

FORMER COMMANDER OIL TERMINAL
1 COMMANDER SQUARE
OYSTER BAY, NEW YORK
NYSDEC BCP ID: C130244

REMEDIAL INVESTIGATION WORK PLAN

SUBMITTED TO:



New York State Department of Environmental Conservation
Division of Environmental Remediation
SUNY Stony Brook
50 Circle Road
Stony Brook, New York 11790-3409

PREPARED FOR:

Commander Terminals Holdings, LLC
255 South Street
Oyster Bay, New York 11771

PREPARED BY:



P.W. Grosser Consulting, Inc.
630 Johnson Avenue, Suite 7
Bohemia, New York 11716
Phone: 631-589-6353
Fax: 631-589-8705

James Rhodes, PG, COO
Thomas Melia, PG, Sr. Project Manager

jimr@pwgrosser.com
thomasm@pwgrosser.com

PWGC Project Number: CTH1901

DECEMBER 2020



P.W. GROSSER CONSULTING, INC.
PROJECT No. CTH1901
New York State Department of Environmental Conservation
Brownfield Site No. C130244

REMEDIAL INVESTIGATION WORK PLAN

Former Commander Oil Terminal
1 Commander Square
Oyster Bay, New York

SUBMITTED:
December 2020

PREPARED FOR:

New York State Department of Environmental Conservation
Division of Environmental Remediation
SUNY Stony Brook
50 Circle Road
Stony Brook, New York 11790-3409

ON BEHALF OF:

Commander Terminals Holdings, LLC
255 South Street
Oyster Bay, New York 11771

PREPARED BY:

P.W. Grosser Consulting, Inc.
630 Johnson Avenue, Suite 7
Bohemia, New York 11716



**REMEDIAL INVESTIGATION WORK PLAN
FOMER COMMANDER OIL TERMINAL
NYSDEC BCP ID: C130244**

TABLE OF CONTENTS		PAGE
1.0	INTRODUCTION	1
2.0	SITE DESCRIPTION AND HISTORY	2
2.1	Site Description	2
2.2	Site History	2
2.3	Regional Geology/Hydrogeology	2
2.4	Site Geology/Hydrogeology	3
2.5	Current Site Use	3
2.6	Future Site Use	3
2.7	Previous Environmental Reports	3
2.7.1	Phase I ESA (August 2019)	4
2.7.2	Limited Subsurface Investigation Report (July 2020)	5
2.7.3	Site Status Update Report - Second Quarter 2020 (July 2020)	6
2.7.4	CVOC Source Area Remediation and Groundwater Assessment (January 2011)	7
2.7.5	Baseline Environmental Site Assessment dated (November 10, 2008)	8
3.0	STANDARDS, CRITERIA, AND GUIDANCE (SCGS)	9
4.0	OBJECTIVES, SCOPE AND RATIONALE	10
4.1	Geophysical Survey	10
4.1.1	Electromagnetic Survey	10
4.1.2	Ground Penetrating Radar Survey	11
4.1.3	Exploratory Test Pits	12
4.2	AOC1 – CVOC Impacted Soils	13
4.2.1	Sampling Protocol	13
4.2.2	Sample Analysis	13
4.3	AOC2 – Petroleum Impacted Soils	14
4.3.1	Sampling Protocol	14
4.3.2	Sample Analysis	15
4.4	AOC3 – General Soil Quality	16
4.4.1	Sampling Protocol	16
4.4.2	Sample Analysis	16
4.5	AOC4 – Groundwater Impact	17
4.5.1	Cluster Well Installation	17
4.5.2	Monitoring Well Sampling	18
4.5.3	Temporary Sampling Point Installation & Sampling	18
4.5.4	Sample Analysis	19
4.6	AOC5 - Soil Vapor Impact	19
4.6.1	Sampling Protocol	20
4.6.2	Sample Analysis	21
4.7	On-site and Off-site Qualitative Human Health Exposure Evaluation	21



**REMEDIAL INVESTIGATION WORK PLAN
FOMER COMMANDER OIL TERMINAL
NYSDEC BCP ID: C130244**

TABLE OF CONTENTS		PAGE
5.0	QUALITY ASSURANCE PROJECT PLAN	22
5.1	Project Organization	22
5.2	Laboratory Analysis.....	23
5.2.1	Soil Samples.....	26
5.2.2	Groundwater Samples.....	26
5.3	Field/Laboratory Data Control Requirements	26
5.4	Special Sampling Considerations for PFAS Sampling	27
5.5	Sample Identification	28
5.6	Chain-of-Custody, Sample Packaging and Shipment	29
5.7	Data Usability and Validation.....	29
5.7.1	Data Usability and Validation Requirements	29
5.7.2	Data Usability and Validation Methods.....	29
5.8	Field Equipment Calibration.....	30
5.9	Equipment Decontamination.....	30
5.9.1	General Procedures	30
5.9.2	Drilling Equipment	30
5.9.3	Sampling Equipment.....	30
5.9.4	Meters and Probes	31
5.10	Management of Investigation Derived Waste	31
5.11	Field Documentation.....	31
6.0	REMEDIAL INVESTIGATION REPORT PREPARATION	33
7.0	HEALTH AND SAFETY	34
8.0	COMMUNITY AIR MONITORING PLAN.....	35
9.0	REFERENCES	36



**REMEDIAL INVESTIGATION WORK PLAN
FOMER COMMANDER OIL TERMINAL
NYSDEC BCP ID: C130244**

FIGURES

Figure 1	Vicinity Map
Figure 2	Site Plan
Figure 3	Historic Soil Sample Results
Figure 4	Historic Groundwater Sample Results – Petroleum
Figure 5	Historic Groundwater Sample Results - CVOCs
Figure 6	Proposed Soil Sampling Locations
Figure 7	Proposed Groundwater Sample Locations
Figure 8	Proposed Soil Vapor Sample Locations

APPENDICES

Appendix A	USEPA Low-Flow Groundwater Sampling Procedure
Appendix B	Project Team Resumes
Appendix C	Health and Safety Plan
Appendix D	Community Air Monitoring Plan



CERTIFICATION

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

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

12-22-2020

Signature

Date

It is a violation of Article 145 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 145, New York State Education Law.



1.0 INTRODUCTION

P.W. Grosser Consulting, Inc. (PWGC) has prepared the following Remedial Investigation Work Plan (RIWP) to outline procedures and a scope of work intended to delineate impacted areas of concern at the Former Commander Oil Terminal site (“Site”) located at 1 Commander Square, Oyster Bay, New York.

The Applicant, Commander Terminals Holdings, LLC, has been accepted into the New York State Department of Environmental Conservation’s (NYSDEC) Brownfield Cleanup Program (BCP) as a volunteer as set forth in a Brownfield Cleanup Agreement (BCA), dated September 24, 2020 (Site No. C130244). As such, the proposed Remedial Investigation (RI) is intended to delineate potential areas of concern within the property boundary and evaluate whether off-site adjacent properties may be impacted.



2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Description

The site is located at 1 Commander Square, Oyster Bay, New York. The site is located within the Town of Oyster Bay and Nassau County. The site is identified as Section 27, Block 16, Lots 2, 3, 4, and 5 in the Nassau County Tax Map. The Site measures approximately 3.17 acres and is bounded by a commercial property (boat storage, shellfish farm) to the north, White's Creek to the south, Oyster Bay Harbor to the east, and Bay Avenue to the west.

A Vicinity Map is included as **Figure 1**. A Site Plan is included as **Figure 2**.

2.2 Site History

Based on review of historic imagery (Sanborn fire insurance maps, aerial photos, topographic maps), the property was initially developed some time prior to 1897, which is the earliest available historical image of the site (topographic map and Sanborn map). Usage subsequent to 1897 is as follows:

- 1897 to 1909 – the eastern portion of the property is used as a sawmill. The western portion of the property is occupied by residential dwellings.
- 1915 to 1922 – the central and eastern portions of the site are used as an ice plant and coal yard. The western portion of the site is occupied by residential dwellings.
- 1928 - the central and eastern portions of the site are used as an ice plant. The western portion of the site is occupied by residential dwellings.
- 1938 to 1958 – the eastern portion of the site is occupied by Commander Oil with 12 ASTs containing fuel oil, gasoline and kerosene. The central portion of the site is occupied by an ice plant and the western portion of the site is occupied by residential dwellings.
- 1962 to present – the entire site is occupied by a bulk fueling terminal with 21 ASTs present.

2.3 Regional Geology/Hydrogeology

The geologic setting of Long Island is well documented and consists of crystalline bedrock composed of schist and gneiss overlain by layers of unconsolidated deposits. Immediately overlying the bedrock is the Raritan Formation, consisting of the Lloyd sand confined by the Raritan Clay Member. The Lloyd sand is an aquifer and consists of discontinuous layers of gravel, sand, sandy and silty clay, and solid clay. The Raritan Clay is a solid and silty clay with: few lenses of sand and gravel; abundant lignite and pyrite; and gray, red or white in color.

Above the Raritan Clay lies the Magothy Formation. The Magothy Aquifer consists of layers of fine to coarse sand of moderate to high permeability, with inter-bedded lenses of silt and clay of low permeability resulting in areas of preferential horizontal flow. Therefore, this aquifer generally becomes more confined with depth. The Magothy Aquifer is overlain by the Upper Glacial Aquifer. The Upper Glacial Aquifer is the water table aquifer at this location and is comprised of medium to coarse sand and gravel with occasional thin lenses of fine sand and brown clay. This aquifer extends from the land surface to the top of the Magothy and, therefore, is hydraulically connected to the Magothy Aquifer.

2.4 Site Geology/Hydrogeology

Based on previous investigations at the Site, stratigraphy at the property, from the surface down, consists of fill material and silty sand from grade to an organic peat layer that is present at depths ranging from approximately six to ten feet below grade. The thickness of the organic peat layer appears to range from approximately two to five feet. Beneath the peat layer soils consist of a mix of fine to coarse grained sands and gravel to approximately 30 feet below grade. The depth to groundwater beneath the site ranges from approximately three to seven feet below grade across the site. Groundwater beneath the site appears to flow toward the southeast (above the peat layer) and east (below the peat layer); a 2011 tidal study performed at the site indicated that tidal influence on groundwater flow is limited to the aquifer formation below the peat layer.

2.5 Current Site Use

The Site is currently utilized as a Major Oil Storage Facility (MOSF) operated by Global Commander Oyster Bay. The MOSF consists of 21 large capacity ASTs, a fueling rack, office building and garage building.

2.6 Future Site Use

The proposed plan for the project is to investigate and remediate the site as part of redevelopment. Development plans have not been finalized for the site; however, the future re-development is expected to consist of a mixed use (commercial and residential) development.

2.7 Previous Environmental Reports

Multiple environmental investigations and assessments have previously been performed at the site. Additionally, groundwater monitoring and sampling related to open NYSDEC spill incidents is performed on a



quarterly basis. Relevant reports are summarized below and were previously provided to NYSDEC; historical soil and groundwater sample data are included in **Figures 3 through 5**.

2.7.1 Phase I ESA (August 2019)

PWGC prepared a Phase I ESA for the site in July 2019. Work was conducted in accordance with the American Society for Testing and Materials (ASTM) Standard E 1527-13 (Standard Practices for Environmental Site Assessment: Phase I Environmental Site Assessment Process), 40 Code of Federal Regulations (CFR) Part 312 (Standards and Practices for All Appropriate Inquiry; Final Rule). Findings of the Phase I ESA are summarized below:

PWGC evaluated the findings associated with the subject property and identified multiple Recognized Environmental Conditions (RECs) with respect to the subject property, as summarized below:

- NYSDEC Spill #85-00426 is an active spill onsite which corresponds to the presence of petroleum impact in the soil and groundwater on the eastern portion of the property including the presence of free product in monitoring wells and free product seeping past the seawall and into Oyster Bay Harbor. The impact of this spill has been monitored routinely and remedial efforts including product removal and chemical oxidation have been applied. However, the impacts of the spill are still present onsite and remains an environmental concern.
- NYSDEC Spill #99-25216 is an active spill onsite which corresponds to the presence of chlorinated solvent impact in the soil and groundwater on the eastern portion of the property. The spill originally occurred in 1995 when approximately 300 gallons of trichloroethene was released to the surface while filling up a coolant storage tank. NYSDEC database notes indicate that most of the surficial spill was cleaned up, but no post cleanup subsurface sampling was performed at that time. The spill was closed by NYSDEC in August 2005 but re-opened in June 2009 after a Baseline ESA at the site identified chlorinated solvent impact in soil and groundwater which was reported to NYSDEC by the current property owner. Remedial activities since 2009 have involved the removal of approximately 125 tons of hazardous soils from the spill area and the installation of a groundwater treatment system. However, the impacts of the spill are still present onsite and contamination from this spill has possibly migrated into the adjacent property to the north.
- The site appears to have been historically used for industrial purposes, including lumber processing (sawmill), coal storage, and gasoline, diesel, and fuel-oil storage. Lumber processing is commonly

associated with the use of heavy machinery and the use of metals and/or creosote for wood preserving. Coal storage can impact the subsurface with heavy metals and VOCs, especially if coal was staged directly on the ground surface. Prior to approximately 2005, the site operated as a MOSF storing and distributing gasoline, fuel-oil, and diesel fuel. Currently, the site is used for only fuel-oil and diesel fuel storage and distribution as it remains an active MOSF. Additionally, three active 275-gallon heating oil ASTs are present onsite to accommodate the heating systems associated with the buildings. Although the ASTs onsite were not identified to be in poor condition, the prolonged use as a MOSF with several ASTs and frequent filling and distribution events occurring, it cannot be ruled out that the site's use as a MOSF has impacted the subsurface.

- The subject site is identified in the database report as a RCRA generator. This RCRA listing appears to be associated with the generation of hazardous chlorinated solvent waste associated with the former gasoline vapor coolant system, remedial activities associated with NYSDEC Spill #99-25216, and waste associated with the groundwater treatment system. The RCRA listing is associated with chlorinated solvent impact onsite which is an environmental concern.
- The subject site has the potential for vapor encroachment due to the documented active TCE and petroleum spills at the site. Such impact can off gas into the vapor phase and cause vapor intrusion issues within onsite buildings.
- The adjacent property to the north was identified to have been used historically for coal storage and to have contained two gasoline USTs onsite. Coal storage can impact the subsurface with contaminants namely heavy metals and VOCs, especially if coal was staged directly on the ground surface, and gasoline USTs are prone to leaks which can impact the subsurface. If potential impact from the coal storage and/or the gasoline UST impacted groundwater, it cannot be ruled out that contamination associated with the potential impact has migrated onto the subject property.

2.7.2 Limited Subsurface Investigation Report (July 2020)

PWGC performed a Limited Subsurface Investigation (LSSI) at the site in July 2020. The LSSI consisted of the collection of soil and groundwater samples from beneath the western portion of the site (Tax Lots 4 & 5). Findings of the LSSI included the following:

- A geophysical survey identified one approximately 1,000-gallon UST abandoned in place on the eastern side of the garage building.



- Petroleum related VOC and SVOC impact above NYSDEC RRSCOs and/or POGSCOs was identified in soil samples collected surrounding the tank containment dike.
- Petroleum related VOC and SVOC impact above NYSDEC standards was identified in groundwater samples collected from south and east (downgradient) of the tank containment dike.
- CVOC impact above NYSDEC standards was not detected in groundwater samples collected as part of the LSSI.

2.7.3 Site Status Update Report - Second Quarter 2020 (July 2020)

Routine groundwater monitoring and remediation is currently being performed at the site by VHB, which is documented in quarterly status reports prepared by VHB and submitted to NYSDEC. As of the date of this RIWP the Second Quarter 2020 Site Status Update Report dated July 2020 is the most recent quarterly report prepared available for the site.

Routine monitoring and remediation during the second quarter 2020 consisted of monthly gauging of onsite monitoring wells for the presence of light non-aqueous phase liquid (LNAPL), quarterly collection of groundwater samples from 24 monitoring wells (wells containing LNAPL excluded from sampling), operation, monitoring and maintenance (OM&M) inspection of an onsite groundwater pump and treat (GWPT) system and an onsite ozone in-situ chemical oxidation (ISCO) remedial system, OM&M of an oil absorbent boom at the northeast corner of the seawall. Findings of second quarter monitoring and relevant historical information in the report included the following:

- LNAPL was detected in five onsite monitoring wells (MW-6, MW-15, MW-18, MW-19 and RW-1), with a maximum thickness of 0.09 feet in monitoring well RW-1. Free product detections were intermittent, as free product was not detected in wells MW-6 and MW-19 during the June monthly monitoring event.
- Petroleum related impact (BTEX and MTBE) were detected at concentrations exceeding their respective AWQS in groundwater samples collected from 14 monitoring wells sampled with the highest total BTEX concentration of 553 ppb detected in the sample collected from monitoring well MW-19. BTEX and MTBE detections were limited to shallow wells screened above the peat layer present at approximately six to ten feet below grade beneath the site.
- CVOC impact, including TCE, DCE, vinyl chloride, was detected at concentrations exceeding their respective AWQS in groundwater samples collected from 22 monitoring wells sampled with the highest total CVOC concentration of 293,290 ppb detected in the sample collected from monitoring well MW-

14. CVOC impact was detected in monitoring wells screened both above and below the peat layer present at approximately six to ten feet below grade beneath the site.

- An air sparge/soil vapor extraction (AS/SVE) system operated at the site from November 2011 to December 2013 and removed approximately 1428 pounds of VOCs.
- An in-situ ozone injection system was installed at the site in June 2017 to address CVOCs beneath the northern portion of the property. This system is currently operational.
- During its lifetime from April 2010 to June 26, 2020, the GWPT system has pumped and treated approximately 7,063,500 gallons of groundwater. Post-treatment effluent samples did not exceed their respective regulatory standards during the second quarter of 2020. In addition, the activated carbon was replaced prior to reactivation of the GWPT system in March 2020. This system is currently operational; however, it is winterized and shut down during winter months to avoid freezing.
- Between June and December 2008 approximately 5250 gallons of a chemical oxidant (Adventus EHC-O) was injected into and behind the northeast corner of the site to address sheen concerns in the adjacent White's Creek.
- CVOC impact appears to be contained onsite and not migrating off of the subject property.

2.7.4 CVOC Source Area Remediation and Groundwater Assessment (January 2011)

Kleinfelder East Inc. (Kleinfelder) performed remediation and groundwater sampling in the suspected CVOC source area in January 2011. The scope of work included the removal of impacted soils, collection of endpoint soil samples, installation and sampling of groundwater vertical profiles, and installation and sampling of monitoring wells. Findings of the report include the following:

- Approximately 58 tons of CVOC impacted soils were removed from a 15 by 40-foot area near the northern property boundary. Due to vapor emissions during excavation (elevated levels of vinyl chloride) use of a foam vapor suppressant was required within the excavation. Excavation depths were limited by the presence of shallow groundwater and the presence of concrete slabs below grade. Six endpoint soil samples were collected from the excavation prior to backfilling; three of the six endpoint samples contained petroleum or CVOC impact above Unrestricted Use SCOs.
- Seven temporary groundwater vertical profiles were installed. Groundwater samples were collected at a minimum of three depth intervals at each vertical profile location. CVOCs at concentrations exceeding their respective AWQS were detected in at least one depth interval at each vertical profile location including samples collected as deep as 32 feet below grade.



- Three groundwater monitoring wells were installed above the peat layer. CVOCs at concentrations exceeding their respective AWQS were detected in each of these wells.

2.7.5 Baseline Environmental Site Assessment dated (November 10, 2008)

Environmental Compliance Services, Inc. (ECS) performed a Baseline Environmental Site Assessment in November 2008. The scope of work included installation of soil borings and monitoring wells, and collection of groundwater samples. Findings of the report include the following:

- Petroleum (BTEX and MTBE) and CVOC impact exceeding Unrestricted Use SCOs was detected in soils throughout the eastern and central portions of the site.
- Petroleum (BTEX and MTBE) and CVOC impact exceeding NYSDEC AWQs was detected in groundwater throughout the eastern and central portions of the site.
- In general, the Baseline ESA findings indicated that petroleum impact to soil and groundwater was primarily present beneath the central and southeastern portions of the site, while CVOC impact to soil and groundwater was primarily present beneath the north-central and central portions of the site.

The CVOC impact identified during this Baseline ESA appears to be related to the surface spill of TCE that occurred in 1995 (spill no. 9925216) which was closed by NYSDEC and subsequently re-opened after the current property owner reported the presence of CVOCs to NYSDEC following completion of the Baseline ESA.



3.0 STANDARDS, CRITERIA, AND GUIDANCE (SCGS)

Based on previous investigations at the site, the primary chemicals of potential concern (COPC) to be encountered at the site are VOCs and SVOCs related to the current/historical usage of the site as an oil terminal.

Applicable regulations at NYSDEC 6 NYCRR Part 375 provide soil cleanup objectives (SCOs) for Unrestricted Use, or restricted use based on the intended usage of the property. Restricted use SCOs include: Residential, Restricted Residential (single family houses not permitted), Commercial, or Industrial. The goal of the cleanup at the site is to achieve Track 1 status, therefore soil sample results will be compared to the Unrestricted Use SCOs. As the likely future intended use of the site is mixed use commercial/residential, soil sample results will also be compared to the Restricted Residential SCOs to evaluate a Track 2 or 4 cleanup in the event that Track 1 standards cannot be achieved.

Groundwater sample results will be compared to the NYSDEC Class GA Ambient Water Quality Standards (AWQS) as specified in the Technical Operation and Guidance Series (TOGS 1.1.1) Ambient Water Quality Standards and Guidance Values.

Soil vapor, indoor air and outdoor Air results will be compared to the Air Guideline Values (AGVs) and Soil Vapor/Indoor Air Decision Matrices specified in NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York.

4.0 OBJECTIVES, SCOPE AND RATIONALE

The primary objectives of the additional work detailed in this plan will be to collect the information and field data necessary to address data gaps pertaining to on-site issues. Based on previous investigations the following areas of concern (AOCs) have been identified for the purposes of this RI:

- AOC1 – CVOC impacted soils near the northern property boundary.
- AOC2 – Petroleum impacted soils throughout the site.
- AOC3 – General soil quality
- AOC4 – CVOC and petroleum impacted groundwater beneath the site.
- AOC5 – Potential soil vapor impact.

The Scope of Work for this RI to address the AOCs detailed above will include the following tasks:

- Geophysical survey
- Additional characterization of onsite soils.
- Additional characterization of on-site groundwater.
- Characterization of onsite soil vapor.
- On-site and off-site qualitative human health exposure evaluation.

4.1 Geophysical Survey

The previous geophysical survey performed as part of the historical investigation was limited to the western half of the site. To determine if subsurface anomalies are present at the site and to clear drilling locations, a geophysical survey will be performed.

4.1.1 *Electromagnetic Survey*

The electromagnetic (EM) method uses the principle of EM induction to measure the variability of electrical conductivity of subsurface materials and the presence of buried metal objects. Significant contrasts in the electrical properties between non-indigenous materials and surrounding soil enable accurate delineation of buried waste materials, fill, and air spaces. The large EM response to metal makes this technique particularly well suited to identify buried objects such as USTs, metallic wastes, buried drums, pipelines, reinforced building foundations, or other metal components of buried structures. It is, however, equally sensitive to metal objects on the ground surface, and it is important to take careful field notes that indicate the position of surface metal to avoid misinterpretation.



A Geonics EM-61 high-resolution time domain metal detector, or equivalent, will be used to conduct the first phase of the investigation. The EM-61 is used to detect both ferrous and non-ferrous metals buried in the upper 10 feet of the subsurface. A powerful transmitter generates a pulsed primary magnetic field, which induces eddy currents in nearby metal objects. The decay of these currents is measured by upper and lower receiver coils mounted in the coil assembly. The responses are recorded and displayed by an integrated data logger as two-channel information. The bottom channel is more sensitive to metallic objects in the shallow (upper few feet) subsurface, and the differential response is more sensitive to metal objects from 3 to 10 feet bgs. The EM-61 can detect a single 55-gallon drum at a depth of more than 10 feet beneath the instrument, yet it is relatively insensitive to interference from nearby surface metal such as fencing, buildings, and automobiles. The instrument is pulled along the ground surface by a single operator, and measurements are collected at desired intervals along the ground surface. The terrain at the site may limit the areas where the EM-61 survey can be completed.

A survey of the area will also be performed using a hand-held split-box metal detector (Fisher Model TW-6). The TW-6 is a split-box electromagnetic metal detector that is very sensitive to near surface ferrous metal objects and is very useful in detecting the surface expression of subsurface ferrous objects. This instrument is commonly used to identify buried storage tanks and other metallic objects.

Anomalies detected during the EM surveys will be marked on the ground and further investigated using ground-penetrating radar (GPR).

4.1.2 Ground Penetrating Radar Survey

The GPR survey will be performed in areas of anomalies detected by the EM survey. The GPR method is based upon the transmission of repetitive, radio-frequency EM pulses into the subsurface. When the transmitted energy of down-going wave contacts an interface of dissimilar electrical character, part of the energy is returned to the surface in the form of a reflected signal. This reflected signal is detected by a receiving transducer and is displayed on the screen of the GPR unit as well as being recorded on the internal hard drive.

The received GPR response remains constant as long as the electrical contrast between media is present and constant. Lateral or vertical changes in the electrical properties of the subsurface result in equivalent changes



in the GPR responses. The system records a continuous image of the subsurface by plotting two-way travel time of the reflected EM pulse versus distance traveled along the ground surface. Two-way travel time values are then converted to depth using known soil velocity functions. Each radar profile will be examined for characteristic GPR signatures that may indicate the presence of buried targets.

Following the geophysical survey, exploratory test pits may be conducted in the vicinity of anomalies in order to determine their origin, if necessary.

4.1.3 Exploratory Test Pits

Exploratory test pits may be performed in areas of anomalies identified during the geophysical survey, if necessary. Test pits will be excavated utilizing a mini-excavator or equivalent. During excavation, soil types, changes in lithology, and wastes (if any) encountered in the test pit will be documented.

If subsurface anomalies such as USTs, buried drums, etc. are identified during performance of test pit activities, their location will be recorded with a GPS and they will be addressed later as part of the remedial activities to be performed at the site.

PWGC does not anticipate that test pits will be necessary, or that soil samples will be collected from them. However, in the event grossly contaminated media is identified during installation of a test pit, a soil sample shall be collected of the material for characterization. The soil sample will be analyzed for:

- VOCs by USEPA Method 8260 (Part 375 List)
- SVOCs by USEPA Method 8270 (Part 375 List)
- Pesticides/PCBs by USEPA Method 8081/8082 (Part 375 List)
- Trivalent & Hexavalent Chromium by USEPA Method 7196
- Total Cyanide by USEPA Method 9012
- Metals by USEPA Method 6010/7471 (Part 375 List)
- Silvex by USEPA Method 8151
- Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) by USEPA Method 537 Modified
- 1,4-Dioxane by USEPA Method 8270-SIM



Soil samples collected for VOCs will be discrete samples (non-composite and non-homogenous) collected in Terra-core (or equivalent) sampling devices to minimize VOC loss.

4.2 AOC1 – CVOC Impacted Soils

Previous investigations at the site have identified an area of CVOC impacted soils near the northern property boundary. To further characterize subsurface conditions in this area, a minimum of five soil borings will be installed. Proposed soil boring locations are illustrated in **Figure 6**.

Soil sampling will be performed in accordance with the Division of Environmental Remediation (DER) DER-10 Technical Guidance for Site Investigation and Remediation, May 2010.

4.2.1 Sampling Protocol

Soil borings will be installed utilizing a Geoprobe® direct-push drill rig outfitted with a macro-core sampler and dedicated acetate liners. Soils will be collected continuously from ground surface to 20 feet below grade, or until no evidence of impact (PID response, etc.) is observed, whichever is shallower.

A minimum of one soil sample from each boring location will be submitted for laboratory analysis. Based on previous investigations, PWGC anticipates that a peat layer will be present in this area at approximately six to eight feet below grade. At boring locations where the peat layer is observed, samples will be collected from above and below the peat layer. Samples will be submitted for analysis from the two-foot interval(s) exhibiting the most evidence of impact (e.g. PID response, staining, odor); in the event that no evidence of impact is identified, sample intervals will be selected from the deepest two foot intervals above and below the peat layer.

4.2.2 Sample Analysis

All soil samples collected from AOC1 will be analyzed for:

- VOCs by USEPA Method 8260 (Part 375 List)

In addition to VOCs, a minimum of approximately 25% of samples associated with AOC1 will also be analyzed for the following parameters:

- SVOCs by USEPA Method 8270 (Part 375 List)
- Pesticides/PCBs by USEPA Method 8081/8082 (Part 375 List)
- Hexavalent Chromium by USEPA Method 7196

- Total Cyanide by USEPA Method 9012
- Metals by USEPA Method 6010/7471 (Part 375 List)
- Silvex by USEPA Method 8151
- PFAS by USEPA Method 537 Modified
- 1,4-Dioxane by USEPA Method 8270-SIM

Soil samples collected for VOCs will be discrete samples (non-composite and non-homogenous) collected in Terra-core (or equivalent) sampling devices to minimize VOC loss.

As detailed above, approximately 25% of samples collected will be analyzed for additional parameters beyond VOCs. At all intervals where VOCs are collected from analysis (as described in Section 4.2.1) a suitable volume of soil will be collected for the additional analyses specified above as well. Following completion of sample collection for AOC1, the 25% of samples to be analyzed for additional parameters will be selected from the appropriate number of sample intervals exhibiting the most evidence of impact within AOC1. At least one sample from above and below the peat layer will be submitted for analysis for the full list of parameters. In the event that no evidence of impact is identified, sample intervals from several depths will be submitted for analysis.

4.3 AOC2 – Petroleum Impacted Soils.

Previous investigations at the site have identified petroleum impacted soils throughout the site. To further characterize subsurface conditions in this area, a minimum of eight soil borings will be installed throughout the site biased toward areas where petroleum impact has been identified in the past. Proposed soil boring locations are illustrated in **Figure 6**.

Soil sampling will be performed in accordance with the Division of Environmental Remediation (DER) DER-10 Technical Guidance for Site Investigation and Remediation, May 2010.

4.3.1 Sampling Protocol

Soil borings will be installed utilizing a Geoprobe® direct-push drill rig outfitted with a macro-core sampler and dedicated acetate liners. Soils will be collected continuously from ground surface to 10 feet below grade, or until no evidence of impact (PID response, etc.) is observed, whichever is shallower.



At boring locations where evidence of significant petroleum impact and/or grossly contaminated media are encountered, additional step out borings will be installed to delineate the areal extent of such impact.

A minimum of one soil sample from each boring location will be submitted for laboratory analysis. Based on previous investigations, PWGC anticipates that a peat layer may be present at some soil boring locations associated with AOC2 at approximately six to eight feet below grade. At boring locations where the peat layer is observed, samples will be collected from above and below the peat layer. Samples will be submitted for analysis from the two-foot interval(s) exhibiting the most evidence of impact (e.g. PID response, staining, odor); in the event that no evidence of impact is identified, sample intervals will be selected from the deepest two foot intervals above and below the peat layer.

4.3.2 Sample Analysis

All soil samples collected from AOC2 will be analyzed for:

- VOCs by USEPA Method 8260 (Part 375 List)
- SVOCs by USEPA Method 8270 (Part 375 List)

In addition to VOCs and SVOCs, a minimum of approximately 25% of samples associated with AOC2 will also be analyzed for the following parameters:

- Pesticides/PCBs by USEPA Method 8081/8082 (Part 375 List)
- Hexavalent Chromium by USEPA Method 7196
- Total Cyanide by USEPA Method 9012
- Metals by USEPA Method 6010/7471 (Part 375 List)
- Silvex by USEPA Method 8151
- PFAS by USEPA Method 537 Modified
- 1,4-Dioxane by USEPA Method 8270-SIM

Soil samples collected for VOCs will be discrete samples (non-composite and non-homogenous) collected in Terra-core (or equivalent) sampling devices to minimize VOC loss.

As detailed above, approximately 25% of samples collected will be analyzed for additional parameters beyond VOCs and SVOCs. At all intervals where VOCs and SVOCs are collected for analysis (as described in Section 4.3.1)

a suitable volume of soil will be collected for the additional analyses specified above as well. Following completion of sample collection for AOC2, the 25% of samples to be analyzed for additional parameters will be selected from the appropriate number of sample intervals exhibiting the most evidence of impact within AOC2. At least one sample from above and below the peat layer will be submitted for analysis for the full list of parameters. In the event that no evidence of impact is identified, sample intervals from several depths will be submitted for analysis.

4.4 AOC3 – General Soil Quality

As the site has been utilized for commercial/industrial purposes since the late 1800s. Previous investigations at the site have focused primarily on petroleum and CVOC impact. Additional sampling will be performed to evaluate soil quality related to the historical usage of the site and general soil quality throughout the site. To further characterize subsurface conditions in this area, a minimum of five soil borings will be installed. Proposed soil boring locations are illustrated in **Figure 6**.

Soil sampling will be performed in accordance with the Division of Environmental Remediation (DER) DER-10 Technical Guidance for Site Investigation and Remediation, May 2010.

4.4.1 Sampling Protocol

Soil borings will be installed utilizing a Geoprobe® direct-push drill rig outfitted with a macro-core sampler and dedicated acetate liners. Soils will be collected continuously from ground surface to 10 feet below grade, or the top of the water table, whichever is shallower.

At boring locations where evidence of significant petroleum impact and/or grossly contaminated media are encountered, additional step out borings will be installed to delineate the areal extent of such impact.

A minimum of one soil sample from each boring location will be submitted for laboratory analysis. Samples will be submitted for analysis from the two-foot interval(s) exhibiting the most evidence of impact (e.g. PID response, staining, odor); in the event that no evidence of impact is identified, sample intervals will be selected from the deepest two foot intervals encountered above the water table.

4.4.2 Sample Analysis

All soil samples collected from AOC3 will be analyzed for:

- VOCs by USEPA Method 8260 (Part 375 List)
- SVOCs by USEPA Method 8270 (Part 375 List)
- Pesticides/PCBs by USEPA Method 8081/8082 (Part 375 List)
- Hexavalent Chromium by USEPA Method 7196
- Total Cyanide by USEPA Method 9012
- Metals by USEPA Method 6010/7471 (Part 375 List)
- Silvex by USEPA Method 8151
- PFAS by USEPA Method 537 Modified
- 1,4-Dioxane by USEPA Method 8270-SIM

Soil samples collected for VOCs will be discrete samples (non-composite and non-homogenous) collected in Terra-core (or equivalent) sampling devices to minimize VOC loss.

4.5 AOC4 – Groundwater Impact

Petroleum and CVOC impact have been documented at the site. Additional sampling will be performed to evaluate groundwater quality related to the historical commercial/industrial usage of the site.

Groundwater sampling will be performed in accordance with the Division of Environmental Remediation (DER) Draft DER-10 Technical Guidance for Site Investigation and Remediation, May 2012.

To characterize groundwater quality beneath the site groundwater samples will be collected from seven existing on-site monitoring wells, and three temporary monitoring wells installed in areas that lack permanent wells. To vertically delineate groundwater impact in the CVOC source area, two new cluster wells will be installed adjacent to the CVOC source area.

Proposed groundwater sample locations are illustrated in **Figure 7**.

4.5.1 Cluster Well Installation

To vertically delineate CVOC impact in the CVOC source area, two cluster wells will be installed. Cluster wells will be installed using a rotary drill rig outfitted for hollow stem auger (HSA) drilling.



Due to high levels of shallow CVOC impact in this area, efforts will be made to avoid cross contamination from shallow deeper depths. Drilling Equipment will be properly decontaminated prior to well installation (see Section 5.9), and bentonite seals will be installed between each cluster interval. However, it should be noted that due to the level of CVOC impact in the source area some cross contamination between shallow and deep may be unavoidable.

Cluster wells will be constructed of one-inch diameter schedule 40 PVC with five-foot screen sections with 0.010-inch slot set at 10-foot intervals. The annulus around each screen section will be filled with #2 morie sand (or equivalent), to one foot above the well screen. A two-foot bentonite seal will be installed between each screen section. Wells screens will be set with one interval above the peat layer (approximately 5 to 10 feet below grade) and two intervals below the peat layer (approximately 20 to 25 and 30 to 35 feet below grade).

Cluster wells will be finished with flush mount curb boxes. Monitoring well construction logs will be prepared for each monitoring well.

Following installation, cluster wells will be developed by over-pumping to restore the hydraulic properties of the aquifer. Well development will continue until the turbidity of the groundwater is less than or equal to 50 Nephelometric Turbidity Units (NTUs), or when pH, temperature, and conductivity measurements stabilize. Stabilization is considered achieved when three consecutive readings of these field parameters are within five percent of each other over a period of 15 minutes. Monitoring well development water will be containerized for off-site disposal.

4.5.2 Monitoring Well Sampling

Groundwater samples from existing monitoring wells will be collected in compliance with the United States Environmental Protection Agency (USEPA) Low Stress (Low Flow) Purging and Sampling Procedure for The Collection of Groundwater Samples from Monitoring Wells (September 2017). A copy of the procedure is included as **Appendix A**.

4.5.3 Temporary Sampling Point Installation & Sampling

Temporary groundwater sampling points will be collected utilizing Geoprobe® technology. At each temporary groundwater sampling location, a four-foot long screen point sampler will be driven to the desired depth (three

feet below the water table). This will allow the sampler screen to intersect the water table. At the desired depth, disposable polyethylene tubing with a stainless-steel check valve will be inserted through the probe rods into the water bearing zone. The tubing will then be oscillated using a peristaltic pump (low flow rate of a maximum of 200 ml/min) to purge the well prior to sampling. After purging each well volume field measurements will be collected using portable field instruments. Turbidity, pH, temperature, and conductivity measurements will be collected. Groundwater samples will be collected after readings stabilize. Stabilization is considered achieved when consecutive readings within five percent of each other are collected between purge volumes. If turbidity cannot be reduced to 50 NTUs, but other parameters stabilize, samples will be collected. All monitoring well purging data will be recorded in a well sampling log.

4.5.4 *Sample Analysis*

Groundwater samples will be analyzed for:

- VOCs by USEPA Method 8260 (Part 375 List)
- SVOCs by USEPA Method 8270 (Part 375 List)
- Pesticides/PCBs by USEPA Method 8081/8082 (Part 375 List)
- Hexavalent Chromium by USEPA Method 7196
- Total Cyanide by USEPA Method 9012
- Metals by USEPA Method 6010/7471 (Part 375 List) – total & dissolved
- Silvex by USEPA Method 8151
- PFAS by USEPA Method 537 Modified
- 1,4-Dioxane by USEPA Method 8270-SIM

4.6 **AOC5 – Soil Vapor Impact**

To date no soil vapor sampling has been performed at the site. Based on documented VOC impact at the site, the presence of impacted soil vapor is likely. To determine whether soil vapor intrusion may be a potential concern for the proposed redevelopment of the property, a total of four soil vapor sampling points will be installed. Due to the documented presence of high levels of CVOC impact beneath the north-central portion of the site, soil vapor samples from this area will be of limited utility. As such, for the purposes of this RI, soil vapor sampling will be limited to areas outside the CVOC plume area to evaluate soil vapor impact. Additional soil vapor evaluation in the CVOC plume area will be performed following the removal/remediation of the CVOC source area, if necessary. Proposed soil vapor sampling points are illustrated in **Figure 8**.



Soil vapor sampling point installation and sample collection will be performed in accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006), and USEPA Standard Operating Procedure (SOP) 2042, Soil Gas Sampling.

4.6.1 Sampling Protocol

Sampling points will be installed using a Geoprobe® direct-push drill rig or manually driven rods to a depth comparable of approximately one foot above the water table. Sampling points will be constructed of a dedicated stainless-steel screen fitted with inert tubing (e.g. polyethylene or Teflon®) to grade. Porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.) will be added to create a sampling zone 1 to 2 feet in length. The sampling point will be sealed above the sampling zone with bentonite slurry for a minimum distance of three feet (if possible, depending on the depth top groundwater) to prevent outdoor air infiltration and the remainder of the borehole will be backfilled with clean material.

Prior to sampling approximately two to three probe volumes will be purged at a flow rate less than 0.2 liters per minute. VOC concentrations will be recorded during purging utilizing a PID. As part of the vapor intrusion evaluation, a tracer gas will be used in accordance with NYSDOH protocols to serve as a quality assurance/quality control (QA/QC) device to verify the integrity of the soil vapor probe seal. Helium will be used as the tracer gas and a box will serve to keep it in contact with the probe during testing. A portable monitoring device will be used to analyze a sample of soil vapor for the tracer prior to sampling. If the tracer sample results show a significant presence of the tracer, the probe seals will be adjusted to prevent infiltration. At the conclusion of the sampling round, tracer monitoring will be performed a second time to confirm the integrity of the probe seals.

Soil vapor samples will be collected using one-liter SUMMA® canisters fitted with a pre-set flow regulator (approximately 8.3 milliliter per minute (mL/min)). The laboratory will provide batch certified-clean canisters with an initial vacuum of approximately 26 inches of mercury (in. of Hg) for sample collection and flow regulators pre-set to provide uniform sample collection over an approximate two-hour sampling period. Sample collection will be ceased (i.e., the valve on the canister closed) when approximately 2 in. of Hg vacuum remains in the canister, leaving a vacuum in the canister as a means for the laboratory to verify the canister did not leak while in transit.



4.6.2 *Sample Analysis*

Soil vapor samples will be analyzed for VOCs by USEPA Method TO-15 (Full List).

4.7 On-site and Off-site Qualitative Human Health Exposure Evaluation

A Qualitative Human Health Exposure Assessment will be completed for the site, characterizing the exposure setting, identifying exposure pathways, and evaluating contaminant fate and transport. The Qualitative Human Health Exposure Assessment will follow DER-10, appendix 3B and Section 3.3 (b) 8.



5.0 QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) presents the objectives, functional activities, methods, and QA/QC requirements associated with sample collection and laboratory analysis for characterization activities. The QAPP follows requirements detailed in DER-10, Section 2.

5.1 Project Organization

The investigative efforts defined in this RIWP will be implemented by PWGC on behalf of Commander Terminals Holdings, LLC. The following identifies the responsibilities of various organizations supporting the RI:

- The NYSDEC Project Manager (Tom Cuff) will be responsible for reviewing and approving this work plan, coordinating approval of requested modifications, and providing guidance on regulatory requirements.
- The PWGC Program Manager (James Rhodes and/or Paul Boyce) will provide technical expertise for review of the project plans, reports and ongoing field activities.
- The PWGC Quality Assurance Manager (Andrew Lockwood) will confirm the quality of work associated with the project is in accordance with all project plans.
- PWGC Project Manager (Thomas Melia) will be responsible for the day-to-day project management, task leadership, and project engineering support and for the planning and implementation of RI activities. The Project Manager is responsible for ensuring that the requirements of this RI work plan are implemented. The project manager will also act as the Site Health and Safety Manager (HSM).
- PWGC Field Team Leader (Nick Russell or designee) will be responsible for sample collection, oversight of subcontractor personnel, and coordination of daily field activities. The Field Team Leader will act as the Site Health and Safety Officer ensuring implementation of the Site Health and Safety Plan.
- A NYSDOH Environmental Laboratory Accreditation Program (ELAP) certified laboratory (Alpha Analytical Laboratories of Westborough, Massachusetts ELAP ID 11148 and 11627) will be contracted to perform required analyses and reporting, including Analytical Services Protocol (ASP) Category B Deliverables, which will allow for data validation.
- An independent third-party data validator (Laboratory Data Consultants of Carlsbad, California) will be contracted to perform data validation and prepare a Data Usability Summary Report (DUSR) in accordance with Section 5.7.
- Subcontractors will perform surveying, drilling, and/or sampling at the direction of the Field Team Leader in accordance with this work plan.

Qualifications for the project team are included in **Appendix A**.

5.2 Laboratory Analysis

Requirements for sample analysis are described below. All samples will be submitted to a NYSDOH ELAP certified laboratory (Alpha Analytical) for analysis. Analytical methods, preservation, container requirements, and holding times are summarized below:

ANALYTICAL METHODS (SOIL)

Analyte/ Analyte Group	Matrix	Method/ SOP	Container(s) (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Estimated Number of Samples to be Collected
TAL Metals	Soil	EPA 6010C	1 x 2 oz, glass	Metals ex	6 months	6 months	10 to 12
TCL VOCs	Soil	EPA 8260C	3 x 40 ml VOA, glass vial	1 x Methanol 2 x DI H ₂ O Cool ≤ 6 °C	48 hours	14 Days	23 to 31
TCL SVOCs	Soil	EPA 8270D	1 x 8 oz, glass	Cool ≤ 6 °C	14 days	40 days	16 to 24
PCBs	Soil	EPA 8082A	1 x 8 oz, glass	Cool ≤ 6 °C	14 days	40 Days	10 to 12
Cyanide	Soil	EPA 9010C/9012B	1 x 250 ml, plastic	Cool ≤ 6 °C	14 days	14 days	10 to 12
Pesticides	Soil	EPA 8081B	1 x 8 oz, glass	Cool ≤ 6 °C	14 days	40 days	10 to 12
Hexavalent Chromium	Soil	EPA 7196A	1 x 4 oz, glass	Cool ≤ 6 °C	14 Days	30 days	10 to 12
Silvex	Soil	EPA 8151A	1 x 4 oz, glass	Cool ≤ 6 °C	14 days	14 days	10 to 12
PFAS	Soil	EPA 537 (modified)	1 x 8 oz, glass	None	14 days	28 days	10 to 12
1,4-dioxane*	Soil	EPA 8270 (SIM)	1 x 8oz, glass	Cool ≤ 6 °C	14 days	40 days	10 to 12
*SIM Mode only necessary if EPA 8260 analysis cannot meet a MDL of 0.1 mg/kg							

ANALYTICAL METHODS (GROUNDWATER)

Analyte/ Analyte Group	Matrix	Method/ SOP	Container(s) (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Estimated Number of Samples to be Collected
Metals	Water	EPA 6020A	1 x 500 ml plastic	HNO ₃	6 months	6 months	10
VOCs	Water	EPA 8260C	3 x 40 ml VOA, glass vial	HCl Cool ≤ 6 °C	48 hours	14 Days	10
SVOCs	Water	EPA 8270D	2 x 1000 ml, amber glass	Cool ≤ 6 °C	7 days	40 days	10
PCBs	Water	EPA 8082A	1 x 1000 ml, amber glass	Cool ≤ 6 °C	7 days	40 Days	10
Cyanide	Water	EPA 9010C/9012B	1 x 250 ml, plastic	NaOH	14 days	14 days	10
Pesticides	Water	EPA 8081B	1 x 500 ml, amber glass	Cool ≤ 6 °C	7 days	40 days	10
Hexavalent Chromium	Water	EPA 7196A	1 x 500 ml plastic	Cool ≤ 6 °C	24 hours	14 days	10
Silvex	Water	EPA 8081B	1 x 500 ml, amber glass	Cool ≤ 6 °C	7 days	14 days	10
PFAS	Water	EPA 537 (modified)	3 x 250 ml HDPE, unlined cap	Trizma Cool < 6 °C	14 days	28 days	10
1,4-Dioxane*	Water	EPA 8270D SIM Mode	2 x 1000 ml, amber glass	Cool ≤ 6 °C	7 days	40 days	10

*SIM Mode to be used to meet required detection limit of 0.35 ug/L

Laboratory Method Detection Limits (MDLs) and Reporting Limits (RLs) for PFAS analysis are detailed in the tables below:

PFAS MDLs & RLs (SOIL)

Analyte	CAS Number	RL (ng/g)	MDL (ng/g)
Perfluorobutanoic Acid (PFBA)	375-22-4	1	0.0213
Perfluoropentanoic Acid (PFPeA)	2706-90-3	1	0.01035
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	1	0.0635
Perfluorohexanoic Acid (PFHxA)	307-24-4	1	0.064
Perfluoroheptanoic Acid (PFHpA)	375-85-9	1	0.064
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	1	0.057
Perfluorooctanoic Acid (PFOA)	335-67-1	1	0.04105
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	1	0.198

Analyte	CAS Number	RL (ng/g)	MDL (ng/g)
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	1	0.136
Perfluorononanoic Acid (PFNA)	375-95-1	1	0.083
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	1	0.1205
Perfluorodecanoic Acid (PFDA)	335-76-2	1	0.072
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	1	0.275
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2355-31-9	1	0.103
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	1	0.056
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	1	0.097
Perfluorooctanesulfonamide (FOSA)	754-91-6	1	0.1025
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	1	0.09
Perfluorododecanoic Acid (PFDoA)	307-55-1	1	0.086
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	1	0.062
Perfluorotetradecanoic Acid (PFTA)	376-06-7	1	0.07
PFOA/PFOS, Total		1	0.04105

PFAS MDLs & RLs (GROUNDWATER)

Analyte	CAS Number	RL (ng/L)	MDL (ng/L)
Perfluorobutanoic Acid (PFBA)	375-22-4	2	0.3732
Perfluoropentanoic Acid (PFPeA)	2706-90-3	2	0.464
Perfluorobutanesulfonic Acid (PFBS)	375-73-5	2	0.38
Perfluorohexanoic Acid (PFHxA)	307-24-4	2	0.492
Perfluoroheptanoic Acid (PFHpA)	375-85-9	2	0.372
Perfluorohexanesulfonic Acid (PFHxS)	355-46-4	2	0.436
Perfluorooctanoic Acid (PFOA)	335-67-1	2	0.46
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	27619-97-2	2	0.194
Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	2	0.52
Perfluorononanoic Acid (PFNA)	375-95-1	2	0.436
Perfluorooctanesulfonic Acid (PFOS)	1763-23-1	2	0.56
Perfluorodecanoic Acid (PFDA)	335-76-2	2	0.62
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	39108-34-4	2	0.2908
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	2355-31-9	2	0.2504
Perfluoroundecanoic Acid (PFUnA)	2058-94-8	2	0.424
Perfluorodecanesulfonic Acid (PFDS)	335-77-3	2	0.386
Perfluorooctanesulfonamide (FOSA)	754-91-6	2	0.556
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	2991-50-6	2	0.3728

Analyte	CAS Number	RL (ng/L)	MDL (ng/L)
Perfluorododecanoic Acid (PFDoA)	307-55-1	2	0.592
Perfluorotridecanoic Acid (PFTrDA)	72629-94-8	2	0.314
Perfluorotetradecanoic Acid (PFTA)	376-06-7	2	0.988
PFOA/PFOS, Total		2	0.46

5.2.1 Soil Samples

Soil samples will be collected as described in Section 4.1. Analysis will conform to NYSDEC Analytical Services Protocol (ASP) Category B data deliverables in accordance with NYSDEC DER-10, Appendix 2B, 1.0 (b), including calibration standards, surrogate recoveries, and chromatograms.

5.2.2 Groundwater Samples

Groundwater samples will be collected as described in Section 4.2. Analysis will conform to NYSDEC Analytical Services Protocol (ASP) Category B data deliverables in accordance with NYSDEC DER-10, Appendix 2B, 1.0 (b), including calibration standards, surrogate recoveries, and chromatograms.

5.3 Field/Laboratory Data Control Requirements

Quality Control (QC) procedures will be followed in the field and at the laboratory to facilitate that reliable data are obtained. When performing field sampling, care shall be taken to prevent the cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity. QC samples will include the following:

- Blind Duplicates – one per 20 environmental samples for each matrix sampled.
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) - one per 20 environmental samples for each matrix sampled.
- Equipment Blank – one per day for each matrix sampled.
- Field Blank – one per day when PFAS samples are collected.
- Trip Blank – one per day.

ESTIMATED QA/QC SAMPLE FREQUENCY

QA/QC Sample Type	Est. Total Soil Samples	Est. Days of Soil Sampling	Est. Total Soil QA/QC Samples	Est. Total Groundwater Samples	Est. Days of Groundwater Sampling	Est. Total Groundwater QA/QC Samples
Blind Duplicate	23 to 31	5	2	10	2	1
MS/MSD	23 to 31	5	2	10	2	1
Equipment Blank	23 to 31	5	2	10	2	1
Field Blank	23 to 31	5	5	10	2	2
Trip Blank	23 to 31	5	5	10	2	1

QA/QC Sample analysis will conform to NYSDEC ASP Category B data deliverables in accordance with NYSDEC DER-10, Appendix 2B, 1.0 (b), including calibration standards, surrogate recoveries, and chromatograms.

5.4 Special Sampling Considerations for PFAS Sampling

There are several potential sources of PFAS that could contribute to the cross-contamination of environmental samples collected during the RI. Weatherproof clothing, pens, logbooks, cosmetics, personal hygiene products, insect repellents, and sampling equipment could contain PFAS that could lead to false positive sampling results.

To ensure that the analytical results obtained during the RI are representative of the actual site conditions several measures should be taken:

- Collection of appropriate field QA/QC samples (blanks, duplicates, equipment rinseate samples, etc.) as detailed in Section 5.3.
- Analysis by the analytical laboratory using established laboratory QA/QC procedures and methods as detailed in Section 5.3.
- During decon, non-dedicated equipment to be used for PFAS sampling will be rinsed with PFAS free water supplied by the laboratory. Equipment will be allowed to fully air dry before use.
- New high-density polyethylene (HDPE) tubing shall be used at each sample location.
- Groundwater samples will be collected in laboratory supplied HDPE containers.
- New nitrile gloves shall be worn between each sample interval.
- Only clean cotton or synthetic clothes shall be worn – preferably washed more than six times, and without the use of fabric softeners. No waterproof or insecticide treated clothing, boots or rain jackets made or treated with Teflon products shall be used at the collection site. This includes all Gore-Tex® and Tyvek® products.

- Do not apply moisturizers or hand creams to hands or face on the day of sampling. No sunblock or insect repellants. Do not bring packaged food to the work site or use aluminum foil.
- Field notes shall be taken using a computer tablet or by using ink pens on non-water proof plain paper attached to a metal clipboard. Do not use Sharpies or markers. Transcribe field notes to Chain-of-Custody forms and official field books when back in the office after the collection process.
- For groundwater samples use only laboratory supplied 250 ml polypropylene sample bottles. Sample bottles should be pre-preserved by the laboratory, if dictated by the analysis method.
- Print labels before going into the field and apply to the sample containers.
- Use only laboratory supplied PFAS-free water for trip, field and equipment blanks.
- Place each sample container in a separate polypropylene zip-lock bag.
- For the shipping coolers, use only regular crushed ice packaged in polypropylene zip-lock plastic bags.
- Use only laboratory supplied shipping coolers that were used to ship sample containers for this project. Tape the cooler shut before shipping samples to the laboratory.

5.5 Sample Identification

Each sample will be identified with a set of information relating individual sample characteristics. Required information consists of Sample Designation, Depth, Date, Time, and Matrix. Examples of sample IDs are shown below.

- SB001(0-2') (soil sample, boring 001 from 0 to 2 feet)
- GW001(6-8') (groundwater sample, soil boring 001 from 6 to 8 feet)
- MW004 (groundwater sample, permanent monitoring well 004)
- CW001 (10-15') (groundwater sample, cluster well 001, 10 to 15 foot interval)
- SV001 (soil vapor point 001)
- SS001 (sub-slab vapor point 001)
- IA001 (indoor air sample 001)
- AA001 (ambient air quality sample 001)

Sample frequency, locations, depths, and nomenclature may change subject to field decisions and professional judgment.

5.6 Chain-of-Custody, Sample Packaging and Shipment

Each day that samples are collected, a chain-of-custody/request for analysis form will be completed and submitted to the laboratory with samples to be analyzed. A copy of the chain-of-custody will be retained by the Project Manager. The chain-of-custody will include the project name, sampler's signature, sample IDs, date and time of sample collection, and analysis requested.

Samples will be packaged and shipped in a manner that maintains sample preservation requirements during transport (i.e., ice to keep samples cool until receipt at the laboratory), ensures that sample holding times can be achieved by the laboratory, and prevents samples from being tampered with.

If a commercial carrier ships samples, a bill of lading (waybill) will be used as documentation of sample custody. Receipts for bills of lading and other documentation of shipment shall be maintained as part of the permanent custody documentation. Commercial carriers are not required to sign the chain-of-custody as long as it is enclosed in the shipping container and evidence tape (custody seal) remains in place on the shipping container.

5.7 Data Usability and Validation

The main purpose of the data is for use in defining the extent of contamination at the site, to aid in evaluation of potential human health and ecological exposure assessments, and to support remedial action decisions. Based upon this, data usability and validation will be performed as described below. Complete data packages will be archived in the project files, and if deemed necessary additional validation can be performed using procedures in the following sections.

5.7.1 Data Usability and Validation Requirements

Data usability and validation are performed on analytical data sets, primarily to confirm that sampling and chain-of-custody documentation are complete, sample IDs can be tied to specific sampling locations, samples were analyzed within the required holding times, and analyses are reported in conformance with NYSDEC ASP, Category B data deliverable requirements as applicable to the method utilized.

5.7.2 Data Usability and Validation Methods

A designee of the PWGC Project Manager will complete a data usability evaluation for the data collected during the RI and a data usability summary report (DUSR) will be prepared. The DUSR will be prepared in accordance with NYSDEC DER-10, Appendix 2B.

Independent third-party data validation will be performed on 5% of the sample data, or on one sample from each sample delivery group (SDG), whichever is greater. Data validation will be performed by a qualified subcontractor independent of the project.

5.8 Field Equipment Calibration

Equipment will be inspected and approved by the Field Team Leader before being used. Equipment will be calibrated to factory specifications, if required. Monitoring equipment will be calibrated following manufacturers recommended schedules. Daily field response checks and calibrations will be performed as necessary (i.e. PID calibrations) following manufacturers standard operating procedures. Equipment calibrations will be documented in a designated field logbook.

5.9 Equipment Decontamination

In order to minimize the potential for cross-contamination, non-dedicated drilling and sampling equipment shall be properly decontaminated prior to and between sampling/drilling locations.

5.9.1 General Procedures

Drilling equipment will be decontaminated in a designated area. Sampling equipment and probes will be decontaminated in an area covered with plastic sheeting near the sampling location. Waste material generated during decontamination activities will be containerized, stored and disposed of in accordance with the procedures detailed in Section 5.9. Decontamination of sampling equipment shall be kept to a minimum, and wherever possible, dedicated sampling equipment shall be used. Personnel directly involved in equipment decontamination shall wear appropriate personal protective equipment (PPE).

5.9.2 Drilling Equipment

Drilling equipment shall be decontaminated prior to performance of the first boring/excavation and between all subsequent borings/excavations. This shall include hand tools, casing, augers, drill rods, temporary well material and other related tools and equipment. Water used during drilling and/or steam cleaning operations shall be from a potable source.

5.9.3 Sampling Equipment

Sampling equipment (i.e., trowels, knives, split-spoons, bowls, hand augers, etc...) will be decontaminated prior to each use as follows:

- Laboratory-grade glassware detergent and tap water scrub to remove visual contamination
- Generous tap water rinse
- Distilled water rinse

5.9.4 *Meters and Probes*

All meters and probes that are used in the field (other than those used solely for air monitoring purposes, e.g., PID meters) will be decontaminated between uses as follows:

- Laboratory-grade detergent and tap water solution wash
- Tap water rinse
- Distilled water rinse (triple rinse)

5.10 **Management of Investigation Derived Waste**

Waste materials generated from the field operations may consist of soil cuttings, purge water, and miscellaneous solid materials such as personal protective equipment (PPE) and supplies. Investigative derived waste (IDW) generated during field operations will be disposed of in accordance with applicable regulations.

Soil cuttings generated from soil boring and well installation activities will be stored in 55-gallon drums. Drums will be labeled to indicate the source of the material and will be stored in a designated area on-site. Soil cores and cuttings will be field screened using a PID, while performing drilling operations. Drummed material will be disposed of at an off-site disposal facility. Following receipt of the analytical results, recommendations for disposition of the drummed material will be provided to the NYSDEC.

Development and purge water generated during the field activities will be stored in a portable holding tank and/or 55-gallon drums. Drums will be labeled to indicate the source of the fluid and will be stored in a designated area on-site. Drummed groundwater will be sampled to determine if discharge to the surface of the site is appropriate or off-site disposal is required. Following receipt of the groundwater sampling results, recommendations for disposition of the water will be provided to NYSDEC.

5.11 **Field Documentation**

Documentation will take place on either appropriate forms or in a dedicated site logbook. Permanent black or blue ink will be used to record information in the logbook. Errors in field documentation will be lined through, initialed, dated, and corrected. Forms will be kept by the PWGC Field Team Leader during the field activities.



Field activities will be documented in the field logbook. The logbook will contain waterproof pages that are consecutively numbered and be permanently bound with a hard cover. Upon completion of daily activities, unused portions of pages will be lined-through and initialed.

The primary purpose of the field logbook is to document the daily field activities and to provide descriptions of each activity. All entries in the field logbook will be recorded and dated by person making the entry.



6.0 REMEDIAL INVESTIGATION REPORT PREPARATION

The Remedial Investigation Report (RIR) will incorporate the methods and findings of the investigation activities performed as outlined in this work plan. The report will identify specific contamination concentrations throughout each media (e.g. soil, groundwater, etc.), delineate the extent of contamination in soil and groundwater, evaluate potential exposure pathways, and provide conclusions and recommendations for additional investigation and/or remedial action. Electronic copies of the Investigation Report will be submitted to the NYSDEC along with hard copies. Analytical results of the investigation will be submitted in the electronic data delivery (EDD) format through the Department's environmental information management system (EIMS).



7.0 HEALTH AND SAFETY

Field operations will be performed in accordance with the health and safety requirements to be provided in the site-specific Health and Safety Plan (HASP). The HASP is included as **Appendix C**. The HASP outlines the requirements for training, medical surveillance, daily tailgate meetings, emergency response, and accident and injury reporting.

Activity hazard analyses (AHAs) have been completed for identified work activities planned for the investigation.

The PWGC Field Team Leader will be responsible for implementing the HASP, completing the daily tailgate safety meetings and performing necessary Industrial Hygiene (IH) monitoring as specified in the HASP.



8.0 COMMUNITY AIR MONITORING PLAN

A site-specific Community Air Monitoring Plan (CAMP) has been prepared to provide measures for protection for the downwind community from potential airborne contaminants as a direct result of the Remedial Investigation. The CAMP is included as **Appendix D**.

The Community Air Monitoring Plan will be implemented and executed in accordance with the New York State Department of Health's (NYSDOH) Generic Community Air Monitoring Plan.



9.0 REFERENCES

NYSDEC, Division of Environmental Restoration, 6 NYCRR Part 375 Subpart 6, Remedial Program Soil Cleanup Objectives

NYSDEC, Division of Environmental Remediation, May 2012, DER-10, Technical Guidance for Site Investigation and Remediation.

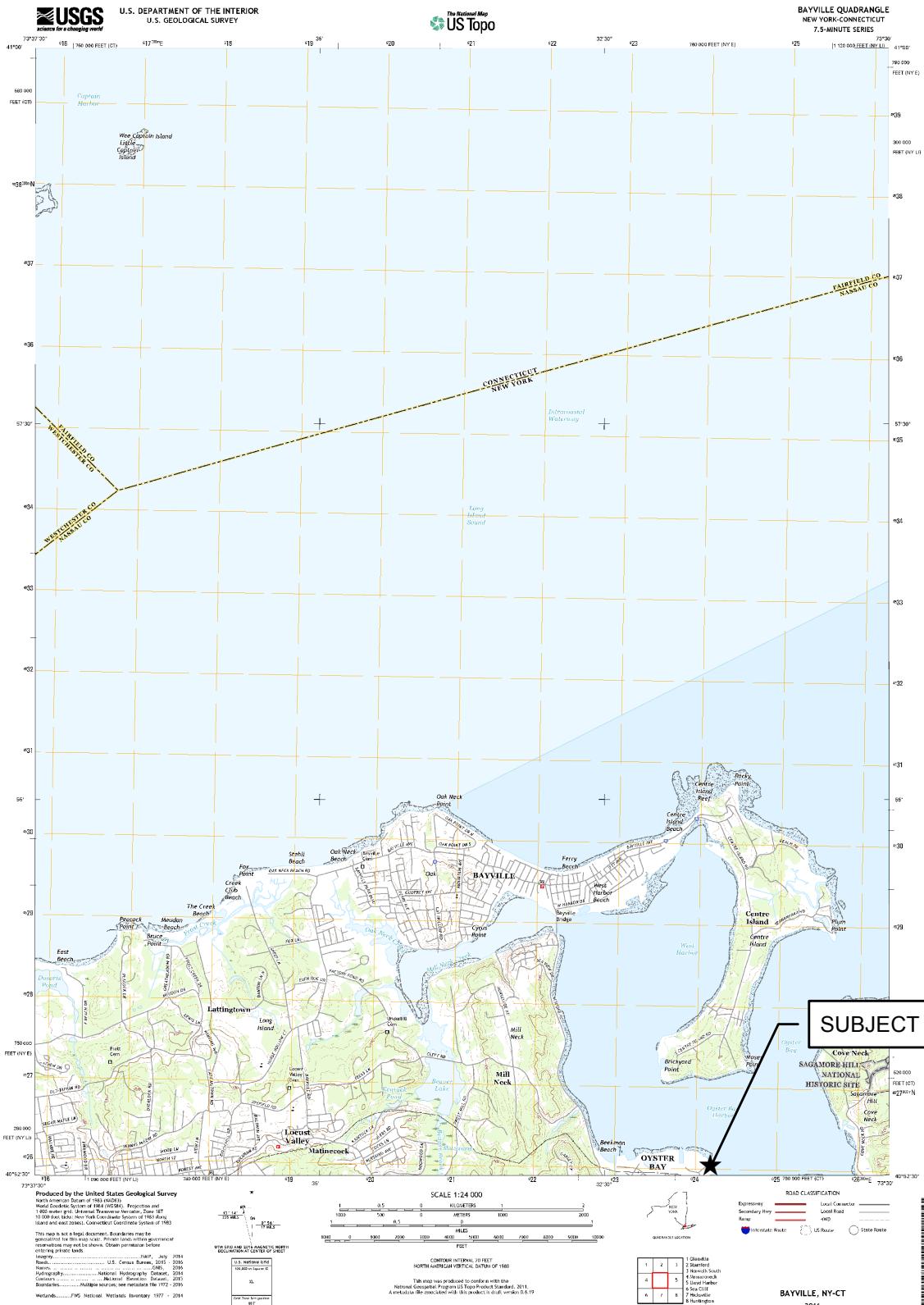
NYSDEC, Division of Environmental Remediation, October 2020, Sampling, Analysis, And Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

NYSDEC, Division of Water, June 1998, Addendum April 2000, Technical and Operational Guidance Series 1:1:1, Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations

NYSDOH, October 2006, Guidance for Evaluating Soil Vapor Intrusion in the State of New York

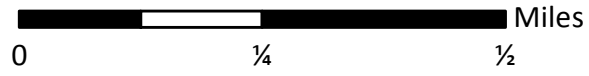


FIGURES



SITE LOCATION

1 Commander Square
Oyster Bay, NY



Project:	CTH1901
Date:	7/17/2019
Designed by:	TM
Drawn by:	TS
Approved by:	TM
Figure No:	1


PWGC
CLIENT DRIVEN SOLUTIONS
P.W. Grosser Consulting, Inc.
630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgrosser.com

Document Path: W:\Projects\A-D\CTH1901\map\Fig01_SiteLocation.mxd



P.W. Grosser Consulting Engineer & Hydrogeologist, PC

630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgros.com

UNAUTHORIZED ALTERATION OR ADDITION TO THIS
DRAWING AND RELATED DOCUMENTS IS A VIOLATION
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

REVISION	DATE	INITIAL	COMMENTS
----------	------	---------	----------

DRAWING INFORMATION:

Project:	CTH1901	Designed by:	TM
Date:	7/16/2019	Drawn by:	TS
Scale:	AS SHOWN	Approved by:	TM

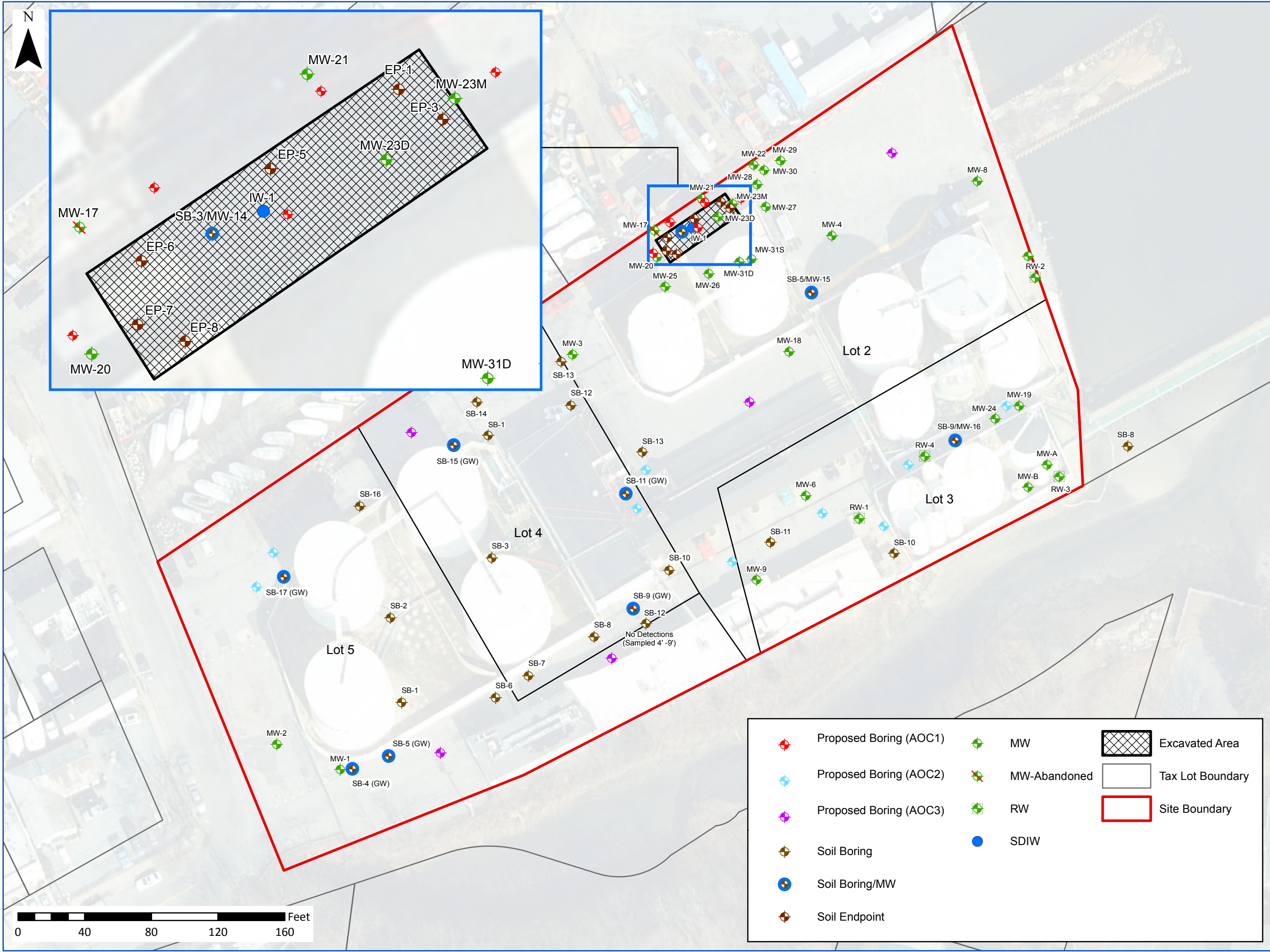
SITE PLAN

1 Commander Square
Oyster Bay, NY

FIGURE NO:

Tax Lot Boundary

Site Boundary



P.W. Grosser Consulting Engineer & Hydrogeologist, PC

630 Johnson Ave., Suite 7
Bohemia, NY 11716

Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgros.com

UNAUTHORIZED ALTERATION OR ADDITION TO THIS
DRAWING AND RELATED DOCUMENTS IS A VIOLATION
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

REVISION	DATE	INITIAL	COMMENTS

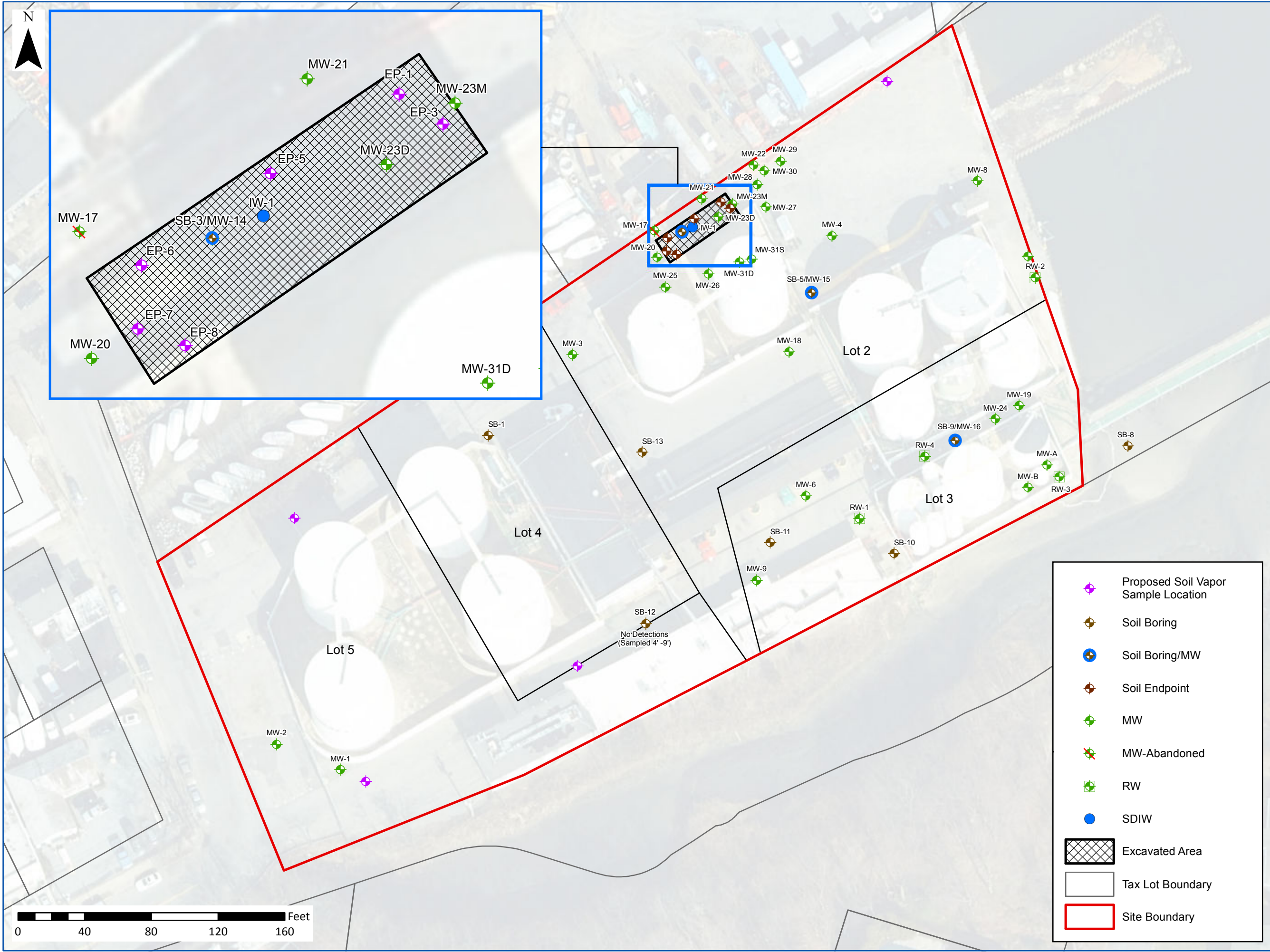
DRAWING INFORMATION:

Project:	CTH1901	Designed by:	TM
Date:	10/23/2020	Drawn by:	PH
Scale:	AS SHOWN	Approved by:	TM

Proposed Soil Sample Locations

1 Commander Square
Oyster Bay, NY

FIGURE NO:



P.W. Grosser Consulting Engineer & Hydrogeologist, PC

630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgros.com

UNAUTHORIZED ALTERATION OR ADDITION TO THIS
DRAWING AND RELATED DOCUMENTS IS A VIOLATION
OF SEC. 7209 OF THE N.Y.S. EDUCATION LAW

DRAWING PREPARED FOR:

REVISION	DATE	INITIAL	COMMENTS
----------	------	---------	----------

DRAWING INFORMATION:

Project:	CTH1901	Designed by:	TM
Date:	10/23/2020	Drawn by:	PH
Scale:	AS SHOWN	Approved by:	TM

Proposed Soil Vapor
Sample Locations

1 Commander Square
Oyster Bay, NY

FIGURE NO:



APPENDIX A

USEPA LOW STRESS PURGING AND SAMPLING PROCEDURE

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUNDWATER SAMPLES FROM MONITORING WELLS

Quality Assurance Unit
U.S. Environmental Protection Agency – Region 1
11 Technology Drive
North Chelmsford, MA 01863

The controlled version of this document is the electronic version viewed on-line only. If this is a printed copy of the document, it is an uncontrolled version and may or may not be the version currently in use.

This document contains direction developed solely to provide guidance to U.S. Environmental Protection Agency (EPA) personnel. EPA retains the discretion to adopt approaches that differ from these procedures on a case-by-case basis. The procedures set forth do not create any rights, substantive or procedural, enforceable at law by party to litigation with EPA or the United States.

Prepared by: _____
(Robert Reinhart, Quality Assurance Unit) Date _____

Approved by: _____
(John Smaldone, Quality Assurance Unit) Date _____

Revision Page

Date	Rev #	Summary of changes	Sections
7/30/96	1	Finalized	
01/19/10	2	Updated	All sections
3/23/17	3	Updated	All sections
9/20/17	4	Updated	Section 7.0

Table of Contents

1.0	USE OF TERMS.....	4
2.0	SCOPE & APPLICATION.....	5
3.0	BACKGROUND FOR IMPLEMENTATION.....	6
4.0	HEALTH & SAFETY	7
5.0	CAUTIONS	7
6.0	PERSONNEL QUALIFICATIONS	9
7.0	EQUIPMENT AND SUPPLIES.....	9
8.0	EQUIPMENT/INSTRUMENT CALIBRATION	13
9.0	PRELIMINARY SITE ACTIVITIES (as applicable)	13
10.0	PURGING AND SAMPLING PROCEDURE.....	14
11.0	DECONTAMINATION	19
12.0	FIELD QUALITY CONTROL.....	21
13.0	FIELD LOGBOOK.....	21
14.0	DATA REPORT	22
15.0	REFERENCES	22
	APPENDIX A.....	24
	PERISTALTIC PUMPS.....	24
	APPENDIX B	25
	SUMMARY OF SAMPLING INSTRUCTIONS.....	25
	Low-Flow Setup Diagram.....	29
	APPENDIX C	30
	WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM	30

1.0 USE OF TERMS

Equipment blank: The equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank needs only to include the pump in subsequent sampling rounds. If the pump and tubing are dedicated to the well, the equipment blank is collected prior to its placement in the well. If the pump and tubing will be used to sample multiple wells, the equipment blank is normally collected after sampling from contaminated wells and not after background wells.

Field duplicates: Field duplicates are collected to determine precision of the sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

Indicator field parameters: This SOP uses field measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH, and oxidation/reduction potential (ORP) as indicators of when purging operations are sufficient and sample collection may begin.

Matrix Spike/Matrix Spike Duplicates: Used by the laboratory in its quality assurance program. Consult the laboratory for the sample volume to be collected.

Potentiometric Surface: The level to which water rises in a tightly cased well constructed in a confined aquifer. In an unconfined aquifer, the potentiometric surface is the water table.

QAPP: Quality Assurance Project Plan

SAP: Sampling and Analysis Plan

SOP: Standard operating procedure

Stabilization: A condition that is achieved when all indicator field parameter measurements are sufficiently stable (as described in the "Monitoring Indicator Field Parameters" section) to allow sample collection to begin.

Temperature blank: A temperature blank is added to each sample cooler. The blank is measured upon receipt at the laboratory to assess whether the samples were properly cooled during transit.

Trip blank (VOCs): Trip blank is a sample of analyte-free water taken to the sampling site and returned to the laboratory. The trip blanks (one pair) are added to each sample cooler that contains VOC samples.

2.0 SCOPE & APPLICATION

The goal of this groundwater sampling procedure is to collect water samples that reflect the total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. This standard operating procedure (SOP) for collecting groundwater samples will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

The SOP emphasizes the need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Indicator field parameters (e.g., dissolved oxygen, pH, etc.) are monitored during purging in order to determine when sample collection may begin. Samples properly collected using this SOP are suitable for analysis of groundwater contaminants (volatile and semi-volatile organic analytes, dissolved gases, pesticides, PCBs, metals and other inorganics), or naturally occurring analytes. This SOP is based on Puls, and Barcelona (1996).

This procedure is designed for monitoring wells with an inside diameter (1.5-inches or greater) that can accommodate a positive lift pump with a screen length or open interval ten feet or less and with a water level above the top of the screen or open interval (Hereafter, the "screen or open interval" will be referred to only as "screen interval"). This SOP is not applicable to other well-sampling conditions.

While the use of dedicated sampling equipment is not mandatory, dedicated pumps and tubing can reduce sampling costs significantly by streamlining sampling activities and thereby reducing the overall field costs.

The goal of this procedure is to emphasize the need for consistency in deploying and operating equipment while purging and sampling monitoring wells during each sampling event. This will help to minimize sampling variability.

This procedure describes a general framework for groundwater sampling. Other site specific information (hydrogeological context, conceptual site model (CSM), DQOs, etc.) coupled with systematic planning must be added to the procedure in order to develop an appropriate site specific SAP/QAPP. In addition, the site specific SAP/QAPP must identify the specific equipment that will be used to collect the groundwater samples.

This procedure does not address the collection of water or free product samples from wells containing free phase LNAPLs and/or DNAPLs (light or dense non-aqueous phase

liquids). For this type of situation, the reader may wish to check: Cohen, and Mercer (1993) or other pertinent documents.

This SOP is to be used when collecting groundwater samples from monitoring wells at all Superfund, Federal Facility and RCRA sites in Region 1 under the conditions described herein. Request for modification of this SOP, in order to better address specific situations at individual wells, must include adequate technical justification for proposed changes. All changes and modifications must be approved and included in a revised SAP/QAPP before implementation in field.

3.0 BACKGROUND FOR IMPLEMENTATION

It is expected that the monitoring well screen has been properly located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant migration. Problems with inappropriate monitoring well placement or faulty/improper well installation cannot be overcome by even the best water sampling procedures. This SOP presumes that the analytes of interest are moving (or will potentially move) primarily through the more permeable zones intercepted by the screen interval.

Proper well construction, development, and operation and maintenance cannot be overemphasized. The use of installation techniques that are appropriate to the hydrogeologic setting of the site often prevent "problem well" situations from occurring. During well development, or redevelopment, tests should be conducted to determine the hydraulic characteristics of the monitoring well. The data can then be used to set the purging/sampling rate, and provide a baseline for evaluating changes in well performance and the potential need for well rehabilitation. Note: if this installation data or well history (construction and sampling) is not available or discoverable, for all wells to be sampled, efforts to build a sampling history should commence with the next sampling event.

The pump intake should be located within the screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The mid-point or the lowest historical midpoint of the saturated screen length is often used as the location of the pump intake. For new wells, or for wells without pump intake depth information, the site's SAP/QAPP must provide clear reasons and instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected. If the depths to top and bottom of the well screen are not known, the SAP/QAPP will need to describe how the sampling depth will be determined and how the data can be used.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU, and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection

may still take place provided the indicator field parameter criteria in this procedure are met. If after 2 hours of purging indicator field parameters have not stabilized, one of three optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization), c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may reflect a sampling bias and therefore, the data may not meet the data quality objectives of the sampling event).

It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Because sampling during freezing temperatures may adversely impact the data quality objectives, the need for water sample collection during months when these conditions are likely to occur should be evaluated during site planning and special sampling measures may need to be developed. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell needs to be used to observe if ice is forming in the cell. If ice starts to form on the other pieces of the sampling equipment, additional problems may occur.

4.0 HEALTH & SAFETY

When working on-site, comply with all applicable OSHA requirements and the site's health/safety procedures. All proper personal protection clothing and equipment are to be worn. Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

5.0 CAUTIONS

The following cautions need to be considered when planning to collect groundwater samples when the below conditions occur.

If the groundwater degasses during purging of the monitoring well, dissolved gases and VOCs will be lost. When this happens, the groundwater data for dissolved gases (e.g., methane, ethene, ethane, dissolved oxygen, etc.) and VOCs will need to be qualified. Some conditions that can promote degassing are the use of a vacuum pump (e.g., peristaltic pumps), changes in aperture along the sampling tubing, and squeezing/pinching the pump's tubing which results in a pressure change.

When collecting the samples for dissolved gases and VOCs analyses, avoid aerating the groundwater in the pump's tubing. This can cause loss of the dissolved gases and VOCs in

the groundwater. Having the pump's tubing completely filled prior to sampling will avoid this problem when using a centrifugal pump or peristaltic pump.

Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of VOCs and dissolved gases. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, etc.). If possible, sampling on hot days, or during the hottest time of the day, should be avoided. The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater.

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblecky 2007).

Failure to calibrate or perform proper maintenance on the sampling equipment and measurement instruments (e.g., dissolved oxygen meter, etc.) can result in faulty data being collected.

Interferences may result from using contaminated equipment, cleaning materials, sample containers, or uncontrolled ambient/surrounding air conditions (e.g., truck/vehicle exhaust nearby).

Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and/or proper planning to avoid ambient air interferences. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

Clean and decontaminate all sampling equipment prior to use. All sampling equipment needs to be routinely checked to be free from contaminants and equipment blanks collected to ensure that the equipment is free of contaminants. Check the previous equipment blank data for the site (if they exist) to determine if the previous cleaning procedure removed the contaminants. If contaminants were detected and they are a concern, then a more vigorous cleaning procedure will be needed.

6.0 PERSONNEL QUALIFICATIONS

All field samplers working at sites containing hazardous waste must meet the requirements of the OSHA regulations. OSHA regulations may require the sampler to take the 40 hour OSHA health and safety training course and a refresher course prior to engaging in any field activities, depending upon the site and field conditions.

The field samplers must be trained prior to the use of the sampling equipment, field instruments, and procedures. Training is to be conducted by an experienced sampler before initiating any sampling procedure.

The entire sampling team needs to read, and be familiar with, the site Health and Safety Plan, all relevant SOPs, and SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

7.0 EQUIPMENT AND SUPPLIES

A. Informational materials for sampling event

A copy of the current Health and Safety Plan, SAP/QAPP, monitoring well construction data, location map(s), field data from last sampling event, manuals for sampling, and the monitoring instruments' operation, maintenance, and calibration manuals should be brought to the site.

B. Well keys.

C. Extraction device

Adjustable rate, submersible pumps (e.g., centrifugal, bladder, etc.) which are constructed of stainless steel or polytetrafluoroethylene (PTFE, i.e. Teflon®) are preferred. PTFE, however, should not be used when sampling for per- and polyfluoroalkyl substances (PFAS) as it is likely to contain these substances.

Note: If extraction devices constructed of other materials are to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

If bladder pumps are selected for the collection of VOCs and dissolved gases, the pump setting should be set so that one pulse will deliver a water volume that is sufficient to fill a 40 mL VOC vial. This is not mandatory, but is considered a “best practice”. For the proper operation, the bladder pump will need a minimum amount of water above the pump; consult the manufacturer for the recommended submergence. The pump’s recommended submergence value should be determined during the planning stage, since it may influence well construction and placement of dedicated pumps where water-level fluctuations are significant.

Adjustable rate, peristaltic pumps (suction) are to be used with caution when collecting samples for VOCs and dissolved gases (e.g., methane, carbon dioxide, etc.) analyses. Additional information on the use of peristaltic pumps can be found in Appendix A. If peristaltic pumps are used, the inside diameter of the rotor head tubing needs to match the inside diameter of the tubing installed in the monitoring well.

Inertial pumping devices (motor driven or manual) are not recommended. These devices frequently cause greater disturbance during purging and sampling, and are less easily controlled than submersible pumps (potentially increasing turbidity and sampling variability, etc.). This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

D. Tubing

PTFE (Teflon®) or PTFE-lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. As discussed in the previous section, PTFE tubing should not be used when sampling for PFAS. In this case, a suitable alternative such as high-density polyethylene tubing should be used.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for metal and other inorganics analyses.

Note: If tubing constructed of other materials is to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

The use of 1/4 inch or 3/8 inch (inside diameter) tubing is recommended. This will help ensure that the tubing remains liquid filled when operating at very low pumping rates when using centrifugal and peristaltic pumps.

Silastic tubing should be used for the section around the rotor head of a peristaltic pump. It should be less than a foot in length. The inside diameter of the tubing used at the pump rotor head must be the same as the inside diameter of tubing placed in the well. A tubing connector is used to connect the pump rotor head tubing to the well tubing. Alternatively, the two pieces of tubing can be connected to each other by placing the one end of the tubing inside the end of the other tubing. The tubing must not be reused.

E. The water level measuring device

Electronic "tape", pressure transducer, water level sounder/level indicator, etc. should be capable of measuring to 0.01 foot accuracy. Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level "tape" at the start and end of each sampling event.

F. Flow measurement supplies

Graduated cylinder (size according to flow rate) and stopwatch usually will suffice.

Large graduated bucket used to record total water purged from the well.

G. Interface probe

To be used to check on the presence of free phase liquids (LNAPL, or DNAPL) before purging begins (as needed).

H. Power source (generator, nitrogen tank, battery, etc.)

When a gasoline generator is used, locate it downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate samples.

I. Indicator field parameter monitoring instruments

Use of a multi-parameter instrument capable of measuring pH, oxidation/reduction potential (ORP), dissolved oxygen (DO), specific conductance, temperature, and coupled with a flow-through-cell is required when measuring all indicator field parameters, except turbidity. Turbidity is collected using a separate instrument. Record equipment/instrument identification (manufacturer, and model number).

Transparent, small volume flow-through-cells (e.g., 250 mLs or less) are preferred. This allows observation of air bubbles and sediment buildup in the cell, which can interfere with the operation of the monitoring instrument probes, to be easily detected. A small volume

cell facilitates rapid turnover of water in the cell between measurements of the indicator field parameters.

It is recommended to use a flow-through-cell and monitoring probes from the same manufacturer and model to avoid incompatibility between the probes and flow-through-cell.

Turbidity samples are collected before the flow-through-cell. A “T” connector coupled with a valve is connected between the pump’s tubing and flow-through-cell. When a turbidity measurement is required, the valve is opened to allow the groundwater to flow into a container. The valve is closed and the container sample is then placed in the turbidimeter.

Standards are necessary to perform field calibration of instruments. A minimum of two standards are needed to bracket the instrument measurement range for all parameters except ORP which use a Zobell solution as a standard. For dissolved oxygen, a wet sponge used for the 100% saturation and a zero dissolved oxygen solution are used for the calibration.

Barometer (used in the calibration of the Dissolved Oxygen probe) and the conversion formula to convert the barometric pressure into the units of measure used by the Dissolved Oxygen meter are needed.

J. Decontamination supplies

Includes (for example) non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.

K. Record keeping supplies

Logbook(s), well purging forms, chain-of-custody forms, field instrument calibration forms, etc.

L. Sample bottles

M. Sample preservation supplies (as required by the analytical methods)

N. Sample tags or labels

O. PID or FID instrument

If appropriate, to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

P. Miscellaneous Equipment

Equipment to keep the sampling apparatus shaded in the summer (e.g., umbrella) and from freezing in the winter. If the pump's tubing is allowed to heat up in the warm weather, the cold groundwater may degas as it is warmed in the tubing.

8.0 EQUIPMENT/INSTRUMENT CALIBRATION

Prior to the sampling event, perform maintenance checks on the equipment and instruments according to the manufacturer's manual and/or applicable SOP. This will ensure that the equipment/instruments are working properly before they are used in the field.

Prior to sampling, the monitoring instruments must be calibrated and the calibration documented. The instruments are calibrated using U.S Environmental Protection Agency Region 1 *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity)*, March 23, 2017, or latest version or from one of the methods listed in 40CFR136, 40CFR141 and SW-846.

The instruments shall be calibrated at the beginning of each day. If the field measurement falls outside the calibration range, the instrument must be re-calibrated so that all measurements fall within the calibration range. At the end of each day, a calibration check is performed to verify that instruments remained in calibration throughout the day. This check is performed while the instrument is in measurement mode, not calibration mode. If the field instruments are being used to monitor the natural attenuation parameters, then a calibration check at mid-day is highly recommended to ensure that the instruments did not drift out of calibration. Note: during the day if the instrument reads zero or a negative number for dissolved oxygen, pH, specific conductance, or turbidity (negative value only), this indicates that the instrument drifted out of calibration or the instrument is malfunctioning. If this situation occurs the data from this instrument will need to be qualified or rejected.

9.0 PRELIMINARY SITE ACTIVITIES (as applicable)

Check the well for security (damage, evidence of tampering, missing lock, etc.) and record pertinent observations (include photograph as warranted).

If needed, lay out a sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, etc.).

Remove well cap and if appropriate measure VOCs at the rim of the well with a PID or FID instrument and record reading in field logbook or on the well purge form.

If the well casing does not have an established reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook (consider a photographic record as well). All water level measurements must be recorded relative to this reference point (and the altitude of this point should be determined using techniques that are appropriate to site's DQOs).

If water-table or potentiometric surface map(s) are to be constructed for the sampling event, perform synoptic water level measurement round (in the shortest possible time) before any purging and sampling activities begin. If possible, measure water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) the day before sampling begins, in order to allow for re-settlement of any particulates in the water column. This is especially important for those wells that have not been recently sampled because sediment buildup in the well may require the well to be redeveloped. If measurement of total well depth is not made the day before, it should be measured after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe may not be necessary unless analytical data or field analysis signal a worsening situation. This SOP cannot be used in the presence of LNAPLs or DNAPLs. If NAPLs are present, the project team must decide upon an alternate sampling method. All project modifications must be approved and documented prior to implementation.

If available check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). If changes are made in the intake depth or extraction rate(s) used during previous sampling event(s), for either portable or dedicated extraction devices, record new values, and explain reasons for the changes in the field logbook.

10.0 PURGING AND SAMPLING PROCEDURE

Purging and sampling wells in order of increasing chemical concentrations (known or anticipated) are preferred.

The use of dedicated pumps is recommended to minimize artificial mobilization and entrainment of particulates each time the well is sampled. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

A. Initial Water Level

Measure the water level in the well before installing the pump if a non-dedicated pump is being used. The initial water level is recorded on the purge form or in the field logbook.

B. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the appropriate depth (may not be the mid-point of the screen/open interval). The Sampling and Analysis Plan/Quality Assurance Project Plan should specify the sampling depth (used previously), or provide criteria for selection of intake depth for each new well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well.

Pump tubing lengths, above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

C. Measure Water Level

Before starting pump, measure water level. Install recording pressure transducer, if used to track drawdowns, to initialize starting condition.

D. Purge Well

From the time the pump starts purging and until the time the samples are collected, the purged water is discharged into a graduated bucket to determine the total volume of groundwater purged. This information is recorded on the purge form or in the field logbook.

Start the pump at low speed and slowly increase the speed until discharge occurs. Check water level. Check equipment for water leaks and if present fix or replace the affected equipment. Try to match pumping rate used during previous sampling event(s). Otherwise, adjust pump speed until there is little or no water level drawdown. If the

minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging.

Monitor and record the water level and pumping rate every five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. If the initial water level is above the top of the screen do not allow the water level to fall into the well screen. The final purge volume must be greater than the stabilized drawdown volume plus the pump's tubing volume. If the drawdown has exceeded 0.3 feet and stabilizes, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.

Avoid the use of constriction devices on the tubing to decrease the flow rate because the constrictor will cause a pressure difference in the water column. This will cause the groundwater to degas and result in a loss of VOCs and dissolved gasses in the groundwater samples.

Note: the flow rate used to achieve a stable pumping level should remain constant while monitoring the indicator parameters for stabilization and while collecting the samples.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (e.g., bladder, peristaltic), and/or the use of dedicated equipment. For new monitoring wells, or wells where the following situation has not occurred before, if the recovery rate to the well is less than 50 mL/min., or the well is being essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. The project manager or field team leader will need to make the decision when samples should be collected, how the sample is to be collected, and the reasons recorded on the purge form or in the field logbook. A water level measurement needs to be performed and recorded before samples are collected. If the project manager decides to collect the samples using the pump, it is best during this recovery period that the pump intake tubing not be removed, since this will aggravate any turbidity problems. Samples in this specific situation may be collected without stabilization of indicator field parameters. Note that field conditions and efforts to overcome problematic situations must be recorded in order to support field decisions to deviate from normal procedures described in this SOP. If this type of problematic situation persists in a well, then water sample collection should be

changed to a passive or no-purge method, if consistent with the site's DQOs, or have a new well installed.

E. Monitor Indicator Field Parameters

After the water level has stabilized, connect the "T" connector with a valve and the flow-through-cell to monitor the indicator field parameters. If excessive turbidity is anticipated or encountered with the pump startup, the well may be purged for a while without connecting up the flow-through-cell, in order to minimize particulate buildup in the cell (This is a judgment call made by the sampler). Water level drawdown measurements should be made as usual. If possible, the pump may be installed the day before purging to allow particulates that were disturbed during pump insertion to settle.

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, ORP, DO) at a frequency of five minute intervals or greater. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 mL flow-through-cell with a flow rate of 50 mLs/min., the monitoring frequency would be every five minutes; for a 500 mL flow-through-cell it would be every ten minutes). If the cell volume cannot be replaced in the five minute interval, then the time between measurements must be increased accordingly. Note: during the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments followed by stabilization of indicator parameters. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings are within the following limits:

Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),

Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),

Specific Conductance (3%),

Temperature (3%),

pH (± 0.1 unit),

Oxidation/Reduction Potential (± 10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Samples for turbidity measurements are obtained before water enters the flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and

continue monitoring activities. Record start and stop times and give a brief description of cleaning activities.

The flow-through-cell must be designed in a way that prevents gas bubble entrapment in the cell. Placing the flow-through-cell at a 45 degree angle with the port facing upward can help remove bubbles from the flow-through-cell (see Appendix B Low-Flow Setup Diagram). Throughout the measurement process, the flow-through-cell must remain free of any gas bubbles. Otherwise, the monitoring probes may act erratically. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must remain submerged in water at all times.

F. Collect Water Samples

When samples are collected for laboratory analyses, the pump's tubing is disconnected from the "T" connector with a valve and the flow-through-cell. The samples are collected directly from the pump's tubing. Samples must not be collected from the flow-through-cell or from the "T" connector with a valve.

VOC samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the pump's flow rate is too high to collect the VOC/dissolved gases samples, collect the other samples first. Lower the pump's flow rate to a reasonable rate and collect the VOC/dissolved gases samples and record the new flow rate.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use the following procedure to collect samples: collect non-VOC/dissolved gases samples first, then increase flow rate slightly until the water completely fills the tubing, collect the VOC/dissolved gases samples, and record new drawdown depth and flow rate.

For bladder pumps that will be used to collect VOC or dissolved gas samples, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL VOC vial.

Use pre-preserved sample containers or add preservative, as required by analytical methods, to the samples immediately after they are collected. Check the analytical methods

(e.g. EPA SW-846, 40 CFR 136, water supply, etc.) for additional information on preservation.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter (transparent housing preferred) is required, and the filter size (0.45 μm is commonly used) should be based on the sampling objective. Pre-rinse the filter with groundwater prior to sample collection. Make sure the filter is free of air bubbles before samples are collected. Preserve the filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health or ecological risk calculations.

Label each sample as collected. Samples requiring cooling will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

G. Post Sampling Activities

If a recording pressure transducer is used to track drawdown, re-measure water level with tape.

After collection of samples, the pump tubing may be dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth annually is usually sufficient after the initial low stress sampling event. However, a greater frequency may be needed if the well has a “silting” problem or if confirmation of well identity is needed.

Secure the well.

11.0 DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well, and then following sampling of each subsequent well. Pumps should not be removed between purging and sampling operations. The pump, tubing, support cable and electrical wires which were in contact with the well should be decontaminated by one of the procedures listed below.

The use of dedicated pumps and tubing will reduce the amount of time spent on decontamination of the equipment. If dedicated pumps and tubing are used, only the initial sampling event will require decontamination of the pump and tubing.

Note if the previous equipment blank data showed that contaminant(s) were present after using the below procedure or the one described in the SAP/QAPP, a more vigorous procedure may be needed.

Procedure 1

Decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump and tubing. The pump may be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Optional - flush with isopropyl alcohol (pesticide grade; must be free of ketones {e.g., acetone}) or with methanol. This step may be required if the well is highly contaminated or if the equipment blank data from the previous sampling event show that the level of contaminants is significant.

Flush with distilled/deionized water. This step must remove all traces of alcohol (if used) from the equipment. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

12.0 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. Quality control samples include field duplicates, equipment blanks, matrix spike/matrix spike duplicates, trip blanks (VOCs), and temperature blanks.

13.0 FIELD LOGBOOK

A field log shall be kept to document all groundwater field monitoring activities (see Appendix C, example table), and record the following for each well:

Site name, municipality, state.

Well identifier, latitude-longitude or state grid coordinates.

Measuring point description (e.g., north side of PVC pipe).

Well depth, and measurement technique.

Well screen length.

Pump depth.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.

Type of tubing used and its length.

Type of pump used.

Clock time of start and end of purging and sampling activity.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analyses.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions, including approximate ambient air temperature.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling/monitoring equipment used, including trade names, model number, instrument identification number, diameters, material composition, etc.

14.0 DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, field indicator parameters measured during purging, field instrument calibration information, and whatever other field logbook information is needed to allow for a full evaluation of data usability.

Note: the use of trade, product, or firm names in this sampling procedure is for descriptive purposes only and does not constitute endorsement by the U.S. EPA.

15.0 REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, *DNAPL Site Evaluation*; C.K. Smoley (CRC Press), Boca Raton, Florida.

Robert W. Puls and Michael J. Barcelona, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, April 1996 (EPA/540/S-95/504).

U.S. Environmental Protection Agency, 1992, *RCRA Ground-Water Monitoring: Draft Technical Guidance*; Washington, DC (EPA/530-R-93-001).

U.S. Environmental Protection Agency, 1987, *A Compendium of Superfund Field Operations Methods*; Washington, DC (EPA/540/P-87/001).

U.S. Environmental Protection Agency, Region 1, *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity)*, March 23, 2017 or latest version.

U.S. Environmental Protection Agency, EPA SW-846.

U.S. Environmental Protection Agency, 40 CFR 136.

U.S. Environmental Protection Agency, 40 CFR 141.

Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, Influence of Dissolved Oxygen Convection on Well Sampling, *Ground Water Monitoring & Remediation* 27, no. 3: 49-58.

APPENDIX A

PERISTALTIC PUMPS

Before selecting a peristaltic pump to collect groundwater samples for VOCs and/or dissolved gases, (e.g., methane, carbon dioxide, etc.) consideration should be given to the following:

- The decision of whether or not to use a peristaltic pump is dependent on the intended use of the data.
- If the additional sampling error that may be introduced by this device is NOT of concern for the VOC/dissolved gases data's intended use, then this device may be acceptable.
- If minor differences in the groundwater concentrations could affect the decision, such as to continue or terminate groundwater cleanup or whether the cleanup goals have been reached, then this device should NOT be used for VOC/dissolved gases sampling. In these cases, centrifugal or bladder pumps are a better choice for more accurate results.

EPA and USGS have documented their concerns with the use of the peristaltic pumps to collect water sample in the below documents.

- "Suction Pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.
- "The agency does not recommend the use of peristaltic pumps to sample ground water particularly for volatile organic analytes" *RCRA Ground-Water Monitoring Draft Technical Guidance*, EPA Office of Solid Waste, November 1992.
- "The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and volatiles loss", *Low-flow (Minimal drawdown) Ground-Water Sampling Procedures*, by Robert Puls & Michael Barcelona, April 1996, EPA/540/S-95/504.
- "Suction-lift pumps, such as peristaltic pumps, can operate at a very low pumping rate; however, using negative pressure to lift the sample can result in the loss of volatile analytes", USGS Book 9 Techniques of Water-Resources Investigation, Chapter A4. (Version 2.0, 9/2006).

APPENDIX B

SUMMARY OF SAMPLING INSTRUCTIONS

These instructions are for using an adjustable rate, submersible pump or a peristaltic pump with the pump's intake placed at the midpoint of a 10 foot or less well screen or an open interval. The water level in the monitoring well is above the top of the well screen or open interval, the ambient temperature is above 32°F, and the equipment is not dedicated. Field instruments are already calibrated. The equipment is setup according to the diagram at the end of these instructions.

1. Review well installation information. Record well depth, length of screen or open interval, and depth to top of the well screen. Determine the pump's intake depth (e.g., mid-point of screen/open interval).
2. On the day of sampling, check security of the well casing, perform any safety checks needed for the site, lay out a sheet of polyethylene around the well (if necessary), and setup the equipment. If necessary a canopy or an equivalent item can be setup to shade the pump's tubing and flow-through-cell from the sun light to prevent the sun light from heating the groundwater.
3. Check well casing for a reference mark. If missing, make a reference mark. Measure the water level (initial) to 0.01 ft. and record this information.
4. Install the pump's intake to the appropriate depth (e.g., midpoint) of the well screen or open interval. Do not turn-on the pump at this time.
5. Measure water level and record this information.
6. Turn-on the pump and discharge the groundwater into a graduated waste bucket. Slowly increase the flow rate until the water level starts to drop. Reduce the flow rate slightly so the water level stabilizes. Record the pump's settings. Calculate the flow rate using a graduated container and a stop watch. Record the flow rate. Do not let the water level drop below the top of the well screen.

If the groundwater is highly turbid or discolored, continue to discharge the water into the bucket until the water clears (visual observation); this usually takes a few minutes. The turbid or discolored water is usually from the well-being disturbed during the pump installation. If the water does not clear, then you need to make a choice whether to continue purging the well (hoping that it will clear after a reasonable time) or continue to

the next step. Note, it is sometimes helpful to install the pump the day before the sampling event so that the disturbed materials in the well can settle out.

If the water level drops to the top of the well screen during the purging of the well, stop purging the well, and do the following:

Wait for the well to recharge to a sufficient volume so samples can be collected. This may take a while (pump may be removed from well, if turbidity is not a problem). The project manager will need to make the decision when samples should be collected and the reasons recorded in the site's log book. A water level measurement needs to be performed and recorded before samples are collected. When samples are being collected, the water level must not drop below the top of the screen or open interval. Collect the samples from the pump's tubing. Always collect the VOCs and dissolved gases samples first. Normally, the samples requiring a small volume are collected before the large volume samples are collected just in case there is not sufficient water in the well to fill all the sample containers. All samples must be collected, preserved, and stored according to the analytical method. Remove the pump from the well and decontaminate the sampling equipment.

If the water level has dropped 0.3 feet or less from the initial water level (water level measure before the pump was installed); proceed to Step 7. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are be collected.

7. Attach the pump's tubing to the "T" connector with a valve (or a three-way stop cock). The pump's tubing from the well casing to the "T" connector must be as short as possible to prevent the groundwater in the tubing from heating up from the sun light or from the ambient air. Attach a short piece of tubing to the other end of the end of the "T" connector to serve as a sampling port for the turbidity samples. Attach the remaining end of the "T" connector to a short piece of tubing and connect the tubing to the flow-through-cell bottom port. To the top port, attach a small piece of tubing to direct the water into a calibrated waste bucket. Fill the cell with the groundwater and remove all gas bubbles from the cell. Position the flow-through-cell in such a way that if gas bubbles enter the cell they can easily exit the cell. If the ports are on the same side of the cell and the cell is cylindrical shape, the cell can be placed at a 45-degree angle with the ports facing upwards; this position should keep any gas bubbles entering the cell away from the monitoring probes and allow the gas bubbles to exit the cell easily (see Low-Flow Setup Diagram). Note:

make sure there are no gas bubbles caught in the probes' protective guard; you may need to shake the cell to remove these bubbles.

8. Turn-on the monitoring probes and turbidity meter.

9. Record the temperature, pH, dissolved oxygen, specific conductance, and oxidation/reduction potential measurements. Open the valve on the "T" connector to collect a sample for the turbidity measurement, close the valve, do the measurement, and record this measurement. Calculate the pump's flow rate from the water exiting the flow-through-cell using a graduated container and a stop watch, and record the measurement. Measure and record the water level. Check flow-through-cell for gas bubbles and sediment; if present, remove them.

10. Repeat Step 9 every 5 minutes or as appropriate until monitoring parameters stabilized. Note: at least one flow-through-cell volume must be exchanged between readings. If not, the time interval between readings will need to be increased. Stabilization is achieved when three consecutive measurements are within the following limits:

Turbidity (10% for values greater than 5 NTUs; if three Turbidity values are less than 5 NTUs, consider the values as stabilized),

Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),

Specific Conductance (3%),

Temperature (3%),

pH (± 0.1 unit),

Oxidation/Reduction Potential (± 10 millivolts).

If these stabilization requirements do not stabilize in a reasonable time, the probes may have been coated from the materials in the groundwater, from a buildup of sediment in the flow-through-cell, or a gas bubble is lodged in the probe. The cell and the probes will need to be cleaned. Turn-off the probes (not the pump), disconnect the cell from the "T" connector and continue to purge the well. Disassemble the cell, remove the sediment, and clean the probes according to the manufacturer's instructions. Reassemble the cell and connect the cell to the "T" connector. Remove all gas bubbles from the cell, turn-on the probes, and continue the measurements. Record the time the cell was cleaned.

11. When it is time to collect the groundwater samples, turn-off the monitoring probes, and disconnect the pump's tubing from the "T" connector. If you are using a centrifugal or peristaltic pump check the pump's tubing to determine if the tubing is completely filled with water (no air space).

All samples must be collected and preserved according to the analytical method. VOCs and dissolved gases samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

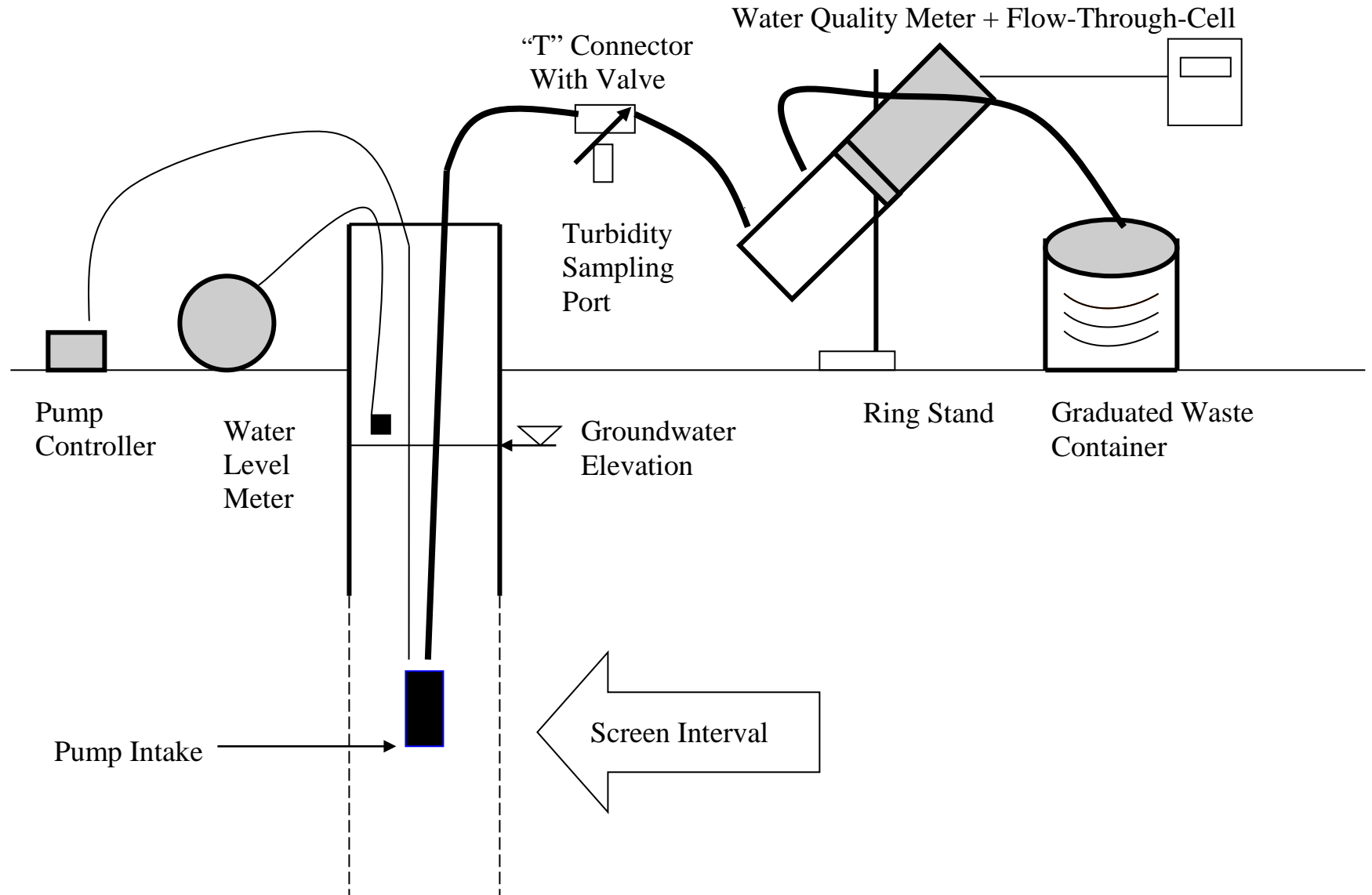
If the pump's tubing is not completely filled with water and the samples are being collected for VOCs and/or dissolved gases analyses using a centrifugal or peristaltic pump, do the following:

All samples must be collected and preserved according to the analytical method. The VOCs and the dissolved gases (e.g., methane, ethane, ethene, and carbon dioxide) samples are collected last. When it becomes time to collect these samples increase the pump's flow rate until the tubing is completely filled. Collect the samples and record the new flow rate.

12. Store the samples according to the analytical method.

13. Record the total purged volume (graduated waste bucket). Remove the pump from the well and decontaminate the sampling equipment.

Low-Flow Setup Diagram



APPENDIX C

EXAMPLE (Minimum Requirements)
WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name)_____	Depth to _____/_____ of screen (below MP) top bottom
Well Number_____ Date_____	Pump Intake at (ft. below MP)_____
Field Personnel_____	Purging Device; (pump type)_____
Sampling Organization_____	Total Volume Purged _____
Identify MP_____	

Stabilization Criteria

3%

3%

± 0.1

 $\pm 10 \text{ mV}$

10%

10%

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. μ Siemens per cm(same as μ mhos/cm)at 25°C.
3. Oxidation reduction potential (ORP)



APPENDIX B

PROJECT TEAM QUALIFICATIONS

James Rhodes, PG • COO

PROFESSIONAL EXPERIENCE

PWGC: 27 years

PRIOR: 5 years

AREAS OF EXPERTISE

Brownfields/Redevelopment Management
Environmental Compliance Management
Property/Real Estate Due Diligence Expert - Transaction & Environmental
Site Assessment & Reuse Analysis
Environmental & Remedial Investigations - Soil/Groundwater and Air Quality

EDUCATION & TRAINING/CERTIFICATION

MS, Earth Science/Hydrogeology, Adelphi University, NY
BS, Geology, SUNY Oneonta, NY
Executive Education (ACEC)
Leading Professional Service Firms - Harvard Business School
Licensed Professional Geologist - NYS
Phase I Environmental Inspector - Environmental Assessment Association
Professional Geologist - American Institute of Professional Geologists
Licensed Real Estate Salesperson - NY
OSHA HAZWOPER 40-hr.



PROFILE

In 2017, James Rhodes was named PWGC's Chief Operating Officer. In this role Mr. Rhodes is responsible for the operations of the business, working in tandem with the CEO and President. Roles will vary by industry but they will typically be involved in day every-day management, particularly business strategy, business planning and monitoring business performance. The COO provides leadership, management and vision necessary to ensure that the firm has the proper operational controls, administrative and reporting procedures and people systems in place to effectively grow the organization and ensure financial strength and operating efficiency. The position accomplishes this through respectful, constructive and energetic communications styles guided by the objectives of the company.

Prior to his promotion, Mr. Rhodes led PWGC's Environmental Unit. There he utilized his 30 years' experience as an expert in managing environmental concerns unique to the real estate market, serving public and private sectors. Through his tenure he has provided guidance to associates and clients, maintains established working relationships with regulators at multiple levels of government. His expertise enables clear communication on project requirements and speeds the approval process.

Mr. Rhodes' expertise in environmental remediation and redevelopment fields includes environmental site assessments (ESA), such as Phase I/II ESAs, RI/FS, NYS Brownfield studies, NYC "E" Designation Program, and cost to cure estimates for real estate tax purposes. His experience with soil and groundwater investigations, air quality studies and remedial measures has benefitted clients that include attorneys and developers, insurance companies and municipal agencies. His resourcefulness to pinpoint key environmental concerns quickly helps avoid unexpected delays and cost overruns, benefitting the client.

NOTABLE PROJECTS

PWGC Environmental Real Estate Sector Services

Phase I & Phase II Environmental Site Assessment (ESA) Management - As Program Director for Property Transactions & Real Estate Environmental Management Services & Support for PWGC, Rhodes oversees Phase I & II ESA planning, implementation and completion. He ensures that each ESA is tailored to client needs and long-term goals. For each project, a targeted scope of work and relevant documentation is prepared for clients to allow them to make cost-effective business decisions. PWGC typically performs more than 60 Phase I & Phase II ESA's annually with clients that include attorneys, lending institutions and municipalities. Given his experience, Rhodes provides clients workable environmental solutions for real estate issues. Under his management, PWGC Phase I/II reports are recognized by peers and clients for effectively utilizing escrow agreements, environmental insurance and cost-to-cure estimates. Mr. Rhodes acts as the Project Director for these projects and is the main liaison with the SCDHS. As part of his duties, Mr. Rhodes participated in meetings with the New York State Department of Environmental Conservation and collaborated with SCDHS to streamline the brownfield restoration process.

Garvies' Point Redevelopment Project

RXR-Glen-Isle Partners, LLC - Mr. Rhodes has been acting as project director overseeing numerous environmental consulting programs for this major waterfront redevelopment project in the City of Glen Cove. PWGC was brought into the project to perform full spectrum environmental due diligence services for the waterfront area when RXR Realty, LLC entered into the project. The waterfront area includes sites in both the New York State and Federal Superfund programs - including the Li



Tungsten and Captain's Cove sites - and the initial due diligence services, which focused on current remedial status and what needed to be completed in order for the redevelopment to proceed. Over the last several years, PWGC has been working closely with the development team including RXR-Glen-Isle Partners, LLC, the City of Glen Cove, regulatory agencies including the NYSDEC, NYSDOH, NCDH, and USEPA to move the project toward redevelopment. Towards this goal, PWGC continues to work with and coordinate services of other consultants to obtain the necessary information to allow the project to proceed. To accomplish this goal, PWGC has prepared numerous plans and reports including a work plan to address data gaps throughout the multiple parcels along the waterfront. The subsurface investigation performed under this plan included more than 200 soil borings to fully characterize the site to eliminate data gaps, which will allow the project to obtain environmental insurance. PWGC has been involved in all aspects of environmental consulting on this project as it readies for redevelopment including evaluation of site specific soil cleanup objectives, SWPPP preparation and oversight, petroleum remediation oversight, radiological monitoring plan preparation, MARSSIM survey support services, building demolition support services, geotechnical support services, TOGS sampling support services, waste characterization and disposal oversight, and dredge spoil characterization and handling. Project related documents prepared by PWGC include the Data Gap Workplan and Report, Visual Stained Petroleum Soil Remediation Report, Synthetic Precipitation Leachate Procedure (SPLP)/Red Flag Area Characterization Plan and Report, Li Tungsten Existing Condition Report and Captains Cove Existing Condition Report. PWGC continues to provide field oversight services for all aspect of the project, including health and safety and community air monitoring services.

Bellport Gas Station-Bellport, NY

Brownfield's Consulting Support Services - This Suffolk County Brownfields site is currently in the New York State Department of Environmental Conservation (NYSDEC) Environmental Restoration Program. Mr. Rhodes oversaw the preparation of a remedial investigation work plan and the Remedial Investigation/Alternative Analysis report. In addition, an Interim Remedial Measure was performed and a final Remedial Action Plan with NYSDEC was negotiated. He submitted a final site management plan with an environmental easement. The site has been remediated and PWGC continues to monitor the site as required.

Avalon Bay Communities - Rockville Center, NY

Brownfields Project Management -& Planning - As project director, Mr. Rhodes provided technical support and acted as a liaison between the New York State Department of Environmental Conservation (NYSDEC), the Village of Rockville Centre, the site's previous owner and new owner, Avalon Bay Communities. He was an advocate for Avalon Bay's needs and goals to redevelop the former industrial site as residential in meetings with NYSDEC and collaborated with the client and project team to develop the most effective strategy to streamline the project's representation with the state under the BCP program. Mr. Rhodes provided invaluable guidance in regard to the project's scope of work and documentation preparation, which included work plans, sampling and RI reporting. He was instrumental in obtaining all permits to complete the IRM work plan as well as throughout the performance of the IRM. The site then went to final remedial action work plan, design and oversight of final remediation, completion of site management plan and easement, which was first project of its type on Long Island to obtain COC and was a winner of ACEC Diamond Award for engineering excellence.

Expeditors c/o Cargo Ventures LLC - Inwood, NY

Environmental Site Assessment, Remediation, & Redevelopment - Mr. Rhodes supervised the investigation, remediation and redevelopment of a New York State Department of Environmental Conservation (NYSDEC) designated spill site on 4.25 acres at a former Shell Oil terminal located along Negro Bar Channel in Inwood, NY. As part of this multifaceted project,

Suffolk County Department of Health Services (SCDHS)

Brownfield Program Engineering Consulting Services Agreement - Through a competitive bidding process, PWGC was chosen by SCDHS as its engineering consultant related to County-owned Brownfield sites. Currently, PWGC is working on five sites for SCDHS in various stages of the Brownfield Cleanup Program (BCP). These sites are in both the municipal Environmental Restoration Program (ERP) and BCP in situations where the county assumed responsibility for the site. PWGC prepared a Phase I Environmental Site Assessment and documented historic environmental work performed at the site to satisfy requirements from associated lending institutions. Rhodes oversaw the completion of a subsurface investigation to determine site conditions to prepare appropriate NYSDEC-approved Corrective and Remedial Action Plans. Further, he oversaw the removal of petroleum-impacted soils, which resulted in an excavation measuring 60,000 square feet and more than 40,000 tons of impacted soils processed.

Benjamin Beechwood, LLC, Arverne Urban Renewal Area (URA) - Far Rockaway, NY

Consulting Services, Multi-Site Phase II Planning & Management - As project director, Mr. Rhodes collaborated with representatives from Benjamin Beechwood, LLC and served as liaison to the New York City Departments of Environmental Protection (NYCDEP) and Housing Preservation and Development (HPD) effectively advocating for their project goals. He supervised environmental due diligence for the development of the site - measuring 25 city blocks wide - and prepared the scope of work for a multi-site Phase II investigation. The result was incorporated into project documents along with work plans, health and safety plans, special area management, and submitted to NYCDEP and HPD. Once approved, Rhodes coordinated with NYCDEP on extensive geophysical and geo-probe investigations, test pits and soil pile characterizations. He directed the multi-faceted project, with tank removals and NYSDEC spill closures, successfully clearing the way for the area's redevelopment and revitalization.

Town of Babylon - Wyandanch, NY

Phase II Site Investigation & Redevelopment - Mr. Rhodes worked with the Town of Babylon's Community Development Agency and private interests, which resulted in the first new supermarket built in the hamlet of Wyandanch in more than 20 years. Rhodes developed a soil and groundwater investigation scope that revealed low tetrachloroethane (PCE) levels in the soil and



higher levels in the groundwater generated by a dry cleaner formerly located at the site. Rhodes documented the PCE was degrading naturally and only low-impact levels were migrating off-site. To determine the off-site plumes' real and potential effect, PWGC conducted an extensive well survey down-gradient of the property to identify potential receptors of the off-site groundwater contamination. The results prompted the Town of Babylon to connect potentially affected residences to public water, safeguarding the contaminant pathway and clearing the site for redevelopment.

Groundwater Specialists, Inc. - Ronkonkoma, NY

QA/QC for Phase I & II Engineering Oversight Services - To assure quality of the remedial investigation, Mr. Rhodes reviewed the proposed work plan, analyses; progress and activities monitoring for the soil-boring program; monitoring well installation; groundwater sampling; and spot-checking of field records. He further reviewed the third party's data evaluation, risk assessment, draft report, and results' documentation to assure completeness and rationality; and assisted the client with the sealing of the final report upon approval.

Village of Lindenhurst - Lindenhurst, NY

Environmental Site Assessment for Property Redevelopment - Mr. Rhodes acted as liaison between Village of Lindenhurst officials and the Suffolk County Department of Health Services (SCDHS) representatives during the environmental assessment facet of a condemnation proceeding ordered by the Village as part of the site's proposed redevelopment into a court complex. Faced with access issues during the initial Phase I and II, PWGC collected enough evidence for SCDHS to obtain a court order for gaining entry to the property. Working in conjunction with the SCDHS, Mr. Rhodes finalized a scope of work and tasks, divided between PWGC and SCDHS personnel. Information collected in the joint venture documented the site's environmental integrity allowing for formulating the proper remedial action plan.

Krumenacker Florist and Nursery - Amityville, NY

Phase II Investigation & Site Remediation - After reviewing an existing Phase I report, Mr. Rhodes performed a Phase II investigation and site remediation to bring the facility into regulatory compliance and clear the path for future development. The Phase II strategy focused on specific areas of concern that could negatively affect the client in the form of greater expense and unexpected delays. The environmental concerns focused on an existing Class V Underground Injection Control Well, underground gasoline storage tanks, potential environmental assessment format issues and impacted soils beneath the former greenhouse. During the greenhouse demolition, Rhodes met with regulatory agencies to ensure that on-going soil sampling and health and safety measures met regulatory requirements.

New York City "E" Designation and Voluntary Cleanup Program (VCP)

In response to the rezoning activities in New York City, its Office of Environmental Remediation (NYCOER) oversees environmental investigation and remediation at suspect sites prior to redevelopment. Rhodes develops scopes of work for environmental investigation required to redevelop the "E" designated property. He oversees Phase I & II work plans, Health and Safety Plan and Construction Health and Safety Plan, which NYCOER must approve prior to the start of work. To assess the soil quality he coordinates and oversees subsurface investigations, including geophysical surveys and soil and groundwater sampling programs. Based on the findings, Rhodes develops and implements remedial strategies and prepares Remedial Action Plans for NYCOER approval. Rhodes provides technical oversight and support on vapor intrusion mitigation, such as vapor barriers and sub-slab depressurization systems, and is experienced with New York State Department of Health requirements on evaluating soil vapor intrusions.

Current NYCOER VCP projects Mr. Rhodes is overseeing include a nine-story affordable housing development for Phipps Houses and a 12-story residential complex in Harlem, NY for HAP Investment Developers, which also includes an affordable housing component.

Mr. Rhodes is also currently overseeing sites within the NYCOER "E" Program. He is working with Bizzi & Partners Development, LLC, in NYC's SoHo location, which will be redeveloped into a 25-story, mixed-use, high-end residential building. And in Long Island City, Mr. Rhodes is working with the Lightstone Group on the redevelopment of a former taxi site, which is being developed into a 10-story mixed-use facility.

Sive, Paget & Riesel, PC (SPR) - New York, NY

Expert Evaluation & Analysis, Carnegie Hill, New York, NY - The law firm of Sive, Paget & Riesel, PC contracted Rhodes to provide an environmental engineering evaluation to determine the source of petroleum contamination in a commercial corridor. A previous investigation conducted by the New York State Department of Environmental Conservation (NYSDEC) contractor identified SPR's client as the responsible party for an oil spill negatively affecting an adjacent building. He used the evaluation of previous reports, proper closure of a 10,000 gallon underground storage tank (UST), and cross match analysis of fuel oil to compare chemical fingerprints of several sources. PWGC prepared a comprehensive project document to illustrate hydrogeologic cross sections, a study of the bedrock, UST construction details, hydrographs and photos. The comprehensive document ultimately proved favorable for the client.

Baumann Bus site, Francis S. Gabreski Airport - Westhampton Beach, NY

UIC Investigation/Remediation - Through New York State's "Rebuild Now" Program, Mr. Rhodes oversaw the investigation/remediation for Underground Injection Control (UIC) sites on 58 acres at Suffolk County's Francis S. Gabreski Airport, a 1,500 acre former US Air Force base in Westhampton. A 2004 site investigation revealed elevated levels of semi-volatile organic compounds. Through analysis of historical maps and geophysical methods, a remedial work plan was prepared for the site to properly locate, characterize and close more than 100 UIC sites. Mr. Rhodes provided technical support to verify protocols on local, state and federal levels, corresponded with the County to negotiate the scope of work, provided quality assurance and verified that all work was done in accordance associated guidelines permitting site redevelopment. PWGC's efforts included a supplemental remedial investigation, final remedial design and preparation of a site management plan and



post remedial monitoring, which is allowing for the development of the Hampton Business District business park by Plainview, NY-based Rechler Equities.

In addition to be UIC work, Mr. Rhodes oversaw remediation efforts at Gabreski associated with the Suffolk County Department of Health Services Brownfield Program, which is administered by PWGC. Other projects successfully completed by Mr. Rhodes and PWGC, or nearing completion, under the Brownfield Program include the Blue Point Laundry site in Blue Point, the Canine Kennel at Gabreski Airport and the Ronkonkoma Wallpaper site in Ronkonkoma.

Jain Center of America - Lake Success, NY

Sub-Surface Investigation Review - Mr. Rhodes reviewed a subsurface investigation of a former gasoline station. While adhering to Village of Lake Success requirements to address past environmental problems at the site, he supported client efforts to obtain construction approval for the property. As part of the SEQRA review process, the Village required the client perform a subsurface investigation. After a review of Nassau County records, Mr. Rhodes discovered an open UIC file resulting from an acceptable endpoint result having not been obtained. He designed a subsurface investigation to address the UIC issue, the former gasoline spill, a sanitary system at the site, and other environmental concerns resulting in an expedited review process.

Penetrex Processing, Glenwood Landing - New York

Subsurface Investigation, NYS Class II Inactive Hazardous Waste Site - As project principal, Mr. Rhodes lead the investigation of an inactive hazardous waste site in accordance with a New York State Department of Environmental Conservation (NYSDEC)-approved work plan, which included sub-slab vapor and indoor air sampling and a sub-slab depressurization system. In addition, he oversaw the preparation of a feasibility study for the site that NYSDEC used to prepare a proposed remedial action plan, which lead to a Record of Decision.

Allstate Insurance Services - Hauppauge, NY

Spill Site Project Management - Mr. Rhodes oversees multiple residential fuel oil spills a year in New York City, Westchester, Nassau, and Suffolk Counties and Upstate New York on behalf of Allstate Insurance Services. He directs PWGC's Allstate team in providing technical oversight to document that spill remediation performed by the homeowner's contractor sufficiently addresses the contamination present and to achieve closure by the New York State Department of Environmental Conservation (NYSDEC). He ensures professional representation at all levels, and coordination with the NYSDEC and the environmental contractor. PWGC addresses all spills in a timely fashion, effectively reducing or eliminating Allstate's liability in such cases.

Sub-Surface Investigation Management & Client Representation Texaco Station, NY - Mr. Rhodes reviewed and supervised a sub-surface investigation to determine whether two underground storage tanks at a Texaco gas station were the potential source of soil and groundwater contamination under remediation at the time. He reviewed existing site data and supervised a subsurface investigation to determine the responsible party. The investigation showed the two storage tanks were not the source of contamination and that the current remediation system appeared ineffective.

Water Authority of Great Neck North - Great Neck NY

Groundwater Study - As project manager, Mr. Rhodes directed multiple studies using groundwater models in conjunction with the Nassau County Department of Public Works, to evaluate the pumpage of Great Neck's public water supply wells for potential for saltwater intrusion to determine the most favorable locations for a proposed well field. Rhodes used the results to prepare an aquifer management plan (AMP) for the authority that described short-term and long-term pumping scenarios. By following the AMP, the Authority has indicated the advancement of multiple saltwater wedges has slowed and/or ceased. He also prepared the water supply application and engineering report for the installation of new wells located off of the Great Neck Peninsula, which was part of the Authority's long term plans contained in the AMP.

John deCuevas, et al. v. East Hampton Golf Club, LLC, et al - East Hampton, NY

Expert Evaluation - Mr. Rhodes conducted an investigation to assess the potential environmental impact of a golf course development on the groundwater resource and to provide testimony on behalf of John DeCuevas. He researched and evaluated the hydrogeologic characteristic beneath the site, local groundwater quality concerns and potential chemical usage of the future golf course. The evaluation identified the potential for groundwater impact and the threat to nearby private drinking water wells from the proposed development. The findings prompted the two parties to agree on the development of a groundwater monitoring program to protect the private wells. Further, the golf course implemented an Integrated Pest Management program to control chemical use at the site. After developing the monitoring program that includes two wells required by Suffolk County Department of Health Services (SCDHS), Rhodes reviewed the data to determine if impacts had occurred and submitted his findings with SCDHS for incorporation in the county's database.

Fong and Wong, PC - New York, NY

New Best Cleaners & Tailors, Inc., Centereach, NY, Environmental Investigation & Remediation - He provided professional consulting services and expert testimony for the attorney who represented the site lessee in litigation with the property owner over the environmental condition and a lease buy-out agreement. He oversaw the soil and groundwater study to evaluate potential impacts and determine multiple sources of contamination, and remediation of sources associated with the dry cleaners, and participated in an on-site meeting with the presiding judge to demonstrate the conditions at the site first hand.

Minmilt Realty - East Farmingdale, NY

Remedial Project Management - As field manager, Mr. Rhodes coordinated a full remedial investigation and provided technical direction during the installation of a deep monitoring well - 180 feet - and defined the vertical extent of contamination and



hydrophobic dyes to determine the movement of dense non-aqueous phase liquids (DNAPL) using groundwater quality screening. He prepared the RI/FS report and oversaw the operation and maintenance of the system.

Computer Circuits - Hauppauge, NY

Remedial Investigation and Feasibility Study (RI/FS) – Mr. Rhodes was a project director for a characterization of a contamination's nature and extent at the former Computer Circuits industrial site, a US Environmental Protection Agency Superfund Site. He coordinated the use of multiple geophysical techniques to determine if unknown buried objects such as drums, tanks, or leaching structures existed. Techniques employed during the course of the project were interior/exterior soil borings, multiple drilling/probe methods, EnCore™ sampler, to preserve VOC sample integrity, and off-site groundwater vertical profile sampling to depths in excess of 200 feet below grade. PWGC utilized an on-site laboratory grade gas chromatograph to screen both soil and groundwater samples and followed New York State Department of Environmental Conservation procedures during the investigation.

Brookhaven National Laboratory - Upton, NY

Major Cesspools Closure – Mr. Rhodes coordinated sampling efforts to comply with the EPA and States regulated UIC program for the closure. He monitored closely the full ASP-B protocol and, after analysis of laboratory data, submitted reports to the client.

Village of Sands Point, NY

Hydrogeologic Investigation – To assess the impact of proposed irrigation wells on the surrounding area, Mr. Rhodes determined the potential screen zones of the wells, considered potentially vulnerable to salt water intrusion. In addition, he assessed the impact on nearby public supply wells operated by the Village.

PUBLICATIONS & PRESENTATIONS

The Significance of the New Brownfields Legislation (NY Real Estate Journal, 03/04; Business Industry Connection (BIC), 03/04 issue)

Brownfields: Timing is Everything (Empire State Report, 09/2004)

Watershed Strategy & Management as a Most Valuable Resource (Watershed Conference, 1996)

Watershed Management for a Limited Coastal Aquifer System (North American Water and Environment Congress '96)



Paul K. Boyce, PE, PG • PRESIDENT/CEO

PROFESSIONAL EXPERIENCE

PWGC: 27 years

AREAS OF EXPERTISE

Water Resource/Supply Design
Civil Site Design
Remedial System Design
Geothermal Systems
Groundwater Hydrology
Groundwater Modeling

EDUCATION & TRAINING/CERTIFICATION

MS, Environmental Engineering, Polytechnic University, NY (now NYU)
BS, Civil Engineering, SUNY Buffalo, NY
Professional Engineer, NY, PA
New York State Professional Geologist
OSHA HAZWOPER 40-hr (29CRR 1910.120)

AFFILIATIONS

American Society of Civil Engineers (ASCE)
NYS Society of Professional Engineers
American Council of Engineering Companies (ACEC)
Long Island Professional Geologists Association
American Water Works Association (AWWA)
National Groundwater Association (NGWA)



PROFILE

An environmental engineering professional Mr. Boyce has amassed an impressive portfolio of successful project in the New York Metropolitan region. He is an expert at providing public and private clients with targeted analyses, designs, modeling services, investigations, master planning development, construction oversight, regulatory, and sustainability consulting.

For more than two decades at PWGC, Mr. Boyce has been immersed in some of the most innovative and successful environmental engineering projects on Long Island, playing key roles in developments that have improved the region's economy and environment. Whether using cutting-edge geothermal technology to assist Amneal Pharmaceuticals in the development of its base of operations in Yaphank or conducting detailed groundwater modeling at Brookhaven National Laboratory, his client expertise covers a wide spectrum of applications including targeted design and analysis, groundwater modeling, environmental investigations, construction oversight, and sustainability consulting.

Overall, Mr. Boyce develops project-specific civil and environmental engineering designs, implementation strategies and project management plans. He is an expert on the design and construction oversight related to the application of geothermal technologies. He assists clients with selecting the appropriate system and location, feasibility assessment, design preparation, system development and startup.

In his tenure at PWGC, Mr. Boyce has earned an industry-recognized reputation for his ability to assess project parameters and design and developing economical environmental engineering solutions that meet the stringent demands of our clients.

NOTABLE PROJECTS

Mr. Boyce's responsibilities with regards to lead sampling and analysis include interpretation of regulatory requirements and federal action levels as they pertain to lead in potable systems, investigations into causes for high lead concentrations in drinking water, recommending solutions to remedy high lead levels, cost estimates for lead treatment strategies, designs for remedial solutions involving flushing, plumbing material replacements and chemical treatment and water chemistry modeling. He provided coordination and supervision of field teams performing lead sample collection. Mr. Boyce was the regulatory agency liaison for all parties involved.

P.W. GROSSER CONSULTING, INC.
P.W. GROSSER CONSULTING ENGINEER & HYDROGEOLOGIST, P.C.

PHONE: 631.589.6353 630 JOHNSON AVENUE, STE 7
PWGROSSER.COM BOHEMIA, NY 11716

LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON



NYC School Construction Authority (SCA)

Discolored Water Investigations and Remedies at Numerous Schools across New York City – Notable projects included: 229K, 163K, R062, Q316. Mr. Boyce's responsibilities included aiding STV and SCA in investigating causes, overseeing field investigation services, water quality sampling, metallurgy of pipe sections, water quality/chemistry analyses, recommending remedies, report preparation, oversight of remedy implementation and follow-up samplings.

Disinfection Oversight – Mr. Boyce's responsibilities included overseeing field teams who were responsible for witnessing disinfection of potable water systems at new or renovated school buildings.

Disinfection Specification Update – Mr. Boyce was responsible for updating the SCA's standard disinfection specification for potable water systems.

Brooklyn Army Terminal Pre-K Site – Incoming potable water into the leased space was experiencing bacteriological issues. Mr. Boyce was responsible for investigating the cause and designing a remedy which consisted of new piping system and filtration units.

Lead Sampling – Mr. Boyce served as a lead consultant to SCA for a major sampling program of all schools in the New York City school system. His responsibilities included assembling lead sampling teams, coordinating and scheduling sampling events with STV and SCA, coordinating with analytical laboratories, review sampling results and consulting with SCA regarding results and potential remedies.

Diocese of Rockville Center

Lead Sampling – Mr. Boyce was responsible for overall project management and coordination of sampling for lead in the potable drinking water systems at more than 25 Long Island Catholic schools in Nassau and Suffolk Counties. His responsibilities included coordinating field sampling teams, working directly with individual school staffs, reviewing lead results and recommending remedies. Once a remedy was implemented, Mr. Boyce oversaw follow-up sampling. Mr. Boyce is the primary point of contact for Senior Diocese management staff.

Northwell Health – Long Island Jewish Medical Center (LIJMC), New Hyde Park, NY

Environmental Policy & Procedures for the Prevention of Legionella Contamination

Mr. Boyce's responsibilities for this project included researching local, state, and federal legionella standards and guidelines and updating a pre-existing environmental policy and procedures manual for the prevention of legionella contamination in LIJMC healthcare facilities. Mr. Boyce coordinated with the New York State Health Department to determine the present status of legionella updates on the state level. Following extensive research on revisions undertaken to various guidelines and standards pertinent to legionella, Mr. Boyce updated the routine legionella sampling program, disinfection procedures, maintenance and long-term control measures to prevent legionellae contamination and the requirements for the development of a water safety management program.

Water Resource Management

Ross School, East Hampton, NY

Master Planning & Campus Design – Mr. Boyce provided civil engineering design services to develop a master plan for the private school campus, which was to be a "one of a kind," transforming the school into a state-of-the-art learning institution, situated in a rural, wooded groundwater recharge area.

Civil Engineering Services – Civil engineering and consulting were provided for grading, drainage, utility layout, roadways, parking, site lighting, athletic playing fields, irrigation, water supply, sanitary, wastewater collection, and open loop geothermal heating/cooling water systems. Throughout the project, Mr. Boyce collaborated with other project consultants, foremost planners, architects, landscape architects, MEP engineers, surveyors, contractors, the construction manager and the school administration. He oversaw and participated in the conceptualization and preliminary design of the campus' proposed layout, which included eco-friendly engineering designs consulting/development and integration of civil engineering design aspects with other important features such as academic programs, architecture, landscaping and pedestrian walkways.

Environmental Engineering Services – The campus was to be as green as possible utilizing available eco-friendly technologies for the most environmentally sensitive and appealing design. The campus' sensitive environmental location as well as sanitary density issues required a sewage treatment plant. Mr. Boyce investigated and evaluated different sewage treatment technologies capable to meet the school's projected needs functionally, aesthetically and academically. Mr. Boyce took into consideration some sustainability goals and follow regulatory requirements.

Environmental Consulting/Conceptual Design Services After researching the latest sewage treatment technologies, Mr. Boyce recommended to the master planning team and school administration a wastewater treatment system that naturally treats sewage and industrial waste to re-use quality that met the Master Plan goals: aesthetics, economic/environmental advantages and well below regulatory discharge standards. The panel accepted his recommendation and he created conceptualized layouts, sited for possible plant locations and designed a preliminary ecologically engineered sewage collection system.

Geothermal Well System Design – Mr. Boyce managed the site assessment, design, construction oversight and preparation of O&M manuals for the systems and conducted a feasibility study of using open-loop geothermal systems to heat and cool two of the school's most prominent buildings – The Center for Well Being (Bldg. 5) and the Media Pavilion (Bldg. 2). He researched local hydrogeological and groundwater quality conditions and analyzed the effects of required flow rates on a nearby Suffolk County Water Authority (SCWA) well field. Mr. Boyce employed Groundwater Vistas by ESI, to create a detailed 3-dimensional model for the area. His analysis illustrated the potential effects of supply and recharge wells on (1) each other, (2) nearby neighboring shallow wells, (3) the SCWA well field, and (4) the local water table (The model also took into account of the local groundwater divide). Once he had demonstrated that operating two separate open-loop geothermal well systems in close proximity would not have an impact, he prepared the engineering report for the NYS Department of Environmental Conservation, along with the appropriate Long Island Well permit applications for approval.



Northwell Health – Glen Cove Hospital, Glen Cove, NY

Northwell Health – Glen Cove Hospital, Glen Cove, NY, Geothermal Wells Project – As project manager, Mr. Boyce prepared the feasibility study, well permits, construction documents, oversaw the construction and fieldwork for the installation of a 400 GPM open-loop groundwater heat pump system. Before design, Mr. Boyce conducted the study to assess the feasibility of augmenting the AC's geothermal well system; he investigated size and location options for new wells and prepared construction cost estimates based on minimizing potential conflicts with existing site constraints and the likelihood of regulatory agency approval. He determined that expansion to the existing system would be feasible based on cost, local hydrogeology, and his modeling results. He advised the client that construction would cause significant disruptions to the hospital's daily operations. In accordance with NYSDEC guidelines, he investigated the potential effects of the proposed project on a nearby inactive hazardous waste site, obtained baseline water quality data, estimated aquifer characteristics to refine and calibrate the model and drafted a design and construction plan of a test and monitoring well to determine local geologic conditions. As liaison between NSUH, the NYSDEC, and the local regulatory agencies, Mr. Boyce established that a scaled-down, relocated system would have negligible effects on the hazardous waste site, and consequently, obtained approval for the proposed construction. NSUH selected Mr. Boyce to design, plan, and oversee the construction of the new system, which involved developing the design and strategy for a supply and recharge well system with inter-connecting process piping, detailed hydraulic analyses, sizing the various system components, and coordination with other project consultants on the installation of piping and process equipment.

Water Supply & Treatment

Suffolk County Department of Public Works, Yaphank, NY

Timber Point Country Club, Great River, Water Supply System & Irrigation Well Upgrades – Mr. Boyce directed the well's condition assessment, including pump test, to determine capacity and water quality and prepared specifications/plans to upgrade supply well with new pump and motor. Further, he designed new piping configurations to integrate an irrigation well with distribution and cross-connection to the Suffolk County Water Authority and specified new variable frequency drive for well pump motor.

West Sayville Golf Course, Sanitary System Improvements – Mr. Boyce oversaw construction phases through completion including, supervised design, development of permitting, bidding and administrative buildings sub-surface sanitary disposal system.

Peconic Dunes Park, Peconic, NY, Water Distribution System Improvements – Mr. Boyce supervised design/development of permitting, bidding, and construction documents to upgrade the existing water distribution system's components including backflow prevention devices water mains/meters, hydrants, and internal plumbing. Further, he oversaw construction phase services through to completion.

BOMARC Police Firing Range Westhampton, Drainage Improvements – Mr. Boyce directed design/development of permitting, bidding, and construction documents for drainage conditions improvements (i.e. stormwater collection/conveyance systems, new recharge system), and oversaw construction phase services through to completion.

Suffolk County Fire Academy, Yaphank, Water Supply Well Improvements – Mr. Boyce supervised design/development of bidding and construction documents for the re-circulated supply system. This included: physical/chemical rehabilitation, electrical service upgrades, a new motor starter, and replacement of a diesel driven booster pump with an electrically operated one, as well as the deep well vertical turbine pump and motor with a new submersible pumping unit. He managed construction phase services (administration, observation) to project completion.

SUNY Stony Brook, Sewer District 21, Groundwater Modeling Study, Stony Brook NY – Mr. Boyce performed a 3-d numerical groundwater modeling to estimate flow path and travel time of sewage treatment plant effluent from recharge basins to the Long Island Sound and prepared an engineering report documenting findings and modeling results.

Water Authority of Great Neck North, Nassau County, NY

Weybridge Road Clearwell Design – Mr. Boyce prepared a design for a new air stripper clearwell, upgraded the booster pump, piping, controls modifications, coordinated with NCDOH, and performed cost estimates. The design is completed and NCDOH has approved it, however, funding constraints have put the project on hold.

SCADA System Design – Mr. Boyce prepared a design for a new Supervisory Control and Data Acquisition System. He prepared bidding and construction documents, providing construction administration and observation services, and cost estimates.

Emergency Water Main Replacement, Berkshire Road – Mr. Boyce prepared design, construction and bidding documents for emergency water main replacements, expedited NCDOH review and approval, and provided PE certification services.

Air Stripper Cap at Watermill Lane – Mr. Boyce coordinated with contractor and WAGNN regarding design and sizing of appropriate air exit cap atop existing air stripper at Watermill Lane treatment plant.

Valve Book Review/Updates – Mr. Boyce updated valve location sketches as new valves are being installed in the distribution system.

Municipal Supply Well Design, Well #14 – Mr. Boyce oversaw the design services for the new 1,400 gpm municipal supply well. The design included an engineering report for NYSDEC and NCDOH review/approval, preparation of plans and specifications for a new well, associated piping, well house, electric, controls, instrumentation, chemical treatment, safeties, etc. Project is just underway as of Sept 2007. Construction phase services will also be provided.

Weybridge Road Ground Storage Tank Replacement – Mr. Boyce lead the project team charged with designing a new 500,000-gallon steel ground storage tank to replace a deteriorated and dilapidated existing 400,000-gallon ground storage tank. The team prepared bidding/construction documents, inclusive plans and specifications, obtained NCDOH approval, provided construction administration and oversight services.



General Consulting Services – Mr. Boyce attended Board of Directors meetings to present monthly engineering report, assist with hydrogeological issues, contaminant fate and transport concerns, well maintenance, water main rehabilitation, etc.

Hampton Bays Water District, Suffolk, NY

Well Field Construction & Integration – Mr. Boyce prepared the structural, mechanical, and electrical designs for a new well field including two pump stations. In addition to construction plans and specifications, Mr. Boyce oversaw the integration of a new well field with an existing distribution system via hydraulic analyses and guided the client through the regulatory agency review and approval process. In a subsequent project phase, he partook in creating the layout of several residential water main projects, for which he analyzed the proposed water main layouts and prepared conceptual designs based on Health Department and ISO requirements.

Caustic Feed Systems Design – Mr. Boyce was responsible for the design of caustic feed systems at all eight District supply wells. He prepared existing conditions drawings by conducting field visits to obtain the necessary information. He then designed caustic feed systems consisting of double-walled underground storage tanks, piping, metering pumps, safety interlocks, controls, alarms and injection equipment to raise the ambient pH of the groundwater withdrawn from the shallow aquifer system to between seven and eight and a half. He was responsible for preparing plans and specifications, obtaining Health Department approval, and then overseeing the construction administration and observation aspects of the project.

Isolated Pressure Zone Design – Mr. Boyce was responsible for designing an isolated pressure zone in an area that was experiencing chronic low-pressure conditions within the District's distribution system. He worked with existing distribution system maps and survey data to identify the boundaries of the proposed zone, he worked with available hydraulic data to estimate pressure conditions and developed a planned approach on how to isolate the zone and create a booster pumping station to raise pressures within the zone to acceptable levels. Mr. Boyce was responsible for preparing the project plans and specifications that included a new packaged booster pumping station, water main and valve work, electrical service and site work. The SCDHS approved the plans and the pressure zones were constructed closely to his design and construction cost estimate.

Good Samaritan Hospital, West Islip, NY

Well Turbidity Study – After review of existing water quality data, Mr. Boyce recommended sampling and analyses for additional parameters. He applied a water quality model, using the existing raw water quality data. To achieve optimal water quality pH-level, hardness, and alkalinity, he performed trial and error solutions using a numerical model. Different treatment chemicals were included in the model in various combinations or by themselves. Concluding modeling efforts led to a realistic chemical concentration.

Copper & Lead Desktop Study – The results of the study Mr. Boyce performed served to identify the possible cases for turbid water condition and proposing alternative options for corrective actions to restore acceptable water quality. He presented each alternative for evaluation and comparison to determine most advantageous choice, based on potential for success, technical complexity, and cost. In addition, he prepared a treatment specification and coordinated with an experienced well driller, resulting in a successful chemical treatment, and restoration of the water quality to acceptable conditions.

Town of Oyster Bay, Syosset, NY

Potable Water Supply System Upgrade Design & Compliance Management Services – As Project Manager, Mr. Boyce coordinates inspection and assessment services for the town's Tobay Beach Park & Marina potable water supply system. PWGC focuses on the water supply system's status of compliance with NYSDOH, NCDOH, 10-State Standards, and provides feasible engineering designs to in response to the town's objectives: Safe, potable water for Tobay Beach patrons, in an economically sound fashion. Mr. Boyce managed the authoring of a feasibility report and selected/recommended minimum corrections and system upgrades. In addition, he prepared the design of a dry-briquette calcium hypochlorite chlorination system and other upgrades at Well House 3 of the Tobay Beach Park & Marina. To date, he continues to provide engineering services and design specifications for wellhead improvements. He also directs PWGC water quality monitoring and assessment services at the beach to determine compliance with local and state health department water quality and equipment guidance.

Civil Site

Three Mile Harbor Boat Yard, East Hampton, NY

Site Planning Analysis – After evaluating site conditions, Mr. Boyce recommended feasible improvements to enhance an existing boat yard facility. He investigated local zoning/building codes, sized/located sanitary facilities, sized/designed layout and arrangement of parking facilities, sized/located/orientated a new proposed structure to house a marine shop, offices, storage, and industrial space. He effectively addressed critical issues such as the site's location in a harbor protection area and no public water access, which put severe constraints on sizing and locating the sanitary facilities. He prepared plans and reports delineating suitable site alternatives and requirements for implementation in compliance with regulatory agencies and utility companies.

Inlet Seafood, East Hampton, NY

Site Plan Application – As senior engineer, Mr. Boyce designed and coordinated the preparation of site-plan application drawings for the commercial/industrial fishing marina looking to expand the site from a commercial to a multiple use area that included retail, restaurant, and commercial fishing. He managed civil/site concerns, which included grading, drainage, sanitary, water supply, utilities, parking, traffic controls, site lighting, and building locations/elevations. Mr. Boyce worked with the owners and other project consultants to conceptualize and plan the site layout for optimum use and compliance with local zoning and building codes. In addition, he prepared site-plan application drawings for the Town Planning Board and local regulatory



agencies. He supervised development of designs and bidding/construction documents for new water mains/services/flow meters, hydrants, and drinking water fountains. Mr. Boyce oversaw construction, and supervised wetlands delineation and permitting with the NYSDEC through to project completion.

Jay Construction Corp, NY

Pile Foundation Designs for Residential Homes - Mr. Boyce was responsible for designing foundations for four residential homes in Patchogue, New York. The design included investigating existing soil conditions, reviewing architectural plans, sizing piles based on soil conditions, locating piles based on architectural layout, determining number of piles based on loads including self-weight, building dead, live, snow and wind load, and worst-case combination of loads based on building code. He created designs for reinforced concrete pile caps in accordance with ACI requirements and created foundation walls to serve as grade beams between pile caps. In addition, Mr. Boyce prepared construction documents including plans and specifications and acted as the primary client contact throughout the project.

Times Square Construction, New York, NY

Geotechnical Report for 47 East 34th Street Building Construction - Mr. Boyce oversaw a rock core boring program, characterized rock core samples and developed a geotechnical report based upon findings of the rock core boring program. He provided foundation recommendations for a new 38 story residential building being erected upon Manhattan schist on the east side of midtown Manhattan. Mr. Boyce assisted with the rock anchor design and specification. He supervised and managed field observation services for rock anchor testing. Supervised and managed the September 2007 design and development of a foundation waterproofing system.

Storm Water Management

Benjamin Beechwood, LLC, Arverne Urban Renewal Area (URA), Far Rockaway, NY

Design/Engineering Management Services, Stormwater Collection & Conveyance System - Mr. Boyce managed the design and siting of a stormwater collection and conveyance system for an 80+ acre development along the south shore of Queens County. He coordinated catch basins locating, grading design, sizing interconnected piping networks and tie-ins with the local NYC storm sewer system. Mr. Boyce was also responsible for incorporating BMP's in the system design.

Stormwater Quality Impact Assessment on Local Surface Water Body - Mr. Boyce was responsible for determining stormwater roadway run-off concentrations for TPH's, suspended solids, metals, coli forms, pH, and dissolved oxygen. To estimate the influence of these parameters on the nearby canal basins into which they were to be discharged, he employed chemical and mathematical relations using chemical properties and mass balances based on flow rates and tidal flushing volumes to estimate potential effects. Subsequently, he assisted in preparing the stormwater portion section of a Draft Environmental Impact Statement.

NYS DOT, Kensico Reservoir Route, Westchester, NY

120 Expansion Stormwater Management System Stormwater Quality Pre-Construction Baseline Assessment - Mr. Boyce directed the roadway run-off sampling of 15 storm events and 5 outfalls along the Reservoir. He oversaw installation of automated sampling equipment to monitor weather conditions, sampling events, and system/statistical data analyses for a stormwater-runoff quality report.

Allied Aviation Services, LaGuardia Airport, NY

Storm water Sediment & pH Control Investigation, LaGuardia Airport, Queens, NY - Mr. Boyce was responsible for reviewing and investigating an ongoing problem of storm water discharge to a surface water body with a too high solids content level. Storm water runoff collected at the fuel tank farm for LGA is passed through a treatment system to remove oils and organic contaminants. Under severe rainfall events, the treated storm water effluent had been discharged to the adjacent harbor with unusually high amounts of suspended solids, which were temporary violations of the facility's State Pollutant Discharge Elimination System permit. To find a cost-effective solution for the continuing problem, he evaluated various alternatives from in line cartridge filters, to settling tanks, to storm drain separators. Aside from cost, he considered other restrictions, such as limited space for installation, maintenance, durability, and reliability. Mr. Boyce studied peak hydrologic events and recommended the most efficient and effective treatment option for the owner to implement. Elevated pH of the discharged treated storm water effluent presented an unexpected, and separate, water quality issue. In addition, he was responsible for investigating the cause of the problem and recommending a course of corrective action.

AIL Systems Inc, Deer Park, NY

Recharge Basin Size Analysis - To assess the feasibility of reclaiming land used for recharge purposes, to sell or alter its land use, Mr. Boyce analyzed the industrial facility's existing cooling water recharge system. His analysis included an investigation of the facility's hydrological and drainage characteristics, and the existing storm water handling facilities' capability to accommodate various storm events. Mr. Boyce reviewed local building codes to make sure any proposed alterations could handle the minimum required storm events. He investigated the cooling water discharge rates to the recharge basins, to determine how much of the existing basins were required to handle the cooling water. With his report, AIL Systems was able to effectively evaluate its real estate options.



Groundwater Remediation

Brookhaven National Laboratory, Upton, NY

Engineering Services for the Glass Holes & Animal Chemical Pits CERCLA Remedial Excavation - Mr. Boyce prepared the excavation plan and design drawings for a remedial excavation of over 50 individual waste pits at the client's site. He managed the waste pits' initial delineation, oversaw the geophysical survey using electromagnetic survey equipment, and prepared the excavation plan detailing technical guidelines for the hazardous waste site's remediation. The plan provided direction for the removal/recovery of organic, inorganic, biological and radioactive buried wastes, as well as explosive, reactive, and corrosive materials. His engineering drawings detailed excavation layout, work/stockpiling areas, grading, drainage, haul routes, utilities, and site restoration. He acted as a field engineer during the field operations, oversaw excavation/waste removal, stockpiling, characterization and segregation of excavated materials, and monitored daily logistics for field crews.

Mercury-Contaminated Soil Treatment Alternatives Evaluation Report - Mr. Boyce's report evaluated various appropriate remedial treatment technologies, including visual and technical system descriptions, a comparison study of each alternative's technology, treatment process efficiency in the types, quantities and concentrations of mercury present in the soil, as well as the overall economics and cost effectiveness. He called attention to the presence of other contaminants such as organics and radioactive parameters and studied the available technologies. He also presented recommendations for a soil stabilization process and options for the remediated soil's disposal.

OUIII Western South Boundary Remedial System Design - Mr. Boyce was responsible for assisting in selecting the appropriate remedial technology for a groundwater pump treatment system for a volatile organic contaminant plume clean up. He suggested appropriate technologies and reviewed them from a feasibility standpoint. He recommended the most applicable one, based on effectiveness, available capital and O&M costs, implementation, reliability, operation, and maintenance. Mr. Boyce was then responsible for preparing a portion of the design of the recommended treatment technology, which included sizing and optimizing the primary treatment equipment (4-foot diameter x 35-foot tall air stripping tower).

Ash Pits Capping -Mr. Boyce was responsible for preparing the design of a capping system for an area formerly used as incinerator ash repository. He conducted the initial investigation to assess the area's extent by reviewing old aerial photographs, digging test pits, and conducting interviews with BNL personnel. Once he had delineated and surveyed the area, Mr. Boyce designed a soil-cap cover system in accordance with NYSDEC regulations to prevent surface exposure to ash and to minimize rainfall infiltration through the area. He was responsible for preparing design/construction drawings that included grading, drainage, slope stabilization details, limits of clearing and coverage and site restoration work such as fencing, roadways, signage, etc.

Minmilt Realty, Farmingdale NY

Groundwater & Soil Remediation Systems Design - Mr. Boyce evaluated, selected and designed appropriate remediation systems to cleanup a large industrial solvent plume that had contaminated nearby soil and groundwater. The chosen groundwater remediation consisted of an air-stripping tower, granular activated carbon (GAC) filters for off gas treatment and recharge structures; the soil treatment system was a soil-vapor extraction system (SVE) and GAC filters. Mr. Boyce's design responsibilities included sizing and selecting remediation system equipment, structural, mechanical, electrical, hydraulic, well, controls and instrumentation design. Mr. Boyce also performed three-dimensional numerical groundwater modeling to evaluate the effectiveness of the proposed groundwater remediation system and to size and locate a series of deep and shallow wells. Mr. Boyce prepared plans and specifications, a technical report for the NYSDEC detailing the choice of the specific components overall design process. He was involved in the construction administration and oversight of the remediation systems and was responsible for reviewing and approving shop drawings and performing routine construction observation services.

Brentwood Water District (BWD) Air Stripper, Plant No. 2, Brentwood, NY

Treatment Alternatives Study & System Design - As Project Engineer, Mr. Boyce conducted the treatment alternatives study for a VOC contaminated well field at BWD. The study ultimately recommended air stripping as the most effective and cost efficient technology to treat groundwater withdrawn from Plant No. 2. Upon the study's completion and acceptance, he prepared the design for the treatment system, which encompassed mechanical, electrical, structural, hydraulic, architectural and site components. Specific design components included an 11' diameter by 30' packed bed depth aluminum air stripper, a 100,000-gallon ground storage clearwell, and booster pumps. Specific design aspects include restaging an existing well pump, electrical service upgrade, a new natural gas engine generator set, stripping tower enclosure and three existing pumping stations refinish. Mr. Boyce prepared the plans and specifications, which were approved by the SCDHS and ultimately used to construct the air stripper and related facilities. Following the design phase of the project Mr. Boyce was responsible for providing construction administration and observation services.

Nitrate Study & Analysis - Mr. Boyce prepared a statistical analysis to compare increasing groundwater nitrate concentrations with pumpage from Plant No. 2 of the BWD. The analysis involved compiling water quality data to measure levels in three wells of Plant No. 2, reviewing the data, and using statistical methods to forecast the water quality of pumpage from the aquifers utilized by the BWD. He superimposed pumpage data from Plant No. 2 over his water quality findings to create a trend analysis, which showed nitrate concentrations fluctuated in the different wells based on pumpage. Mr. Boyce recommended available treatment technologies which eventually would be necessary to slow the deterioration rate of water quality caused by nitrate level changes. He advised that, based on the statistical analysis, establishing pumping sequences would slow the rate of water quality deterioration. His report also included estimates for when treatment of nitrate will become necessary and appropriate treatment technologies available.



Roanoke Sand & Gravel, Mid Island, NY

Sand Mining Design and Permitting – As the primary client contact, Mr. Boyce oversaw the application submittal to the Town of Brookhaven and NYSDEC to expand mining operations at an existing sand and gravel mine. The scope of services included assembling engineering drawings for proposed mining operations by excavating deeper through the bottom; preparing an engineering report addressing environmental, geotechnical and hydrogeological issues; preparing volume estimates to determine how much more sand and gravel could be mined by expanding the operations at the existing site and acting as regulatory liaison for the client.

PUBLICATIONS

- **Not Just a Chemical Interaction: Complementary Roles of Geologist & Engineer on a Hazardous Waste Remediation Project at BNL** (5th Conference: Metropolitan & Long Island Association of Prof'l Geologists (M/LIPAG, 04/98, SUNY Stony Brook)
- **Much Ado About Mercury: Evaluation of Treatment Options for Mercury Contaminated Soil at Brookhaven Nat'l Laboratory (BNL)** (6th Conference, M/LIPAG, 04/99, SUNY Stony Brook)
- **Open-Loop Geothermal Well Systems on Long Island** (10th Conference, M/LIPAG, 04/03, SUNY Stony Brook)

P.W. GROSSER CONSULTING, INC.
P.W. GROSSER CONSULTING ENGINEER & HYDROGEOLOGIST, P.C.

PHONE: 631.589.6353 630 JOHNSON AVENUE, STE 7
PWGROSSER.COM BOHEMIA, NY 11716

LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON



Thomas J. Melia, PG • SR. PROJECT MANAGER

PROFESSIONAL EXPERIENCE

PWGC: 16 years

PRIOR: 2 years

AREAS OF EXPERTISE

Phase I & II Environmental Site Assessments
NYSDEC Brownfield Cleanup Program Management
NYCOER Brownfield and "E" Designation Management
Remedial Activities
Site Investigation/Analysis, Work Plan/Report Preparation
Environmental Compliance and Investigation
Soil/Groundwater Investigation, Analysis, Sampling
UST remediation
Hazardous Waste Site Investigation and Cleanup

EDUCATION & TRAINING/CERTIFICATIONS

MS, Energy & Environmental Systems, Stony Brook University, NY
BS, Geology, Stony Brook University, NY
AS, Earth/Space Sciences, Suffolk Community College, NY
Licensed Professional Geologist - NYS
ASTM Phase I ESA Practices for Commercial Real Estate: Transaction Screen and Phase I Site Assessment
OSHA 40-hour HAZWOPER
OSHA 8-hour HAZWOPER Supervisor



PROFILE

As a Senior Project Manager, Mr. Melia has assisted property buyers, sellers and developers navigate potential environmental concerns, petroleum spills, the NYS Brownfield Cleanup Program, the NYC E-Designation Program/Voluntary Cleanup Program requirements during property transactions and site development. PWGC's role on these projects has included soil/groundwater investigations, air quality studies, and remedial measures. His clients, ranging from developers to attorneys, and municipal agencies, benefit from his expertise in overseeing Phase I and II ESAs, Remedial Investigation/Feasibility Studies, cost to cure estimates for financial institutions, and Brownfields projects. Mr. Melia coordinates with PWGC clients to prepare plans for approval by federal, state, and local agencies (e.g., Remedial Action Plans, Health and Safety Plans, Investigation Work Plans, Interim Remedial Measures) and monitors each project's day-to-day progress to meet the client's objectives and regulatory requirements on time and within budget.

NOTABLE PROJECTS

Federal Superfund Program

145 Marcus Blvd Inc. - Former Computer Circuits Superfund Site, Hauppauge, NY - Remedial Investigation and Feasibility Study
- The Former Computer Circuits site is the location of a former manufacturer of printed circuit boards for military and commercial applications listed on the USEPA National Priority List. The site has since been renovated for use as commercial office space. A RI/FS performed at the site in 2000 documented trichloroethene (TCE) impact to groundwater and soil vapor beneath the site. An IRM consisting of a soil-vapor extraction (SVE) system was implemented at the site in 2007. As part of the IRM, Mr. Melia was responsible for overseeing installation of the SVE system to meet project specifications, preparing quarterly status reports for submittal to USEPA which documented TCE contamination to groundwater and soil vapor, and evaluated offsite transport of TCE impact in groundwater. Following the IRM, Mr. Melia prepared a Remedial Action Work Plan (RAWP) for the final remedy selected for the site which consisted of the continued operation of SVE treatment systems at the site, along with long-term groundwater, soil vapor, and indoor air monitoring. As part of implementation of the RAWP, Mr. Melia prepares annual Site Management Reports for the site which document existing TCE contamination to groundwater, soil vapor and indoor air, evaluate whether the SVE systems are effectively removing TCE impacted soil vapor from the subsurface, and evaluate offsite migration of TCE impacted groundwater.

CDM Federal - Lawrence Aviation Industries Superfund Site, Port Jefferson, NY - Remedial Investigation and Feasibility Study
- Lawrence Aviation Industries is a former manufacturer of titanium for the aeronautics industry. The site has received numerous SCDHS and NYSDEC citations for improper disposal practices and releases, is listed on the National Priority List, and is the

P.W. GROSSER CONSULTING, INC.
P.W. GROSSER CONSULTING ENGINEER & HYDROGEOLOGIST, P.C.

PHONE: 631.589.6353 630 JOHNSON AVENUE, STE 7
PWGROSSER.COM BOHEMIA, NY 11716

LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON



suspected source of trichloroethene (TCE) and tetrachloroethene (PCE) groundwater contamination in the area. Mr. Melia provided field oversight for drilling activities during the EPA Remedial Investigation/Feasibility Study (RI/FS) at the site. This included groundwater vertical profiling, installation and construction of multi-port monitoring wells and installation and sampling of deep soil borings. Roto-sonic drilling technology was utilized for all drilling activities. Mr. Melia's responsibilities included monitoring and documenting drilling activities and well construction, lithologic classification and logging of soils, managing the collection and analysis of soil and groundwater samples and documenting that procedures outlined in the Health & Safety plan were followed.

Brookhaven National Laboratory, Upton, NY

HFBR and G-2 Tritium Investigation - Mr. Melia provided field engineering and oversight support to the HFBR and G-2 Tritium Investigations, which included the installation and sampling of temporary vertical profile wells. These investigations also included the installation and development of monitoring wells equipped with either bladder or submersible pumps. His responsibilities included managing the collection and analysis of groundwater samples, health and safety oversight, and coordinating the necessary permits. The work was performed under a Radiological Work Permit.

Building 96 PCB Remediation - Mr. Melia provided field and Health & Safety oversight for the Building 96 PCB Remediation project, which included the excavation and disposal of approximately 1,000 tons of poly-chlorinated biphenyl (PCB) impacted surface soil from the former scrap yard. Mr. Melia was responsible for monitoring and documenting excavation activities, as well as documenting that procedures outlined in the project Health & Safety Plan were followed.

Building 96 Silt Zone Remediation - Mr. Melia provided field and Health & Safety oversight for the chemical oxidant injection phase of the Building 96 Silt Zone Remediation project. This phase of the project included the collection of real-time VOC data using a membrane interface probe attached to direct push equipment, installation and sampling of monitoring wells within the project area and the chemical oxidation of a subsurface zone of silty soil suspected of being a source of VOC impact. Chemical oxidation of the silt zone was accomplished through the multiple applications of potassium permanganate (KMnO₄) injections throughout the suspected source area. Mr. Melia was responsible for monitoring and documenting drilling activities and chemical mixing and injection procedures, as well as documenting that guidelines outlined in the project Health & Safety Plan and Job Safety Analysis were followed.

OU III Airport Vertical Profiles - Mr. Melia provided field and Health & Safety oversight for the OU III Airport Vertical Profiles. His responsibilities included supervising the installation and sampling of groundwater vertical profiles to provide additional characterization of the carbon tetrachloride plume at the Dowling College Brookhaven Campus. The project was conducted in a residential area south of the BNL property, where residential sensitivity was essential. Mr. Melia was also responsible for sample management, daily reporting and coordinating the management of project generated wastes with the BNL field engineer.

Waste Management Support - Mr. Melia was responsible for the preparation of Maintenance Procedures for multiple systems at the Waste Management Facility including the Overhead Crane, Jib Crane and Shielded Cell in building 865 and the Ventilation Systems, Floor Coating and Grounds throughout the Facility. Mr. Melia also prepared Technical Work Documents and provided oversight for the refurbishment of the Shielded Cell window.

New York State Remedial Programs

AvalonBay Communities, Inc. - Former Darby Drug Facility, Rockville Centre, NY - NYSDEC BCP - The Former Darby Drugs Distribution Center was a commercial warehouse formerly occupied by a textile company which was a source of PCE contamination to soil and groundwater beneath the site. The site was enrolled in the NYSDEC Brownfield Cleanup Program (BCP). Mr. Melia developed a scope of work for a Supplemental RI at the site, which included a Supplemental RI Work Plan, Health and Safety Plan, and Community Air Monitoring Plan. The Supplemental RI included soil sampling to delineate the suspected PCE source area, soil and groundwater sampling above the clay lens to evaluate general soil and groundwater quality above the clay lens, and vertical profile sampling to evaluate groundwater quality beneath the clay lens, and evaluation of soil vapor/indoor air quality. Following preparation of the Supplemental RI Work Plan, Mr. Melia acted as the Field Team Lead to oversee junior staff implementing the work plan, to ensure that data generated during the Supplemental RI was sufficient to develop a remedial plan for the site. Following completion of Supplemental RI field activities, Mr. Melia prepared a Supplemental RI Report. The report detailed the horizontal and vertical extent of contamination beneath the site in multiple media, and an evaluation of the fate and transport of the contamination. The report was utilized to support the preparation of an Interim Remedial Measure, and a Remedial Action Work Plan.

Suffolk County Department of Health Services - Former Canine Kennel Site, Gabreski Airport, Westhampton Beach, NY - NYSDEC BCP and State Superfund Site - The Former Canine Kennel is an approximately one-acre parcel located within the bounds of Gabreski Airport which is owned by Suffolk County. The property was previously owned by the United States Air Force (USAF) when the airport operated as a military air base. The Site is a New York State BCP/State Superfund site. During USAF deactivation prior to transferring the property to Suffolk County, the Former Canine Kennel Area was used for the disposal of PCB containing electrical distribution equipment such as transformers and capacitors. Based on a previously completed RI for the site, Mr. Melia prepared a Remedial Action Work Plan (RAWP) and Alternatives Analysis (AA) for the site to address PCB contamination beneath the site. The AA evaluated several potential remedies for the site. The RAWP selected and detailed the preferred remedy for the site which included the targeted removal of PCB impacted soils from the areas with the highest PCB concentrations to meet site-specific Soil Cleanup Objectives (SCOs), capping of low level surficial PCB impact, and evaluation of PCB impact in groundwater. In addition to the RAWP, a Self-Implementing Cleanup Plan for PCBs was prepared and submitted to USEPA to allow for PCB impacted soils below a certain threshold to be disposed of as non-TSCA waste to minimize disposal costs. Following NYSDEC approval of the RAWP and AA, Mr. Melia was responsible for managing all remedial work performed at the site, which included the removal of over 1,000 tons of PCB impacted soil and debris, collection of over 200 confirmatory endpoint samples, installation of a one-foot cap of clean fill material, and collection of groundwater samples from the site. Following completion of remedial activities, Mr. Melia prepared a draft Final Engineering Report (FER), which



documents soil remediation, and evaluates PCB impact and migration in groundwater, and draft Site Management Plan (SMP), which details the operation and maintenance of engineering controls and institutional controls implemented at the site and specifies a proposed scope of work for long term monitoring and/or remediation of PCB impacted groundwater at the site. The draft FER and SMP are currently awaiting approval by NYSDEC.

PFAS Investigation – Following completion of remedial activities at the Former Canine Kennel Site, per and poly fluoroalkyl substances (PFAS) were detected in groundwater during routine O&M monitoring. Following this discovery, Mr. Melia managed a subsurface investigation at the site to horizontally and vertically delineate the extent of PFAS impact at the site. The investigation consisted of the installation and sampling of groundwater vertical profiles to 100 feet below grade both on and off site. The results of the investigation showed that the source of PFAS impact was upgradient of the Former Canine Kennel Site and that PFAS impact extended to at least 100 feet below grade.

Suffolk County Department of Health Services – Former Baumann Bus Depot, Gabreski Airport, Westhampton Beach, NY – NYSDEC VCP – The Former Baumann Bus Site is an approximately 58-acre parcel located within the bounds of Gabreski Airport which is owned by Suffolk County. The property was previously owned by the United States Air Force (USAF) when the airport operated as a military air base. The Site is a New York State Voluntary Cleanup Program (VCP) site. Mr. Melia managed an Interim Remedial Measure (IRM) at the site to address underground injection control (UIC) structures associated with former USAF base buildings. Mr. Melia was able to rapidly identify and inventory site structures through combination of file review and site inspections. He worked in conjunction with SCHDS to prepare evaluation criteria to assess which structures would require sampling. The revised sampling criteria allowed PWGC to target sampling to structures of concern and to control costs. Mr. Melia prepared an inventory sheet of the UIC structures present for the site, which did not previously exist. He thoroughly addressed site UIC issues so that structures which were not required following site redevelopment could be properly closed without further need for assessment/ remediation. In total the IRM included the assessment of 188 UIC structures and remediation of 29 UIC structures. Following completion of remedial work, Mr. Melia prepared a report summarizing the findings documenting remedial activities performed as part of the IRM. The report was approved by SCHDS and NYSDEC.

B&B Urban LLC – Williamsbridge Gardens – NYSDEC Brownfield Cleanup Program – Williamsbridge Gardens is a former commercial property that was used for vehicle storage, automotive repair and warehouse. Mr. Melia is managing remediation of the subject property under the oversight of NYSDEC via the Brownfield Cleanup Program. Mr. Melia performed environmental due diligence (Phase I & II ESAs), prepared a BCP Application for the site. Upon acceptance into the BCP, Mr. Melia prepared a RI Work Plan and implemented a RI at the site which identified SVOC, metal and pesticide impact in soils at the site from surface grade to bedrock. Following completion of the RI, Mr. Melia prepared a RAWP for the site that includes a Track 1 – Unrestricted Use Cleanup consisting of the removal of all onsite soils exceeding NYSDEC Unrestricted Use SCOs and installation of a chemically resistant vapor barrier to mitigate potential offsite soil vapor intrusion issues. The RAWP has been approved by NYSDEC and will be implemented during redevelopment of the site; redevelopment will consist of the construction of two new eight-story residential buildings with partial basements and a landscaped interior courtyard for residents. The new buildings will be used for affordable housing, including at least 80% at rents below federal low-income housing tax credit rents, and with 30% formerly homeless families. Remediation and construction is scheduled to begin in early 2021.

United Properties Corp. – Jay's Lucky Cleaners – NYSDEC Brownfield Cleanup Program – Jay's Lucky Cleaners is a strip mall located in a mixed commercial/residential area that has been used as a dry cleaner since the 1950s. Mr. Melia is managing remediation of the subject property under the oversight of NYSDEC via the Brownfield Cleanup Program. Mr. Melia managed a RI at the site. The RI identified PCE impacted groundwater both on and offsite. Onsite groundwater impact was limited to the water table interval, while offsite groundwater impact was determined to be migrating downward; soil borings installed during the RI documented the presence of the Gardiners 20-foot Clay approximately 40 feet below grade at the site which may limit the downward migration of PCE impact in groundwater. The RI also identified PCE impact to soil vapor beneath the existing building and at the property boundary abutting residential properties, as well as PFAS impacted groundwater beneath the site. Following the RI, Mr. Melia prepared and implemented an IRM consisting of the installation of a sub-slab depressurization system (SSDS) to mitigate soil vapor intrusion within the existing building and prepared a RAWP for the site that includes a Track 2 – Restricted Use cleanup. The remedial plan for the site includes in-situ bioremediation injections to address impacted groundwater and implementation of a Site Management Plan to govern long term groundwater and soil vapor monitoring. Currently NYSDEC approval of the RAWP is pending.

Commander Terminals Holdings LLC – Former Commander Oil Terminal – NYSDEC Brownfield Cleanup Program – The Former Commander Oil Terminal is an active MOSF since the 1930s and was historically used as a sawmill, coal yard and ice plant prior to that. The site is located on the waterfront in Oyster Bay adjacent to White's Creek. Environmental issues at the site include petroleum impact to soil and groundwater throughout the property related to the property's usage as a MOSF, as well as TCE impact to soil and groundwater beneath the central portion of the site related to a former leaking chiller unit that was used in conjunction with gasoline storage tanks at the site. Preliminary redevelopment plans for the site include decommissioning of the existing MOSF and construction of a mixed-use commercial/residential development. Mr. Melia reviewed existing environmental records for the site dating back to the 1990s and managed a subsurface investigation to supplement the historical data for the purposes of preparing a BCP application for the property. Currently, final NYSDEC approval of the BCP application and issuance of a BCP agreement is pending.

Islip Resource Recovery Agency – Blydenburgh Landfill, Islandia, NY – NYSDEC State Superfund Program – Mr. Melia conducted the quarterly groundwater sampling required by NY Environmental Conservation Rules and Regulations (NYCRR) Part 360. He monitored groundwater and leachate quality near the clean fill landfill, as well as Leachate Containment Basins to determine if landfills/basins operations are impacting groundwater quality and whether unnoticed failures of the leachate collection/storage systems occurred. As defined by NYCRR 360 regulations, Mr. Melia performed one baseline and three routine parameter-



sampling events annually. He was responsible for collection and analysis of groundwater and leachate samples from 27 groundwater-monitoring wells, two leachate containment basins, and four leachate storage tanks and recorded groundwater quality parameters in the field using a multi-parameter water quality meter. In addition, he collected water level measurements from the monitoring wells to prepare groundwater contour and potentiometric surface maps. Mr. Melia used monitoring and data analysis results to assist with quarterly report preparation as well as submittal of one annual report to the IRRRA and NYSDEC and quarterly well condition and leachate monitoring reports to the Suffolk County Department of Public Works (SCDPW) as part of the IRRRA's sewage-discharge certification requirement.

New York City Remedial Programs

Phipps Houses – Phipps Plaza South, New York, NY – NYCOER VCP Implementation During Redevelopment – PWGC performed investigation and remediation of the subject property under the New York City Voluntary Cleanup Program (VCP). The site was assigned a Restrictive Declaration by NYCDEP due to the potential presence of hazardous materials at the site based on historical usage of the property. PWGC performed a Remedial Investigation that identified historic fill material throughout the site and based on those findings developed an appropriate Remedial Action Plan (RAP) for the site. Remediation was performed by the redevelopment contractor concurrently with the construction of the building foundation under the oversight of PWGC. It consisted of removal of impacted soils/historic fill for offsite disposal, and the installation of a composite cover system and vapor barrier to prevent potential future exposures to residual impact left onsite. Remediation was completed in August 2015, and redevelopment was completed in Spring 2016. Mr. Melia managed all aspects of the VCP implementation, including coordination with regulatory agencies, preparation of the RI Work Plan and Report, preparation of the RAP, management remedial activities including soil disposal and vapor barrier installation, and preparation of a Remedial Closure Report.

B&B Urban LLC – Kingsbridge Heights Apartments – NYCDEP City Environmental Quality Review – Mr. Melia managed the remediation of the subject property under the oversight of NYCDEP via the CEQR program. Remediation of the property was performed concurrently with the redevelopment of the property into a 13-story, 150,000-square-foot residential development consisting of 136 apartments for formerly homeless families, low income individuals and families, and moderate-income households. Remediation consisted of the characterization, removal and offsite disposal of impacted soil/historic fill, the installation of a composite cover system capping the entire property to prevent potential future exposures to residual impacted material left onsite, and installation of a vapor barrier beneath the building to mitigate potential soil vapor intrusion. Remediation was completed in Spring 2019; following completion of remediation, Mr. Melia prepared a Remedial Closure Report which was approved by NYCDEP in July 2019.

83 Walker LLC – 83 Walker Street – NYCOER E-Designation Program – 83 Walker Street was a vacant lot formerly used for contractor storage; it was assigned an E-Designation for Hazardous Materials by the New York City Department of City Planning as part of a rezoning action. Mr. Melia managed the remediation of the subject property under the oversight of NYCOER via the E-Designation Program. Remediation of the property was performed concurrently with the redevelopment of the property into a nine-story, 24,000-square-foot residential development. Remediation consisted of the characterization, removal and offsite disposal of impacted soil/historic fill, the installation of a composite cover system capping the entire property to prevent potential future exposures to residual impacted material left onsite, and installation of a vapor barrier beneath the building to mitigate potential soil vapor intrusion. Remediation was completed in Spring 2015; following completion of remediation, Mr. Melia prepared a Remedial Closure Report which was approved by NYCOER in June 2015.

General Consulting Services

Phase I & II Environmental Site Assessments

Mr. Melia manages Phase I & II ESA preparation, implementation, and completion. For each project, he provides a customized scope of work and relevant documentation to provide clients with pertinent information. He performs Phase I & Phase II ESAs for private clients, environmental attorneys, municipalities, and lending institutions for use in property transactions according to ASTM Standards.

Certilman, Balin, Adler & Hyman, LLP

Mr. Melia provided general consulting services in support of potential litigation on behalf of several Funeral Home directors. Mr. Melia prepared a report summarizing applicable regulations and standards pertaining to the discharge of embalming fluids to sanitary and sewer systems as well as potential alternative non-toxic embalming chemicals and waste treatment/disposal methods.



Andrew Lockwood, PG, LEP .

SR. VICE PRESIDENT

PROFESSIONAL EXPERIENCE

PWGC: 15 years

PRIOR: 17 years

AREAS OF EXPERTISE

Phase I and Phase II Environmental Site Assessments
PFAS and other emerging contaminants
Petroleum Spill site investigation/remediation
CERCLA sites
NYSDEC Brownfield Cleanup Program/Environmental Restoration Program
Environmental/Regulatory Compliance (Investigation/Remediation Mgmt)
Radiological Characterization & Remediation
Chemical, Radiological/Mixed Waste Management & Disposal
Groundwater Treatment System (Planning, Design, O&M)
Client Representation & Regulatory Liaison
Environmental Program Mgmt (Planning, Monitoring, Safety)

EDUCATION & TRAINING/CERTIFICATION

BA Geology, SUNY Potsdam, NY
Licensed Professional Geologist - NYS
Licensed Environmental Professional (LEP), State of Connecticut
"D&D of Research Reactors & Other Small Nuclear Facilities" Certificate (Argonne Nat'l Laboratory, 11/2001)
DOE Radiological Worker I & III
OSHA Health & Safety 40-hr, Supervision 8-hr
30-hr OSHA Construction Safety Training, 2009
Advanced Radioactive Material Shipper Certification Training, 2004
Advanced Hazardous Waste Shipper Certification Training, 2004
ISOCs Measurements Using the Inspector, Canberra Industries, Inc, 1999
Groundwater Pollution & Hydrogeology, Princeton University, 1990
Project Leadership Course, PCI Global Inc., 2001



PROFILE

Mr. Lockwood specializes in planning and managing CERCLA/NYSDEC remedial investigations/Feasibility Studies, Phase I and Phase II ESAs, Brownfields Cleanup Program (BCP) projects, and nuclear facility decontamination & decommissioning (D&D). He has worked at numerous DOE and DOD facilities in more than a dozen states across the country managing remedial investigation/feasibility study projects involving the generation of radiological, hazardous and mixed waste. They include multi-year projects that involved complex investigations, remediation and waste management issues. Mr. Lockwood manages PWGC's environmental group, overseeing a staff of more than 30 professionals.

Mr. Lockwood has over 30 years of experience managing environmental investigation and remediation projects including CERCLA RI/FS sites, NYSDEC BCP sites, NYCDEP "E" sites, Municipal Landfill permitting and closure, and environmental investigations for real estate transactions. Mr. Lockwood's clients range from large governmental agencies to small real estate developers. He has performed work across the eastern United States under numerous federal, state, and local regulatory agencies.

NOTABLE PROJECTS

Suffolk County Fire Training Facility - Yaphank, NY—RI/FS

Mr. Lockwood manages the ongoing RI/FS for the Suffolk County fire training facility in Yaphank, NY. The 28-acre site is in the NYSDEC's inactive hazardous waste site program. The site was listed as a NYS Class 2 Inactive Hazardous Waste Disposal Site in August 2017. The primary contaminants of concern are in a class of chemicals referred to as per and poly fluoroalkyl substances (PFAS). The specific PFAS of interest are primarily perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). The presence of these compounds is the result of the use of the Aqueous Film Forming Foam (AFFF) at the site. Mr. Lockwood was responsible for the preparation of the Citizens Participation Plan, Records Search Report, RI Work Plan, Quality Assurance Project Plan and Health and Safety Plan. The RI field work included delineation of PFAS in soil on-site and in groundwater both on and off site. In addition, site specific protection of groundwater soil cleanup objectives were calculated (no soil cleanup standards are available in NYS). PWGC is currently preparing a feasibility study with alternatives to address both soil and groundwater contamination at the site.

P.W. GROSSER CONSULTING, INC.
P.W. GROSSER CONSULTING ENGINEER & HYDROGEOLOGIST, P.C.

PHONE: 631.589.6353 630 JOHNSON AVENUE, STE 7
PWGROSSER.COM BOHEMIA, NY 11716

LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON



Wertheim National Wildlife Refuge - Shirley, NY—POET System Design and O&M

Three Point of Entry Treatment (POET) Systems were designed and installed at the refuge, one in a maintenance garage and two in residential buildings located within the refuge. The POET Systems were designed to remove per and poly fluoroalkyl substances (PFAS) that were detected in the groundwater supply wells servicing the three structures. Mr. Lockwood was responsible for the preparation of an Engineering Report and Operations and Maintenance Manuals for the systems. PWGC oversaw the installation and start up testing of the systems and is performing the scheduled system sampling to ensure that the systems are functioning as designed.

Carmans River - Shirley, NY—Surface Water and Biota Monitoring

Mr. Lockwood managed the investigation of per and poly fluoroalkyl substances (PFAS) in surface water and biota within the Carmans River and other water bodies within Suffolk County. Mr. Lockwood prepared a Biota Monitoring Work Plan/QAPP that included the collection of surface water and biota samples (eels, blue crabs, white perch, and clams) for PFAS analysis. He prepared a Biota Monitoring Report detailing the results of the investigation.

Gabreski Airport - Westhampton Beach, NY

Mr. Lockwood managed a field investigation to investigate the presence of per and poly fluoroalkyl substances (PFAS) in groundwater discovered during routine O&M monitoring of a NYSDEC BCP site. Vertical profile wells were installed upgradient and downgradient of the site. The Investigation is ongoing.

Brookhaven National Laboratory - Upton, NY

Mr. Lockwood served over 10 years as Project Manager on various CERCLA projects for BNL Environmental Restoration Division (ERD). He has managed diverse projects for BNL's Groundwater, Surface, and Reactor Groups. On his most recent projects for the Reactor Group, Mr. Lockwood provided project management services on four remediation projects over a 3-year period with budgets totaling more than 15 million dollars. In addition, he has prepared or assisted in the preparation of site-specific project documents such as work plans, sampling and analysis plans, quality assurance project plans, health and safety plans, records of decision (ROD), completion reports, final status surveys, remedial investigations (RI) and feasibility studies (FS). He has prepared contract documents, including request for proposals (RFP's), scopes of work (SOWs), and contract specifications for both large- and small-scale procurements and has acted as the technical representative on multiple contracts, ensuring the contract scope is being completed.

Mr. Lockwood combines his technical background with his in-depth knowledge of BNL's protocols and procedures to prepare schedules and cost estimates for baseline and fiscal year budgeting and tracking, provide short-term assistance to help BNL complete Baseline Change Proposals, and long-term assistance to manage remedial projects.

Project Manager- Fan Houses and Stack Silencer D&D, Underground Utilities Removal, Perimeter Area Soil Remediation Projects

Mr. Lockwood managed multiple remediation projects at BNL between 2008 and 2011. Project involved overseeing demolition of radiologically contaminated above ground and below ground structures, preparation of project documents including Remedial Action Work Plans, Sampling and Analysis Plans, and Completion Reports. The projects involved the disposition of complex waste streams. He was the primary interface with regulatory agencies and DOE. Mr. Lockwood was responsible for completing the projects on schedule and within the allocated budget. All projects were successfully completed.

Project Manager - Chemical Holes Remediation Project

Mr. Lockwood was involved with the Chemical Holes project since 1995. He served as the project Field Engineer performing and/or overseeing the characterization of the site including soil and groundwater sampling as well as geophysical surveys using EM-51, EM-61, Rapid Geophysical Surveyor (RGS) and multiple GPR surveys to locate the 55 individual waste pits. Pilot Testing for selected remedies was conducted and included in-situ vitrification, excavation, and containment using cement/polymer injection. He participated in the selected remedy, large-scale excavation and disposal, overseeing excavations of the waste pits at the site. He served as the Project Manager for the post-excavation characterization and disposal, wastes generated included mixed, waste, cylinders, liquid mixed waste, and mixed waste soil (mercury). More than 15,000 yd³ of waste was successfully transported for disposal and the site released with no radiological controls, he was responsible for the characterization, management, treatment, transport, and disposal of complex waste streams.

Project Manager - Former Hazardous Waste Management Facility Project

Utilizing his knowledge of chemical and radiological characterization, CERCLA, and DOE procedures and protocols, Mr. Lockwood managed the characterization, and implementation, of a remedial design at a 12-acre site formerly used as the primary facility for the storage, treatment, and packaging of hazardous, radioactive, and mixed waste at BNL. His responsibilities included the development of project plans, project scope and detailed schedule, resource needs and budget estimates. The project involved the characterization of buildings with both hazardous and radiological contamination, their D&D and transport and disposal to permitted facilities. In addition, characterization of the 12-acre facility was performed which included soil, groundwater and sediment sampling, at NYS delineated wetland located within the facility, for chemical and radiological contamination. A remedial design was prepared which included the excavation of approximately 11,000 yd³ of radiologically contaminated soil and sediment and the restoration of the site. As project manager, Mr. Lockwood was responsible for the daily management of this project including preparation of contract specifications, procurement documents and budget forecasting and management. He was responsible for the preparation or approval of all project documents from characterization, contracting, through implementation of the remedial action. Mr. Lockwood coordinated the successful completion of the project tasks overseeing subcontractors and support from other BNL divisions.



Project Engineer OU III Strontium-90 Pilot Study Design – Mr. Lockwood prepared a Pre-Design Characterization Work Plan to support the preparation of a Pilot Study Design for the remediation of Strontium-90 (sr-90) contaminated groundwater at BNL. Groundwater south of the former Chemical/Animal Pits had been impacted with sr-90 at concentrations exceeding NYSDEC groundwater standards. The purpose of the investigation was to delineate the concentrations within and extent of the sr-90 plume. Mr. Lockwood implemented the plan prepared the Pre-Design Characterization Report, and participated in the successful completion of the Pilot Study, which led to the installation of a permanent remedy using resin vessels to remove sr-90 from the groundwater.

Special Projects Manager BNL Waste Management Facility - Mr. Lockwood provided technical services support to the BNL Environmental and Waste Management Services Division. His responsibilities included project planning and implementation of the characterization, packaging, and disposal unknown radioactive sources (including TRU Waste). Mr. Lockwood prepared technical work documents (TWDs) for the D&D of radiologically contaminated equipment including the Building 801 D-Tanks Pipe Removal project and the Building 865 Compactor Repair. He also prepared TWDs for the sampling of low level radioactive liquid wastes in the Bldg. 810/811 storage tanks. Mr. Lockwood prepared maintenance procedures for the facilities infrastructure. Mr. Lockwood prepared and implemented a TWD for the Central Steam Plant Outfall Soil Excavation, Transportation, and Disposal, including preparation of sampling plans, delineation of lead impacted soils, review of contractor deliverables and oversight of the excavation and performance of confirmatory sampling and reporting.

Field Engineer Brookhaven Linear Isotope Producer (BLIP) Investigation - The BLIP facility is used for the production of radioisotopes used in the medical field. Targets are introduced into the beam line produced by a linear accelerator. The facility was constructed with an earthen beam stop. Mr. Lockwood participated in the preparation of a work plan to characterize the nature and extent of soil and groundwater contamination associated with the operation of the facility. Sodium-22 and tritium were identified as the primary contaminants of concern. The extent of the radiological contaminants was identified and a report detailing the results of the investigation prepared.

Field Engineer OU I Western South Boundary Groundwater Remediation System Design - Mr. Lockwood oversaw the implementation of the Characterization Work Plan installing temporary and permanent groundwater monitoring well points to delineate the extent of contamination within the Western South Boundary groundwater contamination plume at the BNL site. Mr. Lockwood oversaw the preparation of the Remedial Design Documents and construction of the groundwater treatment system identified in the design.

Field Engineer Magothy Characterization Project - Mr. Lockwood oversaw the implementation of the Characterization Work Plan installing temporary and permanent groundwater monitoring well points to delineate the extent of contamination within the Magothy aquifer beneath the BNL site.

Brownfield Cleanup (BCP)/Environmental Restoration Program (ERP)

Mr. Lockwood manages BCP and ERP projects for both private and municipal clients. He prepares applications, technical documents, and interfaces with NYSDEC project managers to ensure project schedule and scope meet NYSDEC's requirements for approval of incentives/reimbursements. These sites require preparation of BCP and ERP applications, technical work plans, RI reports, human health and ecological assessments, remedial alternatives reports (FS), citizens participation plans, public meetings and completion reports. Under contract with the Suffolk County department of Health Services (SCDHS) and the Department of Public Works (DPW), Mr. Lockwood assists the County in managing the technical aspects of County owned sites in the NYSDEC Brownfields Cleanup and Environmental Restoration Programs. These sites include former United State Air Force Disposal Sites and former industrial and gasoline service station sites which are currently vacant or unused because the redevelopment of the sites are hampered by historical site uses which have contaminated soil and groundwater.

New York City "E" Designation Sites

In response to the recent rezoning activities in NYC the NYC Department of Environmental Protection (NYCDEP) oversees environmental investigation and remediation at suspect sites prior to redevelopment. Mr. Lockwood develops scopes of work for environmental investigation required to redevelop the "E" designated property. He prepares work plans and HASP reports; which DEP must approve prior to the start of work. To assess the soil quality, he coordinates and oversees subsurface investigations (including geophysical surveys and soil and groundwater sampling programs). Based on the findings he develops and implements remedial strategies and prepares Remedial Action Plans for NYCDEP approval.

Phase I & Phase II Environmental Site Assessment (ESA)

Project Management – Mr. Lockwood managed Phase I & II ESA's preparation, implementation, and completion. Mr. Lockwood performs these services for a variety of clients including banks, developers and municipalities. For each project, he provides a customized scope of work and relevant documentation to provide clients with pertinent information. He performs Phase I & Phase II ESA's for private clients, environmental attorneys, municipalities, and lending institutions for use in property transactions according to ASTM Standards.

Lowe's Home Center

Mr. Lockwood manages Phase II environmental investigations and remediation for Lowe's Home Centers. Mr. Lockwood is one of a team of consultants who manages site development activities at properties identified by Lowe's as potential development sites. These sites include previously developed sites with past commercial and industrial, including one used as a Municipal Solid Waste Landfill. Each site has a unique environmental issues and regulatory involvement. Mr. Lockwood prepares environmental reports, engineering designs and conducts remedial activities to support redevelopment of the sites.



GTJ-Group/Green Bus Lines, Inc - Queens/Brooklyn, NY

Hydrogeology/Environmental/Civil Engineering Services & Compliance Stipulation Agreement -- Services range from Site Remediation Management & Baseline Environmental Report Preparation (Project Coordination, Oversight, Sample Collection) at large bus facilities.

Mr. Lockwood conducted site/facility investigations and provided, on an accelerated time schedule, site investigations and remedial action planning and design for dissolved and free phase groundwater contamination treatment systems.

NYSDEC Spill Program Compliance - In 2005, an Oil Delivery Company had caused a substantial Oil Spill at one of the client's depots; the new release brought attention to outstanding issues required under an existing Stipulation Agreement, although Cleanup tasks were in compliance. The NYSDEC issued a new Order of Consent, with an accelerated time schedule. Under Mr. Lockwood direction, the PWGC team completed an accelerated Site Assessment (delineating the extent of LNAPL and dissolved contamination at the site) and submitted a Remedial Action Plan and preliminary treatment system design to meet the accelerated schedule. Mr. Lockwood managed PWGC construction oversight of the selected remedy and performed operation/maintenance of the remedial system.

PA, City Industries Superfund Site - Winter Park, FL.

Mr. Lockwood managed the preparation of work plans, health and safety plans, project schedule, and budget estimate. He coordinated and supervised soil boring/monitoring well installations and soil and groundwater sampling activities. Analyses were conducted for volatile organics, semi-volatile organics, and chlorinated compounds. Mr. Lockwood served as the primary author of the PA report.

Department of Transportation Facilities - Nashville, TN.

Managed RIs and prepared RI reports and CAPs at several Department of Transportation facilities in Tennessee. Investigations included preparation of work plans, installation of boring and monitoring well networks, and preparation of an RI report. The CAPs included the performance of aquifer pumping tests. The RI report contained options for recovery and treatment of soil and groundwater contamination with dissolved and free phase petroleum compounds. Mr. Lockwood served as primary author of the RI reports and CAP.

Loring AFB Operable Unit 5 RI - Caribou, ME

Field Team Leader for the RI Investigation, Loring AFB - The field effort extended over six months and included the complete investigation of three separate sites. Field activities included the installation of Geoprobe® (250), soil borings (50), and monitoring wells (25) including three multiport Westbay wells; and groundwater, stormwater, and sediment sampling. Mr. Lockwood's responsibilities included preparation of Statements of Work, client interface, and RI report preparation.



Nick Russell • PROJECT HYDROGEOLOGIST

PROFESSIONAL EXPERIENCE

PWGC: 4 years

AREAS OF EXPERTISE

Industrial Hygiene
Water, Soil, Air Sampling
Field Work (Protocol, Oversight, Documentation)
Site Investigation/Analysis
Health & Safety Monitoring

EDUCATION & TRAINING/CERTIFICATION

BA, Environmental Studies (Concentration: Marine Environment), SUNY Stony Brook
New York State Asbestos Inspector
New York State Mold Assessor
USEPA Lead-Based Paint Risk Assessor
OSHA HAZWOPER 40-hr; OSHA HAZWOPER 8-hr refresher
OSHA 10-Hour Construction
OSHA 30-Hour Construction



PROFILE

Mr. Russell is a Field Hydrogeologist/Environmental Scientist. He has conducted field work in the areas of groundwater remediation, soil sampling, air quality sampling and Phase I & II site assessments. He has also conducted several asbestos, mold and lead-based paint inspections throughout New York City and Long Island. He has an excellent record in timely completion and maintenance of project coordination, monitoring, and document preparation, while successfully maintaining communication between clients, government agencies, and other parties involved.

NOTABLE PROJECTS

Lead Sampling Analysis - Mr. Russell performed water sampling to test for lead in accordance with the Lead and Copper Rule (LCR). Mr. Russell coordinated with the building staff to access the sites and assess the building to determine which plumbing fixtures were to be sampled. He accessed the building, after school hours, to create site plan layouts of each floor and the fixtures to be sampled. Samples were drawn within a specific time frame in accordance with clients' requests.

Asbestos Inspections/Investigations - Mr. Russell has conducted asbestos inspections throughout New York State and assisted with inspections within the five boroughs of New York City for multiple clients, including: major hospitals, custom home builders, nationwide retail chains, environmental remediation sites, real estate developers, banks and insurance companies. Mr. Russell has approximately two years of asbestos-project experience.

Mold Investigations - Mr. Russell completed mold investigations at various facilities, including, but not limited to: commercial buildings and banks. Sampling procedures included swab sampling, air sampling and carpet dust sampling.

Lead-Based Paint Assessments - Mr. Russell conducted and oversaw lead-based paint assessments per USEPA protocols for private residences, and construction projects in New York State.

PFC Sampling - Mr. Russell worked alongside the Suffolk County Department of Health Services to test for PFC contamination accumulating in the biota (Blue claw crabs, American Eels and the Hard Clam) of several Suffolk County watersheds. Mr. Russell was responsible for the collection and handling of each species in accordance with a stringent PFC sampling procedure. Mr. Russell was also responsible for maintaining a detailed field log of all the collections.

Subsurface Investigations - Mr. Russell oversaw the removal of contaminated soil and performed endpoint sampling to evaluate the status of the remediation. Mr. Russell was responsible for keeping a detailed field log of all the work performed on the site. Mr. Russell performed air monitoring during the intrusive earth work to assure air quality was in accordance with the Community Air Monitoring Program approved by the NYSDEC and USEPA.

SVE System O&M - Mr. Russell's ongoing responsibilities include quarterly inspections of the sites Soil Vapor Extraction system. He ensures that all aspects of the system are in proper working condition and monitors readings from the systems parameters. Mr. Russell take air samples from the influent and effluent sampling ports on the system to gauge the systems effectiveness. Mr. Russell conducts quarterly ground water sampling. Each of the sites monitoring wells are sampled using a grundfos pump and parameters are recorded with a Horiba or other equivalent water quality meter to ensure the water sample is taken within low-flow water sampling procedures.

P.W. GROSSER CONSULTING, INC.
P.W. GROSSER CONSULTING ENGINEER & HYDROGEOLOGIST, P.C.

PHONE: 631.589.6353 630 JOHNSON AVENUE, STE 7
PWGROSSER.COM BOHEMIA, NY 11716

LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON



UIC Sampling and Remediation Oversight- Mr. Russell has sampled several Underground Injection Control structures (UICs) for the presence of contamination and oversaw the removal of soil and sediment in those above action levels. Mr. Russell collected endpoint samples in the presence of the Suffolk County Department of Health Services to ensure the remediation of the structure. Mr. Russell has also overseen the removal of contaminated soils from soil hotspots at several sites then performed endpoint sampling to ensure the removal of contaminated material. He performed air monitoring for the presence of VOCs in the air while intrusive earth work was taking place at many sites.

Phase II Environmental Site Assessments – Performed various aspects of Phase II ESA scopes of work for commercial and industrial properties, including: field work; subcontractor oversight; coordinating daily with assigned laboratories, and; general project coordination and management.

Residential/Commercial Fuel Oil Spills Oversight - Mr. Russell oversees fieldwork for projects such as petroleum spill remediation. He completes spill reports, and coordinates with contractors and the NYSDEC to ensure that the project stays on schedule, is compliant with regulatory guidelines, and meets the client's goals.

NYCOER Redevelopment Project - Mr. Russell Provides field oversight services to "E" Designation sites. His is responsible for monitoring the air for dust and volatile organic compounds (VOCs) during earthwork. Mr. Russell documents daily soil removal and notes soils that may be contaminated. In addition to these services, he completes daily logs, communicates with NYCOER, clients, government agencies and other parties involved.



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

LDC Company Profile

LDC is a small, minority-owned (SBE/MBE) quality assurance and environmental chemistry company focused on data validation, data quality assessment, database implementation, and data usability. Our primary services include data validation, electronic transfer of data, oversight of quality assurance/quality control (QA/QC) programs, laboratory and field audits, technical support for litigation, and database management. Our corporate office located in Carlsbad, California is directed by Mr. Scott Denzer and Ms. Stella Cuenco, principal chemists with over 45 years of experience between them in the environmental laboratory and data validation industries

LDC is recognized as one of the leaders in the data validation industry through participation on major DoD and commercial projects such as:

- Army Corps of Engineers, DuPont Chambers (Baltimore District)
- Army Corps of Engineers, DuPont Chambers (Philadelphia District)
- Army Corps of Engineers, Various projects (New Mexico)
- Army Corps of Engineers, Camp Navajo (Tetra Tech)
- Army Corps of Engineers, Various projects, 8a Contract (Sacramento District)
- Army Corps of Engineers, Fort Ord (Shaw E&I)
- Las Vegas Wash Henderson Site (ERM)
- DOE NPR-1 Elk Hills (DOE direct and Ahnta)
- Nevada Environmental Response Trust (NERT) Henderson Site (Ramboll Environ)
- NOAA MDRA Mississippi Site (Entrix)
- Stringfellow Superfund Site (DTSC)
- BKK Landfill (Ramboll Environ)
- EPA Region IX ESAT QA Program (ICF)
- AFCEE/AFCEC, Andersen AFB (EA/Shaw)
- AFCEE/AFCEC, Loring/Pease AFB (Bechtel/MWH)
- AFCEE/AFCEC, Mather AFB (MWH)
- AFCEE/AFCEC, Army Corps of Engineers, Travis AFB (CH2M Hill)
- AFCEE/AFCEC, McClellan and Castle AFB (Jacobs Engineering Group)
- AFCEE/AFCEC, Beale AFB (Law/Crandall, Inc.)
- AFCEE/AFCEC, Andrews AFB (URS)
- Navy CLEAN Atlantic Division (EA Engineering)
- Navy CLEAN IV Southwest DIV (AECOM)
- Navy RAC Southwest Division (OHM Remediation/IT Group/Shaw)

LDC has successfully performed over 500 data validation projects worth over 10 million dollars for prime contractors servicing Air Force (AFCEE/AFCEC), Army Corps, Navy, and industrial activities.

LDC has developed well-documented procedures which support all facets of the data validation process. This includes critical steps such as:

- Project tracking
- Peer review for all data validation activities
- Internal training programs
- Internal and external audits
- Strict documentation
- Electronic deliverables



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

LDC as the "Best Value" Contractor

LDC is a data validation subcontractor with an impeccable track record for timeliness, quality, technical expertise, and the ability to mitigate complex data quality issues. Our clients will confirm our current and past performance under DoD (including USACE), DoE, and commercial programs. We have experience and a proven track record commensurate with the requirements of this RFP as demonstrated by the following:

- **LDC is the software developer and expert in the use of the Automated Data Review (ADR) software.** LDC has been using the ADR.NET version for over 3 years and has the current version in full implementation which meets USACE and current DoD QSM requirements. LDC has performed over 1000 ADR projects in the past 10 years, worth over \$2,000,000 in revenue. LDC will provide technical support to the Client as needed for e-QAPP generation or EDD troubleshooting.
- Data validation experience as a subcontractor for more than 100 Army Corps sites, over 140 AFCEE/AFCEC sites, several EPA sites, and under 6 Navy CLEAN and RAC contracts and 150 Navy sites. This experience includes 15 years of data validation work under USACE direction and thorough understanding of the USACE Baltimore, EPA Region 2 and 3 validation guidelines, and the DoD QSM.
- Successful completion of USACE data validation activities since 1992 under subcontracts to various Districts including New England, Baltimore, Philadelphia, Omaha, Albuquerque, Seattle, Sacramento, and Jacksonville.
- Recent project experience in the Eastern region including support to four separate contractors on the Passaic River for varied projects and programs with revenues of 200K, and Gowanus Canal with GEI, revenues of 33K.
- **On-time delivery record of greater than 99%** with the ability to expedite turnaround as needed due to our large experienced staff as noted above.
- Successful completion of five DoD and two DoE audits to approve LDC's internal data validation procedures, QA program and documentation systems. (prior to 2000)
- Thorough secondary QA review program and **the capacity (33 full time chemistry staff) to handle a project of this magnitude and importance.** This significantly reduces additional work the consultant might otherwise need to do upon receipt of LDC reports.



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

Data Validation Capacity

LDC is continually evaluating and monitoring its capacity to meet client needs. It is company policy to not accept a project unless the service can be completed on-time with our expected quality of performance. This policy has proved very successful in meeting past project deadlines. Our client references will confirm our performance of on-time delivery.

Due to the versatile capabilities of our staff, personnel can also support multiple areas which are high in backlog. Our training program documents personnel approvals for all data review activities. All of our staff actively participate in the LDC training program.

LDC has met its contractual turnaround time requirement on over 99% of the projects completed. LDC has successfully completed projects which required data review capacity of as many as 2000 samples in one month.

Technical / Management Approach

LDC has established data validation and data management procedures which enable the thorough, consistent, timely, and efficient review of analytical data. Ms. Stella Cuenco, principal chemist, is responsible for all data validation related activities and has final authority for the company. The designated Project Manager will coordinate the day to day data validation activities and interface with the Client project chemist or PM as necessary. For day to day data review activities, data validators report directly to the senior chemist in the section of the review. Senior chemists report to the technical project manager. Data validation will be performed following the Client project specific requirements as stated in the Scope of Work (SOW).

As the Client alerts LDC of in-coming SDGs and associated ADR EDDs, the LDC project manager will log the order into the up-coming project list identified as the "LDC Project Backlog" form. This is now considered a booked order and is reserved a place in the schedule. The project manager will allocate and schedule staff resources for the project. He will generate a project specific summary which will detail the expected receipt date of the order, the due date, special method or QC requirements, and the data quality objectives (DQOs) of the project.

Once the data packages arrive, the packages are logged in according to LDC SOP 6.0.0 "Standard Operating Procedure for Sample Data Log-in". Computer generated worksheets for each SDG along with the "LDC SDG Table" and "LDC Sample Validation" spreadsheet are distributed to all project staff.

The "LDC SDG Table" spreadsheet is specific to each order and provides the project manager with an overview of individual SDGs and their associated analyses. Progress of projects is indicated daily on the spreadsheet. The "LDC Sample Validation" spreadsheet identifies individual analysis requested for all samples and supports the data reviewer in verifying that appropriate samples have been reviewed in each data package. The previously discussed tools and processes have been used to successfully meet deadlines and estimate project completion dates. Meetings are held routinely to assess the status of each project.

Throughout the data review process, the project manager monitors project status as stated above. If any scheduling or technical complications arise such that the quality of the review will be impacted, data review staff notify the project manager immediately for resolution. The project manager will keep the Client chemist current on the progress of all validation activities on a



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

routine basis via e-mail and telephone. Once the data review worksheets have been completed and approved by a secondary review, the final technical reports are written. All final technical reports are reviewed by at least two senior staff. This may include the Technical Project Manager, QA Director, or Lead Chemist. Upon shipping the final report, the Client project chemist will be contacted by phone.



Data Review/Validation Process

The data review and validation level of effort required for the Scope of Work outlined for this project will encompass several activities. The steps can be categorized in the following manner:

1) Sample Log-in

All samples submitted for data validation are entered into the LDC Log-in system. The system generates various spreadsheets for sample tracking, listings of laboratory and client identifications, sampling dates, analysis requested, matrix, and project due date. These tracking documents are distributed to all data validation, QA and project management staff.

2) Pre-screening of Data Packages

The pre-screening is performed concurrently with the sample log-in process. This task verifies sample chain-of-custody, data package completeness, and concurrence with the authorized delivery order.

3) Data Validation

The execution of the data review task requires the highest level of effort. The review process will be handled in a stepwise fashion including manual and automated data review. The validator will use manual review to document each finding on a Validation Findings form. Along with the finding, the reviewer will document the date of the occurrence, the lab reference identification, the validation criteria, the associated samples, and the qualification of the data. A Validation Checklist form is marked noting if validation criteria was met or exceeded. A Validation Checklist is enclosed for review (Exhibit A). These checklists are used as an inventory sheet to assure all samples were reviewed for each criteria. The findings documented on the Validation Findings form will be transcribed into the final summary report. Examples of recalculation and findings worksheets used for Level 4 validation are available for review upon request.

All initial validation performed by LDC has a secondary peer review. All final reports will be reviewed by a Senior Chemist or Principal Chemist.

4) First Report Review

The first review of the data validation report verifies that all findings and data qualification has been accurately transferred from the data validation worksheets. All sample identifications, methods, formatting, and general text are reviewed.

5) Senior Report Review

The senior review of the data validation report verifies that all findings, data qualification, and professional judgments previously integrated into the reports reflect the overall quality of the data. Any additional comments required to enhance the usability of the report will be inserted at this time.

6) QA Report Review



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

A QA check of selected data validation reports within an individual delivery order will be reviewed by the QA department. A formal nonconformance report will be generated for any identified deficiencies. The deficiency will be addressed with the appropriate staff and corrected prior to submittal to senior management for final review and signature.

7) Senior Management Review

The program/technical manager will perform an overall review of the final reports. He will sign the report cover letter and submit the report to the sample custodian for shipment to the client.

8) Electronic Data Deliverables (EDD)

This process will be initiated at step 1 with the receipt of disks from the client or loading EDDs to LDC's secured Internet portal. After automated verification of the EDD format, content, and fields, the EDD will be populated with the manual review for importing of the final data qualifiers. The final approval of qualifiers will occur after step 5.

LDC will self-perform the above tasks to maintain quality and control of the work product.



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

Exhibit A

VALIDATION COMPLETENESS WORKSHEET

EPA Level IV

LDC #: _____

SDG #: _____

Laboratory: _____

Date: _____

Page: _____ of _____

Reviewer: _____

2nd Reviewer: _____

METHOD: GC/MS VOA (EPA SW 846 8260B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	/	
II.	GC/MS Instrument performance check		
III.	Initial calibration/ICV	/	
IV.	Continuing calibration		
V.	Laboratory Blanks		
VI.	Field blanks		
VII.	Surrogate spikes		
VIII.	Matrix spike/Matrix spike duplicates		
IX.	Laboratory control samples		
X.	Field duplicates		
XI.	Internal standards		
XII.	Compound quantitation RL/LOQ/LODs		
XIII.	Target compound identification		
XIV.	System performance		
XV.	Overall assessment of data		

Note: A = Acceptable
N = Not provided/applicable
SW = See worksheet

ND = No compounds detected
R = Rinsate
FB = Field blank

D = Duplicate
TB = Trip blank
EB = Equipment blank

SB=Source blank
OTHER:

	Client ID	Lab ID	Matrix	Date
1				
2				
3				
4				
5				

Notes:



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

LDC Corporate Resources

LDC personnel have experience and formal training in the areas of data validation, electronic data deliverables and laboratory QA/QC. LDC personnel have performed data validation in all analytical disciplines. These include, but are not limited to, GC/MS volatiles, GC volatiles, GC/MS semivolatiles, GC pesticides, ICP metals, ICP/MS metals, GFAA metals, GC petroleum hydrocarbons, GC/MS dioxins, explosives, radiochemistry, and wet chemistry. This versatility allows our organization to adapt to workload changes and allows for an excellent secondary review system. Our organization is structured to allow direct communication between project managers, data validators, and clerical staff which occurs on a daily basis.

With LDC's 25+ years as a national leader in the data validation industry and extensive experience supporting projects with multiple EPA regions, DoD and DOE facilities, LDC is confident our data validation services will successfully meet all project requirements. The validation group is managed by Ms. Stella Cuenco, principal chemist, who has over 25 years of experience, the software products and services group is managed by Mr. Scott Denzer, who has over 35 years of experience, and the overall operations are directed by Mr. Michael Takaki, president.

The validation group is divided into chemists by discipline, organics (GC/MS, GC and HPLC) and inorganics (wet chemistry, IC, ICP, ICP/MS). All chemists report to senior group leads. A separate group performs data package log-in to the LDC tracking system. Another group performs the EDD population and verification. Shauna McKellar, Chemist and Project Manager, leads this group and has over 6 years of experience in EDD population, preparation, and uploading to various databases.

The majority of the data validation staff at LDC have been employed for over 10 years with some senior staff over 15 years as noted in the attached resumes. This level of stability and experience will ensure project stability and consistency.

In addressing LDC's financial status, LDC has an excellent Dun & Bradstreet report and has been profitable for the past 15 years. LDC has grown at approximately 10% in each of the past 5 years and continues to be a leader in our environmental sector of the data quality business. References are available from our vendors and clients to confirm our business success. Our annual revenue of approximately \$6,000,000 per year in data validation work makes LDC one of the largest independent data validation firms in the nation. In 2001, Mr. Richard Amano was the San Diego SBA Small Businessman of the Year through our sponsor Earth Tech.

LDC will commit the resources and materials to successfully complete this project with the required time period and with a high level of quality.



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

Project Team Summary

LDC personnel have hands-on experience in the areas of data validation, laboratory QA/QC, CLP SOWs, and environmental laboratory analyses. As documented in the resumes of our staff, the project team has significant experience with USACE and DoD protocols, current technology, SW-846, and all methods stated in the SOW.

LDC is presenting the following staff to perform key roles for this contract. The key staff of the project team and their experience are as follows:

- **Stella Cuenco, Principal Chemist/Operations Manager**
Project Role: Principal Chemist/Program Manager
Data Validation Experience: 20 years
Overall Laboratory and Data Validation Experience: 25 years
B.S. Chemistry, University of the Philippines, 1991

Ms. Cuenco has over 25 years of environmental laboratory and data validation experience under DoD and EPA guidelines. Her experience includes performance of data validation in gas chromatography/mass spectrometry for volatile and semivolatile organics and extensive Navy and EPA data review and data verification for all organic and inorganic analyses. Her laboratory experience includes hands-on CLP and SW-846 GC/MS methods.

- **Pei Geng, Senior Chemist/Project Manager**
Project Role: Senior Organic Data Validator
Data Validation Experience: 19 years
Overall Laboratory and Data Validation Experience: 26 years
M.S. Chemistry, Sam Houston University, 1989

Ms. Geng will perform the role of organic data validator for this project. She will perform data validation for GC/MS and gas chromatography analyses and serve as a peer reviewer in the initial validation review process.

Ms. Geng has 26 years of environmental laboratory and data validation experience. Her experience includes performance of data validation in the gas chromatography area for volatile and semivolatile organics and extensive DoD data review and data verification for all organic analyses. Her laboratory experience includes hands-on CLP and SW-846 GC/MS methods.

- **Richard M. Amano, Principal Chemist**
Project Role: Senior Technical Reviewer/Director
Data Validation Experience: 25 years
Overall Laboratory and Data Validation Experience: 37 years
B.S. Biochemistry, UCLA, 1979

Mr. Amano has over 37 years of environmental laboratory, QA/QC, and data validation experience. He has managed data validation projects using the DoD QSM data validation guidelines for the past twenty years. Prior to founding LDC in 1991, he directed two major laboratories, Analytical Technologies, Inc. and Brown and Caldwell, from 1983 to 1991. His data validation experience includes oversight and direction of major efforts for Superfund sites, DoE sites, Navy RI/FS projects, Army Corps of



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

Engineers investigations, and AFCEE/AFCEC projects. He also has overseen several laboratory audits for major analytical testing programs for the Navy, Texaco, and Hewlett-Packard. His laboratory experience includes hands-on CLP and SW-846 GC/MS analysis, direction of GC/MS (including TO-14 air analyses) and radiochemistry groups, dioxins method development, and complex GC data interpretation of Aroclors. He has performed expert witness support for litigation purposes.

- **Erlinda T. Rauto, Principal Chemist**
Project Role: Technical Reviewer
Data Validation Experience: 23 years
Overall Laboratory and Data Validation Experience: 36 years
B.S Chemical Engineering, Feati University, Manila, 1967

Ms. Rauto will perform the role of Technical Reviewer for this project. She will monitor schedules, compliance of the validation to the applicable documents, perform routine surveillance activities such as generation of nonconformance reports, validator training, and QA reports to management.

Ms. Rauto has over 36 years of environmental laboratory and data validation experience. She has worked under the DoD QSM data validation guidelines for the past 10 years. Her experience includes performance of data validation in the GC, trace metals, and wet chemistry areas for major Federal projects. Her laboratory experience includes hands-on CLP and SW-846 ICP/GFAA analysis, pesticide/PCBs and wet chemistry analysis.

- **Christina Rink-Ashdown, Inorganic Chemist**
Project Role: Inorganic Data Validator/Project Manager
Data Validation Experience: 7 years
Overall Laboratory and Data Validation Experience: 9 years
B.S. Biology, University of California, San Diego 2006

Ms. Rink-Ashdown will perform the role of day to day Project Manager for this project. She will monitor schedules, compliance of validation to the Required Guidelines, perform routine surveillance activities such as generation of non-conformance reports, validator training and QA reports to management.

Ms. Rink-Ashdown has over 9 years combined environmental laboratory and data validation experience. Her experience includes performance of data validation in the trace metals, radiochemistry, and wet chemistry areas for major Federal and commercial projects. Her laboratory experience includes hands-on CLP and SW-846 ICP/CVAA analysis and overall technical review of data deliverables.

Ms. Rink-Ashdown specializes in the data validation of radiochemistry, trace metals, wet chemistry, and methyl mercury and analyses under MARLAP and USEPA functional guidelines or equivalent protocol. Over the past two years, she has worked under various DoD, CERCLA and EPA data validation guidelines for the various CERCLA, Navy, Army Corps, AFCEE/AFCEC and commercial projects. She is also certified as a "Radiometric Data Validation Specialist" through course work and testing by the Radiochemistry Society.



LABORATORY DATA CONSULTANTS, INC.

2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760/827-1100 Fax: 760/827-1099

- **Shauna McKellar, Chemist / Project Manager**
Project Role: Chemist
Data Validation Experience: 6 years
Overall Laboratory and Data Validation Experience: 11 years
B.S. Environmental Toxicology, UC Davis, 2006

Ms. McKellar has over 11 years of environmental consulting and data validation experience. She has worked under EPA data validation guidelines for the past 6 years and has inorganic and organic data validation experience using USEPA functional guidelines, Navy procedures, project QAPPs, ADEC checklists, and other applicable documents for EPA, DoD and commercial projects.

Ms. McKellar specializes in the data validation and contract compliance screening using LDC's Automated Data Review (ADR) software, and is familiar with a variety of different Electronic Data Deliverable formats, including SEDD and NEDD. She has supervised large data validation projects under the USACE and Navy Southwest Division RAC contracts

- **Tony Rommelfanger, Data Control Manager**
Project Role: Data Custodian

Mr. Rommelfanger will perform the role of data custodian for this project. He will perform the log-in of all data packages into the LDC tracking system. This system will generate spreadsheets for identifying all samples, their collection date, analysis performed, matrix, and report due date. Upon the completion of each delivery order, he will archive and catalog all reports and data in a secured storage area.

Mr. Rommelfanger has 26 years of experience in laboratory and data management experience. He has experience in organizing, logging in, and tracking data packages for technical staff.



APPENDIX C

HEALTH AND SAFETY PLAN

FORMER COMMANDER OIL TERMINAL
1 COMMANDER SQUARE
OYSTER BAY, NEW YORK
NYSDEC BCP ID: C130244

HEALTH & SAFETY PLAN

SUBMITTED TO:



New York State Department of Environmental Conservation
Division of Environmental Remediation
SUNY Stony Brook
50 Circle Road
Stony Brook, New York 11790-3409

PREPARED FOR:

Commander Terminals Holdings, LLC
255 South Street
Oyster Bay, New York 11771

PREPARED BY:



P.W. Grosser Consulting, Inc.
630 Johnson Avenue, Suite 7
Bohemia, New York 11716
Phone: 631-589-6353
Fax: 631-589-8705

James Rhodes, PG, COO
Thomas Melia, PG, Sr. Project Manager

jimr@pwgrosser.com
thomasm@pwgrosser.com

PWGC Project Number: CTH1901

DECEMBER 2020



P.W. GROSSER CONSULTING, INC.
PROJECT No. CTH1901
New York State Department of Environmental Conservation
Brownfield Site No. C130244

HEALTH AND SAFETY PLAN

Former Commander Oil Terminal
1 Commander Square
Oyster Bay, New York

SUBMITTED:
December 2020

PREPARED FOR:

New York State Department of Environmental Conservation
Division of Environmental Remediation
SUNY Stony Brook
50 Circle Road
Stony Brook, New York 11790-3409

ON BEHALF OF:

Commander Terminals Holdings, LLC
255 South Street
Oyster Bay, New York 11771

PREPARED BY:

P.W. Grosser Consulting, Inc.
630 Johnson Avenue, Suite 7
Bohemia, New York 11716



**HEALTH & SAFETY PLAN
FORMER COMMANDER OIL TERMINAL
NYSDEC BCP ID: C130244**

TABLE OF CONTENTS	PAGE
1.0 STATEMENT OF COMMITMENT	1
2.0 INTRODUCTION AND SITE ENTRY REQUIREMENTS.....	2
2.1 Training Requirements.....	2
2.2 Medical Monitoring Requirements.....	2
2.3 Fit Test Requirements	2
2.4 Site Safety Plan Acceptance, Acknowledgement and Amendments	3
2.5 Daily Safety Meetings.....	3
2.6 Key Personnel – Roles and Responsibilities	3
3.0 SITE BACKGROUND AND SCOPE OF WORK	5
4.0 HAZARD ASSESSMENT.....	7
4.1 Activity-Specific Hazards and Standard Operating Procedures	7
4.1.1 Drilling and Probing Operations.....	7
4.1.2 Work in Extreme Temperatures.....	7
4.1.3 Dust Control and Monitoring	7
4.2 Chemical Hazards	7
4.2.1 Respirable Dust	7
4.2.2 Organic Vapors.....	8
4.3 General Site Hazards	8
5.0 PERSONAL PROTECTIVE EQUIPMENT	10
5.1 Level D.....	10
5.2 Level C	10
5.3 Level B	11
5.4 Activity Specific Levels of Personal Protection	12
6.0 DECONTAMINATION PROCEDURES	13
7.0 AIR MONITORING AND ACTION LEVELS.....	15
8.0 SITE CONTROL	17
8.1 Work Zones	17
8.2 General Field Safety and Standard Operating Procedures	17
9.0 CONFINED SPACE	19
10.0 CONTINGENCY PLAN/EMERGENCY RESPONSE PLAN.....	21
10.1 Emergency Equipment On-site	21
10.2 Emergency Telephone Numbers.....	21
10.3 Personnel Responsibilities During an Emergency	21
10.4 Medical Emergencies	22
10.5 Fire or Explosion.....	22
10.6 Evacuation Routes.....	23
10.7 Spill Control Procedures.....	23
10.8 Vapor Release Plan.....	23



**HEALTH & SAFETY PLAN
FORMER COMMANDER OIL TERMINAL
NYSDEC BCP ID: C130244**

FIGURES

FIGURE 1 ROUTE TO HOSPITAL (APPENDIX G)

APPENDICES

APPENDIX A	SITE SAFETY ACKNOWLEDGMENT FORM
APPENDIX B	SITE SAFETY PLAN AMENDMENTS
APPENDIX C	DRILLING PROTOCOLS
APPENDIX D	HEAT/COLD STRESS PROTOCOLS
APPENDIX E	CHEMICAL HAZARDS
APPENDIX F	CONFINED SPACE ENTRY CHECKLIST/PERMIT
APPENDIX G	EMERGENCY INFORMATION



1.0 STATEMENT OF COMMITMENT

On-site employees may be exposed to risks from hazardous conditions related to Remedial Investigation (RI) activities to be performed at the Former Commander Oil Terminal project site. P.W. Grosser Consulting Inc.'s (PWGC's) policy is to minimize the possibility of work-related injury through awareness and qualified supervision, health and safety training, medical monitoring, use of appropriate personal protective equipment, and the following activity specific safety protocols contained in this Health and Safety Plan (HASP). PWGC has established a guidance program to implement this policy in a manner that protects personnel to the maximum reasonable extent.

This HASP, which applies to PWGC personnel actually or potentially exposed to safety or health hazards, describes emergency response procedures for actual and potential physical and chemical hazards. This HASP is also intended to inform and guide personnel entering site work zones. Persons are to acknowledge that they understand the potential hazards and the contents of this Health and Safety policy by signing off on receipt of their individual copy of the document. Contractors and suppliers are retained as independent contractors and are responsible for ensuring the health and safety of their own employees.

PWGC may require that its personnel take certain precautions in accordance with this HASP, and PWGC requests that others protect their personnel in a manner that they deem necessary or sufficient.



2.0 INTRODUCTION AND SITE ENTRY REQUIREMENTS

This document describes the health and safety guidelines developed by PWGC at the request of the “Volunteer” for the proposed RI to be performed at the Former Commander Oil Terminal project site (“the site”) to protect on-site personnel, visitors, and the public from physical harm and exposure to hazardous materials or wastes. In accordance with the Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910.120 Hazardous Waste Operations and Emergency Response (HAZWOPER) Final rule, this HASP, including the attachments, addresses safety and health hazards relating to each phase of site operations and is based on the best information available. The HASP may be revised by PWGC at the request of the Volunteer, and/or regulatory agency upon receipt of new information regarding site conditions. Changes will be documented by written amendments signed by PWGC’s project director, project manager and/or site safety officer.

2.1 Training Requirements

Personnel entering the exclusion zone or decontamination zone must meet the training requirements for hazardous waste site operations and emergency response operations in accordance with OSHA 29 CFR 1910.120(e).

Each subcontractor and supplier working on the job must provide the site safety officer with training documentation for its personnel upon request.

2.2 Medical Monitoring Requirements

PWGC personnel and visitors entering the exclusion zone or decontamination zone must have completed appropriate medical monitoring required under OSHA 29 CFR 1910.120(f). Medical monitoring enables a physician to monitor each employee’s health, physical condition, and his fitness to wear respiratory protective equipment and carry out on-site tasks.

Evidence of compliance with additional medical monitoring requirements for this site must also be included upon request.

2.3 Fit Test Requirements

Personnel and visitors entering a work zone using a negative pressure air purifying respirator (APR) must have successfully passed a qualitative respirator fit test in accordance with OSHA 29 CFR 1910.134 or the American National Standards Institute (ANSI).



Fit testing documentation is the responsibility of each subcontractor. Documentation of PWGC's personnel fit-testing is maintained on file. PWGC does not anticipate the need for work to be performed using APR's.

2.4 Site Safety Plan Acceptance, Acknowledgement and Amendments

The project superintendent and the site safety officer are responsible for informing personnel (P.W. Grosser employees and/or owner or owners representatives) entering a work area of the contents of this plan and ensuring that each person signs the safety plan acknowledging the on-site hazards and procedures required to minimize exposure to adverse effects of these hazards. A copy of the Acknowledgement Form is included in **Appendix A**.

Site conditions may warrant an amendment to the HASP. Amendments to the HASP are acknowledged by completing forms included in **Appendix B**.

2.5 Daily Safety Meetings

Each day before work begins; the site safety officer will hold safety (tailgate or tool box) meetings to ensure that on-site personnel understand the site conditions and operating procedures and to address safety questions and concerns. Meeting minutes and attendance will be recorded. Personnel eligible to enter a work zone must attend the meetings. Project staff will discuss and remedy health and safety issues at these meetings.

2.6 Key Personnel – Roles and Responsibilities

The following PWGC key personnel are planned for this project:

- PWGC Project Director Mr. James Rhodes
- PWGC Project Manager Mr. Thomas Melia
- PWGC Site Safety Officer Mr. Nick Russell, or assignee

The PWGC project manager is responsible for overall project administration and, with guidance from the PWGC site safety officer, for supervising the implementation of this HASP. The site safety officer will conduct daily (tail gate or tool box) safety meetings at the project site and oversee daily safety issues. Each subcontractor and supplier (defined as an OSHA employer) is also responsible for the health and safety of its employees. If there is any dispute about health and safety or project activities, on-site personnel will attempt to resolve the issue. If the issue cannot be resolved at the site, then the project manager will be consulted.

The PWGC site safety officer is also responsible for coordinating and enforcing health and safety activities on-



site. The site safety officer must meet the emergency response and hazardous materials training requirements of OSHA 29 CFR Part 1910.120; must have completed OSHA supervisor training, 29 CFR 1910.120 (e) 4; and must have appropriate experience to the related site work. The site safety officer is authorized to suspend the site work based on safety concerns, and is responsible for the following:

1. Educating personnel about information in this HASP and other safety requirements to be observed during site operations, including, but not limited to, decontamination procedures, designation of work zones and levels of protection, air monitoring, fit testing, and emergency procedures dealing with fire and first aid.
2. Coordinating site safety decisions with the project manager.
3. Designating exclusion, decontamination and support zones (work zones) on a daily basis.
4. Monitoring the condition and status of known on-site hazards and maintaining and implementing the air quality monitoring program specified in this HASP.
5. Maintaining the work zone entry/exit log and site entry/exit log.
6. Maintaining records of safety problems, corrective measures and documentation of chemical exposures or physical injuries (the site safety officer will document these conditions in a bound notebook and maintain a copy of the notebook on-site).

The person who observes safety concerns and potential hazards that have not been addressed in the daily safety meetings should immediately report their observations/concerns to the site safety officer or appropriate key personnel.



3.0 SITE BACKGROUND AND SCOPE OF WORK

The site is located at 1 Commander Square, Oyster Bay, New York. The site is located within the Town of Oyster Bay and Nassau County. The site is identified as Section 27, Block 16, Lots 2, 3, 4, and 5 in the Nassau County Tax Map. The Site measures approximately 3.17 acres and is bounded by a commercial property (boat storage, shellfish farm) to the north, White's Creek to the south, Oyster Bay Harbor to the east, and Bay Avenue to the west.

The Site is currently utilized as a Major Oil Storage Facility (MOSF) operated by Global Commander Oyster Bay. The MOSF consists of 21 large capacity ASTs, a fueling rack, office building and garage building.

The proposed plan for the project is to investigate and remediate the site as part of redevelopment. Development plans have not been finalized for the site; however, the future re-development is expected to consist of a mixed use (commercial and residential) development.

PWGC prepared a Phase I Environmental Site Assessment (ESA) in August 2019. The Phase I ESA identified the following Recognized Environmental Conditions (RECs) associated with the subject property:

- Two open NYSDEC spill incidents at the subject property related to petroleum and chlorinated volatile organic compounds (CVOCs).
- Historical usage of the subject property for commercial/industrial purposes since the late 1800s.
- Onsite generation of RCRA hazardous wastes associated with the CVOC spill incident.
- Potential vapor encroachment related to the active petroleum and CVOC spill incidents.
- Historical usage of the adjacent property to the north for commercial/industrial purposes.

Based on investigations performed at the site to date, the primary contaminants of concern for the site are VOCs in soil and groundwater exceeding applicable NYSDEC standards.

Soil – soils beneath the site have been documented to contain petroleum related VOC and CVOC impact exceeding Unrestricted Use SCOs. The primary CVOC source area in soil appears to be located along the northern property boundary near the central portion of the site, with CVOC impacted groundwater exceeding NYSDEC Ambient Water Quality Standards (AWQS) extending to the southeast from that area. Petroleum impacted soils have been identified throughout the central and southeastern portions of the site.



Groundwater – groundwater beneath the central and eastern portions of the site has been documented to contain petroleum LNPA and dissolved petroleum impact exceeding NYSDEC AWQs above the peat layer, and dissolved CVOC impact exceeding NYSDEC AWQs both above and below the peat layer to a depth of at least 32 feet below grade.

Soil Vapor – to date, soil vapor samples have not been collected from the site.



4.0 HAZARD ASSESSMENT

This section identifies the hazards associated with the proposed scope of work, general site operations which may also be conducted at site, and the standard operating procedures (SOPs) that should be implemented to reduce the hazards; identifies general physical hazards that can be expected at most sites; and presents a summary of documented or potential chemical hazards at the site. Every effort must be made to reduce or eliminate these hazards. Those that cannot be eliminated must be guarded against using engineering controls and/or personal protective equipment.

4.1 Activity-Specific Hazards and Standard Operating Procedures

4.1.1 *Drilling and Probing Operations*

Soil borings and/or groundwater monitoring wells using Geoprobe® direct push technology and/or rotary drilling technology will be installed as part of the proposed subsurface investigation. PWGC and/or subcontractors shall follow the standard drilling protocols included as **Appendix C**.

4.1.2 *Work in Extreme Temperatures*

Work under extremely hot or cold weather conditions requires special protocols to minimize the chance that employees will be affected by heat or cold stress. As necessary, PWGC shall follow the heat and cold stress safety protocols included as **Appendix D**.

4.1.3 *Dust Control and Monitoring*

Dust generated during work activities may contain contaminants associated with the site characteristics. Dust generation is not anticipated during the subsurface investigation. In the event that fugitive dust is generated, PWGC shall control the dust by wetting the working surface with water, or other approved method of dust suppression.

4.2 Chemical Hazards

Historic environmental investigations at the subject site have identified elevated VOCs in soil and groundwater at the site. The primary routes of exposure to contaminants in soil are inhalation, ingestion and absorption.

Appendix E includes information sheets for the potential chemicals that may be encountered at the site.

4.2.1 *Respirable Dust*

The subsurface investigation activities are not anticipated to generate particulate dust; however dust may be generated from vehicular traffic and/or other construction activities. If visible observation detects elevated levels of dust, a program of wetting will be employed by the site safety officer. If elevated dust levels persist,



the site safety office will employ dust monitoring using a particulate monitor (Miniram or equivalent). If monitoring detects concentrations greater than 150 µg/m³ over daily background, the site safety officer will take corrective actions as defined herein, including the use of water for dust suppression and if this is not effective, requiring workers to wear APRs with efficiency particulate air (HEPA) cartridges.

Absorption pathways for dust and direct contact with soils will be mitigated with the implementation of latex gloves, hand washing and decontamination exercises when necessary.

4.2.2 Organic Vapors

Based upon historical environmental investigations, VOCs impact is present at the site. Therefore, drilling/excavation activities may cause the release of organic vapors to the atmosphere. The site safety officer will monitor organic vapors with a Photoionization Detector (PID) during drilling activities to determine whether organic vapor concentrations exceed action levels shown below.

PID Response	Action
Sustained readings of 5 ppm or greater	Shut down drilling equipment and allow area to vent. Resume when readings return to background
Sustained readings of 5 ppm or greater that do not subside after venting	Implement Vapor Release Plan (Section 9.8). Re-evaluate respiratory protection as upgrade may be required.

4.3 General Site Hazards

Applicable OSHA 29 CFR 1910.120(m) standards for illumination shall apply. Work is to be conducted during daylight hours whenever possible.

Electrical power must be provided through a ground fault circuit interrupter. Equipment that will enter an excavation must be suitable and approved (i.e. intrinsically safe) for use in potentially explosive environments. Applicable OSHA 29 CFR 1926 Subpart K standards for use of electricity shall apply.

Work where there is a fall hazard will be performed using appropriate ladders and/or protection (e.g. body harness and lifeline). All work should be conducted at the ground surface or in trench excavations.

In accordance with 29 CFR 1910.151(c), workers involved in operations where there is the risk of eye injury, (chemical splash, etc.), must have ready access to an approved eye wash unit. Protective eye wear shall be donned in Level D, when directed by the site safety officer.



Operations where there is a potential for fire will be conducted in a manner that minimizes risk. Non-sparking tools and fire extinguishers shall be used or available as directed by the site safety officer when work is in potentially explosive atmospheres. Ignition sources shall be removed from work areas. Explosion-proof instruments and/or bonding and grounding will be used to prevent fire or explosion when the site safety officer directs their use.

Overhead and underground utilities shall be identified and/or inspected and appropriate safety precautions taken before conducting operations where there is potential for contact or interference.



5.0 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) shall be selected in accordance with the site air monitoring program, OSHA 29 CFR 1910.120(c), (g), and 1910.132. Protective equipment shall be NIOSH-approved and respiratory protection shall conform to OSHA 29 CFR Part 1910.133 and 1910.134 specifications; head protection shall conform to 1910.135; eye and face protection shall conform to 1910.133; and foot protection shall conform to 1910.136. The only true difference among the levels of protection from D thru B is the addition of the type of respiratory protection.

PWGC anticipates that work performed under the scope of the proposed Phase II investigation will be conducted in Level D PPE.

5.1 Level D

Level D PPE shall be donned when the atmosphere contains no known hazards and work functions preclude splashes, immersion, or the potential for inhalation of, or contact with, hazardous concentrations of harmful chemicals. Level D PPE consists of:

- Standard work uniform, coveralls, or Tyvek (as needed).
- Steel toe and steel shank work boots (or equivalent).
- Hard hat.
- Gloves (as needed).
- Safety glasses.
- Hearing protection (as needed)
- Equipment replacements are available as needed.

5.2 Level C

Level C PPE shall be donned when the concentrations of measured total organic vapors in the breathing zone exceed background concentrations (using a portable PID, or equivalent), but are less than 5 ppm. The specifications on the APR filters used must be appropriate for contaminants identified or expected to be encountered. Level C PPE shall be donned when the identified contaminants have adequate warning properties and criteria for using APR have been met. Level C PPE consists of:

- Chemical resistant or coated Tyvek coveralls.
- Steel toe and steel shank work boots (or equivalent).
- Chemical resistant over boots or disposable boot covers.



- Disposable inner gloves (surgical gloves).
- Disposable outer gloves.
- Full-face APR fitted with organic vapor/dust and mist filters or filters appropriate for the identified or expected contaminants.
- Hard hat.
- Splash shield (as needed)
- Ankles/wrists taped with duct tape.

The site safety officer will verify if Level C is appropriate by checking organic vapor concentrations using compound and/or class-specific detector tubes.

5.3 Level B

Level B PPE shall be donned when the contaminants have not been identified and/or the concentrations of unknown measured total organic vapors in the breathing zone exceed 5 ppm (using a portable OVA, or equivalent). Level B PPE shall be donned if the IDLH of a known contaminant is exceeded. If a contaminant is identified or is expected to be encountered for which NIOSH and/or OSHA recommend the use of a positive pressure self-contained breathing apparatus (SCBA) when that contaminant is present, Level B PPE shall be donned even though the total organic vapors in the breathing zone may not exceed 5 ppm. Level B shall be donned for confined space entry, and when the atmosphere is oxygen deficient (oxygen less than 19.5%) or potentially oxygen deficient. If Level B PPE is required for a task, at least three people shall be donned in Level B at any one time during that task. PPE shall only be donned at the direction of the site safety officer. Level B PPE consists of:

- Supplied air SCBA or air line system with five-minute egress system.
- Chemical resistant or coated Tyvek coveralls.
- Steel toe and steel shank work boots (or equivalent).
- Chemical resistant over boots or disposable boot covers.
- Disposable inner gloves (surgical gloves).
- Disposable outer gloves.
- Hard hat.
- Ankles/wrists taped with duct tape.



The exact PPE ensemble is decided on a site-by-site basis by the PWGC Health and Safety Officer with the intent to provide the most protective and efficient worker PPE.

5.4 Activity Specific Levels of Personal Protection

The required level of PPE is activity-specific and is based on air monitoring results (Section 7.0) and properties of identified or expected contaminants. It is expected that all site work will be performed in Level D. If air monitoring results indicate the necessity to upgrade the level of protection engineering controls (i.e. Facing equipment away from the wind and placing site personnel upwind of excavations, active venting, etc.) will be implemented before requiring the use of respiratory protection.

6.0 DECONTAMINATION PROCEDURES

Equipment and PPE exiting the exclusion zone must be decontaminated or properly discarded upon exit. Personnel must enter and exit the exclusion zone through the decontamination area. The exclusion and decontamination zones may change depending on the nature of the site work. Plastic bags containing personal protective clothing and equipment will be placed in designated receptacles.

Boots and other potentially contaminated garments that have come in contact with hazardous materials will be cleaned in wash tubs with detergent/water solution and rinsed with water and must remain on site. The wash water, rinse water, and residues will be collected and properly stored until sampling results are received and the final method of disposal can be determined. Disposable PPE, including spent respirator cartridges and canisters, will be properly bagged and disposed. Contaminated boots, clothing, and equipment (e.g. leather boots, equipment carrying straps) that cannot be decontaminated will be disposed of with the disposable garments or left on site in the decontamination area.

The **minimum** measures for Level B doffing and decontamination are:

1. Deposit equipment on plastic drop cloths.
2. Scrub outer boots and gloves with a water and detergent solution and rinse.
3. Remove outer boots and outer gloves. Discard disposable outer garments in receptacle provided.
4. Remove SCBA and face piece and place on rack provided.
5. Remove Tyvek/outer garment and place in receptacle provided.
6. Remove inner gloves and deposit in receptacle provided.
7. Shower/wash face and hands.

The **minimum** measures for Level C doffing and decontamination are:

1. Deposit equipment on plastic drop cloths.
2. Scrub outer boots and gloves (if worn) with a water and detergent solution and rinse.
3. Remove outer boots and outer gloves. Discard disposable outer garments in receptacle provided.
4. Remove Tyvek/outer garment and place in receptacle provided.
5. Remove first pair of inner gloves.
6. Remove respirator (using "clean" inner gloves) and place on rack provided.
7. Remove last pair of inner gloves and deposit in receptacle provided.



8. Shower/wash face and hands.

The second to last item to be removed is the APR, and the last item to be removed is the last of several pairs of surgical gloves. Wearing several pairs of inner gloves permits layers to be removed as needed during various stages of the doffing procedure, and if the APR inadvertently becomes contaminated, inner gloves guard against bare hands contacting the APR.

Equipment that comes into contact with site contaminants is decontaminated according to manufacturer specifications. Decontamination is done in the exclusion or decontamination zones. Rented equipment is photographed after decontamination.

7.0 AIR MONITORING AND ACTION LEVELS

Air monitoring will be performed for protection for on-site workers and the downwind community (i.e., off-site receptors including residences, businesses, and on-site workers not directly involved in the remedial work) from potential airborne contaminant releases resulting from remedial activities at the site. Air monitoring will be used to help to confirm that the remedial work will not spread contamination off-site through the air.

Perimeter air monitoring will be performed in accordance with the Community Air Monitoring Plan (CAMP) for the site included as Appendix E of the RI Work Plan. Air monitoring will be performed for protection for on-site workers as described below.

7.1 Work Zone Monitoring

Respirable dust will be monitored using a MiniRAM Model PDM-3 aerosol monitor (or equivalent) and air will be monitored for VOCs with a MiniRAE 2000 PID (or equivalent) during intrusive activities such as excavation and drilling. Monitoring will be performed continuously during intrusive activities and hourly, at a minimum, otherwise. Upwind readings will be recorded at least twice daily to determine background concentrations at the site.

Monitoring Instrument	Monitoring Location	Monitoring Frequency	Action Level (above background)	Action
PID	Work Area	Continuous during intrusive activities; hourly, at a minimum, otherwise	<p><5ppm*</p> <p>≥5ppm, ≤50ppm*</p> <p>>50ppm*</p>	<p>Level D PPE, continue work</p> <p>Level C PPE, notify PM/HSM</p> <p>Stop work, notify PM/HSM</p>
Particulate monitor	Work Area	Continuous during intrusive activities; hourly, at a minimum, otherwise	<p>≤150 µg/m³</p> <p>>150 µg/m³</p>	<p>Continue work</p> <p>Take corrective actions (see below)</p>
*Sustained levels in the breathing zone for a minimum of 5 minutes				

If particulate monitoring detects concentrations greater than 150 µg/m³ over daily background, the site safety officer will take corrective actions as defined herein, including the use of water for dust suppression and if this



is not effective, requiring workers to wear APRs with efficiency particulate air (HEPA) cartridges.

7.2 Air Monitoring Recordkeeping

The field team lead will document air monitoring data in a log book. Data will include instrument used, calibration date, wind/weather conditions and work activities.

7.3 Calibration Requirements

The PID will be calibrated daily, prior to the start of work. Calibration details (i.e., date, time, span gas, etc...) will be recorded in a log book.



8.0 SITE CONTROL

8.1 Work Zones

The primary purpose of site controls is to establish the perimeter of a hazardous area, to reduce the migration of contaminants into clean areas, and to prevent access or exposure to hazardous materials by unauthorized persons. When operations are to take place involving hazardous materials, the site safety officer will establish an exclusion zone, a decontamination zone, and a support zone. These zones "float" (move around the site) depending on the tasks being performed on any given day. The site safety officer will outline these locations before work begins and when zones change. The site safety officer records this information in the site log book. It is expected that for subsurface investigation activities, identification of an exclusion zone, decontamination zone, and support zone will not be necessary.

Tasks requiring OSHA 40-hour Hazardous Waste Operations and Emergency Response Operations training are carried out in the exclusion zone. The exclusion zone is defined by the site safety officer but will typically be a 50-foot area around work activities. Gross decontamination (as determined by the site Health and Safety Officer) is conducted in the exclusion zone; all other decontamination is performed in the decontamination zone or trailer.

Protective equipment is removed in the decontamination zone. Disposable protective equipment is stored in receptacles staged in the decontamination zone, and non-disposable equipment is decontaminated. All personnel and equipment exit the exclusion zone through the decontamination zone. If a decontamination trailer is provided the first aid equipment, an eye wash unit, and drinking water are kept in the decontamination trailer.

The support zone is used for vehicle parking, daily safety meetings, and supply storage. Eating, drinking, and smoking are permitted only in the support zone. When a decontamination trailer is not provided, the eye wash unit, first aid equipment, and drinking water are kept at a central location designated by the site safety officer.

8.2 General Field Safety and Standard Operating Procedures

PWGC's policy is to control hazards at all site areas by limiting entrance to exclusion zones to essential personnel and by implementing the following rules:

- Non-essential (as judged by the site safety officer) personnel and unauthorized persons will not enter the exclusion or decontamination zone.



- Before entering the exclusion or decontamination zones, all personnel must be familiar with emergency response procedures (Section 9.0), site safety locations, first aid and communication equipment, and the location of the map to the hospital and the list of emergency telephone numbers.
- The buddy system will be used at all times by field personnel in the exclusion zone; no one is to perform work within the exclusion zone alone. When in Level D or C, visual contact or radio contact shall be maintained at all times.
- Contact with contaminated and potentially contaminated surfaces should be avoided. Walk around (not through) puddles and discolored surfaces. Do not kneel on the ground or place equipment on the ground. Protect equipment from contamination.
- Eating, drinking, or smoking is permitted only in designated areas in the support zone.

Each worker must be supplied with and maintain his/her own personal protective equipment.



9.0 CONFINED SPACE

OSHA published a Final Rule on permit-required confined spaces on January 14, 1993, for General Industry at 29 CFR 1910.146 et seq., with an implementation date of April 15, 1993. The rule specifically excludes agriculture, construction, or shipyard employment. Confined space entry and work within confined spaces is not anticipated to be performed under the proposed scope of work. However, if confined space work is conducted it will be performed in accordance with the applicable OSHA regulations. OSHA defines confined space as:

1. is large enough and so configured that an employee can bodily enter and perform assigned work;
2. has limited or restricted areas for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited entry); and
3. is not designed for continuous worker occupancy.

OSHA further requires that an "entry supervisor" (the site designated safety officer) decide at the time of entry whether the space is permit-required or non-permit required space. The site safety officer will monitor the space two hours prior to entry and continuously during work to ensure that the atmosphere is not hazardous.

OSHA defines as hazardous atmosphere as:

1. Flammable gas, vapor, or mist in excess of 10 percent of its lower explosive limit (LEL);
2. Airborne combustible dust at a concentration that meets or exceeds its LEL; NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.
3. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
4. Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z. Toxic
5. and Hazardous Substances, of this part and which could result in employee exposure in excess of its dose or permissible exposure limit;
6. Any other atmospheric condition that is immediately dangerous to life or health.

A space is non-permit required if none of the above defined hazardous conditions are present. OSHA requires that an attendant (e.g., an individual stationed outside one or more spaces who monitors the entrants and who performs air monitoring of the space(s)) be assigned to each space. The attendant is not allowed to perform any direct rescue related duties, but is there to communicate with the entrant and call for rescue procedures if required.



The following protocol applies when PWGC employees must enter a confined space:

- The site safety officer evaluates the space and site conditions to determine whether the space must be considered "confined".
- If so, the site safety officer monitors the space for hazardous atmospheres prior to entry and fills out a pre-entry checklist (**Appendix F**) to determine whether an entry-permit is required.
- If there is no hazardous atmosphere, the space will be continuously monitored during the entry to assure that the atmosphere remains non-hazardous.
- If the space contains a hazardous atmosphere, an entry permit (**Appendix F**) will be prepared and the space will only be entered in accordance with 29 CFR 1910.146.



10.0 CONTINGENCY PLAN/EMERGENCY RESPONSE PLAN

Site personnel must be prepared in the event of an emergency. Emergencies can take many forms: illnesses, injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather.

Emergency telephone numbers and a map to the hospital (Figure 1) will be posted in the command post. Site personnel should be familiar with the emergency procedures, and the locations of site safety, first aid, and communication equipment.

10.1 Emergency Equipment On-site

Private telephones:	Site personnel.
Two-way radios:	Site personnel where necessary.
Emergency Alarms:	On-site vehicle horns*.
First aid kits:	On-site, in vehicles or office.
Fire extinguisher:	On-site, in office or on equipment.

* Horns: Air horns will be supplied to personnel at the discretion of the project manager or site safety officer.

10.2 Emergency Telephone Numbers

General Emergencies – Police/Fire Department/Ambulance	911
Local Emergency Medical Center (Syosset Hospital)	1-516-496-6400
National Response Center	1-800-424-8802
Poison Control	1-212-340-4494
NYSDEC Spills Division	1-800-457-7362
NYSDEC Division of Environmental Remediation	1-631-444-0240
PWGC Project Director, James Rhodes	1-631-589-6353
PWGC Project Manager, Thomas Melia	1-631-589-6353
PWGC Site Safety Officer, Nick Russell (or assignee)	1-516-351-5787

A copy of this page shall be posted in the office and a copy is provided in **Appendix G**.

10.3 Personnel Responsibilities During an Emergency

The project manager is primarily responsible for responding to and correcting any emergency situations. However, in the absence of the project manager, the site safety officer shall act as the project manager's on-site designee and perform the following tasks:



- Take appropriate measures to protect personnel including: withdrawal from the exclusion zone, evacuate and secure the site, or upgrade/downgrade the level of protective clothing and respiratory protection;
- Ensure that appropriate federal, state, and local agencies are informed and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be summoned immediately. If toxic materials are released to the air, the local authorities should be informed in order to assess the need for evacuation;
- Ensure appropriate decontamination, treatment, or testing for exposed or injured personnel;
- Determine the cause of incidents and make recommendations to prevent recurrence; and,
- Ensure that all required reports have been prepared.

The following PWGC key personnel are planned for this project:

- | | |
|----------------------------|-------------------------------|
| • PWGC Project Director | Mr. James Rhodes |
| • PWGC Project Manager | Mr. Thomas Melia |
| • PWGC Site Safety Officer | Mr. Nick Russell, or assignee |

10.4 Medical Emergencies

A person who becomes ill or injured in the exclusion zone will be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination will be completed and first aid administered prior to transport. First aid will be administered while waiting for an ambulance or paramedics. A Field Accident Report (**Appendix G**) must be filled out for any injury.

A person transporting an injured/exposed person to a clinic or hospital for treatment will take the directions to the hospital and information on the chemical(s) to which they may have been exposed (**Appendix G**).

10.5 Fire or Explosion

In the event of a fire or explosion, the local fire department will be summoned immediately. The site safety officer or his designated alternate will advise the fire commander of the location, nature and identification of the hazardous materials on-site. If it is safe to do so, site personnel may:

- Use firefighting equipment available on site.
- Remove or isolate flammable or other hazardous materials that may contribute to the fire.

10.6 Evacuation Routes

Evacuation routes established by work area locations for each site will be reviewed prior to commencing site operations. As the work areas change, the evacuation routes will be altered accordingly, and the new route will be reviewed.

Under extreme emergency conditions, evacuation is to be immediate without regard for equipment. The evacuation signal will be a continuous blast of a vehicle horn, if possible, and/or by verbal/radio communication.

- When evacuating the site, personnel will follow these instructions:
- Keep upwind of smoke, vapors, or spill location.
- Exit through the decontamination corridor if possible.
- If evacuation through the decontamination corridor is not possible, personnel should remove contaminated clothing once they are in a safe location and leave it near the exclusion zone or in a safe place.
- The site safety officer will conduct a head count to ensure that all personnel have been evacuated safely. The head count will be correlated to the site and/or exclusion zone entry/exit log.
- If emergency site evacuation is necessary, all personnel are to escape the emergency situation and decontaminate to the maximum extent practical.

10.7 Spill Control Procedures

Spills associated with site activities may be attributed to project specific heavy equipment and include gasoline, diesel and hydraulic oil. In the event of a leak or a release, site personnel will inform their supervisor immediately, locate the source of spillage and stop the flow if it can be done safely. A spill containment kit including absorbent pads, booms and/or granulated speedy dry absorbent material will be available to site personnel to facilitate the immediate recovery of the spilled material. Daily inspections of site equipment components including hydraulic lines, fuel tanks, etc. will be performed by their respective operators as a preventative measure for equipment leaks and to ensure equipment soundness. In the event of a spill, site personnel will immediately notify the NYSDEC (1-800-457-7362), and a spill number will be generated.

10.8 Vapor Release Plan

If work zone organic vapor (excluding methane) exceeds 5 ppm, then a downwind reading will be made either 200 feet from the work zone or at the property line, whichever is closer. If readings at this location exceed 5 ppm over background, the work will be stopped.



If 5 ppm of VOCs are recorded over background on a PID at the property line, then an off-site reading will be taken within 20 feet of the nearest residential or commercial property, whichever is closer. If efforts to mitigate the emission source are unsuccessful for 30 minutes, then the designated site safety officer will:

- contact the local police;
- continue to monitor air every 30 minutes, 20 feet from the closest off-site property. If two successive readings are below 5 ppm (non-methane), off-site air monitoring will be halted.
- All property line and off site air monitoring locations and results associated with vapor releases will be recorded in the site safety log book.



APPENDIX A

SITE SAFETY ACKNOWLEDGMENT FORM



SITE SAFETY ACKNOWLEDGMENT FORM

This form serves as documentation that field personnel have read, or have been informed of, and understand the provisions of the HASP/EAP. It is maintained on site by the FTL/SHSO as a project record. Each field team member shall sign this section after site-specific training is completed and before being permitted to work on site.

I have read, or have been informed of, the Health and Safety Plan/Emergency Action Plan and understand the information presented. I will comply with the provisions contained therein.

Name (Print and Sign)	Date



APPENDIX B

SITE SAFETY PLAN AMENDMENTS



SITE SAFETY PLAN AMENDMENT FORM

SITE SAFETY PLAN AMENDMENT NUMBER: _____

SITE NAME: _____

REASON FOR AMENDMENT: _____

ALTERNATIVE PROCEDURES: _____

REQUIRED CHANGES IN PPE: _____

SITE SAFETY OFFICER

DATE

PROJECT MANAGER

DATE

PROJECT DIRECTOR

DATE

CLIENT DRIVEN SOLUTIONS

**PHONE: 631.589.6353
PWGROSSER.COM**

**630 JOHNSON AVENUE, STE 7
BOHEMIA, NY 11716**

LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON



APPENDIX C

DRILLING PROTOCOLS



SAFETY PROCEDURES DURING THE OPERATION OF DRILLING/PROBING MACHINES INCLUDE, BUT ARE NOT LIMITED TO THE FOLLOWING:

- All site personnel should know the location of the rig emergency shut-off switch prior to beginning operations.
- The rig should be inspected prior to operation to ensure that it is in proper working condition and that all safety devices are functioning.
- Each rig should have a first-aid kit and fire extinguisher which should be inspected to ensure that they are adequate.
- All operators should wear, at a minimum, hard hats, steel-toe safety shoes or boots, gloves and safety glasses. Additional clothing and protective equipment may be required at sites where hazardous conditions are likely. Clothing must be close fitting, without loose ends, straps, draw strings or belts or other unfastened parts that might catch on moving machinery.
- Work areas should be kept free of materials, debris and obstruction, and substances such as grease or oil that could cause a surface to become slick or otherwise hazardous.
- Prior to drilling, the site must be checked to determine whether it can accommodate the rig and supplies and provide a safe working area.
- The drill rig mast (derrick) must be lowered prior to moving between drilling locations.
- The drill rig masts should not be raised if the rig will not be at least 20 feet away from overhead utilities.
- The location of underground utilities should be determined prior to erecting the rig.
- The drill rigs must be properly erected, leveled and stabilized prior to drilling.
- The operator must shut down the vehicle engine before leaving the vicinity of the machine.
- All personnel not directly involved in operating the rig or in sampling should remain clear of the drilling equipment when it is in operation.
- All unattended boreholes must be adequately covered or otherwise protected to prevent trip and fall hazards. All open boreholes should be covered, protected or backfilled as specified in local or state regulations.
- When climbing to or working on a derrick platform that is higher than 20 feet, a safety climbing device should be used.
- The user of wire line hoists, wire rope and hoisting hardware should be as stipulated by the American Iron and Steel Institute Wire Rope User's Manual.
- The rig should be operated in a manner which is consistent with the manufacturers' ratings of speed, force, torque, pressure, flow, etc. The rig and tools should be used for the purposes for which they were intended.



APPENDIX D

HEAT/COLD STRESS PROTOCOLS

HEAT STRESS

Heat Stress (Hyperthermia)

Heat stress is the body's inability to regulate the core temperature. A worker's susceptibility to heat stress can vary according to his/her physical fitness, degree of acclimation to heat, humidity, age and diet.

1. Prior to site activity, the field team leader may make arrangements for heat stress monitoring (i.e., monitoring heart rate, body temperature, and body water loss) during actual site work if conditions warrant. In addition, the FTL is to ensure that each team member has been acclimatized to the prevailing environmental conditions, that personnel are aware of the signs and symptoms of heat sickness, that they have been adequately trained in first aid procedures, and that there are enough personnel on-site to rotate work assignments and schedule work during hours of reduced temperatures. Personnel should not consume alcoholic or caffeinated beverages but rather drink moderate levels of an electrolyte solution and eat well prior to commencing site work.
2. Although there is no specific test given during a baseline physical that would identify a person's intolerance to heat, some indicators are tobacco or medication use, dietary habits, body weight, and chronic conditions such as high blood pressure or diabetes.
3. *Heat cramps*, caused by profuse perspiration with inadequate fluid intake and salt replacement, most often afflict people in good physical condition who work in high temperature and humidity. Heat cramps usually come on suddenly during vigorous activity. Untreated, heat cramps may progress rapidly to heat exhaustion or heat stroke. First aid treatment: remove victim to a cool place and replace lost fluids with water.
4. Thirst is not an adequate indicator of heat exposure. Drinking fluid by itself does not indicate sufficient water replacement during heat exposure. A general rule, the amount of water administered should replace the amount of water lost, and it should be administered at regular intervals throughout the day. For every half pound of water lost, 8 ounces of water should be ingested. Water should be replaced by drinking 2 – 4 ounce servings during every rest period. A recommended alternative to water is an electrolyte drink split 50/50 with water.
5. Heat exhaustion results from salt and water loss along with peripheral pooling of blood. Like heat cramps, heat exhaustion tends to occur in persons in good physical health who are working in high temperatures and humidity. Heat exhaustion may come on suddenly as dizziness and collapse. Untreated, heat exhaustion may progress to heat stroke.



6. Treatment for heat exhaustion: Move the victim to a cool environment (e.g. air-conditioned room/car), lay victim down and fan him/her. If the air-conditioning is not available, remove the victim to a shaded area, remove shirt, and fan. If symptoms do not subside within an hour, notify 911 to transport to hospital.
7. Heat stroke results from the body's inability to dissipate excess heat. A true medical emergency that requires immediate care, it usually occurs when one ignores the signs of heat exhaustion and continues strenuous activities. Working when the relative humidity exceeds 60% is a particular problem. Workers in the early phase of heat stress may not be coherent or they will be confused, delirious or comatose. Changes in behavior, irritability and combativeness are useful early signs of heat stroke.
8. Treatment of heat stroke: Move the victim to a cool, air-conditioned environment. Place victim in a semi-reclined position with head elevated and strip to underclothing. Cool victim as rapidly as possible, applying ice packs to the arms and legs and massaging the neck and torso. Spray victim with tepid water and constantly fan to promote evaporation. Notify 911 to transport to hospital as soon as possible.

SYMPTOMS OF HEAT STRESS

Heat cramps are caused by heavy sweating with inadequate fluid intake. Symptoms include;

- Muscle cramps
- Cramps in the hands, legs, feet and abdomen

Heat exhaustion occurs when body organs attempt to keep the body cool. Symptoms include;

- Pale, cool moist skin
- Core temperature elevated 1-2o
- Thirst
- Anxiety
- Rapid heart rate
- Heavy sweating
- Dizziness
- Nausea



Heat stroke is the most serious form of heat stress. Immediate action must be taken to cool the body before serious injury and death occur. Symptoms are;

- Red, hot, dry skin
- Lack of perspiration
- Seizures
- Dizziness and confusion
- Strong, rapid pulse
- Core temperature of 104° or above
- Coma

HEAT STRESS INDICATORS

Heat stress indicator:	When to measure:	If Exceeds:	Action:
Heart rate (pulse)	Beginning of rest period	110 beats per minute	Shorten next work period by 33%
Oral temperature	Beginning of rest period	99°F (after thermometer is under tongue for 3 minutes) 100.6°F (after thermometer is under tongue for 3 minutes)	Shorten next work period by 33% Prohibit work in impermeable clothing
Body Weight	1. Before workday begins 2. After workday ends		Increase fluid intake

COLD STRESS

Cold stress (Hypothermia)

In hypothermia the core body temperature drops below 95°F. Hypothermia can be attributed to a decrease in heat production, increased heat loss or both.



Prevention

Institute the following steps to prevent overexposure of workers to cold:

1. Maintain body core temperature at 98.6°F or above by encouraging workers to drink warm liquids during breaks (preferably not coffee) and wear several layers of clothing that can keep the body warm even when the clothing is wet.
2. Avoid frostbite by adequately covering hands, feet and other extremities. Clothing such as insulated gloves or mittens, earmuffs and hat liners should be worn. To prevent contact frostbite (from touching metal and cold surfaces below 20°F), workers should wear gloves. Tool handles should be covered with insulating material.
3. Adjust work schedules to provide adequate rest periods. When feasible, rotate personnel and perform work during the warmer hours of the day.
4. Provide heated shelter. Workers should remove their outer layer(s) of clothing while in the shelter to allow sweat to evaporate.
5. In the event that wind barriers are constructed around an intrusive operation (such as drilling), the enclosure must be properly vented to prevent the buildup of toxic or explosive gases or vapors. Care must be taken to keep a heat source away from flammable substances.
6. Using a wind chill chart such as the one included below, obtain the equivalent chill temperature (ECT) based on actual wind speed and temperature. Refer to the ECT when setting up work warm-up schedules, planning appropriate clothing, etc. Workers should use warming shelters at regular intervals at or below an ECT of 20°F. For exposed skin, continuous exposure should not be permitted at or below an ECT of -25°F.



FROSTBITE

Personnel should be aware of symptoms of frostbite/hypothermia. If the following symptoms are noticed in any worker, he/she should immediately go to a warm shelter.

Condition	Skin Surface	Tissue Under Skin	Skin Color
Frostnip	Soft	Soft	Initially red, then white
Frostbite	Hard	Soft	White and waxy
Freezing	Hard	Hard	Blotchy, white to yellow-grey to grey

1. Frostnip is the incipient stage of frostbite, brought about by direct contact with a cold object or exposure of a body part to cool/cold air. Wind chill or cold water also can be major factors. This condition is not serious. Tissue damage is minor and the response to care is good. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostnip.
2. Treatment of frostnip: Care for frostnip by warming affected areas. Usually the worker can apply warmth from his/her bare hands, blow warm air on the site, or, if the fingers are involved, hold them in the armpits. During recovery, the worker may complain of tingling or burning sensation, which is normal. If the condition does not respond to this simple care, begin treatment for frostbite.
3. Frostbite: The skin and subcutaneous layers become involved. If frostnip goes untreated, it becomes superficial frostbite. This condition is serious. Tissue damage may be serious. The worker must be transported to a medical facility for evaluation. The tip of the nose, tips of ears, upper cheeks and fingers (all areas generally exposed) are most susceptible to frostbite. The affected area will feel frozen, but only on the surface. The tissue below the surface must still be soft and have normal response to touch. DO NOT squeeze or poke the tissue. The condition of the deeper tissues can be determined by gently palpating the affected area. The skin will turn mottled or blotchy. It may also be white and then turn grayish-yellow.
4. Treatment of frostbite: When practical, transport victim as soon as possible. Get the worker inside and keep him/her warm. Do not allow any smoking or alcohol consumption. Thaw frozen parts by immersion, re-warming in a 100°F to 106°F water bath. Water temperature will drop rapidly, requiring additional warm water throughout the process. Cover the thawed part with a dry sterile dressing. Do not puncture or drain any blisters. NOTE: Never listen to myths and folk tales about the care of frostbite. Never rub a



frostbitten or frozen area. Never rub snow on a frostbitten or frozen area. Rubbing the area may cause serious damage to already injured tissues. Do not attempt to thaw a frozen area if there is any chance it will be re-frozen.

5. General cooling/Hypothermia: General cooling of the body is known as systemic hypothermia. This condition is not a common problem unless workers are exposed to cold for prolonged periods of time without any shelter.

Body Temp (°F)	Body Temp (°C)	Symptoms
99-96	37-35.5	Intense uncontrollable shivering
95-91	35.5-32.7	Violent shivering persists. If victim is conscious, has difficulty speaking.
90-86	32.6-30	Shivering decreases and is replaced by strong muscular rigidity. Muscle coordination is affected. Erratic or jerkey movements are produced. Thinking is less clear. General comprehension is dulled. There may be total amnesia. The worker is generally still able to maintain the appearance of psychological contact with his surroundings.
85-81	29.9-27.2	Victim becomes irrational, loses contact with his environment, and drifts into a stupor. Muscular rigidity continues. Pulse and respirations are slow and the worker may develop cardiac arrhythmias.
80-78	27.1-25.5	Victim becomes unconscious. He does not respond to the spoken word. Most reflexes cease to function. Heartbeat becomes erratic
Below 78	Below 25.5	Cardiac and respiratory centers of the brain fail. Ventricular fibrillation occurs; probably edema and hemorrhage in the lungs; death.

6. Treatment of hypothermia: Keep worker dry. Remove any wet clothing and replace with dry clothes, or wrap person in dry blankets. Keep person at rest. Do not allow him/her to move around. Transport the victim to a medical facility as soon as possible.



**COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED
AS AN EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)**

Estimated wind Speed (in mph)	Actual Temperature Reading (°F)P											
	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	15	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	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-146
(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.

(1) Reproduced from American Conference of Governmental Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1985-1986, p.01.



APPENDIX E CHEMICAL HAZARDS

SAFETY DATA SHEET

Creation Date 23-Mar-2012

Revision Date 18-Jan-2018

Revision Number 3

1. Identification

Product Name 1,2,4,5-Tetramethylbenzene

Cat No. : AC138370000; AC138370050; AC138371000; AC138372500;
AC138375000

CAS-No 95-93-2
Synonyms Durene

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.
Details of the supplier of the safety data sheet

Company

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

Emergency Telephone Number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99
CHEMTREC Tel. No.**US**:001-800-424-9300 / **Europe**: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)

Flammable solids

Category 1

Label Elements

Signal Word

Danger

Hazard Statements

Flammable solid

**Precautionary Statements****Prevention**

Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Wear protective gloves/protective clothing/eye protection/face protection

Fire

In case of fire: Use CO₂, dry chemical, or foam for extinction

Hazards not otherwise classified (HNOC)

Very toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
1,2,4,5-Tetramethylbenzene	95-93-2	>95

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention.
Inhalation	Remove from exposure, lie down. Remove to fresh air. If not breathing, give artificial respiration. Get medical attention.
Ingestion	Clean mouth with water. Get medical attention.
Most important symptoms and effects	No information available.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO ₂). Dry chemical. Chemical foam. Water mist may be used to cool closed containers.
Unsuitable Extinguishing Media	Do not use a solid water stream as it may scatter and spread fire
Flash Point	73 °C / 163.4 °F
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

Flammable. Containers may explode when heated. Do not allow run-off from fire-fighting to enter drains or water courses.
 Combustible material.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
0

Flammability
2

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions

Remove all sources of ignition. Take precautionary measures against static discharges.

Environmental Precautions

Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained.

Methods for Containment and Clean Up

Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment. Sweep up and shovel into suitable containers for disposal. Do not let this chemical enter the environment.

7. Handling and storage

Handling

Avoid contact with skin and eyes. Avoid contact with skin and clothing. Avoid breathing vapors or mists. Do not ingest. If swallowed then seek immediate medical assistance. Use spark-proof tools and explosion-proof equipment. Use only non-sparking tools. Keep away from open flames, hot surfaces and sources of ignition.

Storage

Keep in a dry, cool and well-ventilated place. Refer product specification and/or product label for specific storage temperature requirement. Keep away from heat, sparks and flame. Flammables area. Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Engineering Measures

Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection

No protective equipment is needed under normal use conditions.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Beige
Odor	No information available
Odor Threshold	No information available
pH	No information available
Melting Point/Range	78 - 82 °C / 172.4 - 179.6 °F
Boiling Point/Range	196 - 197 °C / 384.8 - 386.6 °F
Flash Point	73 °C / 163.4 °F
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	160 mmHg @ 140 °C
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C10 H14
Molecular Weight	134.22

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Keep away from open flames, hot surfaces and sources of ignition. Incompatible products.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	No information available.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
1,2,4,5-Tetramethylbenzene	LD50 = 6989 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	No information available
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
1,2,4,5-Tetramethylbenzene	95-93-2	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Very toxic 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
1,2,4,5-Tetramethylbenzene	Not listed	LC50 = 30 mg/L 48h	Not listed	EC50 = 0.47 mg/L 48h

Persistence and Degradability May persist

Bioaccumulation/ Accumulation No information available.

Mobility Is not likely mobile in the environment due its low water solubility.

Component	log Pow
1,2,4,5-Tetramethylbenzene	4.17

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 UN1325
 Proper Shipping Name Flammable solid, organic, n.o.s.
 Hazard Class 4.1
 Packing Group II

TDG

UN-No UN1325
 Proper Shipping Name Flammable solid, organic, n.o.s.
 Hazard Class 4.1
 Packing Group II

IATA

UN-No UN1325
 Proper Shipping Name Flammable solid, organic, n.o.s.
 Hazard Class 4.1

Packing Group	II
IMDG/IMO	
UN-No	UN1325
Proper Shipping Name	Flammable solid, organic, n.o.s.
Hazard Class	4.1
Packing Group	II

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
1,2,4,5-Tetramethylbenzene	95-93-2	X	ACTIVE	-

Legend:

TSCA - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
1,2,4,5-Tetramethylbenzene	95-93-2	X	-	202-465-7	X	X	X	X	KE-33556

U.S. Federal Regulations

SARA 313 Not applicable

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

CWA (Clean Water Act) Not applicable

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA Not applicable

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

U.S. State Right-to-Know Regulations Not applicable

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.

Other International Regulations

Mexico - Grade Moderate risk, Grade 2

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	23-Mar-2012
Revision Date	18-Jan-2018
Print Date	18-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



TCI AMERICA

SAFETY DATA SHEET

Revision number: 3
Revision date: 08/18/2015

1. IDENTIFICATION

Product name: Benz[a]anthracene
Product code: B0017

Product use: For laboratory research purposes.
Restrictions on use: Not for drug or household use.

Company:
TCI America
9211 N. Harborage Street
Portland, OR 97203 U.S.A.
Telephone:
+1-800-423-8616 / +1-503-283-1681
Fax:
+1-888-520-1075 / +1-503-283-1987
e-mail:
sales-US@TCIchemicals.com
www.TCIchemicals.com

Emergency telephone number:
Chemical Emergencies:
TCI America (8:00am - 5:00pm) PST
+1-503-286-7624
Transportation Emergencies:
Chemtrec 24-Hour
+1-800-424-9300 (U.S.A.)
+1-703-527-3887 (International)
Responsible department:
TCI America
Environmental Health Safety and Security
+1- 503-286-7624

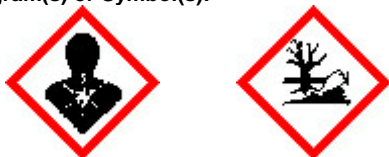
2. HAZARD(S) IDENTIFICATION

OSHA Haz Com: CFR 1910.1200:
Germ Cell Mutagenicity [Category 2]
Carcinogenicity [Category 2]
Aquatic Hazard (Acute) [Category 1]
Aquatic Hazard (Long-Term) [Category 1]

Signal word: Warning!

Hazard Statement(s):
Suspected of causing cancer
Suspected of causing genetic defects
Very toxic to aquatic life
Very toxic to aquatic life with long lasting effects

Pictogram(s) or Symbol(s):



Precautionary Statement(s):
[Prevention]

[Response]
[Storage]
[Disposal]

Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves, protective clothing, eye protection and face protection.
If exposed: Call a poison center or doctor. If exposed or concerned: Get medical advice or attention.
Store locked up.
Dispose of contents and container in accordance with US EPA guidelines for the classification and determination of hazardous waste listed in 40 CFR 261.3. (See Section 13)

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance/Mixture: Substance
Components: Benz[a]anthracene
Percent: >98.0%(GC)
CAS Number: 56-55-3
Molecular Weight: 228.29

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Formula: C₁₈H₁₂
Synonyms: Benzanthrene , Tetraphene

4. FIRST-AID MEASURES

Inhalation: Call emergency medical service. Effects of exposure (inhalation) to substance may be delayed. Inhalation of vapors or contact with substance will result in contamination and potential harmful effects. Move victim to fresh air. Give artificial respiration if victim is not breathing. Administer oxygen if breathing is difficult. Keep victim warm and quiet. Treat symptomatically and supportively. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Skin contact: Call a poison center or doctor if you feel unwell. Effects of exposure (skin contact) to substance may be delayed. Remove and wash contaminated clothing before re-use. In case of contact with substance, immediately flush skin with running water for at least 20 minutes. Treat symptomatically and supportively. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Eye contact: In case of contact with substance, immediately flush eyes with running water for at least 20 minutes. If eye irritation persists get medical advice/attention. Move victim to fresh air. Check for and remove any contact lenses. Keep victim warm and quiet. Treat symptomatically and supportively. Effects of exposure to substance may be delayed. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Ingestion: Effects of exposure (ingestion) to substance may be delayed. If swallowed, seek medical advice immediately and show the container or label. Loosen tight clothing such as a collar, tie, belt or waistband. If a person vomits place them in the recovery position so that vomit will not reenter the mouth and throat. Rinse mouth. Keep victim warm and quiet. Treat symptomatically and supportively. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Symptoms/effects:

Acute: No data available
Delayed: May cause heritable genetic damage in humans. Possibly carcinogenic to humans.

Immediate medical attention:

CAUTION: Victim may be a source of contamination. If breathing has stopped, perform artificial respiration. Use first aid treatment according to the nature of the injury. Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media: Dry chemical, CO₂, water spray, or alcohol-resistant foam. Consult with local fire authorities before attempting large scale fire fighting operations.

Specific hazards arising from the chemical

Hazardous combustion products: These products include: Carbon oxides
Other specific hazards: Closed containers may explode from heat of a fire.

Special precautions for fire-fighters:

Use water spray or fog; do not use straight streams. Dike fire-control water for later disposal; do not scatter the material. Containers may explode when heated. Move containers from fire area if you can do it without risk.

Special protective equipment for fire-fighters:

Wear positive pressure self-contained breathing apparatus (SCBA). Structural fire fighters' protective clothing provides limited protection in fire situations ONLY; it may not be effective in spill situations. Wear chemical protective clothing which is specifically recommended by the manufacturer. It may provide little or no thermal protection.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Avoid contact with skin, eyes, and clothing. Keep people away from and upwind of spill/leak. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing (Section 8). Warn unnecessary personnel to move away. Stop leak if you can do it without risk. Ensure adequate ventilation. Isolate the hazard area and deny entry to unnecessary and unprotected personnel.

Personal protective equipment: Splash goggles. Wear protective clothing (chemical resistant suit and chemical resistant boots). Dust respirator. Be sure to use a MSHA/NIOSH approved respirator or equivalent. Wear protective gloves (nitrile).

Emergency procedures: Prevent dust cloud. Do not clean-up or dispose except under supervision of a specialist. In case of a spill and/or a leak, always shut off any sources of ignition, ventilate the area, and exercise caution. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Warn personnel to move away. Prevent entry into sewers, basements or confined areas; dike if needed.

6. ACCIDENTAL RELEASE MEASURES**Methods and materials for containment and cleaning up:**

ELIMINATE all ignition sources (no smoking, flares, sparks, or flames in immediate area). Stop leak if without risk. Absorb with an inert material and put the spilled material in an appropriate waste disposal container. Use clean non-sparking tools to collect absorbed material. Dike far ahead of spill; use dry sand to contain the flow of material. Ventilate the area.

Environmental precautions:

Keep away from living quarters. Environmental hazard. Do not let product enter drains. Prevent further leakage or spillage if safe to do so. Water runoff can cause environmental damage. Prevent entry into sewers, basements or confined areas; dike if needed.

7. HANDLING AND STORAGE**Precautions for safe handling:**

Avoid inhalation of vapor or mist. Manipulate under an adequate fume hood. Avoid contact - obtain special instructions before use. Avoid prolonged or repeated exposure. Avoid contact with skin and eyes. Normal measures for preventive fire protection. Avoid exposure - obtain special instructions before use. Good general ventilation should be sufficient to control airborne levels. Keep container dry. Handle and open container with care. Wear suitable protective clothing, gloves and eye/face protection. When using do not eat, drink, or smoke. Keep away from sources of ignition.

Conditions for safe storage:

Store locked up. Keep containers tightly closed in a cool, well-ventilated place. Keep away from incompatibles. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Avoid prolonged storage periods.

Storage incompatibilities:

Store away from oxidizing agents

8. EXPOSURE CONTROLS / PERSONAL PROTECTION**Exposure limits:**

No data available

Appropriate engineering controls:

Handle only in a fully enclosed system and equipment. Good general ventilation should be sufficient to control airborne levels. Ventilation is normally required when handling or using this product. Eyewash fountains should be provided in areas where there is any possibility that workers could be exposed to the substance. Follow safe industrial engineering/laboratory practices when handling any chemical.

Personal protective equipment**Respiratory protection:**

Dust respirator. Be sure to use a MSHA/NIOSH approved respirator or equivalent.

Hand protection:

Wear protective gloves.

Eye protection:

Safety glasses.

Skin and body protection:

Wear protective clothing (chemical resistant suit and chemical resistant boots).

9. PHYSICAL AND CHEMICAL PROPERTIES**Physical state (20°C):**

Solid

Form:

Crystal - Powder

Color:

White - Yellow

Odor:

No data available

Odor threshold:

No data available

Melting point/freezing point:

161°C (322°F)

Boiling point/range:

438°C (820°F)

Decomposition temperature:

No data available

Relative density:

No data available

Kinematic Viscosity:

No data available

Partition coefficient:

5.79

n-octanol/water (log P_{ow})**pH:**

No data available

Vapor pressure:

6.7x10⁻⁷Pa /20°C

Vapor density:

No data available

Dynamic Viscosity:

No data available

Evaporation rate:

No data available

(Butyl Acetate = 1)

Flash point:

No data available

Flammability (solid, gas):

No data available

Autoignition temperature:

No data available

Flammability or explosive limits:

Lower: No data available

Upper: No data available

Solubility(ies):**10. STABILITY AND REACTIVITY****Reactivity:**

Not Available.

Chemical Stability:

Stable under recommended storage conditions. (See Section 7)

Possibility of Hazardous Reactions:

No hazardous reactivity has been reported.

Conditions to avoid:

Avoid excessive heat and light.

Incompatible materials:

Oxidizing agents

Hazardous Decomposition Products:

No data available

11. TOXICOLOGICAL INFORMATION**RTECS Number:** CV9275000**Acute Toxicity:**

ivn-rat LD50:>200 mg/kg

ivn-mus LDLo:10 mg/kg

Skin corrosion/irritation:

No data available

Serious eye damage/irritation:

No data available

Respiratory or skin sensitization:

No data available

Germ cell mutagenicity:

dna-mus-skn 192 umol/kg

dni-hmn-oth 10 umol/L

mmo-sat 4 ug/plate (-S9)

Carcinogenicity:

imp-mus TDLo:80 mg/kg

skn-mus TDLo:18 mg/kg

scu-mus TDLo:2 mg/kg

IARC: Group 2B (Possibly carcinogenic to humans) .**NTP:** b (Reasonably anticipated to be carcinogens) .**OSHA:** No data available**Reproductive toxicity:**

No data available

Routes of Exposure:

Inhalation, Eye contact, Ingestion, Skin contact.

Symptoms related to exposure:

No specific information is available in our data base regarding the toxic effects of this material for humans. However, exposure to any chemical should be kept to a minimum. Always follow safe industrial hygiene practices and wear proper protective equipment when handling this compound.

Potential Health Effects:

No specific information available; skin and eye contact may result in irritation. May be harmful if inhaled or ingested.

Target organ(s):

No data available

12. ECOLOGICAL INFORMATION**Ecotoxicity****Fish:**

No data available

Crustacea:

48h LC50:0.0975 mg/L (Daphnia magna)

Algae:

No data available

Persistence and degradability:

No data available

Bioaccumulative potential (BCF):

560 - 18000

Mobility in soil:

No data available

Partition coefficient:

5.79

n-octanol/water (log P_{ow})**Soil adsorption (K_{oc}):**

545000 - 1870000

Henry's Law:

0.8

constant (PaM³/mol)

13. DISPOSAL CONSIDERATIONS

Disposal of product:	Recycle to process if possible. It is the generator's responsibility to comply with Federal, State and Local rules and regulations. 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. This section is intended to provide assistance but does not replace these laws, nor does compliance in accordance with this section ensure regulatory compliance according to the law. US EPA guidelines for Identification and Listing of Hazardous Waste are listed in 40 CFR Parts 261. The product should not be allowed to enter the environment, drains, water ways, or the soil.
Disposal of container:	Dispose of as unused product. Do not re-use empty containers.
Other considerations:	Observe all federal, state and local regulations when disposing of the substance.

DOT (US)

UN number:	Proper Shipping Name:	Class or Division:	Packing Group:
UN3077	Environmentally hazardous substance, solid, n.o.s.	9 Miscellaneous hazardous material	III

IATA

UN number:	Proper Shipping Name:	Class or Division:	Packing Group:
UN3077	Environmentally hazardous substance, solid, n.o.s.	9 Miscellaneous hazardous material	III

IMDG

UN number:	Proper Shipping Name:	Class or Division:	Packing Group:
UN3077	Environmentally hazardous substance, solid, n.o.s.	9 Miscellaneous hazardous material	III

15. REGULATORY INFORMATION**Toxic Substance Control Act (TSCA 8b.):**

This product is ON the EPA Toxic Substances Control Act (TSCA) inventory.

US Federal Regulations**CERCLA Hazardous substance and Reportable Quantity:**

SARA 313:	Listed
SARA 302:	Not Listed

State Regulations**State Right-to-Know**

Massachusetts	Listed
New Jersey	Listed
Pennsylvania	Listed
California Proposition 65:	Listed

Other Information**NFPA Rating:**

Health:	2
Flammability:	0
Instability:	0

HMIS Classification:

Health:	2
Flammability:	0
Physical:	0

International Inventories

WHMIS hazard class:	D2B: Materials causing other toxic effects. (Toxic)
EC-No:	200-280-6

16. OTHER INFORMATION

Revision date: 08/18/2015

Revision number: 3

16. OTHER INFORMATION

TCI 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 affiliates or 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 SDS 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 SDS 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, face mask, fume hood). For proper handling and disposal, always comply with federal, state and local regulations.

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

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

1.1. Product identifier

Chemical name : benzene
EC Index : 601-020-00-8
EC No : 200-753-7
CAS No. : 71-43-2
REACH registration No. : 01-2119447106-44
Formula : C₆H₆

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

Specific use(s) : Use as an intermediate
The substance/product is registered with strictly controlled conditions as defined in Article 18(4) of Regulation (EC) No. 1907/2006 (REACH Regulation) and must therefore be handled as such.

1.3. Details of the supplier of the safety data sheet

Company : Transcor Energy
Parc de L'Alliance, Boulevard de France 7
1420 Braine-L'Alleud, Belgium
Telephone +32 2 663 19 00
Telefax: +32 2 675 49 99
E-mail: reach@transcor.be

1.4. Emergency telephone number

Emergency telephone : +32 3 575 03 30 (This telephone number is available 24 hours per day, 7 days per week.)

IRELAND (REPUBLIC OF)
National Poisons Information Centre
Beaumont Hospital +353 18 37 99 64/+353 1 809 21 66
UNITED KINGDOM
National Poisons Information Service
(Newcastle Centre) 0844 892 0111 (UK only, Monday to Friday, 08.00 to 18.00 hours)
Regional Drugs and Therapeutics Centre,
Wolfson Unit

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

2.1.1. Classification according to Regulation (EU) 1272/2008

CLP-Classification : The product is classified as hazardous in accordance with Regulation (EC) No. 1272/2008.

Flam. Liq. 2 H225
Skin Irrit. 2 H315
Eye Irrit. 2 H319
Muta. 1B H340
Carc. 1A H350
STOT RE 1 H372
Asp. Tox. 1 H304

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

Full text of H-phrases: see section 16

2.1.2. Classification according to EU Directives 67/548/EEC or 1999/45/EC

Classification : This substance is classified as hazardous according to 67/548/EEC.
 F; R11
 Xn; R65
 T; R48/23/24/25
 Xi; R36/38
 Carc.Cat.1; R45
 Muta.Cat.2; R46

Full text of R-phrases: see section 16

2.2. Label elements

2.2.1. Labelling according to Regulation (EU) 1272/2008

Hazard pictograms :



GHS02

GHS07

GHS08

Signal word :

Danger

Hazard statements :

H225 - Highly flammable liquid and vapour.
 H304 - May be fatal if swallowed and enters airways.
 H315 - Causes skin irritation.
 H319 - Causes serious eye irritation.
 H340 - May cause genetic defects.
 H350 - May cause cancer.
 H372 - Causes damage to organs through prolonged or repeated exposure.
 P202 - Do not handle until all safety precautions have been read and understood.
 P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
 P243 - Take precautionary measures against static discharge.
 P280 - Wear protective gloves/protective clothing/eye protection/face protection.
 P301+P310 - IF SWALLOWED: Immediately call a POISON CENTER/doctor/.
 P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
 P331 - Do NOT induce vomiting.

2.2.2. Labelling according to Directives (67/548 - 1999/45)

Not relevant

2.3. Other hazards

Other hazards : Vapours can form explosive mixtures with air.
 Results of PBT and vPvB assessment :
 Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substances

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

Substance name	Product identifier	%	Classification according to Directive 67/548/EEC
Benzene	(CAS No.) 71-43-2 (EC No) 200-753-7 (EC Index) 601-020-00-8 (REACH-no) 01-2119447106-44-0099	100	F; R11 Xn; R65 T; R48/23/24/25 Xi; R36/38 Carc. Cat. 1; R45 Muta. Cat. 2; R46

Substance name	Product identifier	%	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Benzene	(CAS No.) 71-43-2 (EC No) 200-753-7 (EC Index) 601-020-00-8 (REACH-no) 01-2119447106-44-0099	100	Flam. Liq. 2, H225 Skin Irrit. 2, H315 Eye Irrit. 2, H319 Muta. 1B, H340 Carc. 1A, H350 STOT RE 1, H372 Asp. Tox. 1, H304

Full text of R- and H-phrases: see section 16

3.2. Mixtures

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

- | | |
|----------------------|--|
| Inhalation | : Remove person to fresh air and keep comfortable for breathing.
When in doubt or if symptoms are observed, get medical advice.
If breathing is irregular or stopped, administer artificial respiration.
Get medical advice/attention. |
| Skin contact | : Take off contaminated clothing.
Gently wash with plenty of soap and water.
Get medical advice/attention. |
| Eye contact | : Rinse immediately carefully and thoroughly with eye-bath or water.
Remove contact lenses, if present and easy to do. Continue rinsing.
Get immediate medical advice/attention. |
| In case of ingestion | : Rinse mouth thoroughly with water.
Do NOT induce vomiting.
Get immediate medical advice/attention. |
| Additional advice | : First aider: Pay attention to self-protection!
Personal protection equipment: see section 8
Never give anything by mouth to an unconscious person or a person with cramps.
When in doubt or if symptoms are observed, get medical advice.
Show this safety data sheet to the doctor in attendance.
Treat symptomatically. |

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

- | | |
|------------|---|
| Inhalation | : Causes damage to organs through prolonged or repeated exposure. The following symptoms may occur: Dizziness Drowsiness Unconsciousness Headache Nausea Convulsions Shortness of breath. |
|------------|---|

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

- | | |
|-----------------------|--|
| Skin contact | : Causes skin irritation. Causes damage to organs through prolonged or repeated exposure. The following symptoms may occur: Dry skin Pain erythema (redness). |
| Eye contact | : Causes serious eye irritation. The following symptoms may occur: Redness, pain. |
| Ingestion | : May be fatal if swallowed and enters airways. Causes damage to organs through prolonged or repeated exposure. The following symptoms may occur: Abdominal pain Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea. Sore throat. |
| Other adverse effects | : Causes damage to organs through prolonged or repeated exposure. May cause cancer. May cause genetic defects. |

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

No data available

SECTION 5: Firefighting measures

5.1. Extinguishing media

- | | |
|---|---|
| Suitable extinguishing media | : Water spray, alcohol resistant foam, Dry extinguishing powder, Carbon dioxide |
| Extinguishing media which must not be used for safety reasons | : Strong water jet |

5.2. Special hazards arising from the substance or mixture

- | | |
|------------------|--|
| Fire hazard | : Highly flammable liquid and vapour. |
| Specific hazards | : Heating causes rise in pressure with risk of bursting.
Vapours can form explosive mixtures with air.
Vapours are heavier than air, spread along floors and form explosive mixtures with air.
Vapours can travel considerable distances to a source of ignition where they can ignite, flash back, or explode.
Hazardous combustion products:
Carbon oxides
Nitrogen oxides (NOx)
Volatile organic compounds |

5.3. Advice for firefighters

- | | |
|-------------------------|--|
| Advice for firefighters | : Special protective equipment for firefighters.
In case of fire: Wear self-contained breathing apparatus.
Use water spray jet to protect personnel and to cool endangered containers.
Do not allow run-off from fire-fighting to enter drains or water courses.
Dispose according to legislation.
Evacuate area. |
|-------------------------|--|

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

- | | |
|-----------------------------|--|
| For non-emergency personnel | : Evacuate area.
Stay upwind/keep distance from source.
Provide adequate ventilation.
Use personal protective equipment as required.
Personal protection equipment: see section 8
Do not breathe vapour/spray.
Avoid contact with skin, eyes and clothes.
Keep away from heat, hot surfaces, sparks, open flames and other ignition |
|-----------------------------|--|

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

For emergency responders : sources. No smoking.
Ensure that the equipment is adequately grounded.
Use explosion-proof machinery, apparatus, ventilation facilities, tools etc.
Use only non-sparking tools.
: Ensure procedures and training for emergency decontamination and disposal are in place.
Personal protection equipment: see section 8.

6.2. Environmental precautions

Environmental precautions : Do not allow to enter into ground-water, surface water or drains.
If the product contaminates rivers and lakes or drains inform respective authorities.

6.3. Methods and material for containment and cleaning up

Methods for cleaning up : Use foam on spills to minimise vapours.
Stop leak if safe to do so.
Dam up.
Clean-up methods - small spillage: Absorb with liquid-binding material (e.g. sand, diatomaceous earth, acid- or universal binding agents)., Collect in closed and suitable containers for disposal.
Absorb with liquid-binding material (e.g. sand, diatomaceous earth, acid- or universal binding agents).
Sweep or shovel spills into appropriate container for disposal
Clean-up methods - large spillage: Large spills should be collected mechanically (remove by pumping) for disposal., Collect in closed and suitable containers for disposal.
Large spills should be collected mechanically (remove by pumping) for disposal.
Use only explosion-proof equipment.
Dispose of waste product or used containers according to local regulations.

6.4. Reference to other sections

Personal protection equipment: see section 8
Disposal: see section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Handling : Provide adequate ventilation.
Use personal protective equipment as required.
Personal protection equipment: see section 8
Do not breathe vapour/spray.
Avoid contact with skin, eyes and clothes.
Take any precaution to avoid mixing with incompatible materials.
See also section 10
Ensure proper process control to avoid excess waste discharge (temperature, concentration, pH value, time).
Do not allow contact with soil, surface or ground water.
Obtain special instructions before use.
(Do not handle until all safety precautions have been read and understood.)
Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
Ensure that the equipment is adequately grounded.
Use explosion-proof machinery, apparatus, ventilation facilities, tools etc.
Use only non-sparking tools.

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

The substance/product is registered with strictly controlled conditions as defined in Article 18(4) of Regulation (EC) No. 1907/2006 (REACH Regulation) and must therefore be handled as such.

Advices on general occupational hygiene :

- Keep good industrial hygiene.
- Wash hands before breaks and immediately after using the product.
- When using do not eat, drink or smoke.
- Keep away from food, drink and animal feedingstuffs.
- Keep work clothes separately.
- Take off contaminated clothing.
- Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities

Storage :

- Keep in a dry, cool and well-ventilated place.
- Do not store near or with any of the incompatible materials listed in section 10.
- Bund storage facilities to prevent soil and water pollution in the event of spillage.
- Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Packaging materials :

- Keep/Store only in original container.

7.3 Specific end use(s)

Intermediate.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure limit values :

Benzene (71-43-2)		
Belgium	Limit value (mg/m ³)	3,25 mg/m ³
Belgium	Limit value (ppm)	1 ppm
Bulgaria	OEL TWA (mg/m ³)	3,25 mg/m ³
Croatia	GVI (granična vrijednost izloženosti) (mg/m ³)	3,25 mg/m ³
Croatia	GVI (granična vrijednost izloženosti) (ppm)	1 ppm
Cyprus	OEL TWA (mg/m ³)	3,25 mg/m ³
Cyprus	OEL TWA (ppm)	1 ppm
France	VME (mg/m ³)	3,25 mg/m ³ (restrictive limit)
France	VME (ppm)	1 ppm (restrictive limit)
Greece	OEL TWA (mg/m ³)	3,19 mg/m ³
Greece	OEL TWA (ppm)	1,0 ppm
Italy - Portugal - USA ACGIH	ACGIH TWA (ppm)	0,5 ppm
Italy - Portugal - USA ACGIH	ACGIH STEL (ppm)	2,5 ppm
Italy	OEL TWA (mg/m ³)	3,25 mg/m ³
Italy	OEL TWA (ppm)	1 ppm
Latvia	OEL TWA (mg/m ³)	3,25 mg/m ³
Latvia	OEL TWA (ppm)	1 ppm
Spain	VLA-ED (mg/m ³)	3,25 mg/m ³ (manufacturing, commercialization, and use restrictions under REACH; worker protection to carcinogens in the workplace)

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

Spain	VLA-ED (ppm)	1 ppm (manufacturing, commercialization, and use restrictions under REACH; worker protection to exposure to carcinogens and mutagens in the workplace)
Switzerland	VME (mg/m ³)	1,6 mg/m ³
Switzerland	VME (ppm)	0,5 ppm
Netherlands	Grenswaarde TGG 8H (mg/m ³)	3,25 mg/m ³
United Kingdom	WEL TWA (mg/m ³)	3,25 mg/m ³
United Kingdom	WEL TWA (ppm)	1 ppm
United Kingdom	WEL STEL (mg/m ³)	9,75 mg/m ³ (calculated)
United Kingdom	WEL STEL (ppm)	3 ppm (calculated)
Czech Republic	Expoziční limity (PEL) (mg/m ³)	3 mg/m ³
Denmark	Grænseværdie (langvarig) (mg/m ³)	1,6 mg/m ³
Denmark	Grænseværdie (langvarig) (ppm)	0,5 ppm
Finland	HTP-arvo (8h) (mg/m ³)	3,25 mg/m ³
Finland	HTP-arvo (8h) (ppm)	1 ppm
Hungary	MK-érték	3 mg/m ³
Ireland	OEL (8 hours ref) (mg/m ³)	3 mg/m ³
Ireland	OEL (8 hours ref) (ppm)	1 ppm
Ireland	OEL (15 min ref) (mg/m ³)	9 mg/m ³ (calculated)
Ireland	OEL (15 min ref) (ppm)	3 ppm (calculated)
Lithuania	IPRV (mg/m ³)	3,25 mg/m ³
Lithuania	IPRV (ppm)	1 ppm
Lithuania	TPRV (mg/m ³)	19 mg/m ³
Lithuania	TPRV (ppm)	6 ppm
Norway	Gjennomsnittsverdier (AN) (mg/m ³)	3 mg/m ³
Norway	Gjennomsnittsverdier (AN) (ppm)	1 ppm
Norway	Gjennomsnittsverdier (Kortidsverdi) (mg/m ³)	6 mg/m ³
Norway	Gjennomsnittsverdier (Kortidsverdi) (ppm)	3 ppm
Poland	NDS (mg/m ³)	1,6 mg/m ³
Romania	OEL TWA (mg/m ³)	3,25 mg/m ³
Romania	OEL TWA (ppm)	1 ppm
Sweden	nivågränsvärde (NVG) (mg/m ³)	1,5 mg/m ³
Sweden	nivågränsvärde (NVG) (ppm)	0,5 ppm
Sweden	kortidsvärde (KTV) (mg/m ³)	9 mg/m ³
Sweden	kortidsvärde (KTV) (ppm)	3 ppm

Recommended monitoring procedures : Personal air monitoring
 Room air monitoring

8.2. Exposure controls

Personal protection equipment : The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection : In case of insufficient ventilation, wear suitable respiratory equipment.
 Half-face mask (EN 140)
 Full face mask (EN 136)
 Filter type: AP (EN 141)
 The filter class must be suitable for the maximum contaminant

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

	concentration (gas/vapour/aerosol/particulates) that may arise when handling the product. If the concentration is exceeded, self-contained breathing apparatus must be used. (EN 137)
Hand protection	: Wear chemically resistant gloves (tested to EN374) ,Suitable material:;NBR (Nitrile rubber) (> 0.45 mm, BTT > 30 min.),PVA (Polyvinyl alcohol) (BTT > 480 min.),Fluoropolymers (BTT > 480 min.),The quality of the protective gloves resistant to chemicals must be chosen as a function of the specific working place concentration and quantity of hazardous substances.
Eye protection	: Use suitable eye protection. (EN166): Goggles
Body protection	: Wear suitable protective clothing. Wear suitable coveralls to prevent exposure to the skin. Chemical resistant safety shoes
Thermal hazard protection	: Not required under normal use. Use dedicated equipment.
Engineering control measures	: The substance/product is registered with strictly controlled conditions as defined in Article 18(4) of Regulation (EC) No. 1907/2006 (REACH Regulation) and must therefore be handled as such. Provide adequate ventilation. Organisational measures to prevent /limit releases, dispersion and exposure Safe handling: see section 7 . Transfer and handle product only in closed systems. Guarantee that the eye flushing systems and safety showers are closely located to the working place. Store locked up. Take precautionary measures against static discharges. Ensure that the equipment is adequately grounded. Use explosion-proof machinery, apparatus, ventilation facilities, tools etc.
Environmental exposure controls	: Do not allow contact with soil, surface or ground water. Comply with applicable Community environmental protection legislation.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	: liquid
Colour	: clear
Odour	: characteristic
Odour threshold	: No data available
pH	: No data available
Melting point/freezing point	: 5,49 °C
Initial boiling point and boiling range	: 80,09 °C
Flash point	: 11 °C
Evaporation rate	: No data available
Flammability (solid, gas)	: Not applicable, liquid
Upper/lower flammability or explosive limits	: < No data available
Vapour pressure	: 10 kPa (20 °C) 100 kPa (79.9 °C)
Vapour density	: No data available

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

Density	: 0,8765 g/cm ³ (20 °C)
Relative density	: No data available
Water solubility	: ≈ 1,88 g/l (23.5 °C)
Solubility in different media	: Justification for data waiving not relevant
Partition coefficient n-octanol/water	: 2,13
Auto-ignition temperature	: 498 °C
Decomposition temperature	: No data available
Viscosity	: 0,604 mPa.s (25 °C)
Explosive properties	: Not applicable The study does not need to be conducted because there are no chemical groups associated with explosive properties present in the molecule.
Oxidising properties	: Not applicable The classification procedure needs not to be applied because there are no chemical groups present in the molecule which are associated with oxidising properties.

9.2. Other information

Surface tension	: Justification for data waiving not relevant
-----------------	---

SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity	: Highly flammable liquid and vapour. Reference to other sections: 10.4 & 10.5
------------	---

10.2. Chemical stability

Stability	: The product is stable under storage at normal ambient temperatures.
-----------	---

10.3. Possibility of hazardous reactions

Possibility of hazardous reactions	: Vapours can form explosive mixtures with air.
------------------------------------	---

10.4. Conditions to avoid

Conditions to avoid	: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Safe handling: see section 7
---------------------	--

10.5. Incompatible materials

Incompatible materials	: Oxidising substances, Strong acids, Halogens, Safe handling: see section 7
------------------------	--

10.6. Hazardous decomposition products

Hazardous decomposition products	: Reference to other sections: 5.2
----------------------------------	------------------------------------

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity	: Not classified (Based on available data, the classification criteria are not met.)
----------------	--

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

Benzene (71-43-2)	
LD50/oral/rat	> 2000 mg/kg
LD50/dermal/rabbit	> 5000 mg/kg
ATE CLP (vapours)	44,5 mg/l/4h

Skin corrosion/irritation	: Causes skin irritation. pH: No data available
Serious eye damage/eye irritation	: Causes serious eye irritation. pH: No data available
Respiratory or skin sensitisation	: Not classified (Based on available data, the classification criteria are not met.)
Germ cell mutagenicity	: May cause genetic defects.
Carcinogenicity	: May cause cancer. LOAEL, Oral, Rat: 25 mg/kg bw/day
Reproductive toxicity	: Not classified (Based on available data, the classification criteria are not met.) NOAEC, Inhalation: 960 mg/m ³ NOAEC, Developmental toxicity, Inhalation, Rat: 32 mg/m ³
STOT-single exposure	: Not classified (Based on available data, the classification criteria are not met.)
STOT-repeated exposure	: Causes damage to organs through prolonged or repeated exposure.
Aspiration hazard	: May be fatal if swallowed and enters airways.

Other information

Reference to other sections: 4.2, Symptoms related to the physical, chemical and toxicological characteristics, For further information see section 4

SECTION 12: Ecological information

12.1. Toxicity

Benzene (71-43-2)	
LC50 fish 1	eco mg/l (96 h)
EC50 Daphnia 1	10 mg/l (48h)
ErC50 (algae)	100 mg/l (72 h)
LOEC (chronic)	1,6 mg/l
NOEC (chronic)	3 mg/l Invertebrates.
NOEC chronic fish	0,8 mg/l
NOEC chronic crustacea	3 mg/l
NOEC chronic algae	≈
Additional information	ErC10, Biomass, 72h, algae: 10 mg/l ErC10, Growth rate, 72h, algae: 34 mg/l IC50, 24h, micro-organisms: 13 mg/l

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

12.2. Persistence and degradability

Persistence and degradability : Readily biodegradable.

12.3. Bioaccumulative potential

Bioaccumulation : Low potential
 Partition coefficient n-octanol/water : 2,13
 Bioconcentration factor (BCF) : < 10

12.4. Mobility in soil

Mobility :
 Surface tension : Justification for data waiving

12.5. Results of PBT and vPvB assessment

PBT/vPvB data :

12.6. Other adverse effects

Other information :

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product waste: : Do not allow contact with soil, surface or ground water.
 Dispose of empty containers and wastes safely.
 Safe handling: see section 7
 Refer to manufacturer/supplier for information on recovery/recycling
 Recycling is preferred to disposal or incineration
 If recycling is not possible, eliminate in accordance with local valid waste disposal regulations

 Contaminated packaging : Never use pressure to empty container.
 Do not pierce or burn, even after use.
 Handle contaminated packages in the same way as the substance itself.
 Dispose according to legislation.

 List of proposed waste codes/waste designations in accordance with EWC : This material and its container must be disposed of as hazardous waste.
 Waste codes should be assigned by the user based on the application for which the product was used.

SECTION 14: Transport information

14.1. UN number

UN number : 1114

14.2. UN proper shipping name

Proper Shipping Name : BENZENE
 Proper Shipping Name (IATA) : BENZENE
 Proper Shipping Name (IMDG) : BENZENE
 Proper Shipping Name (ADN) : BENZENE

14.3. Transport hazard class(es)

14.3.1. Overland transport

Class(es) : 3 - Flammable liquid
 Hazard identification number (Kemler No.) : 33
 Classification code : F1

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

ADR/RID-Labels : 3 - Flammable liquid



14.3.2. Inland waterway transport (ADN)

Class (UN) : 3

14.3.3. Transport by sea

Class or Division : 3 - flammable liquids

14.3.4. Air transport

Class or Division : 3 - flammable liquids

14.4. Packing group

Packing group : II

14.5. Environmental hazards

Other information : No supplementary information available.

14.6. Special precautions for user

Special precautions for user : No data available.

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

No data available

SECTION 15: Regulatory information

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

15.1.1. EU-Regulations

The following restrictions are applicable according to Annex XVII of the REACH Regulation (EC) No 1907/2006 :

3. Liquid substances or mixtures which are regarded as dangerous in accordance with Directive 1999/45/EC or are fulfilling the criteria for any of the following hazard classes or categories set out in Annex I to Regulation (EC) No 1272/2008 : Benzene

5. Benzene : Benzene

28. Substances which appear in Part 3 of Annex VI to Regulation (EC) No 1272/2008 classified as Carcinogen category 1A or 1B (Table 3.1) or Carcinogen category 1 or 2 (Table 3.2) and listed as follows: Carcinogen category 1A (Table 3.1)/Carcinogen category 1 (Table 3.2) listed in Appendix 1 Carcinogen category 1B (Table 3.1)/Carcinogen category 2 (Table 3.2) listed in Appendix 2 : Benzene

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

29. Substances which appear in Part 3 of Annex VI to Regulation (EC) No 1272/2008 classified as Germ cell Mutagen category 1A or 1B (Table 3.1) or Mutagen category 1 or 2 (Table 3.2) and listed as follows: Mutagen category 1A (Table 3.1)/Mutagen category 1 (Table 3.2) listed in Appendix 3 Mutagen category 1B (Table 3.1)/Mutagen category 2 (Table 3.2) listed in Appendix 4 : Benzene

40. Substances classified as flammable gases category 1 or 2, flammable liquids categories 1, 2 or 3, flammable solids category 1 or 2, substances and mixtures which, in contact with water, emit flammable gases, category 1, 2 or 3, pyrophoric liquids category 1 or pyrophoric solids category 1, regardless of whether they appear in Part 3 of Annex VI to Regulation (EC) No 1272/2008 or not. : Benzene

This product contains an ingredient according to the candidate list of Annex XIV of the REACH Regulation 1907/2006/EC. : none
 Authorisations : Not applicable

15.1.2. National regulations

DE : WGK : 3
 NL : ABM : 2 - May cause heritable genetic damage., 3 - May cause cancer.
 NL : NeR (Nederlandse emissie Richtlijn) : Organic substances in vapour or gaseous form

15.2. Chemical safety assessment

Chemical Safety Assessment : For this substance a chemical safety assessment has been carried out.

SECTION 16: Other information

Full text of R-, H- and EUH-phrases:

Asp. Tox. 1	: Aspiration hazard, Category 1
Carc. 1A	: Carcinogenicity, Category 1A
Eye Irrit. 2	: Serious eye damage/eye irritation Category 2
Flam. Liq. 2	: Flammable liquids, Category 2
Muta. 1B	: Germ cell mutagenicity, hazard categories 1B
Skin Irrit. 2	: Skin corrosion/irritation, Category 2
STOT RE 1	: Specific target organ toxicity — Repeated exposure, Category 1
H225	: Highly flammable liquid and vapour.
H304	: May be fatal if swallowed and enters airways.
H315	: Causes skin irritation.
H319	: Causes serious eye irritation.
H340	: May cause genetic defects.
H350	: May cause cancer.
H372	: Causes damage to organs through prolonged or repeated exposure.
R11	: Highly flammable.
R36/38	: Irritating to eyes and skin.
R45	: May cause cancer.
R46	: May cause heritable genetic damage.
R48/23/24/25	: Toxic: danger of serious damage to health by prolonged exposure through inhalation,

Safety Data Sheet – Benzene

Revision Nr: 3
Issue date: 15/12/2014
Supersedes: 12/08/2011

in contact with skin and if swallowed.
 R65 : Harmful: may cause lung damage if swallowed.
 F : Highly flammable
 T : Toxic
 Xi : Irritant
 Xn : Harmful

Key literature references and sources : CSR
for data

Safety datasheet sections which have : 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16
been updated

Abbreviations and acronyms : ABM = Algemene beoordelingsmethodiek
 ADN = Accord Européen relatif au Transport International des Marchandises
 Dangereuses par voie de Navigation du Rhin
 ADR = Accord européen relatif au transport international des marchandises
 Dangereuses par Route
 CLP = Classification, Labelling and Packaging Regulation according to 1272/2008/EC
 IATA = International Air Transport Association
 IMDG = International Maritime Dangerous Goods Code
 LEL = Lower Explosive Limit/Lower Explosion Limit
 UEL = Upper Explosive Limit/Upper Explosion Limit
 REACH = Registration, Evaluation, Authorisation and Restriction of Chemicals
 BTT = Breakthrough time (maximum wearing time)
 DMEL = Derived minimal effect level
 DNEL = Derived No Effect Level
 EC50 = Median Effective Concentration
 EL50 = Median effective level
 ErC50 = EC50 in terms of reduction of growth rate
 ErL50 = EL50 in terms of reduction of growth rate
 EWC = European Waste Catalogue
 LC50 = Median lethal concentration
 LD50 = Median lethal dose
 LL50 = Median lethal level
 NA = Not applicable
 NOEC = No observed effect concentration
 NOEL: no-observed-effect level
 NOELR = No observed effect loading rate
 NOAEC = No observed adverse effect concentration
 NOAEL = No observed adverse effect level
 N.O.S. = Not Otherwise Specified
 OEL = Occupational Exposure Limits - Short Term Exposure Limits (STELs)
 PNEC = Predicted No Effect Concentration
 Quantitative structure-activity relationship (QSAR)
 STOT = Specific Target Organ Toxicity
 TWA = time weighted average
 VOC = Volatile organic compounds
 WGK = Wassergefährdungsklasse (Water Hazard Class under German Federal Water
 Management Act)

The contents and format of this SDS are in accordance with EEC Commission Directive 1999/45/EC, 67/548/EC, 1272/2008/EC and EEC Commission Regulation 1907/2006/EC (REACH) Annex II.

DISCLAIMER OF LIABILITY The information in this SDS was obtained from sources which we believe are reliable. However, the information is provided without any warranty, express or implied, regarding its correctness. The conditions or methods of

Safety Data Sheet – Benzene

Revision Nr:	3
Issue date:	15/12/2014
Supersedes:	12/08/2011

handling, storage, use or disposal of the product are beyond our control 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 the product. This SDS was prepared and is to be used only for this product. If the product is used as a component in another product, this SDS information may not be applicable.

SAFETY DATA SHEET

Revision Date 14-Feb-2020

Revision Number 2

1. Identification

Product Name Benzo[a]pyrene

Cat No. : 15856

CAS-No 50-32-8
Synonyms Benzo[def]chrysene.; 3,4-Benzopyrene; 3,4-Benzpyrene

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.
Details of the supplier of the safety data sheet

Company

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

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

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

Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 1B
Carcinogenicity	Category 1A
Reproductive Toxicity	Category 1B

Label Elements**Signal Word**

Danger

Hazard Statements

May cause an allergic skin reaction
May cause genetic defects
May cause cancer
May damage fertility. May damage the unborn child

**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
Avoid breathing dust/fume/gas/mist/vapors/spray
Contaminated work clothing should not be allowed out of the workplace
Wear protective gloves

Response

IF exposed or concerned: Get medical attention/advice

Skin

IF ON SKIN: Wash with plenty of soap and water
If skin irritation or rash occurs: Get medical advice/attention
Wash contaminated clothing before reuse

Storage

Store locked up

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Very toxic to aquatic life with long lasting effects
WARNING. Cancer - <https://www.p65warnings.ca.gov/>.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Benzo[a]pyrene	50-32-8	> 96

4. First-aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Get medical attention if symptoms occur.
Most important symptoms and effects	None reasonably foreseeable. . May cause allergic skin reaction. Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Unsuitable Extinguishing Media No information available

Flash Point No information available
Method - No information available

Autoignition Temperature Not applicable

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

Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
2

Flammability
1

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions

Ensure adequate ventilation. Use personal protective equipment as required. Avoid dust formation.

Environmental Precautions

Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained.

Methods for Containment and Clean Up

Sweep up and shovel into suitable containers for disposal. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling

Wear personal protective equipment/face protection. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Avoid dust formation.

Storage

Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Benzo[a]pyrene		TWA: 0.2 mg/m ³		

Legend

OSHA - Occupational Safety and Health Administration

Engineering Measures

Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard

EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

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

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Powder Solid
Appearance	Dark yellow
Odor	aromatic
Odor Threshold	No information available
pH	Not applicable
Melting Point/Range	175 - 179 °C / 347 - 354.2 °F
Boiling Point/Range	495 °C / 923 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	Not applicable
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C ₂₀ H ₁₂
Molecular Weight	252.31

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products.
Incompatible Materials	Oxidizing agent
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity**Product Information****Component Information**

Toxicologically Synergistic No information available

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

Irritation No information available

Sensitization May cause sensitization by skin contact

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Benzo[a]pyrene	50-32-8	Group 1	Reasonably Anticipated	A2	X	A2

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)

Known - Known Carcinogen

Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

A1 - Known Human Carcinogen

A2 - Suspected Human Carcinogen

A3 - Animal Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

NTP: (National Toxicity Program)

ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Endocrine Disruptor Information

Component	EU - Endocrine Disruptors Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Benzo[a]pyrene	Group III Chemical	Not applicable	Not applicable

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

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

Persistence and Degradability May persist

Bioaccumulation/ Accumulation No information available.

Mobility Is not likely mobile in the environment due its low water solubility.

Component	log Pow
Benzo[a]pyrene	6.06

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.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Benzo[a]pyrene - 50-32-8	U022	-

14. Transport information

DOT

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Technical Name	Benzo[a]pyrene
Hazard Class	9
Packing Group	III

TDG

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Hazard Class	9
Packing Group	III

IATA

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Hazard Class	9
Packing Group	III

IMDG/IMO

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Hazard Class	9
Packing Group	III

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Benzo[a]pyrene	50-32-8	X	ACTIVE	-

Legend:

TSCA - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Benzo[a]pyrene	50-32-8	X	-	200-028-5	X	-	-	X	KE-05-0184

U.S. Federal Regulations

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Benzo[a]pyrene	50-32-8	> 96	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
Benzo[a]pyrene	-	-	X	X

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA Not applicable

Component	Hazardous Substances RQs	CERCLA EHS RQs
Benzo[a]pyrene	1 lb	-

California Proposition 65 This product contains the following Proposition 65 chemicals.

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Benzo[a]pyrene	50-32-8	Carcinogen	0.06 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Benzo[a]pyrene	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.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By Health, Safety and Environmental Department
 Email: tech@alfa.com
 www.alfa.com

Revision Date 14-Feb-2020

Print Date 14-Feb-2020

Revision Summary SDS authoring systems update, replaces ChemGes SDS No. 50-32-8/1.

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

SAFETY DATA SHEET

1. Identification

Product identifier	Benzo(b)fluoranthene		
Other means of identification			
Item	N-11165		
Recommended use	For Laboratory Use Only		
Recommended restrictions	None known.		
Manufacturer/Importer/Supplier/Distributor information			
Manufacturer			
Company name	Chem Service, Inc.		
Address	660 Tower Lane West Chester, PA 19380 United States		
Telephone	Toll Free	800-452-9994	
	Direct	610-692-3026	
Website	www.chemservice.com		
E-mail	info@chemservice.com		
Emergency phone number	Chemtrec US	800-424-9300	
	Chemtrec outside US	+1 703-527-3887	

2. Hazard(s) identification

Physical hazards	Not classified.	
Health hazards	Carcinogenicity	Category 1
Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 1
	Hazardous to the aquatic environment, long-term hazard	Category 1
OSHA defined hazards	Not classified.	
Label elements		



Signal word	Danger	
Hazard statement	May cause cancer. Very toxic to aquatic life. Very toxic to aquatic life with long lasting effects.	
Precautionary statement		
Prevention	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Avoid release to the environment. Wear protective gloves/protective clothing/eye protection/face protection.	
Response	If exposed or concerned: Get medical advice/attention. Collect spillage.	
Storage	Store locked up.	
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.	
Hazard(s) not otherwise classified (HNOC)	None known.	
Supplemental information	Not applicable.	

3. Composition/information on ingredients

Substances

Chemical name	Common name and synonyms	CAS number	%
Benzo(b)fluoranthene		205-99-2	100

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First-aid measures

Inhalation	Move to fresh air. Call a physician if symptoms develop or persist.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Rinse with water. Get medical attention if irritation develops and persists.
Ingestion	Rinse mouth. Get medical attention if symptoms occur.
Most important symptoms/effects, acute and delayed	Direct contact with eyes may cause temporary irritation.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.
General information	IF exposed or concerned: Get medical advice/attention. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO ₂).
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	Use water spray to cool unopened containers.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Wear appropriate personal protective equipment. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	This material is classified as a water pollutant under the Clean Water Act and should be prevented from contaminating soil or from entering sewage and drainage systems which lead to waterways. Stop the flow of material, if this is without risk. Collect spillage. Following product recovery, flush area with water. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid release to the environment. Contact local authorities in case of spillage to drain/aquatic environment. Prevent further leakage or spillage if safe to do so. Do not contaminate water. Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Avoid release to the environment. Do not empty into drains.
Conditions for safe storage, including any incompatibilities	Store locked up. Store in original tightly closed container. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Biological limit values	No biological exposure limits noted for the ingredient(s).
Appropriate engineering controls	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.
Individual protection measures, such as personal protective equipment	
Eye/face protection	Use personal protective equipment as required.

Skin protection	
Hand protection	Use personal protective equipment as required.
Other	Use personal protective equipment as required.
Respiratory protection	Use personal protective equipment as required.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance

Physical state	Solid.
Form	Solid. Crystalline Solid
Color	Pale yellow
Odor	Not available.
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	334.4 °F (168 °C)
Initial boiling point and boiling range	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	0.0000001 kPa at 25 °C
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	6.6
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Other information	
Molecular formula	C20-H12
Molecular weight	252.32 g/mol

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	No adverse effects due to inhalation are expected.
Skin contact	No adverse effects due to skin contact are expected.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	Expected to be a low ingestion hazard.

Symptoms related to the physical, chemical and toxicological characteristics	Direct contact with eyes may cause temporary irritation.
--	--

Information on toxicological effects

Acute toxicity	Not available.
Skin corrosion/irritation	Prolonged skin contact may cause temporary irritation.
Serious eye damage/eye irritation	Direct contact with eyes may cause temporary irritation.

Respiratory or skin sensitization

Respiratory sensitization	Not available.
Skin sensitization	This product is not expected to cause skin sensitization.

Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
------------------------	--

Carcinogenicity	May cause cancer.
-----------------	-------------------

IARC Monographs. Overall Evaluation of Carcinogenicity

Benzo(b)fluoranthene (CAS 205-99-2) 2B Possibly carcinogenic to humans.

US. National Toxicology Program (NTP) Report on Carcinogens

Benzo(b)fluoranthene (CAS 205-99-2) Reasonably Anticipated to be a Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure	Not classified.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not available.
Chronic effects	Prolonged exposure may cause chronic effects.

12. Ecological information

Ecotoxicity	Very toxic to aquatic life with long lasting effects. Accumulation in aquatic organisms is expected.
Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	Not available.

Partition coefficient n-octanol / water (log Kow)

6.6

Mobility in soil	No data available.
Other adverse effects	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions	Collect and reclaim or dispose in sealed containers at licensed waste disposal site. This material and its container must be disposed of as hazardous waste. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national/international regulations.
Local disposal regulations	Dispose in accordance with all applicable regulations.
Hazardous waste code	The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products

Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging

Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number	UN3077
UN proper shipping name	Environmentally hazardous substances, solid, n.o.s. (Benzo(b)fluoranthene RQ = 1 LBS)
Transport hazard class(es)	
Class	9
Subsidiary risk	-
Label(s)	9
Packing group	III
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	8, 146, 335, A112, B54, IB8, IP3, N20, T1, TP33
Packaging exceptions	155
Packaging non bulk	213
Packaging bulk	240

IATA

UN number	UN3077
UN proper shipping name	Environmentally hazardous substance, solid, n.o.s. (Benzo(b)fluoranthene)
Transport hazard class(es)	
Class	9
Subsidiary risk	-
Packing group	III
Environmental hazards	No.
ERG Code	9L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Other information	
Passenger and cargo aircraft	Allowed.
Cargo aircraft only	Allowed.

IMDG

UN number	UN3077
UN proper shipping name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Benzo(b)fluoranthene)
Transport hazard class(es)	
Class	9
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	No.
EmS	F-A, S-F
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

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

DOT; IATA; IMDG



General information

DOT Regulated Marine Pollutant. IMDG Regulated Marine Pollutant.

15. Regulatory information

US federal regulations

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
One or more components are not listed on TSCA.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Benzo(b)fluoranthene (CAS 205-99-2) Listed.

SARA 304 Emergency release notification

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Immediate Hazard - No
Delayed Hazard - Yes
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Benzo(b)fluoranthene	205-99-2	100

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Benzo(b)fluoranthene (CAS 205-99-2)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Clean Water Act (CWA) Section 112(r) (40 CFR 68.130)

Priority pollutant
Toxic pollutant

Safe Drinking Water Act (SDWA)

Not regulated.

US state regulations

US - New Jersey RTK - Substances: Listed substance

Benzo(b)fluoranthene (CAS 205-99-2)

US - Pennsylvania RTK - Hazardous Substances: Special hazard

Benzo(b)fluoranthene (CAS 205-99-2)

US. California Controlled Substances. CA Department of Justice (California Health and Safety Code Section 11100)

Not listed.

US. California. Candidate Chemicals List. Safer Consumer Products Regulations (Cal. Code Regs, tit. 22, 69502.3, subd. (a))

Benzo(b)fluoranthene (CAS 205-99-2)

US. Massachusetts RTK - Substance List

Benzo(b)fluoranthene (CAS 205-99-2)

US. New Jersey Worker and Community Right-to-Know Act

Benzo(b)fluoranthene (CAS 205-99-2)

US. Pennsylvania RTK - Hazardous Substances

Benzo(b)fluoranthene (CAS 205-99-2)

US. Pennsylvania Worker and Community Right-to-Know Law

Benzo(b)fluoranthene (CAS 205-99-2)

US. Rhode Island RTK

Benzo(b)fluoranthene (CAS 205-99-2)

US. California Proposition 65

WARNING: This product contains a chemical known to the State of California to cause cancer.

US - California Proposition 65 - CRT: Listed date/Carcinogenic substance

Benzo(b)fluoranthene (CAS 205-99-2)

Listed: July 1, 1987

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	No
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	No
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	No
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 04-29-2015

Version # 01

NFPA ratings Health: 0
Flammability: 0
Instability: 0

Disclaimer

The above information is believed to be correct on the date it was last revised and must not be considered all inclusive. The information has been obtained only by a search of available literature and is only a guide for handling the chemicals. OSHA regulations require that if other hazards become evident, an upgraded SDS must be made available to the employee within three months. RESPONSIBILITY for updates lies with the employer and not with CHEM SERVICE, Inc.

Persons not specifically and properly trained should not handle this chemical or its container. This product is furnished FOR LABORATORY USE ONLY! Our products may NOT BE USED as drugs, cosmetics, agricultural or pesticide products, food additives or as household chemicals.

This Safety Data Sheet (SDS) is intended only for use with Chem Service, Inc. products and should not be relied on for use with materials from any other supplier even if the chemical name(s) on the product are identical! Whenever using an SDS for a solution or mixture the user should refer to the SDS for every component of the solution or mixture. Chem Service warrants that this SDS is based upon the most current information available to Chem Service at the time it was last revised. THIS WARRANTY IS EXCLUSIVE, AND CHEM SERVICE, INC. MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. This SDS is provided gratis and CHEM SERVICE, INC. SHALL NOT BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES.

Copyright © 2000-2014 Chem Service, Inc. All rights reserved except that this SDS may be printed for the use of a customer or prospective customer of Chem Service, Inc provided the entire SDS is printed. The SDS may not be placed in any database or otherwise stored or distributed in electronic or any other form.

This product is furnished FOR LABORATORY USE ONLY.

SAFETY DATA SHEET

Creation Date 03-May-2012

Revision Date 19-Jan-2018

Revision Number 4

1. Identification

Product Name Benzo[ghi]perylene

Cat No. : AC105550000; AC105550050; AC105550250; AC105551000

CAS-No 191-24-2

Synonyms 1,12-Benzoperylene

Recommended Use Laboratory chemicals.

Uses advised against Food, drug, pesticide or biocidal product use.

Details of the supplier of the safety data sheet

Company

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

Emergency Telephone Number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11

Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99

CHEMTREC Tel. No.**US**:001-800-424-9300 / **Europe**:001-703-527-3887

2. Hazard(s) identification

Classification

Classification under 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Label Elements

None required

Hazards not otherwise classified (HNOC)

Very toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
-----------	--------	----------

Benzo(ghi)perylene	191-24-2	>95
--------------------	----------	-----

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention.
Inhalation	Remove from exposure, lie down. Remove to fresh air. If not breathing, give artificial respiration. Get medical attention.
Ingestion	Clean mouth with water. Get medical attention.
Most important symptoms and effects	No information available.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Unsuitable Extinguishing Media	No information available
Flash Point	No information available
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

Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
0

Flammability
1

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment as required.
Environmental Precautions	Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained. See Section 12 for additional Ecological Information. Avoid release to the environment. Collect spillage.
Methods for Containment and Clean Up	Avoid dust formation. Sweep up and shovel into suitable containers for disposal. Do not let this chemical enter the environment.

7. Handling and storage

Handling	Avoid contact with skin and eyes. Do not breathe dust.
Storage	Keep in a dry, cool and well-ventilated place. Refer product specification and/or product label for specific storage temperature requirement. Keep container tightly closed.

8. Exposure controls / personal protection

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.
----------------------------	---

Engineering Measures	Ensure adequate ventilation, especially in confined areas.
-----------------------------	--

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	No protective equipment is needed under normal use conditions.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Yellow
Odor	No information available
Odor Threshold	No information available
pH	No information available
Melting Point/Range	276 - 280 °C / 528.8 - 536 °F
Boiling Point/Range	> 500 °C @ 760 mmHg
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	No information available
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C22 H12
Molecular Weight	276.33

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under recommended storage conditions.
Conditions to Avoid	Excess heat. Exposure to light. Incompatible products.

Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information No information available

Toxicologically Synergistic Products No information available

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

Irritation No information available

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
Benzo(ghi)perylene	191-24-2	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

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

Persistence and Degradability Insoluble in water May persist

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility.

Component	log Pow
Benzo(ghi)perylene	6.58

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 UN3077
Proper Shipping Name Environmentally hazardous substances, solid, n.o.s.
Technical Name Benzo(ghi)perylene
Hazard Class 9
Packing Group III

TDG

UN-No UN3077
Proper Shipping Name Environmentally hazardous substances, solid, n.o.s.
Hazard Class 9
Packing Group III

IATA

UN-No UN3077
Proper Shipping Name Environmentally hazardous substances, solid, n.o.s.
Hazard Class 9
Packing Group III

IMDG/IMO

UN-No UN3077
Proper Shipping Name Environmentally hazardous substances, solid, n.o.s.
Hazard Class 9
Packing Group III

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Benzo(ghi)perylene	191-24-2	-	-	-

Legend:

TSCA - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Benzo(ghi)perylene	191-24-2	-	-	205-883-8	-	-	-	-	-

U.S. Federal Regulations

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Benzo(ghi)perylene	191-24-2	>95	1.0 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
Benzo(ghi)perylene	-	-	-	X

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Benzo(ghi)perylene	5000 lb	-

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

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Benzo(ghi)perylene	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.

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 03-May-2012

Revision Date 19-Jan-2018

Print Date 19-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

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product Identifier

Chemical Name Benzo[k]fluoranthene

Catalogue # B203560

1.2 Relevant Identified Uses of the Substance or Mixture and Uses Advised Against

Product Uses To be used only for scientific research and development. Not for use in humans or animals.

1.3 Details of the Supplier of the Safety Data Sheet

Company Toronto Research Chemicals
2 Brisbane Road
Toronto, ON M3J 2J8
CANADA

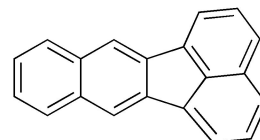
Telephone +14166659696

FAX +14166654439

Email orders@trc-canada.com

1.4 Emergency Telephone Number

Emergency# +1(416) 665-9696 between 0800-1700 (GMT-5)



2. HAZARDS IDENTIFICATION

WHMIS Classification (Canada)

D2A Very Toxic Material Causing Other Toxic Effects
Carcinogen

WHMIS Symbols (Canada)



2.1/2.2 Classification of the Substance or Mixture and Label Elements

GHS Hazards Classification (According to EU Regulation 1272/2008 and US OSHA 1910.1200)

Carcinogenicity (Category 1B)

Hazardous to the Aquatic Environment, Acute Hazard (Category 1)

Hazardous to the Aquatic Environment, Long-Term Hazard (Category 1)

GHS Hazards Identification (According to EU Regulation 1272/2008 and US OSHA 1910.1200)

Signal Word Danger



GHS Hazard Statements

H350 May cause cancer.

H400 Very toxic to aquatic life.

H410 Very toxic to aquatic life with long lasting effects.

GHS Precautionary Statements

P201 Obtain special instructions before use.

P273 Avoid release to the environment.

2.3 Unclassified Hazards/Hazards Not Otherwise Classified

No data available.

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Molecular Formula: C₂₀H₁₂

Molecular Weight: 252.31

CAS Registry #: 207-08-9

EC#: 205-916-6

Synonyms

11,12-Benzofluoranthene; 2,3,1',8'-Binaphthylene; 8,9-Benzfluoranthene; 8,9-Benzofluoranthene; Dibenzo[b,jk]fluorene

3.2 Mixtures

Not a mixture.

4. FIRST AID MEASURES

4.1 Description of First Aid Measures

General Advice

If medical attention is required, show this safety data sheet to the doctor.

If Inhaled

If inhaled, move person to fresh air. If not breathing, give artificial respiration and consult a physician.

In Case of Skin Contact

Wash affected area with soap and water. Consult a physician if any exposure symptoms are observed.

In Case of Eye Contact

Immediately rinse eyes with plenty of water for at least 15 minutes. Consult a physician.

If Swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Do NOT induce vomiting unless advised to do so by a physician or Poison Control Center. Seek medical attention.

4.2 Most Important Symptoms and Effects, Both Acute and Delayed

The most important known symptoms and effects are described in the labeling (see section 2.2) and/or section 11.

4.3 Indication of any Immediate Medical Attention and Special Treatment Needed

No data available.

5. FIREFIGHTING MEASURES

5.1 Extinguishing Media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special Hazards Arising from the Substance or Mixture

Carbon oxides

5.3 Advice for Firefighters

Wear self contained breathing apparatus for fire fighting if necessary.

5.4 Further Information

No data available.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions

Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Method and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE**Precautions for safe handling**

Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed.

Conditions for safe storage

Keep container tightly closed in a dry and well-ventilated place.
Keep in a dry place.

Storage conditions: Refrigerator

7.3 Specific End Uses

For scientific research and development only. Not for use in humans or animals.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION**8.1 Control Parameters**

Contains no components with established occupational exposure limits.

8.2 Exposure Controls**Appropriate Engineering Controls**

A laboratory fumehood or other appropriate form of local exhaust ventilation should be used to avoid exposure.

Personal Protective Equipment

All recommendations below are advisory in nature and a risk assessment should be performed by the employer/end user prior to use of this product. The type of protective equipment must be selected based on the amount and concentration of the dangerous material being used in the workplace.

Eye/Face Protection

Safety goggles or face shield. All equipment should have been tested and approved under appropriate standards, such as NIOSH (US), CSA (Canada), or EN 166 (EU).

Skin Protection

Gloves should be used when handling this material. Gloves are to be inspected prior to use. Contaminated gloves are to be removed using proper glove removal technique so that the outer surface of the glove does not contact bare skin. Dispose of contaminated gloves after use in compliance with good laboratory practices and local requirements.

Gloves used for incidental exposures (splash protection) should be designated as "chemical resistant" by EU standard EN 374 with the resistance codes corresponding to the anticipated use of the material. Unrated gloves are not recommended.

Suggested gloves: AnsellPro Sol-Vex nitrile gloves style 37-175, 15 mil thickness.

Penetration time has not been determined.

Gloves used for prolonged direct exposure (immersion) should be designated "chemical resistant" as per EN 734 with the resistance codes corresponding to the anticipated use of the material.

Suggested gloves: AnsellPro Viton/Butyl gloves style 38-612, 4/8 mil thickness.

Penetration time has not been determined.

These recommendations may not apply if the material is mixed with any other chemical, or dissolved into a solution. A risk assessment must be performed to ensure the gloves will still offer acceptable protection.

Body Protection

Fire resistant (Nomex) coveralls or chemical-resistant bodysuit (laminated Tychem SL or equivalent).

Respiratory Protection

Recommended respirators are NIOSH-approved N100 or CEN-approved FFP3 particulate respirators. These are to be only used as a backup to local exhaust ventilation or other engineering controls. If the respirator is the only means of protection, a full-face supplied air respirator must be used.

9. PHYSICAL AND CHEMICAL PROPERTIES**9.1 Information on Basic Physical and Chemical Properties****A) Appearance****B) Odour**

Light Yellow Solid
C) Odour Threshold
No data available
E) Melting Point/Freezing Point
213-215°C
G) Flash point
No data available
I) Flammability (Solid/Gas)
No data available
K) Vapour Pressure
No data available
M) Relative Density
No data available
O) Partition Coefficient: n-octanol/water
No data available
Q) Decomposition Temperature
No data available
S) Explosive Properties
No data available

No data available
D) pH
No data available
F) Initial Boiling Point/Boiling Range
No data available
H) Evaporation Rate
No data available
J) Upper/Lower Flammability/Explosive Limits
No data available
L) Vapour Density
No data available
N) Solubility
Chloroform (Slightly)
P) Auto-Ignition Temperature
No data available
R) Viscosity
No data available
T) Oxidizing Properties
No data available

9.2 Other Information
no data available

10. STABILITY AND REACTIVITY

10.1 Reactivity

No data available.

10.2 Chemical Stability

Stable under recommended storage conditions.

10.3 Possibility of Hazardous Reactions

No data available.

10.4 Conditions to Avoid

No data available.

10.5 Incompatible Materials

Strong oxidizing agents.

10.6 Hazardous Decomposition Products

In the event of fire: See section 5. Other decomposition products: No data available.

11. TOXICOLOGICAL INFORMATION

11.1 Information on Toxicological Effects

A) Acute Toxicity

Oral LD50: No data available.

Inhalation LC50: No data available.

Dermal LD50: No data available.

B) Skin Corrosion/Irritation

No data available

C) Serious Eye Damage/Irritation

No data available

D) Respiratory or Skin Sensitization

No data available

E) Germ Cell Mutagenicity

No data available

F) Carcinogenicity

Probable human carcinogen.

This compound has been designated by the IARC as Group 2A: Probably carcinogenic to humans.

G) Reproductive Toxicity/Teratogenicity

No data available

H) Single Target Organ Toxicity - Single Exposure

No data available

I) Single Target Organ Toxicity - Repeated Exposure

No data available

J) Aspiration Hazard

No data available

K) Potential Health Effects and Routes of Exposure**Inhalation**

May be harmful if inhaled. May cause respiratory tract irritation.

Ingestion

May be harmful if swallowed.

Skin

May be harmful if absorbed through skin. May cause skin irritation.

Eyes

May cause eye irritation.

L) Signs and Symptoms of Exposure

The most important known symptoms and effects are described in the labeling (see section 2.2) and/or section 11.

To the best of our knowledge, the chemical, physical, and toxicological properties of this material have not been thoroughly investigated.

M) Additional Information

RTECS: DF6350000

12. ECOLOGICAL INFORMATION**12.1 Toxicity**

No data available.

12.2 Persistence and Degradability

No data available.

12.3 Bioaccumulative Potential

No data available.

12.4 Mobility in Soil

No data available.

12.5 Results of PBT and vPvB Assessment

No data available.

12.6 Other Adverse Effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Very toxic to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS**13.1 Waste Treatment Methods****A) Product**

Product may be burned in an incinerator equipped with afterburner and scrubber. Excess and expired materials are to be offered to a licensed hazardous material disposal company. Ensure that all Federal and Local regulations regarding the disposal and destruction of this material are followed.

B) Contaminated Packaging

Dispose of as above.

C) Other Considerations

Product is not to be disposed of in sanitary sewers, storm sewers, or landfills.

14. TRANSPORT INFORMATION**14.1 UN Number**

DOT (US): UN3077

IATA: UN3077

IMDG: UN3077

ADR/RID: UN3077

14.2 UN Proper Shipping Name

DOT (US)/IATA:

Environmentally hazardous substance, solid, n.o.s. (Benzo[k]fluoranthene)

IMDG/ARD/RID:

ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Benzo[k]fluoranthene)

14.3 Transport Hazard Class(es)

DOT (US): 9

IATA: 9

IMDG: 9

ADR/RID: 9

14.4 Packing Group

DOT (US): III

IATA: III

IMDG: III

ADR/RID: III

14.5 Environmental Hazards

DOT (US): None

IATA: None

IMDG: None

ADR/RID: None

14.6 Special Precautions for User

None

15. REGULATORY INFORMATION

This safety data sheet complies with the requirements of WHMIS (Canada), OSHA 1910.1200 (US), and EU Regulation EC No. 1907/2006 (European Union).

15.1 Safety, Health and Environmental Regulations/Legislation Specific for the Substance or Mixture**A) Canada**

DSL/NDSL Status: This product is not listed on the Canadian DSL/NDSL.

B) United States

TSCA Status: This product is not listed on the US EPA TSCA.

C) European Union

ECHA Status: This product is not registered with the EU ECHA.

15.2 Chemical Safety Assessment

No data available

16. OTHER INFORMATION**16.1 Revision History**

Original Publication Date: 7/15/2014

16.2 List of Abbreviations

LD50	Median lethal dose of a substance required to kill 50% of a test population.
LC50	Medial lethal concentration of a substance required to kill 50% of a test population.
LDLo	Lowest known lethal dose
TDLo	Lowest known toxic dose
IARC	International Agency for Research on Cancer
NTP	National Toxicology Program
RTECS	Registry of Toxic Effects of Chemical Substances

16.3 Further Information

Copyright 2015. Toronto Research Chemicals Inc. Copies may be made for internal use only. The above information is believed to be correct to the best of our knowledge, but is to be only used as a guide. To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated. Please take all due care when handling this product.



Fisher Scientific

Part of Thermo Fisher Scientific

SAFETY DATA SHEET

Revision Date 10-Feb-2015

Revision Number 1

1. Identification

Product Name Chrysene, 98%

Cat No. : AC224140010; AC224140050; AC224145000

Synonyms Benzo(a)phenanthrene; 1,2,5,6-Dibenzonaphthalene.; 1,2-Benzophenanthrene

Recommended Use Laboratory chemicals.

Uses advised against No Information available

Details of the supplier of the safety data sheet

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

Entity / Business Name
Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01
/ **Europe** call: +32 14 57 52 11
Emergency Number **US**:001-201-796-7100 /
Europe: +32 14 57 52 99
CHEMTREC Tel. No.**US**:001-800-424-9300 /
Europe: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)

Germ Cell Mutagenicity
Carcinogenicity

Category 2
Category 1B

Label Elements

Signal Word
Danger

Hazard Statements
Suspected of causing genetic defects
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

Response

IF exposed or concerned: Get medical attention/advice

Storage

Store locked up

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Very toxic to aquatic life with long lasting effects

3. Composition / information on ingredients

Component	CAS-No	Weight %
Chrysene	218-01-9	98

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes.
Inhalation	Move to fresh air.
Ingestion	Do not induce vomiting.
Most important symptoms/effects	No information available.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Unsuitable Extinguishing Media	No information available
Flash Point	
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

Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

None known

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
0

Flammability
1

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions
Environmental Precautions

Ensure adequate ventilation. Use personal protective equipment.
See Section 12 for additional ecological information. Avoid release to the environment.
Collect spillage.

Methods for Containment and Clean Up No information available.

7. Handling and storage

Handling Ensure adequate ventilation.

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

8. Exposure controls / personal protection**Exposure Guidelines**

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Chrysene		TWA: 0.2 mg/m ³	

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Chrysene			TWA:

Legend

OSHA - Occupational Safety and Health Administration

Engineering Measures

Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment**Eye/face Protection**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

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

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Light cream
Odor	No information available
Odor Threshold	No information available
pH	
Melting Point/Range	250 255 °C
Boiling Point/Range	°C @ 760 mmHg
Flash Point	
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	No information available
Relative Density	No information available
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available

Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C18H12
Molecular Weight	228.29

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	None under normal use conditions
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Component Information

Toxicologically Synergistic Products	No information available
--------------------------------------	--------------------------

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

Irritation	No information available
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
Chrysene	218-01-9	Group 2B	Not listed	A3	X	Not listed

Mutagenic Effects	No information available
-------------------	--------------------------

Reproductive Effects	No information available.
----------------------	---------------------------

Developmental Effects	No information available.
-----------------------	---------------------------

Teratogenicity	No information available.
----------------	---------------------------

STOT - single exposure	None known
STOT - repeated exposure	None known

Aspiration hazard	No information available
-------------------	--------------------------

Symptoms / effects, both acute and delayed	No information available
--	--------------------------

Endocrine Disruptor Information	No information available
---------------------------------	--------------------------

Other Adverse Effects	The toxicological properties have not been fully investigated.
-----------------------	--

12. Ecological information

Ecotoxicity

Do not empty into drains.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Chrysene	Not listed	Not listed	Not listed	1.9 mg/L EC50 = 2 h

Persistence and Degradability No information available
Bioaccumulation/ Accumulation No information available.

Mobility No information available.

Component	log Pow
Chrysene	5.91

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.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Chrysene - 218-01-9	U050	-

14. Transport information

DOT

UN-No UN3077
 Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
 Hazard Class 9
 Packing Group III

TDG

UN-No UN3077
 Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
 Hazard Class 9
 Packing Group III

IATA

UN-No UN3077
 Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
 Hazard Class 9
 Packing Group III

IMDG/IMO

UN-No UN3077
 Proper Shipping Name ENVIRONMENTALLY HAZARDOUS SUBSTANCE,SOLID, N.O.S.
 Hazard Class 9
 Packing Group III

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Chrysene	X	X	-	205-923-4	-		-	-	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 %
Chrysene	218-01-9	98	1.0 0.1

SARA 311/312 Hazardous Categorization

Acute Health Hazard	No
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Chrysene	-	-	X	X

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA

Not applicable

Component	Hazardous Substances RQs	CERCLA EHS RQs
Chrysene	100 lb	-

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

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Chrysene	218-01-9	Carcinogen	0.35 µg/day	Carcinogen

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Chrysene	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.

Other International Regulations

Mexico - Grade No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class D2A Very toxic materials



16. Other information

Prepared By

Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Revision Date

10-Feb-2015

Print Date

10-Feb-2015

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 on 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 guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as 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 material or in any process, unless specified in the text.

End of SDS

SAFETY DATA SHEET

Creation Date 22-Sep-2009

Revision Date 23-Jan-2018

Revision Number 3

1. Identification

Product Name cis-1,2-Dichloroethylene

Cat No. : AC113380000; AC113380025; AC113380100; AC113380500

Synonyms cis-Acetylene dichloride.

Recommended Use Laboratory chemicals.

Uses advised against 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

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11

Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99

CHEMTREC Tel. No.**US**:001-800-424-9300 / **Europe**: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)

Flammable liquids	Category 2
Acute oral toxicity	Category 4
Acute Inhalation Toxicity - Vapors	Category 4
Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word

Danger

Hazard Statements

Highly flammable liquid and vapor
Harmful if swallowed
Harmful if inhaled

Causes serious eye irritation
Causes skin irritation
May cause respiratory irritation

**Precautionary Statements****Prevention**

Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Avoid breathing dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Take precautionary measures against static discharge
Do not eat, drink or smoke when using this product

Response

Call a POISON CENTER or doctor/physician if you feel unwell

Inhalation

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

Skin

IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation occurs: Get medical advice/attention

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention

Ingestion

Rinse mouth
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell

Fire

Explosion risk in case of fire
Fight fire with normal precautions from a reasonable distance
Evacuate area

Storage

Store in a well-ventilated place. Keep cool
Store in a closed container
Store locked up

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
cis-1,2-Dichloroethylene	156-59-2	97

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Get medical attention.
Inhalation	Remove to fresh air. Get medical attention. If not breathing, give artificial respiration.
Ingestion	Do NOT induce vomiting. Get medical attention.
Most important symptoms and effects	Difficulty in breathing. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO ₂). Dry chemical. Water mist may be used to cool closed containers. Chemical foam. Water mist may be used to cool closed containers.
Unsuitable Extinguishing Media	No information available
Flash Point	6 °C / 42.8 °F
Method -	No information available
Autoignition Temperature	440 °C / 824 °F
Explosion Limits	
Upper	12.80%
Lower	9.70%
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Flammable. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Vapors may form explosive mixtures with air.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂). Hydrogen chloride gas.

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
2

Flammability
3

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment as required. Remove all sources of ignition. Take precautionary measures against static discharges. Avoid contact with skin, eyes or clothing.
Environmental Precautions	See Section 12 for additional Ecological Information. Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling	Ensure adequate ventilation. Wear personal protective equipment/face protection. Use spark-proof tools and explosion-proof equipment. Use only non-sparking tools. Avoid contact with skin, eyes or clothing. Avoid breathing dust/fume/gas/mist/vapors/spray. Avoid ingestion and inhalation. Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharges. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded.
Storage	Keep in a dry, cool and well-ventilated place. Refer product specification and/or product label for specific storage temperature requirement. Keep container tightly closed. Keep away from heat, sparks and flame. Flammables area. Keep container tightly closed in a dry and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
cis-1,2-Dichloroethylene	TWA: 200 ppm			TWA: 200 ppm

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

Engineering Measures	Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location.
-----------------------------	--

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	No protective equipment is needed under normal use conditions.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-80 °C / -112 °F
Boiling Point/Range	60 °C / 140 °F @ 760 mmHg
Flash Point	6 °C / 42.8 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	12.80%
Lower	9.70%
Vapor Pressure	201 mmHg @ 25 °C
Vapor Density	3.34 (Air = 1.0)
Specific Gravity	1.280
Solubility	No information available
Partition coefficient; n-octanol/water	No data available

Autoignition Temperature	440 °C / 824 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C2 H2 Cl2
Molecular Weight	96.94

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Keep away from open flames, hot surfaces and sources of ignition. Exposure to air. Exposure to light. Incompatible products. Exposure to moist air or water.
Incompatible Materials	Bases
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂), Hydrogen chloride gas
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Toxicologically Synergistic Products	No information available
--------------------------------------	--------------------------

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

Irritation	Irritating to eyes, respiratory system and skin
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
cis-1,2-Dichloroethylene	156-59-2	Not listed	Not listed	Not listed	Not listed	Not listed

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	Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains. Do not flush into surface water or sanitary sewer system. 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
cis-1,2-Dichloroethylene	Not listed	Not listed	EC50 = 721 mg/L 5 min EC50 = 905 mg/L 30 min	Not listed

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

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 UN1150
 Proper Shipping Name 1,2-DICHLOROETHYLENE
 Hazard Class 3
 Packing Group II

TDG

UN-No UN1150
 Proper Shipping Name 1,2-DICHLOROETHYLENE
 Hazard Class 3
 Packing Group II

IATA

UN-No UN1150
 Proper Shipping Name 1,2-DICHLOROETHYLENE
 Hazard Class 3
 Packing Group II

IMDG/IMO

UN-No UN1150
 Proper Shipping Name 1,2-DICHLOROETHYLENE
 Hazard Class 3
 Packing Group II

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
cis-1,2-Dichloroethylene	156-59-2	X	ACTIVE	-

Legend:

TSCA - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
cis-1,2-Dichloroethylene	156-59-2	-	X	205-859-7	-	X	X	X	KE-10124

U.S. Federal Regulations

SARA 313	Not applicable
SARA 311/312 Hazard Categories	See section 2 for more information
CWA (Clean Water Act)	Not applicable
Clean Air Act	Not applicable
OSHA - Occupational Safety and Health Administration	Not applicable

CERCLA

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

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
cis-1,2-Dichloroethylene	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.
---	--

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	23-Jan-2018
Print Date	23-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

SAFETY DATA SHEET

Creation Date 06-Aug-2010

Revision Date 17-Jan-2018

Revision Number 6

1. Identification

Product Name Ethylbenzene

Cat No. : O2751-1

CAS-No 100-41-4
Synonyms Ethylbenzol; Phenylethane

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)

Flammable liquids	Category 2
Acute Inhalation Toxicity - Vapors	Category 4
Carcinogenicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system, Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Aspiration Toxicity	Category 1

Label Elements**Signal Word**

Danger

Hazard Statements

Highly flammable liquid and vapor
May be fatal if swallowed and enters airways
Harmful if inhaled
May cause respiratory irritation
May cause drowsiness or dizziness
Suspected of causing cancer
May cause damage to organs through prolonged or repeated exposure

**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
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool

Response

IF exposed or concerned: Get medical attention/advice

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

Ingestion

IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician

Do NOT induce vomiting

Fire

In case of fire: Use CO₂, dry chemical, or foam for extinction

Storage

Store locked up

Store in a well-ventilated place. Keep container tightly closed

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 - <https://www.p65warnings.ca.gov/>.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Ethylbenzene	100-41-4	>95

4. First-aid measures

General Advice

If symptoms persist, call a physician.

Eye Contact

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact

Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

Inhalation	Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention. Aspiration into lungs can produce severe lung damage.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs naturally, have victim lean forward.
Most important symptoms and effects	Breathing difficulties. . Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: May cause central nervous system depression
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	Do not use a solid water stream as it may scatter and spread fire
Flash Point	22 °C / 71 °F
Method -	No information available
Autoignition Temperature	432 °C / 810 °F
Explosion Limits	
Upper	6.8%
Lower	1.2%
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	Yes

Specific Hazards Arising from the Chemical

Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back. Keep product and empty container away from heat and sources of ignition. Thermal decomposition can lead to release of irritating gases and vapors.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO₂)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
3

Flammability
3

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges.
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. Collect spillage.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Ensure adequate ventilation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take
-----------------	---

precautionary measures against static discharges.

Storage

Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Ethylbenzene	TWA: 20 ppm	(Vacated) TWA: 100 ppm (Vacated) TWA: 435 mg/m ³ (Vacated) STEL: 125 ppm (Vacated) STEL: 545 mg/m ³ TWA: 100 ppm TWA: 435 mg/m ³	IDLH: 800 ppm TWA: 100 ppm TWA: 435 mg/m ³ STEL: 125 ppm STEL: 545 mg/m ³	TWA: 100 ppm TWA: 435 mg/m ³ STEL: 125 ppm STEL: 545 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. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment**Eye/face Protection**

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

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

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-95 °C / -139 °F
Boiling Point/Range	136 °C / 276.8 °F
Flash Point	22 °C / 71 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	6.8%
Lower	1.2%
Vapor Pressure	No information available
Vapor Density	No information available
Specific Gravity	0.860
Solubility	Slightly soluble in water
Partition coefficient; n-octanol/water	No data available

Autoignition Temperature	432 °C / 810 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C8 H10
Molecular Weight	106.17

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethylbenzene	3500 mg/kg (Rat)	15400 mg/kg (Rabbit)	17.2 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

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

Irritation	May cause eye, skin, and respiratory tract irritation
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
Ethylbenzene	100-41-4	Group 2B	Not listed	A3	X	Not listed

IARC: (International Agency for Research on Cancer)

Group 2B - Possibly Carcinogenic to Humans

IARC: (International Agency for Research on Cancer)

Group 1 - Carcinogenic to Humans

Group 2A - Probably Carcinogenic to Humans

A1 - Known Human Carcinogen

A2 - Suspected Human Carcinogen

A3 - Animal Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	Respiratory system Central nervous system (CNS)
STOT - repeated exposure	None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: May cause central nervous system depression

Endocrine Disruptor Information No information available

Other Adverse Effects See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity

Do not empty into drains. The product contains following substances which are hazardous for the environment. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Ethylbenzene	EC50: 1.7 - 7.6 mg/L, 96h static (Pseudokirchneriella subcapitata) EC50: 2.6 - 11.3 mg/L, 72h static (Pseudokirchneriella subcapitata) EC50: > 438 mg/L, 96h (Pseudokirchneriella subcapitata) EC50: = 4.6 mg/L, 72h (Pseudokirchneriella subcapitata)	LC50: 11.0 - 18.0 mg/L, 96h static (Oncorhynchus mykiss) LC50: = 4.2 mg/L, 96h semi-static (Oncorhynchus mykiss) LC50: = 32 mg/L, 96h static (Lepomis macrochirus) LC50: 7.55 - 11 mg/L, 96h flow-through (Pimephales promelas) LC50: 9.1 - 15.6 mg/L, 96h static (Pimephales promelas) LC50: = 9.6 mg/L, 96h static (Poecilia reticulata)	EC50 = 9.68 mg/L 30 min EC50 = 96 mg/L 24 h	EC50: 1.8 - 2.4 mg/L, 48h (Daphnia magna)

Persistence and Degradability Insoluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

Component	log Pow
Ethylbenzene	3.2

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 UN1175
 Proper Shipping Name ETHYLBENZENE
 Hazard Class 3
 Packing Group II

TDG

UN-No UN1175
 Proper Shipping Name ETHYLBENZENE
 Hazard Class 3
 Packing Group II

IATA

UN-No UN1175
 Proper Shipping Name ETHYLBENZENE
 Hazard Class 3
 Packing Group II

IMDG/IMO

UN-No UN1175
 Proper Shipping Name ETHYLBENZENE
 Hazard Class 3
 Packing Group II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed The product is classified and labeled according to EC directives or corresponding national laws The product is classified and labeled in accordance with Directive 1999/45/EC

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Ethylbenzene	X	X	-	202-849-4	-		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 %
Ethylbenzene	100-41-4	>95	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
Ethylbenzene	X	1000 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Ethylbenzene	X		-

OSHA Occupational Safety and Health Administration
 Not applicable

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Ethylbenzene	1000 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Ethylbenzene	100-41-4	Carcinogen	54 µg/day 41 µg/day	Carcinogen

**U.S. State Right-to-Know
Regulations**

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Ethylbenzene	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.

Other International Regulations

Mexico - Grade Serious risk, Grade 3

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 06-Aug-2010
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



AccuStandard®, Inc.

125 Market St., New Haven, CT 06513 USA

Tel: 203-786-5290 Fax: 203-786-5287

SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

1.1 - Product Identifiers

Catalog Name: H-157N

Description: Indeno(1,2,3-cd)pyrene

CAS No.: 193-39-5

1.2 - Relevant Identified Uses of the Substance or Mixture

Laboratory Chemical Reference Material

1.3 - Supplier Details

Company: AccuStandard, Inc.
125 Market St.
New Haven, CT 06513 USA

Telephone Number: 203-786-5290

Fax: 203-786-5287

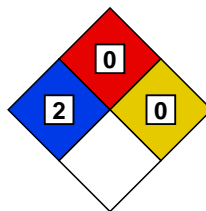
Email: edocs@accustandard.com

1.4 - Emergency Telephone Number

Emergency Phone #: AccuStandard, Inc.
1-203-786-5290
Hours: Monday to Friday 8:00am to 5:00pm EST

SECTION 2 - HAZARDS IDENTIFICATION

2.1 - GHS Label Elements



*	2	HEALTH
0		FLAMMABILITY
0		PHYSICAL HAZARD

Signal Word: Danger

Hazard Codes:

H302 - Harmful if swallowed. (Acute toxicity, oral, category 4)

H332 - Harmful if inhaled. (Acute toxicity, inhalation, category 4)

H335 - May be irritating to mucous membrane and upper respiratory system. (Specific target organ toxicity, single exposure; Respiratory tract irritation, category 3)

H350 - This product is or contains a component that is classified (ACGIH, IARC, NTP, OSHA) as a possible cancer hazard. (Carcinogenicity, category 1B)

Precautionary Codes:

P202 - This product should only be used by persons trained in the safe handling of hazardous chemicals.

P235 - Store in a cool dry place.

P260 - Do not breathe dust.

P262 - Do not get in eyes, on skin or clothing.

SECTION 2 - HAZARDS IDENTIFICATION - continued**2.1 - GHS Label Elements** - continued

P264 - Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available.

P284 - Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

P310 - Ingestion: Call a physician or poison control center immediately. If conscious, give water freely.

P338 - Eye contact: Immediately flush with plenty of water. After initial flushing, remove and contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers.

P360 - Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

P404 - Store in a tightly closed container.

2.2 - Other Hazards**2.2.1 - Symptom of Exposure Health/Environment**

Harmful.

Environmental hazard.

2.2.2 - Potential Health Effects

May be irritating to eyes.

May be irritating to skin.

May be harmful if absorbed through the skin. (Acute toxicity, dermal, category 5)

May be irritating to mucous membrane and upper respiratory system. (Specific target organ toxicity, single exposure; Respiratory tract irritation, category 3)

Harmful if inhaled. (Acute toxicity, inhalation, category 4)

Harmful if swallowed. (Acute toxicity, oral, category 4)

2.2.3 - Routes of Entry

Inhalation, ingestion or skin contact.

2.2.4 - Carcinogenicity

California Proposition 65 cancer hazard.

This product is or contains a component that is classified (ACGIH, IARC, NTP, OSHA) as a possible cancer hazard. (Carcinogenicity, category 1B)

SECTION 3 - COMPOSITION / ANALYTES DATA

Description: Indeno(1,2,3-cd)pyrene

Synonyms: o-Phenylene pyrene; IP; 2,3-Phenylene pyrene

Molecular Weight: 276.34

Molecular Formula: C₂₂H₁₂

EC#: 205-893-2

Analyte	CAS Number	% Concentration	ACGIH -TLV (mg/m ³)			OSHA -PEL (mg/m ³)		
			TWA	STEL	Skin	TWA	STEL	Skin
Indeno(1,2,3-cd)pyrene	193-39-5	100.000						

SECTION 4 - FIRST AID MEASURES**4.1 - First Aid Procedures - General**

Get medical assistance for all cases of overexposure.

4.2 - Eye Contact

Eye contact: Immediately flush with plenty of water. After initial flushing, remove and contact lenses and continue flushing for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. (P338)

4.3 - Skin Contact

Skin contact: Immediately wash skin with soap and plenty of water. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse. (P360)

4.4 - Inhalation

Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.

4.5 - Ingestion

Ingestion: Call a physician or poison control center immediately. If conscious, give water freely. (P310)

SECTION 5 - FIRE FIGHTING MEASURES**5.1 - Flammable Properties**

During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

5.2 - Extinguishing Media

Use alcohol foam, carbon dioxide, dry chemical, or water spray when fighting fires involving this material.

5.3 - Protection of Firefighters

As in any fire, wear self-contained breathing apparatus pressure demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6 - ACCIDENTAL RELEASE MEASURES**6.1 - Spill Response**

Wear a self-contained breathing apparatus and appropriate Personal protection. Prevent contact with skin or eyes. Ventilate area. Avoid raising dust. Take up and containerize for proper disposal. Flush spill area with water. Comply with Federal, State, and local regulations.

SECTION 7 - HANDLING AND STORAGE

Store in a tightly closed container. (P404)

Store in a cool dry place. (P235)

Use with adequate ventilation.

Do not breathe dust. (P260)

Do not get in eyes, on skin or clothing. (P262)

Avoid prolonged or repeated exposure.

This product should only be used by persons trained in the safe handling of hazardous chemicals. (P202)

SECTION 8 - EXPOSURE CONTROLS**8.1 - Engineering Controls/PPE**

Wash thoroughly after handling. Do not take internally. Eye wash and safety equipment should be readily available. (P264)

SECTION 8 - EXPOSURE CONTROLS - continued**8.2 - General Hygiene Considerations**

Respiratory Protection: If workplace exposure limit(s) of product or any component is exceeded (see TLV/PEL), or a risk assessment shows air-purifying respirators are appropriate, use of a NIOSH/MSHA approved air supplied respirator is advised. Use a full-face respirator with multi-purpose combination (US) or type ABEK (EN14387) respirator cartridges in absence of proper environmental control. Always use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Engineering and/or administrative controls should be implemented to reduce exposure.

Material should be handled or transferred in an approved fume hood or with adequate ventilation.

Compatible chemical-resistant protective gloves must be worn to prevent skin contact. Inspect gloves prior to use. Use proper glove removal technique to avoid contact with product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash hands thoroughly and dry.

Use eye protection tested and approved under the appropriate government standards such as NIOSH (US) or EN 166 (EU).

All recommendations are advisory only and must be evaluated by an industrial hygienist and/or safety officer familiar with the specific situation of anticipated use, such as concentration and amount of the substance in the workplace. Any recommendation should not be construed as offering an approval for any specific use of the product.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Solid

Odor: N/A

Odor Threshold: N/A

pH: N/A

Melting Point: 150 - 153 °C

Boiling Point: 497 - 498 °C

Flash Point: 477 °F / 247 °C

Evaporation Rate (Butyl Acetate=1): N/A

Flammability Class: N/A

Lower Flammability Level: N/A

Upper Flammability Level: N/A

Vapor Pressure: N/A

Vapor Density (Air = 1): N/A

Specific Gravity: 1.38 g/cm³

Solubility in Water: Insoluble

Partition Coefficient: log Pow: 6.58

Autoignition Temperature: N/A

Decomposition Temperature: N/A

Viscosity: N/A

VOC Content: N/A

Percent Volatile: N/A

SECTION 10 - STABILITY AND REACTIVITY

Stability: Stable

Materials to Avoid: Oxidizers

Hazardous Decomposition: Oxides of carbon

SECTION 10 - STABILITY AND REACTIVITY - continued

Hazardous Polymerization: Will not occur

Condition to Avoid: Excessive heat

SECTION 11 - TOXICOLOGICAL INFORMATION**Human Health Toxicity**

See section 2 for specific toxicological information for the ingredients of this product.

LD50 (Oral): N/A

LD50 (Dermal) : N/A

LC50 (Inhalation): N/A

As a class of compounds, PAHs are considered to be harmful to human health.

WARNING: This product contains chemical(s) known to the state of California to cause cancer.

No other information related to the toxicological properties of this product is available at this time.

SECTION 12 - ECOLOGICAL INFORMATION**Environmental Toxicity**

By complying with sections 6 and 7 there should be no release to the environment.

LC50 (Fish): N/A

EC50 (Aquatic Invertebrate): N/A

BCF: N/A

As a class of compounds, PAHs are considered to be harmful to the environment.

No other information related to the ecological properties of this product is available at this time.

SECTION 13 - DISPOSAL CONSIDERATIONS

Recycle or incinerate at any EPA approved facility or dispose in compliance with Federal, State and local regulations. Empty containers must be triple-rinsed prior to disposal.

SECTION 14 - TRANSPORT INFORMATIONTransportation Information (DOT/IATA)

UN Number: NR

Class: NR

Packing Group: NR

Proper Shipping Name: Not Regulated for Transport

Poison by Inhalation: No

Marine Pollutant: No

SECTION 15 - REGULATORY INFORMATION

WARNING: This product contains chemical(s) known to the state of California to cause cancer.

This product is subject to SARA section 313 reporting requirements.

The CAS number of this product is listed on the TSCA Inventory.

For laboratory, research and development use only. Not for manufacturing or commercial purposes.

In addition to federal and state regulations, local regulations may apply. Check with your local regulatory authorities.

SECTION 16 - OTHER INFORMATION

This document has been designed to meet the requirements of OSHA, ANSI, GHS and CHIPs regulations. Chemicals are classified using the Globally Harmonized System for Classification and Labeling of Chemicals.

The statements contained herein are offered for informational purposes only and are based on technical data that we believe to be accurate. The manufacturer will not assume any liability for the accuracy and completeness of this information. Final determination of the suitability of the material is the responsibility of the user. Although certain hazards are described herein, the user should not presume that these are the only hazards that exist. Since conditions and manner of use are outside of the manufacturers control, we make

**NO WARRANTY OF MERCHANTABILITY, EXPRESSED OR IMPLIED, AND ASSUME NO LIABILITY
RESULTING FROM ITS USE.**

Legend : N/A = Not Available ND = Not Determined NR = Not Regulated

Alteration of any information contained herein without written permission from the manufacturer is strictly prohibited.

HMIS/NFPA HAZARD INDEX

- 0 - Minimal
- 1 - Slight
- 2 - Moderate
- 3 - Serious
- 4 - Severe

* - Additional Hazard

GHS HAZARD INDEX

- Category 1 - Most Severe
- Category 5 - Least Severe

**** End of Document ****

SAFETY DATA SHEET

Creation Date 28-May-2009

Revision Date 17-Jan-2018

Revision Number 3

1. Identification

Product Name tert-Butyl methyl ether

Cat No. : E127-4; XXE127RS200; NC1240503; XXE127U200LI; NC1568440; E127RS1350ASME; NC1561779

CAS-No 1634-04-4
Synonyms 2-Methyl-2-methoxy propane; MTBE; Methyl tert-butyl ether

Recommended Use Laboratory chemicals.
Uses advised against 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)

Flammable liquids	Category 2
Skin Corrosion/irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Lungs.	

Label Elements

Signal Word

Danger

Hazard Statements

Highly flammable liquid and vapor
Causes skin irritation
May cause respiratory irritation

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool
Avoid breathing dust/fume/gas/mist/vapors/spray

Response

Get medical attention/advice if you feel unwell

Inhalation

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

Skin

If skin irritation occurs: Get medical advice/attention
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
If eye irritation persists: Get medical advice/attention

Fire

In case of fire: Use CO₂, dry chemical, or foam for extinction

Storage

Store in a well-ventilated place. Keep container tightly closed
Store locked up

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)**Other hazards**

Aspiration hazard if swallowed - can enter lungs and cause damage.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Methyl tert-butyl ether	1634-04-4	>95

4. First-aid measures

Eye Contact

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact

Wash off immediately with plenty of water for at least 15 minutes. Obtain medical attention.

Inhalation	Move to fresh air. Get medical attention immediately if symptoms occur. If not breathing, give artificial respiration.
Ingestion	Do not induce vomiting. Obtain medical attention.
Most important symptoms and effects	Breathing difficulties. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	No information available
Flash Point	-28 °C / -18.4 °F
Method -	No information available
Autoignition Temperature	224 °C / 435.2 °F
Explosion Limits	
Upper	15.1 vol %
Lower	1.6 vol %
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO₂)

Protective Equipment and Precautions for Firefighters

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

NFPA

Health	Flammability	Instability	Physical hazards
2	3	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges. Ensure adequate ventilation.
Environmental Precautions	Should not be released into the environment. See Section 12 for additional ecological information.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment. Take precautionary measures against static discharges.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Use explosion-proof equipment. Take precautionary measures against static discharges. Use only under a chemical fume hood. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded.
Storage	Flammables area. Keep away from heat and sources of ignition. Keep container tightly

closed in a dry and well-ventilated place. May form explosive peroxides on prolonged storage.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Methyl tert-butyl ether	TWA: 50 ppm			

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

Engineering Measures Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection No protective equipment is needed under normal use conditions.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Petroleum distillates
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-110 °C / -166 °F
Boiling Point/Range	54 - 56 °C / 129.2 - 132.8 °F
Flash Point	-28 °C / -18.4 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	15.1 vol %
Lower	1.6 vol %
Vapor Pressure	268 mbar @ 20 °C
Vapor Density	0.2
Specific Gravity	0.740
Solubility	Slightly soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	224 °C / 435.2 °F
Decomposition Temperature	No information available
Viscosity	0.36 mPa.s at 20 °C
Molecular Formula	C5 H12 O
Molecular Weight	88.15

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Methyl tert-butyl ether	LD50 = 2963 mg/kg (Rat)	LD50 = 10000 mg/kg (Rabbit)	LC50 = 85 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

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

Irritation Irritating to eyes and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen. Limited evidence of a carcinogenic effect.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Methyl tert-butyl ether	1634-04-4	Not listed	Not listed	A3	Not listed	Not listed

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)

Mutagenic Effects Mutagenic effects have occurred in experimental animals.

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Lungs

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information

Component	EU - Endocrine Disruptors Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Methyl tert-butyl ether	Group III Chemical	Not applicable	Not applicable

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.

12. Ecological information

Ecotoxicity

Do not empty into drains. .

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Methyl tert-butyl ether	800 mg/L EC50 > 72 h 184 mg/L EC50 = 96 h	887 mg/L LC50 96 h 100 mg/L LC50 96 h 929 mg/L LC50 96 h 672 mg/L LC50 96 h	EC50 = 11.4 mg/L 30 min EC50 = 8.23 mg/L 5 min EC50 = 9.67 mg/L 15 min	EC50: = 542 mg/L, 48h (Daphnia magna)

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Methyl tert-butyl ether	1.06

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 UN2398
 Proper Shipping Name METHYL tert-BUTYL ETHER
 Hazard Class 3
 Packing Group II

TDG

UN-No UN2398
 Proper Shipping Name METHYL tert-BUTYL ETHER
 Hazard Class 3
 Packing Group II

IATA

UN-No UN2398
 Proper Shipping Name METHYL tert-BUTYL ETHER
 Hazard Class 3
 Packing Group II

IMDG/IMO

UN-No UN2398
 Proper Shipping Name METHYL tert-BUTYL ETHER
 Hazard Class 3
 Packing Group II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Methyl tert-butyl ether	X	X	-	216-653-1	-		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 %
Methyl tert-butyl ether	1634-04-4	>95	1.0

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

CWA (Clean Water Act) Not applicable

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Methyl tert-butyl ether	X		-

OSHA Occupational Safety and Health Administration

Not applicable

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Methyl tert-butyl ether	1000 lb	-

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

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Methyl tert-butyl ether	X	X	X	X	-

U.S. Department of Transportation

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

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Serious risk, Grade 3

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 28-May-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

1 Identification

Product identifier

Product name: n-Butylbenzene

Stock number: A10910, L07039

CAS Number:

104-51-8

EC number:

203-209-7

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)



GHS02 Flame

Flam. Liq. 3 H226 Flammable liquid and vapour.

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



GHS02

Signal word

Warning

Hazard statements

H226 Flammable liquid and vapour.

Precautionary statements

P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P240 Ground/bond container and receiving equipment.
P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P403+P235 Store in a well-ventilated place. Keep cool.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

WHMIS classification

B3 - Combustible liquid



Classification system

HMIS ratings (scale 0-4)

(Hazardous Materials Identification System)

HEALTH	1	Health (acute effects) = 1
FIRE	2	Flammability = 2
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:

104-51-8 n-Butylbenzene

Identification number(s):

EC number: 203-209-7

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.

Product name: n-Butylbenzene

(Contd. of page 1)

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 product to reach sewage system or any water course.

Methods and material for containment and cleaning up: Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).

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.

Information about protection against explosions and fires: Keep ignition sources away.

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:

The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.

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.

Maintain an ergonomically appropriate working environment.

Breathing equipment: Use suitable respirator when high concentrations are present.

Recommended filter device for short term use:

Use a respirator with multi-purpose combination (US) or type ABEK (EN 14387) as a backup to engineering controls. Risk assessment should be performed to determine if air-purifying respirators are appropriate. Only use equipment tested and approved under appropriate government standards such as NIOSH (USA) or CEN (EU).

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.

Material of gloves Fluorocarbon rubber (Viton)

Penetration time of glove material (in minutes) 480

Glove thickness 0.7 mm

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: Liquid

Odor: Aromatic

Odor threshold: Not determined.

pH-value: Not determined.

Change in condition

Melting point/Melting range: -88 °C (-126 °F)

Boiling point/Boiling range: 181-183 °C (358-361 °F)

Sublimation temperature / start: Not determined

Flash point: 59 °C (138 °F)

(Contd. on page 3)

Product name: n-Butylbenzene

(Contd. of page 2)

Flammability (solid, gaseous)	Not determined.
Ignition temperature:	410 °C (770 °F)
Decomposition temperature:	Not determined.
Auto igniting:	Not determined.
Danger of explosion:	Not determined.
Explosion limits:	
Lower:	0.8 Vol %
Upper:	5.8 Vol %
Vapor pressure at 23 °C (73 °F):	1.33 hPa (1 mm Hg)
Density at 20 °C (68 °F):	0.86 g/cm ³ (7.177 lbs/gal)
Relative density	Not determined.
Vapor density	Not determined.
Evaporation rate	Not determined.
Solubility in / Miscibility with	
Water at 20 °C (68 °F):	0.012 g/l
Partition coefficient (n-octanol/water):	Not determined.
Viscosity:	
dynamic:	Not determined.
kinematic:	Not determined.
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 Reacts with strong oxidizing agents
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 this substance.
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: No sensitizing effects known.
Germ cell mutagenicity: No effects known.
Carcinogenicity: No classification data on carcinogenic properties of this material is available from the EPA, IARC, NTP, OSHA or ACGIH.
Reproductive toxicity: No effects known.
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.
Carcinogenic categories
OSHA-Ca (Occupational Safety & Health Administration) Substance is not listed.


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.
Additional ecological information:
General notes:
 Do not allow undiluted product or large quantities to reach ground water, water course or sewage system.
 Avoid transfer into the environment.
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	UN2709
DOT, IMDG, IATA	
UN proper shipping name	Butyl benzenes
DOT	BUTYLBENZENES
IMDG, IATA	
Transport hazard class(es)	
DOT	
	
Class	3 Flammable liquids.
Label	3
Class	3 (F1) Flammable liquids

(Contd. on page 4)
USA

Product name: **n-Butylbenzene**

(Contd. of page 3)

Label
IMDG, IATA

3

Class
Label3 Flammable liquids.
3Packing group
DOT, IMDG, IATA

III

Environmental hazards:

Not applicable.

Special precautions for user
EMS Number:Warning: Flammable liquids
F-E, S-D

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":

UN2709, Butyl benzenes, 3, 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**

GHS02

Signal word Warning**Hazard statements**

H226 Flammable liquid and vapour.

Precautionary statements

P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P280 Wear protective gloves/protective clothing/eye protection/face protection.

P240 Ground/bond container and receiving equipment.

P303+P361+P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

P403+P235 Store in a well-ventilated place. Keep cool.

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) Substance is not listed.**California Proposition 65****Prop 65 - Chemicals known to cause cancer** Substance is not listed.**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:** For use only by technically qualified individuals.**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** 12/09/2015 / -**Abbreviations and acronyms:**

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)

Flam. Liq. 3: Flammable liquids, Hazard Category 3

SAFETY DATA SHEET

Creation Date 01-May-2012

Revision Date 16-Jan-2019

Revision Number 4

1. Identification

Product Name Phenanthrene

Cat No. : AC130090000; AC130090050; AC130090500; AC130095000

CAS-No 85-01-8
Synonyms No information available

Recommended Use Laboratory chemicals.
Uses advised against 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

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11

Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99

CHEMTREC Tel. No.**US**:001-800-424-9300 / **Europe**: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)

Acute oral toxicity

Category 4

Label Elements

Signal Word

Warning

Hazard Statements

Harmful if swallowed

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product

Ingestion

IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Very toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Phenanthrene	85-01-8	>95

4. First-aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Get medical attention. Wash off immediately with plenty of water for at least 15 minutes.
Inhalation	Remove to fresh air. Get medical attention. If not breathing, give artificial respiration.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Get medical attention if symptoms occur.
Most important symptoms and effects	None reasonably foreseeable.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray, carbon dioxide (CO ₂), dry chemical, alcohol-resistant foam.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
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

Do not allow run-off from fire-fighting to enter drains or water courses.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
1

Flammability
1

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions

Ensure adequate ventilation. Use personal protective equipment as required. Avoid dust formation.

Environmental Precautions

Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained.

Methods for Containment and Clean Up

Sweep up and shovel into suitable containers for disposal. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling

Wear personal protective equipment/face protection. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Avoid dust formation.

Storage

Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines

This product does not contain any hazardous materials with occupational exposure limit established by the region specific regulatory bodies.

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Phenanthrene		TWA: 0.2 mg/m ³		

Engineering Measures

Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection

Wear appropriate protective gloves and clothing to prevent skin exposure.

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

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Beige
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	95 - 101 °C / 203 - 213.8 °F
Boiling Point/Range	336 °C / 636.8 °F
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	1 mmHg @ 116 °C
Vapor Density	Not applicable
Specific Gravity	1.063
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	C14 H10
Molecular Weight	178.23

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Avoid dust formation.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Phenanthrene	1.8 g/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	No information available
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
Phenanthrene	85-01-8	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	None known
STOT - repeated exposure	None known
Aspiration hazard	No information available
Symptoms / effects, both acute and delayed	No information available
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Very toxic 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
Phenanthrene	Not listed	LC50 = 3.2 mg/L 96h	Not listed	LC50 = 0.35 mg/L 48h

Persistence and Degradability May persist

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility.

Component	log Pow
Phenanthrene	4.5

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	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Hazard Class	9
Packing Group	III

TDG

UN-No	UN3077
Proper Shipping Name	Environmentally hazardous substances, solid, n.o.s.
Hazard Class	9
Packing Group	III

IATA

UN-No	UN3077
Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.*
Hazard Class	9
Packing Group	III

IMDG/IMO

UN-No	UN3077
--------------	--------

Proper Shipping Name Environmentally hazardous substances, solid, n.o.s.
 Hazard Class 9
 Packing Group III

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
Phenanthrene	85-01-8	X	ACTIVE	-

Legend:

TSCA - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

'-' - Not Listed

TSCA 12(b) - Notices of Export Not applicable

International Inventories

Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
Phenanthrene	85-01-8	X	-	201-581-5	X	X	X	X	KE-28202

U.S. Federal Regulations

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Phenanthrene	85-01-8	>95	1.0 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
Phenanthrene	-	-	-	X

Clean Air Act Not applicable

OSHA - Occupational Safety and Health Administration Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Phenanthrene	5000 lb	-

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

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Phenanthrene	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.

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 01-May-2012

Revision Date 16-Jan-2019

Print Date 16-Jan-2019

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

SAFETY DATA SHEET

Revision Date 19-Jan-2018

Revision Number 3

1. Identification

Product Name sec-Butylbenzene

Cat No. : AC107860000; AC107860050; AC107860500; AC107862500

CAS-No 135-98-8
Synonyms 2-Phenylbutane

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use.
Details of the supplier of the safety data sheet

Company

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

Emergency Telephone Number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11

Emergency Number **US**:001-201-796-7100 / **Europe**: +32 14 57 52 99

CHEMTREC Tel. No.**US**:001-800-424-9300 / **Europe**: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)

Flammable liquids	Category 3
Skin Corrosion/Irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2

Label Elements

Signal Word

Warning

Hazard Statements

Flammable liquid and vapor
Causes skin irritation
Causes serious eye irritation

**Precautionary Statements****Prevention**

Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge

Skin

If skin irritation occurs: Get medical advice/attention
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
If eye irritation persists: Get medical advice/attention

Fire

In case of fire: Use CO₂, dry chemical, or foam for extinction

Storage

Store in a well-ventilated place. Keep cool

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
sec-Butylbenzene	135-98-8	> 99

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention.
Inhalation	Remove from exposure, lie down. Remove to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention.
Ingestion	Clean mouth with water. Get medical attention.
Most important symptoms and effects	Difficulty in breathing. . Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Water spray. Carbon dioxide (CO ₂). Dry chemical. Water mist may be used to cool closed containers. Chemical foam. Water mist may be used to cool closed containers.
Unsuitable Extinguishing Media	No information available
Flash Point	45 °C / 113 °F
Method -	No information available
Autoignition Temperature	415 °C / 779 °F
Explosion Limits	
Upper	6.90%
Lower	0.80%
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Flammable. Vapors may travel to source of ignition and flash back. Containers may explode when heated. Vapors may form explosive mixtures with air.

Hazardous Combustion Products

Carbon monoxide (CO). Carbon dioxide (CO₂).

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
2

Flammability
2

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions	Remove all sources of ignition. Take precautionary measures against static discharges.
Environmental Precautions	See Section 12 for additional Ecological Information.
Methods for Containment and Clean Up	Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling	Avoid contact with skin and eyes. Do not breathe mist/vapors/spray. Take precautionary measures against static discharges. Use spark-proof tools and explosion-proof equipment. Use only non-sparking tools. Keep away from open flames, hot surfaces and sources of ignition.
Storage	Keep in a dry, cool and well-ventilated place. Refer product specification and/or product label for specific storage temperature requirement. Keep container tightly closed. Keep away from heat, sparks and flame. Flammables area. Keep container tightly closed in a dry and well-ventilated place.

8. Exposure controls / personal protection

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.
----------------------------	---

Engineering Measures Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure.

Respiratory Protection No protective equipment is needed under normal use conditions.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-75 °C / -103 °F
Boiling Point/Range	173 - 174 °C / 343.4 - 345.2 °F @ 760 mmHg
Flash Point	45 °C / 113 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	6.90%
Lower	0.80%
Vapor Pressure	1.33 hPa @ 19 °C
Vapor Density	4.62
Specific Gravity	0.860
Solubility	No information available
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	415 °C / 779 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C10 H14
Molecular Weight	134.22

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Keep away from open flames, hot surfaces and sources of ignition. Incompatible products.

Incompatible Materials Strong oxidizing agents

Hazardous Decomposition Products Carbon monoxide (CO), Carbon dioxide (CO₂)

Hazardous Polymerization No information available.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
sec-Butylbenzene	LD50 = 2240 µL/kg (Rat)	LD50 > 16 mL/kg (Rabbit)	Not listed

Toxicologically Synergistic Products No information available

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

Irritation No information available

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
sec-Butylbenzene	135-98-8	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects, both acute and delayed Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Do not empty into drains.

Persistence and Degradability Insoluble in water May persist based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility.

Component	log Pow
sec-Butylbenzene	4.24

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 UN2709
Hazard Class 3
Packing Group III

TDG

UN-No UN2709
Hazard Class 3
Packing Group III

IATA

UN-No UN2709
Proper Shipping Name BUTYLBENZENES
Hazard Class 3
Packing Group III

IMDG/IMO

UN-No UN2709
Proper Shipping Name BUTYLBENZENES
Hazard Class 3
Packing Group III

15. Regulatory information

United States of America Inventory

Component	CAS-No	TSCA	TSCA Inventory notification - Active/Inactive	TSCA - EPA Regulatory Flags
sec-Butylbenzene	135-98-8	X	ACTIVE	-

Legend:**TSCA** - Toxic Substances Control Act, (40 CFR Part 710)

X - Listed

- - Not Listed

TSCA 12(b) - Notices of Export Not applicable**International Inventories**

Canada (DSL/NDSL), Europe (EINECS/ELINCS/NLP), Philippines (PICCS), Japan (ENCS), Australia (AICS), China (IECSC), Korea (ECL).

Component	CAS-No	DSL	NDSL	EINECS	PICCS	ENCS	AICS	IECSC	KECL
sec-Butylbenzene	135-98-8	X	-	205-227-0	X	X	X	X	KE-04204

U.S. Federal Regulations**SARA 313** Not applicable**SARA 311/312 Hazard Categories** See section 2 for more information**CWA (Clean Water Act)** Not applicable**Clean Air Act** Not applicable**OSHA** - Occupational Safety and Health Administration Not applicable**CERCLA** Not applicable**California Proposition 65** This product does not contain any Proposition 65 chemicals.**U.S. State Right-to-Know**

Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
sec-Butylbenzene	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.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Revision Date 19-Jan-2018

Print Date 19-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

SAFETY DATA SHEET

Creation Date 11-Jun-2009

Revision Date 17-Jan-2018

Revision Number 4

1. Identification

Product Name Toluene

Cat No. : T326F-1GAL; T326P-4; T326S-20; T326S-20LC

CAS-No 108-88-3

Synonyms Tol; Methylbenzene

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)

Flammable liquids	Category 2
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Reproductive Toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system, Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, spleen, Blood.	
Aspiration Toxicity	Category 1

Label Elements

Signal Word

Danger

Hazard Statements

Highly flammable liquid and vapor
May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
May cause respiratory irritation
May cause drowsiness or dizziness

Suspected of damaging the unborn child
Causes damage to organs through prolonged or repeated exposure



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
Wash face, hands and any exposed skin thoroughly after handling
Wear eye/face protection
Do not breathe dust/fume/gas/mist/vapors/spray
Do not eat, drink or smoke when using this product
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool

Response

IF exposed or concerned: Get medical attention/advice

Inhalation

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

Skin

If skin irritation occurs: Get medical advice/attention
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
If eye irritation persists: Get medical advice/attention

Ingestion

IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
Do NOT induce vomiting

Fire

In case of fire: Use CO₂, dry chemical, or foam for extinction

Storage

Store locked up
Store in a well-ventilated place. Keep container tightly closed

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

WARNING. Reproductive Harm - <https://www.p65warnings.ca.gov/>.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Toluene	108-88-3	>95

4. First-aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.
Inhalation	Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur. Risk of serious damage to the lungs.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs naturally, have victim lean forward.
Most important symptoms and effects	Breathing difficulties. Causes central nervous system depression: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	No information available
Flash Point	4 °C / 39.2 °F
Method -	No information available
Autoignition Temperature	535 °C / 995 °F
Explosion Limits	
Upper	7.1 vol %
Lower	1.1 vol %
Oxidizing Properties	Not oxidising
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO₂)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health
3

Flammability
3

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation. Remove all sources of ignition. Take precautionary measures against static discharges.
-----------------------------	--

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Ensure adequate ventilation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. To avoid ignition of vapors by static electricity discharge, all metal parts of the equipment must be grounded. Take precautionary measures against static discharges.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Flammables area. Keep away from heat and sources of ignition.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Toluene	TWA: 20 ppm	(Vacated) TWA: 100 ppm (Vacated) TWA: 375 mg/m ³ Ceiling: 300 ppm (Vacated) STEL: 150 ppm (Vacated) STEL: 560 mg/m ³ TWA: 200 ppm	IDLH: 500 ppm TWA: 100 ppm TWA: 375 mg/m ³ STEL: 150 ppm STEL: 560 mg/m ³	TWA: 50 ppm TWA: 188 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 Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

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 Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	1.74 ppm
pH	Not applicable
Melting Point/Range	-95 °C / -139 °F

Boiling Point/Range	111 °C / 231.8 °F @ 760 mmHg
Flash Point	4 °C / 39.2 °F
Evaporation Rate	2.4 (Butyl acetate = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	7.1 vol %
Lower	1.1 vol %
Vapor Pressure	29 mbar @ 20 °C
Vapor Density	3.1
Specific Gravity	0.866
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	535 °C / 995 °F
Decomposition Temperature	No information available
Viscosity	0.6 mPa.s @ 20 °C
Molecular Formula	C7 H8
Molecular Weight	92.14

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents, Strong acids, Strong bases, Halogenated compounds
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Toluene	> 5000 mg/kg (Rat)	LD50 = 12000 mg/kg (Rabbit)	26700 ppm (Rat) 1 h

Toxicologically Synergistic Products No information available

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

Irritation	Irritating to eyes, respiratory system and skin
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
Toluene	108-88-3	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects Not mutagenic in AMES Test

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects Developmental effects have occurred in experimental animals.

Teratogenicity	Possible risk of harm to the unborn child.
STOT - single exposure	Respiratory system Central nervous system (CNS)
STOT - repeated exposure	Kidney Liver spleen Blood
Aspiration hazard	No information available
Symptoms / effects, both acute and delayed	Causes central nervous system depression: Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Contains a substance which is: The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Toluene	EC50: = 12.5 mg/L, 72h static (Pseudokirchneriella subcapitata) EC50: > 433 mg/L, 96h (Pseudokirchneriella subcapitata)	50-70 mg/L LC50 96 h 5-7 mg/L LC50 96 h 15-19 mg/L LC50 96 h 28 mg/L LC50 96 h 12 mg/L LC50 96 h	EC50 = 19.7 mg/L 30 min	EC50: = 11.5 mg/L, 48h (Daphnia magna) EC50: 5.46 - 9.83 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability Soluble in 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
Toluene	2.7

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.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Toluene - 108-88-3	U220	-

14. Transport information

DOT

UN-No	UN1294
Proper Shipping Name	TOLUENE
Hazard Class	3
Packing Group	II

TDG

UN-No	UN1294
Proper Shipping Name	TOLUENE
Hazard Class	3
Packing Group	II

IATA

UN-No	UN1294
Proper Shipping Name	TOLUENE
Hazard Class	3

Packing Group	II
IMDG/IMO	
UN-No	UN1294
Proper Shipping Name	TOLUENE
Hazard Class	3
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
Toluene	X	X	-	203-625-9	-		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 %
Toluene	108-88-3	>95	1.0

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
Toluene	X	1000 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Toluene	X		-

OSHA Occupational Safety and Health Administration

Not applicable

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Toluene	1000 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Toluene	108-88-3	Developmental	-	Developmental

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Toluene	X	X	X	X	X

U.S. Department of Transportation

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

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade Serious risk, Grade 3

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 11-Jun-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

SAFETY DATA SHEET

Creation Date 03-Feb-2010

Revision Date 14-Jul-2016

Revision Number 2

1. Identification

Product Name Trichloroethylene

Cat No. : T340-4; T341-4; T341-20; T341-500; T403-4

Synonyms Trichloroethene (Stabilized/Technical/Electronic/Certified ACS)

Recommended Use Laboratory chemicals.

Uses advised against

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)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1A
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Heart, spleen, Blood.	

Label Elements**Signal Word**

Danger

Hazard Statements

Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
Suspected of causing genetic defects
May cause cancer
May cause damage to organs through prolonged or repeated exposure

**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
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection

Response

IF exposed or concerned: Get medical attention/advice

Inhalation

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

Skin

IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention

Storage

Store locked up
Store in a well-ventilated place. Keep container tightly closed

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! This product contains a chemical known in the State of California to cause cancer, birth defects or other reproductive harm.

3. Composition / information on ingredients

Component	CAS-No	Weight %
Trichloroethylene	79-01-6	100

4. First-aid measures

General Advice

Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Skin Contact

Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation

Move to fresh air. If not breathing, give artificial respiration. 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. Immediate medical attention is required.

Ingestion Do not induce vomiting. Call a physician or Poison Control Center immediately.

Most important symptoms/effects None reasonably foreseeable. May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable Extinguishing Media No information available

Flash Point No information available
Method - No information available

Autoignition Temperature 410 °C / 770 °F

Explosion Limits

Upper 10.5 vol %

Lower 8 vol %

Oxidizing Properties Not oxidising

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. Containers may explode when heated. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

Hydrogen chloride gas Chlorine Phosgene Carbon monoxide (CO) Carbon dioxide (CO₂)

Protective Equipment and Precautions for Firefighters

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

NFPA

Health
2

Flammability
1

Instability
0

Physical hazards
N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment. Keep people away from and upwind of spill/leak. Evacuate personnel to safe areas.

Environmental Precautions Should not be released into the environment. Do not flush into surface water or sanitary sewer system.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

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

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from light. Do not store in aluminum containers.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Trichloroethylene	TWA: 10 ppm STEL: 25 ppm	(Vacated) TWA: 50 ppm (Vacated) TWA: 270 mg/m ³ Ceiling: 200 ppm (Vacated) STEL: 200 ppm (Vacated) STEL: 1080 mg/m ³ TWA: 100 ppm	IDLH: 1000 ppm	TWA: 100 ppm TWA: 535 mg/m ³ STEL: 200 ppm STEL: 1080 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 adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

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

Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-85 °C / -121 °F
Boiling Point/Range	87 °C / 188.6 °F
Flash Point	No information available
Evaporation Rate	0.69 (Carbon Tetrachloride = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	10.5 vol %
Lower	8 vol %
Vapor Pressure	77.3 mbar @ 20 °C
Vapor Density	4.5 (Air = 1.0)
Specific Gravity	1.460
Solubility	Slightly soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	410 °C / 770 °F
Decomposition Temperature	> 120°C
Viscosity	0.55 mPa.s (25°C)

Molecular Formula
Molecular Weight

C₂ H Cl₃
131.39

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Light sensitive.
Conditions to Avoid	Incompatible products. Excess heat. Exposure to light. Exposure to moist air or water.
Incompatible Materials	Strong oxidizing agents, Strong bases, Amines, Alkali metals, Metals,
Hazardous Decomposition Products	Hydrogen chloride gas, Chlorine, Phosgene, Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Trichloroethylene	LD50 = 4290 mg/kg (Rat) LD50 = 4920 mg/kg (Rat)	LD50 > 20 g/kg (Rabbit) LD50 = 29000 mg/kg (Rabbit)	LC50 = 26 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

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

Irritation Irritating to eyes and skin

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
Trichloroethylene	79-01-6	Group 1	Reasonably Anticipated	A2	X	Not listed

IARC: (International Agency for Research on Cancer)

NTP: (National Toxicity Program)

ACGIH: (American Conference of Governmental Industrial Hygienists)

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)

Known - Known Carcinogen

Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

A1 - Known Human Carcinogen

A2 - Suspected Human Carcinogen

A3 - Animal Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)

Mutagenic Effects Mutagenic effects have occurred in humans.

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure	Central nervous system (CNS)
STOT - repeated exposure	Kidney Liver Heart spleen Blood
Aspiration hazard	No information available
Symptoms / effects, both acute and delayed	Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting. Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
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. Do not empty into drains. The product contains following substances which are hazardous for the environment. Contains a substance which is: Harmful to aquatic organisms. Toxic to aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Trichloroethylene	EC50: = 175 mg/L, 96h (Pseudokirchneriella subcapitata) EC50: = 450 mg/L, 96h (Desmodesmus subspicatus)	LC50: 39 - 54 mg/L, 96h static (Lepomis macrochirus) LC50: 31.4 - 71.8 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 0.81 mg/L 24 h EC50 = 115 mg/L 10 min EC50 = 190 mg/L 15 min EC50 = 235 mg/L 24 h EC50 = 410 mg/L 24 h EC50 = 975 mg/L 5 min	EC50: = 2.2 mg/L, 48h (Daphnia magna)

Persistence and Degradability Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility.

Component	log Pow
Trichloroethylene	2.4

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.

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Trichloroethylene - 79-01-6	U228	-

14. Transport information

DOT

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

TDG

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IATA

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE

Hazard Class	6.1
Packing Group	III
IMDG/IMO	
UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

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
Trichloroethylene	X	X	-	201-167-4	-		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

Component	TSCA 12(b)
Trichloroethylene	Section 5

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Trichloroethylene	79-01-6	100	0.1

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Trichloroethylene	X	100 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Trichloroethylene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Trichloroethylene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Trichloroethylene	79-01-6	Carcinogen Developmental Male Reproductive	14 µg/day 50 µg/day	Developmental Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Trichloroethylene	X	X	X	X	X

U.S. Department of Transportation

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

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

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 03-Feb-2010

Revision Date 14-Jul-2016

Print Date 14-Jul-2016

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

SAFETY DATA SHEET

Vinyl Chloride

Section 1. Identification

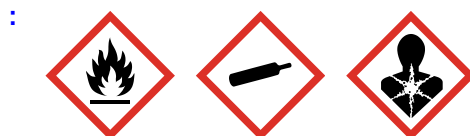
GHS product identifier	: Vinyl Chloride
Chemical name	: vinyl chloride
Other means of identification	: chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC
Product type	: Gas.
Product use	: Synthetic/Analytical chemistry.
Synonym	: chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC
SDS #	: 001067
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
24-hour telephone	: 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 CARCINOGENICITY - Category 1 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2

GHS label elements

Hazard pictograms



Signal word

Hazard statements

- : Danger
- : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite
May displace oxygen and cause rapid suffocation.
May cause cancer.
May cause damage to organs through prolonged or repeated exposure. (liver)

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

- : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Do not breathe gas.

Section 2. Hazards identification

Response	: Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.
Storage	: Store locked up. Protect from sunlight. Store in a well-ventilated place.
Disposal	: Dispose of contents and container in accordance with all local, regional, national and international regulations.
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	: vinyl chloride
Other means of identification	: chloroethylene; Ethene, chloro-; Chloroethene; Vinyl chloride, monomer; Ethene, chloro- (vinyl chloride); Vinyl chloride monomer; Monochloroethylene; Monochloroethene; Ethylene monochloride; VCM; VC
Product code	: 001067

CAS number/other identifiers

CAS number : 75-01-4

Ingredient name	%	CAS number
vinyl chloride	100	75-01-4

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

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.
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 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. Continue to rinse for at least 10 minutes. Get medical attention. 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

Section 4. First aid measures

Eye contact	: No specific data.
Inhalation	: No specific data.
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. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

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 halogenated compounds
---	---

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 specialized 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".

Section 6. Accidental release measures

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).

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. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. 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.

Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not breathe gas. Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood.

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. 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). Store locked up. Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
vinyl chloride	ACGIH TLV (United States, 3/2017). TWA: 1 ppm 8 hours. OSHA PEL (United States, 6/2016). STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours. OSHA PEL 1989 (United States, 3/1989). STEL: 5 ppm 15 minutes. TWA: 1 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.

Section 8. Exposure controls/personal protection

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

- 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** : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. 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. [COLORLESS GAS OR LIQUID (BELOW 7 F) WITH A PLEASANT ODOR AT HIGH CONCENTRATIONS. [NOTE: SHIPPED AS A LIQUEFIED COMPRESSED GAS.]
- Color** : Colorless.
- Odor** : Characteristic.
- Odor threshold** : Not available.
- pH** : Not available.
- Melting point** : -153.8°C (-244.8°F)
- Boiling point** : -13.4°C (7.9°F)
- Critical temperature** : 158.45°C (317.2°F)
- Flash point** : Closed cup: -78°C (-108.4°F)
Open cup: -78°C (-108.4°F)
- Evaporation rate** : Not available.
- Flammability (solid, gas)** : Not available.
- Lower and upper explosive (flammable) limits** : Lower: 3.8%
Upper: 29.3%

Section 9. Physical and chemical properties

Vapor pressure	: Not available.
Vapor density	: 2.2 (Air = 1)
Specific Volume (ft³/lb)	: 6.25
Gas Density (lb/ft³)	: 0.16129 (21.1°C / 70 to °F)
Relative density	: Not applicable.
Solubility	: Not available.
Solubility in water	: 1.1 g/l
Partition coefficient: n-octanol/water	: 1.38
Auto-ignition temperature	: 472°C (881.6°F)
Decomposition temperature	: Not available.
Viscosity	: Not applicable.
Flow time (ISO 2431)	: Not available.
Molecular weight	: 62.5 g/mole
<u>Aerosol product</u>	
Heat of combustion	: -18924336 J/kg

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.
Incompatible materials	: Oxidizers
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

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Section 11. Toxicological information

Classification

Product/ingredient name	OSHA	IARC	NTP
vinyl chloride	+	1	Known to be a human carcinogen.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
vinyl chloride	Category 2	Not determined	liver

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 : May cause damage to organs through prolonged or repeated exposure.
Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.
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
vinyl chloride	1.38	-	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.






[United States - RCRA Toxic hazardous waste "U" List](#)

Ingredient	CAS #	Status	Reference number
Vinyl chloride; Ethene, chloro-	75-01-4	Listed	U043

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1086	UN1086	UN1086	UN1086	UN1086
UN proper shipping name	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED	VINYL CHLORIDE, STABILIZED

Section 14. Transport information

Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

“Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product.”

Additional information

DOT Classification

: **Reportable quantity** 1 lbs / 0.454 kg. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.

Limited quantity Yes.

Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.

Special provisions 21, B44, T50

TDG Classification

: Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).

Explosive Limit and Limited Quantity Index 0.125

ERAP Index 3000

Passenger Carrying Road or Rail Index Forbidden

IATA

: **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 150 kg.

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 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined
Clean Water Act (CWA) 307: vinyl chloride
Clean Air Act (CAA) 112 regulated flammable substances: vinyl chloride

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : 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.

Section 15. Regulatory information

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	vinyl chloride	75-01-4	100
Supplier notification	vinyl chloride	75-01-4	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations


Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

California Prop. 65

 **WARNING:** This product can expose you to Vinyl chloride, which is known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

Ingredient name	No significant risk level	Maximum acceptable dosage level
Vinyl chloride	Yes.	-

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia	: This material is listed or exempted.
Canada	: This material is listed or exempted.
China	: This material is listed or exempted.
Europe	: This material is listed or exempted.
Japan	: Japan inventory (ENCS): This material is listed or exempted. Japan inventory (ISHL): This material is listed or exempted.
Malaysia	: This material is listed or exempted.
New Zealand	: This material is listed or exempted.
Philippines	: This material is listed or exempted.
Republic of Korea	: This material is listed or exempted.
Taiwan	: This material is listed or exempted.
Thailand	: Not determined.
Turkey	: This material is listed or exempted.

Section 15. Regulatory information

United States	: This material is listed or exempted.
Viet Nam	: Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	*	2
Flammability		4
Physical hazards		2

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 and the associated label are not required on SDSs or products leaving a facility 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 trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

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.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1	Expert judgment
GASES UNDER PRESSURE - Liquefied gas	Expert judgment
CARCINOGENICITY - Category 1	Expert judgment
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2	Expert judgment

History

Date of printing	: 7/9/2018
Date of issue/Date of revision	: 7/9/2018
Date of previous issue	: 10/11/2016
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 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution) UN = United Nations
-----------------------------	--

Section 16. Other information

References : Not available.

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.



APPENDIX F

CONFINED SPACE ENTRY CHECKLIST/PERMIT



CONFINED SPACE ENTRY PERMIT

Confined Space <input type="checkbox"/>	Hazardous Area <input type="checkbox"/>	Non Permit Required <input type="checkbox"/>
---	---	--

Notes: No work will be performed unless the space meets non permit requirements
Permit valid 8 hours only. All copies of permit will remain at this job site until job is completed.
A single entry permit can be filled out prior to start of daily work.
SAFETY STANDBY PERSON IS REQUIRED FOR ALL CONFINED SPACE WORK

Site Location and Description: _____

Purpose of Entry: _____

Supervisor(s) in charge of Crew: _____

Requirements	Date	Time	Requirements	Date	Time
Lock Out/De-energize/try-out			Full Body Harness w/"D" Ring		
Line(s) Broken-capped-blanked			Emergency Escape Retrieval		
Purged-Flush and Vent			Lifelines		
Ventilation			Fire Extinguishers		
Secure Area (Post and Flag)			Lighting (Explosive Proof)		
Breathing Apparatus			Protective Clothing		
Resuscitator-Inhalator			Respirator(s) (Air Purifying)		
Standby Safety Personnel			Burning and Welding Permit		

BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED & REVIEWED PRIOR TO ENTRY

Items that do not apply enter N/A in the blank

Monitoring Tests	Permissible Entry Levels	Results (record every 30 minutes beginning ½ hour prior to entry)							
Oxygen	19.5 to 23.5%								
LEL	Below 10%								
Hydrogen sulfide (H ₂ S)	10ppm† 15ppm‡								

†Short term exposure limit (STEL)

‡8 hour Time weighted average (TWA)

Monitoring Equipment

Type	Model #	Serial #
------	---------	----------

Type	Model #	Serial #
------	---------	----------

Safety standby person(s): _____

Supervisor authorizing entry: _____



APPENDIX G

EMERGENCY INFORMATION



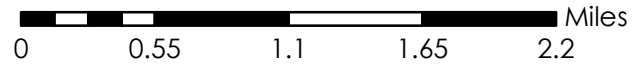
EMERGENCY PHONE NUMBERS

General Emergencies – Police/Fire Department/Ambulance	911
Local Emergency Medical Center (Syosset Hospital)	1-516-496-6400
National Response Center	1-800-424-8802
Poison Control	1-212-340-4494
NYSDEC Spills Division	1-800-457-7362
NYSDEC Division of Environmental Remediation	1-631-444-0240
PWGC Project Director, James Rhodes	1-631-589-6353
PWGC Project Manager, Thomas Melia	1-631-589-6353
PWGC Site Safety Officer, Nick Russell (or assignee)	1-516-351-5787



HOSPITAL ROUTE

1 Commander Square, Oyster Bay, NY
TO
Syosset Hospital: 221 Jericho Turnpike, Syosset, NY



Project:	CTH1901
Date:	10/21/2020
Designed by:	TM
Drawn by:	PH
Approved by:	TM
Figure No:	1

Document Path: W:\Projects\A-D\CTH1901\maps\FIG01_HospitalRoute.mxd



PWGC
CLIENT DRIVEN SOLUTIONS

P.W. Grosser Consulting Engineer & Hydrogeologist, P.C.

630 Johnson Ave., Suite 7
Bohemia, NY 11716
Ph: 631-589-6353 • Fax: 631-589-8705
pwgc.info@pwgrosser.com



INCIDENT / NEAR MISS REPORT AND INVESTIGATION - PAGE 2 OF 2		REPORT NO.
MEDICAL TREATMENT INFORMATION		
WAS MEDICAL TREATMENT PROVIDED? <input type="checkbox"/> YES <input type="checkbox"/> NO		
IF YES, WAS MEDICAL TREATMENT PROVIDED: <input type="checkbox"/> ON-SITE <input type="checkbox"/> DR.'S OFFICE <input type="checkbox"/> HOSPITAL		
NAME OF PERSON(S) PROVIDING TREATMENT:		
ADDRESS WHERE TREATMENT WAS PROVIDED:		
TYPE OF TREATMENT:		
VEHICLE AND PROPERTY DAMAGE INFORMATION		
VEHICLE/PROPERTY DAMAGED:		
DESCRIPTION OF DAMAGE:		
SPILL AND AIR EMISSIONS INFORMATION:		
SUBSTANCE SPILLED OR RELEASED:	FROM WHERE:	TO WHERE:
ESTIMATED QUANTITY/DURATION:		
CERCLA HAZARDOUS SUBSTANCE? <input type="checkbox"/> YES <input type="checkbox"/> NO		
REPORTABLE TO AGENCY? <input type="checkbox"/> YES <input type="checkbox"/> NO SPECIFY:		
WRITTEN REPORT: <input type="checkbox"/> YES <input type="checkbox"/> NO TIME FRAME:		
RESPONSE ACTION TAKEN:		
PERMIT EXCEEDENCE		
TYPE OF PERMIT:	PERMIT #:	
DATE OF EXCEEDENCE:	DATE FIRST KNOWLEDGE OF EXCEEDENCE:	
PERMITTED LEVEL OR CRITERIA:		
EXCEEDENCE LEVEL OR CRITERIA:		
REPORTABLE TO AGENCY? <input type="checkbox"/> YES <input type="checkbox"/> NO SPECIFY:		
WRITTEN REPORT: <input type="checkbox"/> YES <input type="checkbox"/> NO TIME FRAME:		
RESPONSE ACTION TAKEN:		
NOTIFICATIONS		
NAMES OF PERSONNEL NOTIFIED:	DATE/TIME:	
CLIENT NOTIFIED:	DATE/TIME:	
AGENCY NOTIFIED:	DATE/TIME:	
CONTACT NAME:		
PERSONS PREPARING REPORT		
EMPLOYEE'S NAME:(PRINT)	SIGN:	
SUPERVISOR'S NAME:(PRINT)	SIGN:	



INVESTIGATIVE REPORT			
DATE OF INCIDENT:		DATE OF REPORT:	
INCIDENT COST: ESTIMATED: \$ _____		ACTUAL: \$ _____	
OSHA RECORDABLE(S): <input type="checkbox"/> YES <input type="checkbox"/> NO # RESTRICTED DAYS _____ # DAYS AWAY FROM WORK _____			
CAUSE ANALYSIS			
IMMEDIATE CAUSES - WHAT ACTIONS AND CONDITIONS CONTRIBUTED TO THIS EVENT?			
BASIC CAUSES - WHAT SPECIFIC PERSONAL OR JOB FACTORS CONTRIBUTED TO THIS EVENT?			
ACTION PLAN			
REMEDIAL ACTIONS - WHAT HAS AND OR SHOULD BE DONE TO CONTROL EACH OF THE CAUSES LISTED?			
ACTION	PERSON RESPONSIBLE	TARGET DATE	COMPLETION DATE
PERSONS PERFORMING INVESTIGATION			
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
INVESTIGATOR'S NAME: (PRINT)	SIGN:	DATE:	
MANAGEMENT REVIEW			
PROJECT MANAGER: (PRINT)	SIGN:	DATE:	
COMMENTS:			
H&S MANAGER: (PRINT)	SIGN:	DATE:	
COMMENTS:			

EXAMPLES OF IMMEDIATE CAUSES

Substandard Actions

Substandard Conditions

CLIENT DRIVEN SOLUTIONS

PHONE: 631.589.6353
PWGROSSER.COM

630 JOHNSON AVENUE, STE 7
BOHEMIA, NY 11716

LONG ISLAND • MANHATTAN • SARATOGA SPRINGS • SYRACUSE • SEATTLE • SHELTON



- | | |
|---|--|
| <ol style="list-style-type: none">1. Operating equipment without authority2. Failure to warn3. Failure to secure4. Operating at improper speed5. Making safety devices inoperable6. Removing safety devices7. Using defective equipment8. Failure to use PPE properly9. Improper loading10. Improper placement11. Improper lifting12. Improper position for task13. Servicing equipment in operation14. Under influence of alcohol/drugs15. Horseplay | <ol style="list-style-type: none">1. Guards or barriers2. Protective equipment3. Tools, equipment, or materials4. Congestion5. Warning system6. Fire and explosion hazards7. Poor housekeeping8. Noise exposure9. Exposure to hazardous materials10. Extreme temperature exposure11. Illumination12. Ventilation13. Visibility |
|---|--|

EXAMPLES OF BASIC CAUSES

Personal Factors

1. Capability
2. Knowledge
3. Skill
4. Stress
5. Motivation
6. Work Standards
7. Wear and tear
8. Abuse or misuse

Job Factors

1. Supervision
2. Engineering
3. Purchasing
4. Maintenance
5. Tools/equipment

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS

- | | |
|---|--|
| <ol style="list-style-type: none">1. Leadership and administration2. Management training3. Planned inspections4. Task analysis and procedures5. Task observation6. Emergency preparedness7. Organizational rules8. Accident/incident analysis9. Personal protective equipment | <ol style="list-style-type: none">10. Health control11. Program audits12. Engineering controls13. Personal communications14. Group meetings15. General promotion16. Hiring and placement17. Purchasing controls |
|---|--|



APPENDIX D

COMMUNITY AIR MONITORING PLAN

FORMER COMMANDER OIL TERMINAL
1 COMMANDER SQUARE
OYSTER BAY, NEW YORK
NYSDEC BCP ID: C130244

COMMUNITY AIR MONITORING PLAN

SUBMITTED TO:



New York State Department of Environmental Conservation
Division of Environmental Remediation
SUNY Stony Brook
50 Circle Road
Stony Brook, New York 11790-3409

PREPARED FOR:

Commander Terminals Holdings, LLC
255 South Street
Oyster Bay, New York 11771

PREPARED BY:



P.W. Grosser Consulting, Inc.
630 Johnson Avenue, Suite 7
Bohemia, New York 11716
Phone: 631-589-6353
Fax: 631-589-8705

James Rhodes, PG, COO
Thomas Melia, PG, Sr. Project Manager

jimr@pwgrosser.com
thomasm@pwgrosser.com

PWGC Project Number: CTH1901

DECEMBER 2020



P.W. GROSSER CONSULTING, INC.
PROJECT No. CTH1901
New York State Department of Environmental Conservation
Brownfield Site No. C130244

COMMUNITY AIR MONITORING PLAN

Former Commander Oil Terminal
1 Commander Square
Oyster Bay, New York

SUBMITTED:
December 2020

PREPARED FOR:

New York State Department of Environmental Conservation
Division of Environmental Remediation
SUNY Stony Brook
50 Circle Road
Stony Brook, New York 11790-3409

ON BEHALF OF:

Commander Terminals Holdings, LLC
255 South Street
Oyster Bay, New York 11771

PREPARED BY:

P.W. Grosser Consulting, Inc.
630 Johnson Avenue, Suite 7
Bohemia, New York 11716



**COMMUNITY AIR MONITORING PLAN
FORMER COMMANDER OIL TERMINAL
NYSDEC BCP ID: C130244**

TABLE OF CONTENTS	PAGE
1.0 INTRODUCTION	1
1.1 Regulatory Requirements	1
2.0 AIR MONITORING	2
2.1 Real-Time Monitoring	2
2.1.1 Air Monitoring Equipment	2
2.1.2 VOC Monitoring, Response Levels, and Actions	2
2.1.3 Particulate Monitoring, Response Levels, and Actions.....	3
3.0 SPECIAL REQUIREMENTS.....	4
3.1 Requirements for Work within 20 Feet of Potentially Exposed Individuals or Structures	4
3.2 Requirements for Indoor Work with Co-Located Residences or Facilities	4
4.0 VAPOR SUPPRESSION TECHNIQUES.....	5
5.0 DUST SUPPRESSION TECHNIQUES	6
6.0 DATA QUALITY ASSURANCE	7
6.1 Calibration.....	7
6.2 Operations.....	7
6.3 Data Review	7
7.0 RECORDS AND REPORTING	8



1.0 INTRODUCTION

This Community Air Monitoring Plan (CAMP) provides measures for protection for the downwind community (i.e., off-site receptors including residences, businesses, and on-site workers not directly involved) from potential airborne contaminant releases resulting from investigation and/or remedial action at the Former Commander Oil Terminal site.

The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that the investigation and/or remedial work did not spread contamination off-site through the air. The CAMP will be implemented as follows:

- Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.
- Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. Periodic monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

The primary concerns for this site are SVOCs, metals and dust particulates.

1.1 Regulatory Requirements

This CAMP was established in accordance with the following requirements:

- New York State Department of Health's (NYSDOH) Generic Community Air Monitoring Plan: This guidance specifies that a community air-monitoring program shall be implemented to protect the surrounding community and to confirm that the work does not spread contamination off-site through the air.



2.0 AIR MONITORING

The following sections contain information describing the types, frequency and location of real-time monitoring.

2.1 Real-Time Monitoring

This section addresses the real-time monitoring that will be conducted within the work area, and along the site perimeter, during intrusive activities such as excavation, product recovery, manipulation of soil piles, extraction of sheet piling, etc.

Air monitoring data will be documented in a site logbook by the designated site safety officer. PWGC's site safety officer or delegate must ensure that air monitoring instruments are calibrated and maintained in accordance with manufacturer's specifications. All instruments will be zeroed daily and checked for accuracy. A daily log will be kept. If additional monitoring is required, the protocols will be developed and appended to this plan.

2.1.1 Air Monitoring Equipment

Air will be monitored for VOCs with a MiniRAE 2000 PID (or equivalent). This instrument is appropriate to measure the types of contaminants known or suspected to be present, and is capable of calculating 15-minute running average concentrations, which will be compared to the levels specified in Section 2.1.2

Fugitive respirable dust will be monitored using a MiniRAM Model PDM-3 aerosol monitor (or equivalent). This instrument is capable of measuring particulate matter less than 10 micrometers in size (PM-10), is capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level, and is equipped with an audible alarm to indicate exceedance of the action level specified in Section 2.1.3.

2.1.2 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. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. VOC monitoring Action Levels are as described 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 must be temporarily halted and monitoring continued.
- If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over



background, work activities can resume with continued monitoring.

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

All 15-minute readings will be recorded and be available for NYSDEC and/or NYSDOH personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

2.1.3 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. In addition, fugitive dust migration should be visually assessed during all work activities. Particulate monitoring Action Levels are as described below:

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m³) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may 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 must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m³ of the upwind level and in preventing visible dust migration.

All 15-minute readings will be recorded and be available for NYSDEC and/or NYSDOH personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

3.0 SPECIAL REQUIREMENTS

3.1 Requirements for Work within 20 Feet of Potentially Exposed Individuals or Structures

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 exposures 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 mcg/m³, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m³ or less at the monitoring point.
- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen sulfide, carbon monoxide) may also need to be monitored. Response levels and actions should be pre-determined, as necessary, for each site.

3.2 Requirements for Indoor Work with Co-Located Residences or Facilities

Unless a self-contained, negative-pressure enclosure with proper emission controls will encompass the work area, all individuals not directly involved with the planned work must be absent from the room in which the work will occur. Monitoring requirements shall be as stated above under “Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures” except that in this instance “nearby/occupied structures” would be adjacent occupied rooms. Additionally, the location of all exhaust vents in the room and their discharge points, as well as potential vapor pathways (openings, conduits, etc.) relative to adjoining rooms, should be understood and the monitoring locations established accordingly. In these situations, it is strongly recommended that exhaust fans or other engineering controls be used to create negative air pressure within the work area during remedial activities. Additionally, it is strongly recommended that the planned work be implemented during hours (e.g. weekends or evenings) when building occupancy is at a minimum.



4.0 VAPOR SUPPRESSION TECHNIQUES

Vapor suppression techniques must be employed when action levels warrant the use of these techniques.

The techniques to be implemented for control of VOCs from stockpiled soil or from the open excavation will include one or more of the following:

- Cover with plastic.
- Cover with “clean soil”.
- Application of hydro-mulch material*.
- Limit working hours to favorable wind and temperature conditions.

*This material is a seedless version of the hydro-seed product commonly used by commercial landscaping contractors to provide stabilization and rapid grow-in of grasses or wild flowers along highways, embankments and other large areas. Hydro-mulch can be sprayed over open excavation areas, temporary stockpile areas and loaded trucks, as necessary. This is a highly effective method for controlling odors, because the release of odors is sealed immediately at the source.



5.0 DUST SUPPRESSION TECHNIQUES

Reasonable dust-suppression techniques must be employed during all work that may generate dust, such as excavation, grading, and placement of clean fill. The following techniques were shown to be effective for controlling the generation and migration of dust during remedial activities:

- Wetting equipment and excavation faces;
- Spraying water on buckets during excavation and dumping;
- Hauling materials in properly covered containers; and,
- Restricting vehicle speeds to 10 mph.

Using atomizing sprays will prevent overly wet conditions, conserve water, and offer an effective means of suppressing fugitive dust. It is imperative that utilizing water for suppressing dust will not create surface runoff.



6.0 DATA QUALITY ASSURANCE

6.1 Calibration

Instrument calibration shall be documented in the designated field logbook. All instruments shall be calibrated before each shift. Calibration checks may be used during the day to confirm instrument accuracy. Duplicate readings may be taken to confirm individual instrument response.

6.2 Operations

All instruments shall be operated in accordance with the manufacturer's specifications. Manufacturers' literature, including an operations manual for each piece of monitoring equipment will be maintained on-site by the FTL/HSO for reference.

6.3 Data Review

The Field Team Leader FTL/HSO will interpret all monitoring data based on the action levels specified in Sections 2.1.2 and 2.1.3 and his/her professional judgment. The FTL/HSO shall review the data with the HSM to evaluate the potential for worker exposure, upgrades/downgrades in level of protection, comparison to direct reading instrumentation and changes in the integrated monitoring strategy.

Monitoring and sampling data, along with all sample documentation will be periodically reviewed by the HSM.



7.0 RECORDS AND REPORTING

All readings must be recorded and available for review by personnel from NYSDEC and NYSDOH. Should any of the action levels be exceeded, the NYSDEC Division of Air Resources must be notified in writing within five (5) working days.

The notification shall include a description of the control measures implemented to prevent further exceedances.