.

Surrounding Property

A property adjacent to the southeastern boundary of the Site, which is known as 291 Richardson Street (Block 2489, Lot 120) was at one time a portion of the former Goodman Brothers facility that also included the Site. However, environmental investigation and remediation at Block 2489, Lot 120 is being completed by others under a separate BCA (C224292). This RIWP does not include activities at 291 Richardson Street.

The Site is located in a mixed commercial and residential use area. On its north and south, the Site is bordered by the rights of way for Richardson Street and Division Place, respectively. Across Richardson Street from the Site are vacant lots, a multi-unit residential building, buildings used for warehousing or storage, and what appears to be a motorcycle repair business. To the west of the Site is a row of two-story residential properties that front the eastern side of Kingsland Avenue. These properties are multi-unit residential buildings that were constructed in 1930, according to ZoLA. At the southern end of the row of residential buildings, at the northeastern corner of the intersection of Richardson Street and Kingsland Avenue, is a parking lot surrounded by a gated chain link fence. To the north of the Site, across Division Place, are primarily commercial properties, including a dry cleaner business at the northeastern corner of the intersection of Kingsland Avenue and Division Place, a parking lot, an office building, and a business known as Pirate Studios, which rents space for bands to play music indoors. A multi-unit residential building is also present at 17 Division Place. To the east of the Site is a multi-unit residential property at the southwestern corner of Richardson Street and Debevoise Avenue and a mixed-use commercial and residential building at the southwestern corner of the intersection of Debevoise Avenue and Division Place.

2.2 Site Operational History

According to the Goodman Brothers Steel Drum Draft Upland Site Summary (DUSS) document (Ref #6) that was prepared by Anchor QEA and is dated May 2012, the property at 18 Division Place was purchased by Fannie, Morris, and Bessie Goodman in 1911. Property ownership is listed as B&F Goodman Associates as of 1967, and this entity owned the property until at least 2004. In 1972, adjacent parcels were purchased; as the DUSS indicates that these purchases increased “their property southward to Richardson Street,” it is believed that Lots 21 and 24 were purchased in 1972 while at least Lot 10 was purchased in 1911. In 2004, the property was purchased by the most recent prior owners, Richland Properties, Inc. and King Tower Properties, Inc. Richland Properties, Inc. owned 275 and 283 Richardson Street, while King Tower Properties, Inc. owned 14 and 18 Division Place. The properties owned by both entities were purchased recently by the current owner, 18 Division Place Corp.

During the period of ownership of the property by Fannie, Morris, and Bessie Goodman and later by B&F Goodman Associates, the Goodman Brothers Steel Drum Company or its predecessor operations were situated at the Site. Barrels were stored at the Site as early as 1933. Drum re-conditioning and recycling operations are believed to have continued from at least this time through circa 2002, when the business stopped operating because, according to the DUSS, “the company could not then compete with similar steel drum refurbishing facilities in New Jersey”. More recent sources indicate that the Goodman Brothers Steel Drum Company or its predecessors may have begun operations at the 18 Division Place property as early as 1909 or even 1904 and that the operations may not have ceased until 2004. Regardless of the precise dates of operation, it appears that the Goodman Brothers Steel Drum Company and its predecessor companies operated at the Site to store, re-condition, and recycle containers, including drums for most of the 20th century.

2.3 Site Regulatory History

Environmental investigations have been conducted at the Site beginning in 1983, when the Goodman Brothers Steel Drum Company signed a Consent Order with the United States Environmental Protection Agency (US EPA). In 1987 and 2003, the Goodman Brothers Steel Drum Company entered into consent orders with the NYSDEC (Ref #7, Ref #8).

Initial investigations of environmental media at the Site included soil and soil vapor sampling starting in the early 1990s and then a soil and groundwater investigation completed under a RCRA Facility Closure Plan circa 2003. Data collected as part of the Meeker Avenue Plume Trackdown Site Characterization (Site ID No. 224121) was used to list the Goodman Property as a Class 2 Inactive Hazardous Waste Site in 2015 as NYSDEC Site ID C224211.

2.4 Site Environmental Setting

This section reviews the geological and hydrogeological conditions in the vicinity of the Site and identifies potential receptors. Where referenced, the information is from the Site Characterization Report, Phase IX, Site 224121, prepared by "URS Corporation for NYSDEC" dated December 2016 (Ref #4). Additional information was referenced from "Former Goodman Brothers Steel Drum Company Data Summary Report, C224211, dated January 2020 (Ref #5). Other sources are noted where applicable.

Site Geology

Geology at the Site is primarily comprised of, from the land surface downwards, two to 10 feet of fill material that is underlain by at least 105 feet of interbedded strata and lenses of clay, silt, sand, and gravel, which in turn is underlain by low permeability clays of the Raritan Formation. The deposits between the fill and the Raritan Formation are glacial in origin, with some strata being fine-grained glacial lake deposits, some being coarser grained glaciofluvial deposits, and some being till deposits that were subsequently partially eroded. The Raritan Formation is described as a gray to white clay with lenses of sand.

Site Hydrogeology

Despite the heterogeneity of the subsurface strata, the hydrogeology is relatively simple at a large scale. The nearest surface water body is Newtown Creek, which is a tidally influenced tributary to the East River. Newtown Creek itself is located between ½ and ¾ miles to the east-northeast of the Site. Smaller engineered channels that branch off from Newtown Creek are present to the east and southeast of the Site, with the nearest channel being approximately ½ mile to the east-southeast of the Site. The hydraulic gradient at the Site is generally towards the east to east-northeast.

The depth to groundwater at the Site on July 29, 2019 was approximately 15 to 22 feet below grade. Based upon classifications associated with the Meeker Avenue Plume investigation, monitoring wells have been classified as shallow or deep. Shallow monitoring wells are typically, although not universally, screened across the water table. The bottom of the screened interval in shallow monitoring wells is typically at elevations between 22 and 0 feet above mean sea level (AMSL)), while the deep monitoring wells are typically screened at elevations between 0 and -25 feet AMSL. At the Site, there are no continuous low permeability aquitards between the water bearing zones screened by the shallow and deep wells. Furthermore, hydraulic head readings indicate that there is minimal vertical hydraulic head change between the shallow and deep monitoring wells, and the horizontal components of the hydraulic gradient are generally the same (i.e., towards the southeast to northeast). As such, the glacial deposits can be considered to be a single hydrostratigraphic unit, with groundwater flow being primarily through the coarser sand and gravel deposits. While some groundwater flow may occur through the finer-grained silt and clay deposits, most of the flow will be around the silt and clay layers. Additionally, any contaminant mass that seeps into the fine-grained deposits is likely to be released slowly as equilibrium conditions change in the sand.

Based on groundwater elevation measurements made on July 29, 2019 (Data Summary Report, January 2020), the hydraulic gradient in the shallow water bearing zone is approximately 0.035 feet per foot. At the Site itself, there is an even lower hydraulic gradient, and most of the groundwater elevation change was measured in wells east of Debevoise Avenue. In the deep groundwater, based on July 29, 2019 measurements, the horizontal component of the hydraulic gradient is approximately 0.025 feet towards the east to east-northeast. As with the vertical hydraulic gradient, the similarity between the hydraulic gradients in the shallow and deep groundwater zones confirm that the glacial deposits are working as a single hydrogeologic unit.

Historic Soil Vapor

In 2019, URS collected sub-slab soil vapor samples and conducted a soil vapor intrusion sampling program (Data Summary Report, January 2020). URS recorded FID/PID total organic vapors at 70 locations. The highest FID readings were at FGB E-02, northern portion of the Site at 46, 997 parts per million (ppm). The highest PID readings were at FGB G-01 at 1,895 ppm (Data Summary Report, January 2020, Figure 4-5). For soil vapor, the highest concentrations were at location FGB SS-03, northern portion of the Site (Data Summary Report, January 2020, Figure 4-6, Table 4-7). Concentrations of chlorinated VOCs at this location were as follows:

1,1,1-Trichloroethane	8,700,000 µg/m³
1,1-Dichloroethene	44,000 µg/m³
Tetrachloroethene	2,400,000 µg/m³
Trichloroethene	2,800,000 µg/m³

Given the known soil vapor intrusion results from previous investigations, no further investigation is proposed to address this media at this time as a separate interim remedial measure (IRM) will be performed in concurrence with this RIWP. The results of the URS 2020 investigation are provided verbatim as Appendix E.

3. Remedial Investigation Work Plan (RIWP)

For the purposes of this RIWP, Per NYCRR Part 375-6.5, Commercial Soil Cleanup Objectives (SCOs) and Protection of Groundwater SCOs will apply to all analysis. Sampling for 1,4-Dioxane (dioxane) and polyfluoroalkyl substances (PFAS) will be performed under DECs Part 375 Remedial Programs, dated June 2021(Ref #3).

DPC hereby proposes the following Scope of Work and noted referenced to NYSDEC "Former Goodman Brothers Steel Drum Company, Data Summary Report, Work Assignment D007622-41, Section 5.2-Recommendations, dated January 2020" (Data Summary Report, January 2020) (Ref #5).

A Community Air Monitoring Plan (CAMP) will be performed during all work activities, per NYSDOH Generic CAMP with Special Requirements for work within 20 feet of Potentially Exposed Individuals or Populations or Structures and Special Requirements for Indoor Work with co-located Residences and Facilities. Appendix B provided the baseline CAMP requirements for this Site. DPC will collect background readings prior to the start of each workday, which will be provided to NYSDEC and NYSDOH as part of a CAMP summary included in daily reports. DPC will provide to NYSDEC and NYSDOH on a weekly basis a report of CAMP values. Within 24 hours, NYSDOH will be notified of a daily specific exceedances of the established action levels and a summary of all corrective measures taken per exceedance.

3.1 - Additional Soil & Groundwater Delineation

DPC will install the following eighteen (18) soil borings and nine (9) shallow groundwater monitoring wells with corresponding depths of sampling for analysis where noted, as identified on Table 1 and Figures 2-3. Where noted, all soil and groundwater borings will be drilled to the groundwater table, estimated approximately 25'-30' depth.

3.1.1- Task #1 - 14 Division Place Delineation

Objective - "Goodman Report, 2020 Recommendation" - Advance additional soil borings to delineate the horizontal and vertical extent of PCBs in the shallow and deep soil.

Objective - "Goodman Report, 2020 Recommendation" – Investigate on-site PFAS concentrations and delineate horizontal and vertical extent in soil and groundwater"

Objective - "Goodman Report, 2020 Recommendation" – Additional borings/wells may be needed at 14 Division Place and at the DEC-98 monitoring well location to determine if additional sources are present.

Conduct two (2) new soil borings (DPC02 and DPC04) to a depth of at least 25' at 14 Division Place vacant lot. The two soil borings will be distributed evenly at the vacant lot to provide characterization of unknown sources. One location will be converted to a permanent monitoring well (GWDPC02) with screening at the groundwater table (potential depth to 30').

DPC will collect two (2) surficial soil samples from a depth of 0"-2" at the open yard portion to the west of 14 Division Place. The locations will be based on the areas of direct access to surface soils. Sample ID's will be assigned based on depth and final sample location.

See Figure 2 for locations.

3.1.2 – Task #2 - 14 Division Place Supplemental Location

Objective - "Goodman Report, 2020 Recommendation" – Additional borings/wells may be needed at 14 Division Place and at the DEC-98 monitoring well location to determine if additional sources are present. This well has reported the highest dissolved phase concentrations of chlorinated and petroleum VOCs.

Conduct one (1) new soil boring adjacent to DEC-98 (DPC05). This location will be converted to a permanent monitoring well (GWDPC05) with screening at the groundwater table. Conduct three (3) new soil borings (DPC01, DPC13, and DPC14) to a depth of 25' at the interior space at 14 Division Place.

See Figure 2 for locations.

3.1.3 -Task #3 - 18 Division Place

Objective - "Goodman Report, 2020 Recommendation" - Advance additional soil borings to delineate the horizontal and vertical extent of PCBs in the shallow and deep soil.

Objective - "Goodman Report, 2020 Recommendation" – Investigate on-site PFAS concentrations and delineate horizontal and vertical extent in soil and groundwater.

DPC will install eight soil borings at locations on 18 Division Place (DPC06, DPC07, DPC11, DPC12, DPC15, DPC16, DPC17, DPC18), where noted. Two locations will be converted to a permanent monitoring well (GWDPC11, GWDPC12) with screening at the groundwater table. See Figure 2 for locations.

DPC will collect two (2) surficial soil samples from a depth of 0"-2" at the broken asphalt portion behind the two-story building at 18 Division Place. The locations will be based on the areas of direct access to surface soils. Sample ID's will be assigned based on depth and final sample location.

3.1.4 -Task #4 - 275/289 Richardson Street

Objective - "Goodman Report, 2020 Recommendation" – Investigate on-site PFAS concentrations and delineate horizontal and vertical extent in soil and groundwater.

DPC will install three boring locations (DPC08, DPC09) at 275 Richardson Street, and one location (DPC10) at 289 Richardson Street proximate to the rear of the lot. The three locations will be converted to shallow, permanent monitoring wells (GWDPC08, GWDPC09, and GWDPC10) with screening at the groundwater table. See Figure 3 for locations.

Table 1 –Summary of Soil Borings/Groundwater Wells (Shallow)

Boring ID (Well ID)	Location	Depth	Sample Analysis	Monitoring Well
DPC01	14 Division	~25’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	
DPC02 (GWDPC02)	14 Division	~25’-30’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	X
DPC03 (GWDPC03)	14 Division	~25’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	X
DPC04	14 Division	~25’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	
DPC05(GW DPC05)	Adjacent DEC 98	~25’-30’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	X
DPC06 (Eko)	18 Division (Adjacent to Building Wall)	~25’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	
DPC07 (Eko)	18 Division	~25’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	
DPC08 (GWDPC08)	275 Richardson	~25’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	X
DPC09 (GWDPC09)	275 Richardson	~25’-30’	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS,	X

			Dioxane	
DPC10 (GWDPC10)	Rear Lot 289 Richardson	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	X
DPC011 (GWDPC11)	18 Division	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	X
DPC12(GW DPC12)	18 Division	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	X
DPC13	14 Division	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	
DPC14 (GWDPC14)	14 Division	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	X
DPC15	18 Division	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	
DPC16	18 Division	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	
DPC17	18 Division	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	
DPC18	18 Division	~25'-30'	VOCs, SVOCs, Metals, Pesticides, PCBs, PFAS, Dioxane	

#3.2 – Task 5 - Deep Well Installation

Objective - "Goodman Report, 2020 Recommendation" –Install deep wells adjacent to or in the *vicinity of wells DEC-172, DEC-173, DEC-174 and DEC-178. The wells would be installed to depths of approximately 50-60 feet or to the top of interstratified silt or clay if found to be shallower than 50-60 feet deep. These wells will aid in assessing the vertical extent of VOC impacts in the contamination source area.*

Objective - "Goodman Report, 2020 Recommendation" – Install a deeper top of clay well near wells DEC-158/DEC-158D (DEC-158TC). The well would be installed to a depth of approximately 120 feet to assess groundwater quality near the top of the regional clay confining layer (i.e., Raritan Formation). If intermediate silts and/clay strata are present, this well should be installed as a double-cased well to isolate the contamination in the upper groundwater zones.

DPC proposed to install five (5) new groundwater monitoring wells adjacent to DEC-172, DEC-173, DEC-174, DEC-177 and DEC-178. The wells will be installed to depths of approximately 50'-60' feet or to the intermediate strata confining layer if found at 50-60 feet deep. These wells will be identified as DPC-172, DPC-173, DPC-174, DPC-177, DPC-178.

DPC proposed to install one (1) new well (DPCTC158) near DEC-158/DEC-158D to the top of clay layer. This well will be identified as DPC-158. The well would be installed to a depth of approximately 120' feet to assess groundwater quality near the top of the regional clay confining layer. If intermediate silts and/clay strata are present, this well will be installed as double cased to isolate the contamination in the upper groundwater zones. See Figure 4 for locations.

Task #3.3 –Well Sampling & Gauging

Objective - "Goodman Report, 2020 Recommendation" - Conduct one additional groundwater sampling round to include the prior 55 monitoring wells sampled during the Phase I RI and the five new monitoring wells proposed as part of Phase II.

Objective - "Goodman Report, 2020 Recommendation" - Conduct additional quarterly groundwater level measurements to assess and evaluate horizontal and vertical hydraulic gradients and determine the impact on contaminant migration in groundwater around the perimeter of the site, as well as on site areas.

DPC proposes to conduct one round of groundwater sampling at existing wells on-site. The following wells will be sampled as part of this task:

1. DEC-098, DEC-098D
2. DEC-131, DEC-131D
3. DEC-158, DEC-158D, DPC-158 (new well installation)
4. DEC-172, DEC-172D, DPC-172 (new well installation)
5. DEC-173, DEC-173D, DPC-173 (new well installation)
6. DEC-174, DEC-174D, DPC-174 (new well installation)
7. DEC-175, DEC-175D
8. DEC-177, DPC-177(new well installation)
9. DEC-178, DEC-178D, DPC-178 (new well installation).

Conduct one round of groundwater level measurements at all existing wells on-site and immediately adjacent to the site boundary to evaluate hydraulic gradients. The following wells will be gauged:

1. DEC-076, DEC-076D
2. DEC-098, DEC-098D
3. DEC-099
4. DEC-101, DEC-101D
5. DEC-126D, DEC-126
6. DEC-129
7. DEC-130, DEC-130D
8. DEC-131, DEC-131D
9. DEC-145, DEC-145D
10. DEC-158, DEC-158D, DPC-158
11. DEC-164
12. DEC-172, DEC-172D, DPC-172
13. DEC-173, DEC-173D, DPC-173
14. DEC-174, DEC-174D, DPC-174
15. DEC-175, DEC-175D
16. DEC-176, DEC-176D
17. DEC-177
18. DEC-178, DEC-178D, DPC-178

4. REMEDIAL INVESTIGATION METHODS

The following summarizes the methods for the activities proposed in Section 3 of this RIWP. All activities will be completed by the CPE or Equity key personnel proposed below, in accordance with the QAPP in Appendix C, and in accordance with NYSDEC document DER-10. Commercial (SCOs) and Protection of Groundwater SCOs will apply to all analysis.

4.1 – Additional Soil & Groundwater Delineation

A total of eighteen (18) soil and six permanent wells will be installed for this task.

<u>Soil</u>

The soil probes will be assigned consecutive sampling designations DPC01-DPC18. The soil probes will be installed to the approximate depth of groundwater, which is assumed based on historical data to be 25’ (minimum) below grade surface. The exact analysis list is as follows:

1. Target Compound List (TCL) VOCs via USEPA Method 8260
2. Semi Volatile Organic Compounds via USEPA Methos 8270
3. Target Analyte List (TAL) Metals via USEPA Method 6010
4. Pesticides/PCBs by USEPA Methods 8081/8082

5. PFAS by USEPA Method 1633 - PFAS Analyte List
6. 1,4-Dioxane by USEPA Method 8270 SIM

Advanced drilling methods will be considered given the ceiling height restrictions and lithology. For these tasks, a mini sonic drill rig will be the primary drilling equipment. A geoprobe (model to be determined) will be supplemented where necessary to drill in restricted spaces with ceiling height limitations. Five soil samples will be obtained from each soil probe.

The soil samples will be collected in four (4') intervals, as 0'-4, 4'-8', 8'-12' 12'-16', and a sample at 25-feet or immediately above the groundwater interface.

For the purposes of sample collection, each macrocore or sample recovery sleeve (dual tube sleeves will be evaluated for sonic applications) will be specifically analyzed for recovery and analysis of depth within each 4' core. Discreet sampling from the smallest interval possible will be collected based on the drilling method. Discreet sampling and bias will be used based on PID readings, visual contamination, odors, staining, to collect samples from the most defined interval as possible within each recovery sleeve. At a maximum, a two foot interval will be used for any composite samples, although this is not anticipated.

The geologist will characterize each soil sample in the field. The soil characterization will consist of determining the soil classification utilizing the Unified Soil Classification System and screening each sample for organic vapors utilizing a Photoionization Detector (PID).

Soil cuttings and all investigation derivative wastes (IDW) generated during soil probe installation and sampling (acetate liners, gloves etc.) will be placed in one 55-gallon drums and properly disposed of in accordance to DER-10 Technical Guidance for Site Investigation and remediation (May 2010). All boreholes will be backfilled with fine grade sand and properly sealed in surface with a layer of slurry and native shallow dirt.

Groundwater

Shallow Well Installation

A total of nine (9) shallow monitoring wells, designated DPCGW02, DPCGW03, DPCGW05, DPCGW08, DPCGW09, DPCGW10, DPCGW11, DPCGW12, and DPCGW14 will be installed during the investigation. The wells will be installed to 25-30 feet below grade (contingent upon site conditions), which is the anticipated depth to water below the Site. Figure 2-4 provides the proposed monitoring well locations.

The wells will be installed with a GeoProbe and constructed using two-inch diameter Schedule 40 PVC with American Society of Testing (ASTM) F-480 pipe threading and 15 feet of two-inch diameter, pre-packed, 0.020-inch (20-slot) PVC well screen. The water level in the borehole will be measured immediately prior to the construction of the well. The screened interval of the wells will consist of 0.020-inch slots and will be situated approximately 5 feet above the level of groundwater and 10 feet below (15' screen). The pre-pack will consist of sand surrounding the slotted screen with a 2.8-inch steel mesh screen on the outside. Once the well is inserted into the boreholes, they will be completed with a bentonite seal and backfilled to grade.

The bentonite seal will be emplaced, a minimum of two feet, above the sand pack. A protective steel, flush-mounted curb box and locking cap will be installed after completion of the well. Each well will be completed with flush mounted boxes and covers set in concrete pads. The casing of the well will be appropriately labeled.

All installed wells will be monitored and gauged for separate phase product. The monitoring will be performed utilizing a Solinst® 122 Oil/Water Interface Probe (Interface Probe). The Interface Probe can measure depths to water to 0.01 inch. The static depth to water will be measured in each well from the northern portion of the top of casing.

The monitoring wells will be purged and sampled in accordance to the USEPA's Low Stress/Flow Groundwater Sampling Protocol (SOP #GW0001, Rev. 1996) and following the stabilization of water quality indicator parameters. Each well will be developed using the low flow technique until parameters (dissolved oxygen, pH) stabilize to within 10% maximum deviation. All wells will be developed following installation.

Well development will include the use of a surge block as well as a submersible pump. All wells will then be purged and sampled at least two weeks following well development. Sampling of groundwater will occur following the stabilization of the following parameters within in the specified confidence limits: pH, turbidity, specific conductance, ORP/Eh, temperature, and dissolved oxygen. As per the USEPA's Low Stress/Flow Groundwater Sampling Protocol, static depth to water will also be gauged at the end of sampling.

One (1) groundwater sample will be collected from each well. Each groundwater sample will be placed into laboratory supplied containers and appropriately labeled. The groundwater samples will be analyzed for the same analytes investigated in soil.

Any Investigation-Derived Waste (IDW) generated during monitoring well installation and soil probe installation will be placed into 55-gallon drum(s) and properly disposed of in accordance to DER-10 Technical Guidance for Site Investigation and remediation (May 2010)

Deep Well Installation

A total of six (6) monitoring wells, designated DPC 172, DPC 173, DPC 174, DPC177, DPC 178 and DPCTC158 (deep), will be installed during the investigation. These wells will be installed either using mini sonic technology or auger methods if site constraints support the well depth required.

The five wells will be installed to 50-60 feet below grade. This will be determined on a well specific location basis to note each well is intended to be installed at the intermediate confining layer.

The monitoring wells will be installed to span the groundwater table interface using 10- feet of two-inch diameter schedule 40 polyvinyl chloride (PVC) screen (0.010-inch slot), and riser.

The deep 120’ well (DPCTC158) will be constructed using two-inch diameter schedule 40 PVC well screen (0.010-inch slot), and riser to the clay layer. The screening will be at the clay layer to not pierce the clay and cause any contaminant migration.

Once the well is inserted into the boreholes, the annular space will be completed with sand pack (No 1 coarse grade), a bentonite seal, and backfilled to grade. The sand pack will be emplaced so that it extends to a minimum depth of six inches below the bottom of the screen and a minimum of two feet above the top of the well screen.

Each well will be completed with flush mounted boxes and covers set in concrete pads.

All wells will be developed following installation as described above in Task 3.1. All wells will then be purged and sampled at least two weeks following well development.

Well Sampling & Gauging

An initial round of groundwater sampling will be performed from each well in Section 3.3 to characterize groundwater quality at the site. One representative groundwater sample will be collected from each well using low-flow sampling techniques. Sampling will be conducted in accordance with NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010, and Sampling Guidelines and Protocols, dated March 1991.

Low flow sampling of groundwater will occur following the stabilization of the following parameters within in the specified confidence limits: pH, turbidity, specific conductance, ORP/Eh, temperature, and dissolved oxygen.

All groundwater samples retained for laboratory analysis shall be placed in laboratory supplied glassware and packed in a cooler on ice for delivery under proper Chain of Custody procedures. Groundwater samples will be submitted to a NYSDOH ELAP laboratory and tested for the following analytes:

1. Target Compound List (TCL) VOCs via USEPA Method 8260
2. Semi Volatile Organic Compounds via USEPA Methos 8270
3. Target Analyte List (TAL) Metals via USEPA Method 6010
4. Pesticides/PCBs by USEPA Methods 8081/8082
5. PFAS by USEPA Method 1633 - PFAS Analyte List
6. 1,4-Dioxane by USEPA Method 8270 SIM

A professional elevation survey for each installed monitoring well will be completed to measure and routinely monitor the relative groundwater elevation. The monitoring well elevation will be referenced to an arbitrary vertical datum. The surveyor will be requested to provide elevations that can be associated with the existing well survey datum for reference.

After the relative elevation of monitoring wells is determined, a round of water levels will be measured using an interface probe capable of measuring to the nearest one-hundredth of a foot. If non-aqueous phase liquid (NAPL) is observed, the NAPL thickness will be measured.

5. REMEDIAL INVESTIGATION REPORT (RIR)

Following completion of the proposed activities, Equity and CPE will a data submission to NYSDEC to determine if the dataset from the investigation has completed the objectives as requested from NYSDEC and to document the scope, methods, deviations from the NYSDEC-approved RIWP (if any), and results. Upon NYSDEC review, a determination will be made on any supplemental data collection requirements. A section will relate the Data Usability Summary Report, which will be completed by an analytical chemist who is independent of the sampling team. A Qualitative Human Health Exposure Assessment (QHHEA) will be performed to evaluate potential exposure pathways and potential receptors.

CPE anticipates that the following figures, tables, and appendices will be prepared as part of the RIR:

- Site Location Plan
- Site Plan
- Soil Sampling Location Plan
- Soil Sampling Results Map
- Groundwater Elevation Contour Map(s)
- Groundwater Sampling Results Map(s)
- Cross-Sectional Groundwater Elevation and Sampling Results Map(s)
- Table Summarizing Soil Sampling Analytical Data
- Table Summarizing Well Construction and Groundwater Elevation
- Table Summarizing Groundwater Sampling Results
- Appendix of Laboratory Analytical Results
- Appendix Summarizing the Data Usability Sampling Report (DUSR)
- Appendix Summarizing Soil Boring Logs and Well Construction
- Qualitative Human Health Exposure Assessment (QHHEA)

6. ANTICIPATED PROJECT SCHEDULE

The proposed schedule is relative to the NYSDEC's approval of this document.

- NYSDEC Approval of the RIWP – Day 0
- Collection of Existing Well Measurements – Weeks 2-3
- Drilling Borings, Collection of Soil Samples, and Installation of Well – Weeks 5-6
- Surveying and Development of Wells – Week 7
- Groundwater Sampling – Week 9-10
- Receipt of Soil Sample Data and DUSR Preparation – Week 18
- Receipt of Sampling Data and DUSR Preparation – Weeks 24

- Submittal to NYSDEC – Week 32
- NYSDEC and DPC Review of Data – Supplemental RI Schedule - TBD

- Response to NYSDEC Comments– TBD Based on Supplemental Data Requirements

7. KEY PROJECT PERSONNEL

We propose the following key personnel and subcontractors for this work. Key personnel Resumes are provided in Appendix D. Field team personnel will be assigned based on their availability and their experience with the required fieldwork.

- Remedial Engineer – Craig Puerta, PE: Mr. Puerta has over 20 years of experience completing environmental investigations and remedial actions in New York and his company, CPEngineering, will be providing all final engineering certifications, supervision, and principle in charge activities.
- Project Manager – Robert Jackson, PE: Mr. Jackson has over 30 years of experience completing environmental investigations and remedial actions in New York. His experience includes planning and oversight for all activities proposed in this RIWP.
- Field Team Lead – John Vrabel: John has approximately 10 years of experience conducting a variety of environmental investigations in New York. His experience includes drilling hundreds of soil borings, installing hundreds of monitoring wells, completing oversight of subcontractors, and collecting thousands of samples of various environmental media.
- Site H&S Officer – Faron Moser, CHST: Mr. Moser has over 15 years of experience in health and safety program design, implementation, and audit and in completing environmental investigations. He is a Certified H&S Trainer, and routinely assists Equity’s clients in implementation of their H&S programs.
- Driller – Equity proposes to retain Cascade to complete the soil boring work and the installation of proposed monitoring wells.
- Analytical Laboratory – Equity proposes that Pace Laboratories provide the sample bottleware and complete the requested analyses. Pace Laboratories is certified to complete the requested analyses.
- Analytical Chemist – DDMS Inc. will provide third party data validation and prepare the required Data Usability Summary Reports (DUSRs).
- Surveyor– Equity will select a surveyor. This assignment will be made based on proposals received and the firms’ availability to complete the work in the timeframes of the schedule.

References

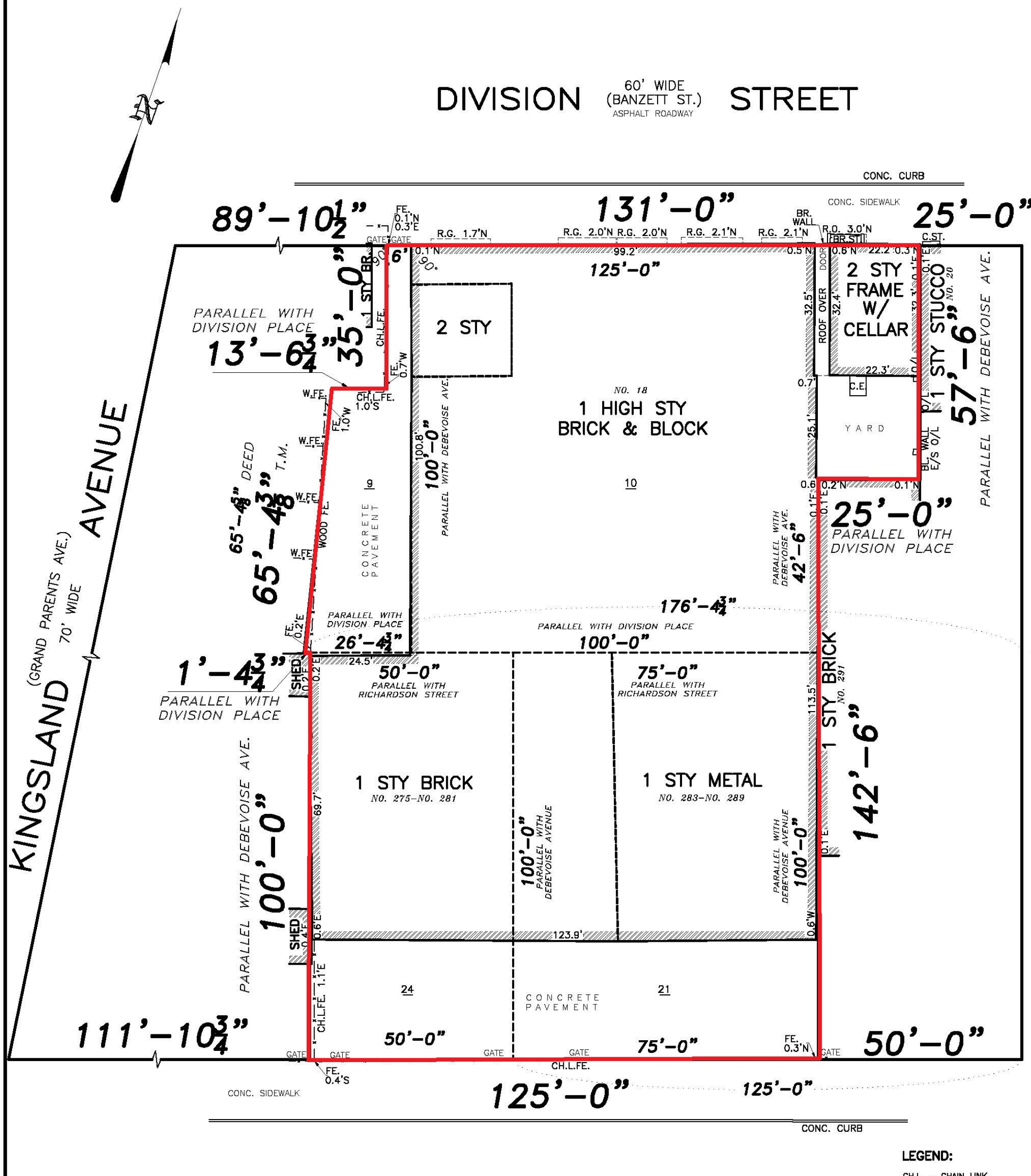
1. DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010 (DER-10
2. NYCRR Part 375-6.5, Commercial Soil Cleanup Objectives (SCOs) and Protection of Groundwater SCOs
3. Sampling for 1,4-Dioxane (dioxane) and polyfluoroalkyl substances (PFAS) will be

performed under DECs Part 375 Remedial Programs, dated June 2021.

4. Site Characterization, Phase IX, Work Assignment D7622-27, Meeker Avenue Plume Trackdown, December 2016. C224121
5. Former Goodman Brothers Steel Drum Company, Data Summary Report, Work Assignment D007622-41, dated January 2020. Site C224211
6. Goodman Brothers Steel Drum Upland Site Summary (DUSS), Anchor QEA, Dated May 2012.
7. NYSDEC Order on Consent, Dated September 23, 1987
8. NYDEC Order on Consent, Dated June 18, 2003.
9. NYSDOH CAMP Generic Requirements – Work Within 20 Feet of Potentially Exposed Individuals or Populations

.

Figure 1
SITE MAP



LEGEND:

CH.L. – CHAIN LINK
C.E. – CELLAR ENTRANCE
R.G. – ROLL-UP GATE
R.O. – ROOF OVER
C.,CONC. – CONCRETE
T.M. – TAX MAP
PLT. – PLATFORM
BR. – BRICK
BL. – BLOCK
W. – WOOD
ST. – STEPS
FE – FENCE
PVMNT – PAVEMENT
O/L – ON LINE
E/S – EAST SIDE

TITLE SURVEY	
SCALE 1" = 25'	JOB NO. NYL20152
DATE 02-27-2020	

Certification indicated hereon signify that this survey was prepared in accordance with the existing Code of Practice for Land Surveys adopted by the New York State Association of Professional Land Surveyors. Said certifications shall run only to the person for whom the survey is prepared, and on his behalf to the title company, governmental agency and lending institution listed hereon, and to the assignees of the lending institution.
Certifications are not transferable to additional institutions or subsequent owner. Unauthorized alteration or addition to a survey map bearing a licensed land surveyor's seal is a violation of section 7209, sub-division 2, of the New York State Education Law.
Only copies from the original of this survey marked with an original of the land surveyor's embossed seal shall be considered to be valid true copies.

EASEMENTS NOT SHOWN ARE NOT GUARANTEED.
THIS SURVEY IS TO BE USED FOR TITLE PURPOSES ONLY.

MALGORZATA GASIOROWSKA N.Y.S. L.L.S. 051047

NY LAND TECH P.C.
LAND SURVEYING
office 516-783-0856
email info@nyland-tech.com
449 Argyle Road, East Meadow NY 11554

THE OFFSETS OR DIMENSIONS SHOWN HEREON, FROM THE PROPERTY LINES TO THE STRUCTURES ARE FOR A SPECIFIC PURPOSE AND USE. THEREFORE THEY ARE NOT INTENDED TO MONUMENT PROPERTY LINES OR TO GUIDE THE ERECTION OF FENCES, ADDITIONAL STRUCTURES OR ANY OTHER IMPROVEMENTS.

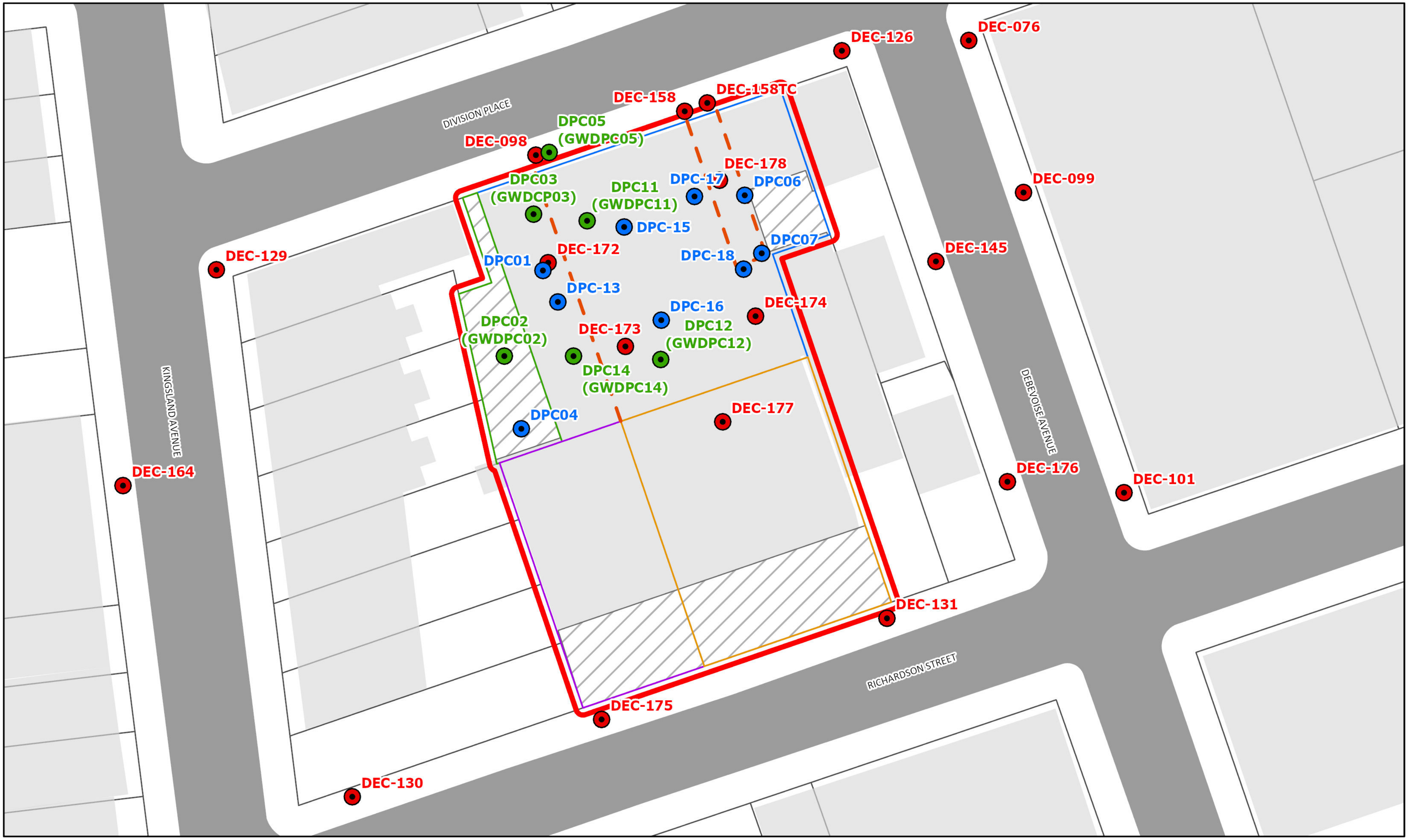
REVISIONS:

ADDRESS:
#14–#18 DIVISION PLACE,
#275–#289 RICHARDSON STREET,
BROOKLYN, KINGS CO., NEW YORK

CERTIFIED TO:

TITLE NO.:

TAX MAP SEC. – BLOCK 2849 LOT(S) 9, 10, 21, 24
FILED MAP – BLOCK – LOT(S) –



Legend

- 🟥 Former Goodman Brothers
- 🟦 14-18 Division Place
- 🟩 Vacant Land
- 🟪 275 Richardson Street
- 🟧 289 Richardson Street
- – – Interior Dividing Walls
- ▨ Paved Area
- ● Proposed Soil Boring
- ● Proposed Soil Boring / Monitoring Well
- ● NYSDEC Monitoring Well

*Surface Soil Samples 0" - 2" from Hatch Area per RIWP

N

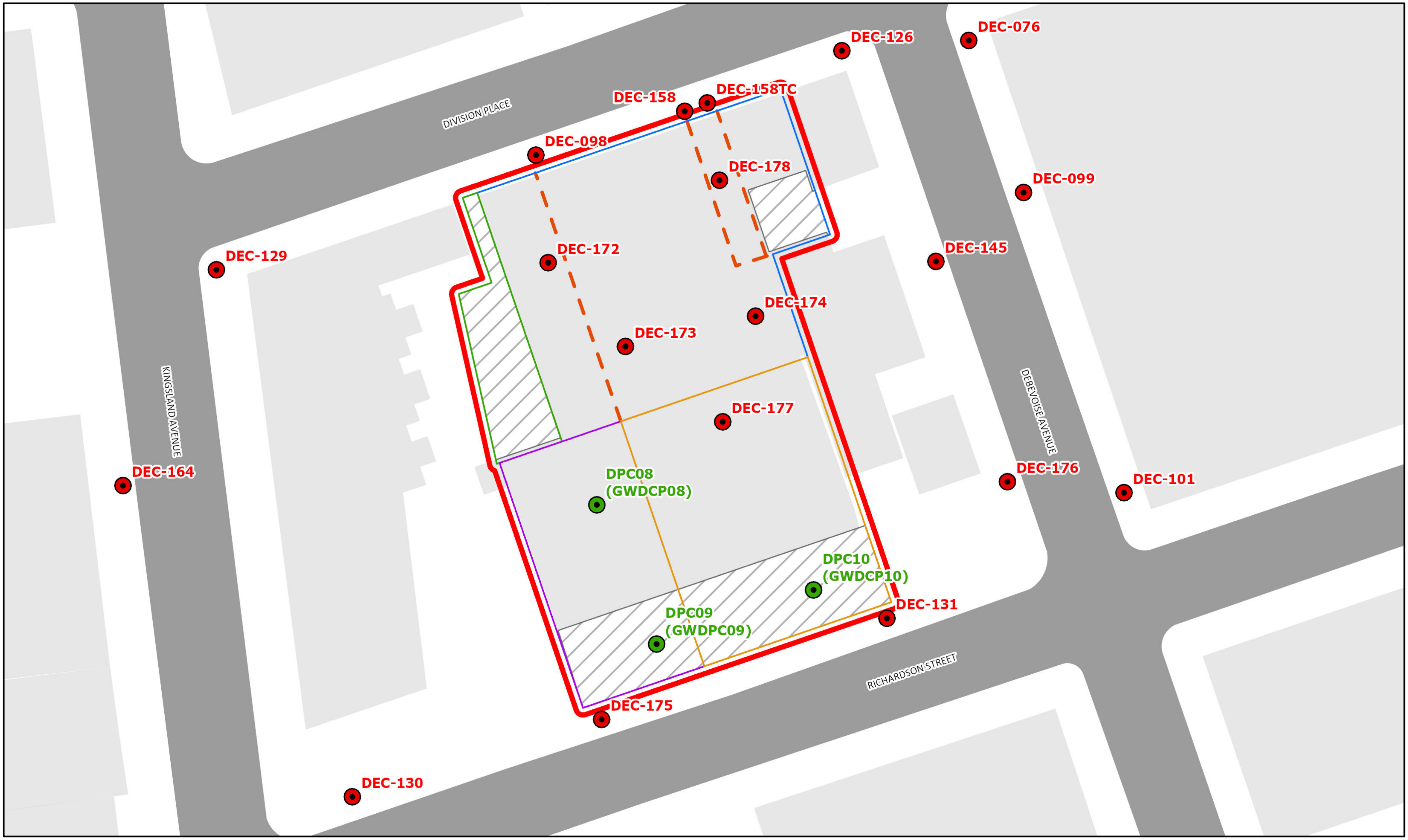
0 25 50 100 US Feet

Figure 2
Remedial Investigation Workplan
14/18 Division Place Delineation - Shallow Wells

18 Division Place
Brooklyn, New York

equity environmental engineering
500 International Drive, Suite 150, Mount Olive, NJ 07828
Office: (973) 527-7451 / Fax: (973) 858-0280

DRAWN BY / DATE	REV / DATE	DRAWING NUMBER
GB/9.1.22		2022020-02



Legend

▭ Former Goodman Brothers
▭ 14-18 Division Place
▭ Vacant Land
▭ 275 Richardson Street
▭ 289 Richardson Street
▨ Paved Area
- - Interior Dividing Walls
● Proposed Soil Boring / Monitoring Well
● NYSDEC Monitoring Well

N

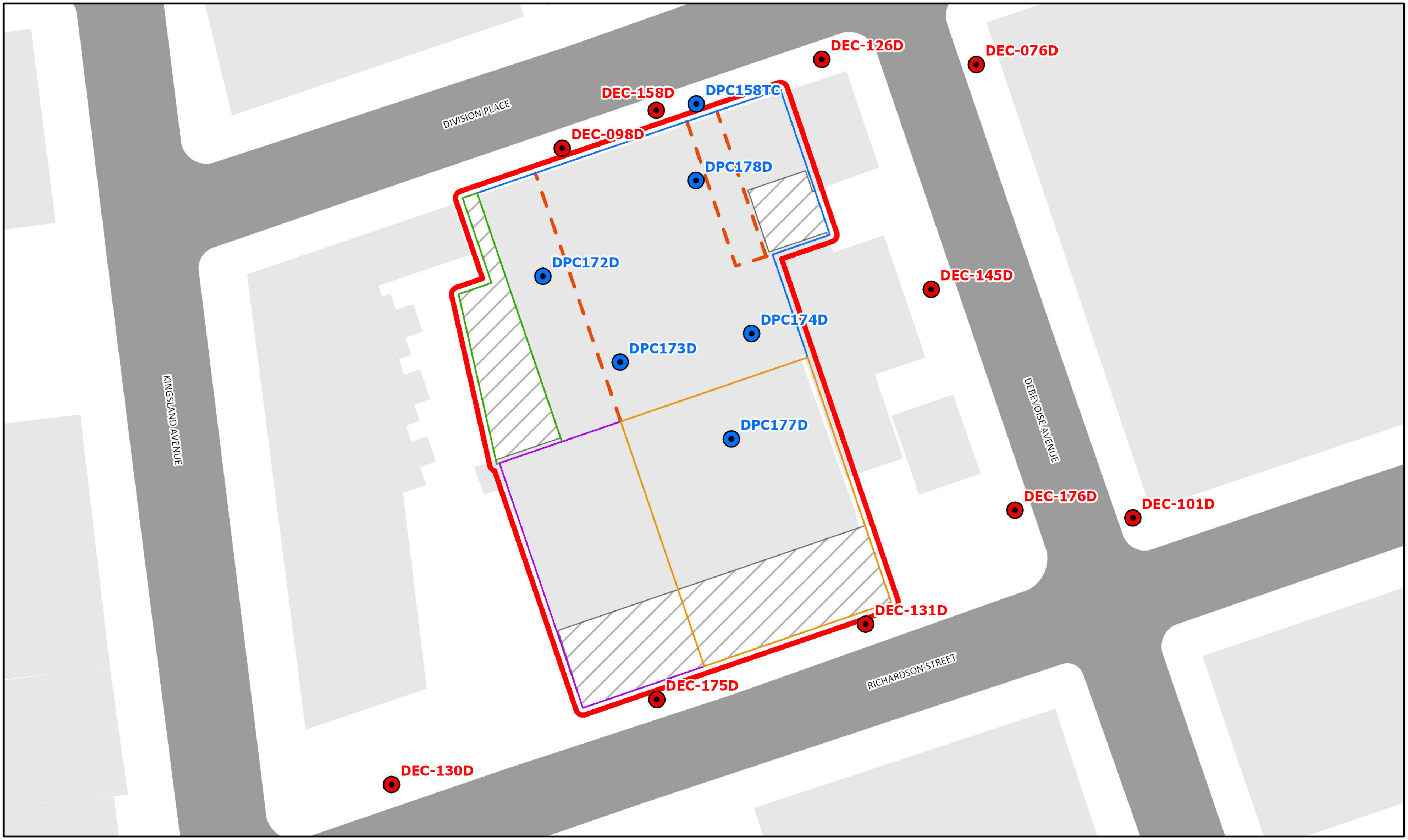
0 25 50 100 US Feet

Figure 3
Remedial Investigation Workplan
275-289 Richardson Street Delineation - Shallow Wells

18 Division Place
Brooklyn, New York

equity environmental engineering
500 International Drive, Suite 150, Mount Olive, NJ 07828
Office: (973) 527-7451 / Fax: (973) 858-0280

DRAWN BY / DATE	REV / DATE	DRAWING NUMBER
GB/9.7.22		2022020-03



Legend

🟥	Former Goodman Brothers
🟦	14-18 Division Place
🟩	Vacant Land
🟪	275 Richardson Street
🟧	289 Richardson Street
▨	Paved Area
- -	Interior Dividing Walls
●	Proposed Soil Boring / Monitoring Well
●	NYSDEC Monitoring Well

N

0 25 50 100 US Feet

Figure 4
Remedial Investigation Workplan
Deep Well Installation

18 Division Place
Brooklyn, New York

equity environmental engineering
500 International Drive, Suite 150, Mount Olive, NJ 07828
Office: (973) 527-7451 / Fax: (973) 858-0280

DRAWN BY / DATE	REV / DATE	DRAWING NUMBER
GB/9.7.22		2022020-04

Appendix A

Site-Specific Health and Safety Plan (HASP)

Project Name: 18 Division Place
Project Number: 2022020

EQUITY ENVIRONMENTAL ENGINEERING, LLC
5 00 International Drive, Suite 150
Mount Olive, New Jersey 07828

SITE-SPECIFIC HEALTH AND SAFETY PLAN

Address: 18 Division Place
Brooklyn, New York 11222

Plan Revisions

Number	Date	Initials
1	11/29/22	CP
2		
3		
4		

Faron Moser, CHST — 11.29.22
Health & Safety Officer — Date

Craig Puerta. — 11.29.22
Principal Project Manager — Date

John Vrabel — 11.29.22
Site Safety Officer — Date

Table of Contents

Page

FORMS

Introduction

This Site-Specific Health and Safety Plan (HASP) has been prepared by Equity Environmental Engineering, LLC (Equity) to summarize the work-related health and safety hazards at the subject site 18 Division Pl., Brooklyn, New York 11222 and the requirements and procedures to protect its employees from them. This plan meets or exceeds the requirements of Occupational Safety and Health Administration (OSHA), 29 CFR 1910.120, for a site-specific health and safety plan.

This plan was designed to reduce the potential for occupational illness or injury resulting from working at this site. The purpose of the HASP is to inform Equity's employees of the health and safety risks present at this site, and the proper methods of protecting themselves from those risks. Each worker must be fully aware of the risks associated with the work to be accomplished, and be dedicated to completing that work safely.

Existing and potential hazards at this site have been identified. As new information becomes available, this HASP will be revised. Standard practices and procedures of industrial hygiene, occupational health, safety, and environmental protection are prescribed in this plan, which was prepared and reviewed by experienced professionals.

Equity employees who work on this site must read the HASP and sign the form included in this plan, to indicate that they understand the plan's contents, and agree to comply with its provisions. Anyone who cannot, or will not comply with this HASP will be excluded from on-site activities. Violations of this HASP or any applicable federal, state, or local health and safety regulations should be reported immediately to the Site Supervisor (SS), or to Equity's Health & Safety Officer (HSO).

This HASP will be readily available so workers can reference it when necessary.

Site Information

Location: 18 Division Place, Brooklyn, NY 11222

Current Site Information:

The Subject Property is located at 18 Division Place, Brooklyn, New York. The Subject Property is a rectangle-shaped lot on Division and Richardson Street. This HASP is for the supplemental investigation of the site.

Location/Class: [X] Industrial [ ] Commercial [] Urban/Vacant[] Urban/Residential
[ ] Suburban [ ] Rural [ ] Public Facility/Institution

Site Regulatory Status: [ ] CERCLA/SARA [ ] US EPA [] NYC DEP
[ ] NPL [ ] RCRA [X] NYS
DEC
[X] Other BCP [ ] Not Regulated

Operations or Tasks to be Performed:

1. **Soil boring and monitoring well installation**
2. **Soil, and groundwater sampling**

Surrounding Population/Structures:

The area surrounding the subject property consists of primarily commercial, industrial, &residential buildings.

Site and Surrounding Topography:

The topography is generally flat on-site.

Known or Suspected Pathways of Contaminant Dispersion:

Soil,

Emergency Shower, Eyewash and First Aid Equipment Located at:

Eyewash and emergency shower will not be available. First Aid Kits will be in the technician's vehicle.

First aid provided by emergency services (911).

Personnel On-Site trained in First Aid:

1. Peter Jaran
2. Bob Jackson
3. Faron Moser
4. John Vrabel
5. Christian DiGennaro
6. Vicki Moore
7. Craig Puerta
8.

Emergency Medical Care

Hospital

Hospital Name: Wyckoff Heights Medical Center Telephone: (718) 963-7272

Address: 374 Stockholm Street, Brooklyn, NY 11237

Contact: Operator

Type of Service (X) Physical Trauma Only

( ) Physical Trauma and Chemical Exposure

(X) Available 24 Hours

Hospital Route:

1. Take Vandervoort Ave to Grand Street
2. Continue on Grand Street to Varick Ave
3. Continue on Varick Ave to Flushing Ave
4. Follow Wyckoff Ave
5. Turn left
6. Go to 374 Stockholm Street

Hospital route information has been provided to satisfy OSHA requirements (29 CFR 1910.120). **However, where 911-emergency service and/or transport is available, Equity personnel are strictly prohibited from transporting accident victims in either company or personal vehicles.

Transporting the injured in non-emergency vehicles increases the potential for motor vehicle accidents during transit to the hospital and further injury to the victim. Also, the victims' condition can worsen during transit. As a result, transportation in non-emergency vehicles can delay or even prevent treatment by trained emergency personnel during a critical time. Employees must remain at the site of the accident, administer appropriate first aid, and await the arrival of **trained emergency and/or rescue personnel.**

Emergency Contacts

	Town	Phone
New York Fire Department/EMS	FDNY Engine 237 43 Morgan Ave Brooklyn, NY	911 (805)-458-1207
New York Police Department	NYPD 94th Precinct 100 Meserole Ave Brooklyn, NY	911 (718) 383-3879
Ambulance/EMS	FDNY EMS Station 57 131 Throop Ave Brooklyn, NY	911 (718) 728-1867
Site Contact	Equity Personnel TBD	All Equity staff have cell phones that are on them at all times.
Site Telephone	Equity Personnel	See Above
Nearest Telephone	Equity Personnel	See Next Page
Federal Agency Representative	NA	NA
State Agency Representative	NA	NA
Local Agency Representative	NA	NA
Pesticide Poisoning	NA	(800) 845-7633
NY Poison Center	State-wide	(212) 764-7667
CHEM TREC	Washington, DC	(800) 424-9300
Utility	**Company Name**	**Phone**
Water Supply	NYC DEP	*
Sewer	NYC DEP	*
Power	*	*
Telephone	*	*
Gas	*	*
NY One Call	NY	811

* NY One Call will supply this information

Equity Environmental Engineering LLC Emergency Contact List
Cell Phone Numbers

Bob Jackson, Equity Managing Director	(973) 641-0825
Faron Moser, Equity H&S Manager	(201) 341-1323
John Vrabel, Equity Field Scientist	(862) 266-6856
Equity Environmental Engineering Office	(973) 527-7451
Peter Jaran, Equity Managing Director	(973) 479-2381
Christian DiGennaro, Equity Junior Field Scientist	(570) 350-9448
Vicki Moore, Equity Junior Field Scientist	(862) 268-6343
Craig Puerta, Principal	(917) 952- 8216

Key Project Personnel

The following describes the project position assignments, associated responsibilities, and reporting relationships.

Position	Job Description	Interactions
Project Manager (PM)	Responsible for technical and administrative performance of the project. Supports Site Supervisor and is available to him at all times. Will visit the site periodically, or as necessary. Reports progress of project on a regular basis. Assigns key personnel, and identifies, requests, secures, and monitors use of resources for project. Approves program expenditures and invoices.	Reports directly to Managing Director. Works closely with Site Supervisor.
Site Supervisor (SS)	Acts as point of contact for client and client's representative(s). Supervises all on-site personnel and subcontractors. Coordinates daily site-specific work efforts, and ensures all activities are in strict compliance with site-specific health and safety plan. Has authority to suspend all work that possesses any health and safety risk. Briefs subordinate technical personnel on task requirements. Identifies and resolves technical problems. Provides periodic review of project progress.	Reports directly to Project Manager.
Health & Safety Officer (HSO)	Develops, implements, and enforces the on-site safety program. Oversees all health and safety aspects of project, conducts periodic audits to ensure compliance. Available at all times to discuss project progress and health and safety related issues.	Reports directly to Managing Director. Works closely with Project Manager, and Site Supervisor.
Onsite Health Physicist	Implementing the radiation safety at the Site with authorization to stop work due to unsafe acts, unsafe conditions, non-compliance and/or non-implementation of the Safety Plan and/or applicable safety and health requirements; performs the proper operation of radiation monitoring equipment; conducts radiation surveys; and notifies anomalies to the site supervisor.	Reports directly to Site Supervisor.

Equity is the entity responsible for managing health and safety for its employees at this site. Key project personnel are as follows:

Site Supervisor:	John Vrabel Name	973-527-7451/862-266-6856 Telephone / Cellular Number
HSO:	Faron Moser Name	973-527-7451/201-341-1323 Telephone / Cellular Number
Project Manager Name	Geoff Clark	973-527-7451/610-216-7460 Telephone / Cellular Number

Medical Surveillance and Training Dates for Authorized Personnel

Employee	Medical Exam	OSHA 8-Hr.	Site Supervisor Training	30 Hr. OSHA Construction	Site Safety Training Card	Respirator Fit Test
Bob Jackson	7/14/21	1/15/22	9/27/2004	Not Required P.E.	Not Required P.E.	8/30/21
Faron Moser	2/11/21	1/9/22	2/10/06	6/27/11 Also a Trainer	5/12/20	8/30/21
John Vrabel	5/8/21	12/14/21	4/4/19	8/31/18	2/25/20	8/30/21
Christian DiGennaro	6/25/21	12/14/21	-	8/19/21	11/1/21	8/30/21
Vicki Moore	8/17/21	12/14/21	-	12/17/21	-	8/30/21
Peter Jaran	12/18/20	12/14/21	Unknown	Not Required P.E.	Not Required P.E.	Not Current
Geoff Clark	4/14/21	12/14/21	-	-	-	-

Task Identification

Tasks covered under this plan:

Task #	Description
1	Soil boring and monitoring well installation
2	Soil,, and groundwater sampling

Off-site tasks planned? No

Describe:

Potential Chemical Hazards MODIFY AS NECESSARY

Task No.(s)	Chemical Name (or class)	PEL	TLV	Other Pertinent Limits (specify)	Primary Hazard			SDS Attached Y/N
					Ingestion	Dermal	Inhalation	
1,2	Benzene	1 ppm	0.5ppm			X	X	Y
1,2	Tetrachloroethene							
1,2	Trichloroethene							
1,2	cis-1,2-dichloroethene							
1,2	Vinyl Chloride							
1,2	1,1,1-Trichloroethane							
1,2	Ethylbenzene	100 ppm	100 ppm		X		X	Y
1,2	p-Xylene		100 ppm	STEL – 150 ppm	X	X	X	Y
1,2	PCBs		0.5 ppb		X	X	X	Y
1,2	Lead	0.5 ppb	0.5 ppb		X	X	X	Y
1,2	Mercury	0.1 ppb	0.025 ppb		X			Y
1,2	Toluene	200 ppm	50 ppm	Ceiling – 300 ppm	X		X	
1,2	Isobutylene						X	Y

PEL –	OSHA Permissible Exposure Limit: the maximum allowable 8-hour time weighted average (TWA) exposure concentration.
TLV –	ACGIH Threshold Limit Value: the recommended 8-hour TWA exposure concentration.
STEL –	ACGIH or OSHA Short-term Exposure Limit: the maximum allowable 15-minute TWA exposure concentration.
Ceiling –	OSHA and Cal-OSHA Ceiling Limit: the maximum exposure concentration above, which an employee shall not be exposed during any period without respiratory protection.

IDLH –	Immediately Dangerous to Life and Health: the concentration at which one could be exposed for 30 minutes without experiencing escape-impairing or irreversible health effects.

**Please note all the chemicals listed above have not been confirmed to exist at the Subject Property. However, per NYC CEQR (New York City, City Environmental Quality Review) requirements, site-specific HASP should include VOCs, SVOCs, Pesticides/PCBs, and Heavy Metals as potential chemicals of concern. Isobutylene is the only chemical we know will be onsite for tasks 1, 2, and 3 and it is used as a calibration gas for PID (Photo-Ionization Detector) equipment.*

Physical and Biological Hazards

Hazard	Yes	No	Task No.(s)	Hazard	Yes	No	Task No.(s)
Electrical (overhead lines)		X		Uneven Terrain	X		1,2
Electrical (underground lines)	X		1,2	Unstable Surfaces		X	
Gas Lines	X		1,2	Elevated Surfaces		X	
Water Lines	X		1,2	Lightning	X		1,2
Drilling Equipment	X		1,2	Rain	X		1,2
Excavation Equipment		X		Snow	X		1,2
Power Tools	X		1,2	Liquefied/Pressurized Gases		X	
Heat Exposure	X		1,2	Lifting Equipment		X	
Cold Exposure	X		1,2	Vermin	X		1,2
Oxygen Deficiency		X		Insects	X		1,2
Confined Spaces		X		Disease-causing organisms	X		1,2
Noise	X		1,2	Others, e.g., marine sampling (specify)		X	
Ionizing Radiation		X		Illness - COVID-19	X		1,2
Non-Ionizing Radiation		X		Slippery Surfaces	X		1,2
Fire	X		1,2				
Explosive Atmospheres		X					
Shoring		X					
Scaffolding		X					
Holes/Ditches	X		1,2				
Steep Grades		X					

Risk Analysis

Task #	Substance	Concentration (if known)	Risk*
1,2	Isobutylene		0/1
1,2	Benzene		0/1
1,2	Tetrachloroethene		0/1
1,2	Trichloroethene		0/1
1,2	cis-1,2-dichloroethene		0/1
1,2	Vinyl chloride		0/1
1,2	1,1,1-Trichloroethane		0/1
1,2	Ethylbenzene		0/1
1,2	p-Xylene		0/1
1,2	PCBs		0/1
1,2	Lead		0/1
1,2	Mercury		0/1
1,2	Toluene		0/1

*Risk
0 – No Risk
1 – Slight Risk
2 – Moderate Risk
3 – Dangerous Conditions/Caution
4 – High Risk
5 – Extremely Dangerous

**Please note all the chemicals listed above have not been confirmed to exist at the Subject Property. However, per NYC CEQR (New York City, City Environmental Quality Review) requirements, site-specific HASP should include VOCs, SVOCs, Pesticides/PCBs, and Heavy Metals as potential chemicals of concern.*

General Safety Rules

1. If an employee must work alone, he/she must call his/her supervisor twice a day. If the supervisor is unavailable, that supervisor's supervisor must be contacted.
2. Workers must wear all personal protective equipment required for the tasks to be performed.
3. Horseplay or practical jokes are forbidden on the job.
4. Compressed air must not be used to blow dirt from clothing, or played with or blown at another person.
5. Drinking of alcoholic beverages or the use of drugs on the job is prohibited. Their use will cause immediate dismissal from the site.
6. All areas must be continually cleaned to maintain good housekeeping. Trash is to be piled neatly and removed promptly. All tools and work areas are to be kept in clean and safe condition.
7. Competent workers must do welding and cutting.
8. Ladders are to be of proper design and tied off while in use. Do not go up or down a ladder without the free use of both hands. Use a rope to lift or lower materials or tools. Always face a ladder when climbing or descending.
9. Every work site must have a complete first aid kit.
10. **ALL** accidents must be investigated and reported. Use the Accident Investigation Form in the back section of this plan.

11. Injuries sustained while on duty must be reported to supervisor immediately, or as soon as possible after injury is sustained.

12. Explosives must be handled and transported by licensed people only.

13. All tools and electrical equipment must be in proper working order.

14. Clothing appropriate to the duties performed shall be worn by all workers. Large pockets, loose jewelry, cuffed trousers and loose or torn clothing are dangerous and should not be worn around machinery, or when climbing ladders, or working on structures.

Heat Stress

Site employees will be trained to recognize signs of heat stress. The Site Supervisor will maintain a log of all site employees exposed to temperature extremes, showing the work and rest times as well as worker monitoring results. Appropriate rest periods will be provided to help site workers accommodate to temperature extremes.

Signs and Symptoms of Heat Stress

- **Heat rash** may result from continuous exposure to heat or humid air.
- **Heat cramps** are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
    - muscle spasms
    - pain in the hands, feet and abdomen
- **Heat exhaustion** occurs from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms are:
    - pale, cool, moist skin
    - heavy sweating
    - dizziness
    - nausea
    - fainting
- **Heat stroke** is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occurs. Competent medical help must be obtained. Signs and symptoms are:
    - red, hot, usually dry skin
    - lack of reduced perspiration
    - nausea
    - dizziness and confusion
    - strong, rapid pulse

- coma

Measures to Avoid Heat Stress

- Establish work-rest cycles (short and frequent are more beneficial than long and seldom).
- Identify a shaded, cool rest area.
- Rotate personnel, alternate job functions.
- Water intake should be equal to the sweat produced. Most workers exposed to hot conditions drink less fluids than needed because of an insufficient thirst. DO NOT DEPEND ON THIRST TO SIGNAL WHEN AND HOW MUCH TO DRINK. For an 8-hour workday, 50 ounces of fluids should be drunk.
- Eat lightly salted foods or drink salted drinks such as Gatorade to replace lost salt.
- Save most strenuous tasks for non-peak hours, such as the early morning or at night.
- Avoid alcohol during prolonged periods of heat. Alcohol will cause additional dehydration.

Site personnel should monitor their pulse rate as an indicator of heat strain by the following method:

At the beginning of the rest period, count the radial pulse during a 30-second period. If the rate exceeds 110 beats per minute, lengthen the rest period by one-third. If the heart rate still exceeds 110 beats per minute at the end of the rest period, shorten the next work cycle by one-third.

Cold Stress

Equity will provide appropriate rest periods to help site workers accommodate to temperature extremes. Site employees will be trained to recognize signs of cold stress

Measures to Avoid Cold Stress

- Wear multi-layer clothing (the outer most layer should be of wind-resistant fabric)
- Drink warm fluids
- Work in pairs
- Avoid heavy sweating

Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)												
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-195

40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect).	LITTLE DANGER In <hr with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trench foot and immersion foot may occur at any point on this chart											

* Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA

The Site Supervisor will maintain a log of all site employees exposed to temperature extremes, showing the work and rest times as well as environmental monitoring results.

Employee Training Program

All personnel performing work in areas on this site covered by this HASP must have completed the appropriate training requirements specified in 29 CFR 1910.120(e). Each individual must have completed an 8-hour refresher-training course and/or initial 40-hour training course within the last two years prior to performing any intrusive work on this site covered by this HASP. Records that demonstrate that all persons subject to the training requirements have actually met them will be maintained either on site or in the project file. The Project Manager and/or Supervisor are responsible for verifying compliance of the project team with these rules.

Prior to commencement of on-site activities, a site safety meeting will be held to review the specific information and requirements of this HASP. HASP sign-off sheets will be collected at the end of this meeting.

Site Specific Training (when applicable) will include:

- Explanation of the overall site HASP.
- Health and safety personnel and organization.
- Brief site history.
- Special attention to signs and symptoms of overexposure to known and suspected site contaminants.
- Health effects of site contaminants.
- Air monitoring description.
- Physical hazards associated with the project.
- Selection, use and limitations of available safety.
- Personal hygiene and decontamination.
- Respirator face-piece fit testing.
- PPE use and maintenance.
- Site rules and regulations.
- Work zone establishment and markings.
- Site communication.
- Emergency preparedness procedures.
- Equipment decontamination.
- Medical monitoring procedures.
- Contingency plan.

Prior to work, each Equity employee will attend the contractor's health and safety orientation, if applicable. In addition, Equity's employees will review health and safety items specific to the tasks to be performed that were not covered in the contractor's orientation.

Site Health and Safety Meetings

In addition, the Site Supervisor will meet daily with all Equity employees prior to beginning work on site. The agenda of the meeting will include a review of important elements of this plan, any special safety items, and a discussion of the emergency response procedures. Also, everyone will agree on a schedule for periodic meetings, (for example, before beginning work each day), to review the effectiveness of this plan and make changes as necessary. If significant changes at the site occur, special meetings will be scheduled.

Training Records

The Site Supervisor will complete a report of the daily safety meetings, using the form in the back section of this plan, and all attending the meeting will sign the Daily Safety Meeting Log.

The training status of contractor and subcontractor employees will be verified that their training criteria meets the requirements specified in 29 CFR 1910.120(e). A copy of all training certificates will be kept for Equity personnel working at the site.

Personal Protective Equipment (PPE) Requirements

Task No.(s)	Level of Protection (A – D)*	Level of Upgrade	PPE Suit	PPE Gloves	PPE Feet	PPE Head	PPE Eye	PPE Ear	PPE Respirator	Additional PPE for Upgrade
1,2	D	NA	Std	N	Steel	HH	Glasses	Plugs	NA	*** Face Mask for COVID-19

SUIT

Std = Standard Work Clothes
Tyvek = Uncoated Tyvek Disposal Coverall
PE Tyvek = Polyethylene-coated Tyvek
Saranex = Saranex-laminated Tyvek
PVC Suite = PVC Raingear

GLOVES

Work = Work Gloves (canvas, leather)
Neo = Neoprene Gloves
PVC = PVC Gloves
N = Nitrile Gloves
V = Vinyl Gloves
L = Latex Gloves

FEET

Steel / Composite = Steel/Composite-toe shoes or boots
Steel+ = Steel-toe shoes or boots & PVC boots
Booties = PVC booties

HEAD

HH = Hardhat

EYE

Glasses = Safety glasses
Goggles = Goggles
Shield = Face shield

EAR

Plugs = Earplugs
Muff = Ear muffs

RESPIRATOR

APR = Air purifying respirator
Full APR = Full face APR
Half APR = Half face APR
SAR = Airline supplied air respirator
SCBA = Self-contained breathing apparatus
Escape = Escape SCBA
OV = Organic Vapor Cartridge
AG = Acid Gas Cartridge
OV/AG = Organic Vapor/Acid Gas Cartridge
AM = Ammonia Cartridge
Dust/Mist = Dust/Mist pre-filter and cover for cartridge
HEPA = High efficiency particulate air filter cartridge

*Note all Equity employees had their quantitative fit test using Full Face MSA Advantage Model 3200.

* For unspecified volatile organics (based on 1-minute breathing zone measurement using PID or OVA):

Up to 1 ppm above background	Level D
1 – 5 ppm above background	Level C
5 – 500 ppm above background	Level B
500 ppm above background	Level A

** Earplugs will be available on-site, but are not required

*** Equity field staff shall implement all COVID 19 Policy and Procedures during the time of the COVID 19 Pandemic.

Suggested Levels of Protection

Level “D” Protection

1. Coveralls (optional)
2. Gloves
3. Boots/shoes – steel toe
4. Boots (outer) chemical resistant (disposable- if required)
5. Safety glasses or chemical splash goggles
6. Hard hat (safety shield if required)

Level “C” Protection

1. Full-face, air-purifying, canister-equipped respirator (NIOSH/MSHA approved)
2. Chemical resistant clothing (coveralls; hooded, two-piece, chemical splash suit; chemical resistant hood & apron; disposable, chemical-resistant coveralls)
3. Coveralls
4. Gloves (outer) chemical-resistant
5. Gloves (inner) chemical-resistant
6. Boots (outer) chemical-resistant
7. Boots (inner) steel toe
8. Hard hat (face shield)
9. Escape mask
10. Two-way radio

Level “B” Protection

1. Pressure/Demand SCBA (MSHA-NIOSH approved)
2. Chemical resistant clothing (overalls and long-sleeved jacket; coveralls; hooded, one- or two-piece chemical splash suite; disposable, chemical-resistant coveralls)
3. Coveralls
4. Gloves (outer) chemical-resistant
5. Gloves (inner) chemical-resistant
6. Boots (outer) chemical-resistant
7. Boots (inner) steel toe
8. Hard hat (face shield)
9. Two-way radio

Level “A” Protection (Equity does not perform work in Level A PPE)

1. Pressure/Demand SCBA (MSHA-NIOSH approved)
2. Fully encapsulating, chemical-resistant suit
3. Coveralls
4. Gloves (outer) chemical-resistant
5. Gloves (inner) chemical-resistant
6. Boots, chemical-resistant, steel toe (depending on suit construction, work over or under suit boot)
7. Hard hat (under suit)
8. Two-way radio

For the 32-12 10th St., Brooklyn, NY project Level D, C, & B will be made available to workers in the event of an upgrade event.

Level B: Level B PPE should be worn when an employee needs the highest level of respiratory protection, but less skin and eye protection is necessary. This protective ensemble is used on initial site entries where hazards may not have been fully identified yet.

Level B protection consists of: 1. Positive pressure air respirator with emergency self-contained breathing apparatus (SCBA) that has been approved by the National Institute for Occupational Safety and Health (NIOSH) 2. Chemical-resistant gloves (double-layered) 3. Clothing that is resistant to chemicals 4. Chemical resistant steel-toe and boots. The boot shank, the supportive structure between the insole and outsole, must also be steel.

Level C: Level C PPE is similar to Level B; however, Level C protection is selected when, "the concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met" (OSHA.gov).

Level C protective equipment consists of: 1. Air purifying half-mask or full-face respirators that have been approved by the National Institute for Occupational Safety and Health (NIOSH) 2. Chemical-resistant clothing, with hood - two-piece chemical-splash suit and disposable chemical-resistant overalls. 3. Out and inner chemical-resistant gloves 4. Chemical resistant steel-toe and boots. The boot shank, the supportive structure between the insole and outsole, must also be steel. 5. Outer boot-covers (chemical-resistant) 9. Escape mask (as needed) 6. Face shield (as needed) 7. Hard hat (as needed) 8. Coveralls (as needed)

Level D: Level D PPE is used for "nuisance" level contaminants and offers minimal protection to the employer.

Level D protection consists of: 1. Coveralls 2. Gloves 3. Steel toe and shank boots (chemical-resistant) 4. Boot covers (disposable) 5. Safety glasses 6. Escape mask (optional) 7. Hard hat (optional) 8. Face shield (optional)

Eye/Face Protection: Wear chemical safety goggles. A face shield (with safety goggles) may also be necessary.

Skin Protection: Wear chemical protective clothing e.g. gloves, aprons, boots. In some operations, it may be necessary to wear a chemical protective, full-body encapsulating suit and self-contained breathing apparatus (SCBA). Suitable materials include: butyl rubber, natural rubber, neoprene rubber, nitrile rubber, polyvinyl chloride (PVC), Viton®, Viton®/butyl rubber, Silver Shield® - PE/EVAL/PE, Tychem® BR/LV, Tychem® Responder® CSM, Tychem® TK. Recommendations are NOT valid for very thin natural rubber, neoprene rubber, nitrile rubber, and PVC gloves (0.3 mm or less).

Respiratory Protection:

Up to 1 mg/m3:
(APF = 10) Any chemical cartridge; or Any supplied-air respirator.

* End of service life indicator (ESLI) required.

APF = Assigned Protection Factor

Recommendations apply only to National Institute for Occupational Safety and Health (NIOSH) approved respirators. Refer to the NIOSH Pocket Guide to Chemical Hazards for more information.

Medical Surveillance

Requirements

All Equity employees covered by this HASP, who engage in site activities governed by 29 CFR 1910.120 for 30 or more days per year, must meet the medical surveillance requirements specified in 1910.120(f). Therefore, such personnel must have completed occupational medical baseline or surveillance examination, performed by a licensed physician, within the last 12 months. The medical examination includes the following components:

- Personal Medical Questionnaire
- Occupational Exposure History
- Physical Examination
- Vision Testing
- Spirometry
- Audiometry
- Blood Chemistry Panel (e.g., SMAC-20)
- Complete Blood Count with Differential
- Urinalysis
- Chest X-Ray (every two years at a minimum)
- Electrocardiogram (at physician's discretion)

Examinations are required upon hiring, annually, termination, and/or exposure to substances at or above the PEL.

Results of the examinations are communicated directly from the physician to the employee. Medical records for Equity's employees are kept by the Company and the employee.

Monitoring Requirements

Monitoring is to be conducted by the Site Supervisor, or his/her designee. Copies of monitoring results and calibration logs will be filed with the HASP and./or within the daily field notes/site notebook

Monitoring is designed to assess exposure to employees during site activities, and to determine if PPE is required and adequate to assure protection. Because investigation and remediation activities at hazardous waste sites are of an inconsistent nature, it is not possible to assign a monitoring protocol that excludes, or is not directly dependent upon, professional judgment in determining when monitoring is required to assess exposure. Thus, the following generic protocol must be followed at a minimum, and should be modified to be more conservative (e.g., require more monitoring) if deemed necessary by the Site Supervisor or HSO. Under no conditions will the required frequency be decreased.

At a minimum, air monitoring will be conducted before and during each task or activities for which air monitoring has been designated. If airborne concentrations of contaminants reach action levels based on observations with the direct reading instruments, then the appropriate PPE upgrade or work stoppage order will be enforced by the Site Supervisor. In case a work stoppage order is given, the area must be cleared of all personnel immediately.

The use of action levels and the basis for the selection of monitoring equipment is explained as follows:

Action levels determine:

(1) the PPE to be used by site workers
(2) their ability to remain and work in the exclusion zone

The selection of the specified monitoring equipment is based on

(1) the nature of the contaminants
(2) the likely concentrations of the contaminants
(3) the probable duration of exposure
(4) the relative sensitivity of the monitoring equipment to the specific contaminants

The following summarizes the calibration requirements for the air monitoring instruments used at the site:

Instrument	Calibration Frequency
PID: Mini RAE-3000 (or equivalent)	Beginning of each work shift and/or as needed.

Air Monitoring and Contaminant Action Levels

Task No.(s)	Location	Contaminant	Monitoring Equipment	Monitoring Frequency	Action Level Concentration	
					Mandatory Respirator Use	Mandatory Work Stoppage
1,2	Work Areas	Volatile Organic	PID: Mini-Rae	Periodically during all tasks/activities.	NA	10 ppm sustained above background in breathing zone for 15 mins

PID = Photoionization Detector (e.g., Multi-Rae, Mini-Rae, HNU, TIP, OVM)

Name(s) of individual(s) responsible for performing the monitoring, and certifying the results:
All Equity field personnel

Type, make and model of instruments used:

1. Mini-Rae 3000 (or equivalent) PID Gas Monitor

Method and frequency of calibration:

- 100 ppm isobutylene-calibration gas. Calibrated prior to each day’s use according to manufacturer’s instruction.

Procedures for Handling Anticipated Wastes

Waste Generation

Anticipated: Yes______ No _X_

Types: Liquid _____ Solid _X_____ Sludge_____ Gas _______

Quantity: Expected volume of each type: Unknow

This project ____ will __X__ will not generate hazardous wastes*.

These wastes will be*:
_____ stored _______ treated
______ transported _______ manifested in the following manner:

Packaging requirements for waste material:

Spill Prevention and Response

Potentially hazardous spill situations can be mitigated by using containment devices and materials in work areas. If site conditions are suitable, earthen berms will be constructed around specific areas. If site conditions are not suitable for this, or the potential spill is smaller, barriers will be constructed with sorbent materials such as “speedi-dry”, sorbent booms and/or straw bales. Dikes and berms will also be used to divert stormwater run-on and run-off away from critical zones.

Because a spill cleanup must be conducted under crisis conditions, it is important that the methods used for dealing with a spill be thought out beforehand. However, the steps followed cannot be inflexible, because no two spills are identical. Factors that will be assessed in the event of any and all spills include:

1. The volume of the hazardous substance released and the rate of release.
2. The nature of the spill material.
3. What danger exists to personnel in the immediate area.
4. Nature of damage and possibilities of repair.
5. If the transfer of material to an alternate containment is advisable.
6. Feasibility of the construction of a containment dike.
7. Nature of spill area.
8. Whether the spilled substance has reached a watercourse or sewer.
9. Danger of explosion or fire.
10. Equipment and supplies necessary to confine the material and carry out the cleanup.

In most cases, the success of a cleanup operation is dependent upon the time it takes to contain the spill. Therefore, Equity’s first attempt at spill containment will be at the point of discharge. This can often be accomplished by closing valves, reinforcing or repairing damaged containers, moving or changing the position of fallen or ruptured containers, or emptying the container by pumping to a temporary storage or holding vessel. Pumps, suction hoses and containers will be available to recover spilled materials when directed to do so by the Site Supervisor.

Handling and transport of drummed waste always must be conducted in a controlled and safe manner, which will minimize damage to structurally sound drums, repacks and overpacks. If leakage or spillage of waste occurs, the drum must immediately be placed within an overpack unit. Overpack units must be provided at each staging area, at areas of existing drums, and along all site roadways.

Task/Work Area	Potential Spill or Discharge	Equipment, Materials, and Procedures for Spill Cleanup
N/A	N/A	N/A

Emergency Procedures

Potential emergencies that may arise are most likely to be associated with physical hazards from heavy equipment operation and/or lifting and loading of debris. Emergency response will, in most cases, be performed in Level D protection.

Modifications to these emergency procedures may be necessary after the actual site set-up, based on prevailing conditions. Periodic reviews of these procedures will be performed by the Site Supervisor to ensure that they are appropriate for all anticipated emergencies.

Responsibilities

The Site Supervisor has the authority and responsibility to commit company resources to appropriately respond to an emergency, and to exclude all personnel not directly responding to the emergency.

Prior to beginning work at the site, Equity will designate an employee, usually the Site Supervisor, to be responsible for initiating any emergency response actions. In the event an injury or illness requires more than first aid treatment, the Site Supervisor (or alternate) will accompany the injured person to the hospital, and will remain with the person until release, admittance is decided, or another Equity staff relieves them of this responsibility.

Evacuation Plan

The basic elements of an emergency evacuation plan include employee training, escape routes, escape procedures, critical operations or equipment, rescue and medical duty assignments, designation of responsible parties, emergency reporting procedures and methods to account for all employees after evacuation.

When appropriate, wind direction will be discussed during the daily safety briefing to all on-site personnel by the Site Supervisor to indicate possible routes of upwind escape. Work-area entrance and exit routes will be planned, and emergency escape routes will be delineated by the Site Supervisor. The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated, will result in the evacuation of the team and a re-evaluation of the hazard and the level of protection required. This re-evaluation will be conducted by appropriate on-site health and safety personnel in coordination with the HSO

In the highly unlikely event that barrels, canisters, or chemical gases or vapors are uncovered during site work, the following procedures shall be followed:

1) In the event that barrels, canisters, or any other vessels are encountered during excavation, all work shall immediately cease and all workers to be removed from the area. The Site Supervisor shall be immediately notified, and he/she shall identify vessel contents, handling procedures and storage and disposal techniques prior to starting work.

2) In the event that high concentrations of gases or vapors are detected, the following actions will be taken:
    - Remove all workers from the area
    - Monitor gas or vapor concentrations to determine the type of respiratory protection that will be required before workers reenter the area.

3) In the highly unlikely event of a major leak of toxic gas, such as might occur if a compressed gas cylinder were ruptured during excavation or drilling, all on-site personnel will be evacuated to a safe distance. The HSO and Emergency services will be contacted immediately and the risk will be assessed prior to restarting work.

Training

Employees will be instructed in the specific aspects of emergency evaluation applicable to the site as part of the site safety meeting prior to the commencement of all on-site activities. On-site refresher or update training is required anytime escape routes or procedures are modified or personnel assignments are changed. During the site safety meeting, all employees will be trained in, and reminded of the location of this plan, the procedures outlined in this plan, and the communication systems and evacuation routes used during an emergency.

On a continuous basis, individual employees should be constantly alert for indicators of potentially hazardous situations, and for signs and symptoms in themselves and others that warn of hazardous conditions and exposures. Rapid recognition of dangerous situations can avert an emergency. In the event of any emergency that necessitates an evaluation of the site, on-site personnel will be notified by the use of car horns sounded in regularly spaced, repeated blasts, as detailed in the next section of this procedure. The Site Supervisor will control the site until the appropriate local or state agency representatives arrive, if required. He will also contact the HSO.

Alarm Systems Emergency Signals

The simplest and most effective emergency communication system, in any situation, is direct voice communications. Voice communications will be supplemented anytime voices cannot be clearly perceived above ambient noise levels (e.g., noise from heavy equipment, drilling rigs or backhoes, and anytime a clear line-of-sight cannot be easily maintained among all site personnel because of distance, terrain, or other obstructions. When voice communications must be supplemented, the following emergency signals, using car horns, will be used.

- One Horn Blast: General Warning

  One blast is used to signal relatively minor, but important events on site. An example would be a minor chemical spill where there is no immediate damage to life or health, yet personnel working on site should be aware of the situation so unnecessary problems are avoided. If one horn blast is sounded, personnel must stop all activity and equipment on site and await further instruction from the Site Supervisor.

- Two Horn Blasts: Medical Emergency

  Two blasts are used to signal a medical emergency where immediate first aid or emergency medical care is required. If two horn blasts are sounded, all first aid and CPR trained personnel should respond, as appropriate. All other activity and equipment should stop, and personnel should await further instructions from the Site Supervisor.

- Three Horn Blasts Followed by One Continuous Blast: Immediate Danger to Life or Health

  Three blasts followed by another extended or continuous horn blast signals a situation that could present an immediate danger to the life or health (IDLH) to all employees on site. Examples of possible IDLH situations could include fires, explosions, hazardous chemical spills or releases, hurricanes, tornadoes, blizzards or floods. If three horn blasts followed by a continuous blast are sounded, all activity and equipment must stop, and all personnel must evacuate the site to an appropriately designated site located outside the site gate, or further off site if necessary. (Note: unless otherwise specified, all decontamination procedures must be implemented.) All personnel must be accounted for by the Site Supervisor, and other response actions determined by the Site Supervisor must be followed.

Employees on site will use the "buddy" system (pairs). Buddies should pre-arrange hand signals or other means of emergency communication in case radios cannot be used, or if the radios no longer operate. The following had signals are suggested:

1. Hand gripping throat: out of air, can't breathe.
2. Grip partner's wrist or place both hands around waist: leave area immediately, no debate.
3. Hand on top of head: need assistance.
4. Thumbs up: OK, I'm alright, I understand.
5. Thumbs down: No, negative.

Visual contact will be maintained between employee pairs. Team members will remain in close proximity to each other in order to provide assistance in case of emergencies, and will inform each other of any of the following effects of exposure to site contamination:

- headaches
- dizziness
- blurred vision
- cramps
- irritation of eyes, skin or respiratory tract

If any member of the work crew experiences any adverse symptoms while on site, the entire work crew will immediately stop work and follow the instructions provided by the Site Supervisor.

Medical Treatment/First Aid

Community emergency services (EMS, fire, and police) will be notified immediately if their resources are needed on site. If necessary, the injured or sick party shall be taken to the nearest hospital.

Inhalation: Take precautions to ensure your own safety before attempting rescue (e.g. wear appropriate protective equipment). Move victim to fresh air. If breathing is difficult, trained personnel should administer emergency oxygen. DO NOT allow victim to move about unnecessarily. Symptoms of pulmonary edema may be delayed. If breathing has stopped, trained personnel should begin artificial respiration (AR). If the heart has stopped, trained personnel should start cardiopulmonary resuscitation (CPR) or automated external defibrillation (AED). Avoid mouth-to-mouth contact by using mouth guards or shields. Immediately call a Poison Centre or doctor. Treatment is urgently required. Transport to a hospital.

Skin Contact: Avoid direct contact. Wear chemical protective clothing if necessary. Quickly take off contaminated clothing, shoes and leather goods (e.g. watchbands, belts). Quickly and gently blot or brush away excess chemical. Wash gently and thoroughly with lukewarm, gently flowing water and non-abrasive soap for 5 minutes. Call a Poison Centre or doctor. Thoroughly clean clothing, shoes and leather goods before reuse or dispose of safely.

Eye Contact: Avoid direct contact. Wear chemical protective gloves if necessary. Quickly and gently blot or brush chemical off the face. Immediately flush the contaminated eye(s) with lukewarm, gently flowing water for 5 minutes, while holding the eyelid(s) open. If irritation or pain persists, see a doctor.

Ingestion: Have victim rinse mouth with water. Immediately call a Poison Centre or doctor.

First Aid Comments: If exposed or concerned, see a doctor for medical advice. Some of the first aid procedures recommended here require advanced first aid training. All first aid procedures should be periodically reviewed by a doctor familiar with the chemical and its conditions of use in the workplace.

Note to Physicians: Some jurisdictions specifically regulate mercury and require a complete medical surveillance program. Specific information should be sought from the appropriate government agency in your jurisdiction.

Emergency Reporting

Any incident (other than minor first aid treatment) resulting in injury, illness or property damage will be reported to Equity. An incident investigation will be initiated as soon as emergency conditions are under control. The purpose of this investigation is not to attribute blame but to determine the pertinent facts so that repeat or similar occurrences can be avoided.

The investigations will begin while details are fresh in the mind of all involved. The person administering first aid may be able to start the fact gathering process if the injured are able to speak. Pertinent facts must be determined. Questions beginning with who, what, when, where, and how are usually most effective to discover ways to improve job performance in terms of efficiency, quality of work, as well as safety and health concerns.

On-Site Evacuation Plan –A series of repeated blasts is the signal for all Equity personnel and subcontractors to evacuate the site and assemble at:

To be determined at the beginning of each field event

The criteria for activating the alarm will be the first sign of any serious problem that requires assistance or evacuation. Should either a fire or explosion occur, all personnel will proceed immediately to the evacuation assembly point and await further instructions. At that time a personnel check will be conducted to determine if anyone is missing, and the local fire and police departments will be called for assistance. Once on site, the acting officer of the fire department and the Site Supervisor will determine if further evacuations are necessary. No Equity personnel will re-enter the site without clearance from the fire/police department and Site Supervisor.

Subcontractor Safety

It has been and shall continue to be the policy of Equity that employees of all subcontractors are required to adhere to all applicable company, local, state, and federal safety rules and regulations.

When an infraction of a local, state, federal, or company safety regulation is observed, the Site Supervisor will request verbally that the subcontractor's supervisory personnel correct the infraction immediately. If correction is not made, then the project manager will request in writing that proper corrective action be taken. Subcontractors who continue to ignore proper safety procedures will have payments withheld until compliance is achieved or be terminated.

Subcontractors are required to hold safety meetings for their employees when they are working on Equity projects, and submit documentation of such meetings to the Project Manager. At a minimum they shall have specific safety procedures for proper use of all heavy equipment such as excavators, drilling rigs, etc., on site during the project. Subcontractor employees are required to attend Equity's safety meetings.

Forms

Job Safety & Health Protection

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Provisions of the Act include the following:

Employers

All employers must furnish to employees' employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational salary and health standards, and its Compliance Safety and Health Officers conduct job site inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection. If they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discriminatory action.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period with which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

Willful violation. The penalty per willful violation under section 17(a) of the Act, 29 U.S.C. 666(a), shall not exceed $145,027.00.

Repeated violation. The penalty per repeated violation under section 17(a) of the Act, 29 U.S.C. 666(a), shall not exceed $145,027.00.

Serious violation. The penalty for a serious violation under section 17(b) of the Act, 29 U.S.C. 666(b), shall not exceed $14,502.00.

Other-than-serious violation. The penalty for an other-than-serious violation under section 17(c) of the Act, 29 U.S.C. 666(c), shall not exceed $14,502.00.

Failure to correct violation. The penalty for a failure to correct a violation under section 17(d) of the Act, 29 U.S.C. 666(d), shall not exceed $14,502.00 per day.

Posting requirement violation. The penalty for a posting requirement violation under section 17(i) of the Act, 29 U.S.C. 666(i), shall not exceed $14,502.00.

Voluntary Activity

While providing penalties for violation, the Act also encourages efforts by labor and management before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort if requested. Also, your local OSHA office can provide considerable help and advice on saving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State of Labor or Health Department or a State University.

Under provisions of Title 29, Code of Federal Regulations, part 1903.2(s)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

HASP Sign-Off Form

INSTRUCTIONS: Site personnel are required to read, understand, and agree to the provision of the plan. Personnel are required to sign this form indicating agreement. The original of this form is maintained by the Project Manager, and becomes part of the permanent site project files upon completion of site work.

Site Name:______18 Division Place______

Location: 18 Division Place, Brooklyn, NY 11222

Project Name and Number:______2022020__________________

I have read, understand, and agree to comply with the provisions of this HASP for work activities on this site.

Name	Signature	Company/Agency	Date

Equipment Calibration Log

Operator Name:__________________ Instrument Notice:______________________

Signature:______________________________ Serial Number:___________________

Date	Time	Concentration	Comments

Sampling Log

Operator Name:__________________ Instrument Notice:______________________

Signature:______________________________ Serial Number:___________________

Was the equipment calibrated? ______ Yes ______ No

Date	Time	Concentration	Comments

Heat Stress Monitoring Log

Employee Name							
Start Time							
Measurement 1 Pulse Work Minutes Rest Minutes							
Measurement 2 Pulse Work Minutes Rest Minutes							
Measurement 3 Pulse Work Minutes Rest Minutes							
Measurement 4 Pulse Work Minutes Rest Minutes							
Measurement 5 Pulse Work Minutes Rest Minutes							
Measurement 6 Pulse Work Minutes Rest Minutes							
Measurement 7 Pulse Work Minutes Rest Minutes							
Measurement 8 Pulse Work Minutes Rest Minutes							

Signature of Site Supervisor (or designee)

Date

Daily Sign In/Sign Out Form

(to be completed on site)

Site Name: ___________18 Division Place____________

Location: 18 Division Place, Brooklyn, NY 11222_

Employee Name	Company Name	Purpose	Time In	Time Out	Date

____ ____________

Signature of Site Supervisor (or designee) Date

Daily Safety Meeting Log

(to be completed on site)

Site Name: __________18 Division Place ____________

Location: 18 Division Place, Brooklyn, NY 11222

Weather ____

Topics ____

Employee Names:	Signatures

Signature of Site Supervisor (or designee)	Date

COVID-19 EMPLOYEE MONITORING FORM

(to be completed on site)

Employee Name	Company Name	Phone	Had Covid-19 within past 2-weeks? (Y / N)	Had contact with person who had Covid-19 in last week? (Y/N)	Are you feeling normal? (Y/N)	Temp. (ºF)	Are you Covid-19 vaccinated? (Y/N)

ACCIDENT INVESTIGATION REPORT

Place Accident Occurred:	Name of Person Involved:		
Site Location	Age	Sex	Job Title
	Yrs. in This Job		Yrs. with Company
Date & Time of Incident AM ___/___/_________________:___ PM	Date & Time of Investigation AM ___/___/______:___ PM		
Date Incident Reported ___/___/	Reported to Whom	Investigated By:	
Regulatory Agencies or Insurance Carriers Contacted:	Witness(es):		
Description from injured or witnesses (use reverse side of form for more space): Signature Date			

Select one or more in each column. Don't hesitate to write in your own words (continue on reverse side, if necessary).

When completing the following task:
- ☐Operating (what machine)
- ☐Using (what tool)
- ☐Handling (what material)
- ☐Maintenance or repair (of what)
- ☐Office or sales task
- ☐Other -- Provide details

The following occurred:
- ☐Amputation (total or partial)
- ☐Burn (thermal)
- ☐Burn (chemical)
- ☐Electric shock
- ☐Concussion/unconscious
- ☐Crushing injury (contusion, crush, bruise) -- intact skin
- ☐Cut, laceration, puncture, abrasion
- ☐Fracture or dislocation
- ☐Sprain/strain
- ☐Cumulative trauma
- ☐Occupational illness or disease
- ☐Internal injuries
- ☐None -- Near accident
- ☐Other -- Provide details
- ☐Respiratory

To the (explain details):
- ☐Head, face, neck
- ☐Eye
- ☐Trunk, abdomen
- ☐Back (upper, lower)
- ☐Arm, shoulder
- ☐Fingers
- ☐Leg, hip, knee
- ☐Ankle, foot
- ☐Toes
- ☐Internal Injuries
- ☐Body System:
- ☐Circulatory
- ☐Digestive
- ☐Musculoskeletal
- ☐Nervous
- ☐Other
- ☐Other (specify)

Person was, or got:
- ☐Struck against (not including falls)
- ☐Struck by
- ☐Fell from (from a higher level)
- ☐Slipped, tripped, fell on (in the same level)
- ☐Foreign body in eye
- ☐Contacted electrical energy from
- ☐Exposure to (substance)
  - from inhalation
  - ingestion
  - skin absorption
- ☐Vehicle accident
- ☐Caught in, under or between
- ☐Repetitive
- ☐Other

While (taking what position) Where (or What):
- ☐Carrying
- ☐Climbing
- ☐Bending
- ☐Driving
- ☐Jumping
- ☐Kneeling
- ☐Lifting - below waist, give weight)
- ☐Lifting - above waist, give weight)
- ☐Pulling
- ☐Pushing
- ☐Reaching or stretching
- ☐Riding
- ☐Running
- ☐Sitting
- ☐Standing

Medical Treatment (check as many as apply)
- ☐The injured employee was able to return to work the same day.
- ☐The injured employee was sent home
- ☐The injured employee was sent to a doctor/ clinic; list the doctor/clinic name, address, and phone:
- ☐The employee was hospitalized. List name and address of hospital:

____

☐Throwing____ __________________________________

____

☐Twisting or turning______________________________________

☐Walking____ Attending physician:__________________

____

☐Other____ __________________________________

____

What conditions contributed
☐Awkward job procedure
☐Inadequate guard/safety device
☐Inadequate warning/labeling system
☐Fire/explosion hazard
☐Not secured against moving
☐Poor housekeeping
☐Protruding object
☐Close clearance/congestion
☐Hazardous arrangement/storage
☐Defective tools/equipment
☐Inadequate ventilation
☐Atmospheric condition: gases, dusts, fumes, vapors
☐Repetitive motion
☐Illumination/noise hazard
☐Other

What unsafe procedures contributed
☐Operating without training/authority
☐Failure to follow proper procedure
☐Failure to secure
☐Operating at unsafe speed
☐Failure to warn/signal
☐Congestion
☐Used defective equipment
☐Used equipment improperly/unsafely
☐Improper loading or placement
☐Horseplay/distraction
☐Improper protective equipment
☐Improper lifting or carrying
☐Taking unsafe or awkward position
☐Servicing moving equipment
☐Other

The underlying causes of the incident are:
☐Unaware of job hazards
☐Inattention to hazard
☐Unaware of how to avoid incident
☐Not enough time to act
☐Person motivated to use unsafe procedure
☐Emotional/mental/physical stress
☐Equipment failed to perform as expected
☐Intoxicant/drugs
☐Failure to report/correct unsafe condition
☐Illness/medical condition
☐Work procedure not ergonomically correct
☐Substandard design
☐Other

Classification (check as many as apply)
☐Fatality
☐Medical treatment other than First Aid
☐Occupation illness or disease
☐First Aid
☐Environmental Release
☐Property Damage
☐Near-accident

ACCIDENT DESCRIPTION (continued):

What steps have already been taken to prevent similar incidents?____

____

____

____

What else can be done (engineering controls, training, enforcement, process changes) to eliminate the hazard?________________________

____

____

____
Site Supervisor Signature Date

Health and Safety Review: Is proposed action appropriate? Yes ☐ No ☐ Comments________________

____

____

____

____

____
HSO Signature Date

VEHICLE ACCIDENT REPORT

EMPLOYEE NAME:________________________ DRV LIC NO.:________________________

COMPANY ADDRESS:________________________ INSURANCE COMPANY________________________

POLICY NO.:________________________

DESCRIPTION OF ACCIDENT

DATE:__________ TIME:__________ SPEED LIMIT________:

LOCATION:________________________

DIRECTION OF TRAVEL:________________________

HOW DID IT HAPPEN?________________________

____

USE SPACE BELOW TO INDICATE VEHICLE PATHS - INDICATE NORTH BY ARROW

POLICE REPORT

NAME OF OFFICER: ________________________ BADGE #:________________________

DEPARTMENT:________________________ LOCATION:________________________

SUMMONS ISSUED? Y [ ] N [ ] TO WHOM?________________________

YOUR VEHICLE

YEAR/MAKE:________________________ REGIST #:________________________

DRIVEN BY:________________________ AGE:_____ TEL #:________________________

ADDRESS:________________________ CITY:______________ STATE:______________

NATURE OF DAMAGE:________________________

OTHER DRIVER

(continue below for additional drivers and witnesses)

NAME:________________________________

ADDRESS:______________________________

____

POLICY NO.:____________________________

DRV LIC NO.:________________________________

VEHICLE REGISTRATION:________________________

INSURANCE COMPANY__________________________

Safety Data Sheets

TCI AMERICA

A0003

Material Safety Data Sheet

HAZARD WARNINGS	RISK PHRASES	PROTECTIVE CLOTHING
✖	**Harmful compound, minimize exposure.** **Irritating to skin, eyes, and the respiratory system.**	

Section I. Chemical Product and Company Identification

Chemical Name **Acenaphthene**

Catalog Number	A0003
Synonym	1,8-Ethylenenaphthalene
Chemical Formula	$C_{12}H_{10}$
CAS Number	83-32-9

Supplier
TCI America
9211 N. Harborgate St.
Portland OR
1-800-423-8616

In case of Emergency Call
Chemtrec®
(800) 424-9300 (U.S.)
(703) 527-3887 (International)

Section II. Composition and Information on Ingredients

Chemical Name	CAS Number	Percent (%)	TLV/PEL	Toxicology Data
Acenaphthene	83-32-9	Min. 99.0 (GC)	Not available.	Mouse LD_{50} (intraperitoneal) 600mg/kg

Section III. Hazards Identification

Acute Health Effects	Harmful if ingested or inhaled. Minimize exposure to this material. Severe overexposure can result in injury or death. Irritating to eyes and skin on contact. Inhalation causes irritation of the lungs and respiratory system. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. Follow safe industrial hygiene practices and always wear proper protective equipment when handling this compound.
Chronic Health Effects	**CARCINOGENIC EFFECTS** : Not available. **MUTAGENIC EFFECTS** : Not available. **TERATOGENIC EFFECTS** : Not available. **DEVELOPMENTAL TOXICITY**:Not available. There is no known effect from chronic exposure to this product. Repeated or prolonged exposure to this compound is not known to aggravate existing medical conditions.

Section IV. First Aid Measures

Eye Contact	Check for and remove any contact lenses. IMMEDIATELY flush eyes with runing water for at least 15 minutes. keeping eyelids open. COLD water may be used. DO NOT use an eye oitment. Flush eyes with running water for a minimum of 15 minutes, occasionally lifting the upper eyelids. Seek medical attention. Treat symptomatically and supportively.
Skin Contact	After contact with skin, wash immediately with plenty of water. Gently and thorough wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. COLD water may be used. Cover the irritated skin with an emollient. Seek medical attention. Treat symptomatically and supportively. Wash any contaminated clothing before reusing.
Inhalation	Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. Seek medical attention. Treat symptomatically and supportively.
Ingestion	INDUCE VOMITING by sticking finger in throat. Lower the head so that the vomit will not reenter the mouth and throat. Loosen tight clothing such as a collar, tie, belt, or waistband. If the victim is not breathing, administer artificial respiration. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Seek immediate medical attention and, if possible, show the chemical label. Treat symptomatically and supportively.

Section V. Fire and Explosion Data

Flammability	May be combustible at high temperature.	Auto-Ignition	Not available.
Flash Points	Not available.	Flammable Limits	Not available.

Combustion Products	These products are toxic carbon oxides (CO, CO_2).
Fire Hazards	No specific information is available regarding the flammability of this compound in the presence of various materials.
Explosion Hazards	Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. No additional information is available regarding the risks of explosion.

Continued on Next Page

Fire Fighting Media and Instructions	SMALL FIRE: Use DRY chemicals, CO_2, water spray or foam. LARGE FIRE: Use water spray, fog or foam. DO NOT use water jet.

Section VI. Accidental Release Measures

Spill Cleanup Instructions	Harmful material. Irritating material. In case of a spill and/or a leak, always shut off any sources of ignition, ventilate the area, and exercise caution. Use a shovel to put the material into a convenient waste disposal container. Consult federal, state, and/or local authorities for assistance on disposal.

Section VII. Handling and Storage

Handling and Storage Information	HARMFUL. IRRITANT. Keep away from heat and sources of ignition. Mechanical exhaust required. When not in use, tightly seal the container and store in a dry, cool place. Avoid excessive heat and light. DO NOT breathe dust. Always store away from incompatible compounds such as oxidizing agents.

Section VIII. Exposure Controls/Personal Protection

Engineering Controls	Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.
Personal Protection	Splash goggles. Lab coat. Dust respirator. Boots. Gloves. Be sure to use a MSHA/NIOSH approved respirator or equivalent. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.
Exposure Limits	Not available.

Section IX. Physical and Chemical Properties

Physical state @ 20°C	Pale yellow needles.	Solubility	1g dissolves in 31mL alcohol, 56mL methanol, 25mL propanol, 2.5mL chloroform, 5mL benzene or toluene, 3.2g/100 mL glacial acetic acid. Insoluble in water.
Specific Gravity	1.189		
Molecular Weight	154.21	Partition Coefficient	Not available.
Boiling Point	279°C (534.2°F)	Vapor Pressure	10 mm Hg @ 20°C
Melting Point	93 to 95°C (199.4 to 203°F)	Vapor Density	5.32
Refractive Index	Not available.	Volatility	Not available.
Critical Temperature	Not available.	Odor	Not available.
Viscosity	Not available.	Taste	Not available.

Section X. Stability and Reactivity Data

Stability	This material is stable if stored under proper conditions. (See Section VII for instructions)
Conditions of Instability	Avoid excessive heat and light.
Incompatibilities	Reactive with strong oxidizing agents.

Section XI. Toxicological Information

RTECS Number	AB1000000
Routes of Exposure	Eye contact. Ingestion. Inhalation. Skin contact.
Toxicity Data	Mouse LD_{50} (intraperitoneal) 600mg/kg IPRRATLD50 600MG/KG
Chronic Toxic Effects	**CARCINOGENIC EFFECTS** : Not available. **MUTAGENIC EFFECTS** : Not available. **TERATOGENIC EFFECTS** : Not available. **DEVELOPMENTAL TOXICITY**: Not available. There is no known effect from chronic exposure to this product. Repeated or prolonged exposure to this compound is not known to aggravate existing medical conditions.
Acute Toxic Effects	Harmful if ingested or inhaled. Minimize exposure to this material. Severe overexposure can result in injury or death. Irritating to eyes and skin on contact. Inhalation causes irritation of the lungs and respiratory system. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. Follow safe industrial hygiene practices and always wear proper protective equipment when handling this compound.

Continued on Next Page

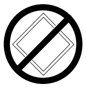
Section XII. Ecological Information

Ecotoxicity	Not available.
Environmental Fate	Acenaphthene is a component of crude oil and a product of combustion which may be produced and released to the environment during natural fires. Emissions from petroleum refining, coal tar distillation, coal combustion and diesel fueled engines are major contributors of acenaphthene to the environment. Acenaphthene isused as a chemical intermediate and may be released to the environment via manufacturing effluents and the disposal of manufacturing waste by products. Because of the widespread use of acenaphthene in a variety of products, acenaphthene may also be released to the environment through landfills, municipal waste water treatment facilities and waste incinerators. Acenaphthene should biodegrade rapidly in the environment. The reported biodegradation half-lives for acenaphthene in aerobic soil and surface waters range from 10 to 60 days and 1 to 25 days, respectively. However, acenaphthene may persist under anaerobic conditions or at high concn due to toxicity to micro-organisms. Acenaphthene is not expected to hydrolyze or bioconcentrate in the environment; yet, it should undergo direct photolysis in sunlit environmental media. A calculated Koc range of 2065 to 3230 indicates acenaphthene will be slightly mobile in soil. In aquatic systems, acenaphthene can partition from the water column to organic matter contained in sediments and suspended solids. A Henry's Law constant of 1.55X10-4 atm-cu m/mole at 25°C suggests volatilization of acenaphthene from environmental waters may be important. The volatilization half-lives from a model river and a model pond, the latter considers the effect of adsorption, have been estimated to be 11 hr and 39 days, respectively. Acenaphthene is expected to exist entirely in the vapor-phase in ambient air. In the atmosphere, the reaction with photochemically produced hydroxyl radicals (half-life of 7.2 hr) is likely to be an important fate process. The most probable human exposure would be occupational exposure, which may occur through dermal contact or inhalation at places where acenaphthene is produced or used. Atmospheric workplace exposures have been documented. Non-occupational exposures would most likely occur via urban atmospheres, contaminated drinking water supplies and recreational contaminated waterways.

Section XIII. Disposal Considerations

Waste Disposal	Recycle to process, if possible. Consult your local or regional authorities. You may be able to dissolve or mix material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber system. Observe all federal, state, and local regulations when disposing of the substance.

Section XIV. Transport Information

DOT Classification	Not a DOT controlled material (United States).
PIN Number	Not applicable.
Proper Shipping Name	Not applicable.
Packing Group (PG)	Not applicable.
DOT Pictograms	

Section XV. Other Regulatory Information and Pictograms

TSCA Chemical Inventory (EPA)	This compound is **ON** the EPA Toxic Substances Control Act (TSCA) inventory list.
WHMIS Classification (Canada)	Not available.
EINECS Number (EEC)	201-469-6
EEC Risk Statements	R20/21/22- Harmful by inhalation, in contact with skin and if swallowed. R36/37/38- Irritating to eyes, respiratory system and skin.
Japanese Regulatory Data	Not available.

Section XVI. Other Information

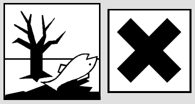
Version 1.0
Validated on 6/7/1999.
Printed 1/12/2005.

Notice to Reader

TCI laboratory chemicals are for research purposes only and are NOT intended for use as drugs, food additives, households, or pesticides. The information herein is believed to be correct, but does not claim to be all inclusive and should be used only as a guide. Neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All chemical reagents must be handled with the recognition that their chemical, physiological, toxicological, and hazardous properties have not been fully investigated or determined. All chemical reagents should be handled only by individuals who are familiar with their potential hazards and who have been fully trained in proper safety, laboratory, and chemical handling procedures. Although certain hazards are described herein, we can not guarantee that these are the only hazards which exist. Our MSDS sheets are based only on data available at the time of shipping and are subject to change without notice as new information is obtained. Avoid long storage periods since the product is subject to degradation with age and may become more dangerous or hazardous. It is the responsibility of the user to request updated MSDS sheets for products that are stored for extended periods. Disposal of unused product must be undertaken by qualified personnel who are knowledgeable in all applicable regulations and follow all pertinent safety precautions including the use of appropriate protective equipment (e.g. protective goggles, protective clothing, breathing equipment, facial mask, fume hood). For proper handling and disposal, always comply with federal, state, and local regulations.

TCI AMERICA

Material Safety Data Sheet

HAZARD WARNINGS	RISK PHRASES	PROTECTIVE CLOTHING
	**POSSIBLE CARCINOGEN. MINIMIZE EXPOSURE.** **Harmful compound, minimize exposure.** **Irritating to skin, eyes, and the respiratory system.** **Lachrymator.** **Photosensitizer.** **Environmental hazard.** **This material is very toxic to aquatic organisms and may cause long term adverse effects to the aquatic environment.**	

Section I. Chemical Product and Company Identification

Chemical Name	**Anthracene**
Catalog Number	A0495
Synonym	Green oil
Chemical Formula	$C_{14}H_{10}$
CAS Number	120-12-7

Supplier

TCI America
9211 N. Harborgate St.
Portland OR
1-800-423-8616

In case of Emergency Call

Chemtrec®
(800) 424-9300 (U.S.)
(703) 527-3887 (International)

Section II. Composition and Information on Ingredients

Chemical Name	CAS Number	Percent (%)	TLV/PEL	Toxicology Data
Anthracene	120-12-7	Min. 96.0(GC)	This chemical is classified as a possible carcinogen. There is no acceptable exposure limit for a carcinogen.	Mouse LD_{50} (intraperitoneal) 430mg/kg

Section III. Hazards Identification

Acute Health Effects

Harmful if ingested or inhaled. Minimize exposure to this material. Severe overexposure can result in injury or death. Irritating to eyes and skin on contact. Inhalation causes irritation of the lungs and respiratory system. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.
Causes photosensitivity. Exposure to light can result in allergic reactions resulting in dermatologic lesions, which can vary from sunburn-like responses to edematous, vesiculated lesions or bullae.
Follow safe industrial hygiene practices and always wear proper protective equipment when handling this compound.

Chronic Health Effects

CARCINOGENIC EFFECTS : IARC- Group 1 (carcinogenic to humans).
MUTAGENIC EFFECTS : Not available.
TERATOGENIC EFFECTS : TUMORIGENIC EFFECTS:
Rat TDLo (oral) 20gm/kg, 79 Weeks, intermittent.
Toxic Effects:
Tumorigenic- Equivocal tumorigenic agent by RTECS criteria.
Liver- Tumors.
Rat TD (subcutaneous) 660mg/kg, 33 Weeks, intermittent.
Toxic Effects:
Tumorigenic- Equivocal tumorigenic agent by RTECS criteria.
Tumorigenic- Tumors at site of application.
Rat TDLo (subcutaneous) 3300mg/kg, 33 Weeks, intermittent.
Toxic Effects:
Tumorigenic- Neoplastic by RTECS criteria.
Tumorigenic-Tumors at site of application.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure to this compound is not known to aggravate existing medical conditions.

Section IV. First Aid Measures

Eye Contact	Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.
Skin Contact	In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
Inhalation	If the victim is not breathing, perform mouth-to-mouth resuscitation. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, oxygen can be administered. Seek medical attention if respiration problems do not improve.
Ingestion	INDUCE VOMITING by sticking finger in throat. Lower the head so that the vomit will not reenter the mouth and throat. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive.

Continued on Next Page

Section V. Fire and Explosion Data

Flammability	May be combustible at high temperature.	Auto-Ignition	540°C (1004°F)
Flash Points	121°C (249.8°F).	Flammable Limits	LOWER: 0.6%
Combustion Products	These products are toxic carbon oxides (CO, CO_2).		
Fire Hazards	Not available.		
Explosion Hazards	Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.		
Fire Fighting Media and Instructions	SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. DO NOT use water jet. Consult with local fire authorities before attempting large scale fire-fighting operations.		

Section VI. Accidental Release Measures

Spill Cleanup Instructions	Possibly carcinogenic material. Harmful material. Irritating material. Lachrymatory material. Photosensitizing material. Environmentally hazardous material. Use a shovel to put the material into a convenient waste disposal container. Prevent entry into sewers, basements or confined areas; dike if needed. Consult federal, state, and/or local authorities for assistance on disposal.

Section VII. Handling and Storage

Handling and Storage Information	POSSIBLE CARCINOGEN. HARMFUL. IRRITANT. LACHRYMATOR. PHOTOSENSITIZER. ENVIRONMENTAL HAZARD. Keep away from heat. Mechanical exhaust required. When not in use, tightly seal the container and store in a dry, cool place. Avoid excessive heat and light. Do not breathe dust. Always store away from incompatible compounds such as oxidizing agents, acids.

Section VIII. Exposure Controls/Personal Protection

Engineering Controls	Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.
Personal Protection	Splash goggles. Lab coat. Dust respirator. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product. Be sure to use a MSHA/NIOSH approved respirator or equivalent.
Exposure Limits	This chemical is classified as a possible carcinogen. There is no acceptable exposure limit for a carcinogen.

Section IX. Physical and Chemical Properties

Physical state @ 20°C	Solid. (Faint yellow to pale yellow crystalline powder.)	Solubility	1g dissolves in 67ml absolute alcohol, 70ml methanol, 62ml benzene, 85ml chloroform, 200ml ether, 31ml carbon disulfide, 86ml carbon tetrachloride, 125ml toluene. Slightly soluble in acetone. 1.29mg/l @ 25°C in distilled water. 0.6mg/l 25°C in salt water.
Specific Gravity	1.25 (water=1) @ 27°C		
Molecular Weight	178.23	Partition Coefficient	Log K_{ow}= 4.45
Boiling Point	342°C (647.6°F)	Vapor Pressure	1mmHg @ 145°C
Melting Point	218°C (424.4°F)	Vapor Density	6.15 (Air = 1)
Refractive Index	Not available.	Volatility	Not available.
Critical Temperature	Not available.	Odor	Weak aromatic odor.
Viscosity	Not available.	Taste	Not available.

Section X. Stability and Reactivity Data

Stability	This material is stable if stored under proper conditions. (See Section VII for instructions)
Conditions of Instability	Avoid excessive heat and light.
Incompatibilities	Reactive with strong oxidizing agents, strong acids, hypochlorites, chromic acid, fluorine, caustics, aliphatic amines, isocyanates.

Continued on Next Page

Section XI. Toxicological Information

RTECS Number	CA9350000
Routes of Exposure	Eye Contact. Ingestion. Inhalation.
Toxicity Data	Mouse LD_{50} (intraperitoneal) 430mg/kg
Chronic Toxic Effects	**CARCINOGENIC EFFECTS** : IARC- Group 1 (carcinogenic to humans). **MUTAGENIC EFFECTS** : Not available. **TERATOGENIC EFFECTS** : TUMORIGENIC EFFECTS: Rat TDLo (oral) 20gm/kg, 79 Weeks, intermittent. Toxic Effects: Tumorigenic- Equivocal tumorigenic agent by RTECS criteria. Liver- Tumors. Rat TD (subcutaneous) 660mg/kg, 33 Weeks, intermittent. Toxic Effects: Tumorigenic- Equivocal tumorigenic agent by RTECS criteria. Tumorigenic- Tumors at site of application. Rat TDLo (subcutaneous) 3300mg/kg, 33 Weeks, intermittent. Toxic Effects: Tumorigenic- Neoplastic by RTECS criteria. Tumorigenic-Tumors at site of application. **DEVELOPMENTAL TOXICITY**: Not available. Repeated or prolonged exposure to this compound is not known to aggravate existing medical conditions.
Acute Toxic Effects	Harmful if ingested or inhaled. Minimize exposure to this material. Severe overexposure can result in injury or death. Irritating to eyes and skin on contact. Inhalation causes irritation of the lungs and respiratory system. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. Causes photosensitivity. Exposure to light can result in allergic reactions resulting in dermatologic lesions, which can vary from sunburn-like responses to edematous, vesiculated lesions or bullae. Follow safe industrial hygiene practices and always wear proper protective equipment when handling this compound.

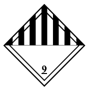
Section XII. Ecological Information

Ecotoxicity	This material is very toxic to aquatic organisms and may cause long term adverse effects to the aquatic environment.
Environmental Fate	Anthracene occurs in fossil fuels and is also released to the environment as a product of incomplete combustion of organic matter. If released to air, anthracene's extrapolated vapor pressure of 2.67X10-6 mm Hg at 25 deg C indicates this compound will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase anthracene will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 3.4 hours. Particulate-phase anthracene will be physically removed from the atmosphere by wet and dry deposition. If released to soil, measured Koc values ranging from 2600 to 8600 indicate anthracene is expected to have slight to no mobility. Volatilization of anthracene from dry soil surfaces is not expected to be an important fate process based on its extrapolated vapor pressure. Anthracene is expected to volatilize slowly from moist soil surfaces based upon its measured Henry's Law constant of 4.88X10-5 atm-cu m/mole. However, adsorption to organic matter may attenuate this process. Biodegradation in soil is expected to be an important fate process based upon half-lives in unacclimated soils ranging from 50 to 134 days. If released into water, anthracene is expected to adsorb to suspended solids and sediment in the water column based upon Koc values ranging from 2600 to 8600. Volatilization from water surfaces is expected to occur given this compound's Henry's Law constant. Estimated volatilization half-lives for a model river and model lake are 1.2 and 13 days, respectively. However, volatilization is expected to be attenuated by adsorption to suspended solids and sediment in the water. Measured BCFs ranging from 162 to 9200 indicate bioconcentration in aquatic organisms is moderate to very high. Humic substances in water may reduce the bioavailability of anthracene to aquatic organisms based on aqueous soil humic acid solution Koc values ranging from 7.1X10+4 to 1.3X10+5. Hydrolysis is not expected to be an important process due to the lack of hydrolyzable functional groups. Biodegradation is expected to be slow in aquatic systems. 5% conversion to CO2 was observed in 18 hr in Third Creek water, no degradation of anthracene was observed in water from Walker Branch; no degradation of anthracene was observed in estuarine water collected in April from the Skidway River, GA, after 24 hours. Anthracene was confirmed to be poorly or non-biodegradable in MITI tests. Occupational exposure to anthracene may occur through inhalation of air contaminated with products of incomplete combustion and dermal contact with soot, motor oil and coal tar. The general population will be exposed to anthracene through the smoking of tobacco, inhalation of particulate matter in air and ingestion of food and water. (HSDB)

Section XIII. Disposal Considerations

Waste Disposal	Recycle to process, if possible. Consult your local regional authorities. You may be able to dissolve or mix material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber system. Observe all federal, state and local regulations when disposing of the substance.

Section XIV. Transport Information

DOT Classification	CLASS 9: Miscellaneous hazardous material.
PIN Number	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Packing Group (PG)	III
DOT Pictograms	

Continued on Next Page

Section XV. Other Regulatory Information and Pictograms

TSCA Chemical Inventory (EPA)	This compound is **ON** the EPA Toxic Substances Control Act (TSCA) inventory list. This product is subject to SARA Section 313 reporting requirements. On EPA IRIS Database.
WHMIS Classification (Canada)	CLASS D-2B: Material causing other toxic effects (TOXIC). On DSL.
EINECS Number (EEC)	204-371-1
EEC Risk Statements	R20/21/22- Harmful by inhalation, in contact with skin and if swallowed. R36/37/38- Irritating to eyes, respiratory system and skin. R45- May cause cancer. R50- Very toxic to aquatic organisms. R53- May cause long-term adverse effects in the aquatic environment.
Japanese Regulatory Data	ENCS No. 4-583; 4-683.

Section XVI. Other Information

Version 1.0
Validated on 10/27/2008.
Printed 10/27/2008.

Notice to Reader

TCI laboratory chemicals are for research purposes only and are NOT intended for use as drugs, food additives, households, or pesticides. The information herein is believed to be correct, but does not claim to be all inclusive and should be used only as a guide. Neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All chemical reagents must be handled with the recognition that their chemical, physiological, toxicological, and hazardous properties have not been fully investigated or determined. All chemical reagents should be handled only by individuals who are familiar with their potential hazards and who have been fully trained in proper safety, laboratory, and chemical handling procedures. Although certain hazards are described herein, we can not guarantee that these are the only hazards which exist. Our MSDS sheets are based only on data available at the time of shipping and are subject to change without notice as new information is obtained. Avoid long storage periods since the product is subject to degradation with age and may become more dangerous or hazardous. It is the responsibility of the user to request updated MSDS sheets for products that are stored for extended periods. Disposal of unused product must be undertaken by qualified personnel who are knowledgeable in all applicable regulations and follow all pertinent safety precautions including the use of appropriate protective equipment (e.g. protective goggles, protective clothing, breathing equipment, facial mask, fume hood). For proper handling and disposal, always comply with federal, state, and local regulations.

ThermoFisher
SCIENTIFIC

SAFETY DATA SHEET

Creation Date 22-Sep-2009 **Revision Date** 17-Jan-2018 **Revision Number** 4

1. Identification

Product Name	**Arsenic, reference standard solution 1000 ppm in 7% nitric acid**
Cat No. :	**SA449-100, SA449-500**
Synonyms	No information available
Recommended Use	Laboratory chemicals.
Uses advised against	Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Corrosive to metals	Category 1
Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1
Carcinogenicity	Category 1A
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
May be corrosive to metals
Causes severe skin burns and eye damage
May cause respiratory irritation
May cause cancer

Precautionary Statements

Prevention

Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Use only outdoors or in a well-ventilated area
Keep only in original container

Response

Immediately call a POISON CENTER or doctor/physician

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Skin

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

Ingestion

IF SWALLOWED: Rinse mouth. DO NOT induce vomiting

Spills

Absorb spillage to prevent material damage

Storage

Store locked up
Store in a well-ventilated place. Keep container tightly closed
Store in corrosive resistant polypropylene container with a resistant inliner
Store in a dry place

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Harmful to aquatic life with long lasting effects

WARNING. Cancer and Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Water	7732-18-5	92 - 93
Nitric acid	7697-37-2	7
Arsenic trioxide	1327-53-3	< 0.5

4. First-aid measures

General Advice	Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Remove and wash

	contaminated clothing before re-use. Call a physician immediately.
Inhalation	If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Remove from exposure, lie down. Call a physician immediately.
Ingestion	Do not induce vomiting. Never give anything by mouth to an unconscious person. Clean mouth with water. Call a physician immediately.
Most important symptoms and effects	Causes burns by all exposure routes. . Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	CO_2, dry chemical, dry sand, alcohol-resistant foam.
Unsuitable Extinguishing Media	No information available
Flash Point	Not applicable
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes.

Hazardous Combustion Products
Nitrogen oxides (NOx) Thermal decomposition can lead to release of irritating gases and vapors

Protective Equipment and Precautions for Firefighters
Thermal decomposition can lead to release of irritating gases and vapors. As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
4	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.
Environmental Precautions	Should not be released into the environment. Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Use only under a chemical fume hood. Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Do not breathe vapors or spray mist. Do not ingest.

Storage	Corrosives area. Keep containers tightly closed in a dry, cool and well-ventilated place. Keep in properly labeled containers.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Nitric acid	TWA: 2 ppm STEL: 4 ppm	(Vacated) TWA: 2 ppm (Vacated) TWA: 5 mg/m^3 (Vacated) STEL: 4 ppm (Vacated) STEL: 10 mg/m^3 TWA: 2 ppm TWA: 5 mg/m^3	IDLH: 25 ppm TWA: 2 ppm TWA: 5 mg/m^3 STEL: 4 ppm STEL: 10 mg/m^3	TWA: 2 ppm TWA: 5 mg/m^3 STEL: 4 ppm STEL: 10 mg/m^3
Arsenic trioxide	TWA: 0.01 mg/m^3		IDLH: 5 mg/m^3 Ceiling: 0.002 mg/m^3	TWA: 0.5 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures	Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection	Tightly fitting safety goggles. Face-shield.
Skin and body protection	Long sleeved clothing.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Keep away from food, drink and animal feeding stuffs. When using, do not eat, drink or smoke. Contaminated work clothing should not be allowed out of the workplace. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. For environmental protection remove and wash all contaminated protective equipment before re-use. Wear suitable gloves and eye/face protection.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Odorless
Odor Threshold	No information available
pH	2.0
Melting Point/Range	0 °C / 32 °F
Boiling Point/Range	100 °C / 212 °F
Flash Point	Not applicable
Evaporation Rate	> 1 (ether = 1)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	14 mmHg @ 20 °C

Vapor Density	0.7 (Air = 1.0)
Specific Gravity	No information available
Solubility	miscible
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Excess heat. Exposure to air or moisture over prolonged periods.
Incompatible Materials	Strong bases, Amines, Strong reducing agents
Hazardous Decomposition Products	Nitrogen oxides (NOx), Thermal decomposition can lead to release of irritating gases and vapors
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50	Category 4. ATE = 300 - 2000 mg/kg. Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Dermal LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Vapor LC50	Category 2. ATE = 0.5 - 2 mg/l. Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	-	Not listed	Not listed
Nitric acid	Not listed	Not listed	LC50 = 2500 ppm. (Rat) 1h
Arsenic trioxide	LD50 = 20 mg/kg (Rat)	Not listed	Not listed

Toxicologically Synergistic Products	No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	Causes burns by all exposure routes
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed
Nitric acid	7697-37-2	Not listed	Not listed	Not listed	Not listed	Not listed
Arsenic trioxide	1327-53-3	Group 1	Known	A1	X	A1

IARC: (International Agency for Research on Cancer)

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)

NTP: (National Toxicity Program)

	Known - Known Carcinogen *Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen*
ACGIH: (American Conference of Governmental Industrial Hygienists)	*A1 - Known Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Animal Carcinogen* *ACGIH: (American Conference of Governmental Industrial Hygienists)*
Mexico - Occupational Exposure Limits - Carcinogens	*Mexico - Occupational Exposure Limits - Carcinogens* *A1 - Confirmed Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Confirmed Animal Carcinogen* *A4 - Not Classifiable as a Human Carcinogen* *A5 - Not Suspected as a Human Carcinogen*

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	Respiratory system
STOT - repeated exposure	None known
Aspiration hazard	No information available
Symptoms / effects,both acute and delayed	Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Nitric acid	Not listed	LC50: = 72 mg/L, 96h (Gambusia affinis)	Not listed	Not listed
Arsenic trioxide	Not listed	LC50: > 1000 mg/L, 96h static (Oncorhynchus mykiss) LC50: 18.8 - 21.4 mg/L, 96h flow-through (Oncorhynchus mykiss) LC50: = 135 mg/L, 96h (Pimephales promelas)	EC50 = 31.43 mg/L 60 min EC50 = 33.39 mg/L 30 min EC50 = 43.56 mg/L 15 min EC50 = 73.73 mg/L 5 min	EC50 = 0.038 mg/L 24h EC50 = 0.96 mg/L 96h EC50 = 0.038 mg/L 24h

Persistence and Degradability	Miscible with water Persistence is unlikely based on information available.
Bioaccumulation/ Accumulation	No information available.
Mobility	Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Nitric acid	-2.3
Arsenic trioxide	18.1

13. Disposal considerations

Waste Disposal Methods	Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Subsidiary Hazard Class	5.1
Packing Group	II

TDG

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Packing Group	II

IATA

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Packing Group	II

IMDG/IMO

UN-No	UN2031
Proper Shipping Name	NITRIC ACID
Hazard Class	8
Packing Group	II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Water	X	X	-	231-791-2	-		X	-	X	X	X
Nitric acid	X	X	-	231-714-2	-		X	X	X	X	X
Arsenic trioxide	X	X	-	215-481-4	-		X	X	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b)	Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold

			Values %
Nitric acid	7697-37-2	7	1.0
Arsenic trioxide	1327-53-3	< 0.5	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Nitric acid	X	1000 lb	-	-
Arsenic trioxide	X	1 lb	X	-

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Arsenic trioxide	X		-

OSHA Occupational Safety and Health Administration
Not applicable

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Nitric acid	-	TQ: 500 lb
Arsenic trioxide	10 µg/m³ TWA 5 µg/m³ Action Level	-

CERCLA Not applicable

Component	Hazardous Substances RQs	CERCLA EHS RQs
Nitric acid	1000 lb	1000 lb
Arsenic trioxide	1 lb	1 lb

California Proposition 65 This product does not contain any Proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Arsenic trioxide	1327-53-3	Carcinogen Developmental	0.06 µg/day 10 µg/day	Developmental Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Water	-	-	X	-	-
Nitric acid	X	X	X	X	X
Arsenic trioxide	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	N
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Component	DHS Chemical Facility Anti-Terrorism Standard
Nitric acid	2000 lb STQ

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific

Email: EMSDS.RA@thermofisher.com

Creation Date	22-Sep-2009
Revision Date	17-Jan-2018
Print Date	17-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

MSDS Number: **B0348** * * * * * *Effective Date:* ***11/21/08*** * * * * * *Supercedes:* ***01/16/06***

MSDS MATERIAL SAFETY DATA SHEET

CHEMTREC: 800-424-9300 (USA)
703-527-3887(Outside USA and Canada)
CANUTEC: 613-996-6666

From: Mallinckrodt Baker, Inc
222 Red School Lane
Phillipsburg, NJ 08865

Emergency Telephone Number: 908-859-2151

NOTE: Use CHEMTREC and CANUTEC phone numbers only in the event of a chemical emergency.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

MALLINCKRODT **J. T. BAKER**

BARIUM CARBONATE

1. Product Identification

Synonyms: Carbonic Acid, Barium Salt; Barium Carbonate (1:1)
CAS No.: 513-77-9
Molecular Weight: 197.34
Chemical Formula: BaCO3
Product Codes:
J.T. Baker: 0950
Mallinckrodt: 3736

2. Composition/Information on Ingredients

```
  Ingredient                                 CAS No        Percent       Hazardous
  ---------------------------------------   ------------  ------------  ---------

  Barium Carbonate                           513-77-9        99 - 100%      Yes
```

3. Hazards Identification

Emergency Overview

DANGER! MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT. AFFECTS MUSCLES (INCLUDING THE HEART), AND CENTRAL NERVOUS SYSTEM.

SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
May cause irritation of the respiratory tract. Excessive exposures may produce lung damage.
Ingestion:
May cause excessive salivation, severe abdominal pain, vomiting, violent diarrhea, muscle twitching progressing to muscular paralysis, gastroenteritis and increased blood pressure. Serious cases may result in convulsions and death.
Skin Contact:
May cause irritation with redness and pain.
Eye Contact:
May cause irritation, redness and pain.
Chronic Exposure:
Long term inhalation of dust may lead to deposition in lungs in sufficient quantities to produce baritosis - a benign pneumoconiosis. This produces a radiological picture. Symptoms and abnormal signs may not be present.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention if irritation persists.

Note to Physician:
Precipitate ingested soluble barium compounds as benign insoluble barium sulfate using an Epsom ($MgSO4$) or a Glauber's ($NaSO4$) salt solution. Dilute copiously with water or milk. Evacuate via nasogastric aspiration or induction of emisis. Monitor electrolytes, especially potassium (treat for hypokalemia), electrocardiogram and rhythm, and acid/base status. Induce brisk diuresis. Calcium gluconate may be helpful for muscle spasms. Provide oxygen by nasal cannula or mask and other supportive treatment for symptoms as clinically indicated.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Keep unnecessary and unprotected people away from area of spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

For Soluble Barium Compounds:

OSHA Permissible Exposure Limit (PEL):

0.5 mg (Ba)/m3

ACGIH Threshold Limit Value (TLV):

0.5 mg (Ba)/m3 A4 - not classifiable as a human carcinogen

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece particulate respirator (NIOSH type N100 filters) may be worn for up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids. glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White powder.
Odor:
Odorless.
Solubility:
Almost insoluble in water.
Specific Gravity:
4.3
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
1300C (2372F) Decomposes.
Melting Point:
811C (1492F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
0 @ 20C (68F) Essentially
Evaporation Rate (BuAc=1):
Not applicable.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May produce oxides of carbon and the contained metal.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Bromine trifluoride, 2-furanpercarboxylic acid. It is acid soluble with release of carbon dioxide.
Conditions to Avoid:
Heat, dusting and incompatibles.

11. Toxicological Information

Oral (Rat) LD50:418 mg/kg Investigated as a reproductive effector.

```
--------\Cancer Lists\------------------------------------------------------
                                       ---NTP Carcinogen---
Ingredient                             Known    Anticipated    IARC Category
------------------------------------   -----    -----------    -------------
Barium Carbonate (513-77-9)             No          No             None
```

12. Ecological Information

Environmental Fate:
This material may bioaccumulate to some extent.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: BARIUM COMPOUND, N.O.S. (BARIUM CARBONATE)
Hazard Class: 6.1
UN/NA: UN1564
Packing Group: III
Information reported for product/size: 225LB

International (Water, I.M.O.)

Proper Shipping Name: BARIUM COMPOUND, N.O.S. (BARIUM CARBONATE)
Hazard Class: 6.1
UN/NA: UN1564
Packing Group: III
Information reported for product/size: 225LB

International (Air, I.C.A.O.)

Proper Shipping Name: BARIUM COMPOUND, N.O.S. (BARIUM CARBONATE)
Hazard Class: 6.1
UN/NA: UN1564
Packing Group: III
Information reported for product/size: 225LB

15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                         TSCA  EC   Japan  Australia
-----------------------------------------------    ----  ---  -----  ---------
Barium Carbonate (513-77-9)                         Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                          --Canada--
Ingredient                                         Korea  DSL   NDSL  Phil.
-----------------------------------------------    -----  ---   ----  -----
Barium Carbonate (513-77-9)                         Yes   Yes   No     Yes
```

```
  --------\Federal, State & International Regulations - Part 1\----------------
                                            -SARA 302-    ------SARA 313------
  Ingredient                                RQ    TPQ     List  Chemical Catg.
  -----------------------------------------  ---   -----   ----  --------------
  Barium Carbonate (513-77-9)               No    No      No    Barium compo

  --------\Federal, State & International Regulations - Part 2\----------------
                                                       -RCRA-    -TSCA-
  Ingredient                                CERCLA     261.33     8(d)
  -----------------------------------------  ------     ------    ------
  Barium Carbonate (513-77-9)               No         No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: No          (Pure / Solid)
```

Australian Hazchem Code: 2Z
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **2** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
DANGER! MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT. AFFECTS MUSCLES (INCLUDING THE HEART), AND CENTRAL NERVOUS SYSTEM.
Label Precautions:
Avoid breathing dust.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
****

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Safety Data Sheet
Revision Date: 03/23/15
www.restek.com

1. IDENTIFICATION

Catalog Number / Product Name:	**31272, 31272-5XX, & 31372 / Benzo (b) Fluoranthene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	1-800-424-9300 (CHEMTREC) +1 703-741-5970 (Outside the US)
Email:	sds@restek.com
Revision Number:	8
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:	Flammable Liquid Category 2 Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3
GHS Signal Word:	Danger
GHS Hazard:	Highly flammable liquid and vapour. May cause drowsiness or dizziness.
GHS Precautions:	
Safety Precautions:	Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilation and lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing dust/fume/gas/mist/vapours/spray. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.
First Aid Measures:	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell. In case of fire: Use extinguishing media in section 5 for extinction.
Storage:	Store in a well-ventilated place. Keep container tightly closed. Store in a well-ventilated place. Keep cool. Store locked up.
Disposal:	Dispose of contents/container according to section 13 of the SDS.
Single Exposure Target Organs:	No data available.
Repeated Exposure Target Organs:	No data available.

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Acetone	67-64-1	200-662-2	99.900000
benzo (b) fluoranthene	205-99-2	205-911-9	0.100000

4. FIRST-AID MEASURES

Inhalation:	Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately
Eyes:	Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.
Skin Contact:	Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.
Ingestion:	Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media:	Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.
Fire and/or Explosion Hazards:	Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a Class B fire. Vapors are heavier than air and may travel to a source of ignition and flash back
Fire Fighting Methods and Protection:	Do not enter fire area without proper protection including self-contained toxic breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface. Use water spray/fog for cooling.
Hazardous Combustion Products:	Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment:	Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.
Methods for Clean-up:	Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

7. HANDLING AND STORAGE

Handling Technical Measures and Precautions:	Harmful or irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
Storage Technical Measures and Conditions:	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
Acetone	67-64-1	2500 ppm IDLH (10% LEL)	750 ppm STEL 750 ppm STEL;	500 ppm TWA 500 ppm TWA; 1188 mg/m3	1000 ppm TWA; 2400 mg/m3 TWA

			1782 mg/m3 STEL	TWA	
benzo (b) fluoranthene	205-99-2	ND		No TLV	No data available.

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapors from handling or thermal processing.
Respiratory Protection:	No respiratory protection required under normal conditions of use. Provide general room exhaust ventilation if symptoms of overexposure occur as explained Section 3. A respirator is not normally required.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Medical Conditions Aggravated By Exposure:	Respiratory disease including asthma and bronchitis

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Depends upon product selection
Odor:	Strong
Physical State:	No data available.
pH:	No data available
Vapor Density:	2.0 (air = 1)
Melting Point:	-95.4 °C Melting Point
Flash Point:	39
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	No data available.
Lower Flammable/Explosive Limit, % in air:	No data available.
Autoignition Temperature:	465 deg C
Decomposition Temperature:	No data available.
Specific Gravity:	0.7845 g/cm3 at 25 °C
Evaporation Rate:	No data available.
Odor Threshold:	ND
Solubility:	Complete; 100%
Partition Coefficient: n-octanol in water:	No data available.
VOC % by weight:	0.00
Molecular Weight:	58.08

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	No data available.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents Strong acids
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion
Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Respiratory Tract, Skin
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Can cause minor skin irritation, defatting, and dermatitis.
Eye Contact:	Can cause minor irritation, tearing and reddening.
Ingestion Irritation:	May be harmful if swallowed.
Ingestion Toxicity:	Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Upon prolonged or repeated contact, can cause minor

skin irritation, defatting, and dermatitis.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Acetone	67-64-1	Inhalation LC50 Rat 50100 mg/m3 8 h

Component Carcinogenic Data:

OSHA:

Chemical Name	CAS No.	
Benzo(b)fluoranthene	205-99-2	Present

ACGIH:

Chemical Name	CAS No.	
Acetone	67-64-1	A4 - Not Classifiable as a Human Carcinogen
Benzo[b]fluoranthene	205-99-2	A2 - Suspected Human Carcinogen

NIOSH:

Chemical Name	CAS No.
No data available.	

NTP:

Chemical Name	CAS No.
No data available.	

IARC:

Chemical Name	CAS No.	Group No.
No data.		Group 1
No data.		Group 2A
Benzo(b)fluoranthene	205-99-2	Group 2B

12. ECOLOGICAL INFORMATION

Overview:	This material is not expected to be harmful to the ecology.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	No data
Ecological Toxicity Data:	No data available.

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.
Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

International:

IATA Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

Marine Pollutant: No

Chemical Name	CAS#	Marine Pollutant	Severe Marine Pollutant
No data available.			

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
Acetone	67-64-1	X	-	-	X
benzo (b) fluoranthene	205-99-2	X	X	-	-

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Benzo[b]fluoranthene	205-99-2	Prop 65 Cancer

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
Acetone	67-64-1	X	X	X	X
benzo (b) fluoranthene	205-99-2	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	05/16/14
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding prodcuts described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

SAFETY DATA SHEET

Based upon Regulation (EC) No. 1907/2006, as amended by Regulation (EC) No. 453/2010

BCR-052: benzo[ghi]perylene

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier:

Product name : BCR-052: benzo[ghi]perylene
Product type REACH : Substance/mono-constituent
CAS number : 191-24-2
EC number : 205-883-8
RTECS number : DI6200500
Molecular mass : 276.34 g/mol
Formula : $C_{22}H_{12}$

1.2 Relevant identified uses of the substance or mixture and uses advised against:

Certified reference material for laboratory use only

1.3 Details of the supplier of the safety data sheet:

Supplier of the safety data sheet

Institute for Reference Materials and Measurements
Retieseweg
B-2440 Geel
Tel: +32 14 57 12 11
Fax: +32 14 59 04 06
JRC-IRMM-RM-Sales@ec.europa.eu

1.4 Emergency telephone number:

Poison Centre:
+32 70 245 245

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture:

2.1.1 Classification according to Regulation EC No 1272/2008

Classified as dangerous according to the criteria of Regulation (EC) No 1272/2008

Class	Category	Hazard statements
Aquatic Acute	category 1	H400: Very toxic to aquatic life.
Aquatic Chronic	category 1	H410: Very toxic to aquatic life with long lasting effects.

2.1.2 Classification according to Directive 67/548/EEC-1999/45/EC

Classified as dangerous in accordance with the criteria of Directives 67/548/EEC and 1999/45/EC

N; R50-53 - Very toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.

2.2 Label elements:

Labelling according to Regulation EC No 1272/2008 (CLP)

Signal word Warning

H-statements

H410 Very toxic to aquatic life with long lasting effects.

P-statements

P273 Avoid release to the environment.
P391 Collect spillage.
P501 Dispose of contents/container to manufacturer/competent authority.

2.3 Other hazards:

CLP

Not readily biodegradable in water

SECTION 3: Composition/information on ingredients

3.1 Substances:

Name (REACH Registration No)	CAS No EC No	Conc. (C)	Classification according to DSD/DPD	Classification according to CLP	Note	Remark
benzo[ghi]perylene	191-24-2 205-883-8		N; R50-53	Aquatic Acute 1; H400 Aquatic Chronic 1; H410	(1)	Mono-constituent

(1) For R-phrases and H-statements in full: see heading 16

3.2 Mixtures:

Not applicable

SECTION 4: First aid measures

4.1 Description of first aid measures:

General:

If you feel unwell, seek medical advice.

After inhalation:

Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

After skin contact:

Wash with water and soap. Take victim to a doctor if irritation persists.

After eye contact:

Rinse with water. Take victim to an ophthalmologist if irritation persists.

After ingestion:

Rinse mouth with water. Immediately after ingestion: give lots of water to drink. Do not induce vomiting. Consult a doctor/medical service if you feel unwell.

4.2 Most important symptoms and effects, both acute and delayed:

4.2.1 Acute symptoms

After inhalation:

No data available.

After skin contact:

No data available.

After eye contact:

No data available.

After ingestion:

No data available.

4.2.2 Delayed symptoms

If applicable and available it will be listed below.

4.3 Indication of any immediate medical attention and special treatment needed:

If applicable and available it will be listed below.

SECTION 5: Firefighting measures

5.1 Extinguishing media:

5.1.1 Suitable extinguishing media:

Water spray. Alcohol-resistant foam. ABC powder. Carbon dioxide.

5.1.2 Unsuitable extinguishing media:

Solid water jet ineffective as extinguishing medium.

5.2 Special hazards arising from the substance or mixture:

Upon combustion: CO and CO2 are formed.

5.3 Advice for firefighters:

5.3.1 Instructions:

Take account of environmentally hazardous firefighting water. Use water moderately and if possible collect or contain it.

5.3.2 Special protective equipment for fire-fighters:

Gloves. Protective clothing. Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

No naked flames.

6.1.1 Protective equipment for non-emergency personnel

See heading 8.2

6.1.2 Protective equipment for emergency responders

Gloves. Protective clothing.

Suitable protective clothing

See heading 8.2

6.2 Environmental precautions:

Contain leaking substance. Dam up the solid spill. Prevent soil and water pollution. Prevent spreading in sewers.

6.3 Methods and material for containment and cleaning up:

Scoop solid spill into closing containers. Carefully collect the spill/leftovers. Clean contaminated surfaces with an excess of water. Wash clothing and equipment after handling.

6.4 Reference to other sections:

See heading 13.

SECTION 7: Handling and storage

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

7.1 Precautions for safe handling:

Avoid raising dust. Keep away from naked flames/heat. Reduce/avoid exposure and/or contact. Keep container tightly closed. Do not discharge the waste into the drain.

7.2 Conditions for safe storage, including any incompatibilities:

7.2.1 Safe storage requirements:

Store in a cool area. Store in a dry area. Store in a dark area. Keep container in a well-ventilated place. Meet the legal requirements.

7.2.2 Keep away from:

Heat sources, oxidizing agents.

7.2.3 Suitable packaging material:

No data available

7.2.4 Non suitable packaging material:

No data available

7.3 Specific end use(s):

If applicable and available, exposure scenarios are attached in annex. See information supplied by the manufacturer.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters:

8.1.1 Occupational exposure

a) Occupational exposure limit values

If limit values are applicable and available these will be listed below.

b) National biological limit values

If limit values are applicable and available these will be listed below.

8.1.2 Sampling methods

Product name	Test	Number
Benzo(g,h,i)perylene (Polynuclear aromatic hydrocarbons)	NIOSH	5515
Benzo(g,h,i)perylene (Polynuclear aromatic hydrocarbons)	NIOSH	5506

8.1.3 Applicable limit values when using the substance or mixture as intended

If limit values are applicable and available these will be listed below.

8.1.4 DNEL/PNEC values

If applicable and available it will be listed below.

8.1.5 Control banding

If applicable and available it will be listed below.

8.2 Exposure controls:

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

8.2.1 Appropriate engineering controls

Avoid raising dust. Keep away from naked flames/heat. Carry operations in the open/under local exhaust/ventilation or with respiratory protection.

8.2.2 Individual protection measures, such as personal protective equipment

Reduce/avoid exposure and/or contact. Keep container tightly closed. Do not eat, drink or smoke during work.

a) Respiratory protection:

Dust formation: dust mask.

b) Hand protection:

Gloves.

c) Eye protection:

Safety glasses. In case of dust production: protective goggles.

d) Skin protection:

Protective clothing.

8.2.3 Environmental exposure controls:

See headings 6.2, 6.3 and 13

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties:

Physical form	Crystalline solid
Odour	No data available on odour
Odour threshold	No data available
Colour	Light yellow-green
Particle size	No data available
Explosion limits	No data available
Flammability	No data available on direct fire hazard
Log Kow	6.51 - 7.23 ; Calculated
Dynamic viscosity	No data available
Kinematic viscosity	No data available
Melting point	272 °C
Boiling point	> 500 °C
Flash point	No data available
Evaporation rate	No data available
Vapour pressure	No data available
Relative vapour density	Not applicable
Solubility	water ; 0.000000026 g/100 ml
	acetone ; soluble
	1,4-dioxane ; soluble
	dichloromethane ; soluble
Relative density	No data available
Decomposition temperature	No data available
Auto-ignition temperature	No data available
Explosive properties	No chemical group associated with explosive properties
Oxidising properties	No chemical group associated with oxidising properties
pH	No data available

Physical hazards

No physical hazard class

9.2 Other information:

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity:

No data available.

10.2 Chemical stability:

Stable under normal conditions.

10.3 Possibility of hazardous reactions:

No data available.

10.4 Conditions to avoid:

Avoid raising dust. Keep away from naked flames/heat.

10.5 Incompatible materials:

Oxidizing agents.

10.6 Hazardous decomposition products:

Upon combustion: CO and CO2 are formed.

SECTION 11: Toxicological information

11.1 Information on toxicological effects:

11.1.1 Test results

Acute toxicity

BCR-052: benzo[ghi]perylene

No (test)data available

Corrosion/irritation

BCR-052: benzo[ghi]perylene

No (test)data available

Respiratory or skin sensitisation

BCR-052: benzo[ghi]perylene

No (test)data available

Specific target organ toxicity

BCR-052: benzo[ghi]perylene

No (test)data available

Mutagenicity (in vitro)

BCR-052: benzo[ghi]perylene

No (test)data available

Mutagenicity (in vivo)

BCR-052: benzo[ghi]perylene

No (test)data available

Carcinogenicity

BCR-052: benzo[ghi]perylene

No (test)data available

Reproductive toxicity

BCR-052: benzo[ghi]perylene

No (test)data available

Toxicity other effects

BCR-052: benzo[ghi]perylene

No (test)data available

Chronic effects from short and long-term exposure

BCR-052: benzo[ghi]perylene

ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: No specific information available. SIMILAR PRODUCTS CAUSE FOLLOWING SYMPTOMS: Feeling of weakness. Cracking of the skin. Skin rash/inflammation. Photoallergy. Skin cancer. Lung tissue affection/degeneration. Enlargement/affection of the liver. Affection of the renal tissue.

11.1.2 Other information

BCR-052: benzo[ghi]perylene

IARC - classification	3

SECTION 12: Ecological information

12.1 Toxicity:

BCR-052: benzo[ghi]perylene

	Parameter	Method	Value	Duration	Species	Test design	Fresh/salt water	Value determination
Acute toxicity invertebrates	LC50		0.0002 mg/l	14 h	Daphnia magna			

Conclusion

Very toxic to invertebrates (Daphnia)

12.2 Persistence and degradability:

BCR-052: benzo[ghi]perylene

Biodegradation water

Method	Value	Duration	Value determination
	18 %	5 week(s)	

Half-life soil (t1/2 soil)

Method	Value	Primary degradation/mineralisation	Value determination
	> 173 day(s)		

May cause long-term adverse effects in the aquatic environment

Conclusion

Not readily biodegradable in water

Non degradable in the soil

12.3 Bioaccumulative potential:

BCR-052: benzo[ghi]perylene

Log Kow

Method	Remark	Value	Temperature	Value determination
		6.51 - 7.23		Calculated

Conclusion

Bioaccumable

12.4 Mobility in soil:

Adsorbs into the soil

12.5 Results of PBT and vPvB assessment:

Due to insufficient data no statement can be made whether the substance fulfils the criteria of PBT and vPvB according to Annex XIII of Regulation (EC) No 1907/2006.

12.6 Other adverse effects:

BCR-052: benzo[ghi]perylene

Ozone-depleting potential (ODP)

Not classified as dangerous for the ozone layer (Regulation (EC) No. 1272/2008 and 1005/2009)

SECTION 13: Disposal considerations

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

13.1 Waste treatment methods:

13.1.1 Provisions relating to waste

Waste material code (Directive 2008/98/EC, decision 2000/0532/EC).
16 05 06* (laboratory chemicals, consisting of or containing dangerous substances, including mixtures of laboratory chemicals). Depending on branch of industry and production process, also other EURAL codes may be applicable. Hazardous waste according to Directive 2008/98/EC.

13.1.2 Disposal methods

Dissolve or mix with a combustible solvent. Remove to an authorized incinerator equipped with an afterburner and a flue gas scrubber with energy recovery. Remove waste in accordance with local and/or national regulations. Hazardous waste shall not be mixed together with other waste. Different types of hazardous waste shall not be mixed together if this may entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. All entities that store, transport or handle hazardous waste shall take the necessary measures to prevent risks of pollution or damage to people or animals. Do not discharge into surface water (2000/60/EC, Council decision 2455/2001/EC, O.J. L331 of 15/12/2001).

13.1.3 Packaging/Container

Waste material code packaging (Directive 2008/98/EC).
15 01 10* (packaging containing residues of or contaminated by dangerous substances).

SECTION 14: Transport information

Road (ADR)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ADR	benzo[ghi]perylene

14.3 Transport hazard class(es):

Hazard identification number	90
Class	9
Classification code	M7

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	274
Special provisions	335
Special provisions	601
Limited quantities	Combination packagings: not more than 5 kg per inner packaging for solids. A package shall not weigh more than 30 kg. (gross mass)

Rail (RID)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name RID	benzo[ghi]perylene

14.3 Transport hazard class(es):

Hazard identification number	90
Class	9
Classification code	M7

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	274
Special provisions	335
Special provisions	601
Limited quantities	Combination packagings: not more than 5 kg per inner packaging for solids. A package shall not weigh more than 30 kg. (gross mass)

Inland waterways (ADN)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ADN	benzo[ghi]perylene

14.3 Transport hazard class(es):

Class	9
Classification code	M7

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	274
Special provisions	335
Special provisions	601
Limited quantities	Combination packagings: not more than 5 kg per inner packaging for solids. A package shall not weigh more than 30 kg. (gross mass)

Sea (IMDG)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name IMO	benzo[ghi]perylene

14.3 Transport hazard class(es):

Class	9

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Marine pollutant	P
Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	274
Special provisions	335
Limited quantities	Combination packagings: not more than 5 kg per inner packaging for solids. A package shall not weigh more than 30 kg. (gross mass)

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code:

Annex II of MARPOL 73/78	Not applicable, based on available data

Air (ICAO-TI/IATA-DGR)

14.1 UN number:

UN number	3077

14.2 UN proper shipping name:

Proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Techn./chem. name ICAO	benzo[ghi]perylene

14.3 Transport hazard class(es):

Class	9

14.4 Packing group:

Packing group	III
Labels	9

14.5 Environmental hazards:

Environmentally hazardous substance mark	yes

14.6 Special precautions for user:

Special provisions	A97
Special provisions	A158
Special provisions	A179
Passenger and cargo transport: limited quantities: maximum net quantity per packaging	30 kg G

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

European legislation:

Volatile organic compounds (VOC)

0 %

15.2 Chemical safety assessment:

No chemical safety assessment has been conducted.

SECTION 16: Other information

Labelling according to Directive 67/548/EEC-1999/45/EC (DSD/DPD)

Not listed in Annex I of directive 67/548/EEC et sequens. Labelling established on the basis of the available data.

Labels

Dangerous for the environment

R-phrases

50/53	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment

S-phrases

60	This material and its container must be disposed of as hazardous waste
61	Avoid release to the environment. Refer to special instructions/safety data sheets.

Full text of any R-phrases referred to under headings 2 and 3:

R50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment
R50 Very toxic to aquatic organisms
R53 May cause long-term adverse effects in the aquatic environment

Full text of any H-statements referred to under headings 2 and 3:

H400 Very toxic to aquatic life.
H410 Very toxic to aquatic life with long lasting effects.

(*) = INTERNAL CLASSIFICATION BY BIG

PBT-substances = persistent, bioaccumulative and toxic substances

DSD	Dangerous Substance Directive
DPD	Dangerous Preparation Directive
CLP (EU-GHS)	Classification, labelling and packaging (Globally Harmonised System in Europe)

The information in this safety data sheet is based on data and samples provided to BIG. The sheet was written to the best of our ability and according to the state of knowledge at that time. The safety data sheet only constitutes a guideline for the safe handling, use, consumption, storage, transport and disposal of the substances/preparations/mixtures mentioned under point 1. New safety data sheets are written from time to time. Only the most recent versions may be used. Old versions must be destroyed. Unless indicated otherwise word for word on the safety data sheet, the information does not apply to substances/preparations/mixtures in purer form, mixed with other substances or in processes. The safety data sheet offers no quality specification for the substances/preparations/mixtures in question. Compliance with the instructions in this safety data sheet does not release the user from the obligation to take all measures dictated by common sense, regulations and recommendations or which are necessary and/or useful based on the real applicable circumstances. BIG does not guarantee the accuracy or exhaustiveness of the information provided. Use of this safety data sheet is subject to the licence and liability limiting conditions as stated in your BIG licence agreement. All intellectual property rights to this sheet are the property of BIG and its distribution and reproduction are limited. Consult your BIG licence agreement for details.

Alfa Aesar

Safety Data Sheet
per OSHA HazCom 2012

Printing date 11/23/2015
Reviewed on 09/09/2011

1 Identification

Product identifier

Product name: Benzo[a]pyrene

Stock number: 15856
CAS Number:
50-32-8
EC number:
200-028-5
Index number:
601-032-00-3
Relevant identified uses of the substance or mixture and uses advised against.
Identified use: SU24 Scientific research and development

Details of the supplier of the safety data sheet
Manufacturer/Supplier:
Alfa Aesar
Thermo Fisher Scientific Chemicals, Inc.
30 Bond Street
Ward Hill, MA 01835-8099
Tel: 800-343-0660
Fax: 800-322-4757
Email: tech@alfa.com
www.alfa.com
Information Department: Health, Safety and Environmental Department
Emergency telephone number:
During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660. After normal business hours, call Carechem 24 at (866) 928-0789.

2 Hazard(s) identification

Classification of the substance or mixture in accordance with 29 CFR 1910 (OSHA HCS)

GHS08 Health hazard

Muta. 1B	H340	May cause genetic defects.
Carc. 1B	H350	May cause cancer.
Repr. 1B	H360	May damage fertility or the unborn child.

GHS07

Skin Sens. 1 H317 May cause an allergic skin reaction.
Hazards not otherwise classified No information known.

Label elements
GHS label elements The product is classified and labeled in accordance with 29 CFR 1910 (OSHA HCS)
Hazard pictograms

GHS07 GHS08

Signal word Danger
Hazard statements
H317 May cause an allergic skin reaction.
H340 May cause genetic defects.
H350 May cause cancer.
H360 May damage fertility or the unborn child.
Precautionary statements
P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P281 Use personal protective equipment as required.
P363 Wash contaminated clothing before reuse.
P405 Store locked up.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
WHMIS classification
D2A - Very toxic material causing other toxic effects

Classification system
HMIS ratings (scale 0-4)
(Hazardous Materials Identification System)

HEALTH	2	Health (acute effects) = 2
FIRE	1	Flammability = 1
REACTIVITY	1	Physical Hazard = 1

Other hazards
Results of PBT and vPvB assessment
PBT: Not applicable.
vPvB: Not applicable.

3 Composition/information on ingredients

Chemical characterization: Substances
CAS# Description:
50-32-8 Benzo[a]pyrene
Identification number(s):
EC number: 200-028-5

(Contd. on page 2)

(Contd. of page 1)

Index number: 601-032-00-3

4 First-aid measures

Description of first aid measures
After inhalation
Supply fresh air. If required, provide artificial respiration. Keep patient warm.
Seek immediate medical advice.
After skin contact
Immediately wash with water and soap and rinse thoroughly.
Seek immediate medical advice.
After eye contact Rinse opened eye for several minutes under running water. Then consult a doctor.
After swallowing Seek medical treatment.
Information for doctor
Most important symptoms and effects, both acute and delayed No further relevant information available.
Indication of any immediate medical attention and special treatment needed No further relevant information available.

5 Fire-fighting measures

Extinguishing media
Suitable extinguishing agents Carbon dioxide, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
Special hazards arising from the substance or mixture
If this product is involved in a fire, the following can be released:
Carbon monoxide and carbon dioxide
Advice for firefighters
Protective equipment:
Wear self-contained respirator.
Wear fully protective impervious suit.

6 Accidental release measures

Personal precautions, protective equipment and emergency procedures
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventilation
Environmental precautions: Do not allow material to be released to the environment without proper governmental permits.
Methods and material for containment and cleaning up:
Dispose of contaminated material as waste according to section 13.
Ensure adequate ventilation.
Prevention of secondary hazards: No special measures required.
Reference to other sections
See Section 7 for information on safe handling
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

Handling
Precautions for safe handling
Keep container tightly sealed.
Store in cool, dry place in tightly closed containers.
Ensure good ventilation at the workplace.
Open and handle container with care.
Information about protection against explosions and fires: No information known.

Conditions for safe storage, including any incompatibilities
Storage
Requirements to be met by storerooms and receptacles: No special requirements.
Information about storage in one common storage facility: Store away from oxidizing agents.
Further information about storage conditions:
Keep container tightly sealed.
Store in cool, dry conditions in well sealed containers.
Specific end use(s) No further relevant information available.

8 Exposure controls/personal protection

Additional information about design of technical systems:
Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute.

Control parameters

Components with limit values that require monitoring at the workplace:	
50-32-8 Benzo[a]pyrene (100.0%)	
PEL (USA)	Long-term value: 0.2 mg/m³ see Coal tar pitch volatiles
REL (USA)	Long-term value: 0.1 mg/m³ Coal tar pitch volatile; Pocket Guide Apps. A+C
TLV (USA)	L; BEIp
EL (Canada)	ACGIH A2; IARC 1

Ingredients with biological limit values:	
50-32-8 Benzo[a]pyrene (100.0%)	
BEI (USA)	- Medium: urine Time: end of shift at end of workweek Parameter: 1-Hydroxypyrene with hydrolysis (nonquantitative)

Additional information: No data

Exposure controls
Personal protective equipment
General protective and hygienic measures
The usual precautionary measures for handling chemicals should be followed.
Keep away from foodstuffs, beverages and feed.
Remove all soiled and contaminated clothing immediately.
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Maintain an ergonomically appropriate working environment.

(Contd. on page 3)

(Contd. of page 2)

Breathing equipment: Use suitable respirator when high concentrations are present.
Protection of hands:
Impervious gloves
Check protective gloves prior to each use for their proper condition.
The selection of suitable gloves not only depends on the material, but also on quality. Quality will vary from manufacturer to manufacturer.
Penetration time of glove material (in minutes) Not determined
Eye protection: Safety glasses
Body protection: Protective work clothing.

9 Physical and chemical properties

Information on basic physical and chemical properties	
General Information	
Appearance:	
Form:	Crystalline
Color:	Not determined
Odor:	Not determined
Odor threshold:	Not determined.
pH-value:	Not applicable.
Change in condition	
Melting point/Melting range:	177-180 °C (351-356 °F)
Boiling point/Boiling range:	495 °C (923 °F)
Sublimation temperature / start:	Not determined
Flammability (solid, gaseous)	Not determined.
Ignition temperature:	Not determined
Decomposition temperature:	Not determined
Auto igniting:	Not determined.
Danger of explosion:	Not determined.
Explosion limits:	
Lower:	Not determined
Upper:	Not determined
Vapor pressure:	Not applicable.
Density at 20 °C (68 °F):	1.28 g/cm³ (10.682 lbs/gal)
Relative density	Not determined.
Vapor density	Not applicable.
Evaporation rate	Not applicable.
Solubility in / Miscibility with	
Water:	Not determined
Partition coefficient (n-octanol/water):	Not determined.
Viscosity:	
dynamic:	Not applicable.
kinematic:	Not applicable.
Other information	No further relevant information available.

10 Stability and reactivity

Reactivity No information known.
Chemical stability Stable under recommended storage conditions.
Thermal decomposition / conditions to be avoided: Decomposition will not occur if used and stored according to specifications.
Possibility of hazardous reactions No dangerous reactions known
Conditions to avoid No further relevant information available.
Incompatible materials: Oxidizing agents
Hazardous decomposition products: Carbon monoxide and carbon dioxide

11 Toxicological information

Information on toxicological effects
Acute toxicity: The Registry of Toxic Effects of Chemical Substances (RTECS) contains acute toxicity data for components in this product.
LD/LC50 values that are relevant for classification: No data
Skin irritation or corrosion: May cause irritation
Eye irritation or corrosion: May cause irritation
Sensitization: May cause an allergic skin reaction.
Germ cell mutagenicity:
May cause genetic defects.
The Registry of Toxic Effects of Chemical Substances (RTECS) contains mutation data for this substance.
Carcinogenicity:
May cause cancer.
EPA-B2: Probable human carcinogen, sufficient evidence from animal studies; inadequate evidence or no data from epidemiologic studies.
IARC-1: Carcinogenic to humans: sufficient evidence of carcinogenicity.
NTP-R: Reasonably anticipated to be a carcinogen: limited evidence from studies in humans or sufficient evidence from studies in experimental animals.
ACGIH A2: Suspected human carcinogen: Agent is carcinogenic in experimental animals at dose levels, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) considered relevant to worker exposure. Available epidemiologic studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans.
The Registry of Toxic Effects of Chemical Substances (RTECS) contains tumorigenic and/or carcinogenic and/or neoplastic data for this substance.
Reproductive toxicity:
May damage fertility or the unborn child.
The Registry of Toxic Effects of Chemical Substances (RTECS) contains reproductive data for this substance.
Specific target organ system toxicity - repeated exposure: No effects known.
Specific target organ system toxicity - single exposure: No effects known.
Aspiration hazard: No effects known.
Subacute to chronic toxicity: No effects known.
Additional toxicological information: To the best of our knowledge the acute and chronic toxicity of this substance is not fully known.

12 Ecological information

Toxicity
Aquatic toxicity: No further relevant information available.
Persistence and degradability No further relevant information available.
Bioaccumulative potential No further relevant information available.
Mobility in soil No further relevant information available.
Ecotoxical effects:
Remark: Very toxic for aquatic organisms

(Contd. on page 4)

(Contd. of page 3)

Additional ecological information:
General notes:
Do not allow material to be released to the environment without proper governmental permits.
Do not allow product to reach ground water, water course or sewage system, even in small quantities.
Danger to drinking water if even extremely small quantities leak into the ground.
Also poisonous for fish and plankton in water bodies.
May cause long lasting harmful effects to aquatic life.
Avoid transfer into the environment.
Very toxic for aquatic organisms
Results of PBT and vPvB assessment
PBT: *Not applicable.*
vPvB: *Not applicable.*
Other adverse effects *No further relevant information available.*

13 Disposal considerations

Waste treatment methods
Recommendation *Consult state, local or national regulations to ensure proper disposal.*
Uncleaned packagings:
Recommendation: *Disposal must be made according to official regulations.*

14 Transport information

UN-Number **DOT, IMDG, IATA**	UN3077
UN proper shipping name	
DOT	Environmentally hazardous substances, solid, n.o.s. (Benzo[a]pyrene)
IMDG, IATA	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Benzo[a]pyrene)
Transport hazard class(es)	
DOT, IMDG	
	
Class	9 Miscellaneous dangerous substances and articles.
Label	9
Class	9 (M7) Miscellaneous dangerous substances and articles
Label	9
IATA	
	
Class	9 Miscellaneous dangerous substances and articles.
Label	9
Packing group **DOT, IMDG, IATA**	III
Environmental hazards:	
Special marking (ADR):	Symbol (fish and tree)
Special marking (IATA):	Symbol (fish and tree)
Special precautions for user	Warning: Miscellaneous dangerous substances and articles
Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.
Transport/Additional information:	
DOT **Marine Pollutant (DOT):**	No
UN "Model Regulation":	UN3077, Environmentally hazardous substances, solid, n.o.s. (Benzo[a]pyrene), 9, III

15 Regulatory information

Safety, health and environmental regulations/legislation specific for the substance or mixture
GHS label elements *The product is classified and labeled in accordance with 29 CFR 1910 (OSHA HCS)*
Hazard pictograms

GHS07 GHS08

Signal word *Danger*
Hazard statements
H317 May cause an allergic skin reaction.
H340 May cause genetic defects.
H350 May cause cancer.
H360 May damage fertility or the unborn child.
Precautionary statements
P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P281 Use personal protective equipment as required.
P363 Wash contaminated clothing before reuse.
P405 Store locked up.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
National regulations
All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical substance Inventory.
All components of this product are listed on the Canadian Domestic Substances List (DSL).

SARA Section 313 (specific toxic chemical listings)	
50-32-8	Benzo[a]pyrene

(Contd. on page 5)

(Contd. of page 4)

California Proposition 65

Prop 65 - Chemicals known to cause cancer	
50-32-8	*Benzo[a]pyrene*

Prop 65 - Developmental toxicity *Substance is not listed.*
Prop 65 - Developmental toxicity, female *Substance is not listed.*
Prop 65 - Developmental toxicity, male *Substance is not listed.*
Information about limitation of use:
Workers are not allowed to be exposed to this hazardous material. Exceptions can be made by the authorities in certain cases.
For use only by technically qualified individuals.
This product is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right to Know Act of 1986 and 40CFR372.
Other regulations, limitations and prohibitive regulations
Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006. *Substance is not listed.*
The conditions of restrictions according to Article 67 and Annex XVII of the Regulation (EC) No 1907/2006 (REACH) for the manufacturing, placing on the market and use must be observed.
Substance is not listed.
Annex XIV of the REACH Regulations (requiring Authorisation for use) *Substance is not listed.*
Chemical safety assessment: *A Chemical Safety Assessment has not been carried out.*

16 Other information

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Material Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

Department issuing SDS: *Global Marketing Department*
Date of preparation / last revision *11/23/2015 / -*
Abbreviations and acronyms:
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
ICAO: International Civil Aviation Organization
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
EINECS: European Inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
vPvB: very Persistent and very Bioaccumulative
ACGIH: American Conference of Governmental Industrial Hygienists (USA)
OSHA: Occupational Safety and Health Administration (USA)
NTP: National Toxicology Program (USA)
IARC: International Agency for Research on Cancer
EPA: Environmental Protection Agency (USA)

Chrysene

sc-239555

Material Safety Data Sheet

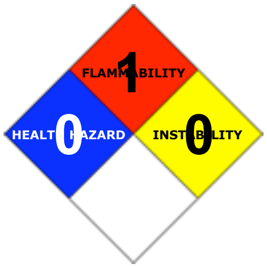
The Power to Question

Hazard Alert Code Key: EXTREME | HIGH | MODERATE | LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
Chrysene

STATEMENT OF HAZARDOUS NATURE
CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

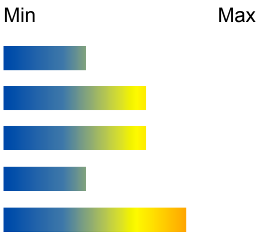
NFPA


SUPPLIER
Santa Cruz Biotechnology, Inc.
2145 Delaware Avenue
Santa Cruz, California 95060
800.457.3801 or 831.457.3800
EMERGENCY:
ChemWatch
Within the US & Canada: 877-715-9305
Outside the US & Canada: +800 2436 2255
(1-800-CHEMCALL) or call +613 9573 3112

SYNONYMS
C18-H12, benz[a]phenanthrene, benz-(alpha)-phenanthrene, "1, 2-benzophenanthrene", "1, 2-benzphenanthrene", "1, 2, 5, 6-dibenzonaphthalene", PAH, "polycyclic aromatic hydrocarbon"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS



Flammability:	1
Toxicity:	2
Body Contact:	2
Reactivity:	1
Chronic:	3

Min/Nil=0
Low=1
Moderate=2
High=3
Extreme=4

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

May cause CANCER.

Possible risk of irreversible effects.

Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ Strong evidence exists that the substance may cause irreversible but non-lethal mutagenic effects following a single exposure.

■ The material has NOT been classified as "harmful by ingestion".

This is because of the lack of corroborating animal or human evidence.

EYE

■ Although the material is not thought to be an irritant, direct contact with the eye may cause transient discomfort characterized by tearing or conjunctival redness (as with windburn).

Slight abrasive damage may also result.

SKIN

■ The material is not thought to be a skin irritant (as classified using animal models).

Abrasive damage however, may result from prolonged exposures.

■ Skin contact with the material may damage the health of the individual; systemic effects may result following absorption.

■ Open cuts, abraded or irritated skin should not be exposed to this material.

■ Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects.

Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED

■ The material is not thought to produce either adverse health effects or irritation of the respiratory tract following inhalation (as classified using animal models).

Nevertheless, adverse effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting.

■ Persons with impaired respiratory function, airway diseases and conditions such as emphysema or chronic bronchitis, may incur further disability if excessive concentrations of particulate are inhaled.

CHRONIC HEALTH EFFECTS

■ There is ample evidence that this material can be regarded as being able to cause cancer in humans based on experiments and other information.

Exposure to the material may result in a possible risk of irreversible effects. The material may produce mutagenic effects in man. This concern is raised, generally, on the basis of

appropriate studies using mammalian somatic cells in vivo. Such findings are often supported by positive results from in vitro mutagenicity studies.

Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung.

Polycyclic aromatic hydrocarbons are found in a number of materials such as coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified as extremely liable to cause cancer, especially that of the lung and genito-urinary tract.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
chrysene	218-01-9	>98

Section 4 - FIRST AID MEASURES

SWALLOWED

· Immediately give a glass of water. · First aid is not generally required. If in doubt, contact a Poisons Information Center or a doctor.

EYE

■ If this product comes in contact with the eyes: · Wash out immediately with fresh running water. · Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.

SKIN

■ If skin contact occurs: · Immediately remove all contaminated clothing, including footwear · Flush skin and hair with running water (and soap if available).

INHALED

· If dust is inhaled, remove from contaminated area. · Encourage patient to blow nose to ensure clear passage of breathing. · If irritation or discomfort persists seek medical attention.

NOTES TO PHYSICIAN

■ Treat symptomatically.

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG):	Negligible
Upper Explosive Limit (%):	Not available
Specific Gravity (water=1):	1.274
Lower Explosive Limit (%):	Not available

EXTINGUISHING MEDIA

· Foam.
· Dry chemical powder.

FIRE FIGHTING

· Alert Emergency Responders and tell them location and nature of hazard.
· Wear breathing apparatus plus protective gloves.
When any large container (including road and rail tankers) is involved in a fire, consider evacuation by 100 metres in all directions.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

· Combustible solid which burns but propagates flame with difficulty.
· Avoid generating dust, particularly clouds of dust in a confined or unventilated space as dusts may form an explosive mixture with air, and any source of ignition, i.e. flame or spark, will cause fire or explosion. Dust clouds generated by the fine grinding of the solid are a particular hazard; accumulations of fine dust may burn rapidly and fiercely if ignited.
Combustion products include: carbon monoxide (CO), carbon dioxide (CO2), other pyrolysis products typical of burning organic material.

FIRE INCOMPATIBILITY

■ Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids,chlorine bleaches, pool chlorine etc. as ignition may result.

PERSONAL PROTECTION

Glasses:
Chemical goggles.
Gloves:
Respirator:
Particulate

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS
· Clean up waste regularly and abnormal spills immediately.
· Avoid breathing dust and contact with skin and eyes.
· Wear protective clothing, gloves, safety glasses and dust respirator.
· Use dry clean up procedures and avoid generating dust.
· Vacuum up or sweep up. NOTE: Vacuum cleaner must be fitted with an exhaust micro filter (HEPA type) (consider explosion-proof machines designed to be grounded during storage and use).
· Dampen with water to prevent dusting before sweeping.
· Place in suitable containers for disposal.
Environmental hazard - contain spillage.
MAJOR SPILLS
· Clear area of personnel and move upwind.
· Alert Emergency Responders and tell them location and nature of hazard.
Environmental hazard - contain spillage.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

· Avoid all personal contact, including inhalation.
· Wear protective clothing when risk of exposure occurs.
Empty containers may contain residual dust which has the potential to accumulate following settling. Such dusts may explode in the presence of an appropriate ignition source.

· Do NOT cut, drill, grind or weld such containers.
· In addition ensure such activity is not performed near full, partially empty or empty containers without appropriate workplace safety authorisation or permit.

RECOMMENDED STORAGE METHODS

■ Glass container.
· Polyethylene or polypropylene container.
· Check all containers are clearly labelled and free from leaks.

STORAGE REQUIREMENTS

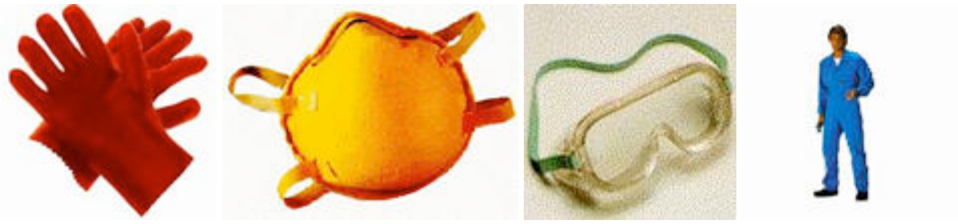
■ Observe manufacturer's storing and handling recommendations.

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m^3	STEL ppm	STEL mg/m^3	Peak ppm	Peak mg/m^3	TWA F/CC	Notes
Canada - British Columbia Occupational Exposure Limits	chrysene (Chrysene Revised 2006)	(L)							2B
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	chrysene (Coal tar pitch volatiles (benzene soluble fraction), anthrancene, BaP, phenanthrene, acidine, chrysene, pyrene)		0.2						
US - Alaska Limits for Air Contaminants	chrysene (Coal tar Pitch volatiles (benzene soluble fraction), chrysene)		0.2						
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	chrysene (Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP,phenanthrene,acridine, chrysene,pyrene)		0.2						
Canada - Alberta Occupational Exposure Limits	chrysene (Kerosene/Jet fuels, as total hydrocarbon vapour)		200						
Canada - Alberta Occupational Exposure Limits	chrysene (Diesel fuel, as total hydrocarbons)		100						
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	chrysene (Diesel fuel as total hydrocarbons, (vapour))		100		150				Skin
Canada - Northwest Territories Occupational Exposure Limits (English)	chrysene (Particulate polycyclic aromatic hydrocarbons (PPAH) as benzene solubles)		0.2		0.6				
Canada - Yukon Permissible Concentrations for Airborne Contaminant	chrysene (K Particulate polycyclic aromatic hydrocarbons (PPAH) (as benzene solubles))		(See Table 14)						

PERSONAL PROTECTION



RESPIRATOR

• particulate.

EYE

· Safety glasses with side shields
· Chemical goggles.

HANDS/FEET

■ Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:
· frequency and duration of contact,
· chemical resistance of glove material,
· glove thickness and
· dexterity
Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).
· When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
· When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
· Contaminated gloves should be replaced.
Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.
Experience indicates that the following polymers are suitable as glove materials for protection against undissolved, dry solids, where abrasive particles are not present.
· polychloroprene
· nitrile rubber
· butyl rubber
· fluorocaoutchouc
· polyvinyl chloride
Gloves should be examined for wear and/ or degradation constantly.

OTHER

· Employees working with confirmed human carcinogens should be provided with, and be required to wear, clean, full body protective clothing (smocks, coveralls, or long-sleeved shirt and pants), shoe covers and gloves prior to entering the regulated area.
· Employees engaged in handling operations involving carcinogens should be provided with, and required to wear and use half-face filter-type respirators with filters for dusts, mists and fumes, or air purifying canisters or cartridges. A respirator affording higher levels of protection may be substituted.
· Emergency deluge showers and eyewash fountains, supplied with potable water, should be located near, within sight of, and on the same level with locations where direct exposure is likely.
· Prior to each exit from an area containing confirmed human carcinogens, employees should be required to remove and leave protective clothing and equipment at the point of exit and at the last exit of the day, to place used clothing and equipment in impervious containers at the point of exit for purposes of decontamination or disposal. The contents of such impervious containers must be identified with suitable labels. For maintenance and decontamination activities, authorized employees entering the area should be provided with and required to wear clean, impervious garments, including gloves, boots and continuous-air supplied hood.
· Prior to removing protective garments the employee should undergo decontamination and be required to shower upon removal of the garments and hood.
· Overalls.
· P.V.C. apron.
· Barrier cream.
· Skin cleansing cream.
· Eye wash unit.

ENGINEERING CONTROLS

· Employees exposed to confirmed human carcinogens should be authorized to do so by the employer, and work in a regulated area.
· Work should be undertaken in an isolated system such as a "glove-box" . Employees should wash their hands and arms upon completion of the assigned task and before engaging in other activities not associated with the isolated system.
· Within regulated areas, the carcinogen should be stored in sealed containers, or enclosed in a closed system, including piping systems, with any sample ports or openings closed while the carcinogens are contained within.
· Open-vessel systems are prohibited.
· Each operation should be provided with continuous local exhaust ventilation so that air movement is always from ordinary work areas to

the operation.
· Exhaust air should not be discharged to regulated areas, non-regulated areas or the external environment unless decontaminated. Clean make-up air should be introduced in sufficient volume to maintain correct operation of the local exhaust system.
· For maintenance and decontamination activities, authorized employees entering the area should be provided with and required to wear clean, impervious garments, including gloves, boots and continuous-air supplied hood. Prior to removing protective garments the employee should undergo decontamination and be required to shower upon removal of the garments and hood.
· Except for outdoor systems, regulated areas should be maintained under negative pressure (with respect to non-regulated areas).
· Local exhaust ventilation requires make-up air be supplied in equal volumes to replaced air.
· Laboratory hoods must be designed and maintained so as to draw air inward at an average linear face velocity of 150 feet/ min. with a minimum of 125 feet/ min. Design and construction of the fume hood requires that insertion of any portion of the employees body, other than hands and arms, be disallowed.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Solid.
Does not mix with water.
Sinks in water.

State	Divided solid	Molecular Weight	228.28
Melting Range (°F)	486- 489	Viscosity	Not Applicable
Boiling Range (°F)	838	Solubility in water (g/L)	Immiscible
Flash Point (°F)	Not available	pH (1% solution)	Not applicable
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available	Vapour Pressure (mmHG)	Negligible
Upper Explosive Limit (%)	Not available	Specific Gravity (water=1)	1.274
Lower Explosive Limit (%)	Not available	Relative Vapor Density (air=1)	Not applicable
Volatile Component (%vol)	Negligible	Evaporation Rate	Not applicable

chrysene	
log Kow (Prager 1995):	5.61-5.91
log Kow (Sangster 1997):	5.86

APPEARANCE

Off-white powder; does not mix with water. Sublimes in vacuo. Exhibits strong fluorescence under UV light. Generally only slightly soluble in cold organic solvents; solubility improves markedly when heated.

log Kow 5.01-6.01

Material	Value

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

· Presence of incompatible materials.
· Product is considered stable.

STORAGE INCOMPATIBILITY

■ Avoid reaction with oxidizing agents.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

chrysene

TOXICITY AND IRRITATION

CHRYSENE:
■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY	IRRITATION
Intraperitoneal (rat) LD50: >320 mg/kg	Nil Reported

▪ The substance is classified by IARC as Group 3:

NOT classifiable as to its carcinogenicity to humans.
Evidence of carcinogenicity may be inadequate or limited in animal testing.
NOTE: Substance has been shown to be mutagenic in at least one assay, or belongs to a family of chemicals producing damage or change to cellular DNA.
Target organs in include skin (tumours at site of application).

CARCINOGEN

chrysene	US - Rhode Island Hazardous Substance List	IARC	
CHRYSENE	US Environmental Defense Scorecard Recognized Carcinogens	Reference(s)	P65
CHRYSENE	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	P65
CHRYSENE/TRIPHENYLENE	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	P65-MC
POLYCYCLIC ORGANIC MATTER (POM)	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	EPA-HEN, P65-MC
Chrysene(BaP) (inhalation)	US Air Toxics Hot Spots TSD for Describing Available Cancer Potency Factors	IARC Class	3
Chrysene(BaP) (oral)	US Air Toxics Hot Spots TSD for Describing Available Cancer Potency Factors	IARC Class	
PBIT_(PERS~	US - Maine Chemicals of High Concern List	Carcinogen	CA Prop 65; IRIS
PBIT_(PERS~	US - Maine Chemicals of High Concern List	Carcinogen	

SKIN

chrysene	Canada - Alberta Occupational Exposure Limits - Skin	Substance Interaction	1

Section 12 - ECOLOGICAL INFORMATION

Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
This material and its container must be disposed of as hazardous waste.
Avoid release to the environment.
Refer to special instructions/ safety data sheets.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
chrysene	LOW	LOW	HIGH	LOW

GESAMP/EHS COMPOSITE LIST - GESAMP Hazard Profiles

Name / EHS TRN A1a A1b A1 A2 B1 B2 C1 C2 C3 D1 D2 D3 E1 E2 E3 Cas No / RTECS No _________ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ Poly(2+)c 224 574 4 4 4 NR (4) NI (1) (1) (2) (1) (1) CM S 3 yclic 6 aromatics / CAS:218- 01-9 /

Legend: EHS=EHS Number (EHS=GESAMP Working Group on the Evaluation of the Hazards of Harmful Substances Carried by Ships) NRT=Net Register Tonnage, A1a=Bioaccumulation log Pow, A1b=Bioaccumulation BCF, A1=Bioaccumulation, A2=Biodegradation, B1=Acuteaquatic toxicity LC/ECIC50 (mg/l), B2=Chronic aquatic toxicity NOEC (mg/l), C1=Acute mammalian oral toxicity LD50 (mg/kg), C2=Acutemammalian dermal toxicity LD50 (mg/kg), C3=Acute mammalian inhalation toxicity LC50 (mg/kg), D1=Skin irritation & corrosion, D2=Eye irritation& corrosion, D3=Long-term health effects, E1=Tainting, E2=Physical effects on wildlife & benthic habitats, E3=Interference with coastal amenities, For column A2: R=Readily biodegradable, NR=Not readily biodegradable. For column D3: C=Carcinogen, M=Mutagenic, R=Reprotoxic, S=Sensitising, A=Aspiration hazard, T=Target organ systemic toxicity, L=Lunginjury, N=Neurotoxic, I=Immunotoxic. For column E1: NT=Not tainting (tested), T=Tainting test positive. For column E2: Fp=Persistent floater, F=Floater, S=Sinking substances. The numerical scales start from 0 (no hazard), while higher numbers reflect increasing hazard.

(GESAMP/EHS Composite List of Hazard Profiles - Hazard evaluation of substances transported by ships)

Section 13 - DISPOSAL CONSIDERATIONS

US EPA Waste Number & Descriptions

B. Component Waste Numbers
When chrysene is present as a solid waste as a discarded commercial chemical
product, off-specification species, as a container residue, or a spill residue,
use EPA waste number U050 (waste code T).

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.
¦ Puncture containers to prevent re-use and bury at an authorized landfill.
Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.
A Hierarchy of Controls seems to be common - the user should investigate:
· Reduction
· Reuse
· Recycling
· Disposal (if all else fails)
This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.
DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.
· Recycle wherever possible.
· Consult manufacturer for recycling options or consult Waste Management Authority for disposal if no suitable treatment or disposal facility can be identified.

Section 14 - TRANSPORTATION INFORMATION

DOT:
Symbols: G Hazard class or Division: 9
Identification Numbers: UN3077 PG: III
Label Codes: 9 Special provisions: 8, 146,
335, B54,
IB8, IP3,
N20, T1,
TP33
Packaging: Exceptions: 155 Packaging: Non- bulk: 213
Packaging: Exceptions: 155 Quantity limitations: No limit
Passenger aircraft/rail:
Quantity Limitations: Cargo No limit Vessel stowage: Location: A
aircraft only:
Vessel stowage: Other: None
Hazardous materials descriptions and proper shipping names:
Environmentally hazardous substance, solid, n.o.s

Air Transport IATA:

ICAO/IATA Class: 9 ICAO/IATA Subrisk: None
UN/ID Number: 3077 Packing Group: III
Special provisions: A97
Cargo Only
Packing Instructions: 400 kg Maximum Qty/Pack: 956
Passenger and Cargo Passenger and Cargo
Packing Instructions: 400 kg Maximum Qty/Pack: 956
Passenger and Cargo Limited Quantity Passenger and Cargo Limited Quantity
Packing Instructions: 30 kg G Maximum Qty/Pack: Y956
Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID,
N.O.S. *(CONTAINS CHRYSENE)

Maritime Transport IMDG:

IMDG Class: 9 IMDG Subrisk: None
UN Number: 3077 Packing Group: III

EMS Number: F-A , S-F Special provisions: 179 274 335 909
Limited Quantities: 5 kg Marine Pollutant: Yes
Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.(contains chrysene)

Section 15 - REGULATORY INFORMATION

chrysene (CAS: 218-01-9) is found on the following regulatory lists;
"Canada - British Columbia Occupational Exposure Limits","Canada - Nova Scotia Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens","Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)","Canada ARET (Accelerated Reduction / Elimination of Toxics) Substance List","Canada Domestic Substances List (DSL)","Canada Ingredient Disclosure List (SOR/88-64)","Canada National Pollutant Release Inventory (NPRI)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs","International Chemical Secretariat (ChemSec) REACH SIN* List (*Substitute It Now!) 1.0","OSPAR List of Substances of Possible Concern","US - Alaska Limits for Air Contaminants","US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified","US - California Proposition 65 - Carcinogens","US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens","US - California Toxic Air Contaminant List Category II","US - Connecticut Hazardous Air Pollutants","US - Idaho - Limits for Air Contaminants","US - Maine Chemicals of High Concern List","US - Massachusetts Oil & Hazardous Material List","US - Minnesota Hazardous Substance List","US - New Jersey Right to Know Hazardous Substances","US - Pennsylvania - Hazardous Substance List","US - Rhode Island Hazardous Substance List","US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants","US - Vermont Hazardous Constituents","US - Vermont Hazardous wastes which are Discarded Commercial Chemical Products or Off-Specification Batches of Commercial Chemical Products or Spill Residues of Either","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Dangerous waste constituents list","US - Washington Discarded Chemical Products List - ""U"" Chemical Products","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US ACGIH Threshold Limit Values (TLV) - Carcinogens","US CAA (Clean Air Act) - HON Rule - Organic HAPs (Hazardous Air Pollutants)","US CERCLA Priority List of Hazardous Substances","US CWA (Clean Water Act) - Priority Pollutants","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA Carcinogens Listing","US EPA National Priorities List - Superfund Chemical Data Matrix (SCDM) - Hazard Ranking System - Hazardous Substance Benchmarks","US List of Lists - Consolidated List of Chemicals Subject to EPCRA, CERCLA and Section 112(r) of the Clean Air Act","US RCRA (Resource Conservation & Recovery Act) - Appendix IX to Part 264 Ground-Water Monitoring List 1","US RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Inorganic and Organic Constituents 1","US RCRA (Resource Conservation & Recovery Act) - List of Hazardous Wastes","US RCRA (Resource Conservation & Recovery Act) - Phase 4 LDR Rule - Universal Treatment Standards","US -Texas Air Monitoring Comparison Values for Evaluating PAHs","US Toxic Substances Control Act (TSCA) - Inventory"

Section 16 - OTHER INFORMATION

Reasonable care has been taken in the preparation of this information, but the author makes no warranty of merchantability or any other warranty, expressed or implied, with respect to this information. The author makes no representations and assumes no liability for any direct, incidental or consequential damages resulting from its use. For additional technical information please call our toxicology department on +800 CHEMCALL.

■ Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.
A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

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Print Date:May-24-2011

Safety Data Sheets (SDS)

SECTION 1-IDENTIFICATION

Product name: Ethylbenzene

Other names:－

Proper shipping name: Ethylbenzene

Recommended use of the chemical and restrictions on use:
The main use of ethylbenzene is to manufacture styrene, a compound used to make plastics. Ethylbenzene is also found in gasoline, paints, inks, insecticides, carpet glues and tobacco products.

Manufacturer/Supplier Name: Taiwan SM Corp., Kaohsiung plant
Address: NO.7, Industrial 1st Rd, Lin-Yuan Kaohsiung County 83203, Taiwan, R.O.C.
Phone No.: 886-7-6414511

Emergency phone No./Fax No.: 886-7-6414511 Ext. 221 (on duty), 886-7-6414517 (off duty)/886-7-6423828

SECTION 2-HAZARDS IDENTIFICATION

GHS Classification:

Flammable Liquid Category 2
Acute Toxicity (Inhalation) Category 4
Skin Corrosion/Irritation Category 3
Serious Eye Damage/Eye Irritation Category 2
Carcinogenicity Category 2
Reproductive Toxicity Category 2
Specific Target Organ Toxicity Repeated Exposure Category 2
Aspiration Hazard Category 1

GHS Label elements:

Hazard symbols

Signal word

Danger

Hazard statements

Flammable liquid and vapor
Harmful if inhaled
Causes skin irritation
Causes serious eye irritation
Suspected of causing cancer
May damage the unborn child
May be harmful to organs by prolonged and repeated exposure
May be fatal if swallowed and enters airways

Precautionary statements

Use only in well ventilated area.
Control of exposure by mechanical ventilation in an unventilated or confined space
Avoid breathing vapors and contact with skin and eyes.
Wear breathing apparatus/protective gloves/face protection.
Store in well-ventilated place.
Disposal must be in accordance with applicable federal, state, or local regulations.

Other hazards:－

SECTION 3-COMPOSITION/INFORMATION ON INGREDIENTS

CAS No.	Chemical Name	wt% by weight	EINECS No.
00100-41-4	Ethylbenzene	99.0 min.	202-849-4
Synonyms	Phenylethane、EB、Ethylbenzol		

SECTION 4-FIRST AID MEASURES

Description of necessary first aid measures

Eye:

1. Flush eye with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids.
2. Get medical aid immediately.

Skin:

1. Washing affected area thoroughly with soap and water for at least 20 minutes.
2. Call a Physician if irritation develops or persists.
3. Removing contaminated clothing, shoes, and leathery wearings, cleaning procedure is available before reused or waste treatment.

Ingestion:

1. If victim is conscious and alert, give 2～4 cupfuls of milk/water to dilute the substance in stomach.
2. Never give anything by mouth to an unconscious person.
3. Don’t induce vomiting unless directed to do so by medical person.
4. Then seek for medical attention.

Inhalation:

1. Remove from further exposure and flush thoroughly with air.
2. If not breathing, give artificial respiration. If breathing is difficult, give Oxygen.
3. If respiratory irritation, seek immediate medical assistance and call a physician.

Most important symptoms/effects, acute and delayed

Headaches, dizziness, fatigue, eye, nose and throat irritation. Target organs: Eyes, upper respiratory system, skin, CNS, lung, liver, kidney, skin (dermatitis), eye (conjuntivitis and other eye injuries), upper respiratory system disorders, and central nervous system disorders.

Indication of immediate medical attention and special treatment needed, if necessary

For acute or short term repeated exposures to Ethylbenzene:

Inhalation:

1. Severe exposures should have cardiac monitoring to detect arrhythmia.
2. If bronchospasm and wheezing occur, consider treatment with inhaled sympathomimetic agents.
3. If pulmonary edema (noncardiogenic) occurs, then maintain ventilation and oxygenation with close arterial blood gas monitoring. Early use of PEEP and mechanical ventilation may be needed to maintain pO2 greater than 50 mmHG with FIO2 less than 60%.

Ingestion:

1. Induction of emesis is not recommended.
2. Cautious gastric lavage followed by administration of activated charcoal may be of benefit if the patient is seen soon after the exposure.

SECTION 5-FIRE FIGHTING MEASURES

Extinguishing media

Foam、CO_2、Dry chemical powder、Water spray or fog – Large fires only.

Specific hazards arising from the chemical

1. Liquid and vapor are flammable.
2. Moderate fire hazard when exposed to heat or flame.
3. Vapor forms an explosive mixture with air.
4. Moderate explosion hazard when exposed to heat or flame.
5. Vapor may travel a considerable distance to source of ignition.
6. Heating may cause expansion or decomposition leading to violent rupture of containers.
7. On combustion, may emit toxic fumes of carbon monoxide (CO).

Special protective equipment and precautions for fire-fighters

1. Must wear MSHA/NOISH approved positive self-contained breathing apparatus（SCBA）and protective clothing.
2. Withdrawing and isolation the possible dangerous sources, fire fighting at safe distance and suitable protection area. Keep toxic vapors and decompositions away from inhalation, when standing at upper-wind area as well.
3. Stop leakage before fire extinguishing, otherwise it may explode again because of vapors above leakage. However, it’s not well extinguishment at nondangerous circumstance, preferring to burning up.
4. Water spray may not work effectively in terms of lower flash point. Better fire fighting performed by experienced people.
5. In huge fire at larger area, automatic water spray system should be recommended. If extinguishing is not available, evacuating people back as soon as possible.
6. Out off the space immediately, if vessel collapsed or pressure relief valve went pop.

SECTION 6-ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedure

1. Personal protective equipment (specified in Section 8)
   Eyes : Chemical safety goggles are recommended, and a face shield is added when needed.
   Skin : Wear appropriate protective gloves to avoid skin contact.
   Clothing : When direct contact is likely, Use rubberized clothings, apron and boots.
   Respiratory : When limits are exceeded, wear a respirator approved by NIOSH/MSHA for protection against organic dust, mists and vapors.
2. Remove all sources of ignition. No smoking, naked lights or ignition sources. Ventilate area of leak or spill.
3. Keep unnecessary and unprotected personnel from entering. Evacuate personnel from the danger area. Consult with an expert about the emergency procedures.

Environmental precautions

1. Prevent spillage from entering drains, surface, and groundwater.
2. Contain and recover liquid when possible. Use non-sparking tools and equipment.
3. Collect liquid in an appropriate container or absorb with an inert material (e.g. vermiculite, dry sand, earth), and place in a chemical waste container.
4. Report the accidental spill/release to Local/State government.

Methods and materials for containment and cleaning up

Minor spill:

1. Remove all ignition sources.
2. Clean up all spills immediately.
3. Avoid breathing vapors and contact with skin and eyes.
4. Control personal contact by using protective equipment.
5. Contain and absorb small quantities with vermiculite or other absorbent material.
6. Wipe up.
7. Collect residues in a flammable waste container.

Major spill

1. Clear area of personnel and move upwind.
2. Alert emergency responders and tell them location and nature of hazard.
3. May be violently or explosively reactive.
4. Wear breathing apparatus plus protective gloves.
5. Prevent spillage from entering drains or water course.
6. No smoking, naked lights or ignition sources. Increase ventilation.
7. Stop leak if safe to do so.
8. Water spray or fog may be used to disperse/absorb vapor.
9. Contain spill with sand, earth or vermiculite.
10. Use only spark-free shovels and explosion proof equipment.
11. Collect recoverable product into labeled containers for recycling..
12. Absorb remaining product with sand, earth or vermiculite.
13. Collect solid residues and seal in labeled drums for disposal.
14. Wash area and prevent runoff into drains.
15. If contamination of drains or waterways occurs, advise emergency services.

SECTION 7-HANDLING AND STORAGE

Precautions for safe handling

1. Wash thoroughly after handling.
2. Use only in well ventilated area.
3. Ground and bond containers when transferring.
4. Use spark-free tools and explosion proof equipment.
5. Empty containers retain product residue (liquid/vapor), and can be dangerous.
6. Do not pressurize, cut, weld, braze, solder, drill, or expose empty containers to heat, sparks or open flames.

Conditions for safe storage, including any incompatibilities

1. Iron, galvanized iron, and steel are suitable metals for tanks.
2. Storage should be located away from any area subject to fire hazards. Storage tanks located in the open or underground minimize the danger of fire, vapor and health problems.
3. All openings in the system should terminate outdoors and be protected by flash screen.
4. Electrical installation should conform to the National Electrical Code.
5. Storage tanks should be electrically bonded and grounded to prevent dangerous accumulations of static electricity. (see NFPA pamphlet “Static Electricity”)
6. Natural ventilation is all that is needed for outdoor storage installation.
7. For indoor storage : Good natural ventilation may be sufficient. The generally considered maximum allowable concentration is 100 ppm by volume in air for an eight-hour working exposure. If other than natural ventilation is required,

the ventilation equipment should be designed to handle the heavy ethylbenzene vapor. Since ethylbenzene vapor is heavier than air, a down draft mechanical exhaust is indicated in those operation in which general ventilation should be to ensure a substantial air flow away from the work area. All ventilating systems require periodic inspection.

SECTION 8-EXPOSURE CONTROLS, PERSONAL PROTECTION

Control parameters

OSHA- Final PELs : 100 ppm TWA.
ACGIH TLV-TEL : 100 ppm.
ACGIH TLV-STEL : 125 ppm.
Taiwan TWA : 100 ppm (skin).
Taiwan STEL : 125 ppm (skin).
Taiwan Ceiling : -------.
Taiwan BEI : 1 mg/l (before on duty).

Engineering control

1. Process should be located at least 17 meter (50 feet) away from open flames and all high temperature operations likely to cause ignition of the ethylbenzene vapor.
2. In venting ethylbenzene vapors, consideration should be given to possible halogenation of the vapors by low concentrations of free chlorine and bromine with the resultant formation of lacrimations.
3. Process should be designed so that the operator is not exposed to direct contact with ethylbenzene or the vapor. The technical problems of designing equipment, providing adequate ventilation and operating procedures which promise maximum security and economy, can best be handled by competent engineers.
4. It is essential for safety that equipment be used and maintained as recommended by the manufacturer.
5. Tanks used to store or process ethylbenzene should be closed vessels vented to a safe point of discharge in the outside atmosphere away from operating stations, roadways, and at least 17 meter (50 feet) from possible sources of ignitions. All sparks, flames, heated surface, or other sources of ignition should be kept away from all vents. It is advisable, to provide suction on vessels when inspection or observation openings are made, to minimize or eliminate escape of vapors.

Personal protective equipment

Personal respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face organic vapor respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator.
(Warning: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.)

Skin protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Transparent liquid	Upper/lower explosive limits : 1.0%～6.7%
Odor: Aromatic odor	Vapor Pressure : 7.1 mmHg @20℃/68℉
Odor threshold : 0.092～0.6 ppm	Vapor Density : 3.66 (air=1)
PH : Not available	Relative density : 0.864 (water=1)
Melting/Freezing Point : －94.9℃	Solubility : 0.015 @25℃ in water
Initial boiling point/boiling range : 132.6℃	Partition coefficient : 3.15 (n-octanol/water)
Flash point : 21℃	Auto-ignition temperature : 432℃
Evaporation Rate : 0.84 (BuAc=1)	Decomposition temperature : Not available
Flammability (solid/gas) : Not available	Viscosity : Not available
Molecular Formula : C_8H_{10}	Molecular Weight : 106.7

SECTION 10-STABILITY AND REACTIVITY

Reactivity

The product is stable. Vapor is explosive when exposed to heat or flame.

Chemical stability

Stable under normal temperatures and pressures.

Possibility of hazardous reaction

Has not been reported.

Condition to avoid
Incompatible materials, ignition sources, excess heat.

Incompatible materials
Oxidizing agents.

Hazardous decomposition products
Carbon dioxide and carbon monoxide may form when heated to decomposition.

SECTION 11-TOXICOLOGICAL INFORMATION

Routes of exposure
Eye, Skin, inhalation, Ingestion.

Symptoms (treatments as indicated in Section 4)
Eye:
May cause irritation, redness, pain, and corneal damage.

Skin:
Causes irritation to skin. Symptoms include redness, itching, and pain. May produce blisters. May be absorbed through the skin.

Ingestion:
May cause irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea. May cause central nervous system depression. Symptoms may include giddiness, headache, dizziness, nausea, anaesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness. Serious poisonings may result in respiratory depression and may be fatal.

Inhalation:
Inhalation of high concentrations of gas/vapor causes lung irritation with coughing and nausea, central nervous depression with headache and dizziness, slowing of reflexes, fatigue and inco-ordination. Central nervous system (CNS) depression may include general discomfort, symptoms of giddiness, headache, dizziness, nausea, anaesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness. Serious poisonings may result in respiratory depression and may be fatal. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Chronic exposure:
There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment. Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems. Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Aggravation of pre-existing conditions:
Persons with pre-existing skin disorders, eye problems, liver disease, central nervous system disorders, or impaired respiratory function may be more susceptible to the effects of the substance.

Toxicity
LD50: 3500 mg/kg (rat, oral)
LC50: 4000 ppm/4h (rat, inhalation)

Irritation
Skin (rabbit): 15 mg/24h Mild
Eye (rabbit): 500 mg- SEVERE

Chronic effect
Carcinogenicity:
ACGIH : A3- Proven for animals.
OSHA : Classified None.
IARC : Group 2B carcinogen.

Epidemiology:
Not available.

Teratogenicity:
Not available.
Reproductive Effects:
Not available.

Neurotoxicity:
Not available

Mutagenicity:
Mutation in mammalian somatic cells（Rodent, mouse）Lymphocyte=80mg/L.

SECTION 12-ECOLOGICAL INFORMATION

Ecotoxicity

LC_{50} (96 hr.) Fish: 32.0～97.1 mg/l
EC_{50} (48 hr.) Water flea: Not available
Biocencentration factor (BCF): Not available

Persistence and degradability

1. In the atmosphere, it exists primarily in the vapor phase based on its vapor pressure. It photochemically degrades by reaction with hydroxyl radicals (half-life 0.5 to 2 days) and partially returns to the earth in rain.
2. Degradation occurs faster under smog conditions. Photooxidation products include ethylphenol, benzaldehyde, acetophenone and m- and p- ethylnitrobenzene.
3. In water, ethylbenzene's concentration decreases by evaporation and biodegradation. The rate of decrease is dependent on the season. Half-lives in water range from several days to 2 weeks.
4. Some ethylbenzene is absorbed by sediment, but bioconcentration in fish is not expected to be significant.

Half-life (Air): 8.56～85.6 hr
Half-life (Surface water): 72～240 hr
Half-life (Ground water): 144～5472 hr
Half-life (Soil): 7.2～240 hr

Bioaccumulative potential

This material is not expected to significantly bioaccumulate.

Mobility in soil

Ethylbenzene is adsorbed moderately by soil. It does not significantly hydrolyze in either water or soil.

Other adverse effects: –

SECTION 13-DISPOSAL CONSIDERATIONS

Residues and spilled material are hazardous waste due to ignitability. Disposal must be in accordance with applicable federal, state, or local regulations.

The container for this product can present explosion or fire hazards, even when emptied. To avoid risk of injury, do not cut, puncture, or weld on or near this container. Since the emptied containers retain product residue, follow label warnings even after container is emptied.

SECTION 14-TRANSPORTATION INFORMATION

US DOT	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3		
	UN Number	1175		
	Packing Group	II		
Sea(IMO/IMDG)	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3.2		
	UN Number	1175		
	Packing Group	II		
Air(ICAO/IATA)	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3		
	Subsidiary Class	1175		
	Packing Group	II		

EUROPEAN RID/ADR (ADR/RID)	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3		
	UN Number	1175		
Canadian TDG	Shipping Name	ETHYLBENZENE	Hazard Labels	
	Hazard Class	3		
	UN Number	1175		
	Packing Group	II		
	Subsidiary Class	9.2		

SECTION 15-REGULATORY INFORMATION

US FEDERAL

TSCA
CAS# 100-41-4 is listed on the TSCA inventory.
Health & Safety Reporting List
CAS# 100-41-4：Effective Date：June 19, 1987；Sunset Date：June 19, 1997
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.

SARA
Section 302 (RQ)
CAS# 100-41-4：final RQ＝1000 pounds（454 ㎏）
Section 302（TPQ）
None of the chemicals in this product have a TPQ.
SARA Codes
CAS# 100-41-4：acute, chronic, flammable.
Section 313
This material contains Ethylbenzene（CAS# 100-41-4, 99.0% ）,which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.

Clean Air Act
CAS# 100-41-4 is listed as a hazardous air pollutant（HAP）.
This material does not contain any class 1 Ozone depletors.
This material does not contain any class 2 Ozone depletors.

Clean Water Act
CAS# 100-41-4 is listed as a hazardous Substance under the CWA.
CAS# 100-41-4 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 100-41-4 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA
None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Ethylbenzene can be found on the following state right to know lists : California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level：None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols : XN F
Risk Phrases : R 11 Highly flammable.
R 20 Harmful by inhalation.
Safety Phrases : S 16 Keep away form sources of ignition-No smoking.
S 24/25 Avoid contact with skin and eyes.
S 29 Do not empty into drains.

CANADA
CAS# 100-41-4 is listed on Canada’s DSL/NDSL list.
This product has a WHMIS classification of B2, D2B.

CAS# 105-05-5 is not listed on Canada’s Ingredient Disclosure List.

SECTION 16-OTHER INFORMATION

References and sources

1. CHEMINFO Data Bank, CCINFO CD, 2005-3
2. HSDB Data Bank, TOMES PLUS CD, Vol.65,2005
3. RETECS Data Bank, TOMES PLUS CD, Vol.65, 2000
4. Hazardous Substance Data Bank, Environment Protection, Administration, Executive Yuan, ROC (Taiwan)
5. Chemwatch Data Bank, 2005-1
6. SDS, GHS in Taiwan, Council of Labor Affairs, Executive Yuan, ROC (Taiwan)

Version	**Date**	**Remark**
Version 1	06/01/1998	Original Version.
Version 2	04/20/2001	Updated 10 sections to 16 sections.
Version 3	08/01/2003	Updated “SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES”.
Version 4	01/01/2006	Updated “SECTION 14-TRANSPORTATION INFORMATION”.
Version 5	08/21/2008	Updated each section by GHS SDS.
Version 6	08/01/2011	Checked each section by SHE
Prepared by	Safety & Environment Protection Section, Taiwan SM Corporation Kaohsiung Plant.	

CADMIUM	**ICSC: 0020** **April 2005**
CAS #: 7440-43-9 **UN #: 2570** **EC Number: 231-152-8**	

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	May ignite spontaneously on contact with air. Gives off irritating or toxic fumes (or gases) in a fire. Finely dispersed particles form explosive mixtures in air.	NO open flames, NO sparks and NO smoking. NO contact with heat or acids. Closed system, dust explosion-proof electrical equipment and lighting. Prevent deposition of dust.	Use dry sand. Use special powder. NO other agents.

PREVENT DISPERSION OF DUST! AVOID ALL CONTACT! IN ALL CASES CONSULT A DOCTOR!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Cough. Sore throat.	Use local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Wear safety goggles or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Abdominal pain. Diarrhoea. Headache. Nausea. Vomiting.	Do not eat, drink, or smoke during work.	Rest. Refer for medical attention .

SPILLAGE DISPOSAL

Evacuate danger area! Personal protection: chemical protection suit including self-contained breathing apparatus. Remove all ignition sources. Sweep spilled substance into covered containers. Carefully collect remainder. Then store and dispose of according to local regulations.

STORAGE

Fireproof. Dry. Keep under inert gas. Separated from ignition sources, oxidants, acids and food and feedstuffs.

PACKAGING

Airtight.
Unbreakable packaging.
Put breakable packaging into closed unbreakable container.
Do not transport with food and feedstuffs.

CLASSIFICATION & LABELLING

According to UN GHS Criteria

Transportation
UN Classification
UN Hazard Class: 6.1

International Labour Organization World Health Organization

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European Commission

CADMIUM **ICSC: 0020**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
SOFT BLUE-WHITE METAL LUMPS OR GREY POWDER. MALLEABLE. TURNS BRITTLE ON EXPOSURE TO 80°C. TARNISHES ON EXPOSURE TO MOIST AIR.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
Reacts with acids. This produces flammable/explosive gas (hydrogen - see ICSC 0001). The dust reacts with oxidants, hydrogen azide, zinc, selenium and tellurium. This generates fire and explosion hazard.

Formula: Cd
Atomic mass: 112.4
Boiling point: 765°C
Melting point: 321°C
Density: 8.6 g/cm³
Solubility in water: none
Auto-ignition temperature: 250°C (cadmium metal dust)

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

Effects of short-term exposure
The fume is irritating to the respiratory tract. Inhalation of fumes may cause lung oedema. See Notes. Inhalation of fumes may cause metal fume fever. The effects may be delayed. Medical observation is indicated.

Inhalation risk
A harmful concentration of airborne particles can be reached quickly when dispersed, especially if powdered.

Effects of long-term or repeated exposure
Repeated or prolonged inhalation of dust particles may cause effects on the lungs. The substance may have effects on the kidneys. This may result in kidney impairment. This substance is carcinogenic to humans.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.01 mg/m^3, as TWA; A2 (suspected human carcinogen); BEI issued.
MAK: (including its inorganic compounds, inhalable fraction): skin absorption (H); carcinogen category: 1; germ cell mutagen group: 3A

ENVIRONMENT

NOTES

Reacts violently with fire extinguishing agents such as water, foam, carbon dioxide and halons.
Depending on the degree of exposure, periodic medical examination is suggested.
The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential.
Do NOT take working clothes home.
Cadmium also exists in a pyrophoric form (EC No. 048-011-00-X), which bears the additional EU labelling symbol F, R phrase 17, and S phrases 7/8 and 43.
UN numbers and packing group will vary according to the physical form of the substance.

ADDITIONAL INFORMATION

EC Classification
Symbol: T+, N; R: 45-26-48/23/25-62-63-68-50/53; S: 53-45-60-61; Note: E

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CHROMIUM Chrome	**ICSC: 0029** **October 2004**
CAS #: 7440-47-3 **EC Number: 231-157-5**	

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Combustible under specific conditions.	If powder: NO open flames Closed system, dust explosion-proof electrical equipment and lighting. Prevent deposition of dust.	In case of fire in the surroundings, use appropriate extinguishing media.

PREVENT DISPERSION OF DUST!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Cough.	Use local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower.
Eyes	Redness.	Wear safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion		Do not eat, drink, or smoke during work.	Rinse mouth.

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Personal protection: particulate filter respirator adapted to the airborne concentration of the substance. Sweep spilled substance into covered containers. If appropriate, moisten first to prevent dusting.	**According to UN GHS Criteria** **Transportation** **UN Classification**
STORAGE	
PACKAGING	

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CHROMIUM **ICSC: 0029**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
GREY POWDER.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
Chromium is a catalytic substance and may cause reaction in contact with many organic and inorganic substances, causing fire and explosion hazard.

Formula: Cr
Atomic mass: 52.0
Boiling point: 2642°C
Melting point: 1900°C
Density: 7.15 g/cm³
Solubility in water: none

EXPOSURE & HEALTH EFFECTS

Routes of exposure

Effects of short-term exposure
May cause mechanical irritation to the eyes and respiratory tract.

Inhalation risk
A harmful concentration of airborne particles can be reached quickly when dispersed.

Effects of long-term or repeated exposure

OCCUPATIONAL EXPOSURE LIMITS

TLV: (as Cr(0), inhalable fraction): 0.5 mg/m^3, as TWA

ENVIRONMENT

NOTES

The surface of the chromium particles is oxidized to chromium(III)oxide in air.
See ICSC 1531.

ADDITIONAL INFORMATION

EC Classification

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DDT **ICSC: 0034**
p,p'-DDT
Dichlorodiphenyltrichloroethane
1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane **April 2004**
2,2-bis(p-Chlorophenyl)-1,1,1-trichloroethane
1,1'-(2,2,2-Trichloroethylidene)bis(4-chlorobenzene)

CAS #: 50-29-3
UN #: 2761
EC Number: 200-024-3

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Combustible. Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Use water spray, powder, foam, carbon dioxide.

PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Cough.	Use local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness.	Wear safety goggles or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Tremor. Diarrhoea. Dizziness. Headache. Vomiting. Numbness. Tingling sensation. Hyperexcitability. Convulsions.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Rest. Refer for medical attention .

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Personal protection: particulate filter respirator adapted to the airborne concentration of the substance. Do NOT let this chemical enter the environment. Sweep spilled substance into covered sealable, non-metallic containers. If appropriate, moisten first to prevent dusting. Carefully collect remainder. Then store and dispose of according to local regulations.	**According to UN GHS Criteria** **Transportation** **UN Classification** UN Hazard Class: 6.1; UN Pack Group: III
STORAGE	
Provision to contain effluent from fire extinguishing. Separated from iron, aluminium, aluminium salts and food and feedstuffs. See Chemical Dangers.	
PACKAGING	
Do not transport with food and feedstuffs. Severe marine pollutant.	

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DDT **ICSC: 0034**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
COLOURLESS CRYSTALS OR WHITE POWDER. TECHNICAL PRODUCT IS WAXY SOLID.

Physical dangers

Chemical dangers
On combustion, forms toxic and corrosive fumes including hydrogen chloride. Reacts with aluminium and iron.

Formula: $C_{14}H_9Cl_5$
Molecular mass: 354.5
Boiling point: 260°C
Melting point: 109°C
Density: 1.6 g/cm³
Solubility in water: poor
Octanol/water partition coefficient as log Pow: 6.36

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by ingestion.

Effects of short-term exposure
May cause mechanical irritation. The substance may cause effects on the central nervous system. This may result in convulsions and respiratory depression. Exposure at high levels could cause death. Medical observation is indicated.

Inhalation risk
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly , especially if powdered.

Effects of long-term or repeated exposure
The substance may have effects on the central nervous system and liver. This substance is possibly carcinogenic to humans. Animal tests show that this substance possibly causes toxicity to human reproduction or development.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 1 mg/m^3, as TWA; A3 (confirmed animal carcinogen with unknown relevance to humans).
MAK: (inhalable fraction): 1 mg/m^3; peak limitation category: II(8); skin absorption (H)

ENVIRONMENT

The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment. Special attention should be given to birds. Bioaccumulation of this chemical may occur along the food chain, for example in milk and aquatic organisms. This substance does enter the environment under normal use. Great care, however, should be taken to avoid any additional release, for example through inappropriate disposal.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested.
Carrier solvents used in commercial formulations may change physical and toxicological properties.
Do NOT take working clothes home.
Consult national legislation.

ADDITIONAL INFORMATION

EC Classification
Symbol: T, N; R: 25-40-48/25-50/53; S: (1/2)-22-36/37-45-60-61

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SELENIUM **ICSC: 0072**
November 2009

CAS #: 7782-49-2
UN #: 3283 (n.o.s.)
EC Number: 231-957-4

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire. Risk of fire and explosion on contact with oxidants.	NO open flames. NO contact with oxidizing agents.	Use foam, powder, carbon dioxide. NO water.

STRICT HYGIENE!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Sore throat. Cough. Nasal discharge. Loss of smell. Headache.	Use ventilation, local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	Redness.	Protective gloves.	Rinse and then wash skin with water and soap.
Eyes	Redness.	Wear safety spectacles or eye protection in combination with breathing protection.	Rinse with plenty of water (remove contact lenses if easily possible).
Ingestion	Garlic breath. Diarrhoea.	Do not eat, drink, or smoke during work.	Rinse mouth. Refer for medical attention .

SPILLAGE DISPOSAL

Personal protection: particulate filter respirator adapted to the airborne concentration of the substance. Do NOT let this chemical enter the environment. Sweep spilled substance into covered containers. If appropriate, moisten first to prevent dusting. Carefully collect remainder. Then store and dispose of according to local regulations.

STORAGE

Separated from strong oxidants, strong acids and food and feedstuffs. Dry. Store in an area without drain or sewer access. Provision to contain effluent from fire extinguishing.

PACKAGING

Airtight.
Do not transport with food and feedstuffs.

CLASSIFICATION & LABELLING

According to UN GHS Criteria

WARNING
May cause respiratory irritation
May cause damage to the nervous system and gastrointestinal tract
May cause damage to nervous system and gastrointestinal tract through prolonged or repeated exposure
Very toxic to aquatic life

Transportation
UN Classification

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SELENIUM **ICSC: 0072**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
GREY SOLID IN VARIOUS FORMS.

Physical dangers
No data.

Chemical dangers
Upon heating, toxic fumes are formed. Reacts with oxidants and strong acids. Reacts , if in amorphous form, with water at 50°C. This produces flammable/explosive gas (hydrogen - see ICSC 0001) and selenious acids.

Formula: Se
Atomic mass: 79.0
Boiling point: 685°C
Melting point: 217°C
Relative density (water = 1): 4.8
Solubility in water: none
Vapour pressure, Pa at 20°C: 0.1

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation and by ingestion.

Effects of short-term exposure
The substance is irritating to the respiratory tract. The substance may cause effects on the gastrointestinal tract and nervous system.

Inhalation risk
A harmful concentration of airborne particles can be reached quickly on spraying or when dispersed, especially if powdered.

Effects of long-term or repeated exposure
The substance may have effects on the respiratory tract, gastrointestinal tract and skin.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.2 mg/m^3, as TWA.

MAK: (inhalable fraction): 0.02 mg/m^3; peak limitation category: II(8); skin absorption (H); carcinogen category: 3B; pregnancy risk group: C

ENVIRONMENT

The substance is very toxic to aquatic organisms. It is strongly advised not to let the chemical enter into the environment.

NOTES

Do NOT take working clothes home.

ADDITIONAL INFORMATION

EC Classification
Symbol: T; R: 23/25-33-53; S: (1/2)-20/21-28-45-61

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p-XYLENE para-Xylene 1,4-Dimethylbenzene p-Xylol paraxylene	**ICSC: 0086** **August 2002**

CAS #: 106-42-3
UN #: 1307
EC Number: 203-396-5

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Flammable. Above 27°C explosive vapour/air mixtures may be formed.	NO open flames, NO sparks and NO smoking. Above 27°C use a closed system, ventilation and explosion-proof electrical equipment. Prevent build-up of electrostatic charges (e.g., by grounding).	Use water spray, powder, foam, carbon dioxide. In case of fire: keep drums, etc., cool by spraying with water.

STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Dizziness. Drowsiness. Headache. Nausea.	Use ventilation, local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	Dry skin. Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Wear safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Burning sensation. Abdominal pain. Further see Inhalation.	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer for medical attention .

SPILLAGE DISPOSAL

Personal protection: filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Ventilation. Remove all ignition sources. Do NOT let this chemical enter the environment. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent. Then store and dispose of according to local regulations.

STORAGE

Fireproof. Separated from strong oxidants and strong acids.

PACKAGING

CLASSIFICATION & LABELLING

According to UN GHS Criteria

Transportation
UN Classification
UN Hazard Class: 3; UN Pack Group: III

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p-XYLENE **ICSC: 0086**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
COLOURLESS LIQUID WITH CHARACTERISTIC ODOUR.

Physical dangers
As a result of flow, agitation, etc., electrostatic charges can be generated.

Chemical dangers
Reacts with strong acids and strong oxidants.

Formula: $C_6H_4(CH_3)_2$ / C_8H_{10}
Molecular mass: 106.2
Boiling point: 138°C
Melting point: 13°C
Relative density (water = 1): 0.86
Solubility in water: none
Vapour pressure, kPa at 20°C: 0.9
Relative vapour density (air = 1): 3.7
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02
Flash point: 27°C c.c.
Auto-ignition temperature: 528°C
Explosive limits, vol% in air: 1.1-7.0
Octanol/water partition coefficient as log Pow: 3.15

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Effects of short-term exposure
The substance is irritating to the eyes and skin. The substance may cause effects on the central nervous system. If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis.

Inhalation risk
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

Effects of long-term or repeated exposure
The substance defats the skin, which may cause dryness or cracking. The substance may have effects on the central nervous system. Exposure to the substance may increase noise-induced hearing loss. Animal tests show that this substance possibly causes toxicity to human reproduction or development.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 100 ppm as TWA; 150 ppm as STEL; A4 (not classifiable as a human carcinogen); BEI issued.
MAK: 440 mg/m^3, 100 ppm; peak limitation category: II(2); skin absorption (H); pregnancy risk group: D.
EU-OEL: 221 mg/m^3, 50 ppm as TWA; 442 mg/m^3, 100 ppm as STEL; (skin)

ENVIRONMENT

The substance is toxic to aquatic organisms.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested.
The recommendations on this Card also apply to technical xylene.
See ICSCs 0084 and 0085.

ADDITIONAL INFORMATION

EC Classification
Symbol: Xn; R: 10-20/21-38; S: (2)-25; Note: C

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NAPHTHALENE Naphthene	**ICSC: 0667** **June 2015**

CAS #: 91-20-3
UN #: 1334 (solid) UN #: 2304 (molten)
EC Number: 202-049-5

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Combustible. Above 80°C explosive vapour/air mixtures may be formed. Finely dispersed particles form explosive mixtures in air.	NO open flames. Closed system, dust explosion-proof electrical equipment and lighting. Prevent deposition of dust.	Use water spray, powder, foam, carbon dioxide.

PREVENT DISPERSION OF DUST!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Headache. Weakness. Sweating. Nausea. Vomiting. Further see Ingestion.	Use ventilation (not if powder), local exhaust or breathing protection.	Fresh air. Refer for medical attention.
Skin	See Inhalation.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Seek medical attention if you feel unwell.
Eyes	Redness.	Wear safety spectacles.	Rinse with plenty of water (remove contact lenses if easily possible).
Ingestion	Abdominal pain. Diarrhoea. Sweating. Headache. Fever. Jaundice. Weakness. Dark-coloured urine. Symptoms may be delayed.	Do not eat, drink, or smoke during work.	Rinse mouth. Do NOT induce vomiting. Refer immediately for medical attention.

SPILLAGE DISPOSAL

Personal protection: filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Do NOT let this chemical enter the environment. Do NOT wash away into sewer. Sweep spilled substance into covered containers. If appropriate, moisten first to prevent dusting. Carefully collect remainder. Then store and dispose of according to local regulations.

STORAGE

Separated from strong oxidants and food and feedstuffs. Store in an area without drain or sewer access. Provision to contain effluent from fire extinguishing.

PACKAGING

Do not transport with food and feedstuffs.
Marine pollutant.

CLASSIFICATION & LABELLING

According to UN GHS Criteria

WARNING

Flammable solid
Harmful if swallowed
May be harmful in contact with skin
Suspected of causing cancer
Very toxic to aquatic life with long lasting effects

Transportation
UN Classification
UN Hazard Class: 4.1; UN Pack Group: III

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NAPHTHALENE **ICSC: 0667**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
WHITE SOLID IN VARIOUS FORMS WITH CHARACTERISTIC ODOUR.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
On combustion, forms irritating and toxic gases. Reacts with strong oxidants. This generates fire and explosion hazard.

Formula: $C_{10}H_8$
Molecular mass: 128.18
Boiling point: 218°C
Sublimes at room temperature
Melting point: 80°C
Density: 1.16 g/cm³
Solubility in water at 20°C: very poor
Vapour pressure, Pa at 25°C: 11
Relative vapour density (air = 1): 4.42
Flash point: 80°C c.c.
Auto-ignition temperature: 540°C
Explosive limits, vol% in air: 0.9-5.9
Octanol/water partition coefficient as log Pow: 3.35

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Effects of short-term exposure
The substance may cause effects on the blood. This may result in lesions of blood cells (haemolysis). See Notes. The effects may be delayed. Ingestion could cause death. Medical observation is indicated.

Inhalation risk
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

Effects of long-term or repeated exposure
The substance may have effects on the blood. This may result in chronic haemolytic anaemia. The substance may have effects on the eyes. This may result in development of cataract. This substance is possibly carcinogenic to humans.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 10 ppm as TWA; (skin); A3 (confirmed animal carcinogen with unknown relevance to humans).
EU-OEL: 50 mg/m^3, 10 ppm as TWA.
MAK: skin absorption (H); carcinogen category: 2; germ cell mutagen group: 3B

ENVIRONMENT

The substance is toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment. Bioaccumulation of this chemical may occur along the food chain, for example in fish.

NOTES

ADDITIONAL INFORMATION

EC Classification
Symbol: Xn, N; R: 22-40-50/53; S: (1/2)-26-36/37/39-45-46-60-61

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CHLORDANE (TECHNICAL PRODUCT) 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene	**ICSC: 0740** **March 1998**
CAS #: 57-74-9 **UN #: 2996** **EC Number: 200-349-0**	

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Use alcohol-resistant foam, powder, carbon dioxide, water spray.

PREVENT GENERATION OF MISTS! STRICT HYGIENE! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN! IN ALL CASES CONSULT A DOCTOR!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	See Ingestion.	Use breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	MAY BE ABSORBED!	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Wear safety goggles, face shield or eye protection in combination with breathing protection.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Confusion. Convulsions. Nausea. Vomiting.	Do not eat, drink, or smoke during work. Wash hands before eating.	Rest. Refer for medical attention .

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Personal protection: chemical protection suit including self-contained breathing apparatus. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent. Then store and dispose of according to local regulations. Do NOT let this chemical enter the environment.	**According to UN GHS Criteria** **Transportation** **UN Classification** UN Hazard Class: 6.1; UN Pack Group: III
STORAGE	
Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs, bases and incompatible materials. See Chemical Dangers. Well closed. Keep in a well-ventilated room.	
PACKAGING	
Do not transport with food and feedstuffs. Severe marine pollutant.	

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CHLORDANE (TECHNICAL PRODUCT) **ICSC: 0740**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
TECHNICAL-GRADE PRODUCT: LIGHT YELLOW-TO-AMBER VISCOUS LIQUID.

Physical dangers

Chemical dangers
Decomposes on burning. Decomposes on contact with bases. This produces toxic fumes including phosgene and hydrogen chloride. Attacks iron, zinc, plastics, rubber and coatings.

Formula: $C_{10}H_6Cl_8$
Molecular mass: 409.8
Boiling point at 0.27kPa: 175°C
Relative density (water = 1): 1.59 - 1.63
Solubility in water: none
Vapour pressure, Pa at 25°C: 0.0013
Octanol/water partition coefficient as log Pow: 2.78

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Effects of short-term exposure
Exposure at high levels could cause disorientation, tremors, convulsions, respiratory failure and death. Medical observation is indicated.

Inhalation risk
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying.

Effects of long-term or repeated exposure
The substance may have effects on the liver and immune system. This may result in tissue lesions and liver impairment. This substance is possibly carcinogenic to humans.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.5 mg/m^3, as TWA; (skin); A3 (confirmed animal carcinogen with unknown relevance to humans).
MAK: (inhalable fraction): 0.5 mg/m^3; peak limitation category: II(8); skin absorption (H); carcinogen category: 3B

ENVIRONMENT

The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment. Special attention should be given to soil organisms and bees. It is strongly advised not to let the chemical enter into the environment. The substance may cause long-term effects in the aquatic environment.

NOTES

If the substance is formulated with solvents also consult the ICSCs of these materials.
Carrier solvents used in commercial formulations may change physical and toxicological properties.
See ICSC 0743.

ADDITIONAL INFORMATION

EC Classification
Symbol: Xn, N; R: 21/22-40-50/53; S: (2)-36/37-60-61

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ALDRIN 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-exo-1,4-endo-5,8-dimethanonaphthalene 1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4aß,5alpha,8alpha,8aß) HHDN	**ICSC: 0774** **March 1998**
CAS #: 309-00-2 **UN #: 2761** **EC Number: 206-215-8**	

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Not combustible. Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings, use appropriate extinguishing media.

PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	See Ingestion.	Use ventilation (not if powder).	Fresh air, rest. Refer for medical attention.
Skin	MAY BE ABSORBED! See Ingestion.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention .
Eyes		Wear safety goggles or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Convulsions. Dizziness. Headache. Nausea. Vomiting. Muscle twitching.	Do not eat, drink, or smoke during work. Wash hands before eating.	Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Rest. Refer for medical attention .

SPILLAGE DISPOSAL

Do NOT wash away into sewer. Sweep spilled substance into covered sealable containers. If appropriate, moisten first to prevent dusting. Carefully collect remainder. Then store and dispose of according to local regulations. Personal protection: chemical protection suit including self-contained breathing apparatus.

STORAGE

Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs and incompatible materials. See Chemical Dangers. Well closed. Keep in a well-ventilated room. Store in an area without drain or sewer access.

PACKAGING

Do not transport with food and feedstuffs.
Severe marine pollutant.

CLASSIFICATION & LABELLING

According to UN GHS Criteria

Transportation
UN Classification
UN Hazard Class: 6.1; UN Pack Group: II

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ALDRIN **ICSC: 0774**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
COLOURLESS CRYSTALS.

Physical dangers

Chemical dangers
Decomposes on heating. This produces toxic and corrosive fumes including hydrogen chloride. Reacts with acids and oxidants. Attacks many metals in the presence of water.

Formula: $C_{12}H_8Cl_6$
Molecular mass: 364.9
Boiling point at 0.27kPa: 145°C
Melting point: 104-105°C
Density: 1.6 g/cm^3
Solubility in water: none
Vapour pressure, Pa at 20°C: 0.009
Octanol/water partition coefficient as log Pow: 7.4

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body through the skin and by ingestion.

Effects of short-term exposure
The substance may cause effects on the central nervous system. This may result in convulsions. The effects may be delayed. Medical observation is indicated.

Inhalation risk
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying.

Effects of long-term or repeated exposure
Cumulative effects are possible. See Acute Hazards/Symptoms.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.05 mg/m^3, as TWA; (skin); A3 (confirmed animal carcinogen with unknown relevance to humans).
MAK: (inhalable fraction): 0.25 mg/m^3; peak limitation category: II(8); skin absorption (H)

ENVIRONMENT

The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment. Special attention should be given to birds and bees. Bioaccumulation of this chemical may occur in aquatic organisms. It is strongly advised not to let the chemical enter into the environment because it is persistent. The substance may cause long-term effects in the aquatic environment. Avoid release to the environment in circumstances different to normal use.

NOTES

Depending on the degree of exposure, periodic medical examination is suggested.
If the substance is formulated with solvent(s) also consult the card(s) (ICSC) of the solvent(s).
Carrier solvents used in commercial formulations may change physical and toxicological properties.
Do NOT take working clothes home.
The recommendations on this Card also apply to ICSC 0787 (dieldrin).

ADDITIONAL INFORMATION

EC Classification
Symbol: T, N; R: 24/25-40-48/24/25-50/53; S: (1/2)-22-36/37-45-60-61

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SILVER Argentium C.I. 77820	**ICSC: 0810** **November 2019**
CAS #: 7440-22-4 **UN #: 3077 (n.o.s.)** **EC Number: 231-131-3**	

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Not combustible. See Notes.		In case of fire in the surroundings: all extinguishing agents allowed.

PREVENT DISPERSION OF DUST!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation	Cough. Sore throat.	Use local exhaust or breathing protection.	Fresh air, rest.
Skin		Protective gloves.	Rinse and then wash skin with water and soap.
Eyes	Redness. Pain.	Wear safety spectacles or eye protection in combination with breathing protection if powder.	Rinse with plenty of water (remove contact lenses if easily possible).
Ingestion	See Inhalation.	Do not eat, drink, or smoke during work.	Give one or two glasses of water to drink.

SPILLAGE DISPOSAL

Personal protection: particulate filter respirator adapted to the airborne concentration of the substance. Collect the spilled substance into containers. Then store and dispose of according to local regulations. Do NOT let this chemical enter the environment.

STORAGE

Separated from : see Chemical Dangers. Store only in original packaging. Store in an area without drain or sewer access.

PACKAGING

CLASSIFICATION & LABELLING

According to UN GHS Criteria

WARNING

Very toxic to aquatic life with long lasting effects

Transportation
UN Classification
UN Hazard Class: 9; UN Pack Group: III

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SILVER **ICSC: 0810**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
WHITE METAL.

Physical dangers
Dust explosion possible if in powder or granular form, mixed with air.

Chemical dangers
See Notes. Reacts with many other substances. This generates fire and explosion hazard. Consult your supplier.

Formula: Ag
Atomic mass: 107.9
Boiling point: 2212°C
Melting point: 962°C
Relative density (water = 1): 10.5
Solubility in water, g/100ml: <0.01 (practically insoluble)

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation and by ingestion.

Effects of short-term exposure
May cause mechanical irritation to the eyes and respiratory tract.

Inhalation risk
No indication can be given whether a harmful concentration in the air will be reached.

Effects of long-term or repeated exposure
The substance may cause a grey-blue discolouration of the eyes, nose, throat and skin (argyria/argyrosis).

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.1 mg/m^3, as TWA.
MAK: (inhalable fraction): 0.1 mg/m^3; peak limitation category: II(8); pregnancy risk group: D.
EU-OEL: 0.1 mg/m^3 as TWA

ENVIRONMENT

The substance is very toxic to aquatic organisms. The substance may cause long-term effects in the aquatic environment. It is strongly advised not to let the chemical enter into the environment.

NOTES

Finely divided silver can be combustible and reactive; in its bulk form silver is stable and non-combustible.
There are insufficient data to assess the hazards of this substance in its nanoform (< 100 nm). Therefore the utmost care must be taken when using the substance. Consult your supplier.

ADDITIONAL INFORMATION

EC Classification

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POLYCHLORINATED BIPHENYL (AROCLOR 1254) Chlorobiphenyl (54% chlorine) Chlorodiphenyl (54% chlorine) PCB	**ICSC: 0939** **October 1999**

CAS #: 11097-69-1
UN #: 2315
EC Number: 215-648-1

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings, use appropriate extinguishing media.

PREVENT GENERATION OF MISTS! STRICT HYGIENE!

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation		Use ventilation.	Fresh air, rest. Refer for medical attention.
Skin	MAY BE ABSORBED! Dry skin. Redness.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention .
Eyes		Wear safety goggles or face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Headache. Numbness.	Do not eat, drink, or smoke during work.	Rest. Refer for medical attention .

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Consult an expert! Personal protection: complete protective clothing including self-contained breathing apparatus. Do NOT let this chemical enter the environment. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent. Then store and dispose of according to local regulations.	**According to UN GHS Criteria** **Transportation** **UN Classification** UN Hazard Class: 9; UN Pack Group: II
STORAGE	
Separated from food and feedstuffs. Cool. Dry. Keep in a well-ventilated room.	
PACKAGING	
Unbreakable packaging. Put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs. Severe marine pollutant.	

International Labour Organization World Health Organization

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POLYCHLORINATED BIPHENYL (AROCLOR 1254) **ICSC: 0939**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
LIGHT YELLOW VISCOUS LIQUID.

Physical dangers
No data.

Chemical dangers
No data.

Molecular mass: 327 (average)
Relative density (water = 1): 1.5
Solubility in water: none
Vapour pressure, Pa at 25°C: 0.01
Octanol/water partition coefficient as log Pow: 6.30 (estimated)

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.

Effects of short-term exposure

Inhalation risk
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

Effects of long-term or repeated exposure
Repeated or prolonged contact with skin may cause dermatitis. May cause chloracne. The substance may have effects on the liver. Animal tests show that this substance possibly causes toxic effects upon human reproduction.

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.5 mg/m^3, as TWA; (skin); A3 (confirmed animal carcinogen with unknown relevance to humans)

ENVIRONMENT

Bioaccumulation of this chemical may occur in aquatic organisms. It is strongly advised not to let the chemical enter into the environment.

NOTES

Changes into a resinous state (pour point) at 10°C.
Distillation range: 365°-390°C.

ADDITIONAL INFORMATION

EC Classification
Symbol: Xn, N; R: 33-50/53; S: (2)-35-60-61; Note: C

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ENDRIN	**ICSC: 1023** **March 2000**
CAS #: 72-20-8 **UN #: 2761** **EC Number: 200-775-7**	

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Not combustible. Liquid formulations containing organic solvents may be flammable. Gives off irritating or toxic fumes (or gases) in a fire.		In case of fire in the surroundings, use appropriate extinguishing media.

PREVENT DISPERSION OF DUST! STRICT HYGIENE! IN ALL CASES CONSULT A DOCTOR!			
	SYMPTOMS	**PREVENTION**	**FIRST AID**
Inhalation	See Ingestion.	Use local exhaust or breathing protection.	Fresh air, rest. Refer for medical attention.
Skin	MAY BE ABSORBED! See Ingestion.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention .
Eyes		Wear face shield or eye protection in combination with breathing protection if powder.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion	Dizziness. Weakness. Headache. Nausea. Vomiting. Convulsions.	Do not eat, drink, or smoke during work. Wash hands before eating.	Give a slurry of activated charcoal in water to drink. Rest. Refer for medical attention .

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Personal protection: chemical protection suit including self-contained breathing apparatus. Do NOT let this chemical enter the environment. Sweep spilled substance into covered sealable containers. If appropriate, moisten first to prevent dusting. Carefully collect remainder. Then store and dispose of according to local regulations. Do NOT wash away into sewer.	**According to UN GHS Criteria** **Transportation** **UN Classification** UN Hazard Class: 6.1; UN Pack Group: I
STORAGE	
Provision to contain effluent from fire extinguishing. Separated from food and feedstuffs. Well closed. Keep in a well-ventilated room. Store in an area without drain or sewer access. Provision to contain effluent from fire extinguishing.	
PACKAGING	
Do not transport with food and feedstuffs. Severe marine pollutant.	

Prepared by an international group of experts on behalf of ILO and WHO, with the financial assistance of the European Commission.
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ENDRIN **ICSC: 1023**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
WHITE CRYSTALS.

Physical dangers

Chemical dangers
Decomposes above 245°C . This produces hydrogen chloride and phosgene.

Formula: $C_{12}H_8Cl_6O$
Molecular mass: 380.9
Decomposes at 245°C
Melting point: 200°C
Density: 1.7 g/cm³
Solubility in water at 25°C: none
Vapour pressure at 25°C: negligible
Octanol/water partition coefficient as log Pow: 5.34

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Effects of short-term exposure
The substance may cause effects on the central nervous system. This may result in convulsions and death. The effects may be delayed. Medical observation is indicated.

Inhalation risk
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly on spraying or when dispersed, especially if powdered.

Effects of long-term or repeated exposure

OCCUPATIONAL EXPOSURE LIMITS

TLV: 0.1 mg/m^3, as TWA; (skin); A4 (not classifiable as a human carcinogen).
MAK: (inhalable fraction): 0.05 mg/m^3; peak limitation category: II(8); skin absorption (H); pregnancy risk group: C

ENVIRONMENT

The substance is very toxic to aquatic organisms. This substance may be hazardous to the environment. Special attention should be given to bees, birds and mammals. It is strongly advised not to let the chemical enter into the environment because it is persistent. Bioaccumulation of this chemical may occur in fish and seafood. Avoid release to the environment in circumstances different to normal use.

NOTES

If the substance is formulated with solvent(s) also consult the card(s) (ICSC) of the solvent(s).
Carrier solvents used in commercial formulations may change physical and toxicological properties.
Do NOT take working clothes home.

ADDITIONAL INFORMATION

EC Classification
Symbol: T+, N; R: 24-28-50/53; S: (1/2)-22-36/37-45-60-61

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PYRENE Benzo (d,e,f) phenanthrene beta-Pyrene	**ICSC: 1474** **November 2003**
CAS #: 129-00-0 **EC Number: 204-927-3**	

	ACUTE HAZARDS	PREVENTION	FIRE FIGHTING
FIRE & EXPLOSION	Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames, NO sparks and NO smoking.	Use water spray, carbon dioxide, dry powder, alcohol-resistant foam, polymer foam.

	SYMPTOMS	PREVENTION	FIRST AID
Inhalation		Avoid inhalation of dust.	Fresh air, rest.
Skin	Redness.	Protective gloves.	Remove contaminated clothes. Rinse and then wash skin with water and soap.
Eyes	Redness.	Wear safety spectacles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.
Ingestion		Do not eat, drink, or smoke during work.	Do NOT induce vomiting. Give one or two glasses of water to drink. Refer for medical attention .

SPILLAGE DISPOSAL	CLASSIFICATION & LABELLING
Personal protection: particulate filter respirator adapted to the airborne concentration of the substance. Do NOT let this chemical enter the environment. Sweep spilled substance into covered containers. If appropriate, moisten first to prevent dusting. Carefully collect remainder.	**According to UN GHS Criteria** **Transportation** **UN Classification**
STORAGE	
Separated from strong oxidants. Keep in a well-ventilated room.	
PACKAGING	
Do not transport with food and feedstuffs.	

Prepared by an international group of experts on behalf of ILO and WHO, with the financial assistance of the European Commission.

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PYRENE **ICSC: 1474**

PHYSICAL & CHEMICAL INFORMATION

Physical State; Appearance
PALE YELLOW OR COLOURLESS SOLID IN VARIOUS FORMS.

Physical dangers

Chemical dangers
Decomposes on heating. This produces irritating fumes.

Formula: $C_{16}H_{10}$
Molecular mass: 202.26
Boiling point: 404°C
Melting point: 151°C
Density: 1.27 g/cm³
Solubility in water, mg/l at 25°C: 0.135
Vapour pressure, Pa at ?°C: 0.08
Octanol/water partition coefficient as log Pow: 4.88

EXPOSURE & HEALTH EFFECTS

Routes of exposure
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

Effects of short-term exposure
Exposure to sun may enhance the irritating effect of this substance. This may result in chronic skin discoloration.

Inhalation risk
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

Effects of long-term or repeated exposure

OCCUPATIONAL EXPOSURE LIMITS

MAK skin absorption (H)

ENVIRONMENT

Bioaccumulation of this chemical may occur in crustacea, fish, milk, algae and molluscs. It is strongly advised not to let the chemical enter into the environment.

NOTES

Pyrene is one of many polycyclic aromatic hydrocarbons - standards are usually established for them as mixtures, e.g., coal tar pitch volatiles.
However, pyrene may be encountered as a laboratory chemical in its pure form.
Health effects of exposure to the substance have not been investigated adequately.
See ICSC 1415.

ADDITIONAL INFORMATION

EC Classification

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SAFETY DATA SHEET

Isobutylene

Section 1. Identification

GHS product identifier : Isobutylene

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

Product use : Synthetic/Analytical chemistry.

Synonym : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

SDS # : 001031

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Emergency telephone number (with hours of operation) : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Extremely flammable gas.
Contains gas under pressure; may explode if heated.
May cause frostbite.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Never Put cylinders into unventilated areas of passenger vehicles. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use and store only outdoors or in a well ventilated place.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight. Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Section 2. Hazards identification

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

CAS number/other identifiers

CAS number : 115-11-7

Product code : 001031

Ingredient name	%	CAS number
2-methylpropene	100	115-11-7

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Section 4. First aid measures

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Section 6. Accidental release measures

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
2-methylpropene	**ACGIH TLV (United States, 3/2012).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Section 8. Exposure controls/personal protection

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state	Gas. [Liquefied compressed gas.]
Color	Colorless.
Molecular weight	56.12 g/mole
Molecular formula	C4-H8
Boiling/condensation point	-6.9°C (19.6°F)
Melting/freezing point	-140.7°C (-221.3°F)
Critical temperature	144.75°C (292.6°F)
Odor	Characteristic.
Odor threshold	Not available.
pH	Not available.
Flash point	Closed cup: -76.1°C (-105°F)
Burning time	Not applicable.
Burning rate	Not applicable.
Evaporation rate	Not available.
Flammability (solid, gas)	Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.
Lower and upper explosive (flammable) limits	Lower: 1.8% Upper: 9.6%

Section 9. Physical and chemical properties

Vapor pressure	: 24.3 (psig)
Vapor density	: 1.94 (Air = 1)
Specific Volume (ft ^{3}/lb)	: 6.6845
Gas Density (lb/ft ^{3})	: 0.1496 (25°C / 77 to °F)
Relative density	: Not applicable.
Solubility	: Not available.
Solubility in water	: 0.263 g/l
Partition coefficient: n-octanol/water	: 2.34
Auto-ignition temperature	: 465°C (869°F)
Decomposition temperature	: Not available.
SADT	: Not available.
Viscosity	: Not applicable.

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.
Incompatibility with various substances	: Extremely reactive or incompatible with the following materials: oxidizing materials.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
2-methylpropene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Section 11. Toxicological information

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Section 11. Toxicological information

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	**LogP_{ow}**	**BCF**	**Potential**
2-methylpropene	2.34	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	**TDG**	**Mexico**	**IMDG**	**IATA**
UN number	UN1055	UN1055	UN1055	UN1055	UN1055
UN proper shipping name	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 

Section 14. Transport information

Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 150 kg **Special provisions** 19, T50	**Explosive Limit and Limited Quantity Index** 0.125 **ERAP Index** 3000 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 29	-	-	**Passenger and Cargo Aircraft**Quantity limitation: 0 Forbidden **Cargo Aircraft Only** Quantity limitation: 150 kg

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act (CAA) 112 regulated flammable substances: 2-methylpropene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Sudden release of pressure

Powered by IHS

Section 15. Regulatory information

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
2-methylpropene	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : This material is listed.
New York : This material is not listed.
New Jersey : This material is listed.
Pennsylvania : This material is listed.
Canada inventory : This material is listed or exempted.

International regulations

International lists : **Australia inventory (AICS)**: This material is listed or exempted.
China inventory (IECSC): This material is listed or exempted.
Japan inventory: This material is listed or exempted.
Korea inventory: This material is listed or exempted.
Malaysia Inventory (EHS Register): Not determined.
New Zealand Inventory of Chemicals (NZIoC): This material is listed or exempted.
Philippines inventory (PICCS): This material is listed or exempted.
Taiwan inventory (CSNN): Not determined.

Chemical Weapons Convention List Schedule I Chemicals : Not listed

Chemical Weapons Convention List Schedule II Chemicals : Not listed

Chemical Weapons Convention List Schedule III Chemicals : Not listed

Canada

WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)

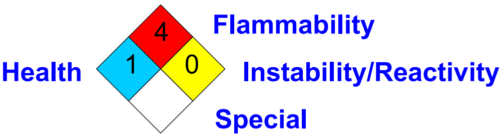
Health	1
Flammability	4
Physical hazards	2

Section 16. Other information

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of printing : 10/15/2014.
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Version : 0.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United NationsACGIH – American Conference of Governmental Industrial Hygienists
AIHA – American Industrial Hygiene Association
CAS – Chemical Abstract Services
CEPA – Canadian Environmental Protection Act
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
CFR – United States Code of Federal Regulations
CPR – Controlled Products Regulations
DSL – Domestic Substances List
GWP – Global Warming Potential
IARC – International Agency for Research on Cancer
ICAO – International Civil Aviation Organisation
Inh – Inhalation
LC – Lethal concentration
LD – Lethal dosage
NDSL – Non-Domestic Substances List
NIOSH – National Institute for Occupational Safety and Health

Section 16. Other information

TDG – Canadian Transportation of Dangerous Goods Act and Regulations
TLV – Threshold Limit Value
TSCA – Toxic Substances Control Act
WEEL – Workplace Environmental Exposure Level
WHMIS – Canadian Workplace Hazardous Material Information System

References : Not available.

◤ **Indicates information that has changed from previously issued version.**

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

FLINN SCIENTIFIC, INC.

Safety Data Sheet (SDS)

SDS #: 432.00

Revision Date: March 25, 2014

SECTION 1 — CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Lead

Flinn Scientific, Inc. P.O. Box 219, Batavia, IL 60510 (800) 452-1261

CHEMTREC Emergency Phone Number: (800) 424-9300

Signal Word **DANGER**

Pictograms

SECTION 2 — HAZARDS IDENTIFICATION

Hazard class: Acute toxicity, oral and inhalation (Category 4). Harmful if swallowed or inhaled (H302+H332). Do not eat, drink or smoke when using this product (P270). Avoid breathing dust and fumes (P261).

Hazard class: Carcinogenicity (Category 2). Suspected of causing cancer (H351). Obtain special instructions before use (P201). Do not handle until all safety precautions have been read and understood (P202). Use personal protective equipment as required (P281). Elemental lead is a possible human carcinogen (IARC-2B).

Hazard class: Reproductive toxicity (Category 1A). May damage fertility or the unborn child (H360).

Hazard class: Specific target organ toxicity, repeated exposure (Category 2). May cause damage to organs through prolonged or repeated exposure (H373). Do not eat, drink or smoke when using this product (P270).

SECTION 3 — COMPOSITION, INFORMATION ON INGREDIENTS

Component Name	CAS Number	Formula	Formula Weight	Concentration
Lead Forms: foil, sheets, shot, strips, and wire.	7439-92-1	Pb	207.19	

SECTION 4 — FIRST AID MEASURES

If exposed or concerned: Get medical advice or attention (P308+P313).
If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing (P304+P340).
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do so. Continue rinsing.
If on skin: Wash with plenty of water.
If swallowed: Rinse mouth. Immediately call a POISON CENTER or physician (P301+P310+P330).

SECTION 5 — FIRE FIGHTING MEASURES

Finely divided lead dust is flammable.
Molten metal may release toxic fumes of lead.
In case of fire: Use a tri-class dry chemical fire extinguisher.

NFPA CODE
None
established

SECTION 6 — ACCIDENTAL RELEASE MEASURES

Sweep up, place in sealed bag or container and dispose. Ventilate area and wash spill site after material pickup is complete. See Sections 8 and 13 for further information.

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SECTION 7 — HANDLING AND STORAGE

Flinn Suggested Chemical Storage Pattern: Inorganic #1. Store with metals and metal hydrides.
Use fume hood when handling powder form.

SECTION 8 — EXPOSURE CONTROLS, PERSONAL PROTECTION

Wear protective gloves, protective clothing, and eye protection. Wash hands thoroughly after handling. Use fume hood when handling powder form.
Exposure guidelines: PEL/TLV 0.05 mg/m^3 (OSHA/ACGIH)

SECTION 9 — PHYSICAL AND CHEMICAL PROPERTIES

Heavy, ductile, gray solid. Odorless.
Soluble: Dilute nitric acid. Insoluble in water.
Lead wire also contains 1% antimony (CAS #7440-36-0)

Boiling point: 1740 ^{o}C
Melting point: 327.4 ^{o}C
Specific gravity: 11.35

SECTION 10 — STABILITY AND REACTIVITY

Avoid strong acids, ammonium nitrate, hydrogen peroxide, sodium azide, zirconium, sodium acetylide, and chlorine.
Shelf life: Indefinite, if stored properly.

SECTION 11 — TOXICOLOGICAL INFORMATION

Acute effects: Convulsions, seizures, weakness, muscle cramps, methemoglobinemia.
Chronic effects: Anemia, reproductive hazard, possible carcinogen.
Target organs: Nerves, brain, blood, kidneys, female/male reproductive system

ORL-Pigeon LDL$_0$: 160 mg/kg
IHL-Human LCL$_0$: 10 ug/m^3
SKN-RBT LD$_{50}$: N.A.

N.A. = Not available, not all health aspects of this substance have been fully investigated.

SECTION 12 — ECOLOGICAL INFORMATION

Accumulates in soil and water. Bioaccumulates in animals. Very toxic to aquatic life with long lasting effects

SECTION 13 — DISPOSAL CONSIDERATIONS

Please review all federal, state and local regulations that may apply before proceeding.
Flinn Suggested Disposal Method #27d is one option.

SECTION 14 — TRANSPORT INFORMATION

Shipping name: Not regulated. Hazard class: N/A. UN number: N/A.

N/A = Not applicable

SECTION 15 — REGULATORY INFORMATION

TSCA-listed, EINECS-listed (231-100-4), RCRA code D008.

SECTION 16 — OTHER INFORMATION

This Safety Data Sheet (SDS) is for guidance and is based upon information and tests believed to be reliable. Flinn Scientific, Inc. makes no guarantee of the accuracy or completeness of the data and shall not be liable for any damages relating thereto. The data is offered solely for your consideration, investigation, and verification. The data should not be confused with local, state, federal or insurance mandates, regulations, or requirements and CONSTITUTE NO WARRANTY. Any use of this data and information must be determined by the science instructor to be in accordance with applicable local, state or federal laws and regulations. The conditions or methods of handling, storage, use and disposal of the product(s) described are beyond the control of Flinn Scientific, Inc. and may be beyond our knowledge. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH THE HANDLING, STORAGE, USE OR DISPOSAL OF THIS PRODUCT(S).

Consult your copy of the *Flinn Science Catalog/Reference Manual* for additional information about laboratory chemicals.

Revision Date: March 25, 2014

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MERCURY

Safety Data Sheet

according to the federal final rule of hazard communication revised on 2012 (HazCom 2012)

Date of issue: 11/19/2013

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Trade name : MERCURY

CAS No : 7439-97-6

Other means of identification : Colloidal Mercury, Quick Silver, Liquid Silver, NCI-C60399, Hydrargyrum

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Variety of industrial, analytical and research applications.

1.3. Details of the supplier of the safety data sheet

Intertek Chemicals & Pharmaceuticals

2 Riverway,Suite 500
Houston, TX 77056

1.4. Emergency telephone number

Emergency number : 1-800-424-9300

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

GHS-US classification

Acute Tox. 1 (Inhalation:dust,mist)	H330
Repr. 1B	H360
STOT RE 1	H372
Aquatic Acute 1	H400
Aquatic Chronic 1	H410

2.2. Label elements

GHS-US labelling

Hazard pictograms (GHS-US) :

GHS06

GHS08

GHS09

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) :
H330 - Fatal if inhaled
H360 - May damage fertility or the unborn child
H372 - Causes damage to organs through prolonged or repeated exposure
H400 - Very toxic to aquatic life
H410 - Very toxic to aquatic life with long lasting effects

Precautionary statements (GHS-US) :
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood
P260 - Do not breathe vapors, gas
P264 - Wash skin, hands thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P271 - Use only outdoors or in a well-ventilated area
P273 - Avoid release to the environment
P280 - Wear eye protection, protective clothing, protective gloves, Face mask
P284 - [In case of inadequate ventilation] wear respiratory protection
P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing
P308+P313 - IF exposed or concerned: Get medical advice/attention
P310 - Immediately call a POISON CENTER/doctor/…
P314 - Get medical advice and attention if you feel unwell
P320 - Specific treatment is urgent (see First aid measures on this label)
P391 - Collect spillage
P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P405 - Store locked up
P501 - Dispose of contents/container to comply with applicable local, national and international regulation.

2.3. Other hazards

other hazards which do not result in classification : When inhaled, Mercury will be rapidly distributed throughout the body. During this time, Mercury will cross the blood-brain barrier, and become oxidized to the Hg (II) oxidation state. The oxidized species of Mercury cannot cross the blood-brain barrier and thus accumulates in the brain. Mercury in other organs is removed slowly from the body via the kidneys. The average half-time for clearance of Mercury for different parts of the human body is as follows: lung: 1.7 days; head: 21 days; kidney region: 64 days; chest: 43 days; whole body: 58 days. Mercury can be irritating to contaminated skin and eye. Prolonged contact may lead to ulceration of the skin. Allergic reactions (i.e. rashes, welts) may occur in sensitive individuals. Mercury can be irritating to contaminated skin and eyes. Short-term over-exposures to high concentrations of mercury vapors can lead to breathing difficulty, coughing, acute, and potentially fatal lung disorders. Depending on the concentration of inhalation over-exposure, heart problems, damage to the kidney, liver or nerves and effects on the brain may occur.

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substance

Not applicable

Full text of H-phrases: see section 16

3.2. Mixture

Name	Product identifier	%	GHS-US classification
Mercury	(CAS No) 7439-97-6	100	Acute Tox. 2 (Inhalation), H330 Repr. 1B, H360 STOT RE 1, H372 Aquatic Acute 1, H400 Aquatic Chronic 1, H410

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Never give anything by mouth to an unconscious person. If exposed or concerned: Get medical advice/attention.

First-aid measures after inhalation : Remove to fresh air and keep at rest in a position comfortable for breathing. Assure fresh air breathing. Allow the victim to rest. Immediately call a POISON CENTER or doctor/physician. In case of irregular breathing or respiratory arrest provide artificial respiration.

First-aid measures after skin contact : Wash immediately with lots of water (15 minutes)/shower. Remove affected clothing and wash all exposed skin area with mild soap and water, followed by warm water rinse. Seek immediate medical advice.

First-aid measures after eye contact : Rinse immediately and thoroughly, pulling the eyelids well away from the eye (15 minutes minimum). Keep eye wide open while rinsing. Seek medical attention immediately.

First-aid measures after ingestion : Immediately call a POISON CENTER or doctor/physician. Rinse mouth. If conscious, give large amounts of water and induce vomiting. Give water or milk if the person is fully conscious. Obtain emergency medical attention.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms/injuries after inhalation : Short-term over-exposures to high concentrations of mercury vapors can lead to breathing difficulty, coughing, acute, chemical pneumonia, and pulmonary edema (a potentially fatal accumulation of fluid in the lungs) . Depending on the concentration of over-exposure, cardiac abnormalities, damage to the kidney, liver or nerves and effects on the brain may occur. Long-term inhalation over-exposures can lead to the development of a wide variety of symptoms, including the following: excessive salivation, gingivitis, anorexia, chills, fever, cardiac abnormalities, anemia, digestive problems, abdominal pains, frequent urination, an inability to urinate, diarrhea, peripheral neuropathy (numbness, weakness, or burning sensations in the hands or feet), tremors (especially in the hands, fingers, eyelids, lips, cheeks, tongue, or legs), alteration of tendon reflexes, slurred speech, visual disturbances, and deafness. Allergic reactions (i.e. breathing difficulty) may also occur in sensitive individuals.

Symptoms/injuries after skin contact : Symptoms of skin exposure can include redness, dry skin, and pain. Prolonged contact may lead to ulceration of the skin. Allergic reactions (i.e. rashes, welts) may occur in sensitive individuals. Dermatitis (redness and inflammation of the skin) may occur after repeated skin exposures.

Symptoms/injuries after eye contact : Symptoms of eye exposure can include redness, pain, and watery eyes. A symptom of Mercury exposure is discoloration of the lens of the eyes.

Symptoms/injuries after ingestion : If Mercury is swallowed, symptoms of such over-exposure can include metallic taste in mouth, nausea, vomiting, central nervous system effects, and damage to the kidneys. Metallic mercury is not usually absorbed sufficiently from the gastrointestinal tract to induce an acute, toxic response. Damage to the tissues of the mouth, throat, esophagus, and other tissues of the digestive system may occur. Ingestion may be fatal, due to effects on gastrointestinal system and kidneys.

Chronic symptoms : Long-term over-exposure can lead to a wide range of adverse health effects. Anyone using Mercury must pay attention to personality changes, weight loss, skin or gum discolorations, stomach pains, and other signs of Mercury over-exposure. Gradually developing syndromes (“Erethism” and “Acrodynia”) are indicative of potentially severe health problems. Mercury can cause the development of allergic reactions (i.e. dermatitis, rashes, breathing difficulty) upon prolonged or repeated exposures. Refer to Section 11 (Toxicology Information) for additional data.

4.3. Indication of any immediate medical attention and special treatment needed

Treatment for Mercury over-exposure must be given. The following treatment protocol for ingestion of Mercury is from Clinical Toxicology of Commercial Products (5th Edition, 1984).

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Foam. Dry powder. Carbon dioxide. Water spray. Sand.

Unsuitable extinguishing media : Do not use a heavy water stream.

5.2. Special hazards arising from the substance or mixture

Fire hazard : Not flammable. Mercury vapors and oxides generated during fires involving this product are toxic.

Reactivity : Stable. Reacts with (some) metals. Mercury can react with metals to form amalgams.

5.3. Advice for firefighters

Firefighting instructions : Use water spray or fog for cooling exposed containers. Exercise caution when fighting any chemical fire. Prevent fire-fighting water from entering environment. Do not allow run-off from fire fighting to enter drains or water courses.

Protective equipment for firefighters : Do not enter fire area without proper protective equipment, including respiratory protection.

Other information : Decontaminate all equipment thoroughly after the conclusion of fire-fighting activities.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Uncontrolled release should be responded to by trained personnel using pre-planned procedures. Evacuate area. Evacuate personnel to a safe area.

6.1.1. For non-emergency personnel

Emergency procedures : Evacuate unnecessary personnel.

6.1.2. For emergency responders

Protective equipment : Equip cleanup crew with proper protection. In the event of a release under 1 pound: the minimum level “C” Personal Protective Equipment is needed. Triple-gloves (rubber gloves and nitril gloves over latex gloves), chemical resistant suit and boots, hard-hat, and Air-Purifying Respirator with Cartridge appropriate for Mercury.
In the event of a release over 1 pound or when concentration of oxygen in atmosphere is less than 19.5% or unknown, the level “B” Personal Protective Equipments which includes Self-Contained Breathing Apparatus must be worn.

Emergency procedures : Ventilate area.

6.2. Environmental precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters. Avoid release to the environment.

6.3. Methods and material for containment and cleaning up

For containment : For larger spills, dike area and pump into waste containers. Put into a labelled container and provide safe disposal.

Methods for cleaning up : There are a variety of methods which can be used to clean-up Mercury spills. Use a commercially available Mercury Spill Kit for small spills. A suction pump with aspirator can also be used during clean-up operations. For larger release, a Mercury vacuum can be used. Calcium polysulfide or excess sulfur can be also used for clean-up. Mercury can migrate into cracks and other difficult-to-clean areas; calcium polysulfide and sulfur can be sprinkled effectively into these areas. Decontaminate the area thoroughly. The area should be inspected visually and with colorimetric tubes for Mercury to ensure all traces have been removed prior to re-occupation by non-emergency personnel. Decontaminate all equipment used in response thoroughly. If such equipments cannot de adequately decontaminated, it must be discarded with other spill residue. Place all spill residues in an appropriate container, seal immediately, and label appropriately. Dispose of in accordance with federal, state, and local hazardous waste disposal requirements. (Refer to Section 13 of this SDS).

6.4. Reference to other sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed : Supervisors and responsible personnel must be aware of personality changes, weight loss, or other sign of Mercury over-exposure in employees using this product; These symptoms can develop gradually and are indicative of potentially severe health effects related to Mercury contamination.

Precautions for safe handling : As with all chemicals, avoid getting Mercury ON YOU or IN YOU. Do not handle until all safety precautions have been read and understood. Obtain special instructions before use. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Provide good ventilation in process area to prevent formation of vapor. Report all Mercury releases promptly. Open container slowly on a stable surface. Drums, flasks and bottles of this product must be properly labeled. Empty containers may contain residual amounts of Mercury and should be handled with care.

Hygiene measures : Do not eat, drink or smoke when using this product. Always wash hands and face immediately after handling this product, and once again before leaving the workplace. Remove contaminated clothing immediately.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures : Follow practice indicated in Section 6. Make certain that application equipment is locked and tagged-out safely. Always use this product in areas where adequate ventilation is provided. Decontaminate equipment thoroughly before maintenance begins.

Storage conditions : Keep container tightly closed. Store drums, flasks and bottles in a cool, dry location, away from direct sunlight, source of intense heat, or where freezing is possible. Store away from incompatible materials. Material should be stored in secondary container or in a diked area, as appropriate.

Incompatible materials : Acetylene and acetylene derivatives, amines, ammonia, 3-bromopropyne, boron diiodophosphide, methyl azide, sodium carbide, heated sulfuric acid, methylsilane/oxygen mixtures, nitric acid/alcohol mixtures, tetracarbonylnickel/oxygen mixtures, alkyne/silver perchlorate mixtures, halogens and strong oxidizers. Mercury can attack copper alloys. Mercury can react with many metals (i.e. calcium, lithium, potassium, sodium, rubidium, aluminum) to form amalgams.

Prohibitions on mixed storage : Mercury can attack copper alloys. Mercury can react with many metals (i.e. calcium, lithium, potassium, sodium, rubidium, aluminum) to form amalgams.

Storage area : Storage area should be made of fire-resistant materials.

Special rules on packaging : Inspect all incoming containers before storage to ensure containers are properly labeled and not damaged.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Mercury (7439-97-6)		
USA ACGIH	ACGIH TWA (mg/m³)	0,025 mg/m³
USA OSHA	OSHA PEL (Ceiling) (mg/m³)	0,1 mg/m³

8.2. Exposure controls

Appropriate engineering controls : Ensure adequate ventilation. Ensure exposure is below occupational exposure limits (where available). Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.

Personal protective equipment : Avoid all unnecessary exposure. Gloves. Protective clothing. Safety glasses. Mist formation: aerosol mask.

Hand protection : Wear neoprene gloves for routine industrial use. Use triple gloves for spill response, as stated in Section 6 of this SDS.

Eye protection : Splash goggles or safety glasses. For operation involving the use of more than 1 pound of Mercury, or if the operation may generate a spray of Mercury, the use of a faceshield is recommended.

Skin and body protection : Wear suitable protective clothing.

Respiratory protection : Maintain airborne contaminants concentration below provided exposure limits. If respiratory protection is needed, use only protection authorized in 29 CFR 1910.134 or applicable state regulations. Use supplied air respiration protection if oxygen levels are below 19.5% or are unknown.

Other information : Do not eat, drink or smoke during use.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Liquid

Colour : Silver white.

Odor	Odorless.
Odor threshold	Not applicable
pH	Not applicable
Relative evaporation rate (butylacetate=1)	No data available
Melting point	No data available
Freezing point	-38,87 °C (-37.97 F)
Boiling point	No data available
Flash point	Not applicable
Self ignition temperature	Not applicable
Decomposition temperature	No data available
Flammability (solid, gas)	No data available
Vapour pressure	0,002 mm Hg at 25°C
Relative vapor density at 20 °C	6,9 (Air = 1)
Relative density	No data available
Relative density of saturated gas/air mixture	13,6
Solubility	No data available
Log Pow	No data available
Log Kow	No data available
Viscosity, kinematic	No data available
Viscosity, dynamic	No data available
Explosive properties	No data available
Oxidizing properties	No data available
Explosive limits	Not applicable

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

Stable. Reacts with (some) metals. Mercury can react with metals to form amalgams.

10.2. Chemical stability

Not established.

10.3. Possibility of hazardous reactions

Not established. Hazardous polymerization will not occur.

10.4. Conditions to avoid

Direct sunlight. Extremely high or low temperatures.

10.5. Incompatible materials

Acetylene and acetylene derivatives, amines, ammonia, 3-bromopropyne, boron diiodophosphide, methyl azide, sodium carbide, heated sulfuric acid, methylsilane/oxygen mixtures, nitric acid/alcohol mixtures, tetracarbonylnickel/oxygen mixtures, alkyne/silver perchlorate mixtures, halogens and strong oxidizers. Mercury can attack copper alloys. Mercury can react with many metals (i.e. calcium, lithium, potassium, sodium, rubidium, aluminum) to form amalgams.

10.6. Hazardous decomposition products

If this product is exposed to extremely high temperature in the presence of oxygen or air, toxic vapor of mercury and mercury oxides will be generated.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	Fatal if inhaled.
Skin corrosion/irritation	Not classified pH: Not applicable
Serious eye damage/irritation	Not classified pH: Not applicable
Respiratory or skin sensitisation	Not classified
Germ cell mutagenicity	Not classified Based on available data, the classification criteria are not met
Carcinogenicity	Not classified

Mercury (7439-97-6)	
IARC group	3

Reproductive toxicity : May damage fertility or the unborn child.
Based on available data, the classification criteria are not met

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Causes damage to organs through prolonged or repeated exposure.
Based on available data, the classification criteria are not met
Causes damage to organs through prolonged or repeated exposure

Aspiration hazard : Not classified
Based on available data, the classification criteria are not met

Potential adverse human health effects and symptoms : Based on available data, the classification criteria are not met. Fatal if inhaled.

Symptoms/injuries after inhalation : Short-term over-exposures to high concentrations of mercury vapors can lead to breathing difficulty, coughing, acute,chemical pneumonia, and pulmonary edema (a potentially fatal accumulation of fluid in the lungs) . Depending on the concentration of over-exposure, cardiac abnormalities, damage to the kidney, liver or nerves and effects on the brain may occur. Long-term inhalation over-exposures can lead to the development of a wide variety of symptoms, including the following: excessive salivation, gingivitis, anorexia, chills, fever, cardiac abnormalities, anemia, digestive problems, abdominal pains, frequent urination, an inability to urinate, diarrhea, peripheral neuropathy (numbness, weakness, or burning sensations in the hands or feet), tremors (especially in the hands, fingers, eyelids, lips, cheeks, tongue, or legs), alteration of tendon reflexes, slurred speech, visual disturbances, and deafness. Allergic reactions (i.e. breathing difficulty) may also occur in sensitive individuals.

Symptoms/injuries after skin contact : Symptoms of skin exposure can include redness, dry skin, and pain. Prolonged contact may lead to ulceration of the skin. Allergic reactions (i.e. rashes, welts) may occur in sensitive individuals. Dermatitis (redness and inflammation of the skin) may occur after repeated skin exposures.

Symptoms/injuries after eye contact : Symptoms of eye exposure can include redness, pain, and watery eyes. A symptom of Mercury exposure is discoloration of the lens of the eyes.

Symptoms/injuries after ingestion : If Mercury is swallowed, symptoms of such over-exposure can include metallic taste in mouth, nausea, vomiting, central nervous system effects, and damage to the kidneys. Metallic mercury is not usually absorbed sufficiently from the gastrointestinal tract to induce an acute, toxic response. Damage to the tissues of the mouth, throat, esophagus, and other tissues of the digestive system may occur. Ingestion may be fatal, due to effects on gastrointestinal system and kidneys.

Chronic symptoms : Long-term over-exposure can lead to a wide range of adverse health effects. Anyone using Mercury must pay attention to personality changes, weight loss, skin or gum discolorations, stomach pains, and other signs of Mercury over-exposure. Gradually developing syndromes (“Erethism” and “Acrodynia”) are indicative of potentially severe health problems. Mercury can cause the development of allergic reactions (i.e. dermatitis, rashes, breathing difficulty) upon prolonged or repeated exposures. Refer to Section 11 (Toxicology Information) for additional data.

SECTION 12: Ecological information

12.1. Toxicity

Ecology - water : Very toxic to aquatic life. Toxic to aquatic life with long lasting effects.

Mercury (7439-97-6)	
LC50 fishes 1	0,5 mg/l (Exposure time: 96 h - Species: Cyprinus carpio)
EC50 Daphnia 1	5,0 µg/l (Exposure time: 96 h - Species: water flea)
LC50 fish 2	0,16 mg/l (Exposure time: 96 h - Species: Cyprinus carpio [semi-static])

12.2. Persistence and degradability

MERCURY (7439-97-6)	
Persistence and degradability	May cause long-term adverse effects in the environment.

12.3. Bioaccumulative potential

MERCURY (7439-97-6)	
Bioaccumulative potential	Not established.

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

Other information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose in a safe manner in accordance with local/national regulations. Waste disposal must be in accordance with appropriate federal, state, and local regulations. This product, if unaltered by use, should be recycled. If altered by use, recycling may be possible. Consult Bethlehem Apparatus Company for information. If Mercury must be disposed of as hazardous waste, it must be handled at a permitted facility or as advised by your local hazardous waste regulatory authority.

Ecology - waste materials : Hazardous waste due to toxicity. Avoid release to the environment.

SECTION 14: Transport information

In accordance with DOT

14.1. UN number

UN-No.(DOT) : 2809

DOT NA no. UN2809

14.2. UN proper shipping name

DOT Proper Shipping Name : Mercury

Department of Transportation (DOT) Hazard Classes : 8 - Class 8 - Corrosive material 49 CFR 173.136

Hazard labels (DOT) : 8 - Corrosive substances
6.1 - Toxic substances

DOT Symbols : A - Material is regulated as a hazardous material only when be transported by air, W - Material is regulated as a hazardous material only when be transported by water

Packing group (DOT) : III - Minor Danger

DOT Packaging Exceptions (49 CFR 173.xxx) : 164

DOT Packaging Non Bulk (49 CFR 173.xxx) : 164

DOT Packaging Bulk (49 CFR 173.xxx) : 240

14.3. Additional information

Other information : No supplementary information available.

Overland transport

No additional information available

Transport by sea

DOT Vessel Stowage Location : B - (i) The material may be stowed ‘‘on deck’’ or ‘‘under deck’’ on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length; and (ii) ‘‘On deck only’’ on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.

DOT Vessel Stowage Other : 40 - Stow ‘‘clear of living quarters’’,97 - Stow ‘‘away from’’ azides

Air transport

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : 35 kg

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : 35 kg

SECTION 15: Regulatory information

15.1. US Federal regulations

Mercury (7439-97-6)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on SARA Section 313 (Specific toxic chemical listings)	
EPA TSCA Regulatory Flag	S - S - indicates a substance that is identified in a proposed or final Significant New Uses Rule.
SARA Section 313 - Emission Reporting	1,0 %

15.2. International regulations

CANADA

Mercury (7439-97-6)	
Listed on the Canadian DSL (Domestic Sustances List) inventory.	
WHMIS Classification	Class D Division 1 Subdivision A - Very toxic material causing immediate and serious toxic effects Class D Division 2 Subdivision A - Very toxic material causing other toxic effects Class E - Corrosive Material

EU-Regulations

Mercury (7439-97-6)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances) substances.

Classification according to Regulation (EC) No. 1272/2008 [CLP]

Classification according to Directive 67/548/EEC or 1999/45/EC

Not classified

15.2.2. National regulations

Mercury (7439-97-6)
Listed on the AICS (the Australian Inventory of Chemical Substances) Listed on Inventory of Existing Chemical Substances (IECSC) Listed on the Korean ECL (Existing Chemical List) inventory. Listed on New Zealand - Inventory of Chemicals (NZIoC) Listed on Inventory of Chemicals and Chemical Substances (PICCS) Poisonous and Deleterious Substances Control Law Pollutant Release and Transfer Register Law (PRTR Law) Listed on the Canadian Ingredient Disclosure List

15.3. US State regulations

Mercury (7439-97-6)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significance risk level (NSRL)
	Yes			

SECTION 16: Other information

Other information : None.

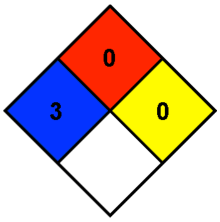
Full text of H-phrases: see section 16:

Acute Tox. 1 (Inhalation:dust,mist)	Acute toxicity (inhalation:dust,mist) Category 1
Acute Tox. 2 (Inhalation)	Acute toxicity (inhalation) Category 2
Aquatic Acute 1	Hazardous to the aquatic environment — AcuteHazard, Category 1
Aquatic Chronic 1	Hazardous to the aquatic environment — Chronic Hazard, Category 1
Repr. 1B	Reproductive toxicity Category 1B
STOT RE 1	Specific target organ toxicity (repeated exposure) Category 1
H330	Fatal if inhaled
H360	May damage fertility or the unborn child
H372	Causes damage to organs through prolonged or repeated exposure
H400	Very toxic to aquatic life
H410	Very toxic to aquatic life with long lasting effects

NFPA health hazard : 3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.

NFPA fire hazard : 0 - Materials that will not burn.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product

Safety Data Sheets (SDS)

SECTION 1-IDENTIFICATION

Product name: Toluene

Other names:-

Proper shipping name: Toluene

Recommended use of the chemical and restrictions on use:
The major use of toluene is as a mixture added to gasoline to improve octane ratings. Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners. Used in the manufacture of chemicals, dyes, explosives, benzoic acid. Some grades of toluene may contain traces of xylene and benzene.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.
WARNING: Intentional misuse by concentrating/inhaling contents may be lethal.

Manufacturer/Supplier Name: Taiwan SM Corp., Kaohsiung plant
Address: NO.7, Industrial 1st Rd, Lin-Yuan Kaohsiung County 83203, Taiwan, R.O.C.
Phone No.: 886-7-6414511

Emergency phone No./Fax No.: 886-7-6414511 Ext. 221 (on duty), 886-7-6414517 (off duty)/886-7-6423828

SECTION 2-HAZARDS IDENTIFICATION

GHS Classification:

Flammable Liquid Category 2
Acute Toxicity (Oral) Category 4
Skin Corrosion/ Irritation Category 2
Serious Eye Damage/ Eye Irritation Category 2
Specific Target Organ Toxicity Repeated Exposure Category 2
Hazardous To The Aquatic Environment (Acute) Category 3
Aspiration Hazard Category 1

GHS Label elements:

Hazard symbols

Signal word

Danger

Hazard statements

Highly flammable liquid and vapor
Harmful if inhaled
Causes skin irritation
Causes serious eye irritation
May cause damage to organs through prolonged or repeated exposure.
May cause long lasting harmful effects to aquatic life.
May be fatal if swallowed and enters airways.

Precautionary statements

Use only in well ventilated area.
Control of exposure by mechanical ventilation in an unventilated or confined space.
Avoid breathing vapors and contact with skin and eyes.
Wear breathing apparatus/protective gloves/face protection.
Store in well-ventilated place.
Disposal must be in accordance with applicable federal, state, or local regulations.

Other hazards: —

SECTION 3-COMPOSITION/INFORMATION ON INGREDIENTS

CAS No.	Chemical Name	wt% by weight	EINECS No.
00108-88-3	Toluene	97.0 min.	203-625-9
Synonyms	**Methylbenzol; Methylbenzene; Toluol; Phenylmethane**		

SECTION 4-FIRST AID MEASURES

Description of necessary first aid measures

Eye:
1. Flush immediately with warm water for at least 20 minutes.
2. Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
3. If pain persists or recurs seek medical attention.
4. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin:
1. Removing contaminated clothing, shoes, and leathery wearings, cleaning procedure is available before reused or waste treatment.
2. Washing affected area thoroughly with soap and water for at least 20 minutes.
3. Call a Physician if irritation develops or persists.

Ingestion:
1. If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomits.
2. If victim is conscious and alert, give 2～4 cupfuls of milk/water to dilute the substance in stomach.
3. Never give anything by mouth to an unconscious person.
4. Don’t induce vomiting unless directed to do so by medical person.
5. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
6. Then seek for medical attention.

Inhalation:
1. Remove from further exposure and flush thoroughly with air.
2. Lay patient down. Keep warm and rested.
3. Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
4. If respiratory irritation, seek immediate medical assistance and call a physician.

Most important symptoms/effects, acute and delayed

Headache, fatigue, drowsiness, insomnia, anorexia and pain in limbs, nervousness, impairment of memory.

Indication of immediate medical attention and special treatment needed, if necessary

For acute or short term repeated exposures to toluene:

Inhalation:
1. Inhalation overexposure can produce toxic effects. Monitor for respiratory distress.
2. If cough or difficulty in breathing develops, evaluate for upper respiratory tract inflammation, bronchitis, and pneumonitis. Administer supplemental oxygen with assisted ventilation, as required.
3. This material (or a component) sensitizes the heart to the effects of sympathomimetic amines. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in individuals exposed to this material.
4. Administration of sympathomimetic drugs should be avoided.

Ingestion:
1. If ingested, this material presents a significant aspiration and chemical pneumonitis hazard.
2. Induction of emesis is not recommended.
3. Consider activated charcoal and/or gastric lavage.
4. If patient is obtunded, protect the airway by cuffed endotracheal intubation or by placement of the body in a Trendelenburg and left lateral decubitus position.

SECTION 5-FIRE FIGHTING MEASURES

Extinguishing media

Foam、CO_2、Dry chemical、Water fog.

Specific hazards arising from the chemical
1. Liquid and vapor are highly flammable.
2. Severe fire hazard when exposed to heat, flame and/or oxidizers.
3. Vapor may travel a considerable distance to source of ignition.
4. Heating may cause expansion or decomposition leading to violent rupture of containers.
5. On combustion, may emit toxic fumes of carbon monoxide (CO).

Special protective equipment and precautions for fire-fighters

1. Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies.
2. Evacuate area and fight the fire from a maximum distance or use unmanned hose holders or monitor nozzles.
3. Cover pooling liquid with foam.
4. Containers can build pressure if exposed to radiant heat; cool adjacent containers with flooding quantities of water until well after the fire is out.
5. Withdraw immediately from the area if there is a rising sound from a venting safety device or discoloration of vessels, tanks, or pipelines.
6. Be aware that burning liquid will float on water.
7. Notify appropriate authorities of potential fire and explosion hazard if liquid enter sewers or waterways

SECTION 6-ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedure

1. Personal protective equipment (specified in Section 8)
   Eyes : Chemical safety goggles are recommended, and a face shield is added when needed.
   Skin : Wear appropriate protective gloves to avoid skin contact.
   Clothing: When direct contact is likely, use rubberized clothings, apron and boots.
   Respiratory : When limits are exceeded, wear a respirator approved by NIOSH/MSHA for protection against organic dust, mists and vapors.
2. Remove all sources of ignition. No smoking, naked lights or ignition sources. Ventilate area of leak or spill.
3. Keep unnecessary and unprotected personnel from entering. Evacuate personnel from the danger area. Consult with an expert about the emergency procedures.

Environmental precautions

1. Prevent spillage from entering drains, surface, and groundwater.
2. Contain and recover liquid when possible. Use non-sparking tools and equipment.
3. Collect liquid in an appropriate container or absorb with an inert material (e.g. vermiculite, dry sand, earth), and place in a chemical waste container.
4. Report the accidental spill/release to Local/State government.

Methods and materials for containment and cleaning up

Minor spill:

1. Remove all ignition sources.
2. Clean up all spills immediately.
3. Avoid breathing vapors and contact with skin and eyes.
4. Control personal contact by using protective equipment.
5. Contain and absorb small quantities with vermiculite or other absorbent material.
6. Wipe up.
7. Collect residues in a flammable waste container.

Major spill

1. Clear area of personnel and move upwind.
2. Alert emergency responders and tell them location and nature of hazard.
3. May be violently or explosively reactive.
4. Wear breathing apparatus plus protective gloves.
5. Prevent spillage from entering drains or water course.
6. No smoking, naked lights or ignition sources. Increase ventilation.
7. Stop leak if safe to do so.
8. Water spray or fog may be used to disperse/absorb vapor.
9. Contain spill with sand, earth or vermiculite.
10. Use only spark-free shovels and explosion proof equipment.
11. Collect recoverable product into labeled containers for recycling..
12. Absorb remaining product with sand, earth or vermiculite.
13. Collect solid residues and seal in labeled drums for disposal.
14. Wash area and prevent runoff into drains.
15. If contamination of drains or waterways occurs, advise emergency services.

SECTION 7-HANDLING AND STORAGE

Precautions for safe handling

1. Wash thoroughly after handling.
2. Use only in well ventilated area.
3. Ground and bond containers when transferring.
4. Use spark-free tools and explosion proof equipment.
5. Empty containers retain product residue (liquid/vapor), and can be dangerous.
6. Do not pressurize, cut, weld, braze, solder, drill, or expose empty containers to heat, sparks or open flames.

Conditions for safe storage, including any incompatibilities

1. Store in original containers in approved flame-proof area.
2. No smoking, naked lights, heat or ignition sources.
3. DO NOT store in pits, depressions, basements or areas where vapors may be trapped.
4. Keep containers securely sealed.
5. Store away from incompatible materials in a cool, dry well ventilated area.
6. Protect containers against physical damage and check regularly for leaks.
7. Keep containers tightly closed and store in a cool, dry, well-ventilated place, plainly labeled, and out of closed vehicles.
8. Ground all equipment containing this material.
9. Observe manufacturer's storing and handling recommendations.
10. Containers should be able to withstand pressures expected from warming and cooling in storage. This flammable liquid should be stored in a separate safety cabinet or room. A refrigerated room is preferable for materials with a flash point temperature lower than 70°F (21°C).

SECTION 8-EXPOSURE CONTROLS, PERSONAL PROTECTION

OSHA - Final PELs : 200 ppm TWA.
OSHA Ceiling : 300ppm.
ACGIH : 50 ppm, skin -potential forcutaneous absorption.
NIOSH : 100 ppm TWA; 375 mg/m^3 TWA; 500 ppm IDLH.
Taiwan TWA : 100 ppm (skin).
Taiwan STEL : 125 ppm (skin).
Taiwan Ceiling : -------.
Taiwan BEI : 1 mg/l (before on duty).

Engineering control

1. Process should be located at least 17 meter (50 feet) away from open flames and all high temperature operations likely to cause ignition of the styrene monomer vapor.
2. In venting styrene monomer vapors, consideration should be given to possible halogenation of the vapors by low concentrations of free chlorine and bromine with the resultant formation of lacrimations.
3. Process should be designed so that the operator is not exposed to direct contact with Toluene or the vapor. The technical problems of designing equipment, providing adequate ventilation and operating procedures which promise maximum security and economy, can best be handled by competent engineers.
4. It is essential for safety that equipment be used and maintained as recommended by the manufacturer.
5. Tanks used to store or process Toluene should be closed vessels vented to a safe point of discharge in the outside atmosphere away from operating stations, roadways, and at least 17 meter (50 feet) from possible sources of ignitions. All sparks, flames, heated surface, or other sources of ignition should be kept away from all vents. It is advisable, to provide suction on vessels when inspection or observation openings are made, to minimize or eliminate escape of vapors.

Personal protective equipment

Eye Protection:
Safety glasses equipped with side shields are recommended as minimum protection in industrial settings. Chemical goggles should be worn during transfer operations or when there is a likelihood of misting, splashing, or spraying of this material. A suitable emergency eye wash water and safety shower should be located near the work station.

Skin protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Clothing:
Avoid skin contact. Wear long-sleeved fire-retardant garments (e.g., Nomex®) while working with flammable and combustible liquids. Additional chemical-resistant protective gear may be required if splashing or spraying conditions exist. This may include an apron, boots and additional facial protection. If product comes in contact with clothing, immediately remove soaked clothing and shower. Promptly remove and discard contaminated leather goods.

Respirators:
For known vapor concentrations above the occupational exposure guidelines (see below), use a NIOSH-approved organic vapor respirator if adequate protection is provided. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134). For airborne vapor concentrations that exceed the recommended protection factors for organic vapor respirators, use a full-face, positive-pressure, supplied air respirator. Due to fire and explosion hazards, do not enter atmospheres containing concentrations greater than 10% of the lower flammable limit of this product.

SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Transparent liquid	Upper/lower explosive limits : 1.2%～7.1%
Odour : pleasant aromatic petroleum odour	Vapor Pressure : 22 mmHg @20℃/68℉
Odour threshold : 0.16～37 ppm (detect) 1.9～69 ppm (recognition)	Vapor Density : 3.1 (air=1)
PH : Not available	Relative density : 0.86 (water=1)
Melting/Freezing Point : －95 ℃	Solubility in water : 54～58 mg/100 ml
Initial boiling point/boiling range : 110.6 ℃	Partition coefficient : 2.73 (n-octanol/water)
Flash point : 4.4 ℃ (closed cup)	Auto-ignition temperature : 480℃
Evaporation Rate : 2.24 (BuAc=1)	Decomposition temperature : Not available
Flammability (solid/gas) : Not available	Viscosity : 0.6 mPa.s max @20℃
Molecular Formula : $C_6H_5CH_3$	Molecular Weight : 92.056

SECTION 10-STABILITY AND REACTIVITY

Reactivity
Vapor is explosive when exposed to heat or flame

Chemical stability
Stable at room temperature in closed containers under normal storage and handling conditions.

Possibility of hazardous reaction
Has not been reported.

Condition to avoid
Product is highly flammable – Keep away from sources of ignition. Avoid the higher temperatures. Keep away from open fire, heating elements and heat radiating surface and prevent from forming of the vapours mixtures with air in explosion limits.

Incompatible materials
Heat, flame, strong oxidizers, nitric and sulfuric acids, chlorine, nitrogen tetraoxide; will attack some forms of plastics, rubber, coatings.

Hazardous decomposition products
Carbon monoxide, carbon dioxide, hydrocarbons.

SECTION 11-TOXICOLOGICAL INFORMATION

Routes of exposure
Eye, Skin, inhalation, Ingestion.

Symptoms (treatments as indicated in Section 4)
Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated. There is evidence that material may produce eye irritation in some persons and produce eye damage 24 hours or more after instillation. Severe inflammation may be expected with pain. There may be damage to the cornea. Unless treatment is prompt and adequate there may be permanent loss of vision. Conjunctivitis can occur following repeated exposure.

Skin: Contact with the material may damage the health of the individual; systemic effects may result following absorption. The material may cause moderate inflammation of the skin either following direct contact or after a delay of some time. Repeated exposure can cause contact dermatitis which is characterized by redness, swelling and blistering. Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

Ingestion: Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual. Swallowing of the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis; serious consequences may result. (ICSC13733). Considered an unlikely route of entry in commercial/industrial environments. The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Inhalation: Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual. There is some evidence to suggest that the material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage. Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by sleepiness, reduced alertness, loss of reflexes, lack of co-ordination, and vertigo. Inhalation of high concentrations of gas/vapour causes lung irritation with coughing and nausea, central nervous depression with headache and dizziness, slowing of reflexes, fatigue and inco-ordination. If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death. The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Chronic exposure: There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment. Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.

Toxicity
LD50: <870 mg/kg (rat, oral)
LC50: 6000 ppm/6h (rat, inhalation)

Chronic effect
Carcinogenicity:
ACGIH : A4-Not classifiable as a Human Carcinogen.
OSHA : Possible select carcinogen.
IARC : Group 3 carcinogen.

Epide miology: Not available.

Teratogenicity: Teratogenic effects have occurred in experimental animals.

Reproductive Effects: Adverse reproductive effects have occurred in experimental animals.

Neurotoxicity: Not available.

Mutagenicity: Not available.

SECTION 12-ECOLOGICAL INFORMATION

Ecotoxicity
LC_{50} (96 hr.) Fish: 7.3～22.8 mg/l
EC_{50} (48 hr.) Water flea: －
Biocencentration factor (BCF): 1.67～380

Persistence and degradability

1. The material are expected to form a slick on the surface of waters after release in calm sea conditions. This is expected to evaporate and enter the atmosphere where it will be degraded through reaction with hydroxyl radicals.
2. Some of the material will become associated with benthic sediments, and it is likely to be spread over a fairly wide area of sea floor. Marine sediments may be either aerobic or anaerobic. The material, in probability, is biodegradable, under aerobic conditions. Evidence also suggests that the hydrocarbons may be degradable under anaerobic conditions although such degradation in benthic sediments may be a relatively slow process.
3. Under aerobic conditions the material will degrade to water and carbon dioxide, while under aerobic processes it will produce water, methane, carbon dioxide and carbon dioxide.
4. Based on test results, as well as theoretical considerations, the potential for bioaccumulation may be high. Toxic effects are often observed in species such as blue mussel, daphnia, freshwater green algae, marine copepods and amphipods.

Half-life (Air): 10～104 hr
Half-life (Surface water): 96～528 hr
Half-life (Ground water): 168～672 hr
Half-life (Soil): 96～528 hr

Bioaccumulative potential
This material is not expected to significantly bioaccumulate.

Mobility in soil: －

Other adverse effects: －

SECTION 13-DISPOSAL CONSIDERATIONS

Residues and spilled material are hazardous waste due to ignitability. Disposal must be in accordance with applicable federal, state, or local regulations.
The container for this product can present explosion or fire hazards, even when emptied. To avoid risk of injury, do not cut, puncture, or weld on or near this container. Since the emptied containers retain product residue, follow label warnings even after container is emptied.

SECTION 14-TRANSPORTATION INFORMATION

US DOT	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3		
	UN Number	1294		
	Packing Group	II		
Sea(IMO/IMDG)	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3.2		
	UN Number	1294		
	Packing Group	II		
	IMDG Code Page	3285		
	MARPOL	Not a DOT "Marine Pollutant" per 49 CFR 171.8.		
Air(ICAO/IATA)	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3.2		
	Subsidiary Class	1294		
	Packing Group	II		
RID/ ADR	No information available.			
Canadian TDG	Shipping Name	Toluene	Hazard Labels	
	Hazard Class	3		
	UN Number	1294		
	Packing Group	II		
	Subsidiary Class	9.2		

SECTION 15-REGULATORY INFORMATION

US FEDERAL

TSCA

CAS# 108-88-3 is listed on the TSCA inventory.

Health & Safety Reporting List

CAS# 108-88-3: Effective Date: 10/4/82; Sunset Date: 10/4/92

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

SARA

Section 302 (RQ)

CAS# 108-88-3 : final RQ = 1000 pounds (454 kg)

Section 302 (TPQ)

None of the chemicals in this material have a TPQ.

SARA Codes

CAS# 108-88-3 : acute, flammable.

Section 313

This material contains Toluene (CAS# 108-88-3, 99% & 100%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 372.

Clean Air Act

CAS# 108-88-3 is listed as a hazardous air pollutant (HAP).
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act

CAS# 108-88-3 is listed as a Hazardous Substance under the CWA.
CAS# 108-88-3 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 108-88-3 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

Toluene can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.

WARNING: This product contains Toluene, a chemical known to the state of California to cause birth defects or other reproductive harm.

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: XN F
Risk Phrases : R 10 Flammable.
R 20 Harmful by inhalation.
Safety Phrases : S 9 Keep container in a well-ventilated place.
S 16 Keep away from sources of ignition - No smoking.
S 25 Avoid contact with eyes.
S 29 Do not empty into drains.
S 33 Take precautionary measures against static discharges.

WGK (Water Danger/Protection)

CAS# 108-88-3: 2

United Kingdom Occupational Exposure Limits

CAS# 108-88-3: OES-United Kingdom, TWA 50 ppm TWA; 191 mg/m3 TWA.
CAS# 108-88-3: OES-United Kingdom, STEL 150 ppm STEL; 574 mg/m3 STEL.

CANADA

CAS#100-42-5 is listed on Canada’s DSL/NDSL list.
This product has a WHMIS classification of B2, D2A (99%)/B3, D2A (100%).
CAS# 105-05-5 is not listed on Canada’s Ingredient Disclosure List.

Exposure Limits

- CAS# 108-88-3: OEL-AUSTRALIA:TWA 100 ppm (375 mg/m3);STEL 150 ppm (560 mg/m3)
- OEL-BELGIUM:TWA 100 ppm (377 mg/m3);STEL 150 ppm (565 mg/m3)
- OEL-CZECHOSLOVAKIA:TWA 200 mg/m3;STEL 1000 mg/m3
- OEL-DENMARK:TWA 50 ppm (190 mg/m3);Skin
- OEL-FINLAND:TWA 100 ppm (375 mg/m3);STEL 150 ppm; Skin
- OEL-FRANCE:TWA 100 ppm (375 mg/m3);STEL 150 ppm (560 mg/m3)
- OEL-GERMANY:TWA 100 ppm (380 mg/m3)
- OEL-HUNGARY:TWA 100 mg/m3;STEL 300 mg/m3;Skin
- OEL-JAPAN:TWA 100 ppm (380 mg/m3)
- OEL-THE NETHERLANDS:TWA 100 ppm (375 mg/m3);Skin
- OEL-THE PHILIPPINES:TWA 100 ppm (375 mg/m3)
- OEL-POLAND:TWA 100 mg/m3
- OEL-RUSSIA:TWA 100 ppm; STEL 50 mg/m3
- OEL-SWEDEN:TWA 50 ppm (200 mg/m3);STEL 100 ppm (400 mg/m3);Skin
- OEL-SWITZERLAND:TWA 100 ppm (380 mg/m3);STEL 500 ppm
- OEL-THAILAND:TWA 200 ppm; STEL 300 ppm
- OEL-TURKEY:TWA 200 ppm (750 mg/m3)
- OEL-UNITED KINGDOM:TWA 100 ppm (375 mg/m3);STEL 150 ppm; Skin OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

SECTION 16-OTHER INFORMATION

References and sources

1. CHEMINFO Data Bank, CCINFO CD, 2005-3
2. HAZARD TEXT Data Bank, TOMES PLUS CD, Vol.65, 2005
3. RETECS Data Bank, TOMES CPS CD, Vol.65, 2005
4. HSDB Data Bank, TOMES CPS CD, Vol.65, 2005
5. Hazardous Substance Data Bank, Environment Protection, Administration, Executive Yuan, ROC (Taiwan)
6. Chemwatch Data Bank, 2005-1
7. SDS, GHS in Taiwan, Council of Labor Affairs, Executive Yuan, ROC (Taiwan)

Version	Date	Remark
Version 1	06/01/1998	Original Version.
Version 2	04/20/2001	Updated 10 sections to 16 sections.
Version 3	08/01/2003	Updated “SECTION 9-PHYSICAL AND CHEMICAL PROPERTIES”.
Version 4	01/01/2006	Updated “SECTION 14-TRANSPORTATION INFORMATION”.
Version 5	08/05/2008	Updated each section by GHS SDS.
Prepared by	Safety & Environment Protection Section, Taiwan SM Corporation Kaohsiung Plant.	

Appendix B

Community Air Monitoring Plan (CAMP)

Community Air Monitoring Program
18 Division Place, Brooklyn, NY
C224211

This site specific Community Air Monitoring Program (CAMP) was prepared in general conformance with the New York State Department of Health (NYSDOH) Generic CAMP and is intended to mitigate potential exposures to known volatile organic compounds at the Site. Exposure pathways will be generated from invasive investigative work proposed as part of the Remedial Investigation Work Plan (RIWP). DPC proposes to establish site specific action exceedance values prior to the start of work with NYSDOH, in accordance with "Special Requirements for Work within 20 feet of Potentially Exposed Individuals or Populations or Structures and Special Requirements for Indoor Work with Co Located Residences and Facilities".

Real-time air monitoring for volatile organic compounds (VOCs) and particulate levels at the perimeter of the exclusion zone or work area will be performed. Continuous monitoring will be performed for all ground intrusive activities and during the handling of contaminated or potentially contaminated media. Ground intrusive activities include, but are not limited to soil/groundwater sampling and handling.

A portable photoionization detector (PID) will be used to monitor the work zone and for periodic monitoring for VOCs during activities such as soil and groundwater sampling. Periodic monitoring for VOCs will be performed during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. Periodic monitoring during sample collection, for instance, will consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location. Depending upon the proximity of potentially exposed individuals, continuous monitoring may be performed during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, or adjacent to a residence. Exceedances of action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the DEC Project Manager and NYSDOH within 24 hours and included in the Daily Report.

VOC Monitoring, Response Levels, and Actions

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

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

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

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

All 15-minute readings must be recorded and be available for NYSDEC & NYCDOH personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

Particulate Monitoring, Response Levels, and Actions

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

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (ug/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust migration.

When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative pressure enclosures, or special ventilation devices should be considered to prevent exposure related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure(s). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.
If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 ug/m3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 ug/m3 or less at the monitoring point.

All readings will be recorded, included in progress reports, and made available for NYSDEC & NYSDOH personnel to review.

Major Emissions

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 odor 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 hot 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.

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

Mitigation & Suppression Techniques

Preventative measures for dust generation may include covering soils with tarps.

Work practices to minimize odors and vapors include limiting the time that the boreholes remain open, and minimizing the handling of contaminated material. Offending odor and organic vapor controls may include the application of foam suppressants, including Rusmar odor-control foam (RusFoam® OC AC645 or approved equivalent) or placing polyethylene sheeting or non-odorous soil over the odor or VOC source areas for short-term control of the odor and VOCs.

If odors develop and cannot otherwise be controlled, additional means to eliminate odor nuisances will include: use of chemical odorants in spray or misting systems; and, use of staff to monitor odors in surrounding neighborhoods.

Where odor nuisances have developed during remedial work and cannot be corrected using the discussed vapor suppression techniques, or where the release of nuisance odors cannot otherwise be avoided due to on-site conditions or close proximity to sensitive receptors, odor control may be achieved by sheltering handling areas under tented containment structures equipped with appropriate air venting/filtering systems. If vapors and odors are generated that cannot be controlled, the need for containment structures will be discussed with the NYSDEC and NYSDOH.

Monitoring of Nearby Structures

This section applies where structures within about 20 feet of the intrusive work may be occupied during the planned remedial action. Where this condition exists, the following will be considered for incorporation into the CAMP:

1. One of the CAMP monitoring stations will be placed between the remedial work area and nearest outside wall of the occupied structure. If site conditions warrant, a third station may be used to accomplish this task.
2. If 15-minute-average total VOC concentrations exceed 1 ppm above background near the outside wall or next to intake vents of the occupied structure, periodic VOC monitoring will be performed within the occupied structure.
3. If 15-minute-average total PM10 concentrations exceed 150 µg/m3 above background near the outside wall or next to intake vents of the occupied structure, work activities will be temporarily suspended until suppression techniques are implemented and

concentrations return to background.

4. Where nuisances have developed during remedial work and cannot be corrected using the techniques described above, use of additional engineering controls may be considered, such as vapor/dust barriers or ventilation devices.
5. Consideration should be given to scheduling or sequencing ground-intrusive activities during periods when potentially exposed populations may not be occupying the structure.

<u>Reporting</u>

A summary of CAMP findings, including triggered action levels, will be provided daily to the NYSDEC and NYSDOH project managers as part of daily reporting. In addition to a summary of CAMP findings, daily reports will include:

1. An update of progress made during the reporting day;
2. Locations of work and quantities of material imported and exported from the site;
3. Locations of CAMP monitoring stations, soil stockpiles, and decontamination stations;
4. References to map for site activities;
5. A summary of any and all complaints with relevant details (names, phone numbers);
6. An explanation of notable site conditions;
7. Actions anticipated for the next reporting day; and
8. Site photographs from the day’s remedial activities.

Daily reports are not intended to be the mode of communication for notification to the NYSDEC or the NYSDOH of emergencies (accident, spill), requests for changes to the CAMP or the IRMWP, or other sensitive or time critical information; however, such conditions will also be included in the daily reports. Emergency conditions and changes to the CAMP or the IRMWP will be addressed directly to the NYSDEC and NYSDOH project managers via personal communication. If site conditions warrant, the remedial engineer may request to change from daily to weekly reports that include the above information.

Appendix C

Quality Assurance Project Plan (QAPP)

QUALITY ASSURANCE PROJECT PLAN
for the Remedial Investigation Workplan
18 Division Place
Brooklyn, New York
BCA #C224211-11-21

Prepared For:

18 Division Place Corp.

18 Division Place

Brooklyn, New York

**EQUITY ENVIRONMENTAL
ENGINEERING, LLC**

**500
International Drive,
Suite 150 Mount
Olive, New Jersey
07828 (973) 527-7451**

November 2022

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SECTION 1

PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP) specifies analytical methods to be used to ensure that data from the proposed remedial action is precise, accurate, representative, comparable, and complete.

1.1 INTRODUCTION

This QAPP has been prepared by Equity Environmental Engineering, LLC (Equity) for 18 Division Place, to investigate soil, soil vapor, and groundwater at the Site, located at 18 Division Place, Brooklyn, New York (BCA #224211-11-21). The RIWP (Remedial Investigation Workplan) and QAPP have been completed in accordance with the Division of Environmental Remediation (DER)-10 and The New York State Department of Health (DOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York.

1.2 PROJECT OBJECTIVES

The objectives of this project are as follows:

1. Installation of additional soil borings, groundwater monitoring wells, and soil-vapor sampling points.
2. Collection of soil, groundwater, soil-vapor, and indoor air samples to assist with the delineation of contamination associated with past onsite operations.

1.3 SCOPE OF WORK

The scope of work at the Subject Property is described in detail in the Remedial Investigation Work Plan (RIWP). Briefly, the scope of work includes the installation of soil borings, monitoring well(s), and the collection of soil, groundwater, to delineate and assess onsite contamination in accordance with the DER-10 requirements.

1.4 DATA QUALITY OBJECTIVES AND PROCESSES

The quality assurance and quality control (QA/QC) objectives for all measurement data include:

- ***Precision*** - an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Field sampling precision will be determined by analyzing coded duplicate samples and analytical precision will be determined by analyzing internal QC duplicates and matrix spike duplicates.

- ***Accuracy*** - a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern. Sampling accuracy will be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy will be assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks.

- ***Representativeness*** - expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness will be determined by assessing a number of investigation procedures, including chain of custody, decontamination, and analysis of field blanks and trip blanks.

- ***Completeness*** - the percentage of measurements made which are judged to be valid. Completeness will be assessed through data validation. The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested.

- ***Comparability*** - expresses the degree of confidence with which one data set can be compared to another. The comparability of all data collected for this project will be ensured using several procedures, including standard methods for sampling and analysis, instrument calibrations, using standard reporting units and reporting formats.

Each of the above objectives is discussed in detail in Section 3.

SECTION 2

PROJECT ORGANIZATION

This Remedial Investigation will be completed for 18 Division Place. Equity will coordinate the field activities and provide an onsite field representative to perform the site Health & Safety, soil, and groundwater sampling. Equity will perform the data analysis and all reporting tasks. The analytical services will be performed by Alpha Analytical Laboratories (NY Certification No. 11148).

Key contacts for this project are as follows:

18 Division Place Corp. Owner	Mr. Bogdan Malinowski Telephone: 917-416-1171 E-mail: bo@maprojectsinc.com
CPE Environmental Engineering Project Manager:	Mr. Craig Puerta. Telephone: (917 952 8216
Alpha Analytical Laboratories: Address: 8 Walkup Drive Westborough, MA 01581	Mr. Paul Simms Telephone: (800) 624-9220 E-mail: psimms@alphalab.com

SECTION 3

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) OBJECTIVES FOR MEASUREMENT OF DATA

3.1 INTRODUCTION

The QA/QC objectives for all measurement data include precision, accuracy, representativeness, completeness, and comparability. These objectives are defined in following subsections. They are formulated to meet the requirements of the USEPA SW-846. The analytical methods are provided in Section 7.

3.2 PRECISION

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), relative range, and relative percent difference (RPD) are common.

For this project, field sampling precision will be determined by analyzing coded duplicate samples (labeled so that the laboratory does not recognize them as duplicates) for the same parameters, and then, during data validation (Section 8), calculating the RPD for duplicate sample results.

Analytical precision will be determined by the laboratory by calculating the RPD for the results of the analysis of internal QC duplicates and matrix spike duplicates. The formula for calculating RPD is as follows:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where:

RPD = Relative Percent Difference.

V1, V2 = The two values to be compared.

|V1 - V2| = The absolute value of the difference between the two values.

(V1 + V2)/2 = The average of the two values.

The data quality objectives for analytical precision, calculated as the RPD between duplicate analyses, are presented in Appendix A.

3.3 ACCURACY

Accuracy is a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern (Taylor, 1987), or the difference between a measured value and the true or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material, and is expressed as the percent of the known quantity which is recovered or measured. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes which are close to the detection limits are less accurate because they are more affected by such factors as instrument "noise". Higher concentrations will not be as affected by instrument noise or other variables and thus will be more accurate.

Sampling accuracy may be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy is typically assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks. Additionally, initial and continuing calibrations must be performed and accomplished within the established method control limits to define the instrument accuracy before analytical accuracy can be determined for any sample set.

Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a spike, added to a sample (matrix spike) or to a blank (blank spike). The %R is calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

%R = Percent recovery.

SSR = Spike sample result: concentration of analyte obtained by analyzing the sample with the spike added.

SR = Sample result: the background value, i.e., the concentration of the analyte obtained by analyzing the sample.

SA = Spiked analyte: concentration of the analyte spike added to the sample.

The acceptance limits for accuracy for each parameter are presented in Appendix A.

3.4 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program (USEPA, 1987). Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, and analysis. Decontamination of sampling devices and digging equipment will be performed between samples as outlined in the Health and Safety Plan, and according to the DER-10 and NYSDOH guidance. Analysis of field blanks, trip blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated during data validation through the analysis of coded field duplicate samples. The analytical laboratory will also follow acceptable procedures to assure the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received.

Chain-of-custody procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. Details of blank, duplicate and Chain-of-custody procedures are presented in Sections 4 and 5.

3.5 COMPLETENESS

Completeness is defined as the percentage of measurements made which are judged to be valid (USEPA, 1987). The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested. Completeness is defined as follows for all sample measurements:

$$\%C = \frac{V}{T} \times 100$$

where:

%C = Percent completeness.

V = Number of measurements judged valid.

T = Total number of measurements.

3.6 COMPARABILITY

Comparability expresses the degree of confidence with which one data set can be compared to another (USEPA, 1987). The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both sampling and analysis phases of this project;
- Requiring traceability of all analytical standards and/or source materials to the U.S. Environmental Protection Agency (USEPA) or National Institute of Standards and Technology (NIST);
- Requiring that all calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable);
- Using standard reporting units and reporting formats including the reporting of QC data;
- Performing a complete data validation on a representative fraction of the analytical results, including the use of data qualifiers in all cases where appropriate; and
- Requiring that all validation qualifiers be used any time an analytical result is used for any purpose.

These steps will ensure all future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

SECTION 4

SAMPLING PROGRAM

4.1 INTRODUCTION

The sampling program will provide data concerning the presence and the nature and extent of soil, groundwater, soil-gas, and indoor air contamination. This section presents sample container preparation procedures, sample preservation procedures, sample holding times, and field QC sample requirements. Sample locations, and the number of environmental and QC samples to be taken are given in Table 4.1. The sampling procedures are presented in the Remedial Investigation Workplan.

4.2 SAMPLE CONTAINER PREPARATION AND SAMPLE PRESERVATION

Sample containers will be properly washed and decontaminated prior to their use by either the analytical laboratory or the container vendor to the specifications required by the DEC. Copies of the sample container QC analyses will be provided by the laboratory for each container lot used to obtain samples. The containers will be tagged and the appropriate preservatives will be added. The types of containers are listed in Tables 4.2 and 4.3.

Samples shall be preserved according to the preservation techniques given in tables in Appendix A. Preservatives will be added to the sample bottles by the laboratory prior to their shipment in sufficient quantities to ensure that proper sample pH is met. Following sample collection, the sample bottles should be placed on ice in the shipping cooler, cooled to 4^oC with ice, and delivered to the laboratory within 24 hours of collection. Chain-of-custody procedures are described in Section 7.

Soil-gas and indoor air samples will be shipped to the laboratory at ambient temperatures with no preservative.

4.3 SAMPLE HOLDING TIMES

The sample holding times for organic and inorganic parameters are given in tables in Appendix A and must be in accordance with the DEC requirements. The DEC holding times must be strictly adhered to by the laboratory. Any holding time exceedances must be reported to Project Manager.

4.4 FIELD QC SAMPLES

To assess field sampling and decontamination performance, two types of "blanks" will be collected and submitted to the laboratory for analyses. In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates. Matrix spike/matrix spike duplicates (MS/MSDs) will be completed by Accutest Laboratories and in accordance with Accutest's Quality System precision, accuracy, and completeness objectives. The blanks will include:

a. Trip Blanks - A Trip Blank will be prepared before the sample containers are sent by the laboratory. The trip blank will consist of a 40-ml VOA vial containing distilled, deionized water, which accompanies the other water sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of water samples VOC analysis. The Trip Blank will be analyzed for VOCs to assess any contamination from sampling and transport, and internal laboratory procedures.

b. Field Blanks - Field Blanks will be taken at a minimum frequency of one per 20 field samples per sample matrix, or one per day. Field blanks are used to determine the effectiveness of the decontamination procedures for sampling equipment. It is a sample of deionized, distilled water provided by the laboratory that has passed through a decontaminated bailer or other sampling apparatus. It is usually collected as a last step in the decontamination procedure, prior to taking an environmental sample. The field blank may be analyzed for all or some of the parameters of interest.

The duplicates will consist of:

a. Coded Field Duplicate - To determine the representativeness of the sampling methods, coded field duplicates will be collected. The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are a duplicate sample. This will eliminate any possible bias that could arise.

b. Matrix Spike/Matrix Spike Duplicate (MS/MSD) - MS/MSD samples (MS/MSD for organics; MS and laboratory duplicate for inorganics) will be completed by the analytical laboratory and/or taken at a frequency of one pair per 20 field samples and/or in accordance with Accutest's Quality System objectives.. These samples are used to assess the effect of the sample matrix on the recovery of target compounds or target analytes. The percent recoveries and RPDs are given in Tables 3.1 through 3.4.

TABLE 4.1
SUMMARY OF SAMPLES AND ANALYSES

Analysis	Bottle Type	Preservation (a)	Holding Time (b)
TCL VOCs	3-40mL glass vial w/Teflon septum	HCL, pH<2, 4° C	14 days
TCL SVOCs	2-250mL {for LVI} Amber Glass w/Teflon	Unpreserved, 4° C	7 Days
Pesticides	2-120mL Amber Glass w/Teflon	Unpreserved, 4° C	7 Days
PCBs	2-120mL Amber Glass w/Teflon	Unpreserved, 4° C	365 Days
TAL Metals	1-5oo mL Plastic	HNO_3, Cool to 4^0C	28 Days Mercury/180 Days
PFAS	1 - 2 Plastic/1 Plastic/1 H20 Plastic	4° C	14 days

(a) Matrix spike / matrix spike duplicate for organic analyses; matrix spike and laboratory duplicate for inorganic analysis; to be completed by Accutest Laboratories.

(b) The total number of soil samples will be determined in the field based on the scheduling and duration of the events.

(c) The total number of groundwater samples will be determined in the field (if necessary).

TABLE 4.2
WATER SAMPLE CONTAINERIZATION, PRESERVATION, AND HOLDING TIMES

Analysis	Bottle Type	Preservation (a)	Holding Time (b)
TCL VOCs	Encore Sampler	Cool to 4^0C	48 hrs
TCL SVOCs	8oz Container	Cool to 4^0C	14 days
Pesticides	8oz Container	Cool to 4^0C	14 days
PCBs	8oz Container	Cool to 4^0C	14 days
TAL Metals	60 ml glass	Cool to 4^0C	28 Days Mercury/180 Days
PFAS	8oz Container	Cool to 4^0C	14 Days

(a) All samples to be preserved in ice during collection and transport.

(b) Days from time of sample receipt at the laboratory. Maximum field holding time for all samples is 48-hours.

TABLE 4.3

SOIL SAMPLE
CONTAINERIZATION AND HOLDING TIMES

Analysis	**Bottle Type**	**Preservation (a)**	**Holding Time (b)**
TCL VOCs	Encore Sampler	Cool to 4^0C	48 hrs
TCL SVOCs			
Pesticides			
PCBs			
TAL Metals	60 ml glass w/PETE line lid	Cool to 4^0C	14 days
PFAS			

(a)All samples to be preserved in ice during collection and transport.

(b)Days from time of sample receipt at the laboratory. Maximum field holding time for all samples is 48-hours.

SECTION 5

SAMPLE TRACKING AND CUSTODY

5.1 INTRODUCTION

This section presents sample custody procedures for both the field and laboratory. Implementation of proper custody procedures for samples generated in the field is the responsibility of field personnel. Both laboratory and field personnel involved in the Chain-of-custody (COC) and transfer of samples will be trained as to the purpose and procedures prior to implementation.

Evidence of sample traceability and integrity is provided by COC procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, to sample shipment, to laboratory receipt and analysis. The sample custody flowchart is shown in Figure 5.1. A sample is considered to be in a person's custody if the sample is:

- In a person's possession;
- Maintained in view after possession is accepted and documented;
- Locked and tagged with Custody Seals so that no one can tamper with it after having been in physical custody; or
- In a secured area which is restricted to authorized personnel.

5.2 FIELD SAMPLE CUSTODY

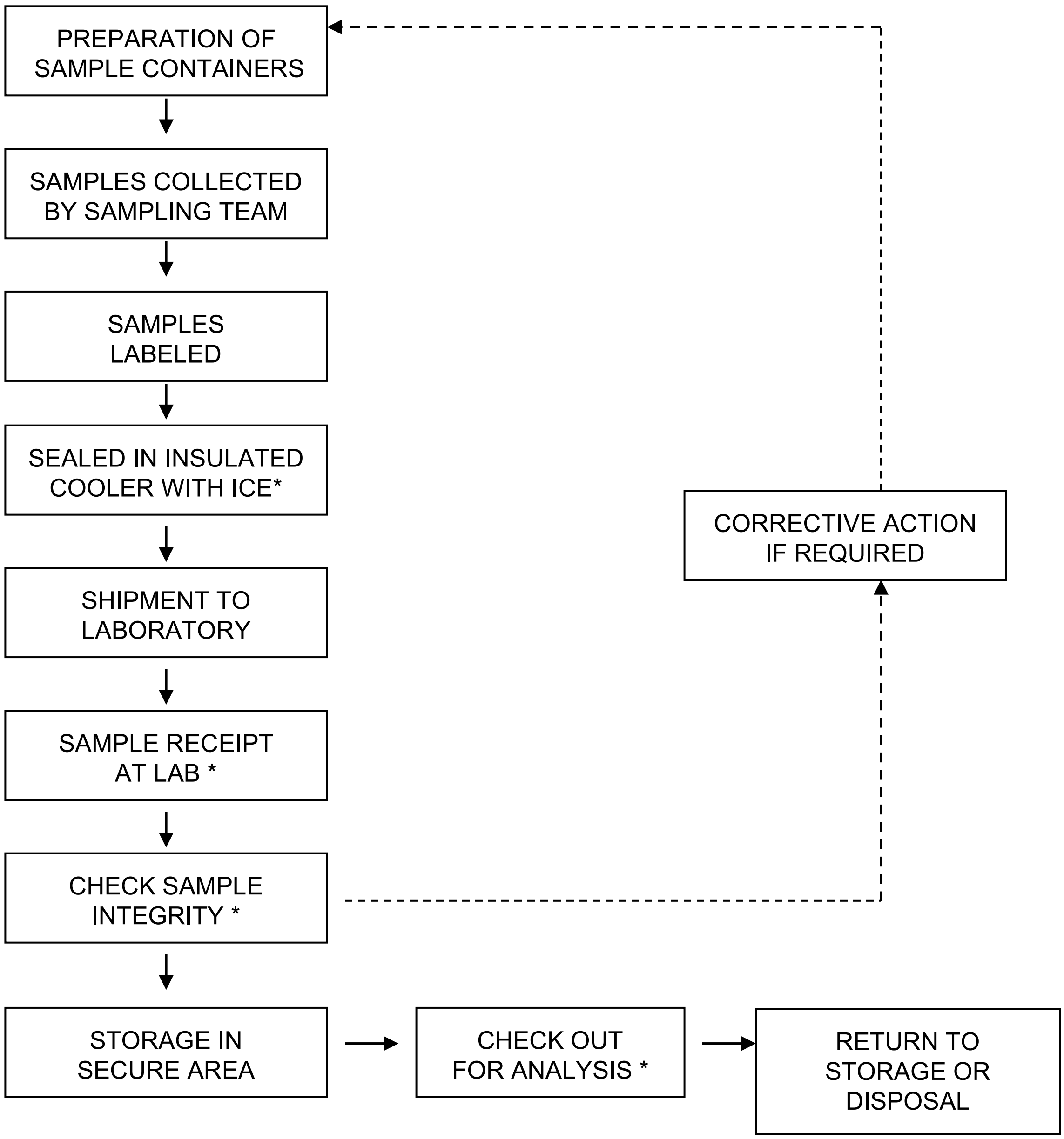
A COC record (Figure 5.2 or equivalent) accompanies the sample containers from selection and preparation at the laboratory, during shipment to the field for sample containment and preservation, and during return to the laboratory. Triplicate copies of the COC must be completed for each sample set collected.

The COC lists the field personnel responsible for taking samples, the project name and number, the name of the analytical laboratory to which the samples are sent, and the method of sample shipment. The COC also lists a unique description of every sample bottle in the set. If samples are split and sent to different laboratories, a copy of the COC record will be sent with each sample.

The REMARKS space on the COC is used to indicate if the sample is a matrix spike, matrix spike duplicate, or any other sample information for the laboratory. Since they are not specific to any one sample point, trip and field blanks are indicated on separate rows. Once all bottles are properly accounted for on the form, a sampler will write his or her signature and the date and time on the first RELINQUISHED BY space. Mistakes will be crossed out with a single line in ink and initialed by the author.

FIGURE 5.1

SAMPLE CUSTODY



* REQUIRES SIGN-OFF ON CHAIN-OF-CUSTODY FORM

NEW YORK CHAIN OF CUSTODY

Westborough, MA 01581
8 Walkup Dr.
TEL: 508-898-9220
FAX: 508-898-9193

Mansfield, MA 02048
320 Forbes Blvd
TEL: 508-822-9300
FAX: 508-822-3288

Service Centers
Mahwah, NJ 07430: 35 Whitney Rd, Suite 5
Albany, NY 12205: 14 Walker Way
Tonawanda, NY 14150: 275 Cooper Ave, Suite 105

Page
of

Date Rec'd in Lab

ALPHA Job #

Client Information

Client:
Address:
Phone:
Fax:
Email:

Project Information

Project Name:
Project Location:
Project #
(Use Project name as Project #) ☐
Project Manager:
ALPHAQuote #:

Turn-Around Time

Standard ☐ Due Date:
Rush (only if pre approved) ☐ # of Days:

Deliverables

☐ ASP-A ☐ ASP-B
☐ EQuIS (1 File) ☐ EQuIS (4 File)
☐ Other

Regulatory Requirement

☐ NY TOGS ☐ NY Part 375
☐ AWQ Standards ☐ NY CP-51
☐ NY Restricted Use ☐ Other
☐ NY Unrestricted Use
☐ NYC Sewer Discharge

Billing Information

☐ Same as Client Info
PO #

Disposal Site Information

Please identify below location of applicable disposal facilities.

Disposal Facility:
☐ NJ ☐ NY
☐ Other:

These samples have been previously analyzed by Alpha ☐

Other project specific requirements/comments:

Please specify Metals or TAL.

ANALYSIS

Sample Filtration
☐ **Done**
☐ **Lab to do**
Preservation
☐ **Lab to do**

(Please Specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials									Sample Specific Comments	Total Bottle

Preservative Code:
A = None
B = HCl
C = HNO_3
D = H_2SO_4
E = NaOH
F = MeOH
G = $NaHSO_4$
H = $Na_2S_2O_3$
K/E = Zn Ac/NaOH
O = Other

Container Code
P = Plastic
A = Amber Glass
V = Vial
G = Glass
B = Bacteria Cup
C = Cube
O = Other
E = Encore
D = BOD Bottle

Westboro: Certification No: MA935
Mansfield: Certification No: MA015

Container Type								
Preservative								

Relinquished By:	Date/Time	Received By:	Date/Time

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. BY EXECUTING THIS COC, THE CLIENT HAS READ AND AGREES TO BE BOUND BY ALPHA'S TERMS & CONDITIONS. (See reverse side.)

Form No: 01-25 HC (rev. 30-Sept-2013)

One copy of the COC is retained by sampling personnel (notations identifying blind duplicate samples will be added to this copy of the COC but not the others that will go to the laboratory) and the other two copies are put into a sealable plastic bag and taped inside the lid of the shipping cooler. The cooler lid is closed, custody seals provided by the laboratory are affixed to the latch and across the back and front lids of the cooler, and the person relinquishing the samples signs their name across the seal. The seal is taped, and the cooler is wrapped tightly with clear packing tape. It is then relinquished by field personnel to personnel responsible for shipment, typically an overnight carrier. The COC seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the sample will only be analyzed pending further investigation.

5.3 LABORATORY SAMPLE CUSTODY

The Project Manager or Field Team Leader will notify the laboratory of upcoming field sampling activities, and the subsequent shipment of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The following laboratory sample custody procedures will be used:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples, and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check cooler temperature, and check the original COC documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the COC record and record the date and time received.
- Care will be exercised to annotate any labeling or descriptive errors. In the event of discrepant documentation, the laboratory will immediately contact the Project Manager or Field Team Leader as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.
- The samples will be stored in a secured area at a temperature of approximately 4 degrees Celsius until analyses commence.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.
- A copy of the tracking record will accompany the laboratory report and will become a permanent part of the project records.

SECTION 6

CALIBRATION PROCEDURES

6.1 FIELD INSTRUMENTS

All field analytical equipment will be calibrated immediately prior to each day's use. The calibration procedures will conform to manufacturer's standard instructions and are described in the Field Sampling Plan. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Records of all instrument calibration will be maintained by the Field Team Leader. Copies of all the instrument manuals will be maintained on-site by the Field Team Leader.

Calibration procedures for instruments used for monitoring health and safety hazards (e.g., photoionization detector; dataRam dust monitors) are provided in the Health and Safety Plan.

6.2 LABORATORY INSTRUMENTS

The laboratory will follow all calibration procedures and schedules as specified in the sections of the USEPA SW-846 and subsequent updates that apply to the instruments used for the analytical methods given in Section 7.

SECTION 7

ANALYTICAL PROCEDURES

Samples will be analyzed according to the USEPA SW-846 "Test Methods for Evaluating Solid Waste," February 2007, revision 6 and subsequent updates. The methods to be used for the laboratory analysis of soil, groundwater, and soil-gas/indoor air samples are referenced in Section 3 and Appendix A.

SECTION 8

DATA REDUCTION, VALIDATION, AND REPORTING

8.1 INTRODUCTION

Data collected during the field investigation will be reduced and reviewed by the laboratory QA personnel, and a report on the findings will be tabulated in a standard format. The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the USEPA SW-846 and subsequent updates. The data package provided by the laboratory will contain all items specified in USEPA SW-846 appropriate for the analyses to be performed, and be reported in standard format.

The completed copies of the Chain-of-custody records accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the analytical reports.

8.2 DATA REDUCTION

One copy of the analytical data packages and an electronic data deliverable (EDD) will be provided by the laboratory approximately 30 days after receipt of a complete sample delivery group. The Project Manager will immediately arrange for filing one package; a second copy, and the CD-ROM, may be used to generate summary tables. These tables will form the database for assessment of the site contamination condition (if present).

The electronic deliverable format required is a tab delimited text file with the fields and character lengths summarized in Table 8.1. Tab delimited EDDs will be processed regardless of the sampling date.

The Project Manager or Task Manager will maintain close contact with the laboratory QA reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA review has been completed, the Project Manager may direct the Team Leaders or others to initiate and finalize the analytical data assessment.

Table 8.1

Field and Character Lengths for Electronic Disk Deliverable

Description	Length	Format
Site ID	12	Character
Site Name	40	Character
Initial Date Sampled	8	Date
Received at Lab Date	8	Date
Analysis Complete Date	8	Date
Laboratory	30	Character
Number of Samples	3	Integer
Contract	6	Character
Report Format	10	Character
Field ID (for each sample)	15	Numeric
Laboratory ID (for each sample)	15	Character
Date Sampled (for each sample)	8	Date
Matrix (for each sample)	10	Character

8.3 DATA VALIDATION

Laboratory data validation may be performed in accordance with the USEPA Region II validation guidelines for organic and inorganic data review. These validation guidelines are regional modifications to the National Functional Guidelines for organic and inorganic data review (USEPA 1994). Validation will include the following:

- Verification of 100% of all QC sample results (both qualitative and quantitative),
- Verification of the identification of 100% of all sample results (both positive hits and non-detects),
- Recalculation of 10% of all investigative sample results, and
- Data Usability Summary Report (DUSR).

The determination to validate data will be made based on the presence of data anomalies, suspect data, or laboratory issues. A data validation report will be prepared and reviewed by the laboratory quality assurance officer (QAO) before issuance. The data validation report will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and COC procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method. A detailed assessment of each SDG will follow. For each of the organic analytical methods, the following will be assessed:

- Holding times;
- Instrument tuning;
- Instrument calibrations;
- Blank results;
- System monitoring compounds or surrogate recovery compounds (as applicable);
- Internal standard recovery results;
- MS and MSD results;
- Target compound identification;
- Chromatogram quality;
- Compound quantization and reported detection limits;
- System performance; and
- Results verification.

For each of the inorganic compounds, the following will be assessed:

- Holding times;
- Calibrations;

- Blank results;
- Interference check sample;
- Laboratory check samples;
- Duplicates;
- Matrix Spike;
- Furnace atomic absorption analysis QC;
- ICP serial dilutions; and
- Results verification and reported detection limits.

Based on the results of the third party data validation, the validated analytical results reported by the laboratory will be assigned one of the following usability flags:

- "U" - Not detected at given value;
- "UJ" - Estimated not detected at given value;
- "J" - Estimated value;
- “N” – Presumptive evidence at the value given;
- "R" - Result not useable; and
- No Flag - Result accepted without qualification.

SECTION 9

INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

9.1 QUALITY ASSURANCE BATCHING

Each set of samples will be analyzed concurrently with calibration standards, method blanks, matrix spikes (MS), matrix spike duplicates (MSD) or laboratory duplicates, and QC check samples (if required by the protocol). MS/MSD samples will be designated by the laboratory and are not proposed to be collected in the field as part of this RIWP.

9.2 CALIBRATION STANDARDS AND SURROGATES

All organic standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. All standards are traceable to a source of known quality certified by the USEPA or NIST, or other similar program. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard solutions are replaced monthly or more frequently, based upon data indicating deterioration.

9.3 ORGANIC BLANKS AND MATRIX SPIKE

Analysis of blank samples verifies that the analytical method does not introduce contaminants or detect "false positives". The blank water can be generated by reverse osmosis and Super-Q filtration systems, or distillation of water containing $KMnO_4$. The matrix spike is generated by addition of surrogate standard to each sample.

9.4 TRIP AND FIELD BLANKS

Trip blanks and field blanks will be utilized in accordance with the specifications in Section 4. These blanks will be analyzed to provide a check on sample bottle preparation and to evaluate the possibility of atmospheric or cross contamination of the samples.

SECTION 10

QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS

10.1 INTRODUCTION

Quality assurance audits may be performed by the project quality assurance group under the direction and approval of the project Quality Assurance Officer (QAO). These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). Functioning as an independent body and reporting directly to corporate quality assurance management, the QAO may plan, schedule, and approve system and performance audits based upon procedures customized to the project requirements. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

10.2 SYSTEM AUDITS

System audits may be performed by the QAO or designated auditors, and encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may occur.

10.3 PERFORMANCE AUDITS

The laboratory may be required to conduct an analysis of Performance Evaluation (PE) samples or provide proof that Performance Evaluation samples submitted by USEPA or a state agency have been analyzed within the past twelve months.

10.4 FORMAL AUDITS

Formal audits refer to any system or performance audit that is documented and implemented by the QA group. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by auditors who have performed the site audit after gathering and evaluating all data. Items, activities, and documents determined by lead auditors to be in noncompliance shall be identified at exit interviews conducted with the involved management. Non-compliance occasions will be logged, and documented through audit findings which are attached to and are a part of the integral audit report. These audit finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within fifteen days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists, audit reports, audit findings, and acceptable resolutions are approved by the QAO prior to issue. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QAO will close out the audit report and findings.

SECTION 11

PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

11.1 PREVENTIVE MAINTENANCE PROCEDURES

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators.

A list of critical spare parts will be established by the operator. These spare parts will be available for use in order to reduce the downtime. A service contract for rapid instrument repair or backup instruments may be substituted for the spare part inventory.

11.2 SCHEDULES

Written procedures will establish the schedule for servicing critical items in order to minimize the downtime of the measurement system. The laboratory will adhere to the maintenance schedule, and arrange any necessary and prompt service. Required service will be performed by qualified personnel.

11.3 RECORDS

Logs shall be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories. The QAO may audit these records to verify complete adherence to these procedures.

SECTION 12

CORRECTIVE ACTION

12.1 INTRODUCTION

The following procedures have been established to ensure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

12.2 PROCEDURE DESCRIPTION

When a significant condition adverse to quality is noted at site, laboratory, or subcontractor location, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QAO, Project Manager, Field Team Leader and involved contractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained;
- When procedure or data compiled are determined to be deficient;
- When equipment or instrumentation is found to be faulty;
- When samples and analytical test results are not clearly traceable;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment;
- As a result of laboratory/field comparison studies; and
- As required by USEPA SW-846, and subsequent updates, or by the DEC.

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities. Work may be audited at the sites, laboratories, or contractor locations. Activities, or documents ascertained to be noncompliant with quality assurance requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Task Manager.

Personnel assigned to quality assurance functions will have the responsibility to issue and control Corrective Action Request (CAR) Forms (Figure 12.1 or similar). The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that all recommended corrective actions are implemented, documented, and approved.

FIGURE 12.1

CORRECTIVE ACTION REQUEST

Number: ___________________________ Date: ____________

TO: ____

You are hereby requested to take corrective actions indicated below and as otherwise determined by you to (a) resolve the noted condition and (b) to prevent it from recurring. Your written response is to be returned to the project quality assurance manager by _______________

CONDITION:

REFERENCE DOCUMENTS:

RECOMMENDED CORRECTIVE ACTIONS:

___________	______	___________	________	____________	________
Originator	Date	Approval	Date	Approval	Date

RESPONSE

CAUSE OF CONDITION

CORRECTIVE ACTION

(A) RESOLUTION

(B) PREVENTION

(C) AFFECTED DOCUMENTS

C.A. FOLLOWUP:

CORRECTIVE ACTION VERIFIED BY: _____________________________ DATE:_____________

SECTION 13

REFERENCES

NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York., 2006

NYSDEC Technical Guidance for Site Investigation and Remediation (DER-10), 5/2010, updated 4/2019.

USEPA, 2002. "Guidance *for Quality Assurance Project Plans*," dated December 2002 . U.S. Environmental Protection Agency, Washington, D.C.

USEPA, 2007. SW-846 *"Test Method for Evaluating Solid Waste,"* dated February 2007. U.S. Environmental Protection Agency, Washington, D.C.

Taylor, J. K., 1987. *"Quality Assurance of Chemical Measurements."* Lewis Publishers, Inc., Chelsea, Michigan

USEPA, 1987. *"Data Quality Objectives for Remedial Response Actions Activities: Development Process, EPA/540/G-87/003, OSWER Directive 9355.0-7."* U.S. Environmental Protection Agency, Washington, D.C.

USEPA, 1992a. *"CLP Organics Data Review and Preliminary Review. SOP No. HW-6, Revision #8,"* dated January 1992. USEPA Region II.

USEPA, 1992b. *"Evaluation of Metals Data for the Contract Laboratory Program (CLP) based on SOW 3/90. SOP No. HW-2, Revision XI,"* dated January 1992. USEPA Region II.

Appendix A
Laboratory Requirements

Soil

Equity Environmental Engineering, LLC

TCL Volatiles - EPA 8260C/5035 High&Low (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - 1 Vial MeOH/2 Vial Water

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Methylene chloride	75-09-2	5	2.29	ug/kg	70-130	30	70-130	30	30			
1,1-Dichloroethane	75-34-3	1	0.145	ug/kg	70-130	30	70-130	30	30			
Chloroform	67-66-3	1.5	0.14	ug/kg	70-130	30	70-130	30	30			
Carbon tetrachloride	56-23-5	1	0.23	ug/kg	70-130	30	70-130	30	30			
1,2-Dichloropropane	78-87-5	1	0.125	ug/kg	70-130	30	70-130	30	30			
Dibromochloromethane	124-48-1	1	0.14	ug/kg	70-130	30	70-130	30	30			
1,1,2-Trichloroethane	79-00-5	1	0.267	ug/kg	70-130	30	70-130	30	30			
Tetrachloroethene	127-18-4	0.5	0.196	ug/kg	70-130	30	70-130	30	30			
Chlorobenzene	108-90-7	0.5	0.127	ug/kg	70-130	30	70-130	30	30			
Trichlorofluoromethane	75-69-4	4	0.695	ug/kg	70-139	30	70-139	30	30			
1,2-Dichloroethane	107-06-2	1	0.257	ug/kg	70-130	30	70-130	30	30			
1,1,1-Trichloroethane	71-55-6	0.5	0.167	ug/kg	70-130	30	70-130	30	30			
Bromodichloromethane	75-27-4	0.5	0.109	ug/kg	70-130	30	70-130	30	30			
trans-1,3-Dichloropropene	10061-02-6	1	0.273	ug/kg	70-130	30	70-130	30	30			
cis-1,3-Dichloropropene	10061-01-5	0.5	0.158	ug/kg	70-130	30	70-130	30	30			
1,3-Dichloropropene, Total	542-75-6	0.5	0.158	ug/kg				30	30			
1,1-Dichloropropene	563-58-6	0.5	0.159	ug/kg	70-130	30	70-130	30	30			
Bromoform	75-25-2	4	0.246	ug/kg	70-130	30	70-130	30	30			
1,1,2,2-Tetrachloroethane	79-34-5	0.5	0.166	ug/kg	70-130	30	70-130	30	30			
Benzene	71-43-2	0.5	0.166	ug/kg	70-130	30	70-130	30	30			
Toluene	108-88-3	1	0.543	ug/kg	70-130	30	70-130	30	30			
Ethylbenzene	100-41-4	1	0.141	ug/kg	70-130	30	70-130	30	30			
Chloromethane	74-87-3	4	0.932	ug/kg	52-130	30	52-130	30	30			
Bromomethane	74-83-9	2	0.581	ug/kg	57-147	30	57-147	30	30			
Vinyl chloride	75-01-4	1	0.335	ug/kg	67-130	30	67-130	30	30			
Chloroethane	75-00-3	2	0.452	ug/kg	50-151	30	50-151	30	30			
1,1-Dichloroethene	75-35-4	1	0.238	ug/kg	65-135	30	65-135	30	30			
trans-1,2-Dichloroethene	156-60-5	1.5	0.137	ug/kg	70-130	30	70-130	30	30			
Trichloroethene	79-01-6	0.5	0.137	ug/kg	70-130	30	70-130	30	30			
1,2-Dichlorobenzene	95-50-1	2	0.144	ug/kg	70-130	30	70-130	30	30			
1,3-Dichlorobenzene	541-73-1	2	0.148	ug/kg	70-130	30	70-130	30	30			
1,4-Dichlorobenzene	106-46-7	2	0.171	ug/kg	70-130	30	70-130	30	30			
Methyl tert butyl ether	1634-04-4	2	0.201	ug/kg	66-130	30	66-130	30	30			
p/m-Xylene	179601-23-1	2	0.56	ug/kg	70-130	30	70-130	30	30			
o-Xylene	95-47-6	1	0.291	ug/kg	70-130	30	70-130	30	30			
Xylene (Total)	1330-20-7	1	0.291	ug/kg				30	30			
cis-1,2-Dichloroethene	156-59-2	1	0.175	ug/kg	70-130	30	70-130	30	30			
1,2-Dichloroethene (total)	540-59-0	1	0.137	ug/kg				30	30			
Dibromomethane	74-95-3	2	0.238	ug/kg	70-130	30	70-130	30	30			
Styrene	100-42-5	1	0.196	ug/kg	70-130	30	70-130	30	30			
Dichlorodifluoromethane	75-71-8	10	0.915	ug/kg	30-146	30	30-146	30	30			
Acetone	67-64-1	10	4.811	ug/kg	54-140	30	54-140	30	30			

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)

Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.

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File: PM12022-1
Page: 2

Equity Environmental Engineering, LLC

TCL Volatiles - EPA 8260C/5035 High&Low (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - 1 Vial MeOH/2 Vial Water

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Carbon disulfide	75-15-0	10	4.55	ug/kg	59-130	30	59-130	30	30			
2-Butanone	78-93-3	10	2.22	ug/kg	70-130	30	70-130	30	30			
Vinyl acetate	108-05-4	10	2.15	ug/kg	70-130	30	70-130	30	30			
4-Methyl-2-pentanone	108-10-1	10	1.28	ug/kg	70-130	30	70-130	30	30			
1,2,3-Trichloropropane	96-18-4	2	0.127	ug/kg	68-130	30	68-130	30	30			
2-Hexanone	591-78-6	10	1.18	ug/kg	70-130	30	70-130	30	30			
Bromochloromethane	74-97-5	2	0.205	ug/kg	70-130	30	70-130	30	30			
2,2-Dichloropropane	594-20-7	2	0.202	ug/kg	70-130	30	70-130	30	30			
1,2-Dibromoethane	106-93-4	1	0.279	ug/kg	70-130	30	70-130	30	30			
1,3-Dichloropropane	142-28-9	2	0.167	ug/kg	69-130	30	69-130	30	30			
1,1,1,2-Tetrachloroethane	630-20-6	0.5	0.132	ug/kg	70-130	30	70-130	30	30			
Bromobenzene	108-86-1	2	0.145	ug/kg	70-130	30	70-130	30	30			
n-Butylbenzene	104-51-8	1	0.167	ug/kg	70-130	30	70-130	30	30			
sec-Butylbenzene	135-98-8	1	0.146	ug/kg	70-130	30	70-130	30	30			
tert-Butylbenzene	98-06-6	2	0.118	ug/kg	70-130	30	70-130	30	30			
o-Chlorotoluene	95-49-8	2	0.191	ug/kg	70-130	30	70-130	30	30			
p-Chlorotoluene	106-43-4	2	0.108	ug/kg	70-130	30	70-130	30	30			
1,2-Dibromo-3-chloropropane	96-12-8	3	0.998	ug/kg	68-130	30	68-130	30	30			
Hexachlorobutadiene	87-68-3	4	0.169	ug/kg	67-130	30	67-130	30	30			
Isopropylbenzene	98-82-8	1	0.109	ug/kg	70-130	30	70-130	30	30			
p-Isopropyltoluene	99-87-6	1	0.109	ug/kg	70-130	30	70-130	30	30			
Naphthalene	91-20-3	4	0.65	ug/kg	70-130	30	70-130	30	30			
Acrylonitrile	107-13-1	4	1.15	ug/kg	70-130	30	70-130	30	30			
n-Propylbenzene	103-65-1	1	0.171	ug/kg	70-130	30	70-130	30	30			
1,2,3-Trichlorobenzene	87-61-6	2	0.322	ug/kg	70-130	30	70-130	30	30			
1,2,4-Trichlorobenzene	120-82-1	2	0.272	ug/kg	70-130	30	70-130	30	30			
1,3,5-Trimethylbenzene	108-67-8	2	0.193	ug/kg	70-130	30	70-130	30	30			
1,2,4-Trimethylbenzene	95-63-6	2	0.334	ug/kg	70-130	30	70-130	30	30			
1,4-Dioxane	123-91-1	80	35.1	ug/kg	65-136	30	65-136	30	30			
1,4-Diethylbenzene	105-05-5	2	0.177	ug/kg	70-130	30	70-130	30	30			
4-Ethyltoluene	622-96-8	2	0.384	ug/kg	70-130	30	70-130	30	30			
1,2,4,5-Tetramethylbenzene	95-93-2	2	0.191	ug/kg	70-130	30	70-130	30	30			
Ethyl ether	60-29-7	2	0.341	ug/kg	67-130	30	67-130	30	30			
trans-1,4-Dichloro-2-butene	110-57-6	5	1.42	ug/kg	70-130	30	70-130	30	30			
1,2-Dichloroethane-d4	*17060-07-0*									*70-130*		
2-Chloroethoxyethane												
Toluene-d8	*2037-26-5*									*70-130*		
4-Bromofluorobenzene	*460-00-4*									*70-130*		
Dibromofluoromethane	*1868-53-7*									*70-130*		

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)
Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.

Equity Environmental Engineering, LLC

NYTCL Semivolatiles - EPA 8270D (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Acenaphthene	83-32-9	0.1332	0.0172494	mg/kg	31-137	50	31-137	50	50			
1,2,4-Trichlorobenzene	120-82-1	0.1665	0.0190476	mg/kg	38-107	50	38-107	50	50			
Hexachlorobenzene	118-74-1	0.0999	0.018648	mg/kg	40-140	50	40-140	50	50			
Bis(2-chloroethyl)ether	111-44-4	0.14985	0.0225774	mg/kg	40-140	50	40-140	50	50			
2-Chloronaphthalene	91-58-7	0.1665	0.0165168	mg/kg	40-140	50	40-140	50	50			
1,2-Dichlorobenzene	95-50-1	0.1665	0.0299034	mg/kg	40-140	50	40-140	50	50			
1,3-Dichlorobenzene	541-73-1	0.1665	0.028638	mg/kg	40-140	50	40-140	50	50			
1,4-Dichlorobenzene	106-46-7	0.1665	0.0290709	mg/kg	28-104	50	28-104	50	50			
3,3'-Dichlorobenzidine	91-94-1	0.1665	0.044289	mg/kg	40-140	50	40-140	50	50			
2,4-Dinitrotoluene	121-14-2	0.1665	0.0333	mg/kg	40-132	50	40-132	50	50			
2,6-Dinitrotoluene	606-20-2	0.1665	0.0285714	mg/kg	40-140	50	40-140	50	50			
Fluoranthene	206-44-0	0.0999	0.0191142	mg/kg	40-140	50	40-140	50	50			
4-Chlorophenyl phenyl ether	7005-72-3	0.1665	0.0178155	mg/kg	40-140	50	40-140	50	50			
4-Bromophenyl phenyl ether	101-55-3	0.1665	0.0254079	mg/kg	40-140	50	40-140	50	50			
Bis(2-chloroisopropyl)ether	108-60-1	0.1998	0.0284382	mg/kg	40-140	50	40-140	50	50			
Bis(2-chloroethoxy)methane	111-91-1	0.17982	0.0166833	mg/kg	40-117	50	40-117	50	50			
Hexachlorobutadiene	87-68-3	0.1665	0.0243756	mg/kg	40-140	50	40-140	50	50			
Hexachlorocyclopentadiene	77-47-4	0.47619	0.150849	mg/kg	40-140	50	40-140	50	50			
Hexachloroethane	67-72-1	0.1332	0.0269397	mg/kg	40-140	50	40-140	50	50			
Isophorone	78-59-1	0.14985	0.0216117	mg/kg	40-140	50	40-140	50	50			
Naphthalene	91-20-3	0.1665	0.0202797	mg/kg	40-140	50	40-140	50	50			
Nitrobenzene	98-95-3	0.14985	0.024642	mg/kg	40-140	50	40-140	50	50			
NitrosoDiPhenylAmine(NDPA)/DPA	86-30-6	0.1332	0.0189477	mg/kg	36-157	50	36-157	50	50			
n-Nitrosodi-n-propylamine	621-64-7	0.1665	0.0257076	mg/kg	32-121	50	32-121	50	50			
Bis(2-Ethylhexyl)phthalate	117-81-7	0.1665	0.057609	mg/kg	40-140	50	40-140	50	50			
Butyl benzyl phthalate	85-68-7	0.1665	0.041958	mg/kg	40-140	50	40-140	50	50			
Di-n-butylphthalate	84-74-2	0.1665	0.0315684	mg/kg	40-140	50	40-140	50	50			
Di-n-octylphthalate	117-84-0	0.1665	0.05661	mg/kg	40-140	50	40-140	50	50			
Diethyl phthalate	84-66-2	0.1665	0.0154179	mg/kg	40-140	50	40-140	50	50			
Dimethyl phthalate	131-11-3	0.1665	0.034965	mg/kg	40-140	50	40-140	50	50			
Benzo(a)anthracene	56-55-3	0.0999	0.0187479	mg/kg	40-140	50	40-140	50	50			
Benzo(a)pyrene	50-32-8	0.1332	0.040626	mg/kg	40-140	50	40-140	50	50			
Benzo(b)fluoranthene	205-99-2	0.0999	0.0280386	mg/kg	40-140	50	40-140	50	50			
Benzo(k)fluoranthene	207-08-9	0.0999	0.02664	mg/kg	40-140	50	40-140	50	50			
Chrysene	218-01-9	0.0999	0.017316	mg/kg	40-140	50	40-140	50	50			
Acenaphthylene	208-96-8	0.1332	0.0257076	mg/kg	40-140	50	40-140	50	50			
Anthracene	120-12-7	0.0999	0.0324675	mg/kg	40-140	50	40-140	50	50			
Benzo(ghi)perylene	191-24-2	0.1332	0.0195804	mg/kg	40-140	50	40-140	50	50			
Fluorene	86-73-7	0.1665	0.0161838	mg/kg	40-140	50	40-140	50	50			
Phenanthrene	85-01-8	0.0999	0.0202464	mg/kg	40-140	50	40-140	50	50			
Dibenzo(a,h)anthracene	53-70-3	0.0999	0.0192474	mg/kg	40-140	50	40-140	50	50			
Indeno(1,2,3-cd)Pyrene	193-39-5	0.1332	0.0232101	mg/kg	40-140	50	40-140	50	50			

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Equity Environmental Engineering, LLC

NYTCL Semivolatiles - EPA 8270D (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Pyrene	129-00-0	0.0999	0.0165501	mg/kg	35-142	50	35-142	50	50			
Biphenyl	92-52-4	0.37962	0.021645	mg/kg	37-127	50	37-127	50	50			
4-Chloroaniline	106-47-8	0.1665	0.030303	mg/kg	40-140	50	40-140	50	50			
2-Nitroaniline	88-74-4	0.1665	0.0321012	mg/kg	47-134	50	47-134	50	50			
3-Nitroaniline	99-09-2	0.1665	0.0314019	mg/kg	26-129	50	26-129	50	50			
4-Nitroaniline	100-01-6	0.1665	0.068931	mg/kg	41-125	50	41-125	50	50			
Dibenzofuran	132-64-9	0.1665	0.0157509	mg/kg	40-140	50	40-140	50	50			
2-Methylnaphthalene	91-57-6	0.1998	0.0201132	mg/kg	40-140	50	40-140	50	50			
Acetophenone	98-86-2	0.1665	0.0206127	mg/kg	14-144	50	14-144	50	50			
2,4,6-Trichlorophenol	88-06-2	0.0999	0.0315684	mg/kg	30-130	50	30-130	50	50			
P-Chloro-M-Cresol	59-50-7	0.1665	0.0248085	mg/kg	26-103	50	26-103	50	50			
2-Chlorophenol	95-57-8	0.1665	0.0196803	mg/kg	25-102	50	25-102	50	50			
2,4-Dichlorophenol	120-83-2	0.14985	0.0267732	mg/kg	30-130	50	30-130	50	50			
2,4-Dimethylphenol	105-67-9	0.1665	0.054945	mg/kg	30-130	50	30-130	50	50			
2-Nitrophenol	88-75-5	0.35964	0.062604	mg/kg	30-130	50	30-130	50	50			
4-Nitrophenol	100-02-7	0.2331	0.067932	mg/kg	11-114	50	11-114	50	50			
2,4-Dinitrophenol	51-28-5	0.7992	0.077589	mg/kg	4-130	50	4-130	50	50			
4,6-Dinitro-o-cresol	534-52-1	0.4329	0.07992	mg/kg	10-130	50	10-130	50	50			
Pentachlorophenol	87-86-5	0.1332	0.03663	mg/kg	17-109	50	17-109	50	50			
Phenol	108-95-2	0.1665	0.0251415	mg/kg	26-90	50	26-90	50	50			
2-Methylphenol	95-48-7	0.1665	0.0258075	mg/kg	30-130.	50	30-130.	50	50			
3-Methylphenol/4-Methylphenol	108-39-4/106-44-5	0.23976	0.0260739	mg/kg	30-130	50	30-130	50	50			
2,4,5-Trichlorophenol	95-95-4	0.1665	0.0319014	mg/kg	30-130	50	30-130	50	50			
Benzoic Acid	65-85-0	0.53946	0.168498	mg/kg	10-110	50	10-110	50	50			
Benzyl Alcohol	100-51-6	0.1665	0.050949	mg/kg	40-140	50	40-140	50	50			
Carbazole	86-74-8	0.1665	0.0161838	mg/kg	54-128	50	54-128	50	50			
1,4-Dioxane	123-91-1	0.024975	0.007659	mg/kg	40-140	50	40-140	50	50			
2-Fluorophenol	*367-12-4*									*25-120*		
Phenol-d6	*13127-88-3*									*10-120*		
Nitrobenzene-d5	*4165-60-0*									*23-120*		
2-Fluorobiphenyl	*321-60-8*									*30-120*		
2,4,6-Tribromophenol	*118-79-6*									*10-136*		
4-Terphenyl-d14	*1718-51-0*									*18-120*		

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Equity Environmental Engineering, LLC

NY PFAAs via LCMSMS-Isotope Dilution (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Plastic 8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluorobutanoic Acid (PFBA)	375-22-4	0.5	0.0227	ng/g	71-135	30	71-135	30	30			
Perfluoropentanoic Acid (PFPeA)	2706-90-3	0.5	0.046	ng/g	69-132	30	69-132	30	30			
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	0.25	0.039	ng/g	72-128	30	72-128	30	30			
Perfluorohexanoic Acid (PFHxA)	307-24-4	0.5	0.0525	ng/g	70-132	30	70-132	30	30			
Perfluoroheptanoic Acid (PFHpA)	375-85-9	0.25	0.0451	ng/g	71-131	30	71-131	30	30			
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	0.25	0.0605	ng/g	67-130	30	67-130	30	30			
Perfluorooctanoic Acid (PFOA)	335-67-1	0.25	0.0419	ng/g	69-133	30	69-133	30	30			
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	0.5	0.1795	ng/g	64-140	30	64-140	30	30			
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	0.5	0.1365	ng/g	70-132	30	70-132	30	30			
Perfluorononanoic Acid (PFNA)	375-95-1	0.25	0.075	ng/g	72-129	30	72-129	30	30			
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	0.25	0.13	ng/g	68-136	30	68-136	30	30			
Perfluorodecanoic Acid (PFDA)	335-76-2	0.25	0.067	ng/g	69-133	30	69-133	30	30			
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	0.5	0.287	ng/g	65-137	30	65-137	30	30			
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA	2355-31-9	0.5	0.2015	ng/g	63-144	30	63-144	30	30			
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	0.5	0.0468	ng/g	64-136	30	64-136	30	30			
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	0.5	0.153	ng/g	59-134	30	59-134	30	30			
Perfluorooctanesulfonamide (FOSA)	754-91-6	0.5	0.098	ng/g	67-137	30	67-137	30	30			
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	0.5	0.0845	ng/g	61-139	30	61-139	30	30			
Perfluorododecanoic Acid (PFDoA)	307-55-1	0.5	0.07	ng/g	69-135	30	69-135	30	30			
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	0.5	0.2045	ng/g	66-139	30	66-139	30	30			
Perfluorotetradecanoic Acid (PFTA)	376-06-7	0.5	0.054	ng/g	69-133	30	69-133	30	30			
PFOA/PFOS, Total		0.25	0.0419	ng/g				30	30			
Perfluoro[13C4]Butanoic Acid (MPFBA)	*NONE*									*61-135*		
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	*NONE*									*58-150*		
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	*NONE*									*74-139*		
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	*NONE*									*66-128*		
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	*NONE*									*71-129*		
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	*NONE*									*78-139*		
Perfluoro[13C8]Octanoic Acid (M8PFOA)	*NONE*									*75-130*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6.	*NONE*									*20-154*		
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	*NONE*									*72-140*		
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	*NONE*									*79-136*		
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	*NONE*									*75-130*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8	*NONE*									*19-175*		
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (	*NONE*									*31-134*		
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	*NONE*									*61-155*		
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	*NONE*									*10-117*		
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d	*NONE*									*34-137*		
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	*NONE*									*54-150*		
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	*NONE*									*24-159*		

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Equity Environmental Engineering, LLC

TCL PCBs - EPA 8082A (SOIL)

Holding Time: 365 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Aroclor 1016	12674-11-2	0.0335	0.0029748	mg/kg	40-140	50	40-140	50	50			
Aroclor 1221	11104-28-2	0.0335	0.0033567	mg/kg	40-140	50	40-140	50	50			
Aroclor 1232	11141-16-5	0.0335	0.007102	mg/kg	40-140	50	40-140	50	50			
Aroclor 1242	53469-21-9	0.0335	0.0045158	mg/kg	40-140	50	40-140	50	50			
Aroclor 1248	12672-29-6	0.0335	0.005025	mg/kg	40-140	50	40-140	50	50			
Aroclor 1254	11097-69-1	0.0335	0.0036649	mg/kg	40-140	50	40-140	50	50			
Aroclor 1260	11096-82-5	0.0335	0.0061908	mg/kg	40-140	50	40-140	50	50			
Aroclor 1262	37324-23-5	0.0335	0.0042545	mg/kg	40-140	50	40-140	50	50			
Aroclor 1268	11100-14-4	0.0335	0.0034706	mg/kg	40-140	50	40-140	50	50			
PCBs, Total	1336-36-3	0.0335	0.0029748	mg/kg				50	50			
2,4,5,6-Tetrachloro-m-xylene	*877-09-8*									*30-150*		
Decachlorobiphenyl	*2051-24-3*									*30-150*		

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Equity Environmental Engineering, LLC

TCL Pesticides - EPA 8081B (SOIL)

Holding Time: 14 days
Container/Sample Preservation: 1 - Glass 250ml/8oz unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Delta-BHC	319-86-8	0.0016008	0.00031349	mg/kg	30-150	30	30-150	50	50			
Lindane	58-89-9	0.000667	0.000298149	mg/kg	30-150	30	30-150	50	50			
Alpha-BHC	319-84-6	0.000667	0.000189428	mg/kg	30-150	30	30-150	50	50			
Beta-BHC	319-85-7	0.0016008	0.00060697	mg/kg	30-150	30	30-150	50	50			
Heptachlor	76-44-8	0.0008004	0.000358846	mg/kg	30-150	30	30-150	50	50			
Aldrin	309-00-2	0.0016008	0.000563615	mg/kg	30-150	30	30-150	50	50			
Heptachlor epoxide	1024-57-3	0.0030015	0.00090045	mg/kg	30-150	30	30-150	50	50			
Endrin	72-20-8	0.000667	0.00027347	mg/kg	30-150	30	30-150	50	50			
Endrin aldehyde	7421-93-4	0.002001	0.00070035	mg/kg	30-150	30	30-150	50	50			
Endrin ketone	53494-70-5	0.0016008	0.000412206	mg/kg	30-150	30	30-150	50	50			
Dieldrin	60-57-1	0.0010005	0.00050025	mg/kg	30-150	30	30-150	50	50			
4,4'-DDE	72-55-9	0.0016008	0.000370185	mg/kg	30-150	30	30-150	50	50			
4,4'-DDD	72-54-8	0.0016008	0.000570952	mg/kg	30-150	30	30-150	50	50			
4,4'-DDT	50-29-3	0.0030015	0.00128731	mg/kg	30-150	30	30-150	50	50			
Endosulfan I	959-98-8	0.0016008	0.000378189	mg/kg	30-150	30	30-150	50	50			
Endosulfan II	33213-65-9	0.0016008	0.000534934	mg/kg	30-150	30	30-150	50	50			
Endosulfan sulfate	1031-07-8	0.000667	0.000317492	mg/kg	30-150	30	30-150	50	50			
Methoxychlor	72-43-5	0.0030015	0.0009338	mg/kg	30-150	30	30-150	50	50			
Toxaphene	8001-35-2	0.030015	0.0084042	mg/kg	30-150	30	30-150	50	50			
cis-Chlordane	5103-71-9	0.002001	0.000557612	mg/kg	30-150	30	30-150	50	50			
trans-Chlordane	5103-74-2	0.002001	0.000528264	mg/kg	30-150	30	30-150	50	50			
Chlordane	57-74-9	0.01334	0.00530265	mg/kg	30-150	30	30-150	50	50			
2,4,5,6-Tetrachloro-m-xylene	*877-09-8*									*30-150*		
Decachlorobiphenyl	*2051-24-3*									*30-150*		

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Equity Environmental Engineering, LLC

METALS by 6010D (SOIL)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria	Holding Time	Container
Aluminum, Total	7429-90-5	4	1.08	mg/kg	48-151		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Antimony, Total	7440-36-0	2	0.152	mg/kg	1-208		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Arsenic, Total	7440-38-2	0.4	0.0832	mg/kg	79-121		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Barium, Total	7440-39-3	0.4	0.0696	mg/kg	83-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Beryllium, Total	7440-41-7	0.2	0.0132	mg/kg	83-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Cadmium, Total	7440-43-9	0.4	0.0392	mg/kg	83-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Calcium, Total	7440-70-2	4	1.4	mg/kg	81-119		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Chromium, Total	7440-47-3	0.4	0.0384	mg/kg	80-120		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Cobalt, Total	7440-48-4	0.8	0.0664	mg/kg	84-115		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Copper, Total	7440-50-8	0.4	0.1032	mg/kg	81-118		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Iron, Total	7439-89-6	2	0.3612	mg/kg	45-155		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Lead, Total	7439-92-1	2	0.1072	mg/kg	81-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Magnesium, Total	7439-95-4	4	0.616	mg/kg	76-124		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Manganese, Total	7439-96-5	0.4	0.0636	mg/kg	81-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Nickel, Total	7440-02-0	1	0.0968	mg/kg	83-117		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Potassium, Total	7440-09-7	100	5.76	mg/kg	71-129		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Selenium, Total	7782-49-2	0.8	0.1032	mg/kg	78-122		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Silver, Total	7440-22-4	0.4	0.1132	mg/kg	75-124		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Sodium, Total	7440-23-5	80	1.26	mg/kg	72-127		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Thallium, Total	7440-28-0	0.8	0.126	mg/kg	80-120		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Vanadium, Total	7440-62-2	0.4	0.0812	mg/kg	78-122		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv
Zinc, Total	7440-66-6	2	0.1172	mg/kg	82-118		75-125	20	20		180 days	Metals Only-Glass 60mL/2oz unpreserv

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)

Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.

Equity Environmental Engineering, LLC

METALS by 7471B (SOIL)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria	Holding Time	Container
Mercury, Total	7439-97-6	0.08	0.05216	mg/kg	72-128		80-120	20	20		28 days	Metals Only-Glass 60mL/2oz unpreserv

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. *(Soil/Solids only)*
Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.

Equity Environmental Engineering, LLC

WETCHEM (SOIL)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Method	Holding Time	Container
Cyanide, Total	57-12-5	1	0.212	mg/kg	80-120	35	75-125	35	35	9010C/9012B	14 days	1 - Glass 250ml/8oz unpreserved

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)

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Groundwater

EQUITYENV
TCL Volatiles - EPA 8260C (WATER)

Holding Time: 14 days
Container/Sample Preservation: 3 - Vial HCl preserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Methylene chloride	75-09-2	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,1-Dichloroethane	75-34-3	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Chloroform	67-66-3	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Carbon tetrachloride	56-23-5	0.5	0.134	ug/l	63-132	20	63-132	20	20			
1,2-Dichloropropane	78-87-5	1	0.137	ug/l	70-130	20	70-130	20	20			
Dibromochloromethane	124-48-1	0.5	0.149	ug/l	63-130	20	63-130	20	20			
1,1,2-Trichloroethane	79-00-5	1.5	0.5	ug/l	70-130	20	70-130	20	20			
Tetrachloroethene	127-18-4	0.5	0.181	ug/l	70-130	20	70-130	20	20			
Chlorobenzene	108-90-7	2.5	0.7	ug/l	75-130	20	75-130	20	20			
Trichlorofluoromethane	75-69-4	2.5	0.7	ug/l	62-150	20	62-150	20	20			
1,2-Dichloroethane	107-06-2	0.5	0.132	ug/l	70-130	20	70-130	20	20			
1,1,1-Trichloroethane	71-55-6	2.5	0.7	ug/l	67-130	20	67-130	20	20			
Bromodichloromethane	75-27-4	0.5	0.192	ug/l	67-130	20	67-130	20	20			
trans-1,3-Dichloropropene	10061-02-6	0.5	0.164	ug/l	70-130	20	70-130	20	20			
cis-1,3-Dichloropropene	10061-01-5	0.5	0.144	ug/l	70-130	20	70-130	20	20			
1,3-Dichloropropene, Total	542-75-6	0.5	0.144	ug/l				20	20			
1,1-Dichloropropene	563-58-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Bromoform	75-25-2	2	0.65	ug/l	54-136	20	54-136	20	20			
1,1,2,2-Tetrachloroethane	79-34-5	0.5	0.167	ug/l	67-130	20	67-130	20	20			
Benzene	71-43-2	0.5	0.159	ug/l	70-130	20	70-130	20	20			
Toluene	108-88-3	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Ethylbenzene	100-41-4	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Chloromethane	74-87-3	2.5	0.7	ug/l	64-130	20	64-130	20	20			
Bromomethane	74-83-9	2.5	0.7	ug/l	39-139	20	39-139	20	20			
Vinyl chloride	75-01-4	1	0.0714	ug/l	55-140	20	55-140	20	20			
Chloroethane	75-00-3	2.5	0.7	ug/l	55-138	20	55-138	20	20			
1,1-Dichloroethene	75-35-4	0.5	0.169	ug/l	61-145	20	61-145	20	20			
trans-1,2-Dichloroethene	156-60-5	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Trichloroethene	79-01-6	0.5	0.175	ug/l	70-130	20	70-130	20	20			
1,2-Dichlorobenzene	95-50-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,3-Dichlorobenzene	541-73-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,4-Dichlorobenzene	106-46-7	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Methyl tert butyl ether	1634-04-4	2.5	0.7	ug/l	63-130	20	63-130	20	20			
p/m-Xylene	179601-23-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
o-Xylene	95-47-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Xylene (Total)	1330-20-7	2.5	0.7	ug/l				20	20			
cis-1,2-Dichloroethene	156-59-2	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,2-Dichloroethene (total)	540-59-0	2.5	0.7	ug/l				20	20			
Dibromomethane	74-95-3	5	1	ug/l	70-130	20	70-130	20	20			
1,2,3-Trichloropropane	96-18-4	2.5	0.7	ug/l	64-130	20	64-130	20	20			
Acrylonitrile	107-13-1	5	1.5	ug/l	70-130	20	70-130	20	20			
Styrene	100-42-5	2.5	0.7	ug/l	70-130	20	70-130	20	20			

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EQUITYENV
TCL Volatiles - EPA 8260C (WATER)

Holding Time: 14 days
Container/Sample Preservation: 3 - Vial HCl preserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Dichlorodifluoromethane	75-71-8	5	1	ug/l	36-147	20	36-147	20	20			
Acetone	67-64-1	5	1.46	ug/l	58-148	20	58-148	20	20			
Carbon disulfide	75-15-0	5	1	ug/l	51-130	20	51-130	20	20			
2-Butanone	78-93-3	5	1.94	ug/l	63-138	20	63-138	20	20			
Vinyl acetate	108-05-4	5	1	ug/l	70-130	20	70-130	20	20			
4-Methyl-2-pentanone	108-10-1	5	1	ug/l	59-130	20	59-130	20	20			
2-Hexanone	591-78-6	5	1	ug/l	57-130	20	57-130	20	20			
Bromochloromethane	74-97-5	2.5	0.7	ug/l	70-130	20	70-130	20	20			
2,2-Dichloropropane	594-20-7	2.5	0.7	ug/l	63-133	20	63-133	20	20			
1,2-Dibromoethane	106-93-4	2	0.65	ug/l	70-130	20	70-130	20	20			
1,3-Dichloropropane	142-28-9	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,1,1,2-Tetrachloroethane	630-20-6	2.5	0.7	ug/l	64-130	20	64-130	20	20			
Bromobenzene	108-86-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
n-Butylbenzene	104-51-8	2.5	0.7	ug/l	53-136	20	53-136	20	20			
sec-Butylbenzene	135-98-8	2.5	0.7	ug/l	70-130	20	70-130	20	20			
tert-Butylbenzene	98-06-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
o-Chlorotoluene	95-49-8	2.5	0.7	ug/l	70-130	20	70-130	20	20			
p-Chlorotoluene	106-43-4	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,2-Dibromo-3-chloropropane	96-12-8	2.5	0.7	ug/l	41-144	20	41-144	20	20			
Hexachlorobutadiene	87-68-3	2.5	0.7	ug/l	63-130	20	63-130	20	20			
Isopropylbenzene	98-82-8	2.5	0.7	ug/l	70-130	20	70-130	20	20			
p-Isopropyltoluene	99-87-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
Naphthalene	91-20-3	2.5	0.7	ug/l	70-130	20	70-130	20	20			
n-Propylbenzene	103-65-1	2.5	0.7	ug/l	69-130	20	69-130	20	20			
1,2,3-Trichlorobenzene	87-61-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,2,4-Trichlorobenzene	120-82-1	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,3,5-Trimethylbenzene	108-67-8	2.5	0.7	ug/l	64-130	20	64-130	20	20			
1,2,4-Trimethylbenzene	95-63-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,4-Dioxane	123-91-1	250	60.8	ug/l	56-162	20	56-162	20	20			
1,4-Diethylbenzene	105-05-5	2	0.7	ug/l	70-130	20	70-130	20	20			
4-Ethyltoluene	622-96-8	2	0.7	ug/l	70-130	20	70-130	20	20			
1,2,4,5-Tetramethylbenzene	95-93-2	2	0.542	ug/l	70-130	20	70-130	20	20			
Ethyl ether	60-29-7	2.5	0.7	ug/l	59-134	20	59-134	20	20			
trans-1,4-Dichloro-2-butene	110-57-6	2.5	0.7	ug/l	70-130	20	70-130	20	20			
1,2-Dichloroethane-d4	*17060-07-0*									*70-130*		
Toluene-d8	*2037-26-5*									*70-130*		
4-Bromofluorobenzene	*460-00-4*									*70-130*		
Dibromofluoromethane	*1868-53-7*									*70-130*		

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EQUITYENV
NYTCL Semivolatiles - EPA 8270D (LVI) (WATER)

Holding Time: 7 days
Container/Sample Preservation: 2 - Amber 250ml unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Acenaphthene	83-32-9	2.002	0.44408	ug/l	37-111	30	37-111	30	30			
1,2,4-Trichlorobenzene	120-82-1	5.0232	0.49868	ug/l	39-98	30	39-98	30	30			
Hexachlorobenzene	118-74-1	2.002	0.46592	ug/l	40-140	30	40-140	30	30			
Bis(2-chloroethyl)ether	111-44-4	2.002	0.50596	ug/l	40-140	30	40-140	30	30			
2-Chloronaphthalene	91-58-7	2.002	0.4368	ug/l	40-140	30	40-140	30	30			
1,2-Dichlorobenzene	95-50-1	2.002	0.455	ug/l	40-140	30	40-140	30	30			
1,3-Dichlorobenzene	541-73-1	2.002	0.40404	ug/l	40-140	30	40-140	30	30			
1,4-Dichlorobenzene	106-46-7	2.002	0.43316	ug/l	36-97	30	36-97	30	30			
3,3'-Dichlorobenzidine	91-94-1	5.0232	1.62344	ug/l	40-140	30	40-140	30	30			
2,4-Dinitrotoluene	121-14-2	5.0232	1.1648	ug/l	48-143	30	48-143	30	30			
2,6-Dinitrotoluene	606-20-2	5.0232	0.93184	ug/l	40-140	30	40-140	30	30			
Fluoranthene	206-44-0	2.002	0.257348	ug/l	40-140	30	40-140	30	30			
4-Chlorophenyl phenyl ether	7005-72-3	2.002	0.48776	ug/l	40-140	30	40-140	30	30			
4-Bromophenyl phenyl ether	101-55-3	2.002	0.37856	ug/l	40-140	30	40-140	30	30			
Bis(2-chloroisopropyl)ether	108-60-1	2.002	0.5278	ug/l	40-140	30	40-140	30	30			
Bis(2-chloroethoxy)methane	111-91-1	5.0232	0.50232	ug/l	40-140	30	40-140	30	30			
Hexachlorobutadiene	87-68-3	2.002	0.65884	ug/l	40-140	30	40-140	30	30			
Hexachlorocyclopentadiene	77-47-4	20.02	0.68796	ug/l	40-140	30	40-140	30	30			
Hexachloroethane	67-72-1	2.002	0.58604	ug/l	40-140	30	40-140	30	30			
Isophorone	78-59-1	5.0232	1.20484	ug/l	40-140	30	40-140	30	30			
Naphthalene	91-20-3	2.002	0.46592	ug/l	40-140	30	40-140	30	30			
Nitrobenzene	98-95-3	2.002	0.77168	ug/l	40-140	30	40-140	30	30			
NitrosoDiPhenylAmine(NDPA)/DPA	86-30-6	2.002	0.4186	ug/l	40-140	30	40-140	30	30			
n-Nitrosodi-n-propylamine	621-64-7	5.0232	0.64428	ug/l	29-132	30	29-132	30	30			
Bis(2-Ethylhexyl)phthalate	117-81-7	3.003	1.53608	ug/l	40-140	30	40-140	30	30			
Butyl benzyl phthalate	85-68-7	5.0232	1.17208	ug/l	40-140	30	40-140	30	30			
Di-n-butylphthalate	84-74-2	5.0232	0.38948	ug/l	40-140	30	40-140	30	30			
Di-n-octylphthalate	117-84-0	5.0232	1.274	ug/l	40-140	30	40-140	30	30			
Diethyl phthalate	84-66-2	5.0232	0.3822	ug/l	40-140	30	40-140	30	30			
Dimethyl phthalate	131-11-3	5.0232	1.82	ug/l	40-140	30	40-140	30	30			
Benzo(a)anthracene	56-55-3	2.002	0.32578	ug/l	40-140	30	40-140	30	30			
Benzo(a)pyrene	50-32-8	2.002	0.40768	ug/l	40-140	30	40-140	30	30			
Benzo(b)fluoranthene	205-99-2	2.002	0.355264	ug/l	40-140	30	40-140	30	30			
Benzo(k)fluoranthene	207-08-9	2.002	0.37492	ug/l	40-140	30	40-140	30	30			
Chrysene	218-01-9	2.002	0.341068	ug/l	40-140	30	40-140	30	30			
Acenaphthylene	208-96-8	2.002	0.46592	ug/l	45-123	30	45-123	30	30			
Anthracene	120-12-7	2.002	0.32942	ug/l	40-140	30	40-140	30	30			
Benzo(ghi)perylene	191-24-2	2.002	0.296296	ug/l	40-140	30	40-140	30	30			
Fluorene	86-73-7	2.002	0.41496	ug/l	40-140	30	40-140	30	30			
Phenanthrene	85-01-8	2.002	0.33124	ug/l	40-140	30	40-140	30	30			
Dibenzo(a,h)anthracene	53-70-3	2.002	0.323232	ug/l	40-140	30	40-140	30	30			
Indeno(1,2,3-cd)Pyrene	193-39-5	2.002	0.39676	ug/l	40-140	30	40-140	30	30			

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EQUITYENV
NYTCL Semivolatiles - EPA 8270D (LVI) (WATER)

Holding Time: 7 days
Container/Sample Preservation: 2 - Amber 250ml unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Pyrene	129-00-0	2.002	0.279552	ug/l	26-127	30	26-127	30	30			
Biphenyl	92-52-4	2.002	0.45864	ug/l	40-140	30	40-140	30	30			
4-Chloroaniline	106-47-8	5.0232	1.07016	ug/l	40-140	30	40-140	30	30			
2-Nitroaniline	88-74-4	5.0232	0.49868	ug/l	52-143	30	52-143	30	30			
3-Nitroaniline	99-09-2	5.0232	0.81536	ug/l	25-145	30	25-145	30	30			
4-Nitroaniline	100-01-6	5.0232	0.8008	ug/l	51-143	30	51-143	30	30			
Dibenzofuran	132-64-9	2.002	0.49868	ug/l	40-140	30	40-140	30	30			
2-Methylnaphthalene	91-57-6	2.002	0.455	ug/l	40-140	30	40-140	30	30			
Acetophenone	98-86-2	5.0232	0.5278	ug/l	39-129	30	39-129	30	30			
2,4,6-Trichlorophenol	88-06-2	5.0232	0.61152	ug/l	30-130	30	30-130	30	30			
P-Chloro-M-Cresol	59-50-7	2.002	0.35126	ug/l	23-97	30	23-97	30	30			
2-Chlorophenol	95-57-8	2.002	0.48048	ug/l	27-123	30	27-123	30	30			
2,4-Dichlorophenol	120-83-2	5.0232	0.41132	ug/l	30-130	30	30-130	30	30			
2,4-Dimethylphenol	105-67-9	5.0232	1.77996	ug/l	30-130	30	30-130	30	30			
2-Nitrophenol	88-75-5	10.01	0.84812	ug/l	30-130	30	30-130	30	30			
4-Nitrophenol	100-02-7	10.01	0.6734	ug/l	10-80	30	10-80	30	30			
2,4-Dinitrophenol	51-28-5	20.02	6.6612	ug/l	20-130	30	20-130	30	30			
4,6-Dinitro-o-cresol	534-52-1	10.01	1.81636	ug/l	20-164	30	20-164	30	30			
Pentachlorophenol	87-86-5	10.01	1.79452	ug/l	9-103	30	9-103	30	30			
Phenol	108-95-2	5.0232	0.56784	ug/l	12-110	30	12-110	30	30			
2-Methylphenol	95-48-7	5.0232	0.4914	ug/l	30-130	30	30-130	30	30			
3-Methylphenol/4-Methylphenol	108-39-4/106-44-5	5.0232	0.48048	ug/l	30-130	30	30-130	30	30			
2,4,5-Trichlorophenol	95-95-4	5.0232	0.77532	ug/l	30-130	30	30-130	30	30			
Benzoic Acid	65-85-0	50.232	2.66084	ug/l	10-164	30	10-164	30	30			
Benzyl Alcohol	100-51-6	2.002	0.58968	ug/l	26-116	30	26-116	30	30			
Carbazole	86-74-8	2.002	0.4914	ug/l	55-144	30	55-144	30	30			
2-Fluorophenol	*367-12-4*									*21-120*		
Phenol-d6	*13127-88-3*									*10-120*		
Nitrobenzene-d5	*4165-60-0*									*23-120*		
2-Fluorobiphenyl	*321-60-8*									*15-120*		
2,4,6-Tribromophenol	*118-79-6*									*10-120*		
4-Terphenyl-d14	*1718-51-0*									*41-149*		

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EQUITYENV
NYTCL Semivolatiles -EPA 8270D-SIM (LVI) (WATER)

Holding Time: 7 days
Container/Sample Preservation: 2 - Amber 250ml unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Acenaphthene	83-32-9	0.1001	0.01442168	ug/l	40-140	40	40-140	40	40			
2-Chloronaphthalene	91-58-7	0.2002	0.01804712	ug/l	40-140	40	40-140	40	40			
Fluoranthene	206-44-0	0.1001	0.02054052	ug/l	40-140	40	40-140	40	40			
Hexachlorobutadiene	87-68-3	0.5005	0.04674852	ug/l	40-140	40	40-140	40	40			
Naphthalene	91-20-3	0.1001	0.04882696	ug/l	40-140	40	40-140	40	40			
Benzo(a)anthracene	56-55-3	0.1001	0.0198198	ug/l	40-140	40	40-140	40	40			
Benzo(a)pyrene	50-32-8	0.1001	0.01493856	ug/l	40-140	40	40-140	40	40			
Benzo(b)fluoranthene	205-99-2	0.1001	0.01156792	ug/l	40-140	40	40-140	40	40			
Benzo(k)fluoranthene	207-08-9	0.1001	0.00889616	ug/l	40-140	40	40-140	40	40			
Chrysene	218-01-9	0.1001	0.01198288	ug/l	40-140	40	40-140	40	40			
Acenaphthylene	208-96-8	0.1001	0.01222676	ug/l	40-140	40	40-140	40	40			
Anthracene	120-12-7	0.1001	0.01450176	ug/l	40-140	40	40-140	40	40			
Benzo(ghi)perylene	191-24-2	0.1001	0.01365	ug/l	40-140	40	40-140	40	40			
Fluorene	86-73-7	0.1001	0.01456364	ug/l	40-140	40	40-140	40	40			
Phenanthrene	85-01-8	0.1001	0.02333604	ug/l	40-140	40	40-140	40	40			
Dibenzo(a,h)anthracene	53-70-3	0.1001	0.0127218	ug/l	40-140	40	40-140	40	40			
Indeno(1,2,3-cd)Pyrene	193-39-5	0.1001	0.01217216	ug/l	40-140	40	40-140	40	40			
Pyrene	129-00-0	0.1001	0.01902264	ug/l	40-140	40	40-140	40	40			
2-Methylnaphthalene	91-57-6	0.1001	0.02192372	ug/l	40-140	40	40-140	40	40			
Pentachlorophenol	87-86-5	0.8008	0.0143416	ug/l	40-140	40	40-140	40	40			
Hexachlorobenzene	118-74-1	0.8008	0.00938028	ug/l	40-140	40	40-140	40	40			
Hexachloroethane	67-72-1	0.8008	0.06320132	ug/l	40-140	40	40-140	40	40			
2-Fluorophenol	*367-12-4*									*21-120*		
Phenol-d6	*13127-88-3*									*10-120*		
Nitrobenzene-d5	*4165-60-0*									*23-120*		
2-Fluorobiphenyl	*321-60-8*									*15-120*		
2,4,6-Tribromophenol	*118-79-6*									*10-120*		
4-Terphenyl-d14	*1718-51-0*									*41-149*		

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)

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EQUITYENV
NY PFAAs via LCMSMS-Isotope Dilution (WATER)

Holding Time: 14 days
Container/Sample Preservation: 1 - 2 Plastic/1 Plastic/1 H20 Plastic

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Perfluorobutanoic Acid (PFBA)	375-22-4	2	0.408	ng/l	67-148	30	67-148	30	30			
Perfluoropentanoic Acid (PFPeA)	2706-90-3	2	0.396	ng/l	63-161	30	63-161	30	30			
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	2	0.238	ng/l	65-157	30	65-157	30	30			
Perfluorohexanoic Acid (PFHxA)	307-24-4	2	0.328	ng/l	69-168	30	69-168	30	30			
Perfluoroheptanoic Acid (PFHpA)	375-85-9	2	0.2252	ng/l	58-159	30	58-159	30	30			
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	2	0.376	ng/l	69-177	30	69-177	30	30			
Perfluorooctanoic Acid (PFOA)	335-67-1	2	0.236	ng/l	63-159	30	63-159	30	30			
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	2	1.332	ng/l	49-187	30	49-187	30	30			
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	2	0.688	ng/l	61-179	30	61-179	30	30			
Perfluorononanoic Acid (PFNA)	375-95-1	2	0.312	ng/l	68-171	30	68-171	30	30			
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	2	0.504	ng/l	52-151	30	52-151	30	30			
Perfluorodecanoic Acid (PFDA)	335-76-2	2	0.304	ng/l	63-171	30	63-171	30	30			
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	2	1.212	ng/l	56-173	30	56-173	30	30			
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA	2355-31-9	2	0.648	ng/l	60-166	30	60-166	30	30			
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	2	0.26	ng/l	60-153	30	60-153	30	30			
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	2	0.98	ng/l	38-156	30	38-156	30	30			
Perfluorooctanesulfonamide (FOSA)	754-91-6	2	0.58	ng/l	46-170	30	46-170	30	30			
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	2	0.804	ng/l	45-170	30	45-170	30	30			
Perfluorododecanoic Acid (PFDoA)	307-55-1	2	0.372	ng/l	67-153	30	67-153	30	30			
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	2	0.3272	ng/l	48-158	30	48-158	30	30			
Perfluorotetradecanoic Acid (PFTA)	376-06-7	2	0.248	ng/l	59-182	30	59-182	30	30			
PFOA/PFOS, Total		2	0.236	ng/l				30	30			
Perfluoro[13C4]Butanoic Acid (MPFBA)	*NONE*									*58-132*		
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	*NONE*									*62-163*		
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	*NONE*									*70-131*		
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	*NONE*									*57-129*		
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	*NONE*									*60-129*		
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	*NONE*									*71-134*		
Perfluoro[13C8]Octanoic Acid (M8PFOA)	*NONE*									*62-129*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6	*NONE*									*14-147*		
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	*NONE*									*59-139*		
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	*NONE*									*69-131*		
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	*NONE*									*62-124*		
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8	*NONE*									*10-162*		
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (	*NONE*									*24-116*		
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	*NONE*									*55-137*		
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	*NONE*									*10-112*		
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d	*NONE*									*27-126*		
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	*NONE*									*48-131*		
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	*NONE*									*22-136*		

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EQUITYENV
TCL PCBs - EPA 8082A (LVI) (WATER)

Holding Time: 365 days
Container/Sample Preservation: 2 - Amber 120ml unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Aroclor 1016	12674-11-2	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
Aroclor 1221	11104-28-2	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
Aroclor 1232	11141-16-5	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
Aroclor 1242	53469-21-9	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
Aroclor 1248	12672-29-6	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
Aroclor 1254	11097-69-1	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
Aroclor 1260	11096-82-5	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
Aroclor 1262	37324-23-5	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
Aroclor 1268	11100-14-4	0.0000714	0.000061047	mg/l	40-140	50	40-140	50	50			
PCBs, Total	1336-36-3	0.0000714	0.000061047	mg/l				50	50			
2,4,5,6-Tetrachloro-m-xylene	*877-09-8*									*30-150*		
Decachlorobiphenyl	*2051-24-3*									*30-150*		

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EQUITYENV
TCL Pesticides - EPA 8081B (WATER)

Holding Time: 7 days
Container/Sample Preservation: 2 - Amber 120ml unpreserved

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria		
Delta-BHC	319-86-8	0.02	0.00467	ug/l	30-150	20	30-150	30	30			
Lindane	58-89-9	0.02	0.00434	ug/l	30-150	20	30-150	30	30			
Alpha-BHC	319-84-6	0.02	0.00439	ug/l	30-150	20	30-150	30	30			
Beta-BHC	319-85-7	0.02	0.0056	ug/l	30-150	20	30-150	30	30			
Heptachlor	76-44-8	0.02	0.0031	ug/l	30-150	20	30-150	30	30			
Aldrin	309-00-2	0.02	0.00216	ug/l	30-150	20	30-150	30	30			
Heptachlor epoxide	1024-57-3	0.02	0.00415	ug/l	30-150	20	30-150	30	30			
Endrin	72-20-8	0.04	0.00429	ug/l	30-150	20	30-150	30	30			
Endrin aldehyde	7421-93-4	0.04	0.0081	ug/l	30-150	20	30-150	30	30			
Endrin ketone	53494-70-5	0.04	0.00477	ug/l	30-150	20	30-150	30	30			
Dieldrin	60-57-1	0.04	0.00429	ug/l	30-150	20	30-150	30	30			
4,4'-DDE	72-55-9	0.04	0.00381	ug/l	30-150	20	30-150	30	30			
4,4'-DDD	72-54-8	0.04	0.00464	ug/l	30-150	20	30-150	30	30			
4,4'-DDT	50-29-3	0.04	0.00432	ug/l	30-150	20	30-150	30	30			
Endosulfan I	959-98-8	0.02	0.00345	ug/l	30-150	20	30-150	30	30			
Endosulfan II	33213-65-9	0.04	0.00519	ug/l	30-150	20	30-150	30	30			
Endosulfan sulfate	1031-07-8	0.04	0.00481	ug/l	30-150	20	30-150	30	30			
Methoxychlor	72-43-5	0.2	0.00684	ug/l	30-150	20	30-150	30	30			
Toxaphene	8001-35-2	0.2	0.0627	ug/l	30-150	20	30-150	30	30			
cis-Chlordane	5103-71-9	0.02	0.00666	ug/l	30-150	20	30-150	30	30			
trans-Chlordane	5103-74-2	0.02	0.00627	ug/l	30-150	20	30-150	30	30			
Chlordane	57-74-9	0.2	0.0463	ug/l	30-150	20	30-150	30	30			
2,4,5,6-Tetrachloro-m-xylene	*877-09-8*									*30-150*		
Decachlorobiphenyl	*2051-24-3*									*30-150*		

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EQUITYENV
METALS by 6020B (WATER)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria	Holding Time	Container
Aluminum, Total	7429-90-5	0.01	0.00327	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Antimony, Total	7440-36-0	0.004	0.000429	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Arsenic, Total	7440-38-2	0.0005	0.000165	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Barium, Total	7440-39-3	0.0005	0.000173	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Beryllium, Total	7440-41-7	0.0005	0.000107	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Cadmium, Total	7440-43-9	0.0002	0.0000599	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Calcium, Total	7440-70-2	0.1	0.0394	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Chromium, Total	7440-47-3	0.001	0.000178	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Cobalt, Total	7440-48-4	0.0005	0.000163	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Copper, Total	7440-50-8	0.001	0.000384	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Iron, Total	7439-89-6	0.05	0.0191	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Lead, Total	7439-92-1	0.001	0.000343	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Magnesium, Total	7439-95-4	0.07	0.0242	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Manganese, Total	7439-96-5	0.001	0.00044	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Nickel, Total	7440-02-0	0.002	0.000556	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Potassium, Total	7440-09-7	0.1	0.0309	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Selenium, Total	7782-49-2	0.005	0.00173	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Silver, Total	7440-22-4	0.0004	0.000163	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Sodium, Total	7440-23-5	0.1	0.0293	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Thallium, Total	7440-28-0	0.001	0.000143	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Vanadium, Total	7440-62-2	0.005	0.00157	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved
Zinc, Total	7440-66-6	0.01	0.00341	mg/l	80-120		75-125	20	20		180 days	1 - Plastic 500ml HNO3 preserved

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EQUITYENV
METALS by 7470A (WATER)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Surrogate Criteria	Holding Time	Container
Mercury, Total	7439-97-6	0.0002	0.0000915	mg/l	80-120		75-125	20	20		28 days	1 - Plastic 500ml HNO3 preserved

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)

Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.

EQUITYENV
WETCHEM (WATER)

Analyte	CAS #	RL	MDL	Units	LCS Criteria	LCS RPD	MS Criteria	MS RPD	Duplicate RPD	Method	Holding Time	Container
Cyanide, Total	57-12-5	0.005	0.0018	mg/l	85-115	20	80-120	20	20	9010C/9012B	14 days	1 - Plastic 250ml NaOH preserved

Please Note that the RL information provided in this table is calculated using a 100% Solids factor. (Soil/Solids only)

Please Note that the information provided in this table is subject to change at anytime at the discretion of Alpha Analytical, Inc.

Appendix D

Qualifications of Environmental Professionals

CRAIG PUERTA, PE, MBA
EMAIL: craig@cpengineeringpc.com, Tel: 917-952-8216 **Environmental and Sustainable Engineering**

INTRODUCTION

Mr. Puerta is a registered Professional Engineer in the states of New York, New Jersey, and Georgia. He holds a Master of Business Administration in Strategic Management and has 19 years of experience in the environmental engineering fields. Mr. Puerta's primary areas of expertise include environmental engineering related to property diligence, environmental investigations, cost forecasting, remedial designs, and long-term operations and maintenance of all classes of properties for environmental sustainability. Mr. Puerta has supported nearly all classes of industry, public and private clients, legal firms and developers with his consulting expertise.

SUMMARY OF EDUCATION

Bachelor of Science, The Pennsylvania State University, University Park, Pennsylvania
Environmental Systems Engineering, December 2000

Master of Business Administration (MBA), Pace University, New York, NY
Strategic Management & Finance, January 2008

SUMMARY OF PROFESSIONAL EXPERIENCE

2011-Present:	CPEngineering, P.C.
2006-2011:	The ELM Group (NYC Office now Integral Consulting) *
2004-2006:	Langan Engineering and Environmental Services (NYC Office) *
2002-2004:	Hanover Engineering Associates (Bethlehem, PA) *
2001-2002:	Traffic Planning & Design, Inc. (Pottstown, PA) *

* Not discussed below

CERTIFICATIONS AND MEMBERSHIPS

- New York State Professional Engineer #087830 (State Authorization #0015546)
- New Jersey Professional Engineer #24GE05179100 (State Authorization #24GA28248600)
- Georgia State Professional Engineer #037230

PROFESSIONAL EXPERIENCE DETAIL

CPENGINEERING, P.C.
New York, NY

October 2011 – Present

Principal Engineer

Currently serving as Principal in responsible charge. CPEngineering's clients have included both public and private sector firms, agencies, and associated supporting companies such as developers and legal firms. CPEngineering holds engineering and business licenses in New York, New Jersey, and Georgia.

PROJECT EXPERIENCE

Project Manager to Potential Responsible Party (PRP) Committee – New York State Brownfields Cleanup Program/Superfund Site

- **Former Waste Oil Recycling Facility - Long Island City, Queens, NY**

Project Manager for the remediation and redevelopment of former waste oil recycling facility and Class 2 Inactive Hazardous Waste Site. The site is closed under the New York State Brownfield Cleanup Program, with NYSDEC and NYSDOH oversight. Responsible for integrating site remediation and redevelopment to addresses the concerns of the developer, regulators, and the public as well as existing and prospective tenants and occupants of adjacent properties. Provide litigation support, oversee preparation of request for proposals, contracting, subcontracting, contractor selection and contractor management; Coordinate discussions on environmental insurance matters; Oversee and coordinates Health and Safety Plan and Community Air Monitoring Plan development, approval, and implementation, permitting, and engineering; manage and coordinates site preparation activities, electrical procurement, asbestos abatement, and demolition; Manage and coordinate Remedial Design and Remedial Action (RD/RA) Work Plan preparation, approval, and implementation; Develop and implement soil vapor sampling and associated risk management strategies; Responsible for schedule management, cost forecasting and budget management (in excess of $15MM).

Project Manager to Private Sector Development Clients

- **Multiple Developments, New York, NY**

Project Manager for environmental remediation of multiple development projects throughout the New York City Metropolitan area. Projects have included redevelopment and construction of public schools, private residences, and commercial office space ranging in size from .25- 10 acres. Projects have involved development of remedial objective strategies and evaluation of remedial technologies for negotiation with clients and regulatory agencies. Role has involved the overall risk management, development of remediation reports and cost estimating to support multiple stakeholder inputs.

- **Institutional Hedge Fund Environmental Risk Advisor, New York, NY**

Lead contact and daily risk advisor for institutionally funded hedge fund focusing on redevelopment properties throughout the New York metropolitan area. Role has involved all aspects of environmental contracting, coordination, and advisor services to solve oil spills, mold, asbestos and lead based paint management and remediation. Additional responsibilities have involved stakeholder management with respect to advising client on pro-forma inputs, long-term liabilities of remedial actions, regulatory impacts, and strategic risks of remedial actions. Provided senior level guidance during pre-construction planning for the construction of a new 90,000 square foot hotel property in midtown Manhattan. Role included advising owners and stakeholders on construction team, planning, schedule analysis, cost analysis, and risk analysis related to construction scenarios.

Engineering Systems Design

- **Multiple Sites**

Served as Project Manager for the engineering design of active and passive sub-slab depressurization systems and soil-venting extracting systems. Role included coordinating design parameters amongst design/construction team, creating cost estimates for construction, advising stakeholders including regulatory agencies of design operation, function, and objectives. Created specifications, bid, and commissioned the systems, which included oversight during construction.

- **Underground/Aboveground Storage Tank (UST/AST) Sites**

Served as Project Manager for the investigation, decommissioning and New York State Spills Program closure of multiple sites in the NYC metro area. These sites involved the administrative investigation per DER-10, DEC administrative investigation, source remediation, and dismantling of both above and below grade petroleum storage tanks.

New Jersey Specific Experience

- **Multiple Sites**

Supported various Licensed Site Remediation Professionals (LSRP) with the engineering and risk management for projects including former manufactured gas plants, pharmaceuticals, blighted land developments/Greenfields and engineering systems. In addition, supported the LSRP in lead negotiations with regulatory authorities, legal teams and expert witness support for cases involving cost recovery and responsible party determinations under the New Jersey Technical Regulations for Site Remediation.

ROBERT L. JACKSON, P.E.

MANAGING DIRECTOR

973-527-7451 x103
Bob.Jackson@equityenvironmental.com

EXPERIENCE
36 years

EDUCATION
B.S. Civil and Environmental Engineering, Cornell University, Ithaca, NY, 1984.

REGISTRATIONS
Professional Engineer: New Jersey #24GE04027600; Pennsylvania #PE073492; Delaware #22690

NJ Subsurface Evaluator #621376

Six Sigma Plus Green Belt Certification – Honeywell International Inc,

SPECIAL TRAINING
NJDEP Site Remediation Basics

NJDEP Subsurface Evaluator

NJDEP DPCC

NYC MOER Turbo Training 40-hour OSHA Course

40-hour OSHA Hazwoper

First Aid/CPR

MEMBERSHIP
New Jersey Environmental Business Council – Regulatory Committee

Society of American Military Engineers

Mr. Jackson is a New Jersey Professional Environmental Engineer with extensive environmental consulting experience that includes program/project management, site characterization and remediation, due diligence, discharge/spill prevention, QA/QC, and regulatory compliance. He is well versed in multiple regulatory programs and has worked primarily in New Jersey, New York and Pennsylvania.

As a Managing Director, Mr. Jackson manages the environmental engineering and consulting group within the firm. He continues to manage a variety of projects including site investigation and remedial design and remedial action, and preparation and certification of DPCC and SPCC Plans, for sites in New Jersey and New York. He has successfully executed project in New York City in conjunction with the Board of Standards and Appeals (BSA), Housing Preservation & Development (HPD), NYC Department of Environmental Protection (DEP), NYC Mayor's Office of Environmental Remediation (OER), New York City Housing Authority (NYCHA), and the New York State Department of Environmental Conservation (DEC). Some of these projects have been completed under the Brownfields and Voluntary Clean-up Programs.

Mr. Jackson is the firm's Quality Assurance/Quality Control officer and has prepared different QA/QC documents for qualification with various state agencies and for site remediation specifically.

Mr. Jackson has prepared and/or implemented Phase II Remedial Investigation Workplans, Remedial Action Work Plans, Stipulation Letters, and Site Management Plans. He has completed the design of Soil Excavation Plans, Vapor Barriers and Sub-slab Depressurization and Soil Vapor Extraction Systems. Mr. Jackson has coordinated and provided Construction Oversight services and prepared the required Closure and Construction Closure Reports for these projects.

Program Manager for due diligence and site remediation for a portfolio of residential and mixed- use properties in New York City for St Nicks Alliance, a non-profit affordable housing organization. Phase I Environmental Site Assessments were completed for 32 properties in Manhattan and the Bronx. Remediation services were provided for 18 properties including the design and construction oversight of sub-slab depressurization systems for seven sites.

EXPERIENCE

Site/remedial investigation projects
Managed site/remedial investigation projects under the LSRP program several of which were given Response Action Outcomes (RAOs). These projects were for both industrial and private clients primarily involving release from USTs.

Assistant Project Manager, cancer cluster exposure assessment, Pennsylvania
Assistant Project Manager for a cancer cluster exposure assessment in Northeastern Pennsylvania for the Center for Disease Control/Agency for Toxic Substances and Disease Registry (CDC/ASTDR). The project included the assimilation and review of historical data

for the study area to attempt to determine the environmental factors associated with the high rate of Polycythemia Vera, blood disorder. Coordinated the efforts of three subcontractors to assess potential air and hydrogeological sources of contamination that may cause the disease.

Complete a Hazard Operations (HAZOP) study for a commercial facility in Rahway, NJ.
The study evaluated the various operations, the probable hazards and non-compliance with applicable federal, state, and local regulations, and how they are addressed by the firm. Issues of non-compliance and methods to correct them are detailed in the project report.

Managed the Phase II site investigation of two properties that were on or adjacent to former Manufactured Gas Plants (MGP) in NYC.
Assisted in the development of the Site Management Plans for each site to ensure that MGP contaminated soils would or were properly handled. Also assisted in the review of potential disposal sites for excess soils based on the proposed development of each site. Both projects required close coordination with the architects and remediation contractors.

Phase I Environmental Site Assessments (ESAs) and Phase II Site Investigations
Conducted Phase I Environmental Site Assessments (ESAs) and Phase II Site Investigations throughout the five New York City boroughs for industrial and residential properties for private clients. Completed Environmental Site Assessment Statements (EAS) and Environmental Assessment Forms (US Dept. of Health and Human Services) for sites in New York City under multiple development scenarios including zoning amendments, bulk variances, etc.

Conducted Preliminary Site Assessments in accordance with NJDEP and NJ Division of Children and Family Services requirements for day care facilities in New Jersey.

Conducted Property Condition Assessments for two PBM Graphics facilities in North Carolina.
The PCAs evaluated the facility structure and parking, HVAC and electrical systems, architectural amenities, security and fire suppression systems, pollution prevention systems and any environmental related activities ongoing. Repair and/or replacement costs were evaluated as part of the project.

Evaluated proposed waste to energy plant environmental issues
including permitting, waste stream analysis, environmental justice, etc. Implemented ASTM protocol for municipal solid waste sampling and analysis.

Conducted nationwide regulatory compliance audits for a confidential spirits manufacturing company.
These audits were conducted to look in depth at specific aspects of the facility operations rather than a comprehensive regulatory audit. Provided temporary, onsite environmental compliance support for their Breinigsville, PA facility while they conducted a search for a full-time employee. Duties included conducting routine facility inspections, completing revisions of the facility emergency response plans, updating the residual waste documentation, making a determination on their hazardous waste generator status, etc.

Environmental Risk Manager for a confidential spirits manufacturing company.
Mr. Jackson performed onsite services as the acting Environmental Risk Manager focusing on maintaining or bringing into compliance environmental activities at their Lehigh, Pennsylvania facility. Mr. Jackson worked full time onsite 2-3 days per week.

Designed an in-door air remediation system for the removal of VOCs at several industrial facilities in New York and New Jersey.
The design included of the use of radon mitigation equipment to evacuate sub-slab VOC vapors which were migrating into the basement above the slab.

Provided construction management for the remediation of the Cragston Landfill in Highland Park, New York.
The remediation was to install an engineered cap over the former garbage landfill. The oversight included inspection of the liner installation, soil cover compaction, and drainage feature design and construction.

Conducted site inspections and provided engineer's certification for DPCC/DCR and SPCC plans for multiple industrial facilities in New Jersey and Delaware.

Team Leader for the Honeywell Study Area 7 (SA7) Treatability Team
focusing on the implementation of the pilot study phase of the program. The pilot program expanded to include additional testing with new reagents. Duties included assisting in the development of the scope of the pilot test program, contracting appropriate technology vendors, coordinating activities with the SA7 Implementation Team and onsite staff, and serving as the onsite construction supervisor for implementation of the pilot test activities. Participate in the development of cost estimates for full scale implementation of specific pilot tests that were successful.

Team Leader for the Honeywell Study Area 7 Treatability (SA7) Team to investigate the treatment of Chromium Ore Processing Residue (COPR).
The Team was chartered to study the mechanisms for COPR heaving and release of hexavalent chromium not only for the SA7 (Study Area 7) site but, for multiple sites in New Jersey and Maryland. This highly significant research and development project included the coordination of approximately 12 contractors and academic entities managing various portions of the $4 million investigation. Duties included providing direction for the project, managing budget and schedule, maintaining the flow of critical information throughout the team, review of various interim and final reports, and applicable technology review.

Resident Contract (Project) Engineer for approximately 20 sites within Honeywell's Corporate Remediation and Evaluation Services (RES) department.
Located at Honeywell's corporate headquarters in Morristown, New Jersey on a 40hour pre-week basis. Activities have included general support for Honeywell Project Managers for projects in multiple states under state regulatory lead, U.S. EPA lead or joint oversight situations. Projects have also been performed under various types of administrative/consent orders and voluntary programs.

RI/FS activities for Honeywell included coordinating and overseeing work on sites of varying size and land use with a wide range of contaminants of concern including VOCs, SVOCs, PCBs, TPH, metals, LNAPL and DNAPL in all media. Investigations have included biota sampling, NAPL fingerprinting, rapid optical screening tool (ROSTtm) testing, tidal studies, and vibracore sampling of sediments.

Remedial Design activities for Honeywell
Included landfill cap designs (RCRA and TSCA) based on state and/or EPA requirements, groundwater treatment plants for contaminated groundwater and leachate, and a conceptual design for a containment disposal facility (CDF) for contaminated sediment.

Remedial Action for Honeywell
has included the installation and operation of several pump and treat groundwater systems, successful development and implementation of natural attenuation proposals for

groundwater, installation and operation of a soil vapor extraction (SVE) system, in-situ chemical oxidation of SVOCs and soil stabilization, and building demolition.

Honeywell Six Sigma Plus – Green Belt certified.
The team I participated on was responsible for developing and implementing a new process to better identify potentially applicable remedial technologies prior to initiating a feasibility study for a site.

Member of the Honeywell Peer Review Team.
The team was developed and the process implemented to provide in-house reviews of projects in various stages of progress up to construction. The reviews focused on remedial investigations, feasibility studies, remedial actions, etc. The reviews resulted in an action item list of things for the project team to investigate that could potentially reduce project capital costs, liability, O&M costs, shorten the duration of remedial actions, etc. Program resulted in the savings of over $1 million because of a mid-course correction suggested during the project's peer review. On another project, potential savings in cost and time were realized as a result of a better understanding of mixed waste (chemical and radioactive) rules and requirements.

Project Engineer for the development, implementation, and oversight of soil erosion controls for consolidation and capping of the Sharkey Landfill in Parsippany, New Jersey.
The project involved working with the design engineer, construction contractor, and county soil erosion control office to provide appropriate erosion control and stabilization measures during the landfill work.

Project Manager.
Managed numerous site and remedial investigations in New Jersey, Pennsylvania, New York, and Connecticut involving all media for a variety of situations resulting from spills, underground storage tank leaks, the discharge of mixed waste material, etc. Duties included managing all aspects of the project; budgeting, staffing, scheduling, client relationship building, preparing project documents and reports, coordination with NJDEP, etc. Projects were completed under consent orders, memorandum of agreements, and at risk. Investigations have resulted in the implementation of Declaration of Environmental Restrictions (DER) and Classification Exemption Areas (CEA). Numerous sites were brought to closure (no further action) in New Jersey.

Site Manager for Superfund remedial investigations in US EPA Region III under the Alternative Remedial Contracting Service (ARCS) program.
Duties included coordinating all aspects of the project, including the stringent contracting and laboratory requirements of the ARCS program. Projects were in Pennsylvania and involved a former plating operation that resulted in chromium contamination of soil and groundwater up to 20% chrome is certain areas; and lithium, chromium and mercury contamination at another site.

Prepared RCRA closure cost estimates that were deemed appropriate for the actual closure plan by the NJDEP for a precious metals manufacturer.
The plan included sufficient detail in explaining the various closure steps that the NJDEP accepted it as a formal closure plan as well as cost estimate.

Project Engineer and construction manager for the modification and upgrade of USTs (underground storage tanks) at several locations within Newark Liberty International Airport for Continental Airlines.
Duties included onsite management of demolition and construction activities, soil sampling, completion of UST modification reports for the NJDEP, and coordination with the New York/New Jersey Port Authority.

Transition Coordinator for Lockheed Martin Missiles and Space plant closure in West Windsor, New Jersey.
Located at facility on a 40-hour per week basis for 14 months. The facility was approximately 750,000 square feet and had over 3,000 employees. Responsibilities included terminating permits, conducting ISRA activities, coordinating decontamination of the facility and facility equipment prior to reassignment, sale, or disposal, and coordinating disposal of hazardous and non-hazardous wastes generated at the facility. Duties also included conducting Phase I ESAs, health and safety training courses, and acting as onsite safety coordinator. The transition/closure was completed on time and under budget while setting an industry record of approximately four (4) million man-hours worked without a lost work day.

Managed and participated in environmental compliance auditing for electric utilities, the petroleum industry, and for the United States Postal Service.
Project included auditing up to 14 different regulatory programs as well as client specific policies and practices. Developed self-sustaining compliance calendars for Koch Industries, a petroleum industry client.

Environmental planning efforts have included preparing sections of various Environmental Assessments (EA) for Jet Blue Airlines and US Airways for projects subject to the National Environmental Protection Act (NEPA).
The work for Jet Blue was to assist them in getting their initial permits to operate at Kennedy International Airport. US Airways was planning a major expansion at the Pittsburgh Airport which required major environmental planning. Evaluated current and future impacts relating to wastewater, storm water run-off, airplane de-icing run-off, solid and hazardous waste, and residual waste program.

Reviewed EAs prepared for United States military under the Base Realignment and Closure (BRAC) Program,
and prepared employee trip reductions programs for the United States Postal Service to help meet air quality standards in non-attainment areas in New Jersey.

Massachusetts Water Resources Authority.
Mr. Jackson worked as project engineer Strategized, planned, and implemented an $8 million facility planning study to determine the most cost-effective control mechanism for the Combined Sewer Overflow (CSO) Program in the greater metropolitan Boston area. Oversaw and directed the efforts of consulting firms maintaining project schedules and budgets and coordinating with local, state, and federal regulatory agencies. Evaluated various CSO control technologies including dry weather overflow mechanisms and best management practices. Conducted public presentations regarding the CSO project to local neighborhood organizations and elected public officials.

Conducted industrial wastewater inspections throughout the MWRA service area of 43 communities surrounding Boston. Prepared follow-up reports with recommendations for appropriate wastewater sampling or enforcement actions. Initiated a program to promote recycling and waste minimization primarily focused on the metal finishing industry.

U.S. EPA, Region I, Boston, MA
Staff Engineer. Provided oversight for site remediation projects to ensure compliance with various orders for remediation issued by EPA Region I. Assisted in the authorization of the state of Maine’s RCRA program. Reviewed and approved RCRA Part B Treatment, Storage, and Disposal (TSD) permit applications for industrial and military facilities.

PAPERS

Wazne, Mahmoud; Papazoglou, Pierantonios; Papastavrou, Marilena; Meng, Xiaoguang; Dermatas, Dimitris; Christodoulatos, Christos; Kaouris, Maria; Morris, John; Jackson, Robert L.; *Remediation of Chromite Ore Processing Residue by Chemical Reductants*, Eighth International Symposium on In Situ and On-Site Bioremediation; Baltimore, MD; June 6, 2005.

JOHN VRABEL

PROJECT SCIENTIST

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John.vrabel@equityenvironmental.com

Mr. Vrabel is a Project Scientist with over 9 years of professional experience that includes conducting soil, groundwater, surface water sampling, potable sampling, gauging wells, performing site reconnaissance, environmental site assessments, radiological remediation, project management assistance, health and safety oversight, contractor oversight, Phase I Environmental Site Assessments, Phase II Site/Remedial Investigations, and preparing deliverables for regulatory and technical reports. He is knowledgeable of decontamination processes, instrument calibration, management of sample ware, and the proper documentation of all field work. He has worked primarily in New Jersey, New York, Massachusetts, and Pennsylvania. Mr. Vrabel has worked on multiple NYC OER projects within New York City where challenging field conditions are often encountered.

EXPERIENCE

Environmental Planning, Engineering, and Remediation Activities

Mr. Vrabel assists project managers in environmental planning, engineering, and remediation activities. His expertise consists of field operations ranging from ground water sampling, soil sampling, soil gas and vapor intrusion sampling activities, noise monitoring, traffic studies, dust monitoring, remedial injections, oversight of contractors, report writing and preparation, completing electronic data deliverables, and completing figures and drawings in Auto-CAD. He is involved in various remediation and planning projects with emphasis on site investigation, and environmental assessment.

Phase I Environmental Site Assessments, and Phase II Site/Remedial Investigations

Mr. Vrabel highly versed in completing Phase I Environmental Site Assessments, and Phase II Site/Remedial Investigations throughout New York and New Jersey. Phase I investigations have included historic and regulatory records review, site reconnaissance, inspections of UST and AST systems, interviews, and reporting. Phase II Site/Remedial Investigations have consisted of sampling for various contaminants in soil, groundwater, and soil vapor including PFOS/PFAS in soil and groundwater using NYSDEC procedures and protocols.

Remedial Activities

Mr. Vrabel assists with remedial activities for including quarterly groundwater sampling, reporting and submittal of NJDEP documents. Remedial activities consisting of UST removal, the excavation of contaminated soils, post excavation soil sampling, implementing and overseeing the application of various bio-remediation products into open excavations and injection wells.

Underground Storage Tanks

Mr. Vrabel has overseen numerous UST removals and is well versed in the inspection of UST conditions and the remediation of UST releases.

EXPERIENCE

9 years

EDUCATION

B.S., Environmental Science and Management, 2011, University of Rhode Island, Rhode Island.

SPECIAL TRAINING

40-hour OSHA Course

30-hour OSHA Course

10-hour Construction Training

8-hour OSHA Refresher

First Aid/CPR

Radiation Worker Training

FEMA Disaster Response and Recovery Training

Defensive Driver Training

Supervisor of Hazardous Waste Operations

TWIC Card

40-Hour NYC DOB Site Safety Training (SST)

Groundwater Monitoring and Reporting

Mr. Vrabel also has extensive experience related to the oversite of monitoring well abandonment and re-installation, groundwater monitoring, reporting, and general communications.

Portfolio of More than 100 Retail Service Station Sites in NJ and PA

Mr. Vrabel performed field and technical tasks in support of a portfolio of more than 100 retail service station sites in NJ and PA for Shell Oil Products and BP Corporation with primary activities consisting of groundwater sampling, vapor sampling, soil sampling, product recovery, Monitoring of soil vapor extraction systems, oversight of well installations/abandonments, oversight of excavations, over-sight and management of UST removals and post excavation sampling at retail petroleum stations, equipment calibration and assistance for preparation of technical and regulatory reports.

Radiological Technician

Mr. Vrabel performed tasks consisting of oversight and management of onsite remediation/radiological services, conducting meter calibrations, routine equipment maintenance, surveying of equipment and field personnel, documentation of routine radiological readings, and onsite housekeeping.

Health and Safety Coordinator

Mr. Vrabel’s experiences include directing and implementing effective safety meetings/trainings; scheduling of initial, annual and exit medical surveillance physicals; preparing and updating of site-specific Health and Safety Plans; equipment inspections; and performing safety audits for field activities.

FARON W. MOSER, CHST

HEALTH AND SAFETY MANAGER

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EXPERIENCE

17 years

EDUCATION

B. S., Wildlife Management, minors in Forestry and Biology, Frostburg State University, 2004

REGISTRATIONS

Subsurface Evaluator, New Jersey #474914

Board of Certified Safety Professionals, CHST# CHST-4723

COMMITTEE INVOLVEMENT

NJ State Industrial Safety Committee – 2019 - Present

Mount Olive Twp. Community Advisory Panel – 2019 - Present

Mount Olive Township Environmental Committee – 2019 - Present

Society of Military Engineers – NJ Chapter Member & Director

Mr. Moser is a Construction Health and Safety Technician (CHST) and an Environmental Scientist that has over 17 years of experience with emphasis in health and safety and environmental assessments, investigations and remediation. He has conducted numerous sites regulatory compliance audits, developed, trained and implemented numerous safety policies and programs, developed numerous training and educational programs related to OSHA standards and other client specific health and safety standards and/or topics.

As a corporate assistant health and safety manager with Sovereign Consulting Inc. Mr. Moser worked on the Shell/MOTIVA, BP, and EXXON/Mobil portfolios to develop a formal process of identifying hazards, assessing the associated risks, and developing appropriate risk reduction measures so that work can be completed safely. This tool assesses a value to the probability of an event/hazard occurring and the severity of any resultant consequences and applies mitigation controls in daily work activities to lessen or eliminate those hazards. Mr. Moser understands and implements all aspects related to USOSHA regulation, and trains the OSHA Construction and General Industry regulations.

SPECIAL TRAINING

Certified Health and Safety Technician (CHST)

40-hour OSHA HAZWOPER Course

8-hour OSHA HAZWOPER Refresher

8-hour OSHA Supervisor

OSHA 500 Trainer in OSHA Standards for Construction

OSHA 501 Trainer in OSHA Standards for General Industry

30 Hour OSHA Construction Industry

10 Hour OSHA Construction Industry

30 Hour OSHA General Industry

OSHA 3015 – Excavation, Trenching & Soil Mechanics

NJIT Construction Management Course

Vapor Intrusion in New Jersey

FEMA – Intro to Incident Command Systems (ICS-100)

FEMA – ICS for Single Resources & Initial Action Incident (ICS-200)

First Aid/CPR

Radiation Training

NJ Traffic Control Coordinator Program

NSC Defensive Driver Training

NJDEP Subsurface Evaluator

NJDEP Site Remediation Basics

NJDEP Case Study for LSRPs

NJDEP Regulatory Training in USTs

NJDEP Environmental Audits and Site Assessments

EXPERIENCE

OSHA Health & Safety Strategy Development

Mr. Moser assisted a small business to address applicable OSHA Health &Safety findings and fines in the work-place and develop an efficient strategy for handling ongoing occupational H&S issues using a Four-Point Workplace Program through H&S education/ training, documentation and H&S Plan/Program review and development. Mr. Moser was also able to negotiate a reduction in fines with OSHA.

Fortune 500 Health and Safety Services

Mr. Moser has provided onsite Health and Safety (H&S) services as a secunded employee at a Fortune 500 company while they transition the facility operations out of state. Duties included working with the client's staff on typical H&S oversight and reporting as well as working on spill and discharge prevention plans, providing H&S orientation presentation, responding to spills and accidents onsite, weekly and monthly calls with corporate personnel, SOP and SDS inventory review/upkeep, laboratory sweeps for proper flammable/hazardous chemical storage, etc. He is also responsible for completing, submitting and closing out various NJDEP and RECRA regulatory reports and permits associated with emissions and/or waste generation by the facility to the appropriate state and federal agencies.

Princeton Hydro

Mr. Moser has provided the following onsite and offsite health and safety services to Princeton Hydro including: Assistance with implementation of their new Health and Safety Program; Training of Princeton Hydro's Regional Safety Leaders; Assistance and review of OSHA Logs and recordkeeping information; Health and Safety Training as needed; Equipment Inspection Lists; Auditing; Management of risk to drive continuous improvement; Assistance with developing a safety culture with results of individual and group values, safety and technical competencies, actions and visible commitment to their new health and safety programs; Assist with incident investigations and lessons learned; and was able to negotiate a reduction in fines with OSHA.

Givaudan

Mr. Moser is Givaudan's on-call health and safety trainer and assists with Hazardous Waste Operations (HAZWOPER) and Jobsite Safety annual 8-hour safety training for Givaudan's Emergency Response Team (ERT). Mr. Moser also provides review and insight related to onsite spills, and insight on SDS program/record keeping.

CMC Workforce's Construction Training

Equity provided CMC Workforce's Construction Training program to train women and men to become highly qualified, skilled trades-people within the construction industry. Mr. Moser conducted multiple OSHA 30-hour trainings for 55 individuals. Mr. Moser was also responsible for all administrative/recordkeeping processes for filings for applicable OSHA cards.

Equity Environmental Engineering, LLC. Health and Safety Manager (2014 – present)

Mr. Moser actively manages Equity's day-to-day health and safety operations. Duties include but are not limited to: Managing and maintaining OSHA recordkeeping information, managing a sub-contractor database, designing – directing -implementing effective safety programs/trainings, and implementing the medical surveillance program.

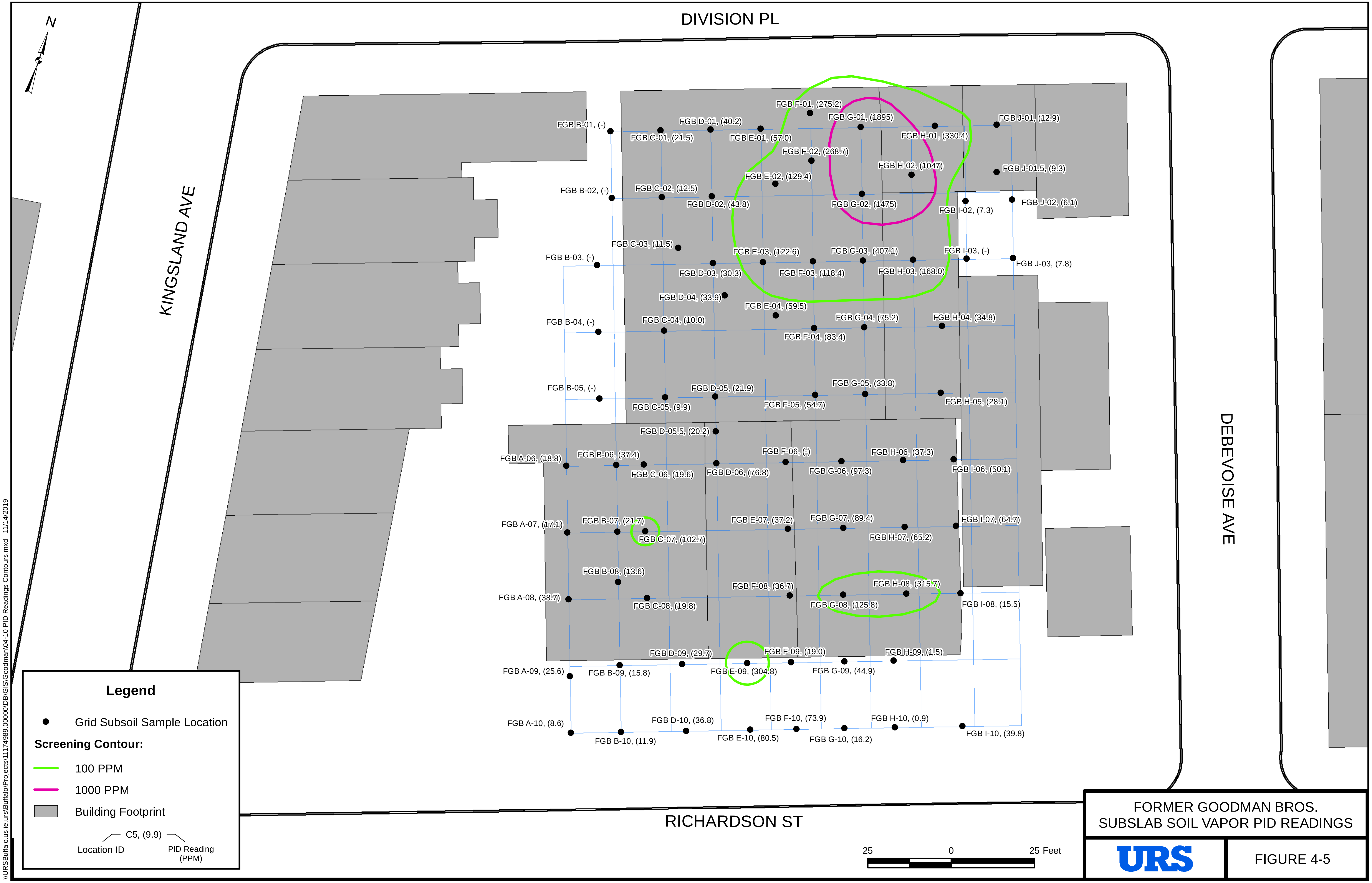
Sovereign Consulting Inc. Corporate Assistant Health and Safety Manager / Project Scientist. (2005 – 2014)
As a corporate assistant health and safety manager with Sovereign Mr. Moser had over six (6) years of experience in environmental health and safety with hands on experience as being the regional safety coordinator supporting the north east region including New Jersey, New York, Connecticut, Massachusetts, New Hampshire and Pennsylvania.

Mr. Moser's experiences as an assistant H&S manager included, but not limited to:

- Managing and maintaining OSHA recordkeeping information such as, but not limited to: Annual OSHA Logs, TRIR, LWCIR, EMR Information, Accident Incident Rate, etc;
- Managing a sub-contractor database of over 500 sub-contractors;
- Development and implementation of traffic control plans per Federal MUTCD standards;
- Designing, directing and implementing effective safety programs/trainings;
- Scheduling of initial, annual and exit medical surveillance physicals; including implementation of the substance abuse policy;
- Prescribing the implementation of multiple client safety requirements;
- Reviewing and updating of Job Safety Analysis Worksheets;
- Preparing and updating of site specific Safety and Health Plans;
- Conducting incident investigation and root cause analysis;
- Verifying compliance with applicable safety and health requirements (i.e. Federal, State, Municipal and Client Standards);
- Conducting and reviewing safety assessments and trending analysis.

Appendix E

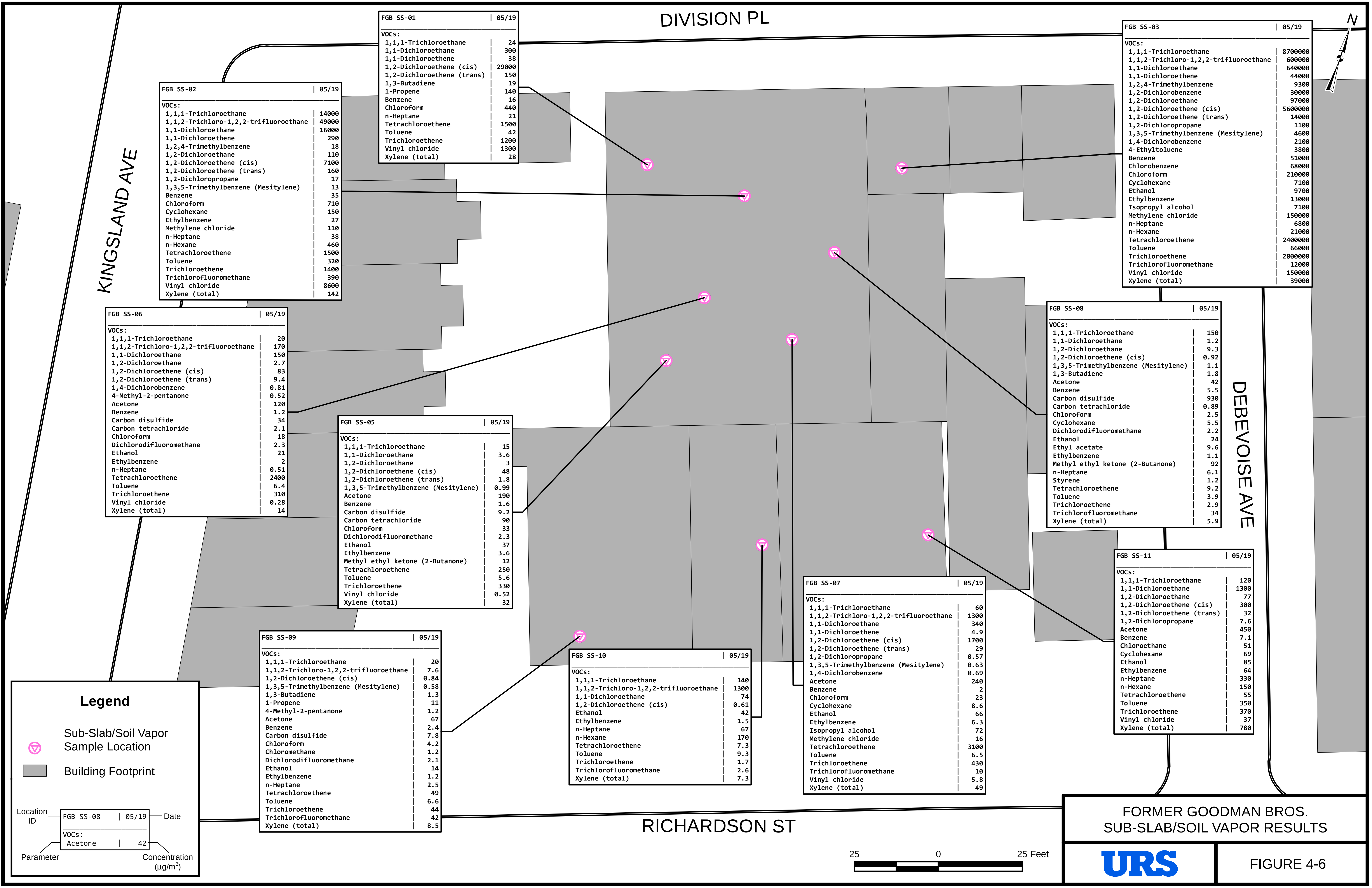
URS 2020 Soil Vapor Data



FORMER GOODMAN BROS.
SUBSLAB SOIL VAPOR PID READINGS

URS

FIGURE 4-5



Legend

⊽ Sub-Slab/Soil Vapor Sample Location

▨ Building Footprint

FGB SS-01	05/19
VOCs:	
1,1,1-Trichloroethane	24
1,1-Dichloroethane	300
1,1-Dichloroethene	38
1,2-Dichloroethene (cis)	29000
1,2-Dichloroethene (trans)	150
1,3-Butadiene	19
1-Propene	140
Benzene	16
Chloroform	440
n-Heptane	21
Tetrachloroethene	1500
Toluene	42
Trichloroethene	1200
Vinyl chloride	1300
Xylene (total)	28

FGB SS-02	05/19
VOCs:	
1,1,1-Trichloroethane	14000
1,1,2-Trichloro-1,2,2-trifluoroethane	49000
1,1-Dichloroethane	16000
1,1-Dichloroethene	290
1,2,4-Trimethylbenzene	18
1,2-Dichloroethane	110
1,2-Dichloroethene (cis)	7100
1,2-Dichloroethene (trans)	160
1,2-Dichloropropane	17
1,3,5-Trimethylbenzene (Mesitylene)	13
Benzene	35
Chloroform	710
Cyclohexane	150
Ethylbenzene	27
Methylene chloride	110
n-Heptane	38
n-Hexane	460
Tetrachloroethene	1500
Toluene	320
Trichloroethene	1400
Trichlorofluoromethane	390
Vinyl chloride	8600
Xylene (total)	142

FGB SS-03	05/19
VOCs:	
1,1,1-Trichloroethane	8700000
1,1,2-Trichloro-1,2,2-trifluoroethane	600000
1,1-Dichloroethane	640000
1,1-Dichloroethene	44000
1,2,4-Trimethylbenzene	9300
1,2-Dichlorobenzene	30000
1,2-Dichloroethane	97000
1,2-Dichloroethene (cis)	5600000
1,2-Dichloroethene (trans)	14000
1,2-Dichloropropane	1100
1,3,5-Trimethylbenzene (Mesitylene)	4600
1,4-Dichlorobenzene	2100
4-Ethyltoluene	3800
Benzene	51000
Chlorobenzene	68000
Chloroform	210000
Cyclohexane	7100
Ethanol	9700
Ethylbenzene	13000
Isopropyl alcohol	7100
Methylene chloride	150000
n-Heptane	6800
n-Hexane	21000
Tetrachloroethene	2400000
Toluene	66000
Trichloroethene	2800000
Trichlorofluoromethane	12000
Vinyl chloride	150000
Xylene (total)	39000

FGB SS-05	05/19
VOCs:	
1,1,1-Trichloroethane	15
1,1-Dichloroethane	3.6
1,2-Dichloroethane	3
1,2-Dichloroethene (cis)	48
1,2-Dichloroethene (trans)	1.8
1,3,5-Trimethylbenzene (Mesitylene)	0.99
Acetone	190
Benzene	1.6
Carbon disulfide	9.2
Carbon tetrachloride	90
Chloroform	33
Dichlorodifluoromethane	2.3
Ethanol	37
Ethylbenzene	3.6
Methyl ethyl ketone (2-Butanone)	12
Tetrachloroethene	250
Toluene	5.6
Trichloroethene	330
Vinyl chloride	0.52
Xylene (total)	32

FGB SS-06	05/19
VOCs:	
1,1,1-Trichloroethane	20
1,1,2-Trichloro-1,2,2-trifluoroethane	170
1,1-Dichloroethane	150
1,2-Dichloroethane	2.7
1,2-Dichloroethene (cis)	83
1,2-Dichloroethene (trans)	9.4
1,4-Dichlorobenzene	0.81
4-Methyl-2-pentanone	0.52
Acetone	120
Benzene	1.2
Carbon disulfide	34
Carbon tetrachloride	2.1
Chloroform	18
Dichlorodifluoromethane	2.3
Ethanol	21
Ethylbenzene	2
n-Heptane	0.51
Tetrachloroethene	2400
Toluene	6.4
Trichloroethene	310
Vinyl chloride	0.28
Xylene (total)	14

FGB SS-07	05/19
VOCs:	
1,1,1-Trichloroethane	60
1,1,2-Trichloro-1,2,2-trifluoroethane	1300
1,1-Dichloroethane	340
1,1-Dichloroethene	4.9
1,2-Dichloroethene (cis)	1700
1,2-Dichloroethene (trans)	29
1,2-Dichloropropane	0.57
1,3,5-Trimethylbenzene (Mesitylene)	0.63
1,4-Dichlorobenzene	0.69
Acetone	240
Benzene	2
Chloroform	23
Cyclohexane	8.6
Ethanol	66
Ethylbenzene	6.3
Isopropyl alcohol	72
Methylene chloride	16
Tetrachloroethene	3100
Toluene	6.5
Trichloroethene	430
Trichlorofluoromethane	10
Vinyl chloride	5.8
Xylene (total)	49

FGB SS-08	05/19
VOCs:	
1,1,1-Trichloroethane	150
1,1-Dichloroethane	1.2
1,2-Dichloroethane	9.3
1,2-Dichloroethene (cis)	0.92
1,3,5-Trimethylbenzene (Mesitylene)	1.1
1,3-Butadiene	1.8
Acetone	42
Benzene	5.5
Carbon disulfide	930
Carbon tetrachloride	0.89
Chloroform	2.5
Cyclohexane	5.5
Dichlorodifluoromethane	2.2
Ethanol	24
Ethyl acetate	9.6
Ethylbenzene	1.1
Methyl ethyl ketone (2-Butanone)	92
n-Heptane	6.1
Styrene	1.2
Tetrachloroethene	9.2
Toluene	3.9
Trichloroethene	2.9
Trichlorofluoromethane	34
Xylene (total)	5.9

FGB SS-09	05/19
VOCs:	
1,1,1-Trichloroethane	20
1,1,2-Trichloro-1,2,2-trifluoroethane	7.6
1,2-Dichloroethene (cis)	0.84
1,3,5-Trimethylbenzene (Mesitylene)	0.58
1,3-Butadiene	1.3
1-Propene	11
4-Methyl-2-pentanone	1.2
Acetone	67
Benzene	2.4
Carbon disulfide	7.8
Chloroform	4.2
Chloromethane	1.2
Dichlorodifluoromethane	2.1
Ethanol	14
Ethylbenzene	1.2
n-Heptane	2.5
Tetrachloroethene	49
Toluene	6.6
Trichloroethene	44
Trichlorofluoromethane	42
Xylene (total)	8.5

FGB SS-10	05/19
VOCs:	
1,1,1-Trichloroethane	140
1,1,2-Trichloro-1,2,2-trifluoroethane	1300
1,1-Dichloroethane	74
1,2-Dichloroethene (cis)	0.61
Ethanol	42
Ethylbenzene	1.5
n-Heptane	67
n-Hexane	170
Tetrachloroethene	7.3
Toluene	9.3
Trichloroethene	1.7
Trichlorofluoromethane	2.6
Xylene (total)	7.3

FGB SS-11	05/19
VOCs:	
1,1,1-Trichloroethane	120
1,1-Dichloroethane	1300
1,2-Dichloroethane	77
1,2-Dichloroethene (cis)	300
1,2-Dichloroethene (trans)	32
1,2-Dichloropropane	7.6
Acetone	450
Benzene	7.1
Chloroethane	51
Cyclohexane	69
Ethanol	85
Ethylbenzene	64
n-Heptane	330
n-Hexane	150
Tetrachloroethene	55
Toluene	350
Trichloroethene	370
Vinyl chloride	37
Xylene (total)	780

FORMER GOODMAN BROS.
SUB-SLAB/SOIL VAPOR RESULTS

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FIGURE 4-6

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TABLE 4-7
SUMMARY OF DETECTED COMPOUNDS IN SOIL VAPOR SAMPLES
FORMER GOODMAN BROTHERS SITE

Location ID		**FGB SS-01**	**FGB SS-02**	**FGB SS-03**	**FGB SS-03**	**FGB SS-05**
Sample ID		**224211-SS-01**	**224211-SS-02**	**20190514-FD-02**	**224211-SS-03**	**224211-SS-05**
Matrix		**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**
Depth Interval (ft)		**-**	**-**	**-**	**-**	**-**
Date Sampled		**05/14/19**	**05/14/19**	**05/14/19**	**05/14/19**	**05/14/19**
Parameter	**Units**			Field Duplicate (1-1)		
Volatile Organic Compounds						
1,1,1-Trichloroethane	UG/M3	24	14,000 D	5,500,000 D	8,700,000 D	15
1,1,2-Trichloro-1,2,2-trifluoroethane	UG/M3		49,000 D	380,000 D	600,000 D	
1,1-Dichloroethane	UG/M3	300	16,000 D	410,000 D	640,000 D	3.6
1,1-Dichloroethene	UG/M3	38	290	27,000	44,000	
1,2,4-Trimethylbenzene	UG/M3		18	5,100 J	9,300 J	
1,2-Dichlorobenzene	UG/M3			16,000 J	30,000 J	
1,2-Dichloroethane	UG/M3		110	60,000	97,000	3.0
1,2-Dichloroethene (cis)	UG/M3	29,000 D	7,100	3,500,000 D	5,600,000 D	48
1,2-Dichloroethene (trans)	UG/M3	150	160	8,600	14,000	1.8
1,2-Dichloropropane	UG/M3		17	720	1,100	
1,3,5-Trimethylbenzene (Mesitylene)	UG/M3		13	2,600 J	4,600 J	0.99
1,3-Butadiene	UG/M3	19				
1,4-Dichlorobenzene	UG/M3				2,100 J	
1-Propene	UG/M3	140				
4-Ethyltoluene	UG/M3			2,200 J	3,800 J	
4-Methyl-2-pentanone	UG/M3					
Acetone	UG/M3					190
Benzene	UG/M3	16	35	33,000	51,000	1.6
Carbon disulfide	UG/M3					9.2
Carbon tetrachloride	UG/M3					90
Chlorobenzene	UG/M3			43,000	68,000	
Chloroethane	UG/M3					
Chloroform	UG/M3	440	710	110,000 J	210,000 DJ	33

Flags assigned during chemistry validation are shown.

Empty cell - Not Detected. J - The reported concentration is an estimated value. D - Result reported from a secondary dilution analysis.

Only Detected Results Reported.

TABLE 4-7
SUMMARY OF DETECTED COMPOUNDS IN SOIL VAPOR SAMPLES
FORMER GOODMAN BROTHERS SITE

Location ID		**FGB SS-01**	**FGB SS-02**	**FGB SS-03**	**FGB SS-03**	**FGB SS-05**
Sample ID		**224211-SS-01**	**224211-SS-02**	**20190514-FD-02**	**224211-SS-03**	**224211-SS-05**
Matrix		**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**
Depth Interval (ft)		**-**	**-**	**-**	**-**	**-**
Date Sampled		**05/14/19**	**05/14/19**	**05/14/19**	**05/14/19**	**05/14/19**
Parameter	**Units**			Field Duplicate (1-1)		
Volatile Organic Compounds						
Chloromethane	UG/M3					
Cyclohexane	UG/M3		150	4,500	7,100	
Dichlorodifluoromethane	UG/M3					2.3
Ethanol	UG/M3			5,600 J	9,700 J	37 J
Ethyl acetate	UG/M3					
Ethylbenzene	UG/M3		27	7,700 J	13,000 J	3.6
Isopropyl alcohol	UG/M3			4,200 J	7,100 J	
Methyl ethyl ketone (2-Butanone)	UG/M3					12
Methylene chloride	UG/M3		110	84,000 J	150,000 DJ	
n-Heptane	UG/M3	21	38	4,400	6,800	
n-Hexane	UG/M3		460	13,000	21,000	
Styrene	UG/M3					
Tetrachloroethene	UG/M3	1,500	1,500	1,700,000 D	2,400,000 D	250
Toluene	UG/M3	42	320	44,000	66,000	5.6
Trichloroethene	UG/M3	1,200	1,400	2,000,000 D	2,800,000 D	330
Trichlorofluoromethane	UG/M3		390	6,600 J	12,000 J	
Vinyl chloride	UG/M3	1,300	8,600 D	96,000 D	150,000 D	0.52
Xylene (total)	UG/M3	28	142	23,800	39,000	32

Flags assigned during chemistry validation are shown.

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Only Detected Results Reported.

TABLE 4-7
SUMMARY OF DETECTED COMPOUNDS IN SOIL VAPOR SAMPLES
FORMER GOODMAN BROTHERS SITE

Location ID		FGB SS-06	FGB SS-07	FGB SS-08	FGB SS-09	FGB SS-09
Sample ID		224211-SS-06	224211-SS-07	224211-SS-08	20190513-FD-01	224211-SS-09
Matrix		Subslab Vapor	Subslab Vapor	Subslab Vapor	Subslab Vapor	Subslab Vapor
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/14/19	05/14/19	05/14/19	05/13/19	05/13/19
Parameter	**Units**				Field Duplicate (1-1)	
Volatile Organic Compounds						
1,1,1-Trichloroethane	UG/M3	20	60	150	18	20
1,1,2-Trichloro-1,2,2-trifluoroethane	UG/M3	170	1,300 D		7.0	7.6
1,1-Dichloroethane	UG/M3	150	340	1.2		
1,1-Dichloroethene	UG/M3		4.9			
1,2,4-Trimethylbenzene	UG/M3					
1,2-Dichlorobenzene	UG/M3					
1,2-Dichloroethane	UG/M3	2.7		9.3		
1,2-Dichloroethene (cis)	UG/M3	83	1,700 D	0.92		0.84
1,2-Dichloroethene (trans)	UG/M3	9.4	29			
1,2-Dichloropropane	UG/M3		0.57			
1,3,5-Trimethylbenzene (Mesitylene)	UG/M3		0.63	1.1		0.58
1,3-Butadiene	UG/M3			1.8	1.1	1.3
1,4-Dichlorobenzene	UG/M3	0.81	0.69			
1-Propene	UG/M3					11
4-Ethyltoluene	UG/M3					
4-Methyl-2-pentanone	UG/M3	0.52			1.2	1.1
Acetone	UG/M3	120	240	42	59	67
Benzene	UG/M3	1.2	2.0	5.5	2.2	2.4
Carbon disulfide	UG/M3	34		930 D	6.9	7.8
Carbon tetrachloride	UG/M3	2.1		0.89		
Chlorobenzene	UG/M3					
Chloroethane	UG/M3					
Chloroform	UG/M3	18	23	2.5	3.9	4.2

Flags assigned during chemistry validation are shown.

Empty cell - Not Detected.   J - The reported concentration is an estimated value.   D - Result reported from a secondary dilution analysis.

Only Detected Results Reported.

TABLE 4-7
SUMMARY OF DETECTED COMPOUNDS IN SOIL VAPOR SAMPLES
FORMER GOODMAN BROTHERS SITE

Location ID		**FGB SS-06**	**FGB SS-07**	**FGB SS-08**	**FGB SS-09**	**FGB SS-09**
Sample ID		**224211-SS-06**	**224211-SS-07**	**224211-SS-08**	**20190513-FD-01**	**224211-SS-09**
Matrix		**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**	**Subslab Vapor**
Depth Interval (ft)		-	-	-	-	-
Date Sampled		**05/14/19**	**05/14/19**	**05/14/19**	**05/13/19**	**05/13/19**
Parameter	**Units**				Field Duplicate (1-1)	
Volatile Organic Compounds						
Chloromethane	UG/M3					1.2 J
Cyclohexane	UG/M3		8.6	5.5		
Dichlorodifluoromethane	UG/M3	2.3		2.2		2.1 J
Ethanol	UG/M3	21 J	66 J	24 J	14 J	14 J
Ethyl acetate	UG/M3			9.6		
Ethylbenzene	UG/M3	2.0	6.3	1.1	1.2	1.1
Isopropyl alcohol	UG/M3		72			
Methyl ethyl ketone (2-Butanone)	UG/M3			92		
Methylene chloride	UG/M3		16			
n-Heptane	UG/M3	0.51		6.1	2.5	2.5
n-Hexane	UG/M3					
Styrene	UG/M3			1.2		
Tetrachloroethene	UG/M3	2,400 D	3,100 D	9.2	45	49
Toluene	UG/M3	6.4	6.5	3.9	4.0	6.6
Trichloroethene	UG/M3	310	430	2.9	41	44
Trichlorofluoromethane	UG/M3		10	34	36	42
Vinyl chloride	UG/M3	0.28	5.8			
Xylene (total)	UG/M3	14	49	5.9	8.5	8.4

Flags assigned during chemistry validation are shown.

Empty cell - Not Detected.   J - The reported concentration is an estimated value.   D - Result reported from a secondary dilution analysis.

Only Detected Results Reported.

TABLE 4-7

SUMMARY OF DETECTED COMPOUNDS IN SOIL VAPOR SAMPLES
FORMER GOODMAN BROTHERS SITE

Location ID		FGB SS-10	FGB SS-11
Sample ID		224211-SS-10	224211-SS-11
Matrix		Subslab Vapor	Subslab Vapor
Depth Interval (ft)		-	-
Date Sampled		05/13/19	05/13/19
Parameter	**Units**		
Volatile Organic Compounds			
1,1,1-Trichloroethane	UG/M3	140	120
1,1,2-Trichloro-1,2,2-trifluoroethane	UG/M3	1,300 D	
1,1-Dichloroethane	UG/M3	74	1,300
1,1-Dichloroethene	UG/M3		
1,2,4-Trimethylbenzene	UG/M3		
1,2-Dichlorobenzene	UG/M3		
1,2-Dichloroethane	UG/M3		77
1,2-Dichloroethene (cis)	UG/M3	0.61	300
1,2-Dichloroethene (trans)	UG/M3		32
1,2-Dichloropropane	UG/M3		7.6
1,3,5-Trimethylbenzene (Mesitylene)	UG/M3		
1,3-Butadiene	UG/M3		
1,4-Dichlorobenzene	UG/M3		
1-Propene	UG/M3		
4-Ethyltoluene	UG/M3		
4-Methyl-2-pentanone	UG/M3		
Acetone	UG/M3		450
Benzene	UG/M3		7.1
Carbon disulfide	UG/M3		
Carbon tetrachloride	UG/M3		
Chlorobenzene	UG/M3		
Chloroethane	UG/M3		51
Chloroform	UG/M3		

Flags assigned during chemistry validation are shown.

Empty cell - Not Detected. J - The reported concentration is an estimated value. D - Result reported from a secondary dilution analysis.

Only Detected Results Reported.

TABLE 4-7
SUMMARY OF DETECTED COMPOUNDS IN SOIL VAPOR SAMPLES
FORMER GOODMAN BROTHERS SITE

Location ID		**FGB SS-10**	**FGB SS-11**
Sample ID		**224211-SS-10**	**224211-SS-11**
Matrix		**Subslab Vapor**	**Subslab Vapor**
Depth Interval (ft)		**-**	**-**
Date Sampled		**05/13/19**	**05/13/19**
Parameter	**Units**		
Volatile Organic Compounds			
Chloromethane	UG/M3		
Cyclohexane	UG/M3		69
Dichlorodifluoromethane	UG/M3		
Ethanol	UG/M3	42 J	85 J
Ethyl acetate	UG/M3		
Ethylbenzene	UG/M3	1.5	64
Isopropyl alcohol	UG/M3		
Methyl ethyl ketone (2-Butanone)	UG/M3		
Methylene chloride	UG/M3		
n-Heptane	UG/M3	67	330
n-Hexane	UG/M3	170 D	150
Styrene	UG/M3		
Tetrachloroethene	UG/M3	7.3	55
Toluene	UG/M3	9.3	350
Trichloroethene	UG/M3	1.7	370
Trichlorofluoromethane	UG/M3	2.6	
Vinyl chloride	UG/M3		37
Xylene (total)	UG/M3	7.3	780

Flags assigned during chemistry validation are shown.

Empty cell - Not Detected.   J - The reported concentration is an estimated value.   D - Result reported from a secondary dilution analysis.