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REMEDIAL INVESTIGATION WORK PLAN

Former Bictos Webster Cleaners

1321 Webster Avenue

Block 2887; Lot 179

Bronx, New York

Prepared For: First Class Management & Development, LLC
9881 Queens Boulevard, Suite 1601
Rego Park, NY 11374

Prepared By: HydroTech Environmental Engineering and Geology, DPC
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Created On: February 16, 2026

HydroTech Job No. 260006

CERTIFICATIONS

I, Tarek Z. Khouri, certify that I am a Professional Engineer (PE) as defined in 6 NYCRR Part 375 and that this Remedial Investigation Work Plan was prepared for the 1321 Webster Avenue in accordance with all applicable statues and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and DER Green Remediation (DER-31).

Tarek Z. Khouri

Name

Signature

February 14, 2026

Date

LIST OF ACRONYMS

Acronym	Definition
AWQS	Ambient Water Quality Standards
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BGS	Below Grade Surface
BN	Base Neutral
CAMP	Community Air Monitoring Plan
C&D	Construction & Demolition
CGI	Combustible Gas Indicator
CPP	Citizen Participation Plan
DCE	Dichloroethene
DB	decibels
DUSR	Data Usability Summary Report
ESA	Environmental Site Assessment
ELAP	Environmental Laboratory Accreditation Program
EZ	Exclusion Zone
FID	Flame Ionization Detector
GHG	Greenhouse Gas
GSR	Green and Sustainable Remediation

HASP	Health and Safety Plan
MDL	Method Detection Limit
NYC DEP	New York City Department of Environmental Protection
NYS DEC	New York State Department of Environmental Conservation
NYS DOH	New York State Department of Health
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PID	Photo Ionization Detector
PFOA	Perfluorooctanoic acid
PM	Particulate Matter
PPE	personal protective equipment (PPE
QAO	Qualified Assurance Officer
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional
QHHEA	Qualitative Human Health Exposure Assessment
QEP	Qualified Environmental Professional
REC	Recognized Environmental Condition
QA/QC	Quality Assurance/Quality Control
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan

SCOs	Soil Cleanup Objectives
SCG	Standards, Criteria and Guidance
SCBA	Self-Contained Breathing Apparatus
SSO	Site Safety Officer
TAL	Full Target Analyte List
TCL	Full Target Compound List
TICs	Tentatively Identified Compounds
TOGS	Technical and Operational Guidance Series
SVOCs	Semi-Volatile Organic Compounds
USCS	Unified Soil Classification System
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds

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1.0 EXECUTIVE SUMMARY

This Remedial Investigation Work Plan (RIWP) has been prepared on behalf of First Class Management & Development LLC (Volunteer) to document the details and protocols for the environmental investigation of the property located at 1321 Webster Avenue, Bronx, New York (the "Site"). The purpose of this RIWP is to further investigate the environmental quality of on-site soil, groundwater and soil vapor to fully characterize the nature and extent of contamination across the Site. All investigation work will be performed in accordance with the New York State Department of Environmental Conservation (NYSDEC) requirements and in compliance with the New York State Department of Health (NYSDOH) Guidance for evaluating Soil Vapor Intrusion in the State of NY (October 2006), NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010), NYSDEC DER-31 for Green Remediation and other acceptable industry standards. A BCP Application is being filed by the Applicant along with this RIWP to investigate and subsequently remediate the Site pursuant to a Brownfield Cleanup Agreement (BCA) that will be executed between First Class Management & Development, LLC and the NYSDEC.

The investigation will be conducted through the installation and sampling of soil probes, soil vapor probes and monitoring wells. All portions of the fieldwork will be conducted in accordance with a site-specific Health & Safety Plan.

The following sections provide the details and specific information pertaining to the various components of the RIWP.

2.0 INTRODUCTION

HydroTech Environmental Engineering and Geology, DPC ("HydroTech") has been retained by First Class Management & Development, LLC to prepare this Remedial Investigation Work Plan (RIWP) for the property located at 1321 Webster Avenue in Bronx, New York (the "Site"). Specifically, this RIWP provides the protocols and specifications for the proposed subsurface investigation to fully characterize the environmental quality of the soil, groundwater and soil vapor beneath the Site in anticipation of the Site remediation under the NYSDEC Brownfield Cleanup Program.

2.1 Site Description

The Site is located at 1321 Webster Avenue in the Fordham North section of Bronx, New York and is identified as Block 2887 and Lot 179 on the New York City Tax Map. The Site is 19,700 square feet in area and is currently improved with an asphalt-paved parking lot used for parking that encompasses the Site footprint, a temporary structure utilized as an office space associated with parking operations, and a former tire service center located on the northern portion of the Site. **Figure 1** provides a Site Location Map.

The Site is bordered by a one-story commercial and office building to the north; Webster Avenue followed by a senior center urgent care facility and a multi-story residential building to the east; East 169th Street followed by a five-story mixed-use commercial and residential building to the south; and multiple two- to three-story residential buildings to the west. The surrounding neighborhood is characterized by multi-story residential and commercial use buildings.

A Receptor Survey was performed within a 500-foot radius of the Site. The results of the sensitive receptor database search identified the following sensitive receptors within the target radius:

- Wildflower New York Charter School at 1343 Webster Avenue, appr. 250 feet to the north-northeast
- Early Scholars Group Family Daycare at 1348 Webster Avenue, appr. 500 feet to the north-northeast
- William Hodson Community Center at 1320 Webster Avenue, appr. 100 feet to the east

Other potential sensitive receptors include residential facilities situated in the immediate vicinities of the Site. No other sensitive receptors including schools, day care, hospitals, rivers or streams were identified within the search distance of 500 feet from the Site.

2.2 Site History

Based on the Phase I Environmental Site Assessment (ESA) completed by H & A of New York Engineering and Geology, LLP (Haley & Aldrich of New York) in December 2024, the Site was first developed in the early 1940s with multiple one-story buildings. The Site was depicted on the 1951 Sanborn Map with multiple one-story buildings labeled as storefronts, an electroplating facility, a carpet cleaner, a carpenter, a machine shop, and an office. Between 1940 and 1961, the Site was occupied by multiple tool and manufacturing shops according to the City Directory labeled as Paragon Tool & Die Company Inc., Adro Tool & Manufacturing Corp., and Metal Inlays Corp. By 1965, the northern portion of the Site operated as a commercial dry-cleaning facility named "Claremont Village Cleaning Center." Dry-cleaning operations continued at the Site until at

least 1979 and by 1980 the dry-cleaning facility was razed. According to the 1984 aerial imagery, the remaining buildings on the Site were razed. By 1989, a gasoline filling station with a fuel island canopy located in the center was depicted on aerial imagery at the Site until at least 2015. According to previous reports, a 550-gallon waste oil underground storage tank (UST) was removed on 24 August 1998 and four 4,000-gallon gasoline USTs and one 4,000-gallon diesel fuel UST associated with the gasoline filling station at the Site were reportedly removed in August 2015. On the 2019 aerial imagery, the Site was depicted as an asphalt paved parking lot. The Site is currently improved with an asphalt-paved parking lot used for parking that encompasses the Site footprint, a temporary structure utilized as an office space associated with parking operations, and a former tire service center located on the northern portion of the Site.

2.3 Previous Remediation and Investigation

To date, the following previous reports and investigations have been prepared for the site:

- *NYSDEC Spill Report Form, Spill Number 9807143*, prepared by NYSDEC, created 11 September 1998, last updated 18 May 2005.
- *NYSDEC Spill Report Form, Spill Number 0001454*, prepared by NYSDEC, created 4 May 2000, last updated 2 March 2016.
- *Quarterly Monitoring Report, Third Quarter 2005, Former Amoco Service Station Number 312, NYSDEC Spill Number 98-07143*, Prepared by Delta Environmental Consultants, Inc. (Delta), Prepared for Atlantic Richfield Company, a BP Affiliated Company, 1 November 2005.
- *NYSDEC Spill Number: 00-01454, Former Amoco Station 00312, 1303 Webster Avenue, Bronx, NY Proposed Monitoring Well Location*, Prepared by Delta,

Prepared for Atlantic Richfield Company, a BP Affiliated Company, 27 February 2009.

- *Work Plan for Sulfate Application Pilot Test, Former Amoco Service Station Number 312*, Prepared by Arcadis U.S., Inc. (Arcadis), Prepared for BP Products North America, 16 March 2010.
- *Results of Third Quarter 2011 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 4 January 2012.
- *Results of Fourth Quarter 2011 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 14 March 2012.
- *Results of First Quarter 2012 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 9 April 2012.
- *Results of Second Quarter 2012 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 19 July 2012.
- *Results of Third Quarter 2012 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 18 October 2012.
- *Results of Fourth Quarter 2012 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 25 March 2013.
- *Results of Second Quarter 2013 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 3 July 2013.
- *Results of Fourth Quarter 2013 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 19 February 2014.
- *Results of First Quarter 2014 Groundwater Monitoring*, Prepared by Arcadis, Prepared for BP Products North America, 2 June 2014.
- *Request for No Further Action – Receptor Evaluation Report*, Prepared by Arcadis, Prepared for BP Products North America, 4 September 2014.

- *Former Service Station, Underground Storage Tanks (USTs) Closure Report, Spill #0001454*, Prepared by Berninger Environmental, Prepared for NYSDEC, 21 September 2015.
- *Addendum to "Request for No Further Action – Receptor Evaluation Report,"* Prepared by Arcadis, Prepared for BP Products North America, 7 October 2015.
- *Spill Closure Notice for NYSDEC Spill No. 00-01454, Former BP 312*, Prepared by NYSDEC, Prepared for Atlantic Richfield Company, 29 January 2016.
- *Monitoring Well Decommissioning Report*, Prepared by Arcadis, Prepared for BP Products North America, 29 February 2016.
- *Geotechnical Investigation and Report for Proposed 7-Story Residential Building, 1311 Webster Avenue, Bronx, New York*, prepared by SESI Consulting Engineers P.C. (SESI), prepared for Jarmel Kizel Architects and Engineers, Inc., 14 March 2016.
- *Phase I Environmental Site Assessment (ESA)*, prepared by Merritt Environmental Consulting Corp. (MECC), prepared for Spaxel Development, LLC, 6 August 2020.
- *Focused Subsurface Site Investigation (FSSI)*, prepared by MECC, prepared for Spaxel Development, LLC, 17 August 2020.
- *FSSI Findings Letter, 1301-1321 Webster Avenue*, Prepared by MECC, Prepared for Spaxel Development, 25 September 2020.
- *Groundwater Monitoring Well Sampling & Laboratory Analysis, 1301-1321 Webster Avenue*, Prepared by MECC, Prepared for Spaxel Development, LLC, 29 September 2020.

- *Draft Limited Phase II Environmental Site Assessment Report*, prepared by Vektor Consultants, LLC (Vektor), prepared for First Class Management & Development LLC, 15 July 2024.
- *Phase I Environmental Site Assessment Report,* prepared by Haley & Aldrich of New York Engineering and Geology, LLP (H&A), prepared for Webster Plaza NY LLC, 1 December 2024

A summary of the environmental findings of these reports is provided below:

NYSDEC Spill Report Form, Spill Number 9807143, prepared by NYSDEC, created 11 September 1998, last updated 18 May 2005

Spill No. 9807143 was reported to the NYSDEC on 11 September 1998 due to petroleum-related contamination identified in soil samples collected at the subject property during removal of the 500-gallon waste oil UST. Approximately 14 tons of impacted soil were removed. On 19 November 2004, the spill case was closed and transferred to Spill No. 0001454.

NYSDEC Spill Report Form, Spill Number 0001454, prepared by NYSDEC, created 4 May 2000, last updated 2 March 2016

Spill No. 0001454 was reported on 4 May 2000 due to a tank test failure for one of the 4,000-gallon gasoline USTs on the subject property, resulting in a release to soil. This spill report summarizes historical remediation and monitoring activities associated with the spill case, including the following:

- A Feasibility Pilot Testing, Analysis, and Report for Multi-Phase Extraction by Delta was submitted to NYSDEC on 25 November 2003. The pilot test consisted of applying vacuum to the vadose and saturated zones and measuring extraction rates of light non-aqueous phase liquid (LNAPL) and vapors at monitoring well MW-1. Approximately 1,194

gallons of water and 40 gallons of LNAPL were removed from MW-1 and approximately 57.5 gallons of LNAPL and vapors were removed.

- Quarterly groundwater monitoring was conducted from 2003 to 2014. The quarterly groundwater monitoring reports suggested a significant percent reduction in benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations at the Site.
- A Remedial Action Plan (RAP) was submitted to NYSDEC (including 25 November 2003 pilot test results) for implementation of multi-phase extraction (MPE). The RAP was approved by NYSDEC on 20 April 2005.
- MPE implementation began in May 2005 and MPE Remedial Event Reports were submitted to NYSDEC. The 18 December 2006 MPE Remedial Event Report indicated that a total of 20 pounds (lbs) of BTEX and 453.25 lbs of total petroleum hydrocarbon (TPH) soil vapors were extracted, and 76,122 gallons of groundwater were removed from the Site since May 2005.
- By April 2007, the MPE events no longer had recovery. A RAP for surfactant injection and water recovery in the wells located in the sidewalk along Webster Avenue, where contamination was reportedly contained, was submitted to NYSDEC.
- As of June 2012, three rounds of injections were completed. Three wells were treated with sulfate solution in March 2012, resulting in a 75 percent reduction of BTEX in MW-8, 66 percent reduction in MW-9, and a 23 percent reduction in EW-1, all of which are located in the sidewalk adjacent to the subject property along Webster Avenue. Benzene was reportedly not responding as well as toluene, ethylbenzene, and total xylenes. A Vacuum Truck Extraction (VTE) event was completed to

remove residual product at IW-2 prior to the March 2012 sulfate injection event.

- As of August 2013, an Epsom salt injection was completed at the Site, resulting in reduced BTEX concentrations.
- Per the NYSDEC record, Spill No. 0001454 was closed on 29 January 2016 based on the following:
  - Source removal was completed on 24 August 1998, including the removal of one 550-gallon waste oil UST and excavation of 14 tons of soil;
  - Source removal was completed in August 2015, including the removal of six pump islands and associated electric wiring and piping, four 4,000-gallon gasoline USTs, one 4,000-gallon diesel fuel UST (with 28 endpoint samples collected, showing minor exceedances), and excavation and disposal of 57.77 tons of petroleum-impacted soil;
  - Delineation of petroleum-related impacts was completed which suggested that soil contamination was contained to the southeastern portion of the Site in the area of the former USTs. Petroleum-impacted soil was removed to bedrock or the extent feasible during UST removal in 2015;
  - Bedrock seismic investigation was completed, indicating bedrock depths between 3 and 25 ft below ground surface (bgs) with the shallowest bedrock located in the northwestern portion of the subject property and the deepest in the southeastern portion of the subject property in the former UST area (overburden groundwater likely pooled within the blasted-out tank mat area);
  - Delineation of groundwater contamination was completed, and

groundwater flow is to the east. Downgradient delineation was completed at MW-10, MW-11, and MW-12, which showed no contamination migration across Webster Avenue, suggesting that the groundwater contamination plume is contained to the sidewalk area adjacent to the subject property;

- The MPE pilot test in MW-1 removed 1,194 gallons of water and 40 gallons of LNAPL;
- Injections were performed to remediate petroleum-related groundwater contamination;
- No detectable product remained in IW-2 following removal of the absorbent sock, however, no dissolved phase groundwater sampling was completed because sampling was done previously and the absence of LNAPL likely resulted in lower concentrations in the dissolved phase than previous results;
- There were no sensitive receptors as the petroleum-related groundwater contamination plume was contained beneath the sidewalk and did not migrate across the street;
- There was no future change in Site use at that time; and,
- The spill closure letter included provisions regarding remaining contamination in the event that the Site was redeveloped.

- The spill case was closed by NYSDEC on 29 January 2016.

On 2 March 2016, the NYSDEC received a Monitoring Well Decommissioning Report dated 29 February 2016 which described the decommissioning of a total of eight monitoring wells (MW-1, MW-5, MW-7 through 12), EW-1, and IW-1 through IW-4 in accordance with NYSDEC Commissioner Policy (CP)-43.

Quarterly Monitoring Report, Third Quarter 2005, Former Amoco Service Station #312, NYSDEC Spill Number 98-07143, Prepared by Delta Environmental Consultants, Inc. (Delta), Prepared for Atlantic Richfield Company, 1 November 2005

This report summarizes the quarterly groundwater sampling conducted at the Site in August 2005, including the network of four on-Site monitoring wells (MW-1, MW-2, MW-3, and MW-5), six off-Site monitoring wells (MW-7, MW-8, MW-9, MW-10, MW-11, and MW-12), and one off-Site extraction well (EW-1). MW-8 and EW-1 were not sampled due to the presence of LNAPL (0.29 ft and 0.02 ft, respectively), and MW-4 and MW-6 were abandoned on 22 December 2004.

Groundwater analytical results indicated the following: BTEX constituent concentrations were detected above applicable NYSDEC Division of Water Technical and Operational Guidance Series (TOGS 1.1.1) Ambient Water Quality Standards and Guidance Values (AWQS) standards in four of the nine monitoring wells sampled, at a maximum total BTEX concentration of 7,726 parts per billion (ppb) in MW-9; and methyl tert-butyl ether (MTBE) was detected at concentrations above applicable AWQS in four of the nine monitoring wells sampled, at a maximum concentration of 1,250 ppb in MW-9.

NYSDEC Spill Number: 00-01454, Former Amoco Station 00312, 1303 Webster Avenue, Bronx, NY Proposed Monitoring Well Location, Prepared by Delta, Prepared for Atlantic Richfield Company, 27 February 2009

Delta prepared a work plan for the installation of one monitoring well in the sidewalk southeast of the subject property along East 169th Street on behalf of Atlantic Richfield Company, a BP Products North America-affiliated company. Delta noted that the proposed monitoring well would be added to the quarterly

monitoring schedule. It is unknown whether this monitoring well was installed.

Work Plan for Sulfate Application Pilot Test, Former Amoco Service Station Number 312, Prepared by Arcadis U.S., Inc (Arcadis), Prepared for BP Products North America, 16 March 2010

On behalf of BP Products North America, Arcadis submitted a work plan for a Sulfate Application Pilot Test in March 2010 to NYSDEC. The work plan included the installation of four shallow injection wells located in the sidewalk adjacent to the subject property along Webster Avenue (IW-1 through IW4), that would be utilized for the injection of a magnesium sulfate solution.

Results of Third and Fourth Quarter 2011 Groundwater Monitoring, Prepared by Arcadis, Prepared for BP Products North America, 4 January 2012 and 14 March 2012

Quarterly Groundwater Monitoring Reports were prepared by Arcadis, summarizing quarterly groundwater monitoring activities completed at the subject property by EnviroTrac Ltd. (EnviroTrac). Additionally, the third quarter report summarizes the injection of magnesium sulfate in August 2011 and post-injection groundwater gauging and monitoring events. The third quarter groundwater sampling event was completed in August 2011 and the fourth quarter in October 2011.

During the third quarter gauging event, LNAPL was observed in IW-2 at a thickness of 0.08 ft. Groundwater analytical results from the August 2011 sampling event included detections of BTEX constituents above the AWQS in five wells, primarily in wells located within the sidewalk east of the subject property and downgradient of the tank mat area, at a maximum total BTEX concentration of 11,000 micrograms per liter (µg/L) in MW-9. MTBE was not

detected in any of the groundwater samples collected.

During the fourth quarter gauging event, LNAPL was observed in IW-2 at thicknesses of 0.13 ft, 0.07 ft, and 0.02 ft. Groundwater analytical results from the October 2011 sampling event included concentrations of BTEX constituents above the AWQS in four wells, at a maximum total BTEX concentration of 11,000 µg/L in IW-4. MTBE was not detected in any of the groundwater samples collected.

Results of First, Second, Third, and Fourth Quarter 2012 Groundwater Monitoring, Prepared by Arcadis, Prepared for BP Products North America, 9 April 2012, 19 July 2012, 18 October 2012, and 25 March 2013

These reports summarize the quarterly groundwater sampling conducted at the Site in 2012, the monthly groundwater gauging events, injection events and post-injection treatment monitoring, and VTE.

LNAPL was observed in IW-2 at a thickness of 0.03 ft during the first quarter of 2012. Groundwater analytical results from the January 2012 sampling event included detections of BTEX constituents above the AWQS in three groundwater samples, at a maximum total BTEX concentration of 3,700 µg/L in MW-9.

LNAPL was not observed during the second and third quarter gauging events. Groundwater analytical results during the April 2012 sampling event included detections of BTEX constituents above the AWQS in one groundwater sample, at a maximum total BTEX concentration of 3,500 µg/L in MW-9.

Groundwater analytical results during the July 2012 sampling event included detections of BTEX constituents above the AWQS in two groundwater samples, at a maximum total BTEX concentration of 3,400 µg/L in MW-9.

Additional post-injection groundwater sampling was conducted in

September 2012. Groundwater analytical results during the September 2012 sampling event included detections of BTEX constituents above AWQS in five groundwater samples, at a maximum total BTEX concentration of 7,200 µg/L in IW-1.

LNAPL was not observed during the fourth quarter gauging events. Groundwater analytical results during the December 2012 sampling event included detections of BTEX constituents above the AWQS in six groundwater samples, at a maximum total BTEX concentration of 5,700 µg/L in IW-4. MTBE was detected in IW-1 at a concentration of 11.0 µg/L.

MTBE was not detected in any groundwater samples collected in 2012, with the exception of the groundwater sample collected from IW-1 during the December 2012 sampling event.

Arcadis requested the removal of monitoring wells from the monitoring program with no detections of Site constituents above AWQS for an extended period of time, including MW-1, MW-2, MW-3, MW-5, MW-11, and MW-12.

Results of Second and Fourth Quarter 2013 Groundwater Monitoring, Prepared by Arcadis, Prepared for BP Products North America, 3 July 2013 and 19 February 2014

Arcadis summarized the second quarter groundwater sampling conducted at the subject property in April 2013 and the fourth quarter sampling in October 2013. Sampling of the on- and off-Site monitoring well network was conducted.

LNAPL was detected in IW-2 at a thickness of 0.04 ft in April 2013. Groundwater analytical results from the April 2013 sampling event included detections of BTEX constituents above the AWQS in four groundwater samples, at a maximum total BTEX concentration of 10,300 µg/L in IW-1. MTBE was detected in IW-1 at a concentration of 23.0 µg/L.

Additional post-injection groundwater sampling was conducted in September 2013. Groundwater analytical results from the September 2013 sampling event did not include detections of BTEX above the AWQS in any groundwater samples collected. A maximum total BTEX concentration of 1,870 µg/L was detected in MW-9, and MTBE was not detected in any groundwater sample collected.

LNAPL was detected in IW-2 at a thickness of 0.02 ft in October 2013. Groundwater analytical results from the October 2013 sampling event did not include detections of BTEX above the AWQS in any groundwater sample collected. A maximum total BTEX concentration of 3,900 µg/L was detected in MW-9, and MTBE was not detected in any groundwater sample collected.

Results of First Quarter 2014 Groundwater Monitoring, Prepared by Arcadis, Prepared for BP Products North America, 2 June 2014

Arcadis prepared this report to summarize quarterly groundwater sampling activities completed at the subject property in January 2014. Sampling of the on and off-Site monitoring well network was conducted.

LNAPL was not observed in the monitoring or injection wells during this event. Groundwater analytical results included detections of BTEX constituents above the AWQS in one groundwater sample collected, at a maximum total BTEX concentration of 5,340 µg/L in MW-9. MTBE was not detected in any groundwater sample collected.

Request for No Further Action – Receptor Evaluation Report, Prepared by Arcadis, Prepared for BP Products North America, 4 September 2014

On behalf of BP Products North America, Arcadis submitted a Request for No

Further Action to the NYSDEC in September 2014 to close Spill Case #0001454. At the time of the request, the subject property was operating as a service station, including a kiosk, six product dispensing pumps, a pump island canopy, a coin-operated car wash, an air pump station, vacuum machines, and five 4,000-gallon gasoline USTs with associated piping. Four on-Site monitoring wells (MW-1, MW-2, MW-3, and MW-5), six off-Site monitoring wells (MW-7 through MW-12), and one off-Site extraction well (EW-1) were also present.

Previous environmental investigations completed at the subject property to evaluate petroleum-related hydrocarbon contamination in soil began in November 1999, after petroleum hydrocarbons were detected in soil during removal of a 550-gallon used oil UST. Several soil borings were advanced at the subject property between November 1999 and December 2004, and 15 soil samples were collected for VOC analysis. The results of this sampling event identified volatile organic compounds (VOCs) above applicable NYSDEC soil cleanup objectives (SCOs) in one soil sample only, specifically, benzene at a concentration of 123 micrograms per kilogram (µg/kg) in SB-2 at a depth of 10 to 12 ft bgs. Soil delineation results indicated that the petroleum-related soil impacts were limited to the vicinity of the tank field.

Previous groundwater investigation activities included the installation of 13 groundwater monitoring wells (MW-1 through MW-12 and EW-1) and the collection of associated groundwater samples for analysis of VOCs and SVOCs. BTEX and MTBE were detected consistently above NYSDEC standards.

A hydrocarbon fingerprint analysis, a geophysical survey, a soil gas survey, and a bedrock seismic survey were completed at the subject property. The hydrocarbon fingerprint analysis of LNAPL sampled from MW-1 indicated that the product was a very highly weathered and degraded regular-grade gasoline

that had been in the subsurface for an extended period of time, and that almost 2 percent of the product was a distillate fuel that had been in the subsurface for less than 10 years. The geophysical survey indicated that an irregular-shaped LNAPL area existed below the surface approximately 20 ft to the west, south, and north of MW-1. The soil gas survey indicated total VOC concentrations in excess of background ambient concentrations were present between the sidewalk on Webster Avenue and the northern kiosk dispenser, and between the sidewalk and the southeastern portion of the tank mat. The bedrock seismic survey indicated that bedrock is present between 3 and 25 ft bgs, is shallowest in the northwestern portion of the subject property, and is deepest in the southeastern portion of the subject property near the gasoline USTs (which was indicated as likely blasted to facilitate installation of the USTs).

Previous remedial actions to address petroleum-related contamination at the subject property included the excavation and removal of approximately 14 tons of petroleum-impacted soil from the subject property in August 1998 and a pilot test to address remaining hydrocarbon impacts on the subject property. Arcadis proposed the pilot test to evaluate the effectiveness of magnesium sulfate hepta hydrate and Epsom salt (magnesium sulfate) application to the source area using newly installed shallow off-Site injection wells IW-1 through IW-4.

The first injection event consisted of a tracer test. Prior to the commencement of the second through fourth injection events, each of the four injection wells was gauged and sampled for BTEX. The second injection event was completed between 29 November 2011 and 2 December 2011, in injection wells IW-1, IW-3, and IW-4. The third injection event was completed between 26 March 2012 and 29 March 2012, in the same injection wells, and utilized an increased volume of solution. The fourth injection event was completed between 9 September 2013

and 12 September 2013 and included injections in the same wells. Gypsum was added to the injection solution during the fourth event to provide a long-term sulfate source. Performance monitoring wells and injection wells were sampled, and water quality parameters were collected during the injection events. The results of groundwater sampling indicated the highest hydrocarbon concentrations located within the vicinity of MW-9 and EW-1, with decreasing trends in concentrations and a significant percent reduction in total BTEX concentrations in groundwater at the subject property over time. Post-injection monitoring data indicated that sufficient quantities of sulfate remained in the subsurface to promote monitored natural attenuation (MNA).

A playground associated with the apartment complex across the street from the subject property was identified during a limited sensitive receptor survey conducted by Delta on 3 April 2003. Arcadis concluded that no off-Site exposure pathways were present based on analytical data from previous on-Site and off-Site sampling.

BTEX concentrations remained above the AWQS in EW-1, MW-8, and MW-9. Total BTEX concentrations showed as much as a 95 percent reduction from the highest concentrations measured historically, with EW-1 and MW-9 each showing a 53 percent reduction and MW-8 showing a 95 percent reduction for two or more quarters of groundwater monitoring, as of April 2014. As such, Arcadis requested closure of NYSDEC Spill No. 0001454.

Former Service Station Underground Storage Tanks (USTs) Closure Report, Spill #0001454, Prepared by Berninger Environmental, Prepared for NYSDEC, 21 September 2015

On 21 September 2015, Berninger Environmental submitted a UST Closure

Report to the NYSDEC. The report summarized the activities associated with the excavation, uncovering, and removal of five 4,000-gallon fuel tanks, six pump islands, and all equipment and piping associated with the pumps and USTs at the subject property. Approximately 58 tons of soil were excavated and separated for off-Site disposal. The excavation area was backfilled with clean soil segregated from the UST excavation pit and virgin fill material from an off-Site source. Confirmation soil samples were collected with detected concentrations below NYSDEC SCOs for VOCs, with the exception of 1,2,4-trimethylbenzene in one soil sample.

Additionally, PAHs were detected at concentrations exceeding NYSDEC SCOs.

Addendum to "Request for No Further Action – Receptor Evaluation Report," Prepared by Arcadis, Prepared for BP Products North America, 7 October 2015

Arcadis submitted an Addendum to the previously submitted Request for No Further Action for NYSDEC Spill Case No. 0001454 on 7 October 2015. The Addendum summarized the activities outlined in the Berninger Environmental UST Closure Report.

Spill Closure Notice for NYSDEC Spill No. 00-01454, Former BP 312, Prepared by NYSDEC, Prepared for Atlantic Richfield Company, 29 January 2016

The NYSDEC issued a spill closure notice for spill number 0001454 on 29 January 2016, which indicated that all wells associated with the project were to be closed according to the NYSDEC's Groundwater Monitoring Well Decommissioning Procedures and further indicated that if subsurface contamination is encountered while excavating for any future construction work,

appropriate remedial and vapor mitigation efforts must be taken to fully prevent vapor intrusion into any Site development and to ensure human health and safety.

Monitoring Well Decommissioning Report, Prepared by Arcadis, Prepared for BP Products North America, 29 February 2016

Arcadis submitted a Monitoring Well Decommissioning Report to NYSDEC on 29 February 2016. The report stated a total of eight monitoring wells, one extraction well, and four injection wells were decommissioned by Clean Environmental, LLC of Brentwood, New York. The wells were abandoned in accordance with the NYSDEC CP-43: Groundwater Monitoring Well Decommissioning Policy (November 2009) (CP-43). It should be noted that two monitoring wells (MW-2 and MW-3) could not be located on the subject property. Arcadis believed that these wells were destroyed during previous redevelopment activities, which began in August 2015.

Geotechnical Investigation and Report for Proposed 7-Story Residential Building, 1311 Webster Avenue, Bronx, New York, prepared by SESI Consulting Engineers P.C. (SESI), prepared for Jarmel Kizel Architects and Engineers, Inc., 14 March 2016

SESI completed a preliminary geotechnical investigation at the subject property in March 2016, including installation of eight borings to a maximum depth of 20 ft bgs, and excavation of six test pits to a maximum depth of 3 ft bgs primarily along the western side of the subject property to determine bedrock depth in these areas.

The following observations were made during the investigation:

- Uncontrolled fill predominantly consisted of medium to fine sand with varying amounts of silt and gravel encountered below the surface material to depths of approximately 9 to 10 ft bgs. Fill was underlain by a layer of natural glacial till soil deposits consisting primarily of brown coarse to fine sand with varying amounts of silt and gravel. This stratum was only encountered within Boring 8 and extended to the completion depth of the boring. The sand layer was underlain by bedrock, which was encountered in all the test borings and test pit excavations at depths ranging from 2 to 20 ft bgs. The rock was cored in five of the eight borings for a depth of 5 ft. The rock recovered from the coring operation was identified as slightly fractured gray, white gneiss.
- Groundwater was reportedly not encountered in any of the borings.

Phase I Environmental Site Assessment (ESA), prepared by Merritt Environmental Consulting Corp. (MECC), prepared for Spaxel Development, LLC, 6 August 2020

MECC completed a Phase I ESA for the subject property for Spaxel Development, LLC in August 2020. The Phase I ESA noted the following Recognized Environmental Conditions (RECs):

- According to the historical sources reviewed, the 1301-1307 portion of the Site was occupied by an electroplating building and carpet cleaner during the years 1940 to 1965. In addition, according to the sources reviewed, the 1321 Webster Avenue portion of the Site was a commercial dry cleaner during the years 1965 to 1978.
- The Site was then occupied by a gasoline station during the years 1989 to 2013. As discussed in the Historical Recognized Environmental Condition (HREC) section, historical USTs and impacted soil were removed and

remediation was completed under Spill No. 0001454. MECC has been provided with NYSDEC Spill Closure Notice for Spill No. 0001454 which was issued on 29 January 2016.

- Due to the limits of a Phase I ESA and as previous investigations /remediation focused primarily on petroleum-related impacts, MECC cannot determine if any of the dry cleaning, manufacturing, and electroplating tenants utilized solvents such as PCE as part of their historical operations. Mishandling of such chemicals can lead to spills or discharges that would impact the subsurface quality of the property and potential vapor issues for any future structures. This constitutes a REC.

The Phase I ESA also noted an HREC associated with two NYSDEC spill events, spill numbers 0001454 and 9807143.

Focused Subsurface Site Investigation (FSSI), prepared by MECC, prepared for Spaxel Development, LLC, 17 August 2020

MECC performed an FSSI at the subject property to determine if the former on-Site gasoline station, electroplating operation, and/or dry cleaning operation adversely impacted the environmental conditions at the subject property. The investigation was performed on 11 August 2020 and included the installation of six soil borings to depths between 3.5 and 15 ft bgs in the parking lot area of the subject property; the installation of one temporary well to 15 ft bgs at soil boring B1 within the area of three previously removed gasoline USTs in the southern portion of the subject property; and the collection of six grab soil samples and one groundwater sample for laboratory analysis. All soil samples were analyzed for VOCs and two soil samples were analyzed for Target Analyte List Heavy Metals (TAL Metals). The groundwater sample was analyzed for VOCs and

dissolved TAL Metals.

Field observations and laboratory analytical results are summarized below:

- The stratigraphy of the Site, from the surface down, generally consisted of fill material composed of medium-grained sand with rock fragments, concrete fragments, and crushed brick with trace wood underlain by bedrock which was encountered at depths ranging from 3.5 to 8 ft bgs in five of the six soil borings. Bedrock was not encountered in soil boring B1, which was installed in the area of the three previously removed USTs. A water-bearing deposit was encountered in the unconsolidated material above bedrock in boring B1 at a depth of approximately 12.4 ft bgs. Additionally, a petroleum-like odor and photoionization detector (PID) reading of 80 parts per million (ppm) were observed at the soil/groundwater interface in soil boring B1. No water-bearing zones were encountered above bedrock in the remaining five borings installed at the Site.
- Soil analytical results were compared to NYSDEC Title 6 of the New York Codes, Rules and Regulations (NYCRR) Part 375 Unrestricted Use Soil Cleanup Objectives (UUSCOs) and/or CP-51 Soil Cleanup Guidance (SCG).
    - VOCs, including CVOCs (specifically PCE) and petroleum-related VOCs, were detected in soil samples B3 and B4; however, no VOCs were detected at concentrations above the UUSCOs and/or CP-51 SCG in any soil samples collected.– Soil samples B2 8’ and B3 5’-6’ were analyzed for TAL Metals. Six metals were detected at concentrations above UUSCOs and/or CP-51 SCGs in soil sample B3 5’-6’, including chromium at a concentration of 120 milligrams per kilogram (mg/kg),

hexavalent chromium at a concentration of 7.8 mg/kg, copper at a concentration of 97 mg/kg, lead at a concentration of 180 mg/kg, nickel at a concentration of 770 mg/kg, and zinc at a concentration of 170 mg/kg. No other TAL Metals were detected above UUSCOs and/or CP-51 SCGs in B3 5'-6'. No TAL Metals were detected above UUSCOs and/or CP-51 SCG in soil sample B2 8'.

- Groundwater results were compared to the New York State Department of Health (NYSDOH) Maximum Contaminant Level for drinking water and/or AWQS standards.
  - Nine VOCs (specifically petroleum-related VOCs) were detected at concentrations above applicable standards in groundwater sample B1GW, including 1,2,4-trimethylbenzene (40 µg/L), 1,3,5-trimethylbenzene (10 µg/L), ethylbenzene (10 µg/L), total xylenes (120 µg/L), naphthalene (11 µg/L), n-butylbenzene (17 µg/L), n-propylbenzene (8.7 µg/L), sec-butylbenzene (12 µg/L), and toluene (24 µg/L). Additionally, CVOCs (including PCE, TCE, and cis-1,2-dichloroethene) were detected above laboratory detection limits but below applicable standards in B1GW. No other VOCs were detected above applicable standards in this groundwater sample.
  - Three dissolved metals were detected above the AWQS in groundwater sample B1GW, including antimony (3.2 µg/L), manganese (340 µg/L), and sodium (65,000 µg/L). No other dissolved metals were detected above the AWQS in this groundwater sample.

and Findings Letter, Prepared by MECC, Prepared for Spaxel Development, LLC, 25 September 2020

MECC prepared a groundwater monitoring well sampling and laboratory analysis report for Spaxel Development, LLC on 29 September 2020 which included the installation and sampling of two bedrock groundwater monitoring wells to determine if an elevated concentration of PCE exists in bedrock groundwater. One monitoring well was installed on the eastern portion of the subject property where the former dry cleaner was present, and the second monitoring well was installed on the western portion of the subject property. Analytical results indicated that PCE was detected at a concentration of 120 ppb in the well near the former dry cleaner facility and at a concentration of 78 ppb in the well on the western portion of the Site. MECC indicated that PCE concentrations were a concern if future development was proposed at the subject property and recommended further investigation.

MECC completed a findings letter for Spaxel Development, LLC on 25 September 2020 outlining the results of the investigation.

Draft Limited Phase II Environmental Site Assessment Report, prepared by Vektor Consultants, LLC (Vektor), prepared for First Class Management & Development LLC, 15 July 2024

Vektor completed a Limited Phase II ESI at the subject property in July 2024 to evaluate the extent of chlorinated solvents in soil vapor and soil beneath the subject property due to the presence of former dry cleaning operations. The investigation included the installation of four soil borings to depths between approximately 1.5 and 5 ft bgs and six temporary soil vapor probes to depths between approximately 4 and 10 ft bgs (depending on bedrock/refusal depths),

and the collection of associated soil and soil vapor samples. A total of four soil samples, six soil vapor samples, and one ambient air sample were collected. Each of the four soil samples was analyzed for VOCs and one soil sample (SB-4) was analyzed for SVOCs. Soil vapor samples were analyzed for VOCs. Field observations and laboratory analytical results are summarized below:

Soil

- Fill generally consisting of brown fine- to medium-grained sand with varying amounts of brick, fine gravel, dark brown medium- to coarse-grained sand, and silt, was observed from the surface to depths between 1.5 to 5 ft bgs (where refusal was encountered). PID readings ranged from 0.0 ppm to 3.6 ppm in the soil samples. Groundwater was reportedly not encountered during the Phase II investigation. Groundwater is anticipated to flow to the east towards the Bronx River.
- Soil analytical results were compared to NYSDEC Title 6 NYCRR Part 375 UUSCOs and Restricted Residential Soil Cleanup Objectives (RRSCOs).
    - One VOC, PCE, was detected in all four soil samples at concentrations below its respective UUSCO (maximum concentration of 0.19 mg/kg). No VOCs were detected above applicable criteria in any soil sample collected.
    - Seven SVOCs, specifically PAHs, were detected above UUSCOs in SB-4, including benzo(a)anthracene (2.14 mg/kg), benzo(a)pyrene (2.18 mg/kg), benzo(b)fluoranthene (3.06 mg/kg), benzo(k)fluoranthene (0.968 mg/kg), chrysene (2.03 mg/kg), dibenzo(a,h)anthracene (0.41 mg/kg), and indeno(1,2,3-cd)pyrene (1.87 mg/kg). Of these, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene also exceeded

their respective RRSCOs in SB-4. No other SVOCs were detected above UUSCOs and/or RRSCOs in SB-4.

Soil vapor

- Soil vapor samples collected during the investigation were compared to the compounds listed in Table 3.1 of the Air Guideline Values (AGVs) derived by the NYSDOH located in the NYSDOH Final Guidance for Evaluating Soil Vapor Intrusion dated October 2006. Results showed trace to moderate concentrations of petroleum-related VOCs and elevated concentrations of CVOCs in all soil vapor samples.
  - Total BTEX concentrations ranged from 19.7 micrograms per cubic meter (µg/m^3) in SV-3 to 114.4 µg/m^3 in sample SV-8.
  - PCE was detected in all soil vapor samples, ranging from 200 µg/m^3 in SV-6 to 18,000 µg/m^3 in SV-1. TCE was detected in all soil vapor samples, ranging from 2.5 µg/m^3 in SV-6 to 200 µg/m^3 in SV-1. These concentrations exceed their respective NYSDOH AGVs for PCE and TCE. SV-1 was located in the former dry-cleaning area (i.e., the suspected source area in the northern portion of the subject property), and SV-6 was located in the southern portion of the subject property.

The Phase II ESI indicates that prior to this sampling event, Vektor conducted a focused soil vapor investigation on behalf of Keren Star Management in June 2024 to evaluate the subsurface conditions at the subject property. Two soil vapor probes were installed in the former dry-cleaning area to a maximum depth of 2.5 ft bgs and two soil vapor samples were collected. Additionally, one ambient background air sample was collected. Elevated concentrations of CVOCs were detected, as were trace concentrations of petroleum-related VOCs. Vektor

recommended further investigation to delineate the horizontal extent of the soil vapor contamination at the subject property.

Phase I Environmental Site Assessment Report, prepared by Haley & Aldrich of New York Engineering and Geology, LLP (H&A), prepared for Webster Plaza NY LLC, 1 December 2024

Based on the Phase I Environmental Site Assessment (ESA) completed by H & A in December 2024, the Site was first developed in the early 1940s with multiple one-story buildings. The Site was depicted on the 1951 Sanborn Map with multiple one-story buildings labeled as storefronts, an electroplating facility, a carpet cleaner, a carpenter, a machine shop, and an office. Between 1940 and 1961, the Site was occupied by multiple tool and manufacturing shops according to the City Directory labeled as Paragon Tool & Die Company Inc., Adro Tool & Manufacturing Corp., and Metal Inlays Corp. By 1965, the northern portion of the Site operated as a commercial dry-cleaning facility named "Claremont Village Cleaning Center." Dry-cleaning operations continued at the Site until at least 1979 and by 1980 the dry-cleaning facility was razed. According to the 1984 aerial imagery, the remaining buildings on the Site were razed. By 1989, a gasoline filling station with a fuel island canopy located in the center was depicted on aerial imagery at the Site until at least 2015. According to previous reports, a 550-gallon waste oil underground storage tank (UST) was removed on 24 August 1998 and four 4,000-gallon gasoline USTs and one 4,000-gallon diesel fuel UST associated with the gasoline filling station at the Site were reportedly removed in August 2015. On the 2019 aerial imagery, the Site was depicted as an asphalt paved parking lot. The Site is currently improved with an asphalt-paved parking lot used for parking that encompasses the Site footprint, a temporary

structure utilized as an office space associated with parking operations, and a former tire service center located on the northern portion of the Site.

The December 2024 Phase I ESA identified the following Recognized Environmental Conditions (RECs) in connection with the Site:

- Historical use of the Subject Property for manufacturing, dry-cleaning, and auto-related purposes
- Known sub-surface contamination at the Subject Property documented in previous Focused Subsurface Investigation, groundwater sampling and Phase II Investigation by others between August 2020 and July 2024.

No Controlled RECs (CRECs) were identified at the Subject Property.

The following Historic RECs (HRECs) were identified:

- Closed spill case associated with former leaking UST (spill #0001454)

The following De Minimis Conditions were identified at the Subject Property:

- Poor housekeeping such as open containers and poor storage of petroleum/chemical products and minor staining on the pavement floor and in the stormwater drains.

The following findings were also listed in the Phase I but were categorized conditions with potential risks that are not clearly identified in the ASTM standards:

- Historic use of the north-adjacent property at 1325 Webster Avenue as auto repair between at least 1951 and early 1990s.
- Six USTs were listed in the Subject Property-related Petroleum Bulk Storage (PBS) database under facility ID 2-602002. Five of the six USTs were reportedly removed in 2015 while the related PBS records remained "Temporarily Out of Service" and should be updated following the tank removal.

Out of the previous remediations and investigations listed above, the following reports are available and provided as part of the BCP Application:

- Geotechnical Investigation and Report, 1311 Webster Avenue, Bronx, NY, March 2016, SESI.
- Focused Subsurface Investigation, 1301-1321 Webster Avenue, Bronx, NY, August 2020, MECC.
- Draft Limited Phase II Environmental Site Assessment, 1321 Webster Avenue, Bronx, NY, Vektor Consultants.
- Phase I Environmental Site Assessment Report, 1321 Webster Avenue, Bronx, NY, December 2024, Haley & Aldrich of New York Engineering and Geology, LLP.

The results from July 2024 Limited Phase II and August 2024 Focused Subsurface Site Investigation are also mapped out and included as **Figure 2, 3 and 4**.

2.4 Environmental Setting

The Site is located in southwestern portion of Bronx, New York. The elevation of the Subject Property is approximately 35 feet above mean sea level (USGS 7.5-Minute Central Park, New York Quadrangle, 2019).

Based upon the United States Geological Survey Bedrock Map of New York, bedrock underlying the Site is the Inwood Marble Formation, which consists of dolomite marble, calc-schist, granulite, and quartzite, overlain by calcite marble.

Based upon the Limited Phase II ESA by Vektor in July 2024, it is estimated that the groundwater flows east towards the Bronx River. Groundwater was encountered between 5 and 14 feet bgs.

2.5 Objective & Project Goals

The objective of the RIWP is to set forth the details and protocols for the characterization of the environmental quality beneath the Site by further delineating the extent of soil, groundwater and soil vapor contamination at the Site, addressing data gaps from previous investigations and developing necessary remedial scopes based upon the known contamination.

All the fieldwork will be performed in accordance with 6NYCRR Part 375-3.8, along with NYSDEC DER-10 and applicable NYSDOH Guidance for Evaluating Soil Vapor Intrusion.

3.0 INVESTIGATION SPECIFICATIONS

3.1 Introduction

The purpose of this section is to document the details and protocols intended to be utilized in the delineation of the contamination present on-site or emanating from adjacent properties, the determination of the site-specific groundwater flow direction and the general characterization of those portions of the Site that have yet not been investigated. To accomplish this, HydroTech will install and sample a series additional soil probes, monitoring wells and soil vapor probes utilizing direct-push technology. Select soil, groundwater and soil vapor samples will be analyzed via approved analytical methods, and all laboratory results will be evaluated and documented in a Remedial Investigation Report. All these activities will be implemented consistent with a NYSDEC BCP Citizen Participation Plan (CPP) and in accordance to a site-specific Health and Safety Plan (HASP) and a Community Air Monitoring Plan (CAMP). Contaminated soil and water generated during an investigation will be containerized in DOT-approved 55-gallon drums and will be subject to waste characterization sampling consistent with disposal facilities requirements. **Appendix A** provides a Site-specific HASP. **Appendix B** provides a Site-specific CAMP.

Prior to the performance of the fieldwork, a public utility mark-out will be requested from the New York City-Long Island One-Call Center. All work will be coordinated with representatives of the NYSDEC. Building demolition will be performed prior to the start of investigation to facilitate the sampling at the building's footprint.

3.2 Soil Probes

A total of thirteen (13) soil probes designated RISB-1 through RISB-13 will be installed throughout the Site.

The purpose of these soil probes is to characterize whether a source area is present on-site or emanating from off-site and delineate the extent of contamination in soil horizontally and vertically from grade to the interface with groundwater.

Specifically, RISB-1 through RISB-13 will be installed across the Site to groundwater interface varying between 5 to 14 feet bgs within the range of or in the direct vicinity of former underground tanks, dispenser island and electroplating operations and former drycleaner as mapped in **Figure 5**.

All soil probes will be installed utilizing a Geoprobe® drill rig, which operates via direct-push (hydraulic percussion) technology and can be fitted with Geoprobe® tooling and sampling equipment.

Soil sampling will comply with NYSDEC DER-10 3.5.2. Soil samples will be collected in all probes at 2-foot intervals utilizing a 5-foot long Macro Core sampler fitted with dedicated acetate liners. The Macro sampler allows for the collection of discrete soil samples. Each sampler will be installed with 2½-inch diameter drill rods.

The soil samples will be placed in clean zip-lock storage bags and characterized in the field by a HydroTech geologist. The characterization will consist of field screening for evidence of organic vapors utilizing a Photoionization Detector (PID) with an 11.7eV bulb and soil classification. Headspace analyses will be conducted on each soil sample by partially filling a zip lock bag and sealing it, thereby creating a void. This void is referred to as the

sample headspace. To facilitate the detection of any hydrocarbons contained within the headspace, the container will be agitated for a period of thirty (30) seconds. The probe of the PID will then be placed within the headspace to measure the hydrocarbon concentrations present.

The soil classification will be based upon the Unified Soil Classification System (USCS). The USCS identifies common soil details such as grain size, shape, sorting and color. In addition, any visual or olfactory evidence of hydrocarbons will be identified. Soil probe logs will be generated based upon the soil characterization, along with the PID field screening. **Appendix C** provides a sample boring log.

Two (2) soil samples will be collected for lab analysis from each soil probe and will consist of the shallow sample from 2-foot interval below surface grade and from 2-foot interval above the groundwater interface or bedrock, whichever is encountered first. A third sample will be collected if it exhibits a considerable level of hydrocarbons based upon the field screening results or will be collected from the historic fill layer if fill material was not intercepted in any of the prior two samples.

All soil samples will be containerized in laboratory supplied soil jars and appropriately labeled.

Table 1 - Summary of Proposed Soil Sampling Locations and Analyses

Soil Probe (SP)	Location	Soil Characterization Depth	Analytical Methods
RISB-1, RISB-9	Northwestern portion of the Site	* Sample from surface to 2 feet bgs * Sample from 2 feet above the groundwater interface or bedrock * Sample that contains the greatest level of hydrocarbons above the groundwater interface if presents, which is not intercepted in above samples	* TCL VOCs via EPA Method 8260 * TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 * TAL Metals via EPA Method 6010 & EPA Method 7471 for Mercury * Emerging Contaminants: - 1,4-Dioxane via Method 8270 SIM
RISB-2, RISB-8	Northeastern portion of the Site, former drycleaner		
RISB-3, RISB-10	Mid-eastern portion of the Site, former fuel dispenser canopy and former used oil UST area		
RISB-4	Mid-western portion of the Site		
RISB-5	Mid-eastern portion of the Site		
RISB-6	Southwestern portion of the Site		

RISB-7, RISB-13	Southeastern portion of the Site, former diesel fuel USTs area		- 21 target Perfluorooctanoic acid (PFOA) via Modified EPA Method 537
RISB-11, RISB-12	Southern portion of the Site, former electroplating operation area		

3.3 Groundwater Monitoring Wells

Seven (7) of the soil probes (RISB-1 through RISB-7) will be converted to monitoring wells after soil sampling and designated as RIMW-1 through RIMW-7, respectively. The locations of the monitoring wells are also shown on **Figure 5**. The monitoring wells are intended to determine the current groundwater quality at the Site and to determine the horizontal groundwater flow beneath the Site.

The monitoring wells will be installed utilizing similar technology to the soil probes (i.e. direct push). All monitoring wells will be constructed of 2-inch diameter PVC. The casing of each well will be appropriately labeled inside the manhole cover by attaching a water-resistant tag listing the well identification number. **Appendix D** provides a sample well construction log.

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

Following the well monitoring, the casing elevation of each well will be surveyed by a land surveyor licensed to practice in the State of New York . The determination of the casing elevation will allow for the calculation of the groundwater elevation beneath the site, which therefore allows for the determination of the groundwater flow direction. The groundwater elevations will then be imported into a computer-contouring program to determine the site-specific groundwater flow direction.

The monitoring wells will be purged and sampled in accordance to the USEPA's Region 1 Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (EQASOP #GW4, Rev. September 19, 2017) and following the stabilization of water quality indicator parameters. Sampling of groundwater will occur following the stabilization of aquifer parameters including pH, dissolved Oxygen, redox potential or ORP, temperature, specific conductance and turbidity within specified confidence limits in the Quality Assurance Project Plan (QAPP) presented in **Appendix E**.

As per the USEPA's Low Stress/Flow Groundwater Sampling Protocol, static depth to water will also be gauged during the purging and sampling exercise.

Each groundwater sample will then be placed into laboratory supplied containers and appropriately labeled.

Table 2 - Summary of Proposed Groundwater Monitoring Well Sampling Locations and Analyses

Well ID	Location	Analysis

RIMW-1	Northwestern portion of the Site	* TCL VOCs via EPA Method 8260 * TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 * TAL Metals via EPA Method 6010 & EPA Method 7471 for Mercury * Emerging Contaminants: - 1,4-dioxane via EPA Method 8270D SIM - 21 target Perfluorooctanoic acid (PFOA) via Modified EPA Method 537
RIMW-2	Northeastern portion of the Site, former drycleaner	
RIMW-3	Mid-eastern portion of the Site, former fuel dispenser canopy and former used oil UST area	
RIMW-4	Mid-western portion of the Site	
RIMW-5	Mid-eastern portion of the Site	
RIMW-6	Southwestern portion of the Site	
RIMW-7	Southeastern portion of the Site, former diesel fuel USTs area	

3.4 Soil Vapor Sampling

Seven (7) soil vapor sampling points, designated RISV-1 through RISV-7, will be installed at the Site in accordance with the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006). The purpose of the soil vapor sampling to assess the level of the required soil vapor mitigation at the Site by further delineating the

extent of soil vapor impact underneath the Site. Previous **Figure 5** provides the location of soil vapor sampling points.

The vapor sampling point will be installed utilizing similar technology to the soil probes (i.e. direct push). Each vapor sampling point will consist of a stainless-steel screen or implant fitted with inert tubing (e.g., polyethylene) of ¼ inch diameter and of laboratory quality to the surface. The soil vapor implants will be installed in the subsurface soil to 2 feet above the groundwater interface or bedrock, whichever is encountered first based upon the soil screening results.

Porous inert backfill material (e.g. glass beads) will be used to create a sampling zone around the stainless-steel screen or implant. Soil vapor points will then be sealed above the sampling zone with a bentonite slurry to prevent outdoor air infiltration and the remainder of the borehole will be backfilled with clean material. The soil vapor probes will be finished to grade with a concrete at surface.

Soil vapor samples from each soil vapor probe will be collected utilizing 6 liter pre-cleaned, passivated, evacuated whole air Summa® Canister. A 60-cm^3 plastic syringe will be used to purge approximately 1 to 3 implant volumes (i.e. the volume of the sample probe and tube) prior to collecting the soil vapor samples. Each air sampling canister will then be connected to a flow control valve set to collect the 6-L sample over a period of 4 hours at a rate of less than 0.2 liter per minute. In order to ensure the integrity of the borehole seal and to verify that ambient air is not inadvertently drawn into the sample, a tracer gas, such as Helium, will be applied to enrich the atmosphere in the immediate vicinity of the sampling location. A portable monitoring device MGD-2002 Helium-Hydrogen Lead Detector; Model 83-219, will be utilized to analyze a real

time sample of soil vapor from each soil vapor sampling point for the tracer prior to purging and after sampling. Plastic sheeting will be used to keep the tracer gas in contact with the soil vapor point during the sampling.

Table 3 - Summary of Proposed Soil Vapor Sampling Locations and Analyses

Vapor Samples (SV)	Location	Analysis
RISV-1	Northwestern portion of the Site	VOCs and via EPA Method TO-15
RISV-2	Northeastern portion of the Site, former drycleaner	
RISV-3	Mid-eastern portion of the Site, former fuel dispenser canopy and former used oil UST area	
RISV-4	Mid-western portion of the Site	
RISV-5	Mid-eastern portion of the Site	
RISV-6	Southwestern portion of the Site	
RISV-7	Southeastern portion of the Site, former diesel fuel USTs area	

3.5 Field Management of Investigation Derived Waste

Soil and Groundwater Sampling

- Soil cuttings generated during soil probe installation and sampling will be placed into 55-gallon drum(s) and properly disposed of.
- Fluids generated during groundwater sampling and equipment decontamination will be contained in the 55-gallons drums and properly disposed of as hazardous waste.
- Fine grade sand will be applied immediately around the boreholes to prevent any runoff of storm water from discharging unknown surface contaminants into the subsurface soil and groundwater. The sand will be disposed of into 55-gallons drum(s) along the soil cuttings.
- The 55-gallon drum containing IDW will be temporarily staged in a secure area on-site at grade level and beneath the unfinished building until waste characterization sampling is complete and arrangements with permitted disposal facility are finalized for. All boreholes will be backfilled with fine grade sand and properly sealed in surface with a layer of slurry and native shallow dirt.

3.6 Laboratory Analytical Methods

As indicated in **Table 1** and **Table 2** all soil and groundwater samples will be analyzed for volatile organic compounds (VOCs) via EPA Method 8260, semi-volatile organic compounds (SVOCs) via EPA Method 8270, Pesticides via EPA Method 8081, Herbicides via EPA Method 8151, Polychlorinated biphenyls via EPA Method 8082 and TAL Metals via EPA Method 6010 and EPA Method 7471 for Mercury. Groundwater samples analysis for TAL Metals will be performed for both filtered and unfiltered samples. Soil and groundwater samples will also be analyzed for Emerging Contaminants, i.e. 1,4-Dioxane via EPA Method 8270D SIM and the 21 target Perfluorooctanoic acid (PFAS) compounds via Modified

EPA Method 537. As indicated in **Table 3** soil vapor samples will be analyzed for VOCs via EPA Method TO-15.

3.7 Quality Assurance/Quality Control

A HydroTech Quality Assurance Officer (QAO) (Ruijie Xu) will adopt a Quality Assurance Project Plan (QAPP) during the collection of soil, groundwater and soil vapor samples in order to ensure that proper procedures are performed and subsequently followed during sample collection and analysis. The QAPP for this investigation is provided in **Appendix E**.

4.0 GREEN AND SUSTAINABLE REMEDIATION AND CLIMATE RESILIENCY

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

4.1 Best Practices and Techniques

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

Typical Green Remediation Techniques	Applicable to this Work Plan (Yes or No)
Increase energy efficiency/minimize total energy use and direct/indirect CO2/GHG emissions to the atmosphere	Yes
Reduce emissions of air pollutants	Yes
Minimize habitat disturbance and create or enhance habitat or usable land	No
Conserve natural resources such as soil and	Yes

water; promote the sequestration of carbon through reforestation or afforestation	
Minimize fresh water consumption and maximize water reuse during daily operations and treatment processes	No
Prevent long-term erosion, surface runoff, and off-site water quality impacts	Yes
Prevent unintended soil compaction	No
Minimize waste or implement beneficial use of materials that would otherwise be considered a waste	No
Minimize equipment and truck idling and use sustainably produced biofuels to reduce discharges of pollutants and GHGs to the atmosphere	Yes
Utilize clean diesel (new or retrofitted) equipment to reduce emissions to atmosphere	No
Minimize truck travel for disposal to save energy, reduce emissions, reduce localized noise, vibration, and wear and tear on roads	Yes
Minimize use of heavy equipment to save	No

energy and reduce emissions	

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

1. All vehicles and fuel-consuming equipment on the Site will be shut off if not in use for more than 5 minutes;
2. Intrusive work will be limited to the proposed sampling locations to avoid significantly disturbing or damaging the existing site surface;
3. Work will be sequenced, to the extent practicable, to allow the direct loading of waste containers for off-site disposal;
4. Work will be sequenced, to the extent practicable, to limit unnecessary mobilizations to and throughout the Site; and
5. To the extent practicable, energy-efficient systems and office equipment will be utilized.

4.2 Reporting

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

4.3 Climate Resiliency Evaluation

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

4.4 Environmental Footprint Analysis

Considering the Remedial Action Work Plan will be developed based upon the findings from implementing this investigation, a preliminary analysis has been performed using SiteWise™ for the investigation. Results of the analysis for the investigation included in **Appendix G** indicate the majority of greenhouse gas emissions, potentially 12.6 tons, to be the product of on-site consumables and transportation of personnel and materials, which takes appr. 78.1% of the total emissions from the Site.

5.0 REPORT OF FINDINGS

A Remedial Investigation Report (RIR) will be prepared following the completion of the fieldwork and the laboratory analyses in accordance with DER-10 Section 3.14 and DER-31. This report will be certified by a QEP as per DER-10 Table 1.5 and will contain the findings and conclusions of the investigation and will include appropriate maps and diagrams, tabulations of all analytical data, written narratives, boring logs and well construction diagrams, well purging and sampling logs, and appendices.

The soil quality results will be compared to the 6 NYCRR Part 375 Unrestricted Residential Use and Restricted Residential Use. The groundwater quality results will be compared to the AWQS documented in NYSDEC's Technical and Operational Guidance Series (TOGS) 1.1.1. All soil samples that exceed their respective soil cleanup objectives (SCOs) and groundwater samples that exceed the Ambient Water Quality Standards (AWQS) will be highlighted in tables and shown on spider diagrams. The RIR will include the Data Usability Summary Report. Based on the results of this phase of remedial investigation, further delineation of the groundwater and soil vapor contamination may be required.

All data will also be submitted electronically to NYSDEC through the Environmental Information Management System, using the standardized electronic data deliverable (EDD) format.

5.1 Anticipated Project Schedule

The table below provides a tentative schedule for the performance of the remedial investigation and other major tasks leading to the date of issuance of a Certificate of Complete (COC). This schedule is tentative based upon the

approvals of documents by the NYSDEC. Demolition of the existing buildings will be performed in compliance with all applicable laws, rules and regulations from NYC Department of Building (DOB) and Fire Department of NYC. Prior to demolition, pre-demolition inspection and/or abatement for asbestos-containing materials will be performed by certified personnel. The demolition shall be performed by State licensed contractor supervised by NYCDOB and Fire Department of NYC to verify the appropriate protocols are followed and to ensure compliance with fire safety standards. The demolition debris will be properly disposed of at a State certified disposal facility.

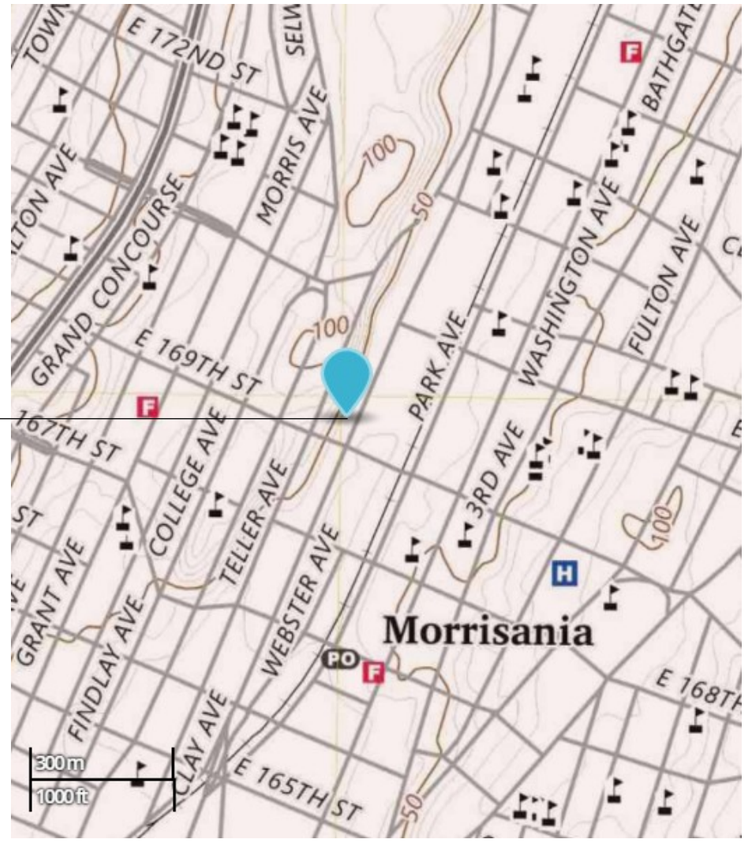
Table 4 - Summary of Anticipated Project Schedule

Schedule Milestone	Anticipated Date
Brownfield Cleanup Agreement Signed	April 2026
Submit Citizen Participation Plan (CPP)	April 2026
NYSDEC Approval of RIWP	April/May 2026
Implementation RIWP	April/May 2026
Submit RIR/RAWP	May/June 2026
Fact Sheet Announcing the 45-day Public Comment Period for RAWP Activities	July 2026
NYSDEC RAWP Approval/ Issuance of Decision Document	August/September 2026

Begin Implementation of Remedial Action	December 2026
Submittal of FER and SMP	July/August 2029
Issuance of Certificate of Completion	December 2029

FIGURES

BCP SITE:
1321 WEBSTER AVENUE, BRONX
BLOCK 2887, LOT 179



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid Universal Transverse Mercator, Zone 18T
This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, July 2017 - December 2017
Roads.....U.S. Census Bureau, 2016 2016
Names.....GNIS, 2017 2017
Hydrography.....National Hydrography Dataset, 2002 - 2022
Contours.....National Elevation Dataset, 2015
Boundaries.....Multiple sources; see metadata file 2020 - 2022
Wetlands.....FWS National Wetlands Inventory 2008 - 2011

UTM GRID AND 2023 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000
1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 MILES 1
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 FEET

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

QUADRANGLE LOCATION
1 Hackensack
2 Yonkers
3 Mount Vernon
4 Whitestoken
5 Flushing
6 Jersey City
7 Brooklyn
8 Bayonne
ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

CENTRAL PARK, NY, NJ
2023

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DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

STATE OF NEW YORK
TAREK ZAKI KHOURI
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086611

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TEL: (631) 462-5866

BASE DRAWING PREPARED BY

USGS TOPO MAP

PROJECT NAME AND ADDRESS

1321 WEBSTER AVENUE, BRONX

PROJECT FIGURE

FIGURE 1: SITE LOCATION PLAN

PROJECT NO.	DATE
260006	**2/6/26**
DRAWN BY **R.X.**	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.

Sample ID	B-3 (5'-6')	Part 375 SCOs	
Sampling Date	8/11/2020	RRSCO	UUSCO
Units	mg/kg	mg/kg	mg/kg
Total Metals			
Chromium	120	180	30
Hexavalent Chromium	7.8	110	1
Copper	97	270	50
Lead	180	400	63
Nickel	770	310	30
Zinc	170	10,000	109

Sample ID	SB-4 (1'-2')	Part 375 SCOs	
Sampling Date	7/3/2024	RRSCO	UUSCO
Units	mg/kg	mg/kg	mg/kg
SVOCs			
Benzo(a)anthracene	2.14	1	1
Benzo(a)pyrene	2.18	1	1
Benzo(b)fluoranthene	3.06	1	1
Benzo(k)fluoranthene	0.968	3.9	0.8
Chrysene	2.03	3.9	1
Dibenzo(a,h)anthracene	0.41	0.33	0.33
Indeno(1,2,3-cd)pyrene	1.87	0.5	0.5

LEGEND:

- SITE BOUNDARY
- JULY 2024 LIMITED PHASE II SOIL BORING LOCATION
- AUGUST 2024 FOCUSED SUBSURFACE SITE INVESTIGATION SOIL BORING LOCATION

1:893

0 0.01 0.01 0.02 mi

0 0.01 0.01 0.03 km

NOTE:

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. EXCEEDANCES OF NYSDEC PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES (UUSCOS) SHOWN IN GRAY
3. EXCEEDANCES OF NYSDEC PART 375 UUSCOS AND RESTRICTED RESIDENTIAL SOIL CLEANUP OBJECTIVES (RRSCOS) SHOWN IN YELLOW

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BASE DRAWING PREPARED BY

NYSDOF TAX MAP

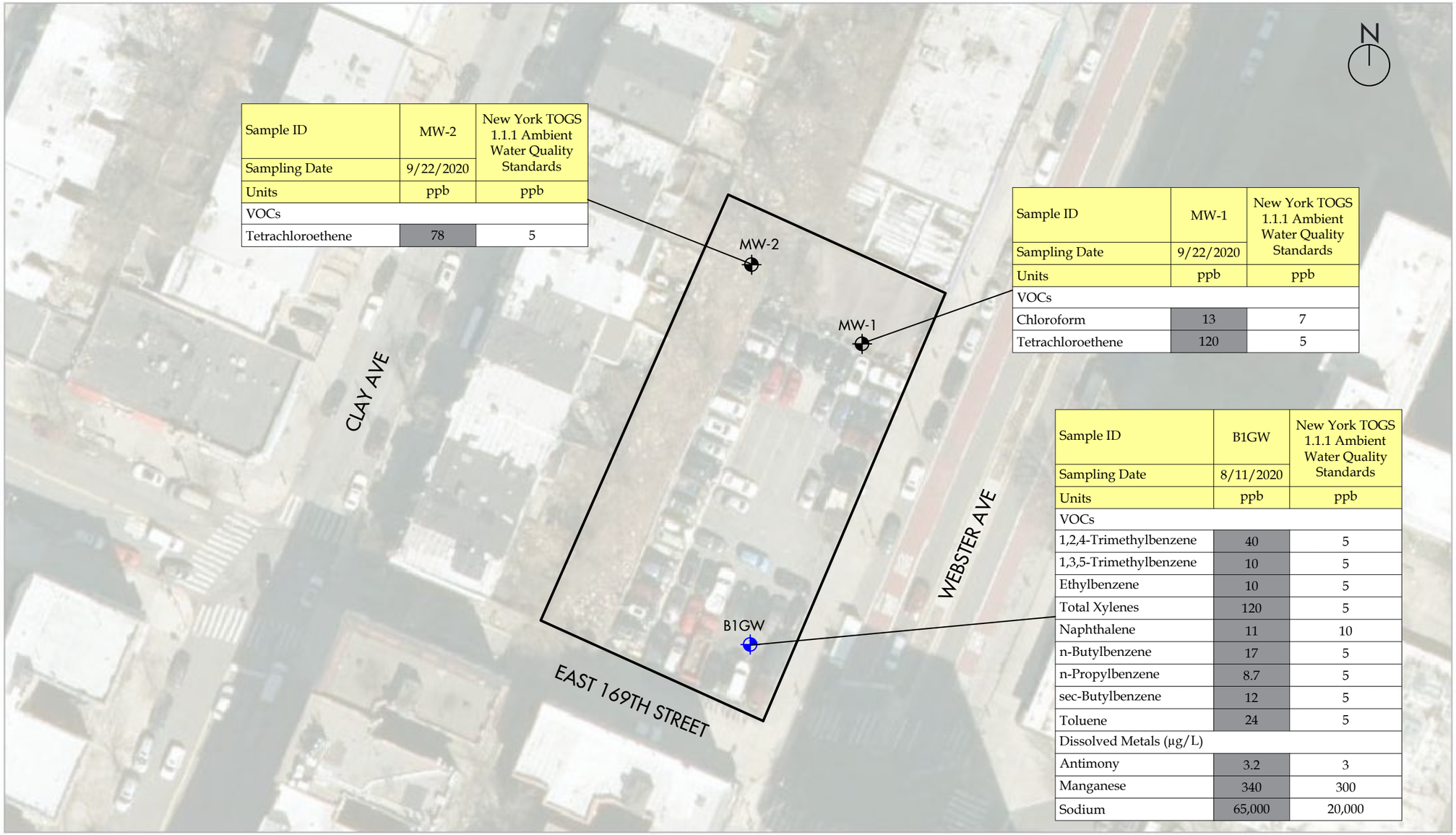
PROJECT NAME AND ADDRESS

1321 WEBSTER AVENUE, BRONX, NY

PROJECT FIGURE

FIGURE 2: PREVIOUS SOIL ANALYTICAL DATA

PROJECT NO.	DATE
260006	02/09/26
DRAWN BY: A.S.	REVIEWED BY: R.X.
SCALE (11X17): AS SHOWN	APPROVED BY: T.K.



Sample ID	MW-2	New York TOGS 1.1.1 Ambient Water Quality Standards
Sampling Date	9/22/2020	
Units	ppb	ppb
VOCs		
Tetrachloroethene	78	5

Sample ID	MW-1	New York TOGS 1.1.1 Ambient Water Quality Standards
Sampling Date	9/22/2020	
Units	ppb	ppb
VOCs		
Chloroform	13	7
Tetrachloroethene	120	5

Sample ID	B1GW	New York TOGS 1.1.1 Ambient Water Quality Standards
Sampling Date	8/11/2020	
Units	ppb	ppb
VOCs		
1,2,4-Trimethylbenzene	40	5
1,3,5-Trimethylbenzene	10	5
Ethylbenzene	10	5
Total Xylenes	120	5
Naphthalene	11	10
n-Butylbenzene	17	5
n-Propylbenzene	8.7	5
sec-Butylbenzene	12	5
Toluene	24	5
Dissolved Metals (µg/L)		
Antimony	3.2	3
Manganese	340	300
Sodium	65,000	20,000

LEGEND:
- SITE BOUNDARY
- AUGUST 2020 FOCUSED SUBSURFACE SITE INVESTIGATION MONITORING WELL LOCATION
- SEPTEMBER 2020 MONITORING WELL LOCATION

1:893
0 0.01 0.01 0.02 mi
0 0.01 0.01 0.03 km

NOTE:
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. GROUNDWATER SAMPLE ANALYTICAL RESULTS ARE COMPARED TO THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) TECHNICAL AND OPERATIONAL GUDIANCE SERIES (TOGS) 1.1.1. AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQS)
3. RESULTS SHADED GRAY EXCEED NYSDEC AWQS

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TEL: (631) 462-5866

BASE DRAWING PREPARED BY

NYSDOF TAX MAP

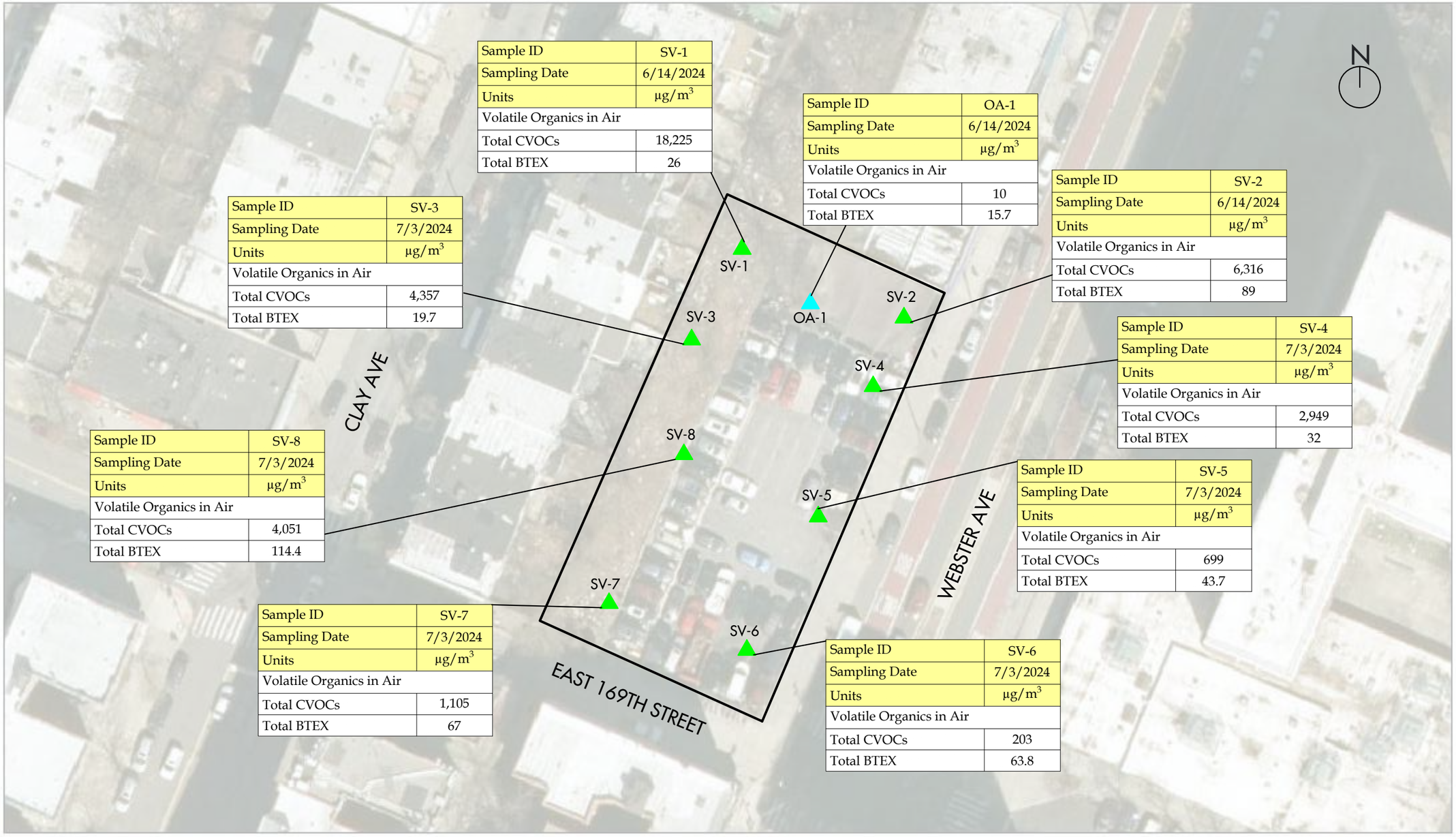
PROJECT NAME AND ADDRESS

1321 WEBSTER AVENUE, BRONX, NY

PROJECT FIGURE

FIGURE 3: PREVIOUS GROUNDWATER ANALYTICAL DATA

PROJECT NO. 260006	DATE 02/09/26
DRAWN BY A.S.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.



Sample ID	SV-1
Sampling Date	6/14/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	18,225
Total BTEX	26

Sample ID	OA-1
Sampling Date	6/14/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	10
Total BTEX	15.7

Sample ID	SV-2
Sampling Date	6/14/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	6,316
Total BTEX	89

Sample ID	SV-3
Sampling Date	7/3/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	4,357
Total BTEX	19.7

Sample ID	SV-4
Sampling Date	7/3/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	2,949
Total BTEX	32

Sample ID	SV-5
Sampling Date	7/3/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	699
Total BTEX	43.7

Sample ID	SV-6
Sampling Date	7/3/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	203
Total BTEX	63.8

Sample ID	SV-7
Sampling Date	7/3/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	1,105
Total BTEX	67

Sample ID	SV-8
Sampling Date	7/3/2024
Units	µg/m³
Volatile Organics in Air	
Total CVOCs	4,051
Total BTEX	114.4

LEGEND:

- SITE BOUNDARY
- JULY 2024 LIMITED PHASE II SOIL VAPOR LOCATION
- JULY 2024 LIMITED PHASE II OUTDOOR AIR SAMPLE LOCATION

NOTE:

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

1:893

0 0.01 0.01 0.02 mi

0 0.01 0.01 0.03 km

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BASE DRAWING PREPARED BY

NYSDOF TAX MAP

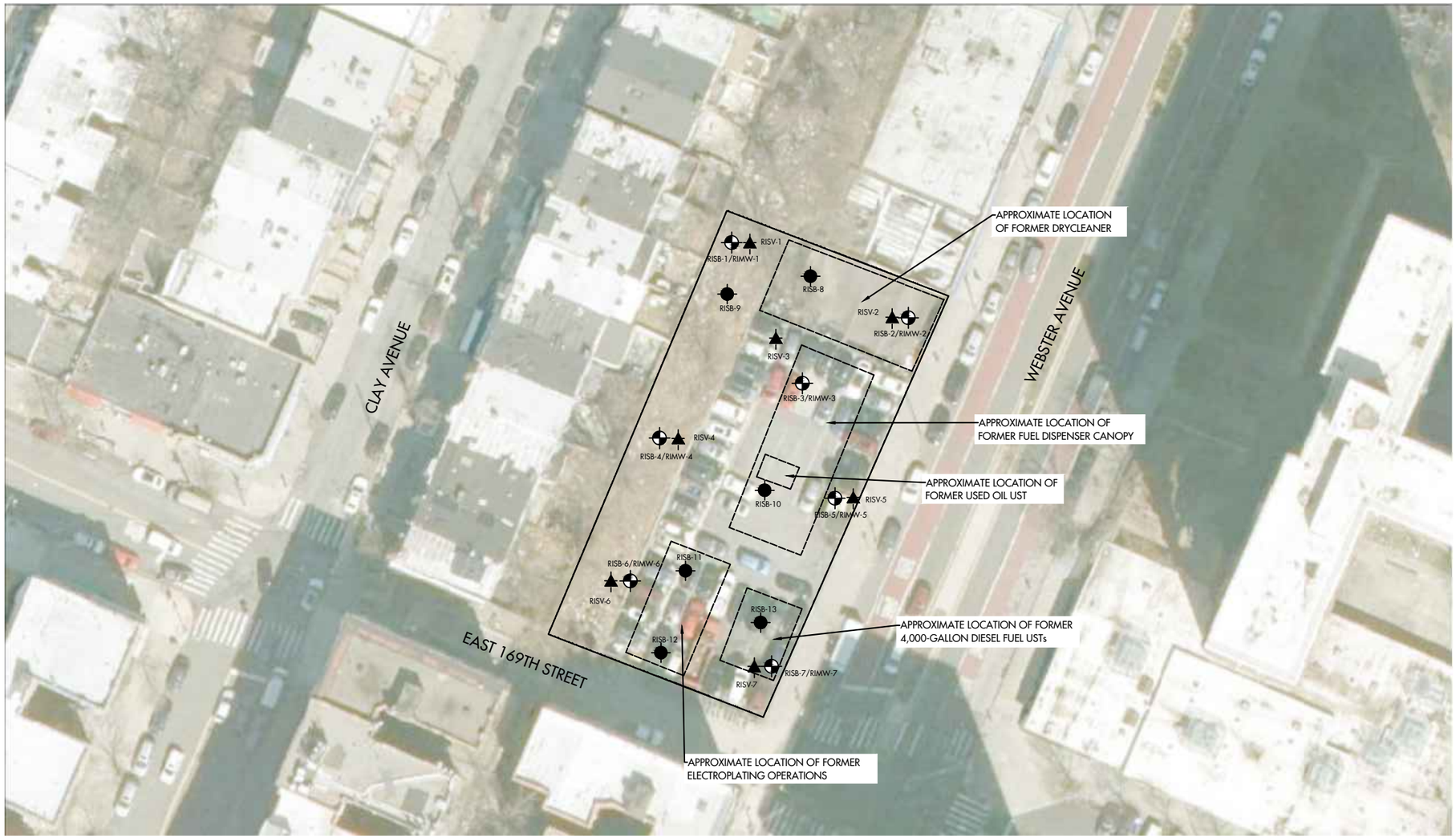
PROJECT NAME AND ADDRESS

1321 WEBSTER AVENUE, BRONX, NY

PROJECT FIGURE

FIGURE 4: PREVIOUS SOIL VAPOR ANALYTICAL DATA

PROJECT NO.	DATE
260006	02/09/26
DRAWN BY A.S.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.



LEGEND

- SITE BOUNDARY
- PROPOSED SOIL BORING/GROUNDWATER MONITORING WELL LOCATION
- PROPOSED SOIL BORING LOCATION
- PROPOSED SOIL VAPOR POINT LOCATION

1:893

0 0.01 0.01 0.02 mi

0 0.01 0.01 0.03 km

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BASE DRAWING PREPARED BY

NYCDOF TAX MAP

PROJECT NAME AND ADDRESS

1321 WEBSTER AVE, BRONX, NY.

PROJECT FIGURE

FIGURE 5: PROPOSED SAMPLING LOCATION MAP

PROJECT NO.	DATE
260006	2/13/26
DRAWN BY E.G.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY R.X.

APPENDICES

APPENDIX A: HASP

HEALTH & SAFETY PLAN

Former Bictos Webster Cleaners
1321 Webster Avenue
Bronx, New York
Block 2887, Lot 179

Table of Contents

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2.0 Health and Safety Staff 4
3.0 Chemical & Waste Description/Characterization 6
4.0 Hazard Assessment 7
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8.0 Air Monitoring Plan 26
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11.0 Emergency Plan 36
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1. Directions to Hospital

Attachments

A. Material Safety Data Sheets
B. Accident/Incident Reporting Log

1.0 Introduction

The HASP has been prepared in conformance with applicable regulations, safe work practices and the project's requirements. It addresses those activities associated with the installation and sampling of soil probes, monitoring wells and soil vapor/sub-slab vapor sampling points and collection of ambient outdoor air samples. The Project Manager (PM), Site Safety Officer (SSO) and HydroTech field staff will implement the Plan during site work. Compliance with this HASP is required of all persons and third parties who perform fieldwork for this project. Assistance in implementing this HASP can be obtained from the HydroTech's SSO. The content of this HASP may change or undergo revision based upon additional information that is made available to health and safety personnel, monitoring results or changes in the technical scope of work. Any changes proposed must be reviewed by the SSO.

SCOPE OF WORK

The Scope of Work activities will include the following:

- Installation of soil probes, monitoring wells and soil vapor sampling points
- Characterization and collection of soil, vapor& groundwater samples

EMERGENCY NUMBERS

Contact	Phone Number
BronxCare Hospital Center	7185901800
New York City EMS	911
NYPD	911
NYFD	911
National Response Center	800-424-8802
Poison Information Center	800-562-8816
Chemtree	800-424-9555

PROJECT MANAGEMENT/HEALTH AND SAFETY PERSONNEL

Title	Contact	Phone Number	Cell Phone
Geologist	Ruijie Xu	631-462-5866	631-229-7090
Site Safety Officer	Ruijie Xu	631-462-5866	631-229-7090
Project Manager	Ruijie Xu	631-462-5866	631-229-7090

DIRECTIONS TO INTERFAITH MEDICAL CENTER

Head south on Webster Avenue and make a right turn on East 168th Street. Then make another right turn onto Clay Avenue and then make a left turn onto East 169th Street. Then make a right turn onto Teller Avenue and drive for 0.9 mile. Then make a left turn onto East Mount Eden Avenue and then make a right turn onto Selwyn Avenue. The hospital will be on the left. **Figure 1** include the map showing the direction to the closest hospital with emergency room(s).

2.0 Health and Safety Staff

This section briefly describes the personnel and their health and safety responsibilities for the:

PROJECT GEOLOGIST– Ruijie Xu

- Has the overall responsibility for the health and safety of site personnel
- Ensures that adequate resources are provided to the field health and safety staff to carry out their responsibilities as outlined below.
- Ensures that fieldwork is scheduled with adequate personnel and equipment resources to complete the job safely.
- Ensures that adequate telephone communication between field crews and emergency response personnel is maintained.
- Ensures that field site personnel are adequately trained and qualified to work at the Site.

SITE SAFETY OFFICER – Ruijie Xu

- Directs and coordinates health and safety monitoring activities.
- Ensures that field teams utilize proper personal protective equipment (PPE).
- Conducts initial onsite, specific training prior to personnel and/or subcontractors proceeding to work.
- Conducts and documents periodic safety briefings; ensures that field team members comply with this HASP.
- Completes and maintains Accident/Incident Report Forms.
- Notifies HydroTech corporate administration of all accidents/incidents.
- Determines upgrade or downgrade of PPE based on site conditions and/or downgrade of PPE based on site conditions and/or real-time monitoring results.
- Ensures that monitoring instruments are calibrated daily or as determined by manufactured suggested instructions.
- Maintains health and safety field log books.
- Develops and ensures implementation of the HASP.
- Approves revised or new safety protocols for field operations.
- Coordinates revisions of this HASP with field personnel and the SSO Division Contracting Officer.
- Responsible for the development of new company safety protocols and procedures and resolution of any outstanding safety issues which may arise during the conduction of site work.
- Reviews personnel and subcontractors current and up-to-date medical examination and acceptability of health and safety training.

FIELD PERSONNEL AND SUBCONTRACTORS (IF ANY)

- Reports any unsafe or potentially hazardous conditions to the SSO.
- Maintains knowledge of the information, instructions and emergency response actions contained in this HASP.
- Comply with rules, regulations and procedures as set forth in this HASP and any revisions that are instituted.
- Prevents admittance to work sites by unauthorized personnel.

3.0 Chemical & Waste Description/Characterization

The following suspect chemicals are likely to be identified during the soil and groundwater sampling at the Site:

- Volatile Organic Compounds
- Semi Volatile Organic Compounds
- Metals
- Polychlorinated Biphenyls (PCBs)
- Pesticides

Attachment A contains information regarding assessing health risks from chemicals of concern, which are suspected to be identified at the Site.

The following information references are presented in order to identify the properties and hazards of the materials that may/will be encountered at the Site.

- Dangerous Properties of Industrial Materials - Sax
- Chemical Hazards of the Workplace - Proctor/Hughes
- Condensed Chemical Dictionary – Hawley
- Rapid Guide to Hazardous Chemical in the Workplace - Lewis 1990.
- NIOSH Guide to Chemical Hazards - 1990
- ACGIH TLV Values and Biological Exposure Indices - 1991-1992

4.0 Hazard Assessment

The potential hazards associated with planned site activities include chemical, physical and biological hazards. This section discusses those hazards that are anticipated to be encountered during the activities listed in the scope of work.

The potential to encounter chemical hazards is dependent upon the work activity performed (invasive or non-invasive), the duration and location of the work activity. Such hazards could include inhalation or skin contact with chemicals that could cause: dermatitis, skin burn, being overcome by vapors or asphyxiation. In addition, the handling of contaminated materials and chemicals could result in fire and/or explosion.

The potential to encounter physical hazards during site work includes: heat stress, exposure to excessive noise, loss of limbs, being crushed, head injuries, cuts and bruises and other physical hazards due to motor vehicle operation, heavy equipment and power tools.

CHEMICAL HAZARDS

The potential for personnel and subcontractors to come in contact with chemical hazards may occur during the following tasks:

- Installation of soil probes, monitoring well and soil vapor/sub-slab vapor sampling points

Exposure Pathways
Exposure to these compounds during ongoing activities may occur through inhalation of contaminated dust particles, inhalation of volatile (VOC) and semi-volatile (SVOC) vapor fume compounds, by way of dermal absorption, and accidental ingestion of the contaminant by either direct or indirect cross contamination activities (eating, smoking, poor hygiene). Indirectly, inhalation of contaminated dust particles (metals, silica, VOCs, SVOCs) can occur during adverse weather conditions (high or changing wind directions) or during operations that may generate airborne dust such as excavation, and sampling activities. Dust control measures such as applying water to roadways and work sites will be implemented, where visible dust is generated from non-contaminated and contaminated soils. Where dust control measures are not feasible or effective, respiratory protection will be used.

Additional Precautions
Dermal absorption or skin contact with chemical compounds is possible during

invasive activities at the Site, including removal of product, excavation of tanks, and handling of contaminated soils. The use of PPE in accordance with Section 9.2 and strict adherence to proper decontamination procedures should significantly reduce the risk of skin contact.

The potential for accidental ingestion of potentially hazardous chemicals is expected to be remote, when good hygiene practices are used.

PHYSICAL HAZARDS

A variety of physical hazards may be present during Site activities. These hazards are similar to those associated with any construction type project. These physical hazards are due to motor vehicles, and heavy equipment operation, the use of improper use of power and hand tools, misuse of pressurized cylinders, walking on objects, tripping over objects, working on surfaces which have the potential to promote falling, mishandling and improper storage of solid and hazardous materials, skin burns, crushing of fingers, toes, limbs, hit on the head by falling objects or hit one's head due to not seeing the object of concern, temporary loss of one's hearing and/or eyesight. Theses hazards are not unique and are generally familiarly to most hazardous waste site workers at construction sites. Additional task specific safety requirements will be covered during safety briefings.

Noise
Noise is a potential hazard associated with operation of heavy equipment, power tools, pumps and generators. High noise operators will be evaluated at the discretion of the SSO. Employees with an 8-hour time weighted average exposure exceeding 85 decibels (db) will be included in the hearing conservation program in accordance with 29 CFR 1910.85.

It is mandated that employees working around heavy equipment or using power tools that dispense noise levels exceeding 95 db are to wear hearing protection that shall consist of earplugs and earphones. This is particularly relevant as the jet engines of modern airplanes can give sound level readings of greater than 110 db.

Heat/Cold Stress
Extremes in temperature and the effects of hard work in impervious clothing can result in heat stress and/or hypothermia. The human body is designed to function at a certain internal temperature. When metabolism or external sources (fire, hot summer day, winter weather, etc.) cause the body temperature to rise or fall excessively, the body seeks to protect itself by triggering cooling/warming

mechanisms. Profuse sweating is an example of a cooling mechanism, while uncontrollable shivering is an example of a warming mechanism. The SSO monitor the temperature to determine potential adverse effects the weather can cause on site personnel.

Protective clothing worn to guard against chemical contact effectively stops the evaporation of perspiration. Thus the use of protective clothing increases heat stress problems. Cold stress can easily occur in winter with sub-freezing ambient temperatures. Workers in protective garments may heat-up and sweat, only to rapidly cool once out of the tank and the PPE. The major disorders due to heat stress are heat cramps, heat exhaustion and heat stroke.

HEAT CRAMPS are painful spasms that occur in the skeletal muscles of workers who sweat profusely in the heat and drink large quantities of water, but fail to replace the body's lost salts or electrolytes. Drinking water while continuing to lose salt tends to dilute the body's extra cellular fluids. Soon water seeps by osmosis into active muscles and causes pain. Muscles fatigued from work as usually most susceptible to cramps.

HEAT EXHAUSTION is characterized by extreme weakness or fatigue, dizziness, nausea, and headache. In serious cases, a person may vomit or lose consciousness. The skin is clammy and moist, complexion pale or flushed, and body temperature normal or slightly higher than normal. Treatment is rest in a cool place and replacement of body water lost by perspiration. Mild cases may recover spontaneously with this treatment; severe cases may require care for several days. There are no permanent effects.

HEAT STROKE is a very serious condition caused by the breakdown of the body's heat regulating mechanisms. The skin is very dry and hot with red mottled or bluish appearance. Unconsciousness, mental confusion or convulsions may occur. Without quick and adequate treatment, the result can be death or permanent brain damage. Get medical assistance quickly! As first aid treatment, the person should be moved to a cool place. Soaking the person's clothes with water and fanning them should reduce body heat artificially, but not too rapidly.
Steps that can be taken to reduce heat stress are:

- Acclimatize the body. Allow a period of adjustment to make further heat exposure endurable.
- Drink more liquids to replace body water lost during sweating.
- Rest is necessary and should be conducted under the monitoring condition

from the SSO and the effect personnel physiological state.

- Wearing personal cooling devices. There are two basic designs; units with pockets for holding frozen packets and units that circulate a cooling fluid from a reservoir through tubes to different parts of the body. Both designs can be in the form of a vest, jacket or coverall. Some circulating units also have a copy for cooling the head.

Cold temperatures can cause problems. The severe effects are FROSTBITE and HYPOTHERMIA.

FROSTBITE is the most common injury resulting from exposure to cold. The extremities of the body are often affected. The signs of frostbite are:

- The skin turns white or grayish-yellow
- Pain is sometimes felt early but subsides later. Often there is no pain
- The affected part feels intensely cold and numb

Shivering, numbness, drowsiness, muscular weakness and a low internal body temperature characterize the condition known as HYPOTHERMIA. This can lead to unconsciousness and death. With both frostbite and hypothermia, the affected areas need to be warmed quickly. Immersing in warm, not hot, water best does this. In such cases medical assistance will be sought.

To prevent these effects from occurring, persons working in the cold should wear adequate clothing and reduce the time spent in the cold area. The field SSO, to determine appropriate time personnel may spend in adverse weather conditions, will monitor this.

Lockout/Tagout

PURPOSE -- This program establishes procedures for de-energizing, isolating and ensuring the energy isolation of equipment and machinery. The program will be used to ensure that equipment and machinery is de-energizing and isolated from unexpected energization by physically locking (Lockout) energy isolation devices or, in the absence of locking capabilities, tagout (Tagout) the device to warn against energization. These procedures will provide the means of achieving the purpose of this program, prevention of injury to HydroTech employees from the unexpected energization or start-up of equipment and machinery, or from the release of stored energy.

APPLICATION -- This program applies to the control of energy during the servicing and/or maintenance of equipment and machinery. This program

covers normal operations only if a guard or other safety device is removed or bypassed, or any part of the body is placed into an area of the equipment or machinery where work is performed on the material, or a danger zone exists during the operating cycle. Minor tool changes, adjustments, and other minor servicing activities which take place during normal production operations do not require isolation and lockout/tagout if they are routine and integral to the use of the equipment.

SCOPE -- This program will include all employees whose duties require them to service, install, repair, adjust, lubricate, inspect or perform work on powered equipment or machinery that may also have the potential for stored energy.

PROGRAM RESPONSIBILITIES -- The SSO will have the overall responsibility of the program to ensure that; authorized and affected employees receive adequate training and information, the program is evaluated annually, and the lockout/tagout equipment is properly used and the procedures of this program are followed.

The program evaluation will be conducted to ensure that the procedures and requirements of the program are being followed and will be utilized to correct any deviations or inadequacies that may be discovered. The evaluation will consist of one or more inspections or audits of actual lockout/tagout procedures being used to isolate equipment. A review of the authorized and affected employee's responsibilities will be conducted at the time of the inspection /audit. Any authorized employee, except the one(s) utilizing the energy isolation procedure being inspected, may perform the inspection/audit.
A record will be maintained of program evaluation inspections and will include:

1. The identity of the equipment or machine on which energy control procedures were being utilized.
2. The date(s) of the inspection(s).
3. The employee(s) included in the inspection(s).
4. The person performing the inspection.

Authorized employees (persons who implement lockout/tagout procedures) will be responsible for following the procedures established by this program.

Affected employees are responsible for understanding the significance of a lockout/tagout device and the prohibition relating to attempts to restart or re-energize equipment or machinery that is locked out or tagged out.

TRAINING – Where applicable, HydroTech employees will be provided

instruction in the purpose and functions of the energy control program to ensure that they understand the significance of locked or tagged out equipment and also have the knowledge and skill to correctly apply and remove energy controls. Training will include:

The recognition of applicable hazardous energy source(s), the type and magnitude of energy available, and the policies and procedures of the HydroTech energy control program.

1. Affected employees will be made aware of the purpose and use of energy control procedures and the prohibition relating to attempts to remove lockout or tagout devices.
2. Instruction in the limitations of tagout as a sole means of energy control.
    a. Tags are warning devices and do not provide the physical restraint that a lock would do.
    b. Tags may provide a false sense of security.
    c. Tags may become detached during use.

Initial training will be provided during to energy control program implementation, when new employees are hired or when job responsibilities change to include utilization of energy control procedures.

Retraining will be conducted whenever there is a change in job assignments that require the employee to utilize energy control procedures, a change in equipment that presents a new hazard, a change in the energy control procedures or when the program evaluation identifies inadequacies in the energy control program procedures.

Records of employee training will be maintained and will include the employee's name and date(s) of training.

STANDARD OPERATING PROCEDURES –where necessary, HydroTech will provide the necessary devices to effectively lockout or tagout energy isolating devices. Lockout/tagout devices will be the only devices used for controlling energy and shall not be used for other purposes. Any device used for lockout/tagout will be capable of withstanding the environment to which they are exposed for the maximum period they are to be exposed. The devices will be substantial enough to prevent removal without excessive force. Excessive force for a locking device would be bolt cutters or other metal cuttings tools. Tagout devices will be attached by a non-reusable method, attachable by hand, and very difficult to remove by hand. A nylon cable tie or equivalent will be used.

Lockout/tagout devices will indicate the identity of the employee who applied the device, and the tagout device will warn against the hazards if the equipment is energized.

Lockout is the preferred method of energy isolation. When physical lockout is not possible, the energy isolation will be tagged out of service with a warning tag attached at the power source. In the case of plug-in power source, the tag will be attached at the male plug. To ensure full employee protection using tagout instead of lockout, additional steps should be taken to guard against accidental or inadvertent energization. These steps may include, where applicable: removal of fuses, blocking switches, removal of a valve handle.

STANDARD OPERATING PROCEDURES

I. APPLICATION OF CONTROLS

A. Preparing to Shut Down Equipment

1. Prior to equipment shutdown, the authorized employee(s) must have knowledge of:
    a. The type(s) and magnitude of power.
    b. The hazards of the energy to be controlled.
    c. The method(s) to control the energy.
    d. The location and identity of all isolating devices that control or feed the equipment to be locked/tagged out.
2. Notify all affected employees that the lockout/tagout system will be in effect.
3. Assemble applicable lockout/tagout devices, i.e., padlocks, tags, multiple lock hasps, etc.

B. Equipment Shutdown and Isolation

1. If equipment is in operation, shut it down by the normal stopping procedure (stop button, switch).
2. Operate disconnects, switches, valves, or other energy isolating devices so that the equipment is de-energizing and isolated from its energy source(s).
3. Verify that equipment is shut down by operating equipment from the normal operating location and any remote locations.

C. Installation of Lockout/Tagout Device, Release of Stored Energy, and Verification

1. Attach individually assigned lock(s) or tag(s) to energy isolating device(s). Where it is not possible to lock a switch, valve or other isolating device, electrical fuses must be removed, blank flanges installed in piping, lines disconnected, or other suitable methods used to ensure that equipment is isolated from energy sources. A tag must be installed at the point of power interruption to warn against energizing.

2. Each lock or tag must positively identify the person who applied it and locks must be individually keyed.
3. If more than one person is involved in the task, employees will place their own lock and tag. Multiple lock hasps are available for this.
4. Release, restrain, or dissipate stored energy such spring tension, elevated machine members, rotating flywheels, hydraulic pressure, pistons and air, gas, steam, water pressure, etc. by repositioning, blocking bleeding, or other suitable means.
5. Prior to starting work on equipment and after ensuring that no personnel are exposed, the authorized employee will verify that isolation and de-energization have been accomplished by:
    a. Attempting, through normal effort, to operate energy isolating devices such as switches, valves, or circuit breaker with locks or tags installed.
    b. Attempting to operate the equipment or machinery that is locked or tagged out. This includes all sources of energy, i.e. electrical, hydraulic, gravity, air, water, stream pressure, etc.
6. Verifying the presence and effectiveness of restraint (blocking) and energy dissipation or release (bleeding).
7. If there is a possibility of the re-accumulation of stored energy to a hazardous level, verification of isolation will be contained until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

D. Group Lockout/Tagout

1. When more than one individual is involved in locking or tagging equipment out of operation, each individual will attach their individual lock or tag, or the equivalent, to the energy isolating device(s).
    a. An equivalent lockout device may be in the form of a group lockout device such as a multiple lock hasp or lock box.
    b. Primary responsibility for a group of authorized employees working under a group lockout device will be vested in a designated authorized employee.
    c. Group lockout methods will provide a level of protection equal to that afforded by a personal lockout/tagout device.

II. RETURNING EQUIPMENT TO SERVICE

A. Restore Equipment to Normal Operating Status

1. Re-install all parts or subassemblies removed for servicing or maintenance.
2. Re-install all tools, rests, or other operating devices
3. Re-install all guards and protective devices (i.e. limit switches).

4. Remove all blocks, wedges, or other restraints from the operating area of the equipment (ways, slides, etc.).
5. Remove all tools, equipment, and shop towels from the operating area of the equipment.

B. Verify Equipment Ready for Operation

1. Inspect area for non-essential items
2. Ensure that all employees are safely positioned clear of the operating areas of the equipment. Post a watch if energy isolation devices are not in line of sight of the equipment.

C. Notify Affected Employees of Impending Start-up

1. The sudden noise of start-up may startle nearby employees.
2. Equipment may need to be tested to determine operational safety by a qualified operator.

D. Remove Energy Isolation Devices - Only by authorized employee(s) who installed it/them.

1. Remove line blanks, reconnect piping (if applicable), and remove warning tag.
2. Close bleeder valves, remove warning tag.
3. Replace fuse(s), close circuit breaker(s) and remove warning tag.
4. Remove lock and tag from control panel, valve, etc.

Employee(s) who installed them may make an exception for removal of lockout/tagout devices. If it is necessary to operate a piece of equipment that is locked/tagged out, <u>every</u> effort must be made to locate the employee whose lock or tag is on the equipment. If he or she cannot be located and only after positive assurance is made that no one is working on the locked out equipment, the <u>supervisor</u> may personally remove the lock. The supervisor must assure that the equipment is once again locked out, or the employee notified that the equipment has been re-energized, before the employee resumes work. Employees will recheck locked out equipment if they have left the equipment (breaks, lunch, and end of shift) to make sure it is still de-energized and locked out.

III. TEMPORARY REMOVAL OF LOCKOUT/TAGOUT PROTECTION

A. In situations when the equipment must be temporarily energized to test or position the equipment or its components, the following steps will be followed:

1. Clear the equipment of tools and materials that are non-essential to the operation.
2. Ensure the equipment components are operationally intact.
3. Remove employees from the equipment area.
4. Remove the lockout/tagout devices by the employee who installed in/them.
5. Energize and proceed with testing or positioning.

6. De-energize all systems and re-install all energy control measures.
7. Verify re-installed energy control measures are effective.

IV. SHIFT OR PERSONNEL CHANGES

A. The following steps will be followed to ensure continuity of employee protection during personnel changes.

1. All personnel involved in the maintenance or servicing activity will be notified that a transfer of personal locks/tags is about to occur.
2. Clear all personnel from hazardous area(s) of equipment.
3. Under the supervision of the shift supervisor or group designee, the off-going employee will immediately install theirs.
    a. If an entire group or more than one employee will be transferring work responsibility, locks/tags will be removed and replaced one at a time in order of installation.
4. When the transfer of lockout/tagout devices is complete, the effectiveness of all energy isolation devices will be verified to the satisfaction of all personnel involved.
5. Once the effectiveness of energy isolation protection is confirmed, the service/maintenance operation may continue.

V. CONTRACTOR NOTIFICATION

A. Whenever outside personnel may be engaged in activities covered by this program, they will inform the contractor of applicable lockout/tagout procedures used to protect HydroTech employees from the hazards of working near energized equipment.

1. The contractor will be expected to ensure that his/her employees understand and comply with the restrictions and prohibitions of this program.
2. HydroTech requires, under these circumstances, the contractor to inform us of their lockout/tagout procedures so that HTE employees can comply with the restrictions and prohibitions of the contractor's program.
3. HydroTech also requires the contractor to notify the program administrator, the area supervisor, and affected HydroTech employees prior to de-energizing, isolating and locking out HydroTech equipment. Conversely, notification is also required when this equipment will be returned to service.

DEFINITIONS

Affected employee - An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee(s) - A person or persons who locks or implements a tagout system procedure to perform servicing or maintenance on a machine or equipment. An authorized employee and an affected employee may be the same person when the affected employee's duties also include performing maintenance or service on a machine or equipment that must be locked or tagged out.

"Capable of being locked out" - An energy isolating device will be considered to be capable of being locked out either if it is designed with a hasp or other attachment or integral part to which, or through which, a lock can be affixed, or if it has a locking mechanism built into it. Other energy isolating devices will also be considered to be capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability.

Energized - Connected to an energy source or containing residual or stored energy.

Energy isolating device - A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a slide gate; a slip blind; a line valve; a block; and any similar device used to block or isolate energy. The term does not include a push button, selector switch, and other control circuit type devices.

Energy source - any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other type of energy.

Lockout - The placement of lockout device on an energy-isolating device, in accordance with an established procedure, is ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device - A device that utilizes positive means such as a lock, either key or combination type, to hold an energy isolating device in the safety position and prevent the energizing of a machine or equipment.

Normal production operations - The utilization of a machine or equipment to perform its intended production function.

Servicing and/or maintenance - Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Setting up - Any work performed to prepare a machine or equipment to perform its normal production operation.

Stored energy - Energy that is available and may cause movement even after energy sources have been isolated. Stored energy may be in the form of compressed springs, elevated equipment components, hydraulic oil pressure, pressurized water, air, steam, or gas, or rotating flywheels, shafts or cams.

Tagout - The placement of a tagout device on an energy-isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device - A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

GENERAL MACHINERY AND EQUIPMENT LIST

EQUIPMENT/LOCATION	ENERGY SOURCES/LOCATION
Geoprobe	Gasoline Engine

5.0 Training

GENERAL HEALTH AND SAFETY TRAINING

In accordance with HydroTech corporate policy, and pursuant to 29 CFR 1910.120, hazardous waste site workers shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations. As a minimum, the training shall have consisted of instruction in the topics outlined in the above reference. Personnel who have not met the requirements for initial training will not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical).

Completion of the HydroTech Health and Safety Training Course for Hazardous Waste Operations or an approved equivalent will fulfill the requirements of this section. In addition to the required initial training, each employee shall have received 3 days of directly supervised on-the-job training. This training will address the duties the employees are expected to perform.
The HydroTech SSO the responsibility of ensuring that personnel assigned to this project complies with these requirements. Written certification of completion of the required training will be provided to the SSO.

MANAGER/SUPERVISOR TRAINING

In accordance with 29 CFR 1910.120, onsite management and supervisors who will be directly responsible for, or who supervise employees engaged in hazardous waste operation shall receive training as required in this HASP and at least eight (8) additional hours of specialized training on managing such operations at the time of job assignment.

ANNUAL 8-HOUR REFRESHER TRAINING

Annual 8-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualification for fieldwork. The following topics will be reviewed: toxicology, respiratory protection, including air purifying devices and self-contained breathing apparatus (SCBA), medical surveillance, decontamination procedures and personnel protective clothing. In addition, topics deemed necessary by the SSO may be added to the above list.

SITE SPECIFIC TRAINING

Prior to commencement of field activities, all personnel assigned to the project

will be provided training that will specifically address the activities, procedures, monitoring and equipment for the site operations. It will include Site and facility layout, hazards, and emergency services at the Site, and will highlight all provisions contained within this HASP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

ONSITE SAFETY BRIEFINGS

Project personnel and visitors will be given periodic onsite health and safety briefings by the SSO, or their designee, to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the Site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

ADDITIONAL TRAINING

Additional training may be required by the SSO for participation in certain field tasks during the course of the project. Such additional training could be in the safe operation of heavy or power tool equipment or hazard communication training.

SUBCONTRACTOR TRAINING

Subcontractor personnel who work onsite, only occasionally, for a specific limited task and who are unlikely to be exposed over permissible exposure limits, may be exempted from the initial 40-hour training requirement. The SSO will determine if this exemption is allowed. In any case, the subcontractor personnel who are exposed to hazards are not exempted from the 40-hours training requirement nor medical surveillance requirements found in Section 8.1.

6.0 Medical Surveillance

GENERAL

All contractor and subcontractor personnel performing field work at the Site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). A physician's medical release for work will be confirmed by the SSO before an employee can begin site activities. Such examinations shall include a statement as to the worker's present health status, the ability to work in a hazardous environment (including any required PPE which may be used during temperature extremes), and the worker's ability to wear respiratory protection.

A medical data sheet will be completed by all onsite personnel and kept at the Site. Where possible, this medical data sheet will accompany the personnel needing medical assistance or transport to hospital facilities.

MEDICAL SURVEILLANCE PROTOCOL

The medical surveillance protocol to be implemented is the occupational physicians' responsibility, but shall meet the requirements of CFR 1910.120 and ANSI Z88.2 (1980). The medical surveillance protocol shall, as a minimum, cover the following:

a. Medical and Occupational History
b. General physical examination (including evaluation of major organ system)
c. Serum lead and ZPP
d. Chest X-ray (performed no more frequently that every four years, except when otherwise indicated).
e. Pulmonary Function Testing (FVC and FEV1.0).
f. Ability to wear respirator
g. Audiometric testing.

Additional clinical tests may be included at the discretion of the occupational physician.

7.0 Site Control, PPE & Communications

SITE CONTROL

A Support Zone (SZ) is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel or materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples. A contamination reduction corridor will be established. This is the route of entry and egress to the Site, and it provides an area for decontamination of personnel and portable equipment as well.

The area where contamination exists is considered to be the Exclusion Zone (EZ). All areas where excavation and handling of contaminated materials take place are considered the EZ. This zone will be clearly delineated by cones, tape or other means. The SSO may establish more than one EZ where different levels of protection may be employed or where different hazards exist. Personnel are not allowed in the EZ without:

- A buddy
- Appropriate personal protective equipment
- Medical authorization
- Training certification

PERSONAL PROTECTIVE EQUIPMENT

GENERAL
The level of protection worn by field personnel will be enforced by the SSO. Levels of protection for general operations are provided below and are defined in this section. Levels of protection may be upgraded or downgraded at the discretion of the SSO. The decision shall be based on real-time air monitoring, site history data, and prior site experience. Any changes in the level of protection shall be recorded in the health and safety field logbook.

PERSONAL PROTECTIVE EQUIPMENT SPECIFICATIONS
For tasks requiring Level B PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Chemical protective suit (e.g. Saran-coated Tyvek®)
- Gloves, inner (latex)

- Gloves, outer (Nitrile®)
- Boots (PVC), steel toe/shank
- Boot Covers (as needed)
- Hard Hat
- Hearing protection (as needed)

For tasks requiring Level C PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Disposable outer coveralls (Poly-coated Tyvek)
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC), steel toe/shank
- Boot covers (as needed)
- Hard Hat
- Hearing protection (as needed)
- Splash suit and face shield for decontamination operations (as needed)

For tasks requiring Level D PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC) steel toe/shank
- Boot covers (as needed)
- Hard hat
- Hearing protection (as needed)
- Safety glasses

For tasks requiring respiratory protection, the following equipment shall be used:

Level D - No respiratory protective equipment necessary except for a dust mask
Level C - A full-face air-purifying respirator equipped with organic vapor/pesticide-HEPA cartridges
Level B - An air line respirator or a self-contained breathing apparatus (SCBA)

INITIAL LEVELS OF PROTECTION
Levels of protection for the activities may be upgraded or downgraded depending on direct-reading instruments or personnel monitoring. The following are the initial levels of protection that shall be used for each planned

field activity.

LEVEL OF PERSONAL PROTECTIVE EQUIPMENT REQUIRED

Activity	Level of Protection Respiratory/PPE
Drilling/Coring	C/D
Sampling	C/D
Ground-Penetrating Radar/Magnetometer	C/D

COMMUNICATIONS

Communications is the ability to talk with others. While working in Level C/B Protection, personnel may find that communication becomes a more difficult task and process to accomplish. This is further complicated by distance and space. In order to address this problem, electronic instruments, mechanical devices or hand signals will be used as follows:

- Walkie-Talkies - Hand held radios would be utilized as much as possible by field teams for communication between downrange operations and the Command Post base station.

- Telephones - A mobile telephone will be located in the Command Post vehicle in the Support Zone for communication with emergency support services/facilities. If a telephone is demobilized, the nearest public phones will be identified.

- Air Horns - A member of the downrange field team will carry an air horn and another will be evident in the Support Zone to alert field personnel to an emergency situation.

- Hand Signals - Members of the field team long with use of the buddy system will employ this communication method. Signals become especially important when in the vicinity of heavy moving equipment and when using Level B respiratory equipment. The signals shall become familiar to the entire field team before site operations commence and they will be reinforced and reviewed during site-specific training.

HAND SIGNALS FOR ONSITE COMMUNICATION

Signal	Meaning
Hand gripping throat	Out of air, can't breathe
Grip partners' wrist	Leave area immediately; no debate

Hands on top of head	Need assistance
Thumbs up	OK, I'm all right; I understand
Thumbs down	No; negative, unable to understand you. I'm not all right

8.0 Air Monitoring Plan

GENERAL

Continuous air monitoring in the EZ during invasive tasks will accompany site operations, as indicated in this HASP or as required by the SSO. Monitoring will be performed to verify the adequacy of respiratory protection, to aid in site layout and to document work exposure. All monitoring instruments shall be operated by qualified personnel only and will be calibrated daily prior to use, or more often as necessary.

REAL-TIME MONITORING

INSTRUMENTATION

At least one (1) of the following monitoring instruments will be available for use during field operations as necessary:

- Photoionization Detector (PID), Rae Instruments with 10.2 EV probe or equivalent
- Flame Ionization Detector (FID), Foxboro Model 128 or equivalent
- Combustible Gas Indicator (CGI)/Oxygen (O_2) Meter, MSA or equivalent.

A FID or PID shall be used to monitor the organic vapor concentrations in active work areas. Organic vapor concentrations shall be measured upwind of the work areas to determine background concentrations. The SSO will interpret monitoring results using professional judgment. The PPE utilized shall always be the most protective, thus the action level criteria are flexible guidelines.

A CGI/O_2 meter shall be used to monitor for combustible gases and oxygen content in the boreholes during drilling activities.

Calibration records shall be documented, and included in the health and safety logbook or instrument calibration logbook. All instruments shall be calibrated before and after each daily use in accordance with the manufacturers' procedures.

ACTION LEVELS

Action levels for upgrading of PPE in this HASP will apply to all site work during the duration of field activities at the Site. Action levels are for unknown contaminants using direct reading in the Breathing Zone (BZ) for organic vapors and dusts, and at the source for combustible gases.

MONITORING DURING FIELD ACTIVITIES

HydroTech shall perform real time air monitoring prior to the commencement of work to establish baseline conditions. Baseline conditions will be established at the approximate center of the Site and at the perimeter of the Site both upwind and downwind.

During all work activities real time monitoring will occur. As necessary, HydroTech shall have at each applicable workstation a PID, explosimeter and oxygen deficiency meter. The real time monitoring for remedial activities will be conducted approximating the Breathing Zone of the workers. The monitoring will be continuous during working operations.

The air-monitoring instrument may indicate that personnel working in the exclusion zone increase their level of protection. All personnel will be trained in the action levels. When conditions warrant an increase in protection, all personnel will stop working and immediately leave the exclusion zone. They will then don the appropriate safety equipment necessary and return to their current workstation. All of this activity will be monitored by the SSO. The SSO will keep the HydroTech Project Manager aware of any extraordinary situations and conditions that may occur. Working conditions and monitoring levels will be noted in the Field Notebook along with the time, date and page number. Verbal reports will be given to the Project Manager when there is a change in the PPE level.

The previous day's results shall be reviewed each morning to determine what actions are necessary and the general conditions resulting from and around the Site.

The record keeping will include:

- Date & Time of Monitoring
- Air Monitoring Location
- Instrument, Model #, Serial #
- Calibration/Background Levels
- Results of Monitoring
- SSO Signature
- Comments

Excavation Operations - Monitoring will be performed continuously during all excavation and demolition operations. A PID and/or FID shall be utilized to

monitor the breathing zone, the excavated area and any material taken from the excavation. A CGI/O_2 meter shall be used to monitor the excavation for the presence of combustible gases.

ACTION LEVELS OF AIRBORNE CONTAMINANTS

INSTRUMENT	ACTION LEVEL	ACTION TO BE TAKEN
FID/PID	< 100 ppm, for a 15-minute average	Stop work & initiate vapor control
	>100 ppm, for a 15-minute average	Stop work & initiate evacuation procedure
CGI	10% LEL	Stop work, initiate ventilating
	50% LEL	Stop work, initiate evacuation procedure and contact fire dept.

PERSONNEL MONITORING PROCEDURE

The Site SSO, concurrent with activities that may generate the contaminants in excess of OSHA PEL's, may perform assessment and evaluation of field personnel exposures to airborne contaminants.

Procedures to be followed include:

The SSO may select high-risk individuals who may be subject to contaminant exposure based on job assignment.
The Personal Sampling is being conducted to determine the proper levels of respiratory protection required, to document potential exposures to compounds, and to assure compliance with OSHA standards. Therefore, it is important that the data collected be from "worst case" locations and personnel.

For example: when work is being conducted to excavate at an underground tank location, those persons closest to the excavation and most intimately involved with the work should be sampled. If a backhoe operator solely conducted the excavation, then that employee should be monitored. However, if there are additional workers who must enter the excavation and work with the freshly excavated soil, these persons would be closer to the potential contaminants and they should be sampled.

To meet the intent of the sampling will require sampling at periods of the most disturbances. To be accurate in determining potential exposures, as many tasks/trades shall be sampled as possible during the course of this project. At completion of the project, a goal of 20% of all workers who must perform their

duties in or around the contaminated soil, tanks and excavations is sought.

All sampling data must be provided in writing to the employees within three (3) days of receipt of results by HydroTech.

Air sampling pumps used to collect employee exposure samples shall be calibrated before and after use each day. Calibration shall be accomplished using a primary standard calibration system, e.g. the bubble tube method. Results of the calibrations shall be included in the health and safety field logbook and with the exposure report.

Chemical analysis of samples collected for assessment of employee exposures shall be performed in accordance with NIOSH or OSHA analytical methods only by laboratories accredited by the American Industrial Hygiene Association.

Results of the personal exposure assessment shall be provided to the individual, in writing within fifteen (15) working days after receipt of laboratory reports. Reports to field personnel shall provide calculated time-weighted average exposures and shall provide comparative information relative to established permissible exposure limits. The air sampling data sheet and laboratory report is considered a part of the employee exposure report. A copy of the employee personal exposure assessment report shall also be included in the project file and the employees' medical record for HydroTech employees. Reports for subcontractor employees will be sent directly to the subcontractors' employer.

AIR MONITORING REPORTS

Air Monitoring Reports will be completed by the SSO and/or authorized personnel and submitted to the Project Manager in the daily safety logs and will include the following:

- Date of monitoring
- Equipment utilized for air monitoring
- Real-time air monitoring results from each work location
- Calibration method of equipment and results

9.0 Safety Considerations

GENERAL

In addition to the specific requirements of this HASP, common sense should be used at all times. The general safety rules and practices below will be in effect at the Site at the discretion of the Project Manager, SSO or other authorized personnel.

- The site will be suitably marked or barricaded as necessary to prevent unauthorized visitors but not hinder emergency services if needed.

- As needed, all open holes, trenches and obstacles will be properly barricaded in accordance with local site requirements. These requirements will be determined by proximity to traffic ways, both pedestrian and vehicular, and site of the hole, trench or obstacle. If holes are required to be left open during non-working hours, they will be adequately decked over or barricaded and sufficiently lighted.

- Before any digging or boring operations are conducted, underground utility locations will be identified. All boring, excavation and other site work will be planned and performed with consideration for underground lines. Any excavation work will be performed in accordance with HydroTech's Standard Operating Procedures for Excavations.

- Either workers or other people will enact dust-mitigating procedures when there exists the potential for the inhalation of dust particles.

- The act of smoking and ignition sources in the vicinity of potentially flammable or contaminated material is strictly prohibited.

- Drilling, boring, and use of cranes and drilling rigs, erection of towers, movement of vehicles and equipment and other activities will be planned and performed with consideration for the location, height, and relative position of aboveground utilities and fixtures, including signs; canopies; building and other structures and construction; and natural features such as trees, boulders, bodies of water, and terrain.

- When working in areas where flammable vapors may be present, particular care shall be exercised with tools and equipment that may be sources of ignition. All tools and equipment provided must be properly bonded and/or

grounded. Metal buttons and zippers are prohibited on safety clothing for areas that may contain a flammable or explosive atmosphere.

- Approved and appropriate safety equipment (as specified in this HASP), such as eye protection, hard hats, foot protection, and respirators, must be worn in areas where required. In addition, eye protection must be worn when sampling soil or water that may be contaminated.

- Beards interfere with respirator fit and are not allowed within the site boundaries because all site personnel may be called upon to use respirator protection is some situations.

- No smoking, eating, chewing tobacco, gum chewing or drinking will be allowed in the contaminated areas.

- Contaminated tools and hands must be kept away from the face.

- Personnel must use personal hygiene safe guards (washing up) at the end of the shift or as soon as possible after leaving the Site.

- Each sample must be treated and handled as though it were contaminated.

- Persons with long hair and/or loose fitting clothing that could become entangled in power equipment must take adequate precautions.

- Horseplay is prohibited in the work area.

- Work while under the influence of intoxicants, narcotics or controlled substances is prohibited.

POSTED SIGNS

Posted danger signs will be used where an immediate hazard exists. Caution signs will be posted to warn against potential hazards and to caution against unsafe practices. Traffic control methods and barricades will be used as needed. Wooden stakes and flagging tape, or equally effective material will be used to demarcate all restricted areas.

Other postings may include the OSHA poster, emergency hospital route and telephone numbers of contact personnel.

INVASIVE OPERATIONS

The SSO will be present onsite during all invasive work (e.g. demolition, excavations). The SSO will ensure that appropriate levels of protection and safety procedures are followed. No personnel will enter any excavations for any reasons. All personnel will stay at least 10 feet back from the edge of the excavation and out of the swing radius of the backhoe. No drums or other potential sources will be sampled or removed during this phase without further additions to the HASP.

The proximity of water, sewer and electrical lines will be identified prior to invasive operations. The possibility of the presence of underground conduits or vessels containing materials under pressure will also be investigated prior to invasive operations. Properly-sized containment systems will be utilized and consideration of the potential volume of liquid or waste released during operations will be discussed with members of the field team to minimize the potential for spills and provide a method for collection of waste materials. Emergency evacuation procedures and the location of safety equipment will be established prior to start up operations. The use of protective clothing, especially hard hats, boots, and gloves will be required during drilling and other heavy equipment work.

SOIL AND GROUNDWATER SAMPLING

Personnel must wear prescribed protective clothing and equipment including eye protection, chemical resistant gloves and splash aprons (where appropriate) when sampling solids and liquids. Sample bottles are to be bagged prior to sampling to ease decontamination. Personnel must be aware of the location of emergency equipment, including spill containment materials prior to sampling. Personnel are to practice contamination avoidance at all times, as well as to utilize the buddy system and maintain communications with the Command Post.

SAMPLE HANDLING

Personnel responsible for the handling of samples will wear the prescribed level of protection. Samples are to be identified as to their hazard and packaged as to prevent spillage or breakage. Any unusual sample conditions shall be noted. Laboratory personnel and all field personnel shall be advised of sample hazard levels and the potential contaminants present. This can be accomplished by a phone call to the lab coordinator and/or including a written statement with the samples reviewing lab safety procedures in handling in order to assure that the

practices are appropriate for the suspected contaminants in the sample.

HEAVY EQUIPMENT DECONTAMINATION

Personnel steam cleaning heavy equipment shall use the prescribed level of protection and adhere to the buddy system. Initially this task usually employs level C. The heavy equipment decontamination shall be restricted to authorized personnel only. Special consideration will be given to wind speed and direction. Downwind areas are to be kept free of personnel to avoid unnecessary exposure to potential airborne contamination.

ADDITIONAL SAFETY CONSIDERATIONS

No other additional safety considerations at this time.

10.0 Decontamination and Disposal Procedures

CONTAMINATION PREVENTION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-contamination. Procedures for contamination avoidance include:

Personnel:
Do not walk through areas of obvious or known contamination
Do not directly handle or touch contaminated materials
Make sure that there are no cuts or tears on PPE
Fasten all closures in suits; cover with tape if necessary
Particular care should be taken to prevent any skin injuries
Stay upwind of airborne contaminants
Do not carry cigarettes, cosmetics, gum, etc. into contaminated areas

Sampling and Monitoring:
When required by the SSO, cover instruments with clear plastic, leaving openings for sampling ports and bag sample containers prior to emplacement of sample material.

Heavy Equipment:
Care should be taken to limit the amount of contamination that comes in contact with heavy equipment (tires, contaminated augers). Dust control measures may be needed on roads inside the site boundaries.

PERSONNEL DECONTAMINATION

All personnel shall pass through an outlined decontamination procedure when exiting the hot zone at each location. Field washes for equipment and PPE shall be set up at each drilling location. The system will include a gross wash and rinse for all disposable clothing and boots worn in the EZ. Upon exiting the EZ, all personnel will wash their hands, arms, neck, and face before entering the Support Zone.

EQUIPMENT DECONTAMINATION

Equipment used at the Site that is potentially contaminated shall be decontaminated to prevent hazardous materials from leaving the Site. All heavy equipment will be decontaminated at the decontamination pad and inspected by

the SSO and Project Manager before it leaves the Site. The decontamination area will provide for the containment of all wastewater from the decontamination process. Respirators, airline and any other personnel equipment that comes in contact with contaminated soils shall pass through a field wash.

DECONTAMINATION DURING MEDICAL EMERGENCIES

If emergency life-saving first aid and/or medical treatment are required, normal decontamination procedures may need to be abbreviated or omitted. The Site SSO or designee will accompany contaminated victims to the medical facility to advice on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances and /or medical personnel. Outer garments are then removed at the medical facility.

No attempt will be made to wash or rinse the victim, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material that could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed. Note that heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention and removal of protective clothing immediately; unless the victim is obviously contaminated, decontamination should be omitted or minimized and treatment begun immediately.

DISPOSAL PROCEDURES

A segregating system of non-hazardous waste and hazardous waste will be developed by the SSO and PM. All discarded material, waste materials or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating sanitary hazards, or causing litter to be left on site. All potentially contaminated materials, e.g. clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for disposal. All non-contaminated materials shall be collected and bagged for appropriate disposal as normal domestic waste.

11.0 Emergency Plan

The potential for the development of an emergency situation is low considering the low concentrations of hazardous substances at the work site. Nevertheless, an emergency situation could occur. All HydroTech and subcontractor field team members prior to the start of work will know the emergency plan outlined in this section. The emergency plan will be available for use at all times during site work.

Various individual site characteristics will determine preliminary actions taken to assure that this emergency plan is successfully implemented in the event of a site emergency. Careful consideration must be given to the proximity of neighborhood housing or places of employment, and to the relative possibility of site fire, explosion or release of vapors or gases that could affect the surrounding community.

The Project Manager shall make contact with local fire, police and other emergency units prior to beginning work on site. In these contacts, the Project Manager will inform the emergency units about the nature and duration of work expected to the Site and the type of contaminants and the possible health or safety effects of emergencies involving these contaminants. At this time, the Project Manager and the emergency response units shall make the necessary arrangements to be prepared for any emergencies that could occur.

The Project Manager shall implement the contingency plan whenever conditions at the Site warrant such action. The Project Manager will be responsible for coordination of the evacuation emergency treatment, and transportation of site personnel as necessary, and notification of emergency response units and the appropriate management staff.

The cases where the PM is not available, the SSO shall serve as the alternate emergency coordinator.

EVACUATION

In the event of an emergency situation, such as fire, explosion, or significant release of toxic gases, an air horn or other appropriate device will be sounded for approximately 10 second intervals indicating the initiation of evacuation procedures. All personnel will evacuate and assemble near the entrance to the site. The location shall be upwind of the Site where possible.
For efficient and safe site evacuation and assessment of the emergency situation, the Project Manager will have authority to initiate action if outside services are

required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The SSO or designated SSO must ensure that access for emergency equipment is provided and that all combustion apparatuses have been shut down once the alarm has been sounded. Once the safety of all personnel is established, the Fire Department and other emergency response groups as necessary will be notified by telephone of the emergency.

POTENTIAL OR ACTUAL FIRE OR EXPLOSION

Immediately evacuate the Site (air horn will sound for 10-second intervals), notify the local fire and police departments, and other appropriate emergency response groups if an actual fire or explosion has taken place.

PERSONNEL INJURY

Emergency first aid shall be applied on site as deemed necessary. If necessary, the individual shall be decontaminated and transported to the nearest medical facility.

The ambulance/rescue squad shall be contacted for transport as necessary in an emergency. However, since some situations may require transport of an injured party by other means, the hospital route is identified below. A map to this facility provided with this HASP in Section 2.2.3.

ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

1. Ruijie Xu-Cell phone 631-229-7090
2. The employer of any injured worker if not an HydroTech employee

Written confirmation of verbal reports is to be submitted within 24 hours. The report form entitled "Accident Data Report" is to be used for this purpose. All HydroTech representatives contacted by telephone are to receive a copy of this report. If the employee involved is not a HydroTech employee, his employer shall receive a copy of this report.

For reporting purposes, the term accident refers to fatalities, lost time injuries, spill or exposure to hazardous materials (toxic materials, explosive or flammable materials).

Any information released from the health care provider, which is not deemed confidential patient information, is to be attached to the appropriate form. Any medical information that is released by patient consent is to be filed in the individuals' medical records and treated as confidential.

OVERT PERSONNEL EXPOSURE

SKIN CONTACT:	Use copious amounts of soap and water. Wash/rinse affected area thoroughly, and then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination.
INHALATION:	Move personnel to fresh air and if necessary, decontaminate and transport to hospital.
INGESTION:	Decontamination and transport to emergency medical facility.
PUNCTURE WOUND OR LACERATION:	Decontaminate and transport to emergency medical facility.

ADVERSE WEATHER CONDITIONS

In the event of adverse weather conditions, the SSO or designee will determine if work can continue without sacrificing the health and safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat stress and heat-related injuries
- Potential for cold stress and cold-related injuries
- Treacherous weather-related conditions
- Limited visibility
- Potential for electrical storms

Site activities will be limited to daylight hours and acceptable weather conditions. Inclement working conditions include heavy rain, fog, high winds, and lighting. Observe daily weather reports and evacuate if necessary in case of inclement weather conditions.

EMERGENCY RESPONSE EQUIPMENT LIST

Some or all of the following will either be available onsite or be able to be brought to the Site within a 2-hour period:

- 55 Gallon Drums
- 85 Gallon Drums
- Absorbent Pads
- Absorbent Booms
- Speedy-Dry
- Plastic Sheeting
- Hay Bales
- Pneumatic Nibbler
- Back Hoe
- Pressure Washer
- Air Compressor
- Wilden Pumps
- Equipment Storage Trailer
- Submersible Pumps
- Miscellaneous Hand Tools
- Portable Lighting

LARGE EQUIPMENT

If necessary, HydroTech can have the following large equipment brought to the Site within 2-hours:

- Large Vacuum Truck
- Super Sucker
- Dump Trucks
- Drill Rig
- Utility Vehicle

12.0 Logs, Reports and Record Keeping

MEDICAL AND TRAINING RECORDS

The employer keeps medical and training records. All subcontractors must provide verification of training and medical qualifications to the SSO. The SSO will keep a log of personnel meeting appropriate training and medical qualifications for site work. The log will be kept in the project file. Medical records will be maintained in accordance with 29 CFR 1910.20.

ONSITE LOG

A log of personnel onsite each day will be kept by the SSO or designee. A copy of these logs will be sent to the HydroTech records coordinator for data entry. Originals will be kept in the project file.

EXPOSURE RECORDS

Any personal monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be kept in accordance with 29 CFR 1910.20. For HydroTech employees, the originals will be sent to the HydroTech records coordinator. For subcontractor employees, the original will be sent to the subcontractor employer and a copy kept in the project file.

ACCIDENT/INCIDENT REPORTS

An accident/incident report must be completed for all accidents and incidents. The originals will be sent to the appropriate HydroTech records coordinator for maintenance by HydroTech. Copies will be distributed as stated. A copy of the Accident/Incident Reporting Log is included in **Attachment B**. A copy of the forms will be kept in the project file.

OSHA FORM 200

An OSHA Form 200 (Log of Occupational Injuries and Illnesses) will be kept at the Site. All recordable injuries or illnesses will be recorded on this form. At the end of the project, the original will be sent to the HydroTech corporate records administrator for maintenance. Subcontractor employers must also meet the requirements of maintaining an OSHA 200 form.

The HydroTech accident/incident report meets the requirements of the OSHA

Form 101 (Supplemental Record) and must be maintained with the OSHA Form 200 for all recordable injuries or illnesses.

HEALTH AND SAFETY FIELD LOG BOOK

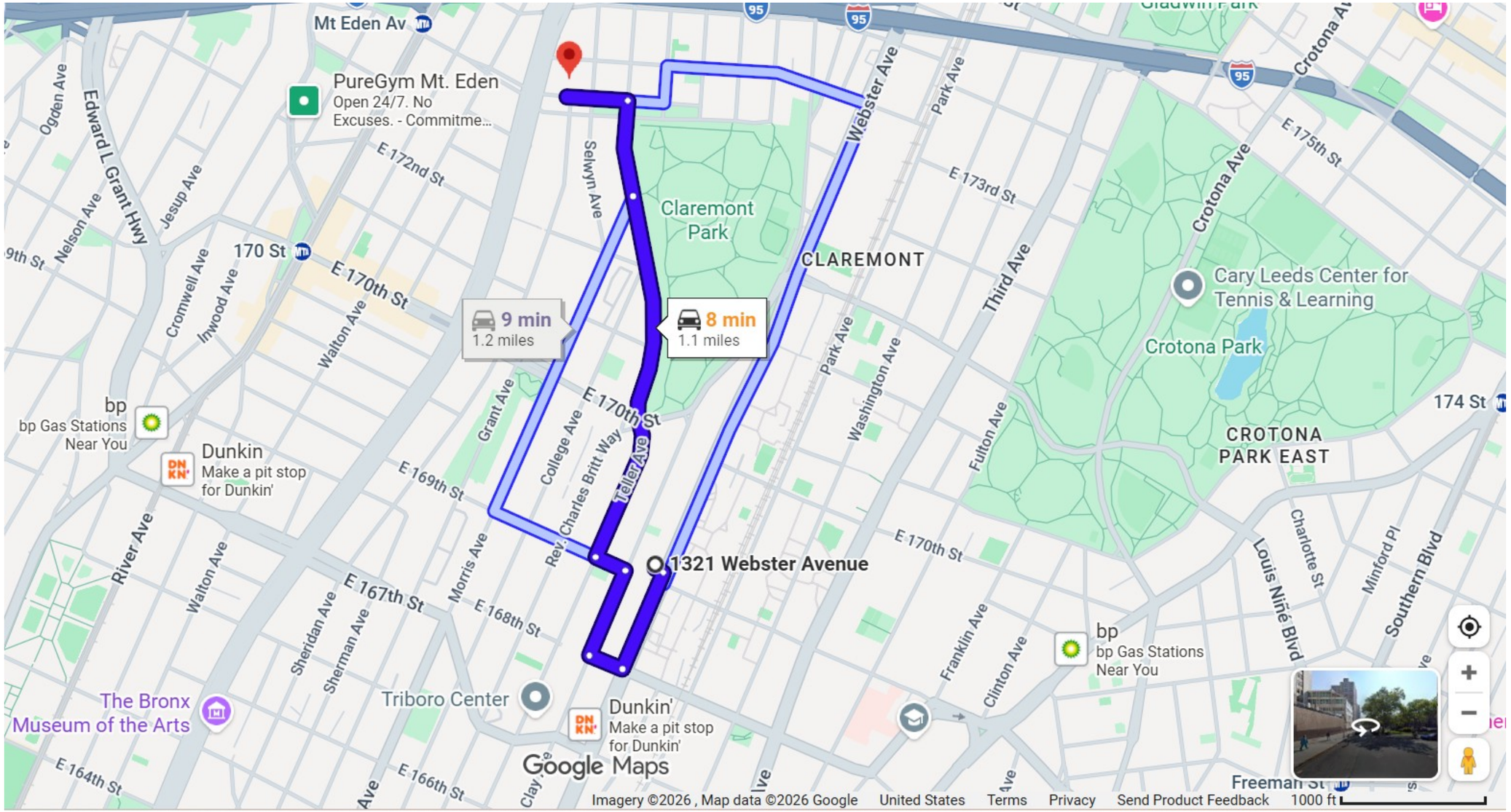
The SSO or designee will maintain the logbook in accordance with standard HydroTech procedures. Daily site conditions, activities, personnel, calibration records, monitoring results and significant events will be recorded. The original logbooks will become part of the exposure records file.

13.0 Sanitation

If sanitary sewers are not provided at the Site, provisions shall be made for access to sanitary systems by using nearby public facilities consistent with provisions of governing local ordinance codes. In the latter case, provisions are required for the removal of accumulated waste products within those units.

If a commercial/industrial laundry is used to clean or launder clothing that is potentially contaminated, they shall be informed of the potential harmful effects of exposure to hazardous substances related to the affected clothing.

Personnel and subcontractors sites shall follow decontamination procedures described in the HASP, or as directed by the SSO. This will generally include at a minimum site-specific training in shower usage and cleanup, personal hygiene requirements and the donning of protective equipment/clothing.



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DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET, SUITE 1104
MANHATTAN, NY 10001

TEL: (631) 462-5866

BASE DRAWING PREPARED BY

GOOGLE MAPS

PROJECT NAME AND ADDRESS

1321 WEBSTER AVENUE, BRONX

PROJECT FIGURE

FIGURE 1: DIRECTIONS TO HOSPITAL

PROJECT NO.	DATE
260006	2/16/2026
DRAWN BY N.P.	REVIEWED BY R.X.
SCALE (11X17) AS NOTED	APPROVED BY T.K.

ATTACHMENT A
MATERIAL SAFETY DATA SHEETS

SAFETY DATA SHEET

Creation Date 03-Feb-2010 **Revision Date** 23-Jan-2018 **Revision Number** 4

1. Identification

Product Name **Trichloroethylene**

Cat No. : **AC421520000; AC421520025; AC421525000**

CAS-No 79-01-6
Synonyms Triclene; Trichloroethene; Ethylene trichloride

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

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)

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

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Trichloroethylene	79-01-6	>95

4. First-aid measures

General Advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact 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 and effects 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 44.8 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 (CO_2)
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	1	0	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/m³ Ceiling: 200 ppm (Vacated) STEL: 200 ppm (Vacated) STEL: 1080 mg/m³ TWA: 100 ppm	IDLH: 1000 ppm	TWA: 100 ppm TWA: 535 mg/m³ STEL: 200 ppm STEL: 1080 mg/m³

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	44.8 vol %
Lower	8 vol %
Vapor Pressure	77.3 mbar @ 20 °C
Vapor Density	4.5 (Air = 1.0)
Specific Gravity	1.460
Solubility	Insoluble 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	C2 H Cl3
Molecular Weight	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 = 4920 mg/kg (Rat) LD50 = 4290 mg/kg (Rat)	LD50 = 29000 mg/kg (Rabbit) LD50 > 20 g/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 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
Trichloroethylene	79-01-6	Group 1	Known 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: 31.4 - 71.8 mg/L, 96h flow-through (Pimephales promelas) LC50: 39 - 54 mg/L, 96h static (Lepomis macrochirus)	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 Section 6

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Trichloroethylene	79-01-6	>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
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 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 10-Dec-2009 **Revision Date** 23-Jan-2018 **Revision Number** 5

1. Identification

Product Name **Tetrachloroethylene**

Cat No. : **AC445690000; ACR445690010; AC445690025; AC445691000**

CAS-No 127-18-4
Synonyms Perchloroethylene

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

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)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Carcinogenicity	Category 1B
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, 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
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)
Toxic to aquatic life with long lasting effects
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Tetrachloroethylene	127-18-4	>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. If skin irritation persists, call a physician.

Inhalation Move 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.

Most important symptoms and 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	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated.

Hazardous Combustion Products
Chlorine Hydrogen chloride gas Phosgene
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	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation.
Environmental Precautions	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. Ensure adequate ventilation. Avoid ingestion and inhalation.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from sunlight.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Tetrachloroethylene	TWA: 25 ppm STEL: 100 ppm	(Vacated) TWA: 25 ppm (Vacated) TWA: 170 mg/m^3 Ceiling: 200 ppm TWA: 100 ppm	IDLH: 150 ppm	TWA: 100 ppm TWA: 670 mg/m^3 TWA: 200 ppm TWA: 1250 mg/m^3 STEL: 200 ppm STEL: 1340 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, sweet
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-22 °C / -7.6 °F
Boiling Point/Range	120 - 122 °C / 248 - 251.6 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	6.0 (Ether = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	18 mbar @ 20 °C
Vapor Density	No information available
Density	1.619
Specific Gravity	1.625
Solubility	0.15 g/L water (20°C)
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	> 150°C
Viscosity	0.89 mPa s at 20 °C
Molecular Formula	C2 Cl4
Molecular Weight	165.83

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

Conditions to Avoid Incompatible products. Excess heat. Exposure to moist air or water.

Incompatible Materials Strong acids, Strong oxidizing agents, Strong bases, Metals, Zinc, Amines, Aluminium

Hazardous Decomposition Products Chlorine, Hydrogen chloride gas, Phosgene

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
Tetrachloroethylene	LD50 = 2629 mg/kg (Rat)	LD50 > 10000 mg/kg (Rat)	LC50 = 27.8 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
Tetrachloroethylene	127-18-4	Group 2A	Reasonably Anticipated	A3	X	A3

IARC: (International Agency for Research on Cancer)

NTP: (National Toxicity Program)

ACGIH: (American Conference of Governmental Industrial Hygienists)

Mexico - Occupational Exposure Limits - Carcinogens

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

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)

STOT - repeated exposure Kidney Liver 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

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Tetrachloroethylene	Group II Chemical	Not applicable	Not applicable

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.

12. Ecological information

Ecotoxicity

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
Tetrachloroethylene	EC50: > 500 mg/L, 96h (Pseudokirchneriella subcapitata)	LC50: 4.73 - 5.27 mg/L, 96h flow-through (Oncorhynchus mykiss) LC50: 11.0 - 15.0 mg/L, 96h static (Lepomis macrochirus) LC50: 8.6 - 13.5 mg/L, 96h static (Pimephales promelas) LC50: 12.4 - 14.4 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 100 mg/L 24 h EC50 = 112 mg/L 24 h EC50 = 120.0 mg/L 30 min	EC50: 6.1 - 9.0 mg/L, 48h Static (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
Tetrachloroethylene	2.53 - 2.88

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
Tetrachloroethylene - 127-18-4	U210	-

14. Transport information

DOT

UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

TDG

UN-No UN1897

Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IATA
UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Packing Group III

IMDG/IMO
UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1
Subsidiary Hazard Class P
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
Tetrachloroethylene	X	X	-	204-825-9	-		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 %
Tetrachloroethylene	127-18-4	>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
Tetrachloroethylene	-	-	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Tetrachloroethylene	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
Tetrachloroethylene	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
Tetrachloroethylene	127-18-4	Carcinogen	14 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Tetrachloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant Y
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 10-Dec-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
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End of SDS

SAFETY DATA SHEET

Creation Date 31-May-2018 **Revision Date** 04-Jun-2018 **Revision Number** 7

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identification

Product Description:	**Xylenes, mixture of isomers**
Cat No. :	**383940000; 383940010; 383940050**
CAS-No	1330-20-7
EC-No.	215-535-7
Molecular Formula	C8 H10

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

Recommended Use	Laboratory chemicals.
Sector of use	SU3 - Industrial uses: Uses of substances as such or in preparations at industrial sites
Product category	PC21 - Laboratory chemicals
Process categories	PROC15 - Use as a laboratory reagent
Environmental release category	ERC6a - Industrial use resulting in manufacture of another substance (use of intermediates)
Uses advised against	No Information available

1.3. Details of the supplier of the safety data sheet

Company	Acros Organics BVBA Janssen Pharmaceuticalaan 3a 2440 Geel, Belgium
E-mail address	begel.sdsdesk@thermofisher.com

1.4. 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

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

CLP Classification - Regulation (EC) No 1272/2008

Physical hazards

Flammable liquids	Category 3 (H226)

Health hazards

Aspiration Toxicity	Category 1 (H304)
Acute dermal toxicity	Category 4 (H312)
Acute Inhalation Toxicity - Vapors	Category 4 (H332)
Skin Corrosion/irritation	Category 2 (H315)
Serious Eye Damage/Eye Irritation	Category 2 (H319)
Specific target organ toxicity - (single exposure)	Category 3 (H335)
Specific target organ toxicity - (repeated exposure)	Category 2 (H373)

Environmental hazards	
Chronic aquatic toxicity	Category 3 (H412)

2.2. Label elements

Signal Word **Danger**

Hazard Statements

H226 - Flammable liquid and vapor
H304 - May be fatal if swallowed and enters airways
H312 - Harmful in contact with skin
H332 - Harmful if inhaled
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation
H373 - May cause damage to organs through prolonged or repeated exposure
H412 - Harmful to aquatic life with long lasting effects

Precautionary Statements

P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking
P303 + P361 + P353 - IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower
P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician
P331 - Do NOT induce vomiting
P304 + P340 - IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing
P264 - Wash face, hands and any exposed skin thoroughly after handling
P337 + P313 - If eye irritation persists: Get medical advice/ attention
P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection
P332 + P313 - If skin irritation occurs: Get medical advice/ attention

2.3. Other hazards

No information available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substances

Component	CAS-No	EC-No.	Weight %	CLP Classification - Regulation (EC) No 1272/2008
Xylenes (o-, m-, p- isomers)	1330-20-7	EEC No. 215-535-7	>95	Flam. Liq. 3 (H226) Asp. Tox. 1 (H304) Acute Tox. 4 (H312) Acute Tox. 4 (H332)

				Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) STOT SE 3 (H335) STOT RE 2 (H373) Aquatic Chronic 3 (H412)

Full text of Hazard Statements: see section 16

SECTION 4: FIRST AID MEASURES

4.1. Description of 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.

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.

Inhalation Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur. Risk of serious damage to the lungs.

Self-Protection of the First Aider Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.

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

Breathing difficulties. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting

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

Notes to Physician Treat symptomatically. Symptoms may be delayed.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Suitable Extinguishing Media
Cool closed containers exposed to fire with water spray.

Extinguishing media which must not be used for safety reasons
Do not use a solid water stream as it may scatter and spread fire.

5.2. Special hazards arising from the substance or mixture

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
None under normal use conditions.

5.3. Advice for 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. Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation. Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges.

6.2. Environmental precautions

Do not flush into surface water or sanitary sewer system.

6.3. Methods and material for containment and cleaning up

Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Take precautionary measures against static discharges. Use spark-proof tools and explosion-proof equipment.

6.4. Reference to other sections

Refer to protective measures listed in Sections 8 and 13.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Wear personal protective equipment. Ensure adequate ventilation. 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.

Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice. Keep away from food, drink and animal feeding stuffs. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing before re-use. Wash hands before breaks and at the end of workday.

7.2. Conditions for safe storage, including any incompatibilities

Keep away from heat and sources of ignition. Flammables area. Keep container tightly closed in a dry and well-ventilated place.

7.3. Specific end use(s)

Use in laboratories

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Exposure limits
List source(s): **EU** - Commission Directive 2006/15/EC of 7 February 2006 establishing a second list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC and amending Directives 91/322/EEC and 2000/39/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. **UK** - EH40/2005 Containing the workplace exposure limits (WELs) for use with the Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended). Updated by September 2006 official press release and October 2007 Supplement. **IRE -** 2010 Code of Practice for the

Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001. Published by the Health and Safety Authority.

Component	The United Kingdom	European Union	Ireland
Xylenes (o-, m-, p- isomers)	STEL: 100 ppm 15 min STEL: 441 mg/m³ 15 min TWA: 50 ppm 8 hr TWA: 220 mg/m³ 8 hr Skin	TWA: 50 ppm 8 hr TWA: 221 mg/m³ 8 hr STEL: 100 ppm 15 min STEL: 442 mg/m³ 15 min Possibility of significant uptake through the skin	TWA: 50 ppm 8 hr. TWA: 221 mg/m³ 8 hr. STEL: 100 ppm 15 min STEL: 442 mg/m³ 15 min Skin

Biological limit values
List source(s): **UK** - Biological Monitoring Guidance Values provided by the UK's Health and Safety Executive (HSE) Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended) and EH40/2005.

Component	United Kingdom	European Union
Xylenes (o-, m-, p- isomers)	Methyl hippuric acid: 650 mmol/mol creatinine urine post shift	

Monitoring methods
BS EN 14042:2003 Title Identifier: Workplace atmospheres. Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents.
MDHS70 General methods for sampling airborne gases and vapours
MDHS 88 Volatile organic compounds in air. Laboratory method using diffusive samplers, solvent desorption and gas chromatography
MDHS 96 Volatile organic compounds in air - Laboratory method using pumped solid sorbent tubes, solvent desorption and gas chromatography

Derived No Effect Level (DNEL) No information available

Route of exposure	Acute effects (local)	Acute effects (systemic)	Chronic effects (local)	Chronic effects (systemic)
Oral				
Dermal				
Inhalation				

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

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.
Wherever possible, engineering control measures such as the isolation or enclosure of the process, the introduction of process or equipment changes to minimise release or contact, and the use of properly designed ventilation systems, should be adopted to control hazardous materials at source

Personal protective equipment

Eye Protection Goggles (European standard - EN 166)

Hand Protection Protective gloves

Glove material	Breakthrough time	Glove thickness	EU standard	Glove comments
Viton (R)	See manufacturers recommendations	-	EN 374	(minimum requirement)

Skin and body protection Long sleeved clothing

Inspect gloves before use.
Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. (Refer to manufacturer/supplier for information)

Ensure gloves are suitable for the task: Chemical compatability, Dexterity, Operational conditions, User susceptibility, e.g. sensitisation effects, also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion.
Remove gloves with care avoiding skin contamination.

Respiratory Protection	When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. To protect the wearer, respiratory protective equipment must be the correct fit and be used and maintained properly
Large scale/emergency use	Use a NIOSH/MSHA or European Standard EN 136 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced **Recommended Filter type:** Organic gases and vapours filter Type A Brown conforming to EN14387
Small scale/Laboratory use	Use a NIOSH/MSHA or European Standard EN 149:2001 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced. **Recommended half mask:-** Valve filtering: EN405; or; Half mask: EN140; plus filter, EN 141 When RPE is used a face piece Fit Test should be conducted
Environmental exposure controls	Prevent product from entering drains. Do not allow material to contaminate ground water system. Local authorities should be advised if significant spillages cannot be contained.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Appearance		
Physical State	Liquid	
Odor	No information available	
Odor Threshold	No data available	
pH	No information available	
Melting Point/Range	-34 °C / -29.2 °F	
Softening Point	No data available	
Boiling Point/Range	136 - 140 °C / 276.8 - 284 °F	@ 760 mmHg
Flash Point	23 °C / 73.4 °F	**Method -** No information available
Evaporation Rate	No data available	
Flammability (solid,gas)	Not applicable	Liquid
Explosion Limits	No data available	
Vapor Pressure	No data available	
Vapor Density	No data available	(Air = 1.0)
Specific Gravity / Density	0.865	
Bulk Density	Not applicable	Liquid
Water Solubility	Insoluble	
Solubility in other solvents	No information available	
Partition Coefficient (n-octanol/water)		
Component	**log Pow**	
Xylenes (o-, m-, p- isomers)	3.15	
Autoignition Temperature	No data available	
Decomposition Temperature	No data available	
Viscosity	No data available	
Explosive Properties	No information available	explosive air/vapour mixtures possible
Oxidizing Properties	No information available	

9.2. Other information

Molecular Formula	C8 H10

Molecular Weight 106.17

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

None known, based on information available

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Hazardous Polymerization No information available.
Hazardous Reactions None under normal processing.

10.4. Conditions to avoid

Keep away from open flames, hot surfaces and sources of ignition.

10.5. Incompatible materials

None known.

10.6. Hazardous decomposition products

None under normal use conditions.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Product Information

(a) acute toxicity;
Oral Based on available data, the classification criteria are not met
Dermal Category 4
Inhalation Category 4

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Xylenes (o-, m-, p- isomers)	LD50 = 3500 mg/kg (Rat)		29.08 mg/L [MOE Risk Assessment Vol.1, 2002]

(b) skin corrosion/irritation; Category 2

(c) serious eye damage/irritation; Category 2

(d) respiratory or skin sensitization;
Respiratory Based on available data, the classification criteria are not met
Skin Based on available data, the classification criteria are not met

(e) germ cell mutagenicity; Based on available data, the classification criteria are not met

(f) carcinogenicity; Based on available data, the classification criteria are not met

There are no known carcinogenic chemicals in this product

(g) reproductive toxicity; Based on available data, the classification criteria are not met

(h) STOT-single exposure; Category 3

Results / Target organs Respiratory system.

(i) STOT-repeated exposure; Category 2

Target Organs No information available.

(j) aspiration hazard; Category 1

Symptoms / effects,both acute and delayed Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecotoxicity effects The product contains following substances which are hazardous for the environment. Contains a substance which is:. Very toxic to aquatic organisms.

Component	Freshwater Fish	Water Flea	Freshwater Algae	Microtox
Xylenes (o-, m-, p- isomers)	LC50: 13.1 - 16.5 mg/L, 96h flow-through (Lepomis macrochirus) LC50: = 19 mg/L, 96h (Lepomis macrochirus) LC50: 7.711 - 9.591 mg/L, 96h static (Lepomis macrochirus) LC50: 23.53 - 29.97 mg/L, 96h static (Pimephales promelas) LC50: = 780 mg/L, 96h semi-static (Cyprinus carpio) LC50: > 780 mg/L, 96h (Cyprinus carpio) LC50: 30.26 - 40.75 mg/L, 96h static (Poecilia reticulata) LC50: 13.5 - 17.3 mg/L, 96h (Oncorhynchus mykiss) LC50: = 13.4 mg/L, 96h flow-through (Pimephales promelas) LC50: 2.661 - 4.093 mg/L, 96h static (Oncorhynchus mykiss)	EC50: = 3.82 mg/L, 48h (water flea) LC50: = 0.6 mg/L, 48h (Gammarus lacustris)		EC50 = 0.0084 mg/L 24 h

12.2. Persistence and degradability

Persistence Persistence is unlikely.

Degradation in sewage treatment plant Contains substances known to be hazardous to the environment or not degradable in waste water treatment plants.

12.3. Bioaccumulative potential

Bioaccumulation is unlikely

Component	log Pow	Bioconcentration factor (BCF)
Xylenes (o-, m-, p- isomers)	3.15	0.6 - 15

12.4. Mobility in soil Spillage unlikely to penetrate soil The product is insoluble and floats on water Is not likely mobile in the environment due its low water solubility.

12.5. Results of PBT and vPvB assessment No data available for assessment.

12.6. Other adverse effects

Endocrine Disruptor Information This product does not contain any known or suspected endocrine disruptors
Persistent Organic Pollutant This product does not contain any known or suspected substance
Ozone Depletion Potential This product does not contain any known or suspected substance

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from Residues / Unused Products Waste is classified as hazardous. Dispose of in accordance with the European Directives on waste and hazardous waste. Dispose of in accordance with local regulations.

Contaminated Packaging Dispose of this container to hazardous or special waste collection point. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep product and empty container away from heat and sources of ignition.

European Waste Catalogue (EWC) According to the European Waste Catalogue, Waste Codes are not product specific, but application specific.

Other Information Do not dispose of waste into sewer. Waste codes should be assigned by the user based on the application for which the product was used. Can be incinerated, when in compliance with local regulations. Do not let this chemical enter the environment. Do not empty into drains.

SECTION 14: TRANSPORT INFORMATION

IMDG/IMO

14.1. UN number UN1307
14.2. UN proper shipping name XYLENES
14.3. Transport hazard class(es) 3
14.4. Packing group III

ADR

14.1. UN number UN1307
14.2. UN proper shipping name XYLENES
14.3. Transport hazard class(es) 3
14.4. Packing group III

IATA

14.1. UN number UN1307
14.2. UN proper shipping name XYLENES
14.3. Transport hazard class(es) 3
14.4. Packing group III

14.5. Environmental hazards No hazards identified

14.6. Special precautions for user No special precautions required

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code Not applicable, packaged goods

SECTION 15: REGULATORY INFORMATION

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

International Inventories X = listed.

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	IECSC	AICS	KECL
Xylenes (o-, m-, p- isomers)	215-535-7	-		X	X	-	X	X	X	X	X

National Regulations

Component	Germany - Water Classification (VwVwS)	Germany - TA-Luft Class
Xylenes (o-, m-, p- isomers)	WGK 2	

Component	France - INRS (Tables of occupational diseases)
Xylenes (o-, m-, p- isomers)	Tableaux des maladies professionnelles (TMP) - RG 4bis,RG 84

Take note of Control of Substances Hazardous to Health Regulations (COSHH) 2002 and 2005 Amendment.

15.2. Chemical safety assessment

A Chemical Safety Assessment/Report (CSA/CSR) has not been conducted

SECTION 16: OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3

H304 - May be fatal if swallowed and enters airways
H312 - Harmful in contact with skin
H332 - Harmful if inhaled
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation
H373 - May cause damage to organs through prolonged or repeated exposure
H412 - Harmful to aquatic life with long lasting effects
H226 - Flammable liquid and vapor

Legend

CAS - Chemical Abstracts Service
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
IECSC - Chinese Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
ENCS - Japanese Existing and New Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

WEL - Workplace Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
DNEL - Derived No Effect Level
RPE - Respiratory Protective Equipment
LC50 - Lethal Concentration 50%
NOEC - No Observed Effect Concentration
PBT - Persistent, Bioaccumulative, Toxic
TWA - Time Weighted Average
IARC - International Agency for Research on Cancer
PNEC - Predicted No Effect Concentration
LD50 - Lethal Dose 50%
EC50 - Effective Concentration 50%
POW - Partition coefficient Octanol:Water
vPvB - very Persistent, very Bioaccumulative

ADR - European Agreement Concerning the International Carriage of Dangerous Goods by Road
IMO/IMDG - International Maritime Organization/International Maritime Dangerous Goods Code
OECD - Organisation for Economic Co-operation and Development
BCF - Bioconcentration factor
ICAO/IATA - International Civil Aviation Organization/International Air Transport Association
MARPOL - International Convention for the Prevention of Pollution from Ships
ATE - Acute Toxicity Estimate
VOC - Volatile Organic Compounds

Key literature references and sources for data
Suppliers safety data sheet, Chemadvisor - LOLI, Merck index, RTECS

Training Advice
Chemical hazard awareness training, incorporating labelling, Safety Data Sheets (SDS), Personal Protective Equipment (PPE) and hygiene.
Use of personal protective equipment, covering appropriate selection, compatibility, breakthrough thresholds, care, maintenance, fit and standards.
First aid for chemical exposure, including the use of eye wash and safety showers.
Chemical incident response training.
Fire prevention and fighting, identifying hazards and risks, static electricity, explosive atmospheres posed by vapours and dusts.

Creation Date	31-May-2018
Revision Date	04-Jun-2018
Revision Summary	SDS sections updated, 2, 3.

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 Safety Data Sheet

SAFETY DATA SHEET

Creation Date 26-Sep-2009 **Revision Date** 23-Jan-2018 **Revision Number** 4

1. Identification

Product Name **m-Xylene**

Cat No. : **AC610470000; AC610471000**

CAS-No 108-38-3
Synonyms 1,3-Dimethylbenzene

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

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 3
Acute dermal toxicity	Category 4
Acute Inhalation Toxicity - Vapors	Category 4
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2

Label Elements

Signal Word
Warning

Hazard Statements
Flammable liquid and vapor
Harmful in contact with skin
Causes skin irritation
Causes serious eye irritation
Harmful if inhaled

Precautionary Statements
Prevention
Wear protective gloves/protective clothing/eye protection/face protection
Avoid breathing dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wash face, hands and any exposed skin thoroughly after handling
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
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
Call a POISON CENTER or doctor/physician if you feel unwell
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 %
m-Xylene	108-38-3	>95

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Move to fresh air. 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. If not breathing, give artificial respiration.

Ingestion Do not induce vomiting. Call a physician or Poison Control Center immediately.

Most important symptoms and effects Breathing difficulties. Symptoms of overexposure may be 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 25 °C / 77 °F

Method - No information available

Autoignition Temperature 465 °C / 869 °F

Explosion Limits

Upper 7.0%

Lower 1.1%

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 (CO_2)

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.

Environmental Precautions 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. 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. 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)
m-Xylene	TWA: 100 ppm STEL: 150 ppm		IDLH: 900 ppm TWA: 100 ppm TWA: 435 mg/m³ STEL: 150 ppm STEL: 655 mg/m³	TWA: 100 ppm TWA: 435 mg/m³ STEL: 150 ppm STEL: 655 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
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. 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 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	-48 °C / -54.4 °F
Boiling Point/Range	139 - 139 °C / 282.2 - 282.2 °F
Flash Point	25 °C / 77 °F
Evaporation Rate	0.7
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	7.0%
Lower	1.1%
Vapor Pressure	8 mbar @ 20 °C
Vapor Density	3.66
Specific Gravity	0.864
Solubility	slightly soluble
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	465 °C / 869 °F
Decomposition Temperature	No information available
Viscosity	0.62 mPa.s at 20 °C
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, Strong acids

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
m-Xylene	LD50 = 5 g/kg (Rat)	LD50 = 12.18 g/kg (Rabbit) LD50 = 14100 µL/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 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
m-Xylene	108-38-3	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

The product contains following substances which are hazardous for the environment. Contains a substance which is:. Toxic to aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
m-Xylene	EC50: = 4.9 mg/L, 72h static (Pseudokirchneriella subcapitata)	LC50: = 8.4 mg/L, 96h semi-static (Oncorhynchus mykiss) LC50: 14.3 - 18 mg/L, 96h flow-through (Pimephales promelas) LC50: = 12.9 mg/L, 96h semi-static (Poecilia reticulata)	EC50 = 0.0084 mg/L 24 h	EC50: 2.81 - 5.0 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability Persistence is unlikely

Bioaccumulation/ Accumulation No information available.

Mobility Will likely be mobile in the environment due to its volatility. Is not likely mobile in the environment due its low water solubility.

Component	log Pow
m-Xylene	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 UN1307
Proper Shipping Name XYLENES
Hazard Class 3
Packing Group III

TDG

UN-No UN1307
Proper Shipping Name XYLENES
Hazard Class 3
Packing Group III

IATA

UN-No UN1307
Proper Shipping Name XYLENES
Hazard Class 3
Packing Group III

IMDG/IMO

UN-No UN1307
Proper Shipping Name XYLENES
Hazard Class 3
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
m-Xylene	X	X	-	203-576-3	-		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 %
m-Xylene	108-38-3	>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
m-Xylene	X	-	-	-

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
m-Xylene	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
m-Xylene	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
m-Xylene	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	26-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 26-Sep-2009 **Revision Date** 26-Jan-2018 **Revision Number** 6

1. Identification

Product Name **Mesitylene**

Cat No. : **AC125580000; AC125580010; AC125580025; AC125580050; AC125582500**

CAS-No 108-67-8
Synonyms 1,3,5-Trimethylbenzene

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

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 3
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system, Central nervous system (CNS).	
Aspiration Toxicity	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
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

Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Do not breathe dust/fume/gas/mist/vapors/spray
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
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
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)
Toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
1,3,5-Trimethylbenzene	108-67-8	97-99

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 soap and plenty of water while removing all contaminated clothes and shoes. Obtain medical attention.
Inhalation	Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention. 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. Vapors may cause drowsiness and dizziness: Symptoms may be delayed: Symptoms of overexposure may be 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	44 °C / 111.2 °F
Method -	No information available
Autoignition Temperature	550 °C / 1022 °F
Explosion Limits	
Upper	6.00%
Lower	1.00%
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 (CO_2)
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	Flammability	Instability	Physical hazards
3	2	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges.
Environmental Precautions	Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. 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. Ensure adequate ventilation. 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. Take precautionary measures against static discharges. Use explosion-proof equipment.

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)
1,3,5-Trimethylbenzene			TWA: 25 ppm TWA: 125 mg/m^3	

Legend

NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Ensure adequate ventilation, especially in confined areas. 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 Tightly fitting safety goggles. Face-shield.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures 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	-45 °C / -49 °F
Boiling Point/Range	163 - 166 °C / 325.4 - 330.8 °F @ 760 mmHg
Flash Point	44 °C / 111.2 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	6.00%
Lower	1.00%
Vapor Pressure	2.5 mbar @ 20 °C
Vapor Density	4.1 (Air = 1.0)
Specific Gravity	0.868
Solubility	slightly soluble
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	550 °C / 1022 °F
Decomposition Temperature	No information available

Viscosity	No information available
Molecular Formula	C9 H12
Molecular Weight	120.19

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, Nitric acid

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

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
1,3,5-Trimethylbenzene	LD50 = 5000 mg/kg (Rat)	Not listed	LC50 = 24 g/m³ (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, 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
1,3,5-Trimethylbenzene	108-67-8	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects Not mutagenic in AMES Test

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 Category 1

Symptoms / effects,both acute and delayed Vapors may cause drowsiness and dizziness: Symptoms may be 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

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
1,3,5-Trimethylbenzene	Not listed	LC50: = 3.48 mg/L, 96h (Pimephales promelas)	Not listed	EC50: = 50 mg/L, 24h (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.

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** UN2325
- **Proper Shipping Name** 1,3,5-TRIMETHYLBENZENE
- **Hazard Class** 3
- **Packing Group** III

TDG

- **UN-No** UN2325
- **Proper Shipping Name** 1,3,5-TRIMETHYLBENZENE
- **Hazard Class** 3
- **Packing Group** III

IATA

- **UN-No** UN2325
- **Proper Shipping Name** 1,3,5-TRIMETHYLBENZENE
- **Hazard Class** 3
- **Packing Group** III

IMDG/IMO

- **UN-No** UN2325
- **Proper Shipping Name** 1,3,5-TRIMETHYLBENZENE
- **Hazard Class** 3
- **Packing Group** III

15. Regulatory information

All of the components in the product are on the following Inventory lists: Australia Complete Regulatory Information contained in following SDS's X = listed China Canada 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 Europe TSCA Korea Philippines Japan U.S.A. (TSCA) Canada (DSL/NDSL) Europe (EINECS/ELINCS/NLP) Australia (AICS) Korea (ECL) China (IECSC) Japan (ENCS) Philippines (PICCS)

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
1,3,5-Trimethylbenzene	X	X	-	203-604-4	-		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 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
1,3,5-Trimethylbenzene	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 Moderate risk, Grade 2

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Email: EMSDS.RA@thermofisher.com

Creation Date 26-Sep-2009
Revision Date 26-Jan-2018
Print Date 26-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).

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End of SDS

Safety Data Sheet

Prepared in accordance with Commission Regulation (EU) 2015/830

Stock Number: 31275
Revision Date: 24-04-2018
This document replaces SDS dated: 06-01-2017
2 Letter ISO country code/language code: UK/EN

Chrysene Standard

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

1.1 Product identifier: **Chrysene Standard**
Stock Number: 31275

Other means of identification:
Synonyms: None Known
REACH Registration No.: None Known

1.2 Relevant identified uses of the substance or mixture and uses advised against:
Relevant identified uses: For Laboratory use only
Uses advised against: Uses other than recommended use.

1.3 Details of the Supplier of the Safety Data Sheet:	**Manufacturer**	**Supplier**
	Restek Corporation 110 Benner Circle Bellefonte, Pa. 16823 USA 00 1 814-353-1300 00 1 814-353-1309 sds@restek.com	Thames Restek UK LTD Units 8-16, Ministry Wharf Wycombe Road, Saunderton Buckinghamshire United Kingdom HP14 4HW 01494 563377 sales@thamesrestek.co.uk
1.4 Emergency telephone number:	00 1 800-424-9300 (CHEMTREC within the US) 00 1 703-741-5970 (Outside USA)	0870-8200418 (CHEMTREC within the UK) +1 703-741-5970 (CHEMTREC International)

Poison Centre contact information: National Poisons Information Service (NPIS)
Email: director.birmingham.unit@npis.org
Website: http://www.npis.org/

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture:

Classification according to Regulation (EC) No 1272/2008 [CLP]:
Carcinogenicity Category 1B
Flammable Liquid Category 2
Serious Eye Damage/Eye Irritation Category 2

Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3

2.2 Label elements:

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

Hazard pictograms:

Signal Word:	Danger
Hazard Statements:	H225 - Highly flammable liquid and vapour H319 - Causes serious eye irritation H336 - May cause drowsiness or dizziness H350 - May cause cancer.
Precautionary Statements:	P201 - Obtain special instructions before use. P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. P280 - Wear protective gloves/protective clothing/eye protection/face protection. P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing. P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Supplemental Hazard information (EU):	None Known
2.3 Other hazards:	This substance does not meet the PBT or vPvB criteria of REACH, Annex XIII

SECTION 3: Composition/information on ingredients

3.1 Substances:
Not applicable

3.2 Mixtures:

Chemical Name	%	CAS #	EC No. REACH Registration No.	Classification (EC) No 1272/2008	M Factor	SCL	Acute Toxicity Estimates
chrysene	0.1	218-01-9	205-923-4 None Known	Aquatic Acute 1; H400 Aquatic Chronic 1; H410 Carc. 1B; H350 Muta. 2; H341	No data available	No data available	Not determined
Acetone	99.9	67-64-1	200-662-2 None Known	Eye Irrit. 2; H319 Flam. Liq. 2; H225 STOT SE 3; H336 EUH066	No data available	No data available	Not determined

For full text of H-statements see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures:

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eye contact: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

Self protection of the first aider: No data available

4.2 Most important symptoms and effects, both acute and delayed: Causes serious eye irritation May cause drowsiness or dizziness

4.3 Indication of any immediate medical attention and special treatment needed: No additional first aid information available

SECTION 5: Firefighting measures

5.1 Extinguishing media:

Suitable extinguishing media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire.

Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Unsuitable extinguishing media: None Known

5.2 Special hazards arising from the substance or mixture: Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a Class B fire. Vapors are heavier than air and may travel to a source of ignition and flash back

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

5.3 Advice for firefighters: Do not enter fire area without proper protection including self-contained toxic breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface. Use water spray/fog for cooling. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

Non-emergency personnel: Non-emergency personnel should be kept clear of the area

Emergency responders: Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.

6.2 Environmental precautions: No data available

6.3 Methods and material for containment and cleaning up:

Small spills: Refer to information provided for large spills

Large spills: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike

with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

6.4 Reference to other sections: Refer to section 13 for disposal information

SECTION 7: Handling and storage

7.1 Precautions for safe handling: Harmful or irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment

7.2 Conditions for safe storage, including any incompatibilities:

Conditions for safe storage: Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

Materials to Avoid/Chemical Incompatibility: Strong oxidizing agents, Strong acids

7.3 Specific end use(s): For Laboratory use only

SECTION 8: Exposure controls/personal protection

8.1 Control parameters:

Occupational Exposure limit values:

Chemical Name	United Kingdom - Workplace Exposure Limits (WELs) - TWAs	United Kingdom - Workplace Exposure Limits (WELs) - STELs	United Kingdom - Biological Monitoring Guidance Values
Acetone	500 ppm TWA; 1210 mg/m3 TWA	1500 ppm STEL; 3620 mg/m3 STEL	No data available

DNEL: None Known

PNEC: None Known

8.2 Exposure controls:

Appropriate engineering controls: Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.

Individual protection measures, such as personal protective equipment:

Eye and face protection: Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.

Skin Protection:

Hand protection: Nitrile Neoprene

Other skin protection: Wear protective gloves. Inspect gloves for chemical break-through and

	replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Respiratory Protection:	No respiratory protection required under normal conditions of use. Provide general room exhaust ventilation if symptoms of overexposure occur as explained Section 3. A respirator is not normally required.
Respirator Type(s):	Not normally required.
Thermal Hazards:	Not applicable
Environmental exposure controls:	No data available

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties:

Appearance:	No data available
Colour:	Depends upon product selection
Odour:	Strong
Odour threshold:	ND
pH:	Not applicable
Melting Point/Freezing Point (°C):	
Melting point (°C):	-95
Freezing point (°C):	No data available
Initial boiling point and boiling range (°C):	56
Flash point (°C):	-20
Evaporation Rate (water = 1):	No data available
Flammability (solid, gas):	No data available
Upper/lower flammability or explosive limits:	
Upper flammable or explosive limit, % in air:	No data available
Lower flammable or explosive limit, % in air:	No data available
Vapour pressure:	No data available
Vapor Density (Air=1):	2
Relative density (water = 1):	0.791
Solubility(ies):	Complete; 100%

Partition coefficient: n-octanol/water:	No data available
Auto-ignition temperature (°C):	465
Decomposition temperature (°C):	No data available
Viscosity:	No data available
Explosive properties:	No data available
Oxidizing properties:	No data available

9.2 Other information:

Volatile Organic Chemicals:	0
Bulk density:	6.601

SECTION 10: Stability and reactivity

10.1 Reactivity:	Not expected to be reactive
10.2 Chemical stability:	Stable under normal conditions.
10.3 Possibility of hazardous reactions:	None expected under standard conditions of storage
10.4 Conditions to avoid:	No data available
10.5 Incompatible materials:	Strong oxidizing agents, Strong acids
10.6 Hazardous decomposition products:	Carbon dioxide, Carbon monoxide

SECTION 11: Toxicological information

11.1 Information on toxicological effects:

Acute toxicity:

Chemical Name	ORAL LD50 (rat)	DERMAL LD50 (rabbit)	INHALATION LC50 (rat)
Acetone	ORAL LD50 Rat 5800 mg/kg	DERMAL LD50 Rabbit > 15700 mg/kg	INHALATION LC50-8H Rat 50100 MG/M3

Based on available data, the classification criteria are not met.

Skin corrosion/irritation:
Based on available data, the classification criteria are not met.

Serious eye damage/irritation:

pH	Not applicable

Classification is based on pH and the components listed in Section 3.

Respiratory or skin sensitisation:
Based on available data, the classification criteria are not met.

Germ cell mutagenicity:
Based on available data, the classification criteria are not met.

Carcinogenicity:
Classification has been based on toxicological information of the components in Section 3.

Reproductive toxicity:
Based on available data, the classification criteria are not met.

STOT-single exposure:
Classification has been based on toxicological information of the components in Section 3.

STOT-repeated exposure:
Based on available data, the classification criteria are not met.

Aspiration hazard:
Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1 Toxicity: This material is not expected to be harmful to the ecology.

Ecological Toxicity Data:

Chemical Name	CAS #	Aquatic EC50 Crustacea	Aquatic ERC50 Algae	Aquatic LC50 Fish
No data available				

12.2 Persistence and degradability: No data
No data

12.3 Bioaccumulative potential: No data

12.4 Mobility in soil: No data

12.5 Results of PBT and vPvB assessment: No data available

12.6 Other adverse effects: None Known

12.7 Additional information: No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods:

Disposal methods: Spent or discarded material is a hazardous waste.
Dispose of by incineration following Federal, State, Local, or Provincial regulations.

Waste codes / waste designations according to LoW: No data available

SECTION 14: Transport information

International carriage of dangerous goods by road (ADR), rail or inland waterways:

14.1 UN number: UN1090

14.2 UN proper shipping name: Acetone

14.3 Transport hazard class(es): 3

14.4 Packing group: II

International carriage of dangerous goods by air (IATA):

14.1 UN number: UN1090

14.2 UN proper shipping name: Acetone

14.3 Transport hazard class(es): 3

14.4 Packing group: II

14.5 Environmental hazards: No

14.6 Special precautions for user: No data available

14.7 Transport in bulk according to Annex II of MARPOL 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:

Chemical Name	EINECS	SVHC
Acetone	Yes	No
chrysene	Yes	No

15.2 Chemical Safety Assessment No Chemical Safety Assessment has been carried out for this

substance/mixture by the supplier.

SECTION 16: Other information

Revision Date: 24-04-2018

Indication of changes: Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.

Abbreviations and acronyms:

CAS = Chemical Abstract Service
DNEL= Derivative No Effect Level
EC= European Community
EINECS = European Inventory of Existing Chemical Substances
MSHA = Mine Safety Health Administration
NIOSH = National Institute of Occupational Safety & Health
OEL = Occupational Exposure Limit
PBT= Persistent, Bioaccumulative, Toxic
PNEC= Predicted No Effect Concentration
SCOEL= Scientific Committee on Occupational Exposure Limits
TLV = Threshold Limit Value
TWA= Time Weighted Average
vPvB= Very Persistent, Very Bioaccumulative
Wt.% = Weight Percent

Key literature references and sources for data: No data available

Hazard phrase(s) referenced in section 3

H341 - Suspected of causing genetic defects.

H350 - May cause cancer.

H225 - Highly flammable liquid and vapour

H319 - Causes serious eye irritation

H336 - May cause drowsiness or dizziness

H410 - Very toxic to aquatic life with long lasting effects

Precautionary Statements:

Prevention:

P201 - Obtain special instructions before use.

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.

	P240 - Ground/bond container and receiving equipment.
	P241 - Use explosion-proof electrical/ventilating/lighting equipment.
	P242 - Use only non-sparking tools.
	P243 - Take precautionary measures against static discharge.
	P261 - Avoid breathing dust/fume/gas/mist/vapours/spray.
	P264 - Wash thoroughly after handling.
	P271 - Use only outdoors or in a well-ventilated area.
	P280 - Wear protective gloves/protective clothing/eye protection/face protection.
Response:	P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
	P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.
	P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
	P308+P313 - IF exposed or concerned: Get medical advice/ attention.
	P312 - Call a POISON CENTER/doctor if you feel unwell.
	P337+P313 - If eye irritation persists: Get medical advice/attention.
	P370+P378 - In case of fire: Use an appropriate extinguisher (see section 5) to extinguish.
Storage:	P403+P233 - Store in a well-ventilated place. Keep container tightly closed.
	P403+P235 - Store in a well-ventilated place. Keep cool.
	P405 - Store locked up.
Disposal:	P501 - Dispose of contents/container to a suitable disposal site in accordance with local/national/international regulations.

Disclaimer of Liability:

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assumed. All such being given and accepted at your risk.

Safety Data Sheet

Revision Date: 08/13/18
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**31272 / Benzo(b)fluoranthene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	10
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:	Carcinogenicity Category 1B Flammable Liquid Category 2 Serious Eye Damage/Eye Irritation Category 2 Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3
GHS Signal Word:	Danger
GHS Hazard:	Highly flammable liquid and vapour. Causes serious eye irritation. May cause drowsiness or dizziness. May cause cancer.
GHS Precautions:	
Safety Precautions:	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilation and lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing dust/fume/gas/mist/vapours/spray. Wash hands and skin thoroughly after handling. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.
First Aid Measures:	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF exposed or concerned: Get medical advice/attention. Call a POISON CENTER or doctor/physician if you feel unwell. If eye irritation persists: Get medical advice/attention. In case of fire: Use extinguishing media in section 5 for extinction.

Storage: Store in a well-ventilated place. Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 3: H336 May cause drowsiness or dizziness.

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Acetone	67-64-1	200-662-2	99.9
benzo (b) fluoranthene	205-99-2	205-911-9	0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Fire and/or Explosion Hazards: Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a Class B fire. Vapors are heavier than air and may travel to a source of ignition and flash back

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained toxic breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface. Use water spray/fog for cooling. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal

evaluation.

7. HANDLING AND STORAGE

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

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
Acetone	67-64-1	2500 ppm IDLH (10% LEL)	750 ppm STEL; 1782 mg/m3 STEL	500 ppm TWA; 1188 mg/m3 TWA	1000 ppm TWA; 2400 mg/m3 TWA
benzo (b) fluoranthene	205-99-2	Not established	None Known	Not established	No data available

Personal Protection:

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

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Depends upon product selection
Odor:	Strong
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.0 (air = 1)
Boiling Point (°C):	56.05 °C at 1013.25 hPa
Melting Point (°C):	-95.4 °C Melting Point
Flash Point (°F):	39
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	465 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.7845 g/cm3 at 25 °C
Evaporation Rate:	No data available
Odor Threshold:	ND
Solubility:	Complete; 100%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	0
Molecular Weight:	58.08

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents Strong acids
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion

Target Organs Potentially Affected By Exposure: Eyes, Central nervous system stimulation, Respiratory Tract, Skin

Chemical Interactions That Change Toxicity: None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation: Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.

Skin Contact: Can cause minor skin irritation, defatting, and dermatitis.

Eye Contact: Can cause minor irritation, tearing and reddening.

Ingestion Irritation: May be harmful if swallowed.

Ingestion Toxicity: Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity: Contains a probable or known human carcinogen.

Reproductive and Developmental Toxicity: No data available to indicate product or any components present at greater than 0.1% may cause birth defects.

Inhalation: Upon prolonged and/or repeated exposure, can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.

Skin Contact: Upon prolonged or repeated contact, can cause minor skin irritation, defatting, and dermatitis.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Acetone	67-64-1	Dermal LD50 Rabbit >15700 mg/kg; Inhalation LC50 Rat 50100 mg/m3 8 h; Oral LD50 Rat 5800 mg/kg

Component Carcinogenic Data:

OSHA:

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

ACGIH:

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

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 92 [2010]; Supplement 7 [1987]; Monograph 32 [1983]	205-99-2	Group 2B

12. ECOLOGICAL INFORMATION

Overview: This material is not expected to be harmful to the ecology.

Mobility: No data

Persistence: No data

Bioaccumulation: No data

Degradability: No data

Ecological Toxicity Data: No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product: Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.

Disposal Methods: Dispose of by incineration following Federal, State, Local, or Provincial regulations.

Waste Disposal of Packaging: Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

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

International:

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

Marine Pollutant: No

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

15. REGULATORY INFORMATION

United States:

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

The following chemicals are listed on CA Prop 65:

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

State Right To Know Listing:

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

16. OTHER INFORMATION

Prior Version Date: 12/08/16

Other Information: Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.

References: No data available

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SAFETY DATA SHEET

Version 4.7
Revision Date 12/28/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Lead

Product Number : 695912
Brand : Aldrich

CAS-No. : 7439-92-1

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

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Oral (Category 4), H302
Carcinogenicity (Category 2), H351
Reproductive toxicity (Category 2), H361
Specific target organ toxicity - repeated exposure (Category 2), H373
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)
H302 Harmful if swallowed.
H351 Suspected of causing cancer.
H361 Suspected of damaging fertility or the unborn child.
H373 May cause damage to organs through prolonged or repeated exposure.
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and

	understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	:	Pb
Molecular weight	:	207.20 g/mol
CAS-No.	:	7439-92-1
EC-No.	:	231-100-4

Hazardous components

Component	Classification	Concentration
Lead		
	Acute Tox. 4; Carc. 2; Repr. 2; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H361, H373, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Lead oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods 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.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.
Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	See 1910.1025		
Lead	7439-92-1	TWA	0.05 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		

		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Lead	7439-92-1	Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Not critical			
		Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
		Not critical			

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Shot
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 327.4 °C (621.3 °F) - lit.
f)	Initial boiling point and boiling range	1,740 °C (3,164 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	No data available
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety 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 acids

10.6 Hazardous decomposition products

Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity

Rat
Cytogenetic analysis

Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC:	2B - Group 2B: Possibly carcinogenic to humans (Lead)
NTP:	Reasonably anticipated to be a human carcinogen (Lead)
	Reasonably anticipated to be a human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Lead)
OSHA:	1910.1025 (Lead)
	OSHA specifically regulated carcinogen (Lead)

Reproductive toxicity
Suspected human reproductive toxicant

Reproductive toxicity - Rat - Inhalation
Effects on Newborn: Biochemical and metabolic.

Reproductive toxicity - Rat - Oral
Effects on Newborn: Behavioral.

Reproductive toxicity - Mouse - Oral
Effects on Fertility: Female fertility index (e.g., # females pregnant per # sperm positive females; # females pregnant per # females mated). Effects on Fertility: Pre-implantation mortality (e.g., reduction in number of implants per female; total number of implants per corpora lutea).

Developmental Toxicity - Rat - Inhalation
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow).

Developmental Toxicity - Rat - Oral
Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow). Effects on Newborn: Growth statistics (e.g., reduced weight gain).

Developmental Toxicity - Rat - Oral
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

Developmental Toxicity - Mouse - Oral
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
May cause damage to organs through prolonged or repeated exposure.

Aspiration hazard
No data available

Additional Information
RTECS: OF7525000

anemia

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	mortality LOEC - Oncorhynchus mykiss (rainbow trout) - 1.19 mg/l - 96.0 h
	LC50 - Micropterus dolomieui - 2.2 mg/l - 96.0 h
	mortality NOEC - Salvelinus fontinalis - 1.7 mg/l - 10.0 d
Toxicity to daphnia and other aquatic invertebrates	mortality LOEC - Daphnia (water flea) - 0.17 mg/l - 24 h
	mortality NOEC - Daphnia (water flea) - 0.099 mg/l - 24 h
Toxicity to algae	mortality EC50 - Skeletonema costatum - 7.94 mg/l - 10 d

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
Bioaccumulation: Oncorhynchus kisutch - 2 Weeks - 150 µg/l

Bioconcentration factor (BCF): 12

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

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

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Lead)
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 3077 Class: 9 Packing group: III EMS-No: F-A, S-F
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Lead)
Marine pollutant:yes
IATA
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Lead)

Further information
EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer. Lead	CAS-No. 7439-92-1	Revision Date 1989-07-10
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Lead	CAS-No. 7439-92-1	Revision Date 1989-07-10

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.

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

HMIS Rating

Health hazard:	1
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	1
Fire Hazard:	0
Reactivity Hazard:	0

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 12/28/2015 Print Date: 05/01/2016

SAFETY DATA SHEET

Version 3.12
Revision Date 12/02/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Mercury

Product Number : 215457
Brand : Sigma-Aldrich
Index-No. : 080-001-00-0

CAS-No. : 7439-97-6

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

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Inhalation (Category 2), H330
Reproductive toxicity (Category 1B), H360
Specific target organ toxicity - repeated exposure (Category 1), H372
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H330 Fatal if inhaled.
H360 May damage fertility or the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.

P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P284	Wear respiratory protection.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	:	Hg
Molecular weight	:	200.59 g/mol
CAS-No.	:	7439-97-6
EC-No.	:	231-106-7
Index-No.	:	080-001-00-0

Hazardous components

Component	Classification	Concentration
Mercury		
	Acute Tox. 2; Repr. 1B; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H330, H360, H372, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Mercury/mercury oxides.

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal. In some instances, a mercury spill kit may be used. Please consult with your site EHS representative to determine the most appropriate clean up method.Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Store under inert gas.
Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Mercury	7439-97-6	C	0.1 mg/m3	USA. NIOSH Recommended Exposure Limits
	Remarks	Potential for dermal absorption		

		CEIL	1.0mg/10m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		TWA	0.05 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		Skin notation		
		TWA	0.025 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen Danger of cutaneous absorption		
		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Mercury	7439-97-6	Mercury	0.0400 mg/g	In urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to shift (16 hours after exposure ceases)			
		Mercury	15.0000 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

8.2 Exposure controls

Appropriate engineering controls
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Colour: silver, white
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: -38.87 °C (-37.97 °F) - lit.
f)	Initial boiling point and boiling range	356.6 °C (673.9 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	< 0.01 hPa (< 0.01 mmHg) at 20 °C (68 °F) 1 hPa (1 mmHg) at 126 °C (259 °F)
l)	Vapour density	6.93 - (Air = 1.0)
m)	Relative density	13.55 g/cm3 at 25 °C (77 °F)
n)	Water solubility	0.00006 g/l at 25 °C (77 °F)
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Relative vapour density	6.93 - (Air = 1.0)

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, Ammonia, Azides, Nitrates, Chlorates, Copper

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

LC50 Inhalation - Rat - male - 2 h - < 27 mg/m3

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC:	3 - Group 3: Not classifiable as to its carcinogenicity to humans (Mercury)
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
Presumed human reproductive toxicant

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard
No data available

Additional Information
RTECS: OV4550000

Mercury accumulates in almost all tissues, especially in the:, Kidney, Effects due to ingestion may include:, Nausea, Vomiting, Diarrhoea, intestinal bleeding

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	mortality LC50 - Cyprinus carpio (Carp) - 0.160 mg/l - 96 h

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential

Bioaccumulation	Carassius auratus (goldfish) - 1,789 d - 0.25 µg/l
	Bioconcentration factor (BCF): 155,986

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

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.

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 2809 Class: 8 (6.1) Packing group: III
Proper shipping name: A,W Mercury
Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 2809 Class: 8 (6.1) Packing group: III EMS-No: F-A, S-B
Proper shipping name: MERCURY
Marine pollutant:yes

IATA
UN number: 2809 Class: 8 (6.1) Packing group: III
Proper shipping name: Mercury

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Mercury	7439-97-6	2013-12-20

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H330	Fatal if inhaled.
H360	May damage fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
Repr.	Reproductive toxicity

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information
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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information
Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 3.12 Revision Date: 12/02/2015 Print Date: 05/01/2016

SAFETY DATA SHEET

Version 4.7
Revision Date 05/23/2016
Print Date 06/23/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Arsenic

Product Number : 202657
Brand : Aldrich
Index-No. : 033-001-00-X

CAS-No. : 7440-38-2

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

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Oral (Category 4), H302
Acute toxicity, Inhalation (Category 3), H331
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H302 Harmful if swallowed.
H331 Toxic if inhaled.
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
P271 Use only outdoors or in a well-ventilated area.
P273 Avoid release to the environment.

P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P304 + P340 + P311	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	:	As
Molecular weight	:	74.92 g/mol
CAS-No.	:	7440-38-2
EC-No.	:	231-148-6
Index-No.	:	033-001-00-X

Hazardous components

Component	Classification	Concentration
Arsenic		
	Acute Tox. 4; Acute Tox. 3; Aquatic Acute 1; Aquatic Chronic 1; H302, H331, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
No data available

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods 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.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.
Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Arsenic	7440-38-2	TWA	0.01 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Lung cancer Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed human carcinogen		
		C	0.0020 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A 15 minute ceiling value		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Arsenic	7440-38-2	inorganic arsenic plus methylated metabolites	35µg As/l	In urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of the workweek (After four or five consecutive working days			

		with exposure)			
		inorganic arsenic plus methylated metabolites	35µg As/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of the workweek (After four or five consecutive working days with exposure)			

8.2 Exposure controls

Appropriate engineering controls
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Pieces Colour: grey
b)	Odour	No data available
c)	Odour Threshold	No data available

d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 817 °C (1,503 °F) - lit.
f)	Initial boiling point and boiling range	613 °C (1,135 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	5.727 g/mL at 25 °C (77 °F)
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety 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
Heat Exposure to air may affect product quality.

10.5 Incompatible materials
Oxidizing agents, Halogens, Palladium undergoes a violent reaction with arsenic, Zinc, Platinum oxide, Nitrogen trichloride, Bromine azide

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Arsenic oxides
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 763 mg/kg
Remarks: Behavioral:Ataxia. Diarrhoea

LD50 Oral - Mouse - 145 mg/kg
Remarks: Behavioral:Ataxia. Diarrhoea

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

This is or contains a component that has been reported to be carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

IARC:	1 - Group 1: Carcinogenic to humans (Arsenic)
NTP:	Known to be human carcinogen (Arsenic)
	Known to be human carcinogen (Arsenic)
OSHA:	OSHA specifically regulated carcinogen (Arsenic)

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: CG0525000

Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer.

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 9.9 mg/l - 96.0 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 3.8 mg/l - 48 h

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
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

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

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 1558 Class: 6.1 Packing group: II
Proper shipping name: Arsenic
Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 1558 Class: 6.1 Packing group: II EMS-No: F-A, S-A
Proper shipping name: ARSENIC
Marine pollutant:yes

IATA
UN number: 1558 Class: 6.1 Packing group: II
Proper shipping name: Arsenic

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.	CAS-No.	Revision Date
Arsenic	7440-38-2	2008-10-10

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H302	Harmful if swallowed.
H331	Toxic if inhaled.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 05/23/2016 Print Date: 06/23/2016

SAFETY DATA SHEET

Version 4.7
Revision Date 12/28/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Nickel

Product Number : 268259
Brand : Aldrich
Index-No. : 028-002-00-7

CAS-No. : 7440-02-0

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

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin sensitisation (Category 1), H317
Carcinogenicity (Category 2), H351
Specific target organ toxicity - repeated exposure, Inhalation (Category 1), H372
Acute aquatic toxicity (Category 3), H402
Chronic aquatic toxicity (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H317 May cause an allergic skin reaction.
H351 Suspected of causing cancer.
H372 Causes damage to organs through prolonged or repeated exposure if inhaled.
H412 Harmful to aquatic life with long lasting effects.

Precautionary statement(s)
P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and

	understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	:	Ni
Molecular weight	:	58.69 g/mol
CAS-No.	:	7440-02-0
EC-No.	:	231-111-4
Index-No.	:	028-002-00-7

Hazardous components

Component	Classification	Concentration
Nickel		
	Skin Sens. 1; Carc. 2; STOT RE 1; Aquatic Acute 3; Aquatic Chronic 3; H317, H351, H372, H412	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Nickel/nickel oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods 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.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.
Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Nickel	7440-02-0	TWA	1.500000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Dermatitis Pneumoconiosis Not suspected as a human carcinogen		
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		

		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		TWA	1.5 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Dermatitis Pneumoconiosis Not suspected as a human carcinogen		
		TWA	1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Foil Colour: white, silver, metallic
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 1,453 °C (2,647 °F) - lit.
f)	Initial boiling point and boiling range	2,732 °C (4,950 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	1 hPa (1 mmHg) at 1,810 °C (3,290 °F)
l)	Vapour density	No data available
m)	Relative density	8.9 g/mL at 25 °C (77 °F)
n)	Water solubility	insoluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety 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
acids, Oxidizing agents, Sulphur compounds, Hydrogen gas, Oxygen, Methanol, organic solvents, Aluminium, Fluorine, Ammonia

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
May cause sensitisation by skin contact.

Germ cell mutagenicity
No data available

Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC:	2B - Group 2B: Possibly carcinogenic to humans (Nickel)
	1 - Group 1: Carcinogenic to humans (Nickel)
	2B - Group 2B: Possibly carcinogenic to humans (Nickel)
IARC:	2B - Group 2B: Possibly carcinogenic to humans (Nickel)
	1 - Group 1: Carcinogenic to humans (Nickel)
	2B - Group 2B: Possibly carcinogenic to humans (Nickel)
NTP:	Reasonably anticipated to be a human carcinogen (Nickel)
	Reasonably anticipated to be a human carcinogen (Nickel)
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
Inhalation - Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard
No data available

Additional Information
RTECS: QR5950000

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Cyprinus carpio (Carp) - 1.3 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 1 mg/l - 48 h

12.2 Persistence and degradability
Not applicable

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
Harmful to aquatic life with long lasting effects.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Nickel	7440-02-0	2007-07-01

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Nickel	7440-02-0	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Nickel	7440-02-0	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Nickel	7440-02-0	2007-07-01

California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.	CAS-No.	Revision Date
Nickel	7440-02-0	2007-09-28

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H317	May cause an allergic skin reaction.
H351	Suspected of causing cancer.
H372	Causes damage to organs through prolonged or repeated exposure if inhaled.
H402	Harmful to aquatic life.
H412	Harmful to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 12/28/2015 Print Date: 05/01/2016

SAFETY DATA SHEET
Calcium Standard

Revision: 04/16/2015
Supersedes Revision: 06/09/2011

according to Regulation (EC) No. 1907/2006 as amended by (EC) No. 1272/2008

Section 1. Identification of the Substance/Mixture and of the Company/Undertaking

1.1 Product Code: 700552
Product Name: Calcium Standard

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

Relevant identified uses: For research use only, not for human or veterinary use.

1.3 Details of the Supplier of the Safety Data Sheet:

Company Name: Cayman Chemical Company
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108

Web site address: www.caymanchem.com

Information: Cayman Chemical Company +1 (734)971-3335

1.4 Emergency telephone number:

Emergency Contact: CHEMTREC Within USA and Canada: +1 (800)424-9300
CHEMTREC Outside USA and Canada: +1 (703)527-3887

Section 2. Hazards Identification

2.1 Classification of the Substance or Mixture:

2.1.1 Classification according to Regulation (EC) No 1272/2008 [CLP]:

Skin Corrosion/Irritation, Category 3

2.2 Label Elements:

2.2.1 Labeling according to Regulation (EC) No 1272/2008 [CLP]:

GHS Signal Word: **Warning**

GHS Hazard Phrases:

H316: Causes mild skin irritation.

GHS Precaution Phrases:

No phrases apply.

GHS Response Phrases:

P332+313: If skin irritation occurs, get medical advice/attention.

GHS Storage and Disposal Phrases:

Please refer to Section 7 for Storage and Section 13 for Disposal information.

2.3 Adverse Human Health Effects and Symptoms: Causes mild skin irritation.
Material may be irritating to the mucous membranes and upper respiratory tract.
May be harmful by inhalation, ingestion, or skin absorption.
May cause eye or respiratory system irritation.
To the best of our knowledge, the toxicological properties have not been thoroughly investigated.

Section 3. Composition/Information on Ingredients

CAS # / RTECS #	Hazardous Components (Chemical Name)/ REACH Registration No.	Concentration	EC No./ EC Index No.	GHS Classification
471-34-1 FF9335000	Calcium carbonate	2.0 %	207-439-9 NA	No data available.
77-86-1 TY2900000	Trizma base	1.21 %	201-064-4 NA	Skin Corr. 2: H315 Eye Damage 2: H319 STOT (SE) 3: H335 H336
7732-18-5	Water	96.79 %	231-791-2	No data available.

ZC0110000			NA	

Section 4. First Aid Measures

4.1 Description of First Aid Measures: No data available.

In Case of Inhalation: Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Get immediate medical attention.

In Case of Skin Contact: Immediately wash skin with soap and plenty of water for at least 15 minutes. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.

In Case of Eye Contact: Hold eyelids apart and flush eyes with plenty of water for at least 15 minutes. Have eyes examined and tested by medical personnel.

In Case of Ingestion: Wash out mouth with water provided person is conscious. Never give anything by mouth to an unconscious person. Get medical attention. Do NOT induce vomiting unless directed to do so by medical personnel.

Section 5. Fire Fighting Measures

5.1 Suitable Extinguishing Media: Use alcohol-resistant foam, carbon dioxide, water, or dry chemical spray.
Use water spray to cool fire-exposed containers.

Unsuitable Extinguishing Media: A solid water stream may be inefficient.

5.2 Flammable Properties and Hazards: No data available.

Flash Pt: No data.

Explosive Limits: LEL: No data. UEL: No data.

Autoignition Pt: No data.

5.3 Fire Fighting Instructions: As in any fire, wear self-contained breathing apparatus pressure-demand (NIOSH approved or equivalent), and full protective gear to prevent contact with skin and eyes.

Section 6. Accidental Release Measures

6.1 Protective Precautions, Protective Equipment and Emergency Procedures: Avoid breathing vapors and provide adequate ventilation.
As conditions warrant, wear a NIOSH approved self-contained breathing apparatus, or respirator, and appropriate personal protection (rubber boots, safety goggles, and heavy rubber gloves).

6.2 Environmental Precautions: Take steps to avoid release into the environment, if safe to do so.

6.3 Methods and Material For Containment and Cleaning Up: Contain spill and collect, as appropriate.
Transfer to a chemical waste container for disposal in accordance with local regulations.

Section 7. Handling and Storage

7.1 Precautions To Be Taken in Handling: Avoid breathing dust/fume/gas/mist/vapours/spray.
Avoid prolonged or repeated exposure.

7.2 Precautions To Be Taken in Storing: Keep container tightly closed.
Store in accordance with information listed on the product insert.

Section 8. Exposure Controls/Personal Protection

8.1 Exposure Parameters:

CAS #	Partial Chemical Name	Britain EH40	France VL	Europe
471-34-1	Calcium carbonate	No data.	TWA: 10 mg/m3	No data.
77-86-1	Trizma base	No data.	No data.	No data.
7732-18-5	Water	No data.	No data.	No data.

CAS #	Partial Chemical Name	OSHA TWA	ACGIH TWA	Other Limits
471-34-1	Calcium carbonate	No data.	TLV: 10 mg/m3 (E)	No data.
77-86-1	Trizma base	No data.	No data.	No data.
7732-18-5	Water	No data.	No data.	No data.

8.2 Exposure Controls:

8.2.1 Engineering Controls (Ventilation etc.): Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

8.2.2 Personal protection equipment:

Eye Protection: Safety glasses

Protective Gloves: Compatible chemical-resistant gloves

Other Protective Clothing: Lab coat

Respiratory Equipment (Specify Type): NIOSH approved respirator, as conditions warrant.

Work/Hygienic/Maintenance Practices: Do not take internally.
Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.
Wash thoroughly after handling.
No data available.

Section 9. Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Physical States: [ ] Gas [X] Liquid [ ] Solid

Appearance and Odor: Solution

pH: 7.0

Melting Point: No data.

Boiling Point: No data.

Flash Pt: No data.

Evaporation Rate: No data.

Explosive Limits: LEL: No data. UEL: No data.

Vapor Pressure (vs. Air or mm Hg): No data.

Vapor Density (vs. Air = 1): No data.

Specific Gravity (Water = 1): No data.

Solubility in Water: No data.

Autoignition Pt: No data.

9.2 Other Information

Percent Volatile: No data.

Section 10. Stability and Reactivity

10.1 Reactivity: No data available.

10.2 Stability: Unstable [ ] Stable [X]

10.3 Stability Note(s): Stable if stored in accordance with information listed on the product insert.

Polymerization: Will occur [ ] Will not occur [X]

10.4 Conditions To Avoid: No data available.

10.5 Incompatibility - Materials To Avoid: No data available.

10.6 Hazardous Decomposition Or Byproducts: No data available.

Section 11. Toxicological Information

11.1 Information on Toxicological Effects: The toxicological effects of this product have not been thoroughly studied.

Carcinogenicity: NTP? No IARC Monographs? No OSHA Regulated? No

CAS #	Hazardous Components (Chemical Name)	NTP	IARC	ACGIH	OSHA
471-34-1	Calcium carbonate	n.a.	n.a.	n.a.	n.a.
77-86-1	Trizma base	n.a.	n.a.	n.a.	n.a.
7732-18-5	Water	n.a.	n.a.	n.a.	n.a.

Section 12. Ecological Information

12.1 Toxicity: Avoid release into the environment.
Runoff from fire control or dilution water may cause pollution.

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: No data available.

Section 13. Disposal Considerations

13.1 Waste Disposal Method: Dispose in accordance with local, state, and federal regulations.

Section 14. Transport Information

14.1 LAND TRANSPORT (US DOT):

DOT Proper Shipping Name: Not dangerous goods.

DOT Hazard Class:

UN/NA Number:

14.1 LAND TRANSPORT (European ADR/RID):

ADR/RID Shipping Name: Not dangerous goods.

UN Number:

Hazard Class:

14.3 AIR TRANSPORT (ICAO/IATA):

ICAO/IATA Shipping Name: Not dangerous goods.

Additional Transport Information: Transport in accordance with local, state, and federal regulations.

Section 15. Regulatory Information

EPA SARA (Superfund Amendments and Reauthorization Act of 1986) Lists

CAS #	Hazardous Components (Chemical Name)	S. 302 (EHS)	S. 304 RQ	S. 313 (TRI)
471-34-1	Calcium carbonate	No	No	No
77-86-1	Trizma base	No	No	Yes-Cat. N106
7732-18-5	Water	No	No	No

CAS #	Hazardous Components (Chemical Name)	Other US EPA or State Lists
471-34-1	Calcium carbonate	CAA HAP,ODC: No; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No
77-86-1	Trizma base	CAA HAP,ODC: HAP; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No
7732-18-5	Water	CAA HAP,ODC: No; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No

Regulatory Information Statement: This SDS was prepared in accordance with 29 CFR 1910.1200 and Regulation (EC) No.1272/2008.

Section 16. Other Information

Revision Date: 04/16/2015

Additional Information About This Product: No data available.

Company Policy or Disclaimer: DISCLAIMER: This information is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes.

SAFETY DATA SHEET

Version 4.10
Revision Date 12/29/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Cadmium

Product Number : 414891
Brand : Aldrich
Index-No. : 048-002-00-0

CAS-No. : 7440-43-9

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

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Inhalation (Category 2), H330
Germ cell mutagenicity (Category 2), H341
Carcinogenicity (Category 1B), H350
Reproductive toxicity (Category 2), H361
Specific target organ toxicity - repeated exposure (Category 1), H372
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Danger

Hazard statement(s)
H330 Fatal if inhaled.
H341 Suspected of causing genetic defects.
H350 May cause cancer.
H361 Suspected of damaging fertility or the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
H410 Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P284	Wear respiratory protection.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	:	Cd
Molecular weight	:	112.41 g/mol
CAS-No.	:	7440-43-9
EC-No.	:	231-152-8
Index-No.	:	048-002-00-0

Hazardous components

Component	Classification	Concentration
Cadmium Included in the Candidate List of Substances of Very High Concern (SVHC) according to Regulation (EC) No. 1907/2006 (REACH)		
	Acute Tox. 2; Muta. 2; Carc. 1B; Repr. 2; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H330, H341, H350, H361, H372, H410	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Cadmium/cadmium oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Wear respiratory protection. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods 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.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.

Air sensitive.
Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Cadmium	7440-43-9	TWA	0.010000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section)		

		Suspected human carcinogen		
		TWA	0.002000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen		
		Substance listed; for more information see OSHA document 1910.1027		
		TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.300000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.600000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.300000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		Potential Occupational Carcinogen See Appendix A		
		TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.600000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		PEL	0.005000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1027 This standard applies to all occupational exposures to cadmium and cadmium compounds, in all forms, and in all industries covered by the Occupational Safety and Health Act, except the construction-related industries, which are covered under 29 CFR 1926.63. OSHA specifically regulated carcinogen		

		Potential Occupational Carcinogen See Appendix A		
		Potential Occupational Carcinogen See Appendix A		
		TWA	0.010000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen varies		
		TWA	0.002000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen varies		
		PEL	0.005000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1027 This standard applies to all occupational exposures to cadmium and cadmium compounds, in all forms, and in all industries covered by the Occupational Safety and Health Act, except the construction-related industries, which are covered under 29 CFR 1926.63. OSHA specifically regulated carcinogen		
		TWA	0.1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		TWA	0.2 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.3 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.6 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		Substance listed; for more information see OSHA document 1910.1027		
		Potential Occupational Carcinogen See Appendix A		
		TWA	0.01 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen varies		

		TWA	0.002 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen varies		
		PEL	0.005 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1027 This standard applies to all occupational exposures to cadmium and cadmium compounds, in all forms, and in all industries covered by the Occupational Safety and Health Act, except the construction-related industries, which are covered under 29 CFR 1926.63. OSHA specifically regulated carcinogen		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Cadmium	7440-43-9	cadmium	0.0050 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Not critical			
		cadmium	5.0000 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		Not critical			
		cadmium	5 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		Not critical			
		cadmium	5µg/g creatinine	Urine	ACGIH - Biological Exposure Indices (BEI)
		Not critical			

8.2 Exposure controls

Appropriate engineering controls
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: granular Colour: light grey
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 320.9 °C (609.6 °F) - lit.
f)	Initial boiling point and boiling range	765 °C (1,409 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	8.65 g/cm3 at 25 °C (77 °F)
n)	Water solubility	0.0023 g/l at 20 °C (68 °F)
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety 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
Oxidizing agents, acids

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 2,330 mg/kg

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC:	1 - Group 1: Carcinogenic to humans (Cadmium)
NTP:	Known to be human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Cadmium)
OSHA:	OSHA specifically regulated carcinogen (Cadmium)

Reproductive toxicity

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: EU9800000

Damage to the lungs., Kidney injury may occur., prolonged or repeated exposure can cause:, Vomiting, Diarrhoea, Lung irritation

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 0.001 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 0.024 mg/l - 48 h
Toxicity to algae	static test EC50 - Selenastrum capricornutum (green algae) - 0.023 mg/l - 72 h (OECD Test Guideline 201)

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
Bioaccumulation: Oncorhynchus mykiss (rainbow trout) - 72 d - 1.27 µg/l

Bioconcentration factor (BCF): 55

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

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.

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3288 Class: 6.1 Packing group: II
Proper shipping name: Toxic solid, inorganic, n.o.s. (Cadmium)
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 3288 Class: 6.1 Packing group: II EMS-No: F-A, S-A
Proper shipping name: TOXIC SOLID, INORGANIC, N.O.S. (Cadmium)
Marine pollutant:yes

IATA
UN number: 3288 Class: 6.1 Packing group: II

Proper shipping name: Toxic solid, inorganic, n.o.s. (Cadmium)

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Cadmium	7440-43-9	2007-07-01

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Cadmium	7440-43-9	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Cadmium	7440-43-9	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Cadmium	7440-43-9	2007-07-01

California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer. Cadmium	CAS-No. 7440-43-9	Revision Date 2009-02-01
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Cadmium	CAS-No. 7440-43-9	Revision Date 2009-02-01

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H330	Fatal if inhaled.
H341	Suspected of causing genetic defects.
H350	May cause cancer.
H361	Suspected of damaging fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	4
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	4
Fire Hazard:	0

Reactivity Hazard: 0

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.10 Revision Date: 12/29/2015 Print Date: 05/01/2016

SAFETY DATA SHEET

Version 4.7
Revision Date 02/27/2015
Print Date 05/24/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Copper

Product Number : 12816
Brand : Aldrich

CAS-No. : 7440-50-8

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

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Not a hazardous substance or mixture.

2.2 GHS Label elements, including precautionary statements

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula : Cu
Molecular weight : 63.55 g/mol
CAS-No. : 7440-50-8
EC-No. : 231-159-6

Hazardous components

Component	Classification	Concentration
Copper		
		<= 100 %

4. FIRST AID MEASURES

4.1 Description of first aid measures

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration.

In case of skin contact
Wash off with soap and plenty of water.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Copper oxides

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Avoid dust formation. Avoid breathing vapours, mist or gas.
For personal protection see section 8.

6.2 Environmental precautions
No special environmental precautions required.

6.3 Methods and materials for containment and cleaning up
Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place.

Store under inert gas. Air sensitive.
Storage class (TRGS 510): Non Combustible Solids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Copper	7440-50-8	TWA	1.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Irritation Gastrointestinal metal fume fever		
		TWA	0.200000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Irritation Gastrointestinal metal fume fever		
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants

8.2 Exposure controls

Appropriate engineering controls
General industrial hygiene practice.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
No special environmental precautions required.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Foil Colour: light red
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 1,083.4 °C (1,982.1 °F)
f)	Initial boiling point and boiling range	2,567 °C (4,653 °F)
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	No data available
l)	Vapour density	No data available
m)	Relative density	8.940 g/cm3
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety 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 acids, Strong oxidizing agents, Acid chlorides, Halogens

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

LD50 Intraperitoneal - Mouse - 3.5 mg/kg

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: GL5325000

Symptoms of systemic copper poisoning may include: capillary damage, headache, cold sweat, weak pulse, and kidney and liver damage, central nervous system excitation followed by depression, jaundice, convulsions, paralysis, and coma. Death may occur from shock or renal failure. Chronic copper poisoning is typified by hepatic cirrhosis, brain damage and demyelination, kidney defects, and copper deposition in the cornea as exemplified by humans with Wilson's disease. It has also been reported that copper poisoning has lead to hemolytic anemia and accelerates arteriosclerosis.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No data available

12.2 Persistence and degradability

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG
UN number: 3077 Class: 9 Packing group: III EMS-No: F-A, S-F
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Copper)
Marine pollutant:yes

IATA
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Copper)

Further information
EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Massachusetts Right To Know Components
No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Copper	7440-50-8	1989-08-11

New Jersey Right To Know Components

	CAS-No.	Revision Date
Copper	7440-50-8	1989-08-11

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

Further information

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Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 02/27/2015 Print Date: 05/24/2016

SAFETY DATA SHEET

Version 5.8
Revision Date 10/12/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name	:	Zinc
Product Number	:	96454
Brand	:	Sigma-Aldrich
CAS-No.	:	7440-66-6

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

Identified uses	:	Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich 3050 Spruce Street SAINT LOUIS MO 63103 USA
Telephone	:	+1 800-325-5832
Fax	:	+1 800-325-5052

1.4 Emergency telephone number

Emergency Phone #	:	(314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Combustible dust,
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word: Warning

Hazard statement(s)

	May form combustible dust concentrations in air
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273	Avoid release to the environment.
P391	Collect spillage.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Combustible dust

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Formula : Zn
Molecular weight : 65.39 g/mol

Hazardous components

Component		Classification	Concentration
Zinc powder (stabilized)			
CAS-No. EC-No. Index-No.	7440-66-6 231-175-3 030-001-01-9	Aquatic Acute 1; Aquatic Chronic 1; H410	<= 100 %
Zinc oxide			
CAS-No. EC-No. Index-No.	1314-13-2 215-222-5 030-013-00-7	Aquatic Acute 1; Aquatic Chronic 1; H410	>= 5 - < 10 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Special powder against metal fire Dry sandUse water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable extinguishing media
Water

5.2 Special hazards arising from the substance or mixture

Zinc/zinc oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.
For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods 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.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Keep in a dry place.
Storage class (TRGS 510): Non Combustible Solids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Zinc oxide	1314-13-2	TWA	2.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	metal fume fever		
		STEL	10.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		metal fume fever		

		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	10.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		C	15.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	15.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder Colour: grey
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	Not applicable
e)	Melting point/freezing point	Melting point/range: 420 °C (788 °F) - lit.
f)	Initial boiling point and boiling range	907 °C (1,665 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	May form combustible dust concentrations in air
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	Not applicable
l)	Vapour density	No data available
m)	Relative density	7.133 g/mL at 25 °C (77 °F)
n)	Water solubility	insoluble
o)	Partition coefficient: n-octanol/water	Not applicable
p)	Auto-ignition temperature	does not ignite
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	During processing, dust may form explosive mixture in air.
t)	Oxidizing properties	No data available

9.2 Other safety information

Bulk density	1.8 - 3.2 kg/m3

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
Dust may form explosive mixture in air.

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong oxidizing agents, Acids and bases

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available (Zinc powder (stabilized))

Inhalation: No data available (Zinc powder (stabilized))

Dermal: No data available (Zinc powder (stabilized))

No data available (Zinc powder (stabilized))

Skin corrosion/irritation
No data available (Zinc powder (stabilized))

Serious eye damage/eye irritation
No data available (Zinc powder (stabilized))

Respiratory or skin sensitisation
Did not cause sensitisation on laboratory animals. (Zinc powder (stabilized))

Germ cell mutagenicity
No data available (Zinc powder (stabilized))

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

ACGIH: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available (Zinc powder (stabilized))

No data available (Zinc powder (stabilized))

Specific target organ toxicity - single exposure
No data available (Zinc powder (stabilized))

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available (Zinc powder (stabilized))

Additional Information
RTECS: ZG8600000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Effects due to ingestion may include:, chills, dry throat, sweet taste, Fever, Cough, Nausea, Vomiting, Weakness, Contact with eyes or skin may cause:, Irritation (Zinc powder (stabilized))

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Cyprinus carpio (Carp) - 450 µg/l - 96 h (Zinc powder (stabilized))
Toxicity to daphnia and other aquatic invertebrates	LC50 - Daphnia magna (Water flea) - 0.068 mg/l - 48 h (Zinc powder (stabilized))
	mortality NOEC - Daphnia (water flea) - 0.101 - 0.14 mg/l - 7 d (Zinc powder (stabilized))

12.2 Persistence and degradability

The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

Bioaccumulation	Algae - 7 d at 16 °C - 5 µg/l (Zinc powder (stabilized))
	Bioconcentration factor (BCF): 466

12.4 Mobility in soil

No data available (Zinc powder (stabilized))

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

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.

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Zinc powder (stabilized))
Reportable Quantity (RQ): 1020 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 3077 Class: 9 Packing group: III EMS-No: F-A, S-F
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Zinc powder (stabilized))
Marine pollutant:yes

IATA
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Zinc powder (stabilized))

Further information
EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

15. REGULATORY INFORMATION

SARA 302 Components
No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Zinc oxide	1314-13-2	2007-03-01
Zinc powder (stabilized)	7440-66-6	1993-04-24

SARA 311/312 Hazards
No SARA Hazards

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

	May form combustible dust concentrations in air
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

Further information
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Product Safety – Americas Region
1-800-521-8956

Version: 5.8 Revision Date: 10/12/2015 Print Date: 05/01/2016

Safety Data Sheet

Revision Date: 08/13/18
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**31272 / Benzo(b)fluoranthene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	10
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:	Carcinogenicity Category 1B Flammable Liquid Category 2 Serious Eye Damage/Eye Irritation Category 2 Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3
GHS Signal Word:	Danger
GHS Hazard:	Highly flammable liquid and vapour. Causes serious eye irritation. May cause drowsiness or dizziness. May cause cancer.
GHS Precautions:	
Safety Precautions:	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilation and lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing dust/fume/gas/mist/vapours/spray. Wash hands and skin thoroughly after handling. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.
First Aid Measures:	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF exposed or concerned: Get medical advice/attention. Call a POISON CENTER or doctor/physician if you feel unwell. If eye irritation persists: Get medical advice/attention. In case of fire: Use extinguishing media in section 5 for extinction.

Storage: Store in a well-ventilated place. Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 3: H336 May cause drowsiness or dizziness.

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Acetone	67-64-1	200-662-2	99.9
benzo (b) fluoranthene	205-99-2	205-911-9	0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Fire and/or Explosion Hazards: Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a Class B fire. Vapors are heavier than air and may travel to a source of ignition and flash back

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained toxic breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface. Use water spray/fog for cooling. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal

evaluation.

7. HANDLING AND STORAGE

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

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
Acetone	67-64-1	2500 ppm IDLH (10% LEL)	750 ppm STEL; 1782 mg/m3 STEL	500 ppm TWA; 1188 mg/m3 TWA	1000 ppm TWA; 2400 mg/m3 TWA
benzo (b) fluoranthene	205-99-2	Not established	None Known	Not established	No data available

Personal Protection:

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

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Depends upon product selection
Odor:	Strong
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.0 (air = 1)
Boiling Point (°C):	56.05 °C at 1013.25 hPa
Melting Point (°C):	-95.4 °C Melting Point
Flash Point (°F):	39
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	465 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.7845 g/cm3 at 25 °C
Evaporation Rate:	No data available
Odor Threshold:	ND
Solubility:	Complete; 100%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	0
Molecular Weight:	58.08

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents Strong acids
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion

Target Organs Potentially Affected By Exposure: Eyes, Central nervous system stimulation, Respiratory Tract, Skin

Chemical Interactions That Change Toxicity: None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation: Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.

Skin Contact: Can cause minor skin irritation, defatting, and dermatitis.

Eye Contact: Can cause minor irritation, tearing and reddening.

Ingestion Irritation: May be harmful if swallowed.

Ingestion Toxicity: Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity: Contains a probable or known human carcinogen.

Reproductive and Developmental Toxicity: No data available to indicate product or any components present at greater than 0.1% may cause birth defects.

Inhalation: Upon prolonged and/or repeated exposure, can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.

Skin Contact: Upon prolonged or repeated contact, can cause minor skin irritation, defatting, and dermatitis.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Acetone	67-64-1	Dermal LD50 Rabbit >15700 mg/kg; Inhalation LC50 Rat 50100 mg/m3 8 h; Oral LD50 Rat 5800 mg/kg

Component Carcinogenic Data:

OSHA:

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

ACGIH:

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

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 92 [2010]; Supplement 7 [1987]; Monograph 32 [1983]	205-99-2	Group 2B

12. ECOLOGICAL INFORMATION

Overview: This material is not expected to be harmful to the ecology.

Mobility: No data

Persistence: No data

Bioaccumulation: No data

Degradability: No data

Ecological Toxicity Data: No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product: Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.

Disposal Methods: Dispose of by incineration following Federal, State, Local, or Provincial regulations.

Waste Disposal of Packaging: Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

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

International:

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

Marine Pollutant: No

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

15. REGULATORY INFORMATION

United States:

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

The following chemicals are listed on CA Prop 65:

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

State Right To Know Listing:

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

16. OTHER INFORMATION

Prior Version Date: 12/08/16

Other Information: Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.

References: No data available

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Safety Data Sheet

Revision Date: 06/15/18
www.restek.com

2 Letter ISO country code/language code: US/EN

1. IDENTIFICATION

Catalog Number / Product Name:	**31274 / Benzo(k)fluoranthene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	11
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:	Carcinogenicity Category 1B Flammable Liquid Category 2 Serious Eye Damage/Eye Irritation Category 2 Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3
GHS Signal Word:	Danger
GHS Hazard:	Highly flammable liquid and vapour. Causes serious eye irritation. May cause drowsiness or dizziness. May cause cancer.
GHS Precautions:	
Safety Precautions:	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep away from heat/sparks/open flames/hot surfaces. – No smoking. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilation and lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing dust/fume/gas/mist/vapours/spray. Wash hands and skin thoroughly after handling. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.
First Aid Measures:	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF exposed or concerned: Get medical advice/attention. Call a POISON CENTER or doctor/physician if you feel unwell. If eye irritation persists: Get medical advice/attention. In case of fire: Use extinguishing media in section 5 for extinction.

Storage: Store in a well-ventilated place. Keep container tightly closed.
Store in a well-ventilated place. Keep cool.
Store locked up.

Disposal: Dispose of contents/container according to section 13 of the SDS.

Single Exposure Target Organs: Specific target organ toxicity - Single exposure - STOT SE 3: H336 May cause drowsiness or dizziness.

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Acetone	67-64-1	200-662-2	99.9
benzo (k) fluoranthene	207-08-9	205-916-6	0.1

4. FIRST-AID MEASURES

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eyes: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Fire and/or Explosion Hazards: Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a Class B fire. Vapors are heavier than air and may travel to a source of ignition and flash back

Fire Fighting Methods and Protection: Do not enter fire area without proper protection including self-contained toxic breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface. Use water spray/fog for cooling. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions and Equipment: Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.

Methods for Clean-up: Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal

evaluation.

7. HANDLING AND STORAGE

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

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	CAS No.	IDLH	ACGIH STEL	ACGIH TLV-TWA	OSHA Exposure Limit
Acetone	67-64-1	2500 ppm IDLH (10% LEL)	750 ppm STEL; 1782 mg/m3 STEL	500 ppm TWA; 1188 mg/m3 TWA	1000 ppm TWA; 2400 mg/m3 TWA
benzo (k) fluoranthene	207-08-9	Not established	None Known	Not established	No data available

Personal Protection:

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

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Depends upon product selection
Odor:	Strong
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.0 (air = 1)
Boiling Point (°C):	480 °C 56.05 °C at 1013.25 hPa
Melting Point (°C):	-95.4 °C Melting Point
Flash Point (°F):	39
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	465 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.7845 g/cm3 at 25 °C
Evaporation Rate:	No data available
Odor Threshold:	ND
Solubility:	Complete; 100%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	0
Molecular Weight:	58.08

10. STABILITY AND REACTIVITY

Stability:	Stable under normal conditions.
Conditions to Avoid:	None known.
Materials to Avoid / Chemical Incompatiability:	Strong oxidizing agents Strong acids
Hazardous Decomposition Products:	Carbon dioxide Carbon monoxide

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion

Target Organs Potentially Affected By Exposure: Eyes, Central nervous system stimulation, Respiratory Tract, Skin

Chemical Interactions That Change Toxicity: None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation: Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.

Skin Contact: Can cause minor skin irritation, defatting, and dermatitis.

Eye Contact: Can cause minor irritation, tearing and reddening.

Ingestion Irritation: May be harmful if swallowed.

Ingestion Toxicity: Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity: Contains a probable or known human carcinogen.

Reproductive and Developmental Toxicity: No data available to indicate product or any components present at greater than 0.1% may cause birth defects.

Inhalation: Upon prolonged and/or repeated exposure, can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.

Skin Contact: Upon prolonged or repeated contact, can cause minor skin irritation, defatting, and dermatitis.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Acetone	67-64-1	Dermal LD50 Rabbit >15700 mg/kg; Inhalation LC50 Rat 50100 mg/m3 8 h; Oral LD50 Rat 5800 mg/kg

Component Carcinogenic Data:

OSHA:

Chemical Name	CAS No.	
Benzo(k)fluoranthene	207-08-9	Present

ACGIH:

Chemical Name	CAS No.	
Acetone	67-64-1	A4 - Not Classifiable as a Human Carcinogen

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 92 [2010]; Supplement 7 [1987]; Monograph 32 [1983]	207-08-9	Group 2B

12. ECOLOGICAL INFORMATION

Overview: This material is not expected to be harmful to the ecology.

Mobility: No data

Persistence: No data

Bioaccumulation: No data

Degradability: No data

Ecological Toxicity Data: No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product: Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.

Disposal Methods: Dispose of by incineration following Federal, State, Local,

or Provincial regulations.

Waste Disposal of Packaging: Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

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

International:

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

Marine Pollutant: No

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

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
Acetone	67-64-1	X	-	-	X
benzo (k) fluoranthene	207-08-9	X	X	-	-

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Benzo[k]fluoranthene	207-08-9	Prop 65 Cancer

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
Acetone	67-64-1	X	X	X	X
benzo (k) fluoranthene	207-08-9	X	X	X	X

16. OTHER INFORMATION

Prior Version Date: 12/30/16

Other Information: Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.

References: No data available

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

Material Safety Data Sheet

Benzo[a]pyrene, 98%

MSDS# 37175

Section 1 - Chemical Product and Company Identification

MSDS Name:	Benzo[a]pyrene, 98%
Catalog Numbers:	AC105600000, AC105600010, AC105601000, AC377200000, AC377200010, AC377201000 AC377201000
Synonyms:	3,4-Benzopyrene; 3,4-Benzpyrene; Benzo[def]chrysene.

Company Identification:	Acros Organics BVBA Janssen Pharmaceuticalaan 3a 2440 Geel, Belgium
Company Identification: (USA)	Acros Organics One Reagent Lane Fair Lawn, NJ 07410
For information in the US, call:	800-ACROS-01
For information in Europe, call:	+32 14 57 52 11
Emergency Number, Europe:	+32 14 57 52 99
Emergency Number US:	201-796-7100
CHEMTREC Phone Number, US:	800-424-9300
CHEMTREC Phone Number, Europe:	703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#:	50-32-8
Chemical Name:	Benzo[a]pyrene
%:	>96
EINECS#:	200-028-5

Hazard Symbols: T N

Risk Phrases: 45 46 60 61 43 50/53

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Danger! May cause allergic skin reaction. Cancer hazard. May cause harm to the unborn child. May impair fertility. May cause eye, skin, and respiratory tract irritation. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. May cause heritable genetic damage. Target Organs: Reproductive system, skin.

Potential Health Effects

Eye:	May cause eye irritation.
Skin:	May cause skin irritation. May be harmful if absorbed through the skin. May cause an allergic reaction in certain individuals.
Ingestion:	May cause irritation of the digestive tract. The toxicological properties of this substance have not been fully investigated. May be harmful if swallowed.
Inhalation:	May cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated. May be harmful if inhaled.

Chronic: May cause cancer in humans. May cause reproductive and fetal effects. Laboratory experiments have resulted in mutagenic effects.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

Ingestion: Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or appropriate foam.

Autoignition Temperature: Not available.

Flash Point: Not available

Explosion Limits: Lower: Not available

Explosion Limits: Upper: Not available

NFPA Rating: health: 2; flammability: 0; instability: 0;

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.

Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Benzo[a]pyrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Benzo[a]pyrene: 0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches)

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

Personal Protective Equipment

Eyes:	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:	Wear appropriate protective gloves to prevent skin exposure.
Clothing:	Wear appropriate protective clothing to prevent skin exposure.
Respirators:	A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State:	Powder
Color:	yellow to brown
Odor:	faint aromatic odor
pH:	Not available
Vapor Pressure:	Not available
Vapor Density:	Not available
Evaporation Rate:	Not available
Viscosity:	Not available
Boiling Point:	495 deg C @ 760 mm Hg (923.00°F)
Freezing/Melting Point:	175 - 179 deg C
Decomposition Temperature:	Not available
Solubility in water:	1.60x10-3 mg/l @25°C
Specific Gravity/Density:	
Molecular Formula:	C20H12
Molecular Weight:	252.31

Section 10 - Stability and Reactivity

Chemical Stability:	Stable under normal temperatures and pressures.
Conditions to Avoid:	Dust generation.
Incompatibilities with Other Materials	Strong oxidizing agents.
Hazardous Decomposition Products	Carbon monoxide, carbon dioxide.
Hazardous Polymerization	Has not been reported.

Section 11 - Toxicological Information

RTECS#:	CAS# 50-32-8: DJ3675000
LD50/LC50:	RTECS: Not available.
Carcinogenicity:	Benzo[a]pyrene - ACGIH: A1 - Confirmed Human Carcinogen (Coal tar pitches). California: carcinogen, initial date 7/1/87 NTP: Suspect carcinogen IARC: Group 1 carcinogen
Other:	The toxicological properties have not been fully investigated.

Section 12 - Ecological Information

Not available

Section 13 - Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

Section 14 - Transport Information

US DOT
Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOL (Benzo{a} pyrene)
Hazard Class: 9
UN Number: UN3077
Packing Group: III
Canada TDG
Shipping Name: Not available
Hazard Class:
UN Number:
Packing Group:

USA RQ: CAS# 50-32-8: 1 lb final RQ; 0.454 kg final RQ

Section 15 - Regulatory Information

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: T N

Risk Phrases:

R 45 May cause cancer.

R 46 May cause heritable genetic damage.

R 61 May cause harm to the unborn child.

R 43 May cause sensitization by skin contact.

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

R 60 May impair fertility.

Safety Phrases:

S 53 Avoid exposure - obtain special instructions before use.

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S 60 This material and its container must be disposed of as hazardous waste.

S 61 Avoid release to the environment. Refer to special instructions/safety data sheets.

WGK (Water Danger/Protection)

CAS# 50-32-8: Not available

Canada

CAS# 50-32-8 is listed on Canada's DSL List

Canadian WHMIS Classifications: D2A, D2B

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

CAS# 50-32-8 is listed on Canada's Ingredient Disclosure List

US Federal

TSCA

CAS# 50-32-8 is listed on the TSCA Inventory.

Section 16 - Other Information

MSDS Creation Date: 9/02/1997

Revision #8 Date 7/20/2009

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantibility or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential, or exemplary damages howsoever arising, even if the company has been advised of the possibility of such damages.

Safety Data Sheet

Prepared in accordance with Commission Regulation (EU) 2015/830

Stock Number: 31270
Revision Date: 13-08-2018
This document replaces SDS dated: 08-12-2016
2 Letter ISO country code/language code: UK/EN

Benzo(a)anthracene Standard

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

1.1 Product identifier: **Benzo(a)anthracene Standard**

Stock Number: 31270

Other means of identification:

Synonyms: None Known

REACH Registration No.: None Known

Molecular formula: CH3OH

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

Relevant identified uses: For Laboratory use only

Uses advised against: Uses other than recommended use.

1.3 Details of the Supplier of the Safety Data Sheet:	**Manufacturer**	**Supplier**
	Restek Corporation 110 Benner Circle Bellefonte, Pa. 16823 USA 00 1 814-353-1300 00 1 814-353-1309 sds@restek.com	Thames Restek UK LTD Units 8-16, Ministry Wharf Wycombe Road, Saunderton Buckinghamshire United Kingdom HP14 4HW 01494 563377 sales@thamesrestek.co.uk
1.4 Emergency telephone number:	00 1 800-424-9300 (CHEMTREC within the US) 00 1 703-741-5970 (Outside USA)	0870-8200418 (CHEMTREC within the UK) +1 703-741-5970 (CHEMTREC International)

Poison Centre contact information: National Poisons Information Service (NPIS)
Email: director.birmingham.unit@npis.org
Website: http://www.npis.org/

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture:

Classification according to Regulation (EC) No 1272/2008 [CLP]: Carcinogenicity Category 1B
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 1

Flammable Liquid Category 2
Hazardous to the aquatic environment - Chronic Category 2
Acute Toxicity - Dermal Category 3
Acute Toxicity - Oral Category 3

2.2 Label elements:

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

Hazard pictograms:

Signal Word: Danger

Hazard Statements:
H225 - Highly flammable liquid and vapour
H301+H311 - Toxic if swallowed or in contact with skin
H350 - May cause cancer.
H370 - Causes damage to organs
H411 - Toxic to aquatic life with long lasting effects

Precautionary Statements:
P201 - Obtain special instructions before use.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P233 - Keep container tightly closed.
P260 - Do not breathe dust/fume/gas/mist/vapours/spray.
P280 - Wear protective gloves/protective clothing/eye protection/face protection.
P301+P310 - IF SWALLOWED: Immediately call a POISON CENTER/doctor.

Supplemental Hazard information (EU): None Known

2.3 Other hazards: This substance does not meet the PBT or vPvB criteria of REACH, Annex XIII

SECTION 3: Composition/information on ingredients

3.1 Substances:
Not applicable

3.2 Mixtures:

Chemical Name	%	CAS #	EC No. REACH Registration No.	Classification (EC) No 1272/2008	M Factor	SCL	Acute Toxicity Estimates
benz (a) anthracene	0.1	56-55-3	200-280-6 None Known	Aquatic Acute 1; H400 Aquatic Chronic 1; H410 Carc. 1B; H350	AQUATIC CHRONIC 1: M = 100 AQUATIC ACUTE 1: M = 100	No data available	Not determined
methanol	99.9	67-56-1	200-659-6 None Known	Acute Tox. 3 (Dermal); H311 Acute Tox. 3 (Inh Dust/Mist); H331 Acute Tox. 3 (Oral); H301 Flam. Liq. 2; H225 STOT SE 1; H370	No data available	STOT SE 2: 3%<10% STOT SE 1: 10%	Not determined

For full text of H-statements see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures:

Inhalation: Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately

Eye contact: Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.

Skin Contact: Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.

Ingestion: Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.

Self protection of the first aider: No data available

4.2 Most important symptoms and Coma and death

effects, both acute and delayed:

4.3 Indication of any immediate medical attention and special treatment needed: IF exposed or concerned: Get medical advice/ attention. IF exposed or concerned: Call a POISON CENTER/doctor. Call a POISON CENTER/doctor if you feel unwell.

SECTION 5: Firefighting measures

5.1 Extinguishing media:

Suitable extinguishing media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.

Unsuitable extinguishing media: None Known

5.2 Special hazards arising from the substance or mixture: Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

5.3 Advice for firefighters: Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

Non-emergency personnel: Non-emergency personnel should be kept clear of the area

Emergency responders: Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.

6.2 Environmental precautions: No data available

6.3 Methods and material for containment and cleaning up:

Small spills: Refer to information provided for large spills

Large spills: Prevent the spread of any spill to minimize harm to human health and the

environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

6.4 Reference to other sections: Refer to section 13 for disposal information

SECTION 7: Handling and storage

7.1 Precautions for safe handling: Toxic or severely irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment

7.2 Conditions for safe storage, including any incompatibilities:

Conditions for safe storage: Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

Materials to Avoid/Chemical Incompatibility: Strong oxidizing agents

7.3 Specific end use(s): For Laboratory use only

SECTION 8: Exposure controls/personal protection

8.1 Control parameters:

Occupational Exposure limit values:

Chemical Name	United Kingdom - Workplace Exposure Limits (WELs) - TWAs	United Kingdom - Workplace Exposure Limits (WELs) - STELs	United Kingdom - Biological Monitoring Guidance Values
methanol	200 ppm TWA; 266 mg/m3 TWA	250 ppm STEL; 333 mg/m3 STEL	No data available

DNEL: None Known

PNEC: None Known

8.2 Exposure controls:

Appropriate engineering controls: Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.

Individual protection measures, such as personal protective equipment:

Eye and face protection: Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.

Skin Protection:

Hand protection: No information available

Other skin protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Respiratory Protection:	If an exposure limit is exceeded or if an operator is experiencing symptoms of inhalation overexposure as explained in Section 3, provide respiratory protection. Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.
Respirator Type(s):	None required where adequate ventilation is provided. If airborne concentrations are above the applicable exposure limits, use NIOSH/MSHA approved respiratory protection.
Thermal Hazards:	Not applicable
Environmental exposure controls:	No data available

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties:

Appearance:	No data available
Colour:	No data available
Odour:	Mild
Odour threshold:	No data available
pH:	Not applicable
Melting Point/Freezing Point (°C):	
Melting point (°C):	No data available
Freezing point (°C):	No data available
Initial boiling point and boiling range (°C):	65
Flash point (°C):	11
Evaporation Rate (water = 1):	No data available
Flammability (solid, gas):	No data available
Upper/lower flammability or explosive limits:	
Upper flammable or explosive limit, % in air:	36
Lower flammable or explosive limit, %	6

in air:

Vapour pressure:	No data available
Vapor Density (Air=1):	1.1
Relative density (water = 1):	0.800
Solubility(ies):	Moderate; 50-99%
Partition coefficient: n-octanol/water:	No data available
Auto-ignition temperature (°C):	464
Decomposition temperature (°C):	No data available
Viscosity:	No data available
Explosive properties:	No data available
Oxidizing properties:	No data available

9.2 Other information:

Volatile Organic Chemicals:	0
Bulk density:	6.676

SECTION 10: Stability and reactivity

10.1 Reactivity:	Not expected to be reactive
10.2 Chemical stability:	Stable under normal conditions.
10.3 Possibility of hazardous reactions:	None expected under standard conditions of storage
10.4 Conditions to avoid:	No data available
10.5 Incompatible materials:	Strong oxidizing agents
10.6 Hazardous decomposition products:	Carbon dioxide, Carbon monoxide

SECTION 11: Toxicological information

11.1 Information on toxicological effects:

Acute toxicity:

Chemical Name	ORAL LD50 (rat)	DERMAL LD50 (rabbit)	INHALATION LC50 (rat)
methanol	No data available	No data available	INHALATION LC50-8H Rat 22500 ppm

Classification has been based on toxicological information of the components in Section 3.

Skin corrosion/irritation:
Based on available data, the classification criteria are not met.

Serious eye damage/irritation:
Based on available data, the classification criteria are not met.

Respiratory or skin sensitisation:
Based on available data, the classification criteria are not met.

Germ cell mutagenicity:
Based on available data, the classification criteria are not met.

Carcinogenicity:
Classification has been based on toxicological information of the components in Section 3.

Reproductive toxicity:
Based on available data, the classification criteria are not met.

STOT-single exposure:
Classification has been based on toxicological information of the components in Section 3.

STOT-repeated exposure:
Based on available data, the classification criteria are not met.

Aspiration hazard:
Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1 Toxicity: Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.

Ecological Toxicity Data:

Chemical Name	CAS #	Aquatic EC50 Crustacea	Aquatic ERC50 Algae	Aquatic LC50 Fish
No data available				

12.2 Persistence and degradability: Biodegrades slowly.
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: None Known

12.7 Additional information: No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods:

Disposal methods: Spent or discarded material is a hazardous waste.
Dispose of by incineration following Federal, State, Local, or Provincial regulations.

Waste codes / waste designations according to LoW: No data available

SECTION 14: Transport information

International carriage of dangerous goods by road (ADR), rail or inland waterways:

14.1 UN number: UN1230

14.2 UN proper shipping name: Methanol

14.3 Transport hazard class(es): 3(6.1)

14.4 Packing group: II

International carriage of dangerous goods by air (IATA):

14.1 UN number: UN1230

14.2 UN proper shipping name: Methanol

14.3 Transport hazard class(es): 3(6.1)

14.4 Packing group: II

14.5 Environmental hazards: Yes

14.6 Special precautions for user: No data available

14.7 Transport in bulk according to Annex II of MARPOL 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:

Chemical Name	EINECS	SVHC
methanol	Yes	No

benz (a) anthracene	Yes	No

15.2 Chemical Safety Assessment No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

SECTION 16: Other information

Revision Date: 13-08-2018

Indication of changes: Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.

Abbreviations and acronyms:

CAS = Chemical Abstract Service
DNEL= Derivative No Effect Level
EC= European Community
EINECS = European Inventory of Existing Chemical Substances
MSHA = Mine Safety Health Administration
NIOSH = National Institute of Occupational Safety & Health
OEL = Occupational Exposure Limit
PBT= Persistent, Bioaccumulative, Toxic
PNEC= Predicted No Effect Concentration
SCOEL= Scientific Committee on Occupational Exposure Limits
TLV = Threshold Limit Value
TWA= Time Weighted Average
vPvB= Very Persistent, Very Bioaccumulative
Wt.% = Weight Percent

Key literature references and sources for data: No data available

Hazard phrase(s) referenced in section 3

H350 - May cause cancer.
H225 - Highly flammable liquid and vapour
H301+H311+H331 - Toxic if swallowed, in contact with skin or if inhaled
H370 - Causes damage to organs
H410 - Very toxic to aquatic life with long lasting effects

Precautionary Statements:

Prevention:

P201 - Obtain special instructions before use.
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.
	P233 - Keep container tightly closed.
	P240 - Ground/bond container and receiving equipment.
	P241 - Use explosion-proof electrical/ventilating/lighting equipment.
	P242 - Use only non-sparking tools.
	P243 - Take precautionary measures against static discharge.
	P260 - Do not breathe dust/fume/gas/mist/vapours/spray.
	P264 - Wash thoroughly after handling.
	P270 - Do not eat, drink or smoke when using this product.
	P273 - Avoid release to the environment.
	P280 - Wear protective gloves/protective clothing/eye protection/face protection.
Response:	P301+P310 - IF SWALLOWED: Immediately call a POISON CENTER/doctor.
	P302+P352 - If on skin: Wash with plenty of water.
	P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
	P308+P311 - IF exposed or concerned: Call a POISON CENTER/doctor.
	P308+P313 - IF exposed or concerned: Get medical advice/ attention.
	P312 - Call a POISON CENTER/doctor if you feel unwell.
	P321 - Specific treatment (see Sections 4 to 8 on this SDS and any additional information on this label).
	P330 - Rinse mouth.
	P361+P364 - Take off immediately all contaminated clothing and wash it before reuse.
	P370+P378 - In case of fire: Use an appropriate extinguisher (see section 5) to extinguish.
	P391 - Collect spillage.
Storage:	P233 - Keep container tightly closed.
	P403+P235 - Store in a well-ventilated place. Keep cool.
	P405 - Store locked up.
Disposal:	P501 - Dispose of contents/container to a suitable disposal site in accordance with local/national/international regulations.

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Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

Material Safety Data Sheet
Chrysene, 98%

ACC# 95251

Section 1 - Chemical Product and Company Identification

MSDS Name: Chrysene, 98%
Catalog Numbers: AC224140000, AC224140010, AC224140050, AC224145000
Synonyms: 1,2-Benzophenanthrene; Benzo(a)phenanthrene; 1,2,5,6-Dibenzonaphthalene.
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
218-01-9	Chrysene	98	205-923-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: very light beige solid.
Caution! May cause eye and skin irritation. May cause respiratory tract irritation. May cause cancer in humans.
Target Organs: Liver, skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: May cause respiratory tract irritation.
Chronic: May cause cancer according to animal studies.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. This material in sufficient quantity and reduced particle size is capable of creating a dust explosion.
Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.
Flash Point: Not applicable.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: ; Flammability: 1; Instability:

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Wear a self contained breathing apparatus and appropriate personal protection. (See Exposure Controls, Personal Protection section). Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Wash thoroughly after handling. Avoid contact with eyes, skin, and clothing. Use only with adequate ventilation. Avoid breathing dust.
Storage: Store in a tightly closed container. Store in a cool, dry area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Chrysene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Chrysene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: 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: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: 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.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: very light beige
Odor: Not available.
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 448 deg C @ 760 mm Hg
Freezing/Melting Point:250-255 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density: Not available.
Molecular Formula:C18H12
Molecular Weight:228.29

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 218-01-9: GC0700000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 218-01-9:

- **ACGIH:** A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
- **California:** carcinogen, initial date 1/1/90
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: Chrysene was mutagenic to S. Typhimurium in the presence of an exogenous metabolic system.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Water flea LC50 = 1.9 mg/L; 2 Hr.; Unspecified Fish toxicity : LC50 (96hr) Neauthes arenacedentata >1ppm.(Rossi,S.S. et al Marine Pollut. Bull. 1978) Invertebrate toxicity : lethal treshold concentration (24hr) Daphnia Magna 0,7æg/l.(* Newsted,J.L. et al Environ. Toxicol. Chem. 1987) Bioaccumulation : 24hr Daphnia Magna log bioconcentration factor 3.7845 (*)
Environmental: Degradation studies : biodegradated by white rot fungus (Proc.Annu.Meet.Am.Wood-Preserv.Assoc.1989) May be utilised by axenic cultures of microorganisms e.g. Pseudomonas pancimobilis EPA505, which may have novel degradative systems(Mueller,J.G. et al ppl.Environ.Microbiol.1990; Mueller, J.G. et al Environ.Sci.Technol.1991).
Physical: Not found.
Other: No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series:
CAS# 218-01-9: waste number U050.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	DOT regulated - small quantity provisions apply (see 49CFR173.4)	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 218-01-9 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
CAS# 218-01-9: 100 lb final RQ; 45.4 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
Section 313
This material contains Chrysene (CAS# 218-01-9, 98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA. CAS# 218-01-9 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

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

STATE

CAS# 218-01-9 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65

The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:

WARNING: This product contains Chrysene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 218-01-9: 0.35 æg/day NSRL (oral)

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T

Risk Phrases:

R 45 May cause cancer.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)

CAS# 218-01-9: No information available.

Canada - DSL/NDSL

CAS# 218-01-9 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2A.
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 218-01-9 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 6/30/1999
Revision #5 Date: 11/20/2008

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

SAFETY DATA SHEET (SDS)

MSDS: Magnesium WIRE AND RODS
REVISED 5-2018
SDS Number: 014- MAG

For Welding Consumables and Related Products
Conforms to the criteria of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS),
OSHA Hazard Communication Standard 29CFR 1910.1200
Standard Must Be Consulted for Specific Requirements

SECTION I – IDENTIFICATION of Product and Company

Manufacturer/Supplier: Washington Alloy Company	Recommended use:	Restriction on use:	Telephone No: 704-598-1325
Address: 7010-G Reames Rd, Charlotte, NC 28216	Welding, Filler Metal, Brazing	Not Known	Emergency No: 704-598-1325
Trade Name of Magnesium: AZ61A, AZ92A, AZ101A			Specification: AWS A5.19

SECTION II – COMPOSITION / INFORMATION ON INGREDIENTS

GHS Hazard Classification: STOT SE 3 (H336, H335), (H372), Aquatic Acute 1 (H400)/ **Label Elements** - Hazard symbol and Signal word =

GHS07 GHS08 GHS09

Danger

Hazard statement and Precautionary statement =

Very toxic to aquatic life, Causes damage to organs through prolonged or repeated exposure, May cause drowsiness or dizziness, May cause respiratory irritation.; Wash thoroughly after handling. Do not eat, drink or smoke when using this product Do not breathe dust/fume/gas/mist/vapors/spray. Avoid breathing dust/fume/gas/mist/vapor/spray.. Use only outdoors or in a well-ventilated area. Avoid release to the environment. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell. Get medical advice and attention if you feel unwell. Collect spillage. Store in a well-ventilated place; Keep container tightly closed. Store locked up. Dispose of contents/container in accordance with local/ regional/ national/ international regulations. Manganese and Manganese compounds above safe exposure limits can affect or cause irreversible damage to the central nervous system, including the brain: symptoms may result in impaired speech and movement, lack of energy, stiffness in legs, feet, toes, muscular weakness as well as psychological disturbances. Reports of bronchitis and lung fibrosis have also been noted.

Other Hazards which do not result in GHS classification and Overview: Electric shock can kill. Wear approved head, hand and body protection, which help to prevent injury from radiation, sparks and electrical shock. Welding arc and sparks can ignite combustibles or flammable materials. See ANSI Z-49.1. This would include wearing welder's gloves and a protective face shield and may include arm protectors, apron, hats, shoulder protection, as well as dark substantial clothing. Welders should be trained not to allow electrically live parts to contract the skin or wet clothing and gloves. The welders should insulate themselves from the work and ground. Arc Rays can injure eyes and burn skin. Read and understand the manufacturer's instructions and precautionary label on this product and your employer's safety practices. See Section XIII.

As shipped these are odorless, solid rods that are nonflammable, non-explosive, non-reactive and non –hazardous with a metallic luster.

Substance: Welding fumes and gases cannot be classified simply. The composition and quantity of these fumes and gases are dependent upon the metal being welded, the procedures followed, and the electrodes used. Fumes may affect eyes, skin, respiratory system as well as pancreas and liver.

Workers should be aware that the composition and quantity of fumes and gases to which they may be exposed, are influenced by: coatings which may be present on the metal being welded (such as paint, plating, or galvanizing), the number of welders in operation and the volume of the work area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing procedure). When the electrode is consumed, the fumes and gas decomposition products generated are different in percent and form from the ingredients listed in Section III, The composition of these fumes and gases are the concerning matter and not the composition of the electrode itself. Decomposition products include those originating from the volatilization, reaction, or oxidation of the ingredients shown in Section III, plus those from the base metal, coating and the other factors noted above. Reasonable expected fume constituents of this product would include: Complex oxides or compounds of chromium, magnesium, manganese, silicon, copper, aluminum, zinc and may be present. (Other complex oxides may be present when using fluxes).

Ingredients listed in Section III

Chemical Identity	CAS No.	EINECS#
Carbon dioxide	124-38-9	204-696-9
Carbon monoxide	630-8-0	211-128-3
Nitrogen dioxide	10102-44-0	-
Ozone	10028-15-6	233-069-2
Manganese (Mn)	7439-96-5	231-105-1

SECTION III – COMPOSITION / INFORMATION ON INGREDIENTS

*The term "HAZARDOUS MATERIALS" should be interpreted as a term required and defined in OSHA HAZARD COMMUNICATION STANDARD 29 CFR 1910.1200 however the use of this term does not necessarily imply the existence of any hazard.

Chemical Identity Ingredients	CAS No.	EINECS#	Composition percent in Weight (%)		
			AZ61A	AZ92A	AZ101A
Aluminum	7429-90-5	231-072-3	5.8-7.2	8.3-9.7	9.5-10.5
Zinc (Zn) Fume[(1)]	7440-66-6	231-175-3	0.40-1.5	1.7-2.3	0.75-1.25
Beryllium	7440-41-7	231-150-7	0.0002-0.0008		
Copper	7440-50-8	231-159-6	0.05		
Manganese (Mn) (limits as fume) [(1)]	7439-96-5	231-105-1	0.15-0.5		
Iron	7439-89-6	231-096-4	0.005		
Silicon (Si)	7440-21-3	231-130-8	0.05		
Magnesium (Mg)	7439-95-4	231-104-6	Balance		
Nickel (Ni)	7440-02-0	231-111-4	0.005		

Other elements or ingredients may be present but in quantities much less than 1%. [(1)] Subject to reporting requirements of Section 302, 304, 311, 312, and 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and 40CFR 370 and 372; (Resp) = Respiratory/ Respiration: Welding and cutting of products that contain Chromium may produce hexavalent chromium and YOU should read and follow OSHA's final rules Fed Register #:71:10099-10385 dated 02-28-2006. Occupational Safety and Health Administration 29 CFR 1910.1000 Permissible Exposure Limit (PEL). American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV[R]). *Ceiling Limit **Short Term Exposure Limit Single values are maximum

SECTION IV – FIRST AID MEASURES

Contact with skin, eyes, ingestion or injection should not be a source for exposure with proper protection.

Ingestion: Avoid contact with metal fume or powers which may lead to ingestion which may be harmful. Do not induce vomiting unless directed by medical personnel. Rinse mouth with water if conscious. Call a physician or poison control center immediately.

Inhalation: If breathing has stop or difficult move to fresh air and as needed perform artificial respiration. Call medical assistance or physician.

Skin Contact: Remove any contaminated clothing, gloves or other personnel equipment and promptly wash/flush with mild soap and water. For reddish or blistered skin from thermal/arc radiation promptly wash/flush with water. Get medical assistance or physician help as needed.

Eye Contact: Arc radiation can injure eyes and cause an arc flash – if this occurs, move to dark room removing lenses as required and get rest and cover eyes with non-stick dressings (padded dressing) Removal of dust and fumes requires flushing with abundant amounts of clean water for at least 15 minutes. Get medical assistance or physician help as needed or if issues persist.

Most important symptoms/effects, acute and delayed:

Symptoms: Short-term (acute) overexposure to welding fumes may result in discomfort such as metal fume fever, dizziness, nausea, dryness or irritation of nose, throat, or eyes. Pre-existing respiratory issues may be aggregated. Long-term (chronic) over-exposure to welding fumes can lead to siderosis (iron deposits in lung) and is believed to affect pulmonary function. Manganese and Manganese compounds above safe exposure limits can affect or cause irreversible damage to the central nervous system, including the brain: symptoms may result in impaired speech and movement, lack of energy, stiffness in legs, feet, toes, muscular weakness as well as psychological disturbances. Reports of bronchitis and lung fibrosis have also been noted.

Hazards: Welding fumes and gases cannot be classified simply. Refer to Section II under Substance and Section VIII

SECTION V – FIRE-FIGHTING MEASURES

As shipped these are odorless, solid rods that are nonflammable, non-explosive, non-reactive and non –hazardous. Welding arcs and sparks can ignite combustibles or flammable materials Read and understand the manufacturer's instructions and precautionary label on this product and your employer's safety practices. Read and understand: American National Standard ANSI Z49.1 *Safety in Welding, Cutting and Allied Processes*, published by the AMERICAN WELDING SOCIETY, 550 N.W. LeJeune Road, Miami, Florida 33126; OSHA *Safety and Health Standards* are published by the U.S. Government Printing Office, 732 North Capitol Street NW, Washington, DC 20401. Also, National Fire Protection Association NFPA 51B, *Standard for Fire Prevention During Welding, Cutting and other Hot Work; Also See NFPA 651*

Suitable (and unsuitable) extinguishing media: As shipped these items will not burn however in the event use media recommended for the burning materials and fire situation and surroundings. No unsuitable media known at this time. Do not use water or halogenated on molten metals.

Specific hazards arising from the chemicals: Welding arcs and sparks can ignite combustibles or flammable materials

Specific protective equipment and precautions for firefighters: Wear self-contained breathing apparatus and full protective clothing in case of fire or when fumes and vapors are present. Follow general fire-fighting precautions as in the workplace. Do not allow run off to enter drains or water sources.

SECTION VI – ACCIDENTAL RELEASE MEASURES

Personal Precautions, protective equipment and emergency procedures: With airborne dust and fumes, be sure to use adequate engineering ventilation controls and personal protection to prevent overexposure limits recommendations found in Section VIII.

Environment precautions: Control work practices to eliminate environmental release. These products are solid metal rods, with no spill or leak hazards as shipped. If product becomes molten dam up with sand type media until it cools back to a solid and reuse/recycle as scrap.

Methods and Materials for containment and cleaning up: Solid rods can be picked up and placed back in the original container. Clean up immediately while following all safety guidelines as well as using all personal protection safety listed in section VIII. Avoid generating dust and prevent materials from entering and drains, sewers or water sources. Disposal considerations found in Section XIII. When fumes and vapors are present follow general fire-fighting precautions as in the workplace and all applicable regulations

SECTION VII – HANDLING AND STORAGE

Precautions for safe handling: Handle with care wearing gloves and keep formation of airborne dust and fumes to a minimum. If needed use adequate engineering ventilation controls and personal protection to prevent overexposure limits recommendations found in Section VIII. Also read American National Standard ANSI Z49.1 *Safety in Welding, Cutting and Allied Processes*, published by the AMERICAN WELDING SOCIETY, 550 N.W. LeJeune Road, Miami, Florida 33126; OSHA *Safety and Health Standards* are published by the U.S. Government Printing Office, 732 North Capitol Street NW, Washington, DC 20401. Do not eat or drink while using these products and ensure proper ventilation is used. Wash hands after use. **Conditions for safe storage, including any incompatibilities:** All employees who handle these products should be trained to handle it safely. Open packages of these products/containers on a safe stable surface and must be properly labeled at all times. Store products in original closed packages, cool dry place, while avoiding extreme temperatures or incompatible items such as acids, strong bases, oxidizers and halogens. Always follow all regulations in accordance with local/regional/state/national guidelines.

SECTION VIII – EXPOSURE CONTOLS/PERSONAL PROTECTION

Control parameters

Flux or other ingredients	CAS No.	EINECS#	Exposure Limit (mg/m^3)	
			OSHA PEL	ACGIH TLV
Iron (Fe) (limits as oxide fume)	7439-89-6	231-096-4	10	5 (Resp)
Manganese (Mn) (limits as fume) [(1)]	7439-96-5	231-105-1	1 , 3.0** , 5*	0.02 (Resp) 0.1***
Silicon (Si)	7440-21-3	231-130-8	15 (dust) 5 (Resp)	WITHDRAWN
Nickel (Ni) [(1)]	7440-02-0	231-111-4	1	1.5 (inhalable fraction)
Copper (Cu) [(A) (1)]	7440-50-8	231-159-6	1 (dust) 0.1(fume)	1 (dust) 0.2 (fume)
Magnesium (Mg)	7439-95-4	231-105-1	15 (total particulate)	10
Zinc (Zn) Fume[(1)]	7440-66-6	231-175-3	5 mg/m3 5 mg/m3 (Resp) 15 mg/m3 (total dust)	2 (Resp)10**
Beryllium	7440-41-7	239-981-7	0.002, 0.005 Ceiling, 0.025 for 30 minutes	0.00005***
Aluminum (Al) [(1) (2)]	7429-90-5	231-072-3	15 (total dust) 5 (Resp)	10 (dust)1 (Resp)

Other elements or ingredients may be present but in quantities much less than 1%.[(1)] Subject to reporting requirements of Section 302, 304, 311, 312, and 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and 40CFR 370 and 372; (Resp) = Respiratory/ Respiration: Welding and cutting of products that contain Chromium may produce hexavalent chromium and YOU should read and follow OSHA's final rules Fed Register #:71:10099-10385 dated 02-28-2006. Occupational Safety and Health Administration 29 CFR 1910.1000 Permissible Exposure Limit (PEL). American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV[R]). *Ceiling Limit **Short Term Exposure Limit ***Inhalable fraction **ACGIH** - **A**merican **C**onference of **G**overnmental **I**ndustrial **H**ygienists, a professional association which establishes exposure limits used a guideline in control for health hazards but not an indication of safe and dangerous exposure limits **TLV - Threshold Limit Value** - an airborne concentration of a substance, which represents conditions under which it is generally believed that nearly all workers, may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour & **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. **OSHA** - U.S. Occupational Safety and Health Administration. **PEL - Permissible Exposure Limit** - this exposure value means the same as a TLV, except that it is limits guideline by OSHA. **Eye Protection:** Wear a helmet or face shield with a filter lens shade number 12-14 or darker for arc welding. Shield other workers by providing screens and flash goggles. Use face-shield with filter lens of appropriate shade number (per ANSI Z49.1-1988, "Safety in Welding and Cutting"). **Protective Clothing:** Wear approved head, hand and body protection, which help to prevent injury from radiation, sparks and electrical shock. See ANSI Z-49.1. This would include wearing welder's gloves and a protective face shield and may include arm protectors, apron, hats, shoulder protection, as well as dark substantial clothing. Welders should be trained not to allow electrically live parts to contract the skin or wet clothing and gloves. The welders should insulate themselves from the work and ground. **Ventilation:** Use plenty of ventilation and/or local exhaust at the arc, to keep the fumes and gases below the threshold limit value within the worker's breathing zone and the general work area. Welders should be advised to keep their head out of the fumes.

Respiratory Protection: Use respirable fume respirator or air supplied respirator when welding in a confined space or general work area where local exhaust and/or ventilation does not keep exposure below the threshold limit value.

HYGIENE/ WORK PRACTICES: With all chemicals/materials, avoid getting these products ON YOU or IN YOU. Wash hands after handling these products. Do not eat or drink while handling these products. Use ventilation and other engineering controls to minimize potential exposure to these products.

SECTION IX – PHYSICAL AND CHEMICAL PROPERTIES

Appearance / Color / Odor / Physical state / Form: Solid rods that are nonflammable, non-explosive, non-reactive and non –hazardous with a metallic luster. **Odor Threshold / pH / Flash Point / Evaporation Rate / Flammability (Solid, Gas) / Upper & Lower Flammability or Explosive Limits:** No data available **Vapor Pressure & Density / Relative Density / / Partition coefficient (n-octanol/water) / Auto-ignition Decomposition temperature:** No data available **MELTING POINT**: 1112°F (600 °C) SPECIFIC GRAVITY N/A **Solubility(water/other); Insoluble**

SECTION X – STABILITY and REACTIVITY

Chemical stability: These products are considered stable as shipped and under normal conditions
Possibility of hazard reactions: No data and will not occur
Conditions to avoid: Avoid exposure to extreme temperatures, Incompatible materials
Incompatible materials: Incompatible items such as acids, oxidizers, halogens, Strong bases, mineral acids, and halogens.
Hazardous decomposition products: Read Substance in Section II. Welding and cutting of products that contain Chromium may produce hexavalent chromium and YOU should read and follow OSHA's final rules Fed Register #:71:10099-10385 dated 02-28-2006. Occupational Safety and Health Administration 29 CFR 1910.1000 Permissible Exposure Limit (PEL). The best method to determine the actual composition of generated fumes and gases is to take an air sample from inside the welder's helmet if worn or in breathing zone. For additional information, refer to the American Welding Society Publication, "Fumes and Gases in the Welding Environment".

SECTION XI- TOXICOLOGICAL INFORMATION

Oral/Dermal/inhalation: **Acute oral toxicity;** Iron: (Human-child); TDLo: 77 mg/kg. Oral (rat); LD50:30 gm/kg. Intraperitoneal (rabbit); LDLo: 20 mg/kg. Oral (guinea pig); LD50:20 gm/kg. Oral (rat); TDLo: 63 gm/kg/6W-C. Inhalation (rat); 250 mg/m3/6H/4W-I. Intratracheal (rat); TDLo: 450 mg/kg/15W-I. Silicon: Acute oral toxicity (LD50): 3160 mg/kg [Rat]. Manganese: Acute oral toxicity (LD50): 9000 mg/kg [Rat].; TCLo 2300 mg/m3 (inhalation human central nervous); Silicon : Acute oral toxicity (LD50): 3160 mg/kg [Rat].; Copper: Acute oral toxicity (TDLo): 12 mg/kg, gastrointestinal effects; Zinc: (TDLo): 124 mg//m3/50mins, pulmonary effects of skin; **Skin corrosion or irritation / Serious eye damage or irritation / Respiratory or skin sensitization / Germ cell mutagenicity / Reproductive toxicity / Specific target organ toxicity – single exposure / Specific target organ toxicity – repeated exposure**: Not classified **Carcinogenicity:** Overall Evaluation of welding fume and Nickel is listed by IARC as possibly carcinogenic to humans (Group 2B). **National Toxicology Program** (NTP) list Nickel with Reasonably Anticipated to be a Human Carcinogen; Nickel and compounds pose a respiratory cancer risk, and may give skin itch to dermatitis Arc Rays can injure eyes and burn skin. Skin cancer has been reported **Information on the likely routes of exposures: Ingestion** is not a likely route of exposure for this product or expected under normal use. If swallowed call physician immediately! Do not induce vomiting unless directed by medical personnel. Rinse mouth with water if person is conscious. Never give fluids or induce vomiting if person is unconscious, having convulsions, or not breathing. **Inhalation** of welding fumes and gases can be dangerous to your health. **Skin/Eye Contact:** Arc Rays can injure eyes and burn skin. Skin cancer has been reported. **IARC**- has classified welding fumes as a possible carcinogenic to humans (Group 2B) **Symptoms related to physical, chemical and toxicological characteristics: Inhalation:** Short-term(acute) overexposure to welding fumes may result in discomfort such as metal fume fever, dizziness, nausea, dryness or irritation of nose, throat, or eyes. Pre-existing respiratory issues may be aggregated. Long-term (chronic) over-exposure to welding fumes can lead to siderosis (iron deposits in lung) and is believed to affect pulmonary function. Manganese and Manganese compounds above safe exposure limits can affect or cause irreversible damage to the central nervous system, including the brain: symptoms may result in impaired speech and movement, lack of energy, stiffness in legs, feet, toes, muscular weakness as well as psychological disturbances. Reports of bronchitis and lung fibrosis have also been noted. **Delayed and immediate effects and also chronic effects from short and long-term exposure:** There are no immediate health hazards associated with the wire or rod form of this product. Skin, respiratory, pancreas, and liver disorders may be aggravated by prolonged over-exposures to the dusts or fumes generated by these products. Pre-existing respiratory issues may be aggregated. Long-term (chronic) over-exposure to welding fumes can lead to siderosis (iron deposits in lung) and is believed to affect pulmonary function. Manganese and Manganese compounds above safe exposure limits can affect or cause irreversible damage to the central nervous system, including the brain: symptoms may result in impaired speech and movement, lack of energy, stiffness in legs, feet, toes, muscular weakness as well as psychological disturbances. Reports of bronchitis and lung fibrosis have also been noted. Treat symptoms and eliminate overexposure.
Other information during use: **Inhalation acute toxicity**: Carbon dioxide LC Lo (Human, 5 min): 90000 ppm Carbon monoxide LC 50 (Rat, 4 h): 1,300 mg/l Nitrogen dioxide LC 50 (Rat, 4 h): 88 ppm

SECTION XII- TOXICOLOGICAL INFORMATION

Ecotoxicity: Iron = LC50 Channel catfish (Ictalurus punctatus) > 500 mg/l, 96 hours**; Manganese** = EC 50 (Water flea (Daphnia magna), 48 h): 40 mg/l; **Nickel** LC50 Fathead minnows (Pimephales promelas) 2.916 mg/l, 96 hours**,** *EC50 Water flea* (Daphnia obtusa) 1 mg/l, 48 hours **; Aluminum** (Al) LC 50 (Grass carp, white amur (Ctenopharyngodon idella) 96 h): 0.21-0.31 mg/l**: Copper** LC50 Fathead minnows (Pimephales promelas) 1.6 mg/l, 96 hours**,** *EC50 Water flea* (Daphnia obtusa) 0.102 mg/l, 48 hours **; Specified substance(s):** Nickel Zebra mussel (Dreissana polymorpha), Bioconcentration Factor (BCF): 5,000 – 10,000 (lotic) Biocencentration factor calculated using dry weight tissue concentration: Copper and/or copper alloys and compounds (as Cu) Blue-green algae (Anacystis nidulans), Bioconcentration Factor (BCF): 36.01 (Static); **Persistence and Degradability / Bioaccumulative Potential / Mobility in Soil:** No data

Other Adverse Effects: Possibly harmful to aquatic life. Do not allow material to be released to the environment without proper governmental permits. No further relevant information available.

SECTION XIII- DISPOSAL CONCIDERATIONS

Disposal Methods: Avoid or minimize generating waste**.** When possible collect scrap and by-products with proper id for recycling. Waste disposal must be in accordance with appropriate Federal, National, Provincial, State, and local regulations. These products, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.

SECTION XIV- TRANSPORT INFORMATION

UN Number / UN Proper shipping name / Transport Hazard class (es)/ Packing group / Marine pollutant / Special Precautions: Not Regulated as Dangerous Good or Not Regulated, No international regulations

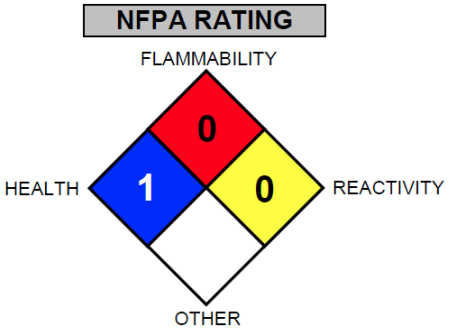
SECTION XV- REGULATORY INFORMATION

United States: TSCA INVENTORY STATUS: The components of these products are listed on the TSCA Inventory; **CERCLA REPORTABLE QUANTITY (RQ):** Beryllium, Nickel, Copper, Manganese, Zinc, Manganese = Reportable quantity: Included in the regulation but with no data values. See regulation (40 CFR 302.4). **EPCRA/SARA Title III 313 Toxic Chemicals** The following metallic components are listed as SARA 313 "Toxic Chemicals" and potential subject to annual SARA 313 reporting. See Section III for weight percent. Ingredient & Disclosure threshold: Aluminum, Chromium, Copper, Manganese, Vanadium, Zinc all @ 1.0% de minimis concentration: Hexavalent chromium compounds 0.1% de minimis concentration N090; Zinc oxide 1.0% de minimis concentration N982
Superfund Amendments and Reauthorization Act 1986 (SARA): As shipped: Immediate (Acute) In use: Immediate delayed (Delayed)

California Proposition 65: **WARNING**: This product may expose you to chemicals including [Cobalt (II) Oxide, Titanium dioxide (airborne, unbound particles of respirable size), Chromium (hexavalent compounds), Nickel, Lead and Lead Compounds, Carbon Black, Cadmium, Beryllium and Beryllium Compounds] which are known to the State of California to cause cancer, and [Chromium (hexavalent compounds), Nickel, Lead and Lead Compounds, Cadmium] which are known to the State of California to cause birth defects and/or other reproductive harm. For more information go to https://www.p65warnings.ca.gov/
Beryllium and Nickel, is on the California Proposition 65 lists. Hexavalent chromium compounds, Beryllium, Nickel, listed in the following- Carcinogens & Reproductive Toxic Listed Substance, Carcinogenic Substance 2/27/1987, Developmental Toxin 12/19/2008, Female Reproductive Toxin 12/19/2008, Male Reproductive Toxin 12/19/2008
US State Regulations list: See Section III for contents and weight percent
Alaska-Designated Toxic and Hazardous Substances: Aluminum Welding Fumes, Manganese,
California-Permissible Exposure Limits for Chemical Contaminants: Aluminum, Aluminum oxide, Beryllium, Nickel, Manganese, Silicon, Magnesium, Magnesium Oxide, Copper, Iron, Iron oxide, Zinc and Zinc oxide
Florida-Substance List: Aluminum, Manganese,
Illinois-Toxic Substance List: Aluminum, Copper, Manganese, and Silicon.
Kansas-Section 302/313 List: Aluminum, Copper, and Manganese.
Massachusetts-Substance List: Aluminum, Aluminum oxide, Beryllium, Nickel, Copper, Magnesium, Magnesium Oxide, Manganese, Iron oxide, Silicon, Zinc, Zinc oxide
Michigan - Critical Materials Register: Copper.
Minnesota-List of Hazardous Substances: Aluminum Welding Fumes, Beryllium, Nickel, Copper, Manganese, and Silicon.
Missouri-Employer Information/Toxic Substance List: Aluminum, Copper, Manganese, Molybdenum, Silicon,
New Jersey-Right to Know Hazardous Substance List Aluminum, Aluminum oxide, Copper, Iron oxide, Magnesium, Magnesium Oxide, Manganese, Silicon, Beryllium, Nickel, Zinc oxide
North Dakota-List of Hazardous Chemicals, Reportable Quantities: Copper.
Pennsylvania-Hazardous Substance List: Aluminum, Aluminum oxide, Copper, Iron oxide, Iron oxide, Magnesium, Manganese, Silicon, Welding Fume, Zinc oxide Beryllium, Nickel,
Rhode Island-Hazardous Substance List: Aluminum Welding Fumes, Manganese, Silicon, and Zirconium.
Texas-Hazardous Substance List: Manganese,
West Virginia-Hazardous Substance List: Manganese,
Wisconsin-Toxic and Hazardous Substances: Manganese,

SECTION XVI- OTHER INFORMATION

Approval Date:5-29-2018 NEW SDS Number: 014-MAG
NFPA CODES: FIRE: 0 HEALTH: 1 REACTIVITY: 0
U.S. DOT = Material is not hazardous and is not considered as a dangerous item.
Washington Alloy Co. Believes that the information contained in this (SDS) Safety Data Sheet is accurate. However, Washington Alloy Co. does not express or implies any warranty with respect to this information.
Download the most current SDS and product information @ www.weldingwire.com



SAFETY DATA SHEET

Creation Date 08-Nov-2010 **Revision Date** 16-Jan-2019 **Revision Number** 6

1. Identification

Product Name **Fluoranthene**

Cat No. : **AC119170000; AC119170250; AC119171000; AC119175000**

CAS-No 206-44-0
Synonyms Benzo[j,k]fluorene

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 %
Fluoranthene	206-44-0	>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.

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 Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable Extinguishing Media No information available

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available
Explosion Limits
Upper No data available
Lower No data available
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO_2)

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	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment. Avoid dust formation.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Sweep up or vacuum up spillage and collect in suitable container for disposal. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling Ensure adequate ventilation. Wear personal protective equipment. Avoid dust formation. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation.

Storage Keep in a dry, cool and well-ventilated place. Keep container tightly closed.

8. Exposure controls / personal protection

Exposure Guidelines This product does not contain any hazardous materials with occupational exposure limitsestablished by the region specific regulatory bodies.

Engineering Measures 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	Powder Solid
Appearance	Light green
Odor	Odorless
Odor Threshold	No information available
pH	Not applicable
Melting Point/Range	109 - 111 °C / 228.2 - 231.8 °F
Boiling Point/Range	384 °C / 723.2 °F
Flash Point	Not applicable
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
Specific Gravity	No information available
Solubility	insoluble
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C16 H10
Molecular Weight	202.25

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 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

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Fluoranthene	LD50 = 2 g/kg (Rat)	LD50 = 3180 mg/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
Fluoranthene	206-44-0	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. See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity

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

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Fluoranthene	Not listed	Oncorhynchus mykiss: LC50=0.0077 mg/L 96h	Not listed	EC50: 0.78 mg/L 20h

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available.

Mobility .

Component	log Pow
Fluoranthene	5.1

13. Disposal considerations

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

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Fluoranthene - 206-44-0	U120	-

14. Transport information

DOT

UN-No	UN3077
Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
Proper technical name	Fluoranthene
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

All of the components in the product are on the following Inventory lists: 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 Europe China Canada TSCA Japan X = listed Australia U.S.A. (TSCA) Canada (DSL/NDSL) Europe (EINECS/ELINCS/NLP) Australia (AICS) Korea (ECL) China (IECSC) Japan (ENCS) Philippines (PICCS) Complete Regulatory Information contained in following SDS's

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Fluoranthene	X	-	X	205-912-4	-		-	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 %
Fluoranthene	206-44-0	>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
Fluoranthene	-	-	X	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
Fluoranthene	100 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
Fluoranthene	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	08-Nov-2010
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

Material Safety Data Sheet
Phenanthrene, 98+%

ACC# 96981

Section 1 - Chemical Product and Company Identification

MSDS Name: Phenanthrene, 98+%
Catalog Numbers: AC130090000, AC130090050, AC130090500, AC130091000, AC130095000
Synonyms:
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
85-01-8	Phenanthrene	>98.0	201-581-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: brown.
Warning! Harmful if swallowed. May cause allergic skin reaction. May cause eye, skin, and respiratory tract irritation. Cancer suspect agent.
Target Organs: Skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May be harmful if absorbed through the skin. May cause an allergic reaction in certain individuals.
Ingestion: Harmful if swallowed. May cause irritation of the digestive tract.
Inhalation: May be harmful if inhaled. Inhalation of dust may cause respiratory tract irritation.
Chronic: Limited evidence of a carcinogenic effect.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid imme diately.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. Dusts at sufficient concentrations can form explosive mixtures with air. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray or dry chemical.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 1; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation. Do not let this chemical enter the environment.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Phenanthrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Phenanthrene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: 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: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: 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.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: brown
Odor: None reported
pH: Not available.
Vapor Pressure: 1 mm Hg @116c
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 340 deg C
Freezing/Melting Point:101 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density:1.0630g/cm3
Molecular Formula:C14H10
Molecular Weight:178.23

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, dust generation, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 85-01-8: SF7175000
LD50/LC50:
CAS# 85-01-8:
Oral, mouse: LD50 = 700 mg/kg;
Oral, rat: LD50 = 1.8 gm/kg;
.

Carcinogenicity:
CAS# 85-01-8:

- **ACGIH:** A1 - Confirmed Human Carcinogen (listed as 'Coal tar pitches').
- **California:** Not listed.
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: No information found
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 85-01-8 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
CAS# 85-01-8: 5000 lb final RQ; 2270 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 85-01-8: immediate.
Section 313
This material contains Phenanthrene (CAS# 85-01-8, >98.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA. CAS# 85-01-8 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 85-01-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as Coal tar pitches), Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

XN N

Risk Phrases:

R 22 Harmful if swallowed.
R 40 Limited evidence of a carcinogenic effect.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 29 Do not empty into drains.
S 36/37 Wear suitable protective clothing and gloves.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)

CAS# 85-01-8: No information available.

Canada - DSL/NDSL

CAS# 85-01-8 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2B.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 85-01-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 7/14/1998
Revision #5 Date: 5/05/2009

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Sources of Exposure

General Populations

- The most likely source of exposure is ingestion of contaminated food and drinking water. Exposure can also occur via inadvertent ingestion of contaminated soil/dust or lead-based paint.
- Lead can leach into drinking water from lead-soldered joints or leaded pipes in water distribution systems or individual houses. Lead may also enter foods if they are put into improperly glazed pottery or ceramic dishes.
- Some non-Western folk remedies may contain substantial amounts of lead. Some types of hair dyes and cosmetics may contain lead compounds.
- Other potential sources of exposure are hobbies that use lead: casting ammunition and m fishing weights; soldering with lead solder; making stained glass; using firing ranges. Leaded gasoline is still used in some race cars, airplanes, and off-road vehicles.

Occupational Populations

- Potentially high levels of lead may occur in the following industries: lead smelting and refining industries, battery manufacturing plants, steel welding or cutting operations, construction, rubber products and plastics industries, printing industries, firing ranges, radiator repair shops and other industries requiring flame soldering of lead solder.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- Approximately 95% of deposited inorganic lead that is inhaled is absorbed.
- The extent and rate of gastrointestinal absorption of inorganic lead are influenced by the physiological state of the exposed individual and the species of the lead compound.
- Gastrointestinal absorption of lead is higher in children (40–50%) than in adults (3–10%). The presence of food in the gastrointestinal tract decreases absorption.
- Absorption of lead from soil is less than that of dissolved lead, but is similarly depressed by meals (26% fasted; 2.5% when ingested with a meal).
- In adults, about 94% of the total amount of lead in the body is contained in the bones and teeth versus about 73% in children.
- The elimination half-lives for inorganic lead in blood and bone are approximately 30 days and 27 years, respectively.
- Independent of the route of exposure, absorbed lead is excreted primarily in urine and feces.

Normal Human Levels

- Lead levels in blood (geometric mean, 1999-2002):
  1.9 µg/dL for children 1-5 years
  1.5 µg/dL for adults 20–59 years
- Lead levels in urine (geometric mean, 2001-2002):
  0.677 µg/L for ≥6 years of age

Biomarkers/Environmental Levels

Biomarkers

- Analysis of lead in whole blood is the most common and accurate method of assessing lead exposure. Erythrocyte protoporphyrin (EP) tests can also be used, but are not as sensitive at low blood lead levels (<20 µg/dL). Lead in blood reflects recent exposure.
- Bone lead measurements are an indicator of cumulative exposure.
- Measurements of urinary lead levels and hair have been used to assess lead exposure; however, they are not as reliable.

Environmental Levels

Air

- The concentration of lead in air samples (2002) is <0.05 µg/m^3.

Sediment and Soil

- The natural lead content of soil typically ranges from <10 to 30 µg/g. However, lead levels in the top layers of soil vary widely due to deposition and accumulation of atmospheric particulates from anthropogenic sources.

Water

- Levels of lead in surface water and groundwater in the U.S. range between 5 and 30 µg/L.

Reference

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

ToxGuide™ for Lead

Pb

CAS# 7439-92-1

October 2007

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

Contact Information:
Division of Toxicology
and Environmental Medicine
Applied Toxicology Branch

1600 Clifton Road NE, F-32
Atlanta, GA 30333
1-800-CDC-INFO
1-800-232-4636

www.atsdr.cdc.gov/toxpro2.html

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Chemical and Physical Information

Lead is a metal

- Lead is a naturally-occurring bluish-gray metal that is rarely found in its elemental form, but occurs in the Earth's crust primarily as the mineral galena (PbS), and to a lesser extent as anglesite ($PbSO_4$) and cerussite ($PbCO_3$).
- Lead is not a particularly abundant element, but its ore deposits are readily accessible and widely distributed throughout the world. Its properties, such as corrosion resistance, density, and low melting point, make it a familiar metal in pipes, solder, weights, and storage batteries.
- Natural lead is a mixture of four stable isotopes, ^{208}Pb (51–53%), ^{206}Pb (23.5–27%), ^{207}Pb (20.5–23%), and ^{204}Pb (1.35–1.5%). Lead isotopes are the stable decay product of three naturally radioactive elements: ^{205}Pb from uranium, ^{207}Pb from actinium, and ^{208}Pb from thorium.

Routes of Exposure

- Inhalation – Primary route for occupational exposure. Larger particles (>2.5 µm) that are deposited in the ciliated airways (nasopharyngeal and tracheobronchial regions) can be transferred by mucociliary transport into the esophagus and swallowed.
- Oral – Primary route of exposure for the general population.
- Dermal – Studies in animals have shown that organic lead is well absorbed through the skin.

Lead in the Environment

- Lead is dispersed throughout the environment primarily as the result of anthropogenic activities. In the air, lead is in the form of particles and is removed by rain or gravitational settling.
- The fate of lead in soil is affected by the adsorption at mineral interfaces, which are dependent upon physical and chemical characteristics of the soil (e.g., pH, soil type, particle size, organic matter content).
- Sources of lead in dust and soil can include lead from weathering and chipping of lead-based paint from buildings, bridges, and other structures.
- The solubility of lead compounds in water is a function of pH, hardness, salinity, and the presence of humic material. Solubility is highest in soft, acidic water.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

- MRLs were not derived for lead because a clear threshold for some of the more sensitive effects in humans has not been identified.
- In lieu of MRLs, ATSDR has developed a framework to guide decisions at lead sites. This approach utilizes site-specific exposure data to estimate internal doses as measured by blood lead levels (PbBs) (see Appendix D in the Toxicological Profile).

Health Effects

Hematological

- Decreased activity of several heme biosynthesis enzymes at PbB <10 µg/dL.

Gastrointestinal

- Colic in children – PbB 60–100 µg/dL.

Cardiovascular

- Elevated blood pressure – PbB<10 µg/dL.

Renal

- Decreased glomerular filtration rate at mean PbB <20 µg/dL.

Neurological

- Encephalopathy – PbB100–120 µg/dL (adults) 70–100 µg/dL (children).
- Peripheral neuropathy – PbB40 µg/dL.
- Neurobehavioral and neuropsychological effects in adults – PbB40–80 µg/dL.
- Cognitive and neurobehavioral effects in children at PbB <10 µg/dL.

Reproductive

- Reduced fertility – PbB>40 µg/dL.

Children's Health

- Children are more vulnerable to the effects of lead than adults.
- The most common source of lead exposure for children is lead-based paint.
- Lead exposures during infancy or childhood may result in anemia, neurological impairment, renal alterations, colic, and impaired metabolism of vitamin D.
- Lead exposures either *in utero*, during infancy, or during childhood may result in delays or impairment of neurological development, neurobehavioral deficits including IQ deficits, low birth weight, and low gestational age, growth retardation, and delayed sexual maturation in girls.
- Ensuring a diet that is nutritionally adequate in calcium and iron may decrease the absorbed dose of lead.

Mercury - ToxFAQs™

CAS # 7439-97-6

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

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

What is mercury?

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

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

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

What happens to mercury when it enters the environment?

- Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.
- It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.
- Methylmercury may be formed in water and soil by small organisms called bacteria.
- Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

How might I be exposed to mercury?

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

How can mercury affect my health?

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

Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

Mercury

CAS # 7439-97-6

How likely is mercury to cause cancer?

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

How can mercury affect children?

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

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

How can families reduce the risk of exposure to mercury?

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

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

Pregnant women and children should keep away from rooms where liquid mercury has been used.

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

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

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

Has the federal government made recommendations to protect human health?

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

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

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

References

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

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Arsenic - ToxFAQs™

CAS # 7440-38-2

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

HIGHLIGHTS: Exposure to higher than average levels of arsenic occur mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found in at least 1,149 of the 1,684 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

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

Inorganic arsenic compounds are mainly used to preserve wood. Copper chromated arsenate (CCA) is used to make "pressure-treated" lumber. CCA is no longer used in the U.S. for residential uses; it is still used in industrial applications. Organic arsenic compounds are used as pesticides, primarily on cotton fields and orchards.

What happens to arsenic when it enters the environment?

- Arsenic occurs naturally in soil and minerals and may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching.
- Arsenic cannot be destroyed in the environment. It can only change its form.
- Rain and snow remove arsenic dust particles from the air.
- Many common arsenic compounds can dissolve in water. Most of the arsenic in water will ultimately end up in soil or sediment.
- Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How might I be exposed to arsenic?

- Ingesting small amounts present in your food and water or breathing air containing arsenic.
- Breathing sawdust or burning smoke from wood treated with arsenic.
- Living in areas with unusually high natural levels of arsenic in rock.
- Working in a job that involves arsenic production or use, such as copper or lead smelting, wood treating, or pesticide application.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs.

Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Almost nothing is known regarding health effects of organic arsenic compounds in humans. Studies in animals show that some simple organic arsenic

compounds are less toxic than inorganic forms. Ingestion of methyl and dimethyl compounds can cause diarrhea and damage to the kidneys.

How likely is arsenic to cause cancer?

Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. The Department of Health and Human Services (DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans.

How can arsenic affect children?

There is some evidence that long-term exposure to arsenic in children may result in lower IQ scores. There is also some evidence that exposure to arsenic in the womb and early childhood may increase mortality in young adults.

There is some evidence that inhaled or ingested arsenic can injure pregnant women or their unborn babies, although the studies are not definitive. Studies in animals show that large doses of arsenic that cause illness in pregnant females, can also cause low birth weight, fetal malformations, and even fetal death. Arsenic can cross the placenta and has been found in fetal tissues. Arsenic is found at low levels in breast milk.

How can families reduce the risks of exposure to arsenic?

- If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
- If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.
- If you work in a job that may expose you to arsenic, be aware that you may carry arsenic home on your clothing, skin, hair, or tools. Be sure to shower and change clothes before going home.

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

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

Has the federal government made recommendations to protect human health?

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

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) of 10 micrograms of arsenic per cubic meter of workplace air (10 $\mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

References

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

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

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ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

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Polychlorinated Biphenyls - ToxFAQs™

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

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

What are polychlorinated biphenyls?

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

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

What happens to PCBs when they enter the environment?

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

How might I be exposed to PCBs?

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

How can PCBs affect my health?

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

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over

several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. PCBs have been classified as probably carcinogenic, and carcinogenic to humans (group 1) by the Environmental Protection Agency (EPA) and International Agency for Research on Cancer (IARC), respectively.

How can PCBs affect children?

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

How can families reduce the risks of exposure to PCBs?

- You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.
- Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.
- Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

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

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

Has the federal government made recommendations to protect human health?

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

References

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

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

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ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

http://www.epa.gov/pesticides/factsheets/riskassess.htm
Last updated on Wednesday, May 09, 2012

Pesticides: Topical & Chemical Fact Sheets

Assessing Health Risks from Pesticides

Este Web page está disponible en español

Current as of: April 5, 2007
735-F-99-002

Questions on Pesticides?

- Contact the National Pesticide Information Center (NPIC) 1-800-858-7378

The Federal Government, in cooperation with the States, carefully regulates pesticides to ensure that they do not pose unreasonable risks to human health or the environment. As part of that effort, the Environmental Protection Agency (EPA) requires extensive test data from pesticide producers that demonstrate pesticide products can be used without posing harm to human health and the environment. EPA scientists and analysts carefully review these data to determine whether to register (license) a pesticide product or a use and whether specific restrictions are necessary. This fact sheet is a brief overview of EPA's process for assessing potential risks to human health when evaluating pesticide products.

Background

There are more than 1055 active ingredients registered as pesticides, which are formulated into thousands of pesticide products that are available in the marketplace.

EPA plays a critical role in evaluating these chemicals prior to registration, and in reevaluating older pesticides already on the market, to ensure that they can be used with a reasonable certainty of no harm. The process EPA uses for evaluating the health impacts of a pesticide is called risk assessment.

EPA uses the National Research Council's four-step process for human health risk assessment:

Step One: Hazard Identification
Step Two: Dose-Response Assessment
Step Three: Exposure Assessment
Step Four: Risk Characterization

Step One: Hazard Identification (Toxicology)

The first step in the risk assessment process is to identify potential health effects that may occur from different types of pesticide exposure. EPA considers the full spectrum of a pesticide's potential health effects.

Generally, for human health risk assessments, many toxicity studies are conducted on animals by pesticide companies in independent laboratories and evaluated for acceptability by EPA scientists. EPA evaluates pesticides for a wide range of adverse effects, from eye and skin irritation to cancer and birth defects in laboratory animals. EPA may also consult the public literature or other sources of supporting information on any aspect of the chemical.

Step Two: Dose-Response Assessment

Paracelsus, the Swiss physician and alchemist, the “father” of modern toxicology (1493-1541) said,

> "The dose makes the poison."

In other words, **the amount of a substance a person is exposed to** is as important as **how toxic the chemical might be**. For example, small doses of aspirin can be beneficial to people, but at very high doses, this common medicine can be deadly. In some individuals, even at very low doses, aspirin may be deadly.

Dose-response assessment involves considering the dose levels at which adverse effects were observed in test animals, and using these dose levels to calculate an equal dose in humans.

Step Three: Exposure Assessment

People can be exposed to pesticides in three ways:

1. Inhaling pesticides (inhalation exposure),
2. Absorbing pesticides through the skin (dermal exposure), and
3. Getting pesticides in their mouth or digestive tract (oral exposure).

Depending on the situation, pesticides could enter the body by any one or all of these routes. Typical sources of pesticide exposure include:

- **Food**
  Most of the foods we eat have been grown with the use of pesticides. Therefore, pesticide residues may be present inside or on the surfaces of these foods.
- **Home and Personal Use Pesticides**
  You might use pesticides in and around your home to control insects, weeds, mold, mildew, bacteria, lawn and garden pests and to protect your pets from pests such as fleas. Pesticides may also be used as insect repellants which are directly applied to the skin or clothing.
- **Pesticides in Drinking Water**
  Some pesticides that are applied to farmland or other land structures can make their way in small amounts to the ground water or surface water systems that feed drinking water supplies.
- **Worker Exposure to Pesticides**
  Pesticide applicators, vegetable and fruit pickers and others who work around pesticides can be exposed due to the nature of their jobs. To address the unique risks workers face from occupational exposure, EPA evaluates occupational exposure through a separate program. All pesticides registered by EPA have been shown to be safe when used properly.

Step Four: Risk Characterization

Risk characterization is the final step in assessing human health risks from pesticides. It is the process of combining the hazard, dose-response and exposure assessments to describe the overall risk from a pesticide. It explains the assumptions used in assessing exposure as well as the uncertainties that are built into the dose-response assessment. The strength of the overall database is considered, and broad conclusions are made. EPA’s role is to evaluate both toxicity and exposure and to determine the risk associated with use of the pesticide.

Simply put,

> RISK = TOXICITY x EXPOSURE.

This means that the risk to human health from pesticide exposure depends on both the toxicity of the pesticide and the likelihood of people coming into contact with it. At least *some* exposure and *some* toxicity are required to result in a risk. For example, if the pesticide is very poisonous, but no people are exposed, there is no risk. Likewise, if there is ample exposure but the chemical is non-toxic, there is no risk. However, usually when pesticides are used, there is some toxicity and exposure, which results in a potential risk.

EPA recognizes that effects vary between animals of different species and from person to person. To account for this variability, *uncertainty factors* are built into the risk assessment. These uncertainty factors create an additional margin of safety for protecting people who may be exposed to the pesticides. FQPA requires EPA to use an extra 10-fold safety factor, if necessary, to protect infants and children from effects of the pesticide.

Types of Toxicity Tests EPA Requires for Human Health Risk Assessments

EPA evaluates studies conducted over different periods of time and that measure specific types of effects. These tests are evaluated to screen for potential health effects in infants, children and adults.

Acute Testing: Short-term exposure; a single exposure (dose).

- Oral, dermal (skin), and inhalation exposure
- Eye irritation
- Skin irritation
- Skin sensitization
- Neurotoxicity

Sub-chronic Testing: Intermediate exposure; repeated exposure over a longer period of time (i.e., 30-90 days).

- Oral, dermal (skin), and inhalation
- Neurotoxicity (nerve system damage)

Chronic Toxicity Testing: Long-term exposure; repeated exposure lasting for most of the test animal's life span. Intended to determine the effects of a pesticide after prolonged and repeated exposures.

- Chronic effects (non-cancer)
- Carcinogenicity (cancer)

Developmental and Reproductive Testing: Identify effects in the fetus of an exposed pregnant female (birth defects) and how pesticide exposure affects the ability of a test animal to successfully reproduce.

Mutagenicity Testing: Assess a pesticide's potential to affect the cell's genetic components.

Hormone Disruption: Measure effects for their potential to disrupt the endocrine system. The endocrine system consists of a set of glands and the hormones they produce that help guide the development, growth, reproduction, and behavior of animals including humans.

Risk Management

Once EPA completes the risk assessment process for a pesticide, we use this information to determine if (when used according to label directions), there is a reasonable certainty that the pesticide will not harm a person’s health.

Using the conclusions of a risk assessment, EPA can then make a more informed decision regarding whether to approve a pesticide chemical or use, as proposed, or whether additional protective measures are necessary to limit occupational or non-occupational exposure to a pesticide. For example, EPA may prohibit a pesticide from being used on certain crops because consuming too much food treated with the pesticide may result in an unacceptable risk to consumers. Another example of protective measures is requiring workers to wear personal protective equipment (PPE) such as a respirator or chemical resistant gloves, or not allowing workers to enter treated crop fields until a specific period of time has passed.

If, after considering all appropriate risk reduction measures, the pesticide still does not meet EPA's safety standard, the Agency will not allow the proposed chemical or use. Regardless of the specific measures enforced, EPA's primary goal is to ensure that legal uses of the pesticide are protective of human health, especially the health of children, and the environment.

Human Health Risk Assessment and the Law

Federal law requires detailed evaluation of pesticides to protect human health and the environment. In 1996, Congress made significant changes to strengthen pesticide laws through the Food Quality Protection Act (FQPA). Many of these changes are key elements of the current risk assessment process. FQPA required that EPA consider:

- **A New Safety Standard**: FQPA strengthened the safety standard that pesticides must meet before being approved for use. EPA must ensure with a reasonable certainty that no harm will result from the legal uses of the pesticide.
- **Exposure from All Sources**: In evaluating a pesticide, EPA must estimate the combined risk from that pesticide from all non-occupational sources, such as:
  - Food Sources
  - Drinking Water Sources
  - Residential Sources
- **Cumulative Risk**: EPA is required to evaluate pesticides in light of similar toxic effects that different pesticides may share, or "a common mechanism of toxicity." Read about how EPA evaluates cumulative risk for pesticides.
- **Special Sensitivity of Children to Pesticides**: EPA must ascertain whether there is an increased susceptibility from exposure to the pesticide to infants and children. EPA must build an additional 10-fold safety factor into risk assessments to ensure the protection of infants and children, unless it is determined that a lesser margin of safety will be safe for infants and children.

For More Information

If you would like more information about EPA's pesticide programs, contact the Communication Service Branch at (703) 305-5017 or visit the Pesticides Web site.

For more information on specific pesticides, or to inquire about the symptoms of pesticide poisoning, call the National Pesticide Information Center (NPIC), a toll-free hotline information at: 1-800-858-7378, or visit their Web site EXIT Disclaimer .

Español (https://www.atsdr.cdc.gov/es/index.html)

(https://atsdr.cdc.gov)

ATSDR Agency for Toxic Substances and Disease Registry

Substance Priority List

ATSDR's Substance Priority List

What is the Substance Priority List (SPL)?

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 104 (i), as amended by the Superfund Amendments and Reauthorization Act (SARA), requires ATSDR and the EPA to prepare a list, in order of priority, of substances that are most commonly found at facilities on the National Priorities List (NPL) and which are determined to pose the most significant potential threat to human health due to their known or suspected toxicity and potential for human exposure at these NPL sites. CERCLA also requires this list to be revised periodically to reflect additional information on hazardous substances. In CERCLA, it is called the priority list of hazardous substances that will be candidates for toxicological profiles.
This substance priority list is revised and published on a 2-year basis, with a yearly informal review and revision. (No list was published in 2009 while ATSDR transitioned to a new agency science database.) Each substance on the list is a candidate to become the subject of a toxicological profile prepared by ATSDR. The listing algorithm prioritizes substances based on frequency of occurrence at NPL sites, toxicity, and potential for human exposure to the substances found at NPL sites.

2017 Substance Priority List

Click here to view the ATSDR 2017 Substance Priority List

It should be noted that this priority list is not a list of "most toxic" substances, but rather a prioritization of substances based on a combination of their frequency, toxicity, and potential for human exposure at NPL sites.

Thus, it is possible for substances with low toxicity but high NPL frequency of occurrence and exposure to be on this priority list. The objective of this priority list is to rank substances across all NPL hazardous waste sites to provide guidance in selecting which substances will be the subject of toxicological profiles prepared by ATSDR.

Where can I find more information on the Substance Priority List?

Substantial additional information can be found on the SPL Resource page, including:

- Past Substance Priority Lists
- A Support Document describing the algorithm in detail
- A comprehensive SPL spreadsheet with data for all current and past lists, including candidate substances that did not make the top of the list

The ATSDR 2017 Substance Priority List

Hide/Show Table

2017 Rank	Substance Name	Total Points	CAS RN
1	ARSENIC	1674	7440-38-2
2	LEAD	1531	7439-92-1
3	MERCURY	1458	7439-97-6
4	VINYL CHLORIDE	1358	75-01-4
5	POLYCHLORINATED BIPHENYLS	1345	1336-36-3
6	BENZENE	1329	71-43-2
7	CADMIUM	1320	7440-43-9
8	BENZO(A)PYRENE	1306	50-32-8
9	POLYCYCLIC AROMATIC HYDROCARBONS	1279	130498-29-2
10	BENZO(B)FLUORANTHENE	1251	205-99-2
11	CHLOROFORM	1203	67-66-3
12	AROCLOR 1260	1191	11096-82-5
13	DDT, P,P'-	1183	50-29-3
14	AROCLOR 1254	1172	11097-69-1
15	DIBENZO(A,H)ANTHRACENE	1156	53-70-3
16	TRICHLOROETHYLENE	1155	79-01-6
17	CHROMIUM, HEXAVALENT	1148	18540-29-9
18	DIELDRIN	1144	60-57-1
19	PHOSPHORUS, WHITE	1141	7723-14-0
20	HEXACHLOROBUTADIENE	1130	87-68-3
21	DDE, P,P'-	1127	72-55-9
22	CHLORDANE	1126	57-74-9
23	AROCLOR 1242	1126	53469-21-9
24	COAL TAR CREOSOTE	1124	8001-58-9
25	ALDRIN	1116	309-00-2
26	DDD, P,P'-	1114	72-54-8
27	AROCLOR 1248	1105	12672-29-6
28	HEPTACHLOR	1102	76-44-8
29	AROCLOR	1101	12767-79-2

30	BENZIDINE	1093	92-87-5
31	ACROLEIN	1090	107-02-8
32	TOXAPHENE	1089	8001-35-2
33	TETRACHLOROETHYLENE	1078	127-18-4
34	HEXACHLOROCYCLOHEXANE, GAMMA-	1076	58-89-9
35	CYANIDE	1071	57-12-5
36	HEXACHLOROCYCLOHEXANE, BETA-	1054	319-85-7
37	DISULFOTON	1049	298-04-4
38	BENZO(A)ANTHRACENE	1047	56-55-3
39	1,2-DIBROMOETHANE	1043	106-93-4
40	ENDRIN	1039	72-20-8
41	DIAZINON	1038	333-41-5
42	HEXACHLOROCYCLOHEXANE, DELTA-	1036	319-86-8
43	BERYLLIUM	1031	7440-41-7
44	ENDOSULFAN	1029	115-29-7
45	AROCLOR 1221	1028	11104-28-2
46	1,2-DIBROMO-3-CHLOROPROPANE	1027	96-12-8
47	HEPTACHLOR EPOXIDE	1022	1024-57-3
48	ENDOSULFAN, ALPHA	1019	959-98-8
49	CIS-CHLORDANE	1017	5103-71-9
50	CARBON TETRACHLORIDE	1014	56-23-5
51	COBALT	1013	7440-48-4
52	AROCLOR 1016	1012	12674-11-2
53	DDT, O,P'-	1009	789-02-6
54	PENTACHLOROPHENOL	1008	87-86-5
55	METHOXYCHLOR	1007	72-43-5
56	ENDOSULFAN SULFATE	1005	1031-07-8
57	NICKEL	996	7440-02-0
58	DI-N-BUTYL PHTHALATE	995	84-74-2
59	ENDRIN KETONE	993	53494-70-5

60	DIBROMOCHLOROPROPANE	984	67708-83-2
61	BENZO(K)FLUORANTHENE	970	207-08-9
62	TRANS-CHLORDANE	969	5103-74-2
63	ENDOSULFAN, BETA	968	33213-65-9
64	CHLORPYRIFOS	965	2921-88-2
65	XYLENES, TOTAL	964	1330-20-7
66	CHROMIUM(VI) TRIOXIDE	961	1333-82-0
67	AROCLOR 1232	959	11141-16-5
68	ENDRIN ALDEHYDE	959	7421-93-4
69	METHANE	952	74-82-8
70	3,3′-DICHLOROBENZIDINE	942	91-94-1
71	2-HEXANONE	941	591-78-6
72	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	941	1746-01-6
73	BENZOFLUORANTHENE	937	56832-73-6
74	TOLUENE	917	108-88-3
75	ZINC	915	7440-66-6
76	PENTACHLOROBENZENE	907	608-93-5
77	DI(2-ETHYLHEXYL)PHTHALATE	906	117-81-7
78	CHROMIUM	895	7440-47-3
79	AROCLOR 1240	889	71328-89-7
80	2,4,6-TRINITROTOLUENE	879	118-96-7
81	NAPHTHALENE	877	91-20-3
82	1,1-DICHLOROETHENE	876	75-35-4
83	BROMODICHLOROETHANE	868	683-53-4
84	DDD, O,P’-	867	53-19-0
85	2,4,6-TRICHLOROPHENOL	867	88-06-2
86	BIS(2-CHLOROETHYL) ETHER	867	111-44-4
87	HYDRAZINE	862	302-01-2
88	METHYLENE CHLORIDE	860	75-09-2
89	2,4-DINITROPHENOL	859	51-28-5

90	4,4′-METHYLENEBIS(2-CHLOROANILINE)	859	101-14-4
91	1,2-DICHLOROETHANE	852	107-06-2
92	THIOCYANATE	847	302-04-5
93	HEXACHLOROBENZENE	844	118-74-1
94	ASBESTOS	841	1332-21-4
95	RDX (Cyclonite)	833	121-82-4
96	RADIUM-226	833	13982-63-3
97	URANIUM	832	7440-61-1
98	2,4-DINITROTOLUENE	832	121-14-2
99	ETHION	831	563-12-2
100	4,6-DINITRO-O-CRESOL	828	534-52-1
101	RADIUM	827	7440-14-4
102	THORIUM	824	7440-29-1
103	DIMETHYLARSINIC ACID	822	75-60-5
104	CHLORINE	821	7782-50-5
105	1,3,5-TRINITROBENZENE	820	99-35-4
106	RADON	818	10043-92-2
107	HEXACHLOROCYCLOHEXANE, ALPHA-	817	319-84-6
108	RADIUM-228	815	15262-20-1
109	THORIUM-230	813	14269-63-7
110	URANIUM-235	812	15117-96-1
111	THORIUM-228	810	14274-82-9
112	RADON-222	810	14859-67-7
113	URANIUM-234	809	13966-29-5
114	N-NITROSODI-N-PROPYLAMINE	808	621-64-7
115	COAL TARS	808	8007-45-2
116	METHYLMERCURY	808	22967-92-6
117	1,1,1-TRICHLOROETHANE	807	71-55-6
118	COPPER	807	7440-50-8
119	CHRYSOTILE ASBESTOS	806	12001-29-5

120	PLUTONIUM-239	806	15117-48-3
121	POLONIUM-210	805	13981-52-7
122	PLUTONIUM-238	805	13981-16-3
123	LEAD-210	805	14255-04-0
124	AMOSITE ASBESTOS	804	12172-73-5
124	PLUTONIUM	804	7440-07-5
124	STRONTIUM-90	804	10098-97-2
127	RADON-220	804	22481-48-7
128	CHLOROBENZENE	804	108-90-7
129	AMERICIUM-241	804	86954-36-1
130	HYDROGEN CYANIDE	803	74-90-8
131	AZINPHOS-METHYL	803	86-50-0
132	ETHYLBENZENE	802	100-41-4
133	CHLORDECONE	802	143-50-0
134	BARIUM	802	7440-39-3
135	NEPTUNIUM-237	802	13994-20-2
136	PLUTONIUM-240	801	14119-33-6
137	1,2,3-TRICHLOROBENZENE	801	87-61-6
138	FLUORANTHENE	800	206-44-0
139	S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	799	78-48-8
140	MANGANESE	798	7439-96-5
141	CHRYSENE	792	218-01-9
142	2,4,5-TRICHLOROPHENOL	792	95-95-4
143	PERFLUOROOCTANE SULFONIC ACID	788	1763-23-1
144	POLYBROMINATED BIPHENYLS	785	67774-32-7
145	DICOFOL	785	115-32-2
146	SELENIUM	776	7782-49-2
147	1,1,2,2-TETRACHLOROETHANE	776	79-34-5
148	PARATHION	774	56-38-2
149	HEPTACHLORODIBENZO-P-DIOXIN	774	37871-00-4

150	HEXACHLOROCYCLOHEXANE, TECHNICAL GRADE	774	608-73-1
151	TRICHLOROFLUOROETHANE	773	27154-33-2
152	BROMINE	771	7726-95-6
153	AROCLOR 1268	765	11100-14-4
154	1,3-BUTADIENE	762	106-99-0
155	PERFLUOROOCTANOIC ACID	758	335-67-1
156	HEPTACHLORODIBENZOFURAN	756	38998-75-3
157	TRIFLURALIN	755	1582-09-8
158	PERFLUOROHEXANESULFONIC ACID	749	355-46-4
159	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	743	39001-02-0
160	AMMONIA	742	7664-41-7
161	2-METHYLNAPHTHALENE	727	91-57-6
162	2,3,4,7,8-PENTACHLORODIBENZOFURAN	724	57117-31-4
163	1,4-DICHLOROBENZENE	724	106-46-7
164	1,1-DICHLOROETHANE	721	75-34-3
165	NALED	721	300-76-5
166	1,1,2-TRICHLOROETHANE	720	79-00-5
167	HEXACHLOROCYCLOPENTADIENE	719	77-47-4
168	1,2-DIPHENYLHYDRAZINE	718	122-66-7
169	PHORATE	716	298-02-2
170	TRICHLOROETHANE	713	25323-89-1
171	ACENAPHTHENE	710	83-32-9
172	TETRACHLOROBIPHENYL	710	26914-33-0
173	PALLADIUM	706	7440-05-3
174	OXYCHLORDANE	705	27304-13-8
175	CRESOL, PARA-	704	106-44-5
176	INDENO(1,2,3-CD)PYRENE	702	193-39-5
177	GAMMA-CHLORDENE	702	56641-38-4
178	TETRACHLOROPHENOL	699	25167-83-3
179	1,2-DICHLOROBENZENE	697	95-50-1

180	1,2-DICHLOROETHENE, TRANS-	691	156-60-5
181	CHLOROETHANE	687	75-00-3
182	P-XYLENE	687	106-42-3
183	ALUMINUM	687	7429-90-5
184	PHENOL	686	108-95-2
185	CARBON MONOXIDE	684	630-08-0
186	CARBON DISULFIDE	682	75-15-0
187	2,4-DIMETHYLPHENOL	680	105-67-9
188	DIBENZOFURAN	676	132-64-9
189	ACETONE	672	67-64-1
190	HEXACHLOROETHANE	671	67-72-1
191	BUTYL METHYL PHTHALATE	668	34006-76-3
192	CHLOROMETHANE	665	74-87-3
193	HEXACHLORODIBENZOFURAN	660	55684-94-1
194	BUTYL BENZYL PHTHALATE	658	85-68-7
195	HYDROGEN SULFIDE	658	7783-06-4
196	DICHLORVOS	656	62-73-7
197	DIBENZOFURANS, CHLORINATED	653	42934-53-2
198	CRESOL, ORTHO-	653	95-48-7
199	HEXACHLORODIBENZO-P-DIOXIN	652	34465-46-8
200	VANADIUM	650	7440-62-2
201	N-NITROSODIMETHYLAMINE	649	62-75-9
202	1,2,4-TRICHLOROBENZENE	647	120-82-1
203	PERFLUORONONANOIC ACID	647	375-95-1
204	ETHOPROP	644	13194-48-4
205	TETRACHLORODIBENZO-P-DIOXIN	641	41903-57-5
206	BROMOFORM	635	75-25-2
207	PENTACHLORODIBENZOFURAN	632	30402-15-4
208	1,3-DICHLOROBENZENE	628	541-73-1
209	PENTACHLORODIBENZO-P-DIOXIN	626	36088-22-9

210	N-NITROSODIPHENYLAMINE	625	86-30-6
211	2,4-DICHLOROPHENOL	619	120-83-2
212	2,3-DIMETHYLNAPHTHALENE	619	581-40-8
213	2,3,7,8-TETRACHLORODIBENZOFURAN	619	51207-31-9
214	1,4-DIOXANE	617	123-91-1
215	FLUORINE	613	7782-41-4
216	NITRITE	610	14797-65-0
217	CESIUM-137	610	10045-97-3
217	CHROMIC ACID	610	7738-94-5
219	2-BUTANONE	608	78-93-3
220	1,2-DICHLOROETHYLENE	608	540-59-0
221	POTASSIUM-40	608	13966-00-2
222	DINITROTOLUENE	607	25321-14-6
223	NITRATE	606	14797-55-8
224	FORMALDEHYDE	605	50-00-0
225	SILVER	605	7440-22-4
226	COAL TAR PITCH	605	65996-93-2
227	THORIUM-227	605	15623-47-9
228	ARSENIC ACID	604	7778-39-4
229	ARSENIC TRIOXIDE	604	1327-53-3
230	BENZOPYRENE	603	73467-76-2
231	CHLORDANE, TECHNICAL	602	12789-03-6
232	STROBANE	602	8001-50-1
233	4-AMINOBIPHENYL	602	92-67-1
233	PYRETHRUM	602	8003-34-7
235	ARSINE	602	7784-42-1
235	DIMETHOATE	602	60-51-5
237	BIS(CHLOROMETHYL) ETHER	602	542-88-1
237	CARBOPHENOTHION	602	786-19-6
239	ALPHA-CHLORDENE	601	56534-02-2

239	IODINE-131	601	10043-66-0
239	MERCURIC CHLORIDE	601	7487-94-7
239	SODIUM ARSENITE	601	7784-46-5
239	URANIUM-233	601	13968-55-3
244	ANTIMONY	601	7440-36-0
245	DIBROMOCHLOROMETHANE	601	124-48-1
246	CRESOLS	598	1319-77-3
247	DICHLOROBENZENE	596	25321-22-6
248	2,4-D	595	94-75-7
249	2-CHLOROPHENOL	591	95-57-8
250	BUTYLATE	591	2008-41-5
251	DIMETHYL FORMAMIDE	585	68-12-2
252	PHENANTHRENE	585	85-01-8
253	4-NITROPHENOL	580	100-02-7
254	DIURON	580	330-54-1
255	TETRACHLOROETHANE	577	25322-20-7
256	DICHLOROETHANE	568	1300-21-6
257	ETHYL ETHER	566	60-29-7
258	DIMETHYLANILINE	563	121-69-7
259	1,3-DICHLOROPROPENE, CIS-	561	10061-01-5
260	PYRENE	561	129-00-0
261	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	559	35822-46-9
262	PHOSPHINE	557	7803-51-2
263	TRICHLOROBENZENE	556	12002-48-1
264	2,6-DINITROTOLUENE	555	606-20-2
265	FLUORIDE ION	550	16984-48-8
266	PENTAERYTHRITOL TETRANITRATE	549	78-11-5
267	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	549	67562-39-4
268	1,3-DICHLOROPROPENE, TRANS-	548	10061-02-6
269	ACRYLONITRILE	544	107-13-1

270	BIS(2-ETHYLHEXYL)ADIPATE	543	103-23-1
271	CARBAZOLE	541	86-74-8
272	2-CHLOROANILINE	539	95-51-2
273	METOLACHLOR	539	51218-45-2
274	1,2-DICHLOROETHENE, CIS-	539	156-59-2
275	1,2,3-TRICHLOROPROPANE	537	96-18-4

Substances were assigned the same rank when two (or more) substances received equivalent total point scores.

CAS RN= Chemical Abstracts Service Registry Number

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Contact Information

Further information can be obtained by contacting the ATSDR Information Center at:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences
1600 Clifton Road NE, Mailstop F-57
Atlanta, GA 30329
Phone: 1-800-CDC-INFO 888-232-6348 (TTY)
Email: Contact CDC-INFO (https://www.cdc.gov/cdc-info/requestform.html)

Page last reviewed: August 10, 2017

ATTACHMENT B
ACCIDENT/INCIDENT REPORTING LOG

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC
231 West 29th Street, Suite 1104
New York, New York 10001 USA
Tel: (631) 462-5866
Email: Info@hydrotechenvironmental.com
WWW.HYDROTECHENVIRONMENTAL.COM
USA – Middle East – North Africa

Accident / Incident Reporting Log

Unit:	Chartering Organization:

INFORMATION ON PERSON IN CHARGE OF THE GROUP

Name:		
Address:		
Phone numbers:	Home:	Work:
	Fax:	E-Mail:

INFORMATION ON THE INCIDENT

Nature of the activity:	
Place of the activity:	
Date of the incident:	Time of the incident:
Exact location of the incident:	
Weather Conditions (if applicable):	
Name of Person in charge at the time:	
Description of incident (if machinery involved, list owner and operator and details on incident)	

Witness Name:	Home Phone:	Work Phone:
Witness Name:	Home Phone:	Work Phone:

COMPLETE ONLY IF THIS INCIDENT WAS REPORTED TO THE NYPD or FDNY

Station Name, Number:
Station Address:
Name and Phone Number of Officer in Charge:

INFORMATION ON INJURED PERSON OR OWNER OF DAMAGED PROPERTY		
Name:		Birth date:
Address:		
Phone Numbers:	Home:	Work:
Please describe nature of injury or property damage		
Complete if applicable:	Name of doctor consulted:	Phone:
Complete if applicable:	Name and address of hospital or clinic:	Phone:

REPORTING DETAILS		
This report must be signed by person in charge of Site Operations at time of incident including Site Supervisor, or Project Manager or Site Safety officer	Print full name:	
	Position:	
	Street Address:	
	Town, State, Zip:	
	Telephone (Home)	(work)
	Fax:	Email:
	Signature:	Date:

APPENDIX B: CAMP

COMMUNITY AIR MONITORING PLAN (CAMP)

Former Bictos Webster Cleaners

1321 Webster Avenue

Bronx, New York

Block 2887, Lot 179

1. Introduction

The Community Air Monitoring Plan (CAMP) has been prepared to monitor the air quality during the intrusive activities proposed as a part of the Remedial Investigation (RI) activities at the property located at 1321 Webster Avenue in Bronx, NY. This plan has been prepared in accordance with requirements, processes and action levels established in Appendix 1A New York State Department of Health Generic Community Air Monitoring Plan and Appendix 1B Fugitive Dust and Particulate Monitoring (see **Attachment A**) from DER-10/Technical Guidance for Site Investigation and Remediation issued by New York State Department of Environmental Conservation. Levels of VOCs and dust in the air will be monitored continuously and periodically utilizing a Photo Ionization Detector (PID) and Real-Time Particulate Dust Tracker, respectively. For this investigation, the PID will be calibrated at the beginning of each day to the compound isobutylene, which is published by the manufacturer. The PID has a minimum detection limit of 0.1 parts per million (ppm). The Dust Tracker provides real-time measurement based on 90° light scattering. The Dust Tracker has a minimum detection limit of 0.001 mg/m^3.

Continuous real-time air monitoring for VOCs and particulate levels at the perimeter of the exclusion zone or work area will be performed for all ground intrusive activities. Ground intrusive activities include but are not limited to the installation of soil borings, monitoring wells and soil vapor probes.

Periodic monitoring for VOCs will be performed during non-intrusive activities such as the collection of soil samples, the collection of groundwater samples from monitoring wells. For instance, periodic monitoring during sample collection will consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location. Depending upon the proximity of potentially exposed individuals, continuous monitoring may be performed during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence. Exceedances of action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the NYSDEC and recorded in a field daily log. A summary of daily logs/reports will be provided in the Remedial Investigation Report (RIR).

2. VOCs Monitoring, Response Levels and Actions

VOCs will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis during invasive work. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a PID, which will be calibrated at least daily for isobutylene. The PID will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

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

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

3. Activities will be shut down if the organic vapor level at the perimeter of the work area is above 25 ppm.

4. All 15-minute readings must be recorded in a daily field log. Instantaneous readings, if any, used for decision purposes will also be recorded.

3. PM Monitoring, Response Levels And Actions

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

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

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are 150 mcg/m^3 or greater above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings will be recorded in a daily field log.

4. CAMP with Special Requirements

CAMP with special requirements will be implemented if residential buildings or sensitive receptors such as day care, hospitals, public schools and health care facilities are located within 20 feet radius of the Site. The purpose of CAMP with special requirements is to provide additional protection for the nearest potentially exposed individuals and the intake for the ventilation systems in these structures. Currently, there's no residential buildings or sensitive receptors located within 20 feet radius of the Site. A commercial/office building is located at the east-adjacent lot, which is within 20 feet radius of the Site. The action levels for CAMP with special requirements are specified below:

1. If total VOC concentrations along the walls of occupied structures or next to the intake vents exceeded 1 ppm, then monitoring will be conducted within the occupied structure. Background readings in the occupied spaces will be taken prior to the commencement of the planned work.

2. If total particulate concentrations along walls of occupied structures or next to intake vents exceeded 100 mcg/m^3 above background concentrations measured at the upwind direction, work activities will then be suspended until controls are implemented and the

total particulate concentration falls below 100 mcg/m^3 above background concentrations and prevented visible dust migration by using water to dampen the surrounding area.

ATTACHMENT A: APPENDIX 1A AND APPENDIX 1B FROM DER-10

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

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

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

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

Community Air Monitoring Plan

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

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

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

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

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

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

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

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

Particulate Monitoring, Response Levels, and Actions

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

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

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

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

December 2009

Appendix 1B
Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50^{o} C (14 to 122^{o} F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m3, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m3 continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

(a) Applying water on haul roads;
(b) Wetting equipment and excavation faces;
(c) Spraying water on buckets during excavation and dumping;
(d) Hauling materials in properly tarped or watertight containers;
(e) Restricting vehicle speeds to 10 mph;
(f) Covering excavated areas and material after excavation activity ceases; and
(g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m3 action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

APPENDIX C: SAMPLE BORING LOG

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC
231 West 29th Street, Suite 1104
New York, New York 10001 USA
Tel: (631) 462-5866
Email: Info@hydrotechenvironmental.com
WWW.HYDROTECHENVIRONMENTAL.COM
USA – Middle East – North Africa

Soil Probe Log

Job No: xxxxxx
Date: xx/xx/xxxx
Page: 1 of 1

Location: ABCD, EF, GH

Boring No.: SP-x
Drilling Method: Direct Push
Total Depth: 12 feet

Sampling Interval: 2 feet
Sampling Method: Grab
Driller:
Depth to Water:

USCS SYMBOLS

GW - Well Graded Gravel
GP - Poorly Graded Gravel
GM - Silty Gravel
GC - Clayey Gravel
SW - Well Graded Sand
SP - Poorly Graded Sand
SM - Silty Sand
SC - Clayey Sand
ML - Inorganic Silt / Sandy Silt
CL - Inorganic Clays/Sandy Clay
OL - Inorganic Silts/Organic Silty Clay
MH- Elastic Silts
CH - Inorganic Clay, High Plastic
OH - Organic Silt / Clay
PT - Peat/High Organics

Depth Below Grade and Lithology	PID Reading (ppm)	USCS	Soil Description
0	0.0	SP	concrete/dark brown, med grained sandy loam with brick and pebble sized clasts
-2	0.0	SP	dark brown, med grained sandy loam with brick and pebble sized clasts
-4	0.0	SP	brown, med grained sand
-6	0.0	SP	brown, med grained sand
-8	0.0	SP	brown, med grained sand
-10	0.0	SP	brown, med grained sand
-12			

APPENDIX D: SAMPLE WELL CONSTRUCTION LOG

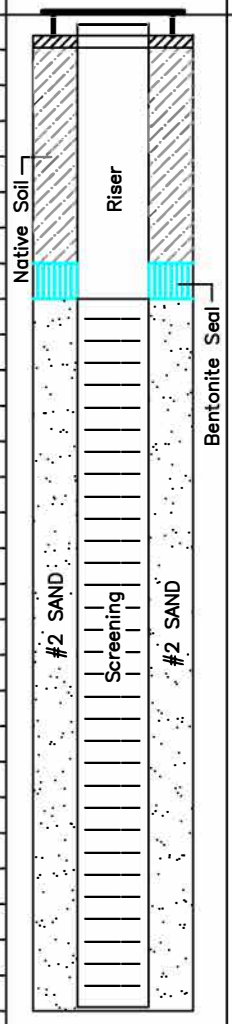
HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC
MAIN OFFICE
231 WEST 29TH STREET SUITE 1104
NEW YORK, NY 10001
TEL: (631) 472 - 5866

WELL CONSTRUCTION LOG

Job No: _____ Date: _____ Page: 1 OF 1

Location: _____

Well Number:	MW–1	Screen Size:	0.010"
Drilling Method:	DIRECT PUSH	Screen Interval:	20.00'
Total Depth:	28'	Diameter:	1"
Depth to Water:	14.71"	Riser Length:	8'
Manhole Size:	5"	Sand Size:	#2

Depth Below Grade (ft.)	Sample Interval (ft.)	Well Construction	Description
2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36			5" Manhole Cover 0' – 7.00' – Native Soil 7' – 8.00' – Bentonite Seal 8' – 28.00' – #2 Sand 0' – 8.00' – Riser 8' – 28.00' – Screen

APPENDIX E: QAPP

QUALITY ASSURANCE PROJECT PLAN

Former Bictos Webster Cleaners

1321 Webster Avenue

Bronx, New York

Block 2887, Lot 179

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1. Sampling & Analytical Method Requirements for Soil
2. Sampling & Analytical Method Requirements for Groundwater
3. Sampling & Analytical Method Requirements for Soil Vapor

Attachments

A. USEPA Low Flow Sampling Protocol
B. Guidelines and Protocols for PFOA Sampling
C. Groundwater Sampling/Purge Log
D. Resumes of Key Personnel involved in this Project
E. Sample Chain of Custody Form
F. Conventional Laboratory QA/QC

1.0 Introduction

This Quality Assurance Project Plan (QAPP) has been prepared for the samples to be collected in accordance with the Remedial Investigation Work Plan (RIWP) developed for the property located at 1321 Webster Avenue in Bronx, NY. The intent of the QAPP is to ensure that (1) proper equipment handling and maintenance is followed, (2) cross-contamination between sampling locations does not occur, (3) standard number of quality control replicate environmental samples are obtained, (4) proper procedures for samples custody are performed and (5) data review, validation and verification requirements are complete.

All related portions of the fieldwork will be performed, at a minimum, in accordance with acceptable industry standards. These acceptable industry standards include, but are not limited to, the ASTM Standard Guide for Phase II Environmental Site Assessments (E 1903-97) and the New York State Department of Environmental Conservation (NYSDEC) Bureau of Spill Prevention & Response Sampling Guidelines and Protocols, March 1991 and NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation, May 2010, 6 NYCRR Subpart 360.

2.0 Project Objective and Scope of Work

The objective of the investigation as set forth in the RIWP is to characterize the vertical and horizontal delineation of contamination beneath the Site and determine the groundwater flow beneath the Site. This investigation will be performed in accordance to the New York State Department of Environmental Conservation (NYSDEC) requirements under the NYS Brownfield Cleanup Program (BCP) and in compliance with the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010), New York State Department of Health (NYSDOH) Guidance for evaluating Soil Vapor Intrusion in the State of NY (October 2006) and other acceptable industry standards.

To meet the above objectives a total of thirteen (13) soil probes, seven (7) monitoring wells and seven (7) soil vapor probe sampling points will be installed and sampled during this investigation. Soil boring and monitoring well installation, construction, and development shall conform to NYCRR Part 360.

3.0 Sampling Procedures, Decontamination Methods and Data Quality Usability Objectives

3.1 Soil Sampling

Soil samples will be collected from thirteen (13) soil borings designated as SB-1 through SB-13. All soil samples will be obtained at 2-foot intervals utilizing a 5-foot long Macro Core sampler fitted with dedicated acetate liners. The location of the soil probes is provided in **Figure 4** of the RIWP.

At minimum two (2) soil samples will be collected from each of the soil probes for lab analysis and will consist of the 2-foot interval below surface grade and the 2-foot sample above groundwater table or bedrock. A third sample will be collected if it exhibits a considerable level of hydrocarbons based upon the field screening results or will be collected from the historic fill layer if fill material was not intercepted in any of the prior two samples.

Each soil sample will be placed directly into pre-cleaned containers provided by the laboratory samples from select soil probes. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 1** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for soil samples.

3.2 Groundwater Sampling

Groundwater samples will be obtained from the new seven (7) monitoring wells designated as MW-1 to MW-7 that will be installed during the investigation. Groundwater samples will be collected utilizing a low flow pump fitted with dedicated polyethylene tubing. Initially, each monitoring well will be purged prior to sampling. Purging and sampling of the monitoring wells will be conducted according USEPA's Region 1 Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (EQASOP #GW4, Rev. September 19, 2017) utilizing a portable water quality meter YSI-6820, which utilizes an in-line flow cell for water quality indicator measurements (the USEPA's Region 1 Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells guidance is provided in Attachment A). Groundwater will be purged at a low flow rate of less than 500 milliliter per minute (mL/min) until water quality indicator parameters including pH, temperature, specific conductivity, oxidation reduction potential, dissolved oxygen and turbidity are stabilized within the specified confidence limits for three consecutive readings:

- pH (±1 unit),
- Dissolved Oxygen (10% for values exceeding 5 mg/L or considered stabilized if less than 5 mg/L),
- Specific Conductance (3%),
- ORP (±10 millivolts),

- Temperature (3%), and
- Turbidity (10% for values exceeding 5 NTU or considered stabilized if less than 5 NTU).

During this low flow sampling from each monitoring well, the use of any equipment, materials or sampling jars that are known to contain Perfluorinated Compounds (PFCs) or polytetrafluoroethylene (PTFE) such as teflon tubing, low density polyethylene (LDPE) tubing or sample bottle cap liners should be prevented. Besides any contact with PFC waterproofed cloths or PFC containing materials such as aluminum foils and many food and drink packaging materials and should be avoided (Attachment B provides sampling guidelines and protocols for FPOA).

The sampling of each well will be performed once groundwater purging is completed. **Attachment C** provides a sample Groundwater Sampling/Purge Log. The location of the monitoring wells is provided in **Figure 4** of the RIWP.

Each groundwater sample will be placed directly into pre-cleaned containers provided by the laboratory. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 2** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for the groundwater samples.

3.3 Soil vapor sampling points

The seven (7) soil vapor probes designated as SV-1 through SV-7 will be installed and sampled utilizing in accordance with the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York October 2006. Soil vapor samples will be collected utilizing 6 liter pre-cleaned, passivated, and evacuated whole air Summa® Canister. A 60-cm^3 plastic syringe will be used to purge approximately 1 to 3 implant volumes (i.e. the volume of the sample probe and tube) prior to collecting the soil vapor samples. Each air sampling canister will then be connected to a flow control valve set to collect the 6-L sample over a period of 4 hours at a rate of less than 0.2 liter per minute.

The vapor samples will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 3** provides the sample containers, volumes, test methods, reporting limits and holding times for the soil vapor samples. The location of the soil vapor sampling location is provided in **Figure 4** of the RIWP.

3.4 Decontamination Procedures

During the field sampling, Ruijie Xu, who is a Project Manager (PM) and also the Quality Assurance Officer (QAO) at HydroTech Environmental Engineering and Geology, DPC will be responsible for monitoring the decontamination procedure of

every piece of sampling equipment prior to each use by field personnel. The following procedure will be implemented during the decontamination process:

- Wipe clean and wash with Alconox®
- Potable water rinse
- Methanol rinse
- Deionized water rinse
- Air dry

All decontamination procedures will be performed in an area segregated from any sampling areas. Any rinsate from the decontamination area will be contained and placed in 55-gallons drums and properly disposed of.

3.5 Quality Assurance and Quality Control (QA/QC)

The following Quality Assurance (QA) and Quality Control (QC) samples will also be collected and analyzed.

- One trip blank per trip will be analyzed via EPA Method 8260
- One field blank (rinsate blank) for soil will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081, EPA Method 8151, EPA Method 8082, EPA Method 6010 and EPA Method 7471 and also for EPA Method 8270D SIM and Modified EPA Method 537M.
- One field blank (rinsate blank) for groundwater will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081, EPA Method 8151, EPA Method 8082, EPA Method 6010, EPA Method 7471 and also EPA Method 8270D SIM and Modified EPA Method 537M.

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) samples will also be collected and analyzed.

- One MS soil sample and one MSD soil sample will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081, EPA Method 8151, EPA Method 8082, EPA Method 6010 and EPA Method 7471, and also for EPA Method 8270 and EPA Method 537M.
- One MS groundwater sample and one MSD groundwater sample will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081, EPA Method 8151, EPA Method 8082, EPA Method 6010, EPA Method 7471 and also EPA Method 8270D SIM and Modified EPA Method 537M.

Tables 1, Table 2 and Table 3 provide the sampling and analytical Method Requirements along with a summary of anticipated QA/QC for soil, groundwater and vapor.

3.6 General QA/QC Considerations

The soil and groundwater samples and the soil vapor samples will be managed as per the following protocols:

- HydroTech PM and QAO (Ruijie Xu) shall perform field audits to verify compliance with the RIWP and identify corrective measures where problems are identified. A resume for Ruijie Xu is included in **Attachment D**
- Samples will be labeled and logged in a monitor notebook and Chain of Custody upon collection including sampler name, sampling identification, date and time of sample collection and sampling depth, sampling methods and devices.
- In the field, samples will be the responsibility of, and will stay with, the HydroTech field geologist (Ruijie Xu).
- Once samples have been collected, they are returned to HydroTech office and logged in for temporary storage under a proper Chain of Custody. **Attachment E** provides a sample chain of custody form.
- Soil samples will be refrigerated to maintain a temperature at a maximum 4 degrees Celsius.
- HydroTech staff will be then responsible for transporting samples to State-certified (ELAP) laboratory for analysis under a proper Chain of Custody.
- Laboratory personnel will record the date and time of samples arrival at the lab and ensure that all holding times for each matrix and analysis will be met.
- After samples are analyzed, laboratory information is added to the label.
- The Sample Chain of Custody form will be used to record all transport and storage information.
- Samples analytical data report will undergo QA/QC performed by a laboratory QA officer who checks each data sheet for precision, missing or illegible information, errors in calculation and values outside of the expected range. A minimum of five percent of the total of a given type of sample shall be devoted to internal QC checks. These checks are designed to ensure accuracy in the sampling procedure and the analytical methods and include blanks, duplicates, matrix spikes reference standards and performance evaluation samples. **Attachment F** provides a conventional lab QA/QC procedures associated with soil samples and analysis.
- The Laboratory data packages will conform to the Analytical Services Protocols (ASP) Category B Deliverables in accordance to NYSDEC DER-10 Appendix 2B.
- To ensure that data quality objectives are met, HydroTech QAO will assess data precision, accuracy, degree of representation, comparability and completeness of samples and data. This is primarily accomplished in the evaluation of data

together with field notes and sampling logs. In order to ensure that cross-contamination between sampling locations did not occur, each piece of detection and reporting limits shall allow for comparison with soil quality standards.

- All deficiencies identified by HydroTech PM during the performance of field audits or evaluation of the data will be immediately reported to the field Geologist, and the NYSDEC. In addition to identifying deficiencies, the HydroTech PM is responsible for recommending corrective actions.
- The analytical data generated from this project will be provided in an electronic format in accordance with NYSDECs DER-10 Section 1.15. Specifically, the final reports shall be in an electronic format that complies with the NYSDEC's Electronic Document Standards (EDS).
- A Category B deliverable is required and a Data Usability Summary Report (DUSR) will be prepared. The DUSR will include all data and answer the following questions:
  1. Is the data package complete as defined under the requirements for the most current DEC ASP Category B or USEPA CLP data deliverables?
  2. Have all holding times been met?
  3. Do all the QC data; blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
  4. Have all of the data been generated using established and agreed upon analytical protocols?
  5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?
  6. Have the correct data qualifiers been used and are they consistent with the most current DEC ASP?
  7. Have any quality control (QC) exceedances been specifically noted in the DUSR and have the corresponding QC summary sheets from the data package been attached to the DUSR?
- All validated data will be reviewed by Mohammed I. AI-Qina, an independent QAO of the laboratory who is responsible of generating a data usability analysis. This analysis shall consist of (1) an assessment to determine if the data quality objectives were met; (2) evaluation of field duplicate results to indicate the samples are representative; (3) comparison of the results of trip blanks and methods blanks with full data sets to provide information concerning contaminants that may have been introduced during sampling, shipping or analyzing; (4) evaluation of matrix effects to assess the performance of the analytical method with respect to sample matrix, and determine whether the data have been biased high or low due to matrix effects. A Data Usability Summary Report (DUSR) will be prepared and provided in an electronic format

in accordance to NYSDEC DER-10 Appendix 2B and in compliance with the NYSDEC's Electronic Document Standards (EDS). A resume for Mohammed I. AI-Qina is included in **Attachment D.**

- Field investigation will be performed under the full oversight of Tarek Z. Khouri, a NYS registered professional engineer. A resume for Tarek Z. Khouri is included in **Attachment D**.

TABLES

Table 1: Sampling & Analytical Method Requirements – Soil Samples

Soil Matrix[1] / Sample ID	Parameters	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
RISB-1 through RISB-13 & Matrix Spike/Matrix Spike Duplicate	TCL VOCs	120 ml + 2 oz	2 oz. clear wide-mouth glass with Teflon lined septum + 40 ml methanol vial with Teflon lined cap + 40 ml DI water vial with Teflon lined cap + 40 ml unpreserved vial with Teflon lined cap	Cool to 4 °C[2]	EPA Method 8260	Compound Specific (0.001-0.05 mg/Kg)	14 days
	TCL SVOCs	8 oz	8 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Method 8270	Compound Specific (0.065-0.250 mg/Kg)	14 days
	TAL Metals	8 oz	8 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Method 6010/EPA 7470 for Mercury	Compound Specific (0.05-10 mg/Kg)	6 months/ Chromium Hexavalent 24 hours/Mercury 28 days
	Herbicides/ Pesticides	8 oz	8 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Methods 8082/8151	Compound Specific (0.005-0.02 mg/Kg)	14 days
	PCBs	8 oz	8 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Method 8081	Compound Specific (0.025 mg/Kg)	14 days
	1,4-Dioxane	500 mL	4 oz. clear glass	Cool 4°C	EPA Method 8270D SIM	0.1 mg/Kg	14 days
	21 Target PFOAs	5g	40 ml VOC vial + Bisulfate	Cool 4°C	Modified EPA Method 537M	0.001 mg/Kg	14 days
Field Blank	TCL VOCs	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCl to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days
	TCL SVOCs	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8270	Compound Specific (2-20 µg/L)	7 days
	TAL Metals	500 ml	500 ml Poly cup with Teflon lined cap	HNO_3 to pH<2 Cool to 4 °C	EPA Method 6010/EPA 7470 for Mercury	Compound Specific (2-20 µg/L)	6 months/ Chromium Hexavalent 24 hours/Mercury 28 days
	Herbicides/ Pesticides	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Methods 8082/8151	Compound Specific (0.01-0.1 µg/L)	7 days
	PCBs	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8081	Compound Specific (0.05 µg/L)	7 days
	1,4-Dioxane	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8270D SIM	Compound Specific (≤0.35 µg/L)	7 days
	21 Target PFOAs	500	500 ml HDPE or polypropylene	Cool to 4 °C	Modified EPA Method 537	Compound Specific (≤2 ng/L)	14 days
Trip Blank	TCL VOCs	80 ml	40 ml VOC vial with Teflon lined cap	1:1 HCl to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days

(1)…Analytical Services Protocols (ASP) Deliverables Package Category B.

(2)…If samples are not delivered to the lab with 48 hours after collection, the 40 ml DI Water vials should be preserved in a frozen condition following sampling

Table 2: Sampling & Analytical Method Requirements – Groundwater Samples

Groundwater Matrix[1] / Sample ID	Parameters	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
RIMW-1 to RIMW-7 & Matrix Spike /Matrix Spike Duplicate & & Field Blank	TCL VOCs	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCl to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days
	TCL SVOCs	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8270	Compound Specific (2-20 µg/L)	7 days
	TAL Metals	500 ml	500 ml Poly cup with Teflon lined cap	HNO_3 to pH<2 Cool to 4 °C	EPA Method 6010/EPA 7470 for Mercury	Compound Specific (2-20 µg/L)	6 months/ Chromium Hexavalent 24 hours/Mercury 28 days
	Herbicides/ Pesticides	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Methods 8082/8151	Compound Specific (0.01-0.1 µg/L)	7 days
	PCBs	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8081	Compound Specific (0.05 µg/L)	7 days
	1,4 Dioxane	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8270D SIM	Compound Specific (≤0.28 µg/L)	7 days
	Perfluorooctanoic acid (PFOA) and other perfluorinated compounds (PFCs)	500 ml	500 ml HDPE or polypropylene	Cool to 4 °C	Modified EPA Method 537	Compound Specific (≤2 ng/L)	14 days
Trip Blank	TCL VOCs	80 ml	40 ml VOC vial with Teflon lined cap	1:1 HCl to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.5-20 µg/L)	14 days

(1)…Analytical Services Protocols (ASP) Deliverables Package Category B.

Table 3: Sampling & Analytical Method Requirements – Vapor Samples

Vapor Matrix Sample ID	Parameters	No. of Samples	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
RISV-1 through RISV-7	VOCS	7	6 L	Summa® Canister	NA	TO-15	Compound Specific (1-20 µg/m³)	30 days

ATTACHMENT A
USEPA LOW FLOW SAMPLING PROTOCOL

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

Revision Page

Date	Rev #	Summary of changes	Sections
7/30/96	1	Finalized	
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3/23/17	3	Updated	All sections
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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" (Vroblesky 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.

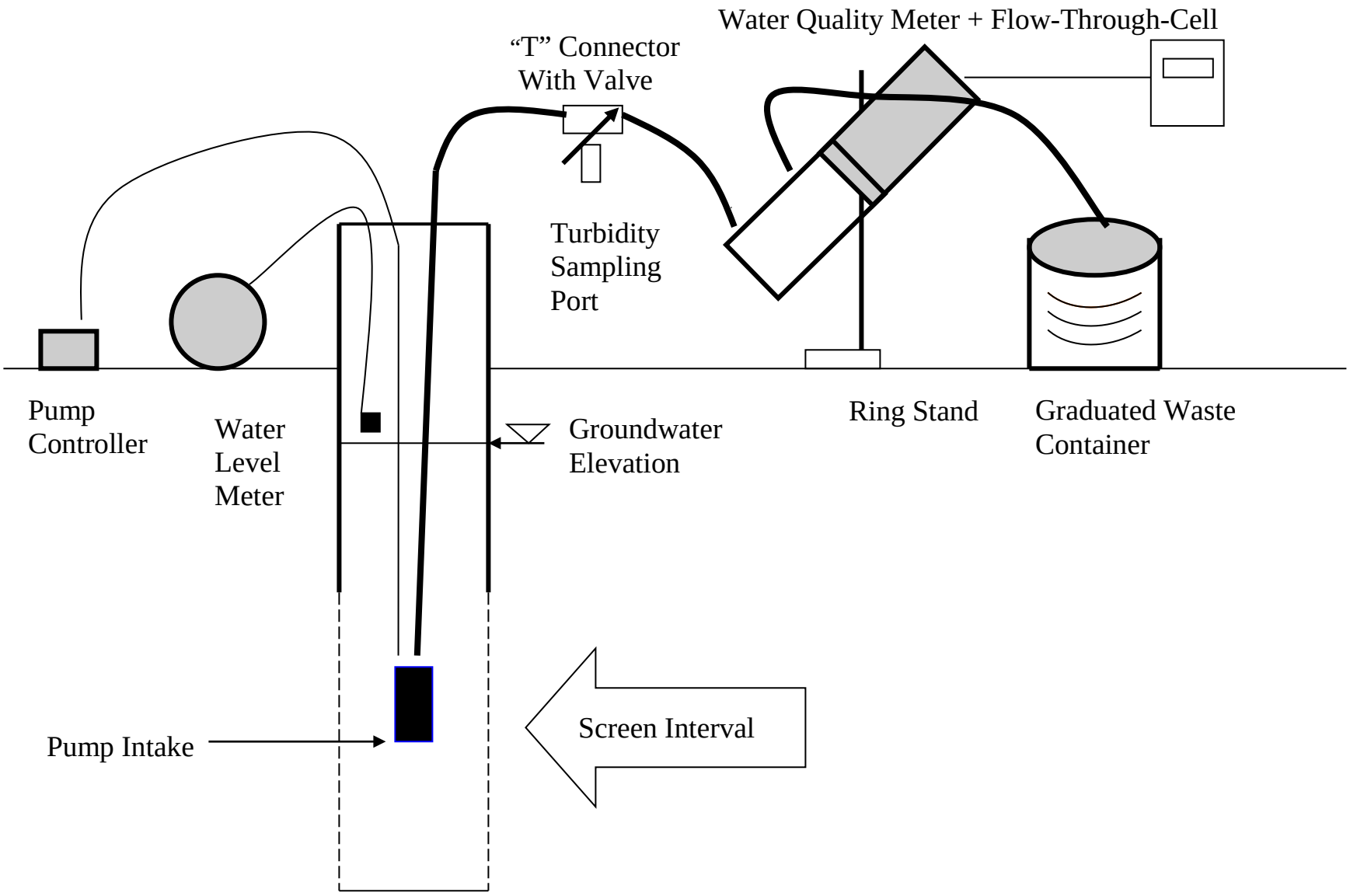
If the pump's tubing is not completely filled with water and the samples are being collected for VOCs and/or dissolved gases analyses using a centrifugal or peristaltic pump, do the following:

> 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
Well Number_____ Date_____ (below MP) top bottom
Field Personnel_____ Pump Intake at (ft. below MP)_____
Sampling Organization_____ Purging Device; (pump type)_____
Identify MP_____ Total Volume Purged _____

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. "C	Spec. Cond.[2] µS/cm	pH	ORP[3] mv	DO mg/L	Tur-bidity NTU	Comments
Stabilization Criteria					3%	3%	±0.1	±10 mv	10%	10%	

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

ATTACHMENT B
GUIDELINES AND PROTOCOLS FOR FPOA SAMPLING

February 2019

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

Objective

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

Sample Planning

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

Upon a new site being brought into any program (e.g., SSF, BCP), PFAS and 1,4-dioxane will be incorporated into the investigation of potentially affected media, including soil, groundwater, surface water, and sediment as an addition to the standard "full TAL/TCL sampling." Biota sampling may be necessary based upon the potential for biota to be affected as determined pursuant to a Fish and Wildlife Impact analysis. Soil vapor sampling for PFAS and 1,4-dioxane is not required.

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

Soil imported to a site for use in a soil cap, soil cover, or as backfill must be sampled for 1,4-dioxane and PFAS contamination in general conformance with DER-10, section 5.4(e). Assessment of the soil data will be made on a site-specific basis to determine appropriateness for use.

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

Analysis and Reporting

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

PFAS analysis and reporting: DEC has developed a *PFAS Analyte List* (below) for remedial programs. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any compounds, the DEC project manager, in consultation with the DEC remedial program chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site.

Currently, ELAP does not offer certification for PFAS compounds in matrices other than finished drinking water. However, laboratories analyzing environmental samples (e.g., soil, sediments, and groundwater) are required by DER to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537 or ISO 25101.

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

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

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

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

PFAS-containing materials can be made up of per- and polyfluoroalkyl substances that are not analyzable by routine analytical methodology (LC-MS/MS). The TOP assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by current analytical methodology. Please note that analysis of highly contaminated samples, such as those from an AFFF site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. Please consult with a DEC remedial program chemist for assistance interpreting the results.

1,4-Dioxane analysis and reporting: The reporting limit for 1,4-dioxane in groundwater should be no higher than 0.35 µg/L (ppb) and no higher than 0.1 mg/kg (ppm) in soil. Although ELAP offers certification for both EPA Method 8260 SIM and EPA Method 8270 SIM in waters, DER is advising the use of Method 8270 SIM because it provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents. The analysis currently performed for SVOCs in soil is adequate for evaluation of 1,4-dioxane in soil, which already has an established SCO.

Refinement of sample analyses

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

PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanessulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Groundwater Sampling for Emerging Contaminants

February 2018

Issue: NYSDEC has committed to analyzing representative groundwater samples at remediation sites for emerging contaminants (1,4-dioxane and PFAS) as described in the below guidance.

Implementation

NYSDEC project managers will be contacting site owners to schedule sampling for these chemicals. Only groundwater sampling is required. The number of samples required will be similar to the number of samples where "full TAL/TCL sampling" would typically be required in a remedial investigation. If sampling is not feasible (e.g., the site no longer has any monitoring wells in place), sampling may be waived on a site-specific basis after first considering potential sources of these chemicals and whether there are water supplies nearby.

Upon a new site being brought into any program (i.e., SSF, BCP), PFAS and 1,4-dioxane will be incorporated into the investigation of groundwater as part of the standard "full TAL/TCL" sampling. Until an SCO is established for PFAS, soil samples do not need to be analyzed for PFAS unless groundwater contamination is detected. Separate guidance will be developed to address sites where emerging contaminants are found in the groundwater. The analysis currently performed for SVOCs in soil is adequate for evaluation of 1,4-dioxane, which already has an established SCO.

Analysis and Reporting

Labs should provide a full category B deliverable, and a DUSR should be prepared by a data validator.

The work plan should explicitly describe analysis and reporting requirements.

PFAS sample analysis: Samples should be analyzed by an environmental laboratory certified by ELAP to use EPA method 537 or ISO 25101. ELAP does not currently offer certification for PFAS analysis of non-drinking water samples (including groundwater, soil and sediment), so there is no requirement to use an ELAP certified method. The preferred method is the modified EPA Method 537. Labs have been able to achieve reporting limits for PFOA and PFOS of 2 ng/l (part per trillion). If labs are not able to achieve similar reporting limits, the NYSDEC project manager will make case-by-case decisions as to whether the analysis can meet the needs for the specific site.

PFAS sample reporting: DER has developed a PFAS target analyte list (below) with the intent of achieving reporting consistency between labs for commonly reportable analytes. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. This list may be updated in the future as new information is learned and as labs develop new capabilities. If lab and/or matrix specific issues are encountered for any particular compounds, the NYSDEC project manager will make case-by-case decisions as to whether particular analytes may be temporarily or permanently discontinued from analysis for each site. Any technical lab issues should be brought to the attention of a NYSDEC chemist.

Some sampling using this full PFAS target analyte list is needed to understand the nature of contamination. It may also be critical to differentiate PFAS compounds associated with a site from other sources of these chemicals. Like routine refinements to parameter lists based on investigative findings, the full PFAS target analyte list may not be needed for all sampling intended to define the extent of

Collection of Groundwater Samples for Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) from Monitoring Wells Sample Protocol

Samples collected using this protocol are intended to be analyzed for perfluorooctanoic acid (PFOA) and other perfluorinated compounds by Modified (Low Level) Test Method 537.

The procedure used must be consistent with the NYSDEC March 1991 Sampling Guidelines and Protocols http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf with the following materials limitations.

At this time acceptable materials for sampling include: stainless steel, high density polyethylene (HDPE), PVC, silicone, acetate and polypropylene. Equipment blanks should be generated at least daily. Additional materials may be acceptable if pre-approved by NYSDEC. Requests to use alternate equipment should include clean equipment blanks. **NOTE: Grunfos pumps and bladder pumps are known to contain PFC materials (e.g. Teflon™ washers for Grunfos pumps and LDPE bladders for bladder pumps).** All sampling equipment components and sample containers should not come in contact with aluminum foil, low density polyethylene (LDPE), glass or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer. Standard two step decontamination using detergent and clean water rinse will be performed for equipment that does come in contact with PFC materials. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFC materials must be avoided. Many food and drink packaging materials and “plumbers thread seal tape” contain PFCs.

All clothing worn by sampling personnel must have been laundered multiple times. The sampler must wear nitrile gloves while filling and sealing the sample bottles.

Pre-cleaned sample bottles with closures, coolers, ice, sample labels and a chain of custody form will be provided by the laboratory.

1. Fill two pre-cleaned 500 mL HDPE or polypropylene bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at 4 ± 2º Celsius.

Collect one equipment blank for every sample batch, not to exceed 20 samples.

Collect one field duplicate for every sample batch, not to exceed 20 samples.

Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples.

Request appropriate data deliverable (Category A or B) and an electronic data deliverable.

contamination. Project managers may approve a shorter analyte list (e.g., just the UCMR3 list) for some reporting on a case by case basis.

1,4-Dioxane Analysis and Reporting: The method detection limit (MDL) for 1,4-dioxane should be no higher than 0.28 µg/l (ppb). ELAP offers certification for both EPA Methods 8260 and 8270. In order to get the appropriate detection limits, the lab would need to run either of these methods in "selective ion monitoring" (SIM) mode. DER is advising PMS to use 8270, since this method provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents (we acknowledge that 8260 has been shown to have a higher recovery in some studies).

Full PFAS Target Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	**Perfluorobutanesulfonic acid**	**PFBS**	**375-73-5**
	Perfluorohexanesulfonic acid	**PFHxS**	**355-46-4**
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanessulfonic acid	**PFOS**	**1763-23-1**
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	**PFHpA**	**375-85-9**
	Perfluorooctanoic acid	**PFOA**	**335-67-1**
	Perfluorononanoic acid	**PFNA**	**375-95-1**
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Bold entries depict the 6 original UCMR3 chemicals

ATTACHMENT C

GROUNDWATER SAMPLING/PURGE LOG

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC

Monitoring Well Sampling Log Sheet

Job No.: _____ **Well No.:** _____ **Date:** __/__/__

Well Depth: _____ **Screen Length:** _____ **Well Diameter:** _____ **Casing Type:** _____

Sampling Device: _____ **Tubing Type:** _____ **Initial DTP:** _____ **Initial DTW:** _____

Well Volume: _____ **Total Volume Purged:** _____

Sampling Personnel:_____

Low Flow Sampling required ? Yes : _____ No: _____

Order of stabilization			a	b	c	e	f	d	
Deviation			±1		± 3%	± 10%	± 10%	± 10 mv	
Time	**DTP (ft)**	**DTW (ft)**	**pH**	**Temp (ºF)**	**Cond. (S/Cm)**	**Dis.O2 (mg/L)**	**Turb.(NTU)**	**ORP (mV)**	**Notes**

ATTACHMENT D

RESUME OF KEY PERSONNEL

TAREK Z. KHOURI, P.E. *Principal Environmental Engineer*

Education
M.S. Environmental Engineering, University of Central Florida

B.S. Chemistry, University of Central Florida

Professional Registration
Professional Engineer (P.E.)
Connecticut # 0031583
D.C. # 908711
Maryland # 49155
Massachusetts # 52601
New Jersey # 24GE04697200
New York # 086611
Pennsylvania # PE084919
Rhode Island # 12059
Texas # 125442
Virginia # 0402056415

Certifications
OSHA: 40 Hour HAZWOPER; 8 Hour Supervisor Management; 10 Hour Construction Safety

USACE Construction Quality Management

Affiliations
Transportation & Infrastructure Committee, NY Building Congress (NYBC), NY, USA

Environmental and Energy Committee, American Society of Engineering Companies (ACEC) NY, USA

Chairman (2013), Solid Waste Committee, Qatar Green Building Council (QGBC) Qatar

Legislative Committee (2008-2010), National Brownfield Association (NBA), NY, USA

Environmental Council (2008-2010), The Business Council of NY State (BCNY), NY, USA

Summary of Experience
Mr. Khouri has more than 20 years of experience in the real estate development, construction and engineering industries.

He has been a trusted partner, providing environmental consulting services to public and private sector clients including developers, real estate owners, investors, facility managers and city, state and federal agencies and municipalities.

Mr. Khouri has participated and managed the remediation and reuse of contaminated properties for over 20 years. He has performed, directed, and overseen environmental investigations and remedial actions at petroleum and chlorinated solvent spill sites, fuel farms, refineries, former manufactured gas, landfills, and a variety of residential, commercial and industrial settings.

Mr. Khouri integrates environmental risk management with land use planning and sustainable development to meet the needs and objectives of diverse clients and stakeholders for residential, commercial, and industrial real estate, in urban and rural environment. Mr. Khouri utilizes his technical expertise as well as his leadership and management skills to direct and oversee teams of professionals for the successful completion of these complex projects.

Relevant Experience
- **Principal Environmental Engineer –** Hydro Tech Environmental Engineering and Geology, DPC (2017-Present)
- **Senior Vice President** – HAKS (2015-2017)
- **Vice President** – Langan Engineering and Environmental Services, USA. (2013-2015)
- **Managing Director** – Averda Environmental Services, Qatar. (2011-2013)
- **Managing Director** – Clean Planet International, USA, Africa and Middle East. (2010-2011)
- **Associate** – Langan Engineering and Environmental Services, USA and Middle East. (2004-2010)
- **Senior Project Manager** – URS Corporation, USA and Middle East. (1998-2004)
- **Senior Scientist** – Solidere, Lebanon. (1996-1998)
- **Environmental Engineer** – University of Central Florida, USA. (1994-1996)

- **Environmental Impact Assessments, Phase I ESAs, and Phase II ESIs - Clients: Developers, Property Managers, Environmental Attorneys, Architects, Banks, and Insurance Firms** - Conducted 100s of environmental assessments for various entities specializing in urban renewal: Mixed use, residential, commercial, retail, warehouses, manufacturing facilities, gas stations and vacant lands. I also designed and executed subsurface investigations for soil, groundwater, and soil gas.

- **Remedial Investigation, Remedial Design and Associated Remediation Projects - Clients: Developers, Property Managers, Environmental Attorneys, Architects, Banks, Insurance Firms -** Managed myriads of environmental investigations and remedial actions at petroleum and chlorinated solvent spill sites, former manufactured gas and a variety of other commercial and industrial settings. Constituents of concern have included LNAPLs and DNAPLs, petroleum hydrocarbons, chlorinated solvents, soil vapor, coal tar, creosote, PCBs, and metals. Managed and participated in historical research, sample collection and data evaluation, synthesis of information to determine site-specific cleanup levels, remedial technology evaluation, design of treatment systems, site cleanup, installation and operation of treatment systems, optimizing systems, and performance monitoring.

- **LIRR/MTA East Side Access Project, New York, NY - Client: MTA** - The project involves the construction of new metro tunnels system in densely developed areas of midtown Manhattan, new tunnels system construction beneath active Amtrak, Metro North and NYCTA facilities, construction of new terminals, ventilation facilities, off street entrances, and yards development. In addition to establishing the guidelines of the project specific environmental management system, I provided direct and extensive public and community relations outreach, educational and awareness programs, as well technical support for the design engineering and construction teams, inspectors, and environmental sub consultants, so that construction of the project proceeds in compliance with environmental commitments, be conducted under budget and on time, while maintaining the utmost quality. Another key component of the project success was the direct and constant coordination between the environmental department and the multiple agencies and operators/owners of the project, such as USEPA, NYSDEC, NYSDOH, NYCDOT, NYCDEP, NYCDOB, MTA, LIRR, NYCTA, Amtrak, and Metro North. Construction Cost: $8.4 Billion

- **Hudson Yards, Proposed New York Jets Stadium, New York, NY – Client: NY Jets -** Served as the environmental project manager for the due diligence, investigation, and preliminary design phases of the proposed Jets Stadium. The work included subsurface investigation for soil, groundwater, and soil gas, and required close interaction with multiple entities including the MTA, LIRR, NYCTA, NYCDOS, NYSDEC, and Amtrak. Construction Cost: $1.4 Billion

- **Columbia University Manhattanville Expansion Project, New York, NY – Client: Columbia University -** Columbia University new campus will be built within a 17-acre area and will be comprised of academic and research facilities, housing, as well as commercial retail stores and open space areas. As the senior environmental project manager, I oversaw all environmental engineering related activities, including site assessment prior to the development, pre-construction support for demolition, recycling, soil and groundwater management, air quality controls, and LEED certification support. Construction Cost: $2+ Billion

- **Potable Water System Testing for Lead, New York, NY – Client: NYCSCA** - Directly managed the emergency work for the sampling, testing, evaluation and reporting of lead in the potable water of approximately 300 public schools in New York City. HAKS was one of the main consultants working for NYCSCA to implement a potable water system testing protocol which included coordination with school facilities, field work encompassing flushing and sampling, laboratory testing, analyzing, and reporting sample results. The project was conducted on a tight 24/7 timetable. The project was completed successfully under the direct supervision and daily coordination with the NYCSCA, with limited to no disturbance to schools' schedule and extracurricular activities, on time and on budget.

- **City University of New York, Tank Rehabilitation, Remediation and Closure Program, New York, NY – Client: DASNY -** Served as the project manager for the technical assessment, remediation design, and oversight of the Underground Storage Tank (UST) facilities at seven City

University campuses. Tanks sizes ranged from 550 Gal to 50,000 Gal. The work included design drawings and construction documents for the tanks and dispensing systems for vapor recovery, fire suppression, electronic monitoring/sensing, pumping/delivery, storage tank details, site restoration, subsurface investigation, and spill remediation. Construction Cost: $5 Million

- **Active Fuel Oil Terminal, Brooklyn, NY – Client: Bayside Fuel Oil Depot Corporation -** Managed the remedial investigation in connection with petroleum releases at an active fuel oil terminal located on Gravesend Bay. Developed and executed a strategy to manage client's liability relating to light non-aqueous phase liquid (LNAPL). Negotiated an alternative remedial action which benefitted the adjacent property and NYSDEC while eliminating client from liabilities at the adjacent property. Investigated and evaluated storm water infrastructure, and included an updated storm water management plan, as part of a sustainable groundwater remedy. Fees: $1.1 Million

- **54 Rutledge St, Insitu Bio-Remediation, Brooklyn, NY – Client: Fortis Property Group -** Managed the implementation of a remedial action for major petroleum and gasoline spills. The remedial action consisted of a multi-phased approach to site cleanup, which included excavation and removal of contaminated soil and groundwater, removal of underground storage tanks, injection of chemical oxidation compounds into the groundwater table, installation of permanent remedial injection and monitoring points, installation of a soil vapor mitigation system, and delineation of off-site contamination. Fees: $1.0 Million

- **Circuitron Corporation Superfund Site, Ground Water Treatment System, East Farmingdale, NY – Client: USACE** - Served as the Project Engineer and the Health and Safety Officer providing technical direction for on-site staff, guidance in hazardous waste/material management, and performing technical review of reports and contract deliverables. Coordinated with USEPA and USACE for the day-to-day operations and quality control matters. Fees: $1.6 Million

- **Constructability Review – Justice Sonia Sotomayor Houses, Bronx, NY – Client: NYCHA -** Constructability Review for the upgrading/rehabilitation of the Justice Sonia Sotomayor Houses in the Bronx for the New York City Housing Authority (NYCHA). The scope of work includes such repairs as Local Law 11 Brick Facade repair/waterproofing for areas of significant disrepair (including brick masonry, window sills/lintels, and brick parapet replacement with metal railing); roof replacement (asbestos abatement, 4-ply insulated roofing, roof drains); interior repairs/sheet rock/painting to apartments with water damage, new window installation at all locations; replacement of the water tanks, pumps, and repairs to the water tank structures in particular buildings; repairs to the property's main loop and improvements to entrances, lobbies and security. Construction Cost: $102 Millions

- **LCP Chemicals Inc. Superfund Site, Linden, NJ – Client: LCP Chemicals Inc. -** Served as the Project Manager and the Health and Safety Officer for the interim removal action program for mercury clean up and removal, petroleum contaminated soil excavation, storage tanks and steel structure demolition. The job also included a drum landfill investigation, done in level B PPE. Awarded the 74th Annual Governor's Occupational Safety & Health Award Citation of Merit of the State of New Jersey in 2002. Fees: $1.1 Million

- **FAA Technical Center, PCB Soil Remediation at Area 20A Superfund Site, Atlantic City, NJ – Client: USACE -** Served as a Laboratory Manager for the PCB contaminated soils removal project at FAA Technical Center. Responsibilities included the development of sampling and analysis plans, establishment of project data quality objectives, evaluation and selection of laboratories for testing programs, data quality assessment, and reports preparation. Fees: $3.2 Million

- **FAA Technical Center, Area D Jet Fuel Farm Superfund Site, Atlantic City, NJ – Client: USACE** - Served as the Quality Control Manager, supervising laboratory prequalification, fieldwork, and laboratory analysis. Evaluated and optimized the operation of the groundwater treatment system, CEM, and SVE bioremediation system, and prepared quarterly reports deliverables to the USEPA and the USACE. Also performed quality assurance audit and review for the pre-excavation sampling results performed by FAA subcontractors, using field test kits for PCB and TPH. Fees: $2.1 Million

- **US Federal Government, Anthrax Investigation, New Jersey and New York – Client: USPS -** Mr. Khouri was part of a team that was contracted by the Federal Government and the United States Postal Services (USPS) to perform Anthrax sampling and investigation throughout dozens of USPS facilities in the Northeast.

International Representative Projects

- **Global Infrastructure Project, Harare, Zimbabwe** – Provided owner representation services for conducting due diligence and feasibility studies for multibillion dollars infrastructure development projects. Projects are BOT and included a 120,000-bbd oil refinery, 300 Km oil pipeline, 20,000 unit's housing project, resorts, telecommunication improvement, and assessing mining concessions. Construction Cost: $7.2 Billion

- **OQYANA World First, Dubai, UAE** – Provided geotechnical and waterfront/marine engineering evaluations of the island's perimeter seawalls and ground improvement schemes, as well as seismic slope stability analysis at the edge of the islands. The proposed design effort and creative approach led to enormous budget and schedule savings for the client. Construction Cost: $1+ Billion

- **Normandy Landfill Treatment Project, Beirut, Lebanon** - Managed the remediation program of a 60 acres' landfill reclamation project. Additionally, I corresponded with management, owners, developers, and government representatives, and my involvement with the project from the design stage throughout the full remediation led to the project ultimate success with regard to the remediation design and schedule and budget compliance. Construction Cost: $65 Million

- **Beach Restoration, Al Athaiba Beach (Muscat, Oman) and Saint Germain sur Ay Beach (La Manche, France) -** Provided environmental engineering and site civil support for erosion control and restoration of the beach. Fees: $500,000

Publications

- Reductive Dehalogenation of Tetrachloroethylene by Soil Sulfate Reducing Microbes Under Various Electron Donor Conditions (2000).

- The Effect of Organic Substrates on Enhanced Biological Phosphorus Removal in Continuous Culture and Batch Experiments (1998).

- Comparison of Enhanced Biological Phosphorus Removal Populations under Ten Different Environmental Conditions (1998).

- Observations From Steady State and Batch Experiments Concerning the Effect on Enhanced Biological Phosphorus Removal of Volatile Fatty Acids and Glucose (1997).

- Single Stage Anaerobic and Aerobic Sequencing Biotransformation and Mineralization of Tetrachloroethylene (PCE) for the Remediation of Contaminated Soils and Groundwater (1996).

Dr. Mohammed I. Al-Qinna

Associate Professor in Environmental Soil Physics & Irrigation

KEY QUALIFICATION

I have more than 26 years of professional experience in agricultural–environmental management, climate change analytics, hydrology, smart irrigation, soil–water–plant systems, environmental modelling, and sustainable land and water resource development. My work spans national and international programs across the Middle East and Gulf region, where I support the design, monitoring, evaluation, and policy development of complex environmental and agricultural projects.

Alongside this multidisciplinary background, I also have strong expertise in environmental data validation, QA/QC evaluation, and data usability assessment using internationally recognized frameworks. My work aligns with major global standards including USEPA SW-846 analytical methods, the USEPA Contract Laboratory Program (CLP), the USEPA National Functional Guidelines (NFG) for organics and inorganics, and USEPA QA/QC guidance for sampling and analysis. In addition, I apply international ISO standards, particularly ISO/IEC 17025 for laboratory competence, ISO 5667 for water sampling, ISO 18400 for soil quality and sampling, and ISO 18512/24095 for dust and analytical QA/QC. Together, these frameworks allow me to ensure that environmental datasets—water, soil, dust, wastewater, groundwater, and agricultural samples—are scientifically defensible, traceable, and suitable for modelling, reporting, and decision-making.

My analytical and data-science capabilities include data mining, environmental statistics, and advanced modelling, supported by experience with major analytical platforms such as SAS, JMP Pro, SPSS, Minitab, Python, and R, as well as geospatial and modelling tools such as ArcGIS, QGIS, MODFLOW, HYDRUS, SWAT, AquaCrop, DSSAT, and remote sensing systems. This combination of environmental expertise and analytical proficiency enables me to integrate validated data into climate, hydrological, environmental, and agricultural assessments with high confidence.

Throughout my career, I have implemented and delivered capacity-building programs for ministries, laboratories, universities, and international organizations on climate change, environmental monitoring, QA/QC, data validation, smart irrigation, and integrated natural resource management. My work continues to support evidence-based policy development, improved environmental governance, agricultural productivity, and climate resilience across the region.

EDUCATION

PhD. In **Environmental Soil Physics**. 2003. Department of Crop, Soil, & Environmental Sciences, Faculty of Agriculture, University of Arkansas, Arkansas, USA. Dissertation title: "***Measuring & Modelling Soil Water & Solute Transport with Emphasis on Physical Mechanisms in Karst Topography***". Advisor: Prof. Don H. Scott

M.S. In **Soil & Irrigation**. 1997. Department of Soil & Irrigation, Faculty of Agriculture, University of Jordan, Amman, Jordan. Thesis Title: "***Infiltration and Soil Water Storage as Affected by Irrigation Methods in Al-Muwaqqar Region***". Advisor: Prof. Ahmad Abu-Awwad

B.S. In **Soil & Irrigation**. 1994. Department of Soil & Irrigation, Faculty of Agriculture, University of Jordan, Amman, Jordan.

Phone: +962 79 6700222, P.O. Box 926804, Zip Code 11190, Amman, Jordan,
e-mail: qinna@hu.edu.jo; e-mail: mqinna@hotmail.com

AREAS OF SPECIALIZATION

- **Sustainable Land & Rangeland Management –** conservation agriculture, soil restoration, land rehabilitation, and integrated rangeland strategies for arid and semi-arid regions, with emphasis on climate resilience and long-term land productivity.
- **Soil Physics, Soil Quality & Productivity Enhancement –** advanced evaluation of soil physical, chemical, and biological properties; soil amendment trials; fertility optimization; and enhancement of soil structure and microbial activity for improved land performance.
- **Soil–Water–Plant–Climate Interactions –** climate-smart agriculture, SMART irrigation, fertigation, deficit irrigation, and soilless agricultural systems (hydroponics, NFT, DWC, climate-controlled greenhouses), focusing on maximizing WUE and crop performance.
- **Irrigation & Water Resources Management –** design, modelling, monitoring, and evaluation of pressurized irrigation systems; automated and sensor-based irrigation; water-saving technologies; and integrated water resources management (IWRM) for agriculture and ecosystem protection.
- **Climate Change Assessment & Policy Development –** national climate vulnerability and impact assessments, mitigation and adaptation planning, downscaled climate modelling, UNFCCC reporting (NCs, BURs, NDCs, NAP), and authorship of national climate change policies and frameworks.
- **Environmental Data Validation & QA/QC –** verification and validation of environmental, agricultural, and analytical datasets (water, soil, dust, wastewater, groundwater) using international frameworks including USEPA SW-846, USEPA CLP, USEPA National Functional Guidelines, NYSDEC DER-10, FAO and WHO environmental standards, USDA soil/water guidelines, and ISO/IEC 17025 and ISO sampling standards (ISO 5667, ISO 18400, ISO 18512). Ensuring scientific defensibility, reliability, and regulatory compliance of datasets used in modelling, monitoring, and decision-making.
- **Data Analytics, Data Mining & Modelling –** advanced environmental statistics, machine learning, and data mining using SAS, JMP Pro, SPSS, Python, R, and mathematical/spatial modelling for land degradation, desertification, salinization, climate variability, and solute/contaminant transport.
- **Geospatial Strategy, GIS/RS & Enterprise Data Systems –** design of integrated geospatial strategies and environmental/agricultural data systems; conceptual and logical data modelling; enterprise data architecture; and GIS/remote sensing applications for land–water–agriculture management.
- **Hydrology & Contaminant Transport Modelling –** simulation of water and solute movement in heterogeneous soils and karst systems; groundwater recharge and pollution risk mapping; drought and flood assessments; and modelling using MODFLOW, HYDRUS, SWAT, AquaCrop, and GeoStudio.
- **Environmental Assessment & EIA –** assessment of soil, water, groundwater, and ecological systems under agricultural, urban, and industrial pressures; identification of environmental risks, pollution pathways, and mitigation options.
- **Agricultural Strategy, Policy & Sector Development –** development of regional agricultural strategies, production system optimization, sectoral assessments, tariff and market analyses, and agriculture-driven economic development planning.
- **Capacity Building, Advisory Services & Institutional Strengthening –** design and delivery of technical training programs, farmer field schools, ToT modules, and institutional capacity development on smart irrigation, climate change, environmental monitoring, QA/QC, WEFE Nexus, and sustainable land–water management.
- **Gender, Livelihoods & Rural Development –** design and implementation of livelihood diversification programs, women-led agriculture initiatives, and rural innovation projects linking environmental sustainability with community empowerment.

- **Project Leadership, Monitoring & Evaluation –** management of large-scale, multi-stakeholder environmental and agricultural projects; development of monitoring frameworks; reporting; extraction of lessons learned; and documentation of success stories for national and international partners.

WORK EXPERIENCES

2025 – Now	Dean Assistant for Academic Development, Prince El Hassan Bin Talal Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2021 – 2025	Agriculture / Land, Water, and Environment Management, Consultant and Project Manager at The Palladium Group, Ministry of Environment, Water, and Agriculture (MEWA), KSA.
2020 – 2021	Associate Professor, Department of Land Management & Environment, Prince El Hassan Bin Talal Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2019 – 2020	Associate Professor, Department of Land Management & Environment, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2018– 2019	Department Chairman, Department of Land Management & Environment, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2017– 2018	Vice Dean, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2015 –2017	Department Chairman, Department of Land Management & Environment, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2014 – Now	Associate Professor, Department of Land Management & Environment, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2010 – 2011	Vice Dean, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2008 – 2010	Dean Assistant, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2005 – 2006	Department Chairman, Department of Land Management & Environment, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2003 – 2014	Assistant Professor, Department of Land Management & Environment, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan.
2000 – 2003	Graduate Assistant, Department of Crop, Soil, & Environmental Sciences, Faculty of Agriculture, University of Arkansas, Arkansas, USA.
1998 – 1999	Research and Teaching Assistant, Department of Land Management, Institute of Land, Water and Environment, Hashemite University, Zarqa, Jordan.
1997 – 1998	Research Assistant, Jordan Arid Zone Productivity Project, Faculty of Agriculture, University of Jordan, Amman, Jordan.
1994 – 1997	Teaching Assistant, Dept. of Soil Science & Irrigation, Faculty of Agriculture, University of Jordan, Amman, Jordan.

COMMUNITY SERVICES ACHIEVEMENTS

Outside the University

- Member of the National Committee to Combat Desertification in Jordan, Ministry of Environment, Amman, Jordan.
- Member of the Climate Change Thematic Research Group at the Ministry of Environment, Ministry of Environment, Amman, Jordan.
- Member of the Agriculture and Environment Technical and Consulting Council at the Higher Council for Scientific Research.
- Member of the Accreditation and Quality Assurance for Higher Education Institutional Council for Land,

Water and Environment Program, Ministry of Higher Education and Scientific Research.

- Member of the Water Resources and Environment Division Committee, Jordanian Agriculture Engineers Association.
- Member of the steering committee to supervise the preparation of the national strategic document for Ministry of Environment entitled (Jordan Environment 2030)

Within the University:

- Member of Arid Land Academy Council 2016, 2017, 2018.
- Committee Member of the University Scientific Research, 2015, 2018.
- Committee Member of the University Graduate Studies 2014, 2017.
- Environmental Club Counsellor at the Hashemite University.
- Member of the Jordanian Ranking for Universities 2018, 2019.
- Member of the Academic Quality Assurance Council, Academic Quality Assurance at the Hashemite University.
- Member of University Research Participation in the 1st Student Scientific Research.
- Member of the development Committee to Identify and Evaluate the Effectiveness of Teaching Process.
- Member of the Election Commission in the Hashemite University.
- Committee Member of the Detailed Geological and Hydrological Maps Committee.
- Committee Member to Study the Draft Line Carrier and the Reuse of Treated Water to the University.
- Committee Member to Study the Draft Water Harvesting at the Hashemite University.
- Committee Member for the establishment of a Wastewater Treatment Plant at the Hashemite University.
- Committee Member to Identify and Record the Available Natural Resources in Zarqa Governorate.
- Committee Member for Studying the Hashemite Brigade afforestation Project to Reduce Pollution.
- Committee Member for the preparation of the (collapsed) and the Handbook on Faculty of Natural Resources and the Environment.
- Member of the College for the Tempus Foundation.
- Committee Member for investigating on the Impact of Wastewater Coming from Free Zones Corporation Hashemite University.
- Committee Member of the Environmental Activities at the Hashemite University.
- Committee Member of the Master Program entitled "Climate Change and Sustainable Land Management", directed and funded by MAPEC, 2013/2015.
- University Committee Member for updating the Educational Curriculum, 2014.
- Consultant for the university committee to establish Arid Lands Academy (ALA) at the HU campus, 2014.
- Member of Program entitled “Development of Interdisciplinary Programmes on Climate Change & Sustainability Policy (CLIMASP)” Funded by TEMPUS, 2014.
- Member of the Program entitled "Geodesy and Geoinformatics for Sustainable Development in Jordan (GEO4D)" Funded by Erasmus+, 2017.
- Chairman of the Potential Trees and Plants Plantation Booklet, 2018.

Within the Faculty:

- Vice Dean of the Faculty of National Resources and Environment.
- Dean Assistant for students' affairs at the Faculty of National Resources and Environment.
- Head and member of Land Management and Environment Department Council.
- Member of Faculty of Natural Resources & Environment Council.
- Department and Faculty head and member of the Undergraduate Programs Committee.
- Department and Faculty head and member of the Appointment and Promotion Committee.
- Department and Faculty Council head for Student Training.
- Department and Faculty head and member of the Postgraduate Programs Committee.
- Department and Faculty head and member of the Scientific Research Committee.

- Member of the Scientific Journals and Text Books Committee.
- Department and Faculty head and member of the Examination Committee.
- Department and Faculty head and member of the Students Curriculum.
- Department and Faculty head and member of the Technical Scientific Laboratories Equipment Committee.
- Department and Faculty head and member of the Workshops and Seminars Committee.
- Department and Faculty head and member of the Association Council.
- Head and Member of the Faculty Budget Committee.
- Department and Faculty head and member of the University and Society Committee.
- Head of the Faculty Web Site Development Committee at the Faculty.
- Department and Faculty head and member of the Students Discipline Committee.
- Department and Faculty head and member of the Committee on Stimulating Students' Enrolment for the Master Programs Offered in the Faculty.
- Department and Faculty head and member of the Student Guidance Committee.

PROJECTS & CONSULTATIONS

1. ***Design of Climate-Smart Soilless Agricultural Demonstration Systems,*** IUCN, King Salman Bin Abdulaziz Royal Natural Reserve KSA, 2025-now.
2. ***Aseer High Potential Sectors Assessment: Comprehensive Current Assessment of the Agriculture Sector and Opportunities.*** Aseer Development Agency (ASDA), KSA, February to August, 2025.
3. ***Studying the impact of raising water and electricity tariffs on farms in the Emirate of Dubai.*** Agriculture Department, Dubai Municipality, UAE, 2024-2025.
4. ***Building Agriculture Strategy for Agriculture Production in Dubai*.** Agriculture Department, Dubai Municipality, UAE, 2024-2025.
5. ***Developing of Sustainable Rangeland Management Plan***, National Center for Vegetation Cover Development and Combating Desertification. Hafr Al-Batin, KSA, 2023-2024.
6. ***Geospatial Strategy for Ministry of Environment, Water, and Agriculture***, Ministry of Environment, Water, and Agriculture, Riyadh, KSA, 2022-2023.
7. ***Enhancing NEOM Land Productivity through Soil Amendments***, The Palladium Group, NEOM, Tabuk, KSA, 2022-2024.
8. ***Sustainable Farm Modelling,*** The Saudi Irrigation Organization, KSA, 2022-2023.
9. ***Jordan UN Common Country Assessment (CCA) to feed into the UN Sustainable Development Cooperation Framework (CF).*** FAO, Jordan, 2021-2022.
10. ***4th National Communication Report for the UNFCCC***. United Nations Development Programme (UNDP), Jordan, 2021-2023.
11. ***Climate Change Policy (2020-2050)***. United Nations Development Programme (UNDP), Jordan, 2020.
12. ***SDG Climate Facility country grant proposal development.*** United Nations Development Programme (UNDP), Jordan, 2020-2021.
13. ***Mid-Term Evaluation for Jordan's Adaptation Fund Program titled "Increasing the Resilience of Poor and Vulnerable Communities to Climate Change Impacts in Jordan through Implementing Innovation Projects in Water and Agriculture in Support of Adaptation to Climate Change".*** Arabtech Jardaneh, Ministry of Planning and International Cooperation, Amman, Jordan, 2020.
14. ***Potential of AquaSource for Jordan: Alleviating Plant Stress from Water Shortage.*** Ecotechnology LLC-Armenia, and The Hashemite University-Jordan, Funded by INNOWWIDE program, European Union, 2020.
15. ***Strengthening the national water governance capacities in drought management project: Drought Vulnerability & Impact Assessment for Amman-Zarqa, Yarmouk Basins, Azraq & Mujib Basins.*** United Nations Development Programme (UNDP), Jordan, 2019.
16. ***Analysis of the Impacts of Future Droughts on Water and Sanitation Systems in Jordan.*** Funded by ICBA, 2019.
17. ***Protection of Water Dams in Jordan through Labour-Intensive Activities.*** Funded by GIZ, Amman, Jordan, 2018.

18. ***Participatory Consultation and Drafting of the National Climate Change Adaptation Plan (NAP); Climate vulnerability and Agriculture/Land Management Expert.*** IUCN West Asia Regional Office, funded by GIZ, Amman, Jordan, 2018.
19. ***Preparation of the Project Document for "Fourth National Communication and Second Biennial Update Report under the UNFCCC" project.*** United Nations Development Programme (UNDP), Jordan, 2018.
20. ***Comprehensive Assessment Report for the State of Methane and its Mitigation Potential in all relevant sectors and activities in Jordan*** Within the Project Title "Supporting National Planning for action on SLCPs - SNAP" and within the framework and funding of the Climate and Clean Air Coalition (CCAC), United Nations Environment Programme (UNEP), Ministry of Environment, 2017/2018.
21. ***Review, Prioritization and Monitoring of NDCs Implementation in Jordan*** within the International Climate Initiative "Policy dialogue and knowledge management on low emissions development strategies, in particular on renewable energies, in the MENA region" funded by GIZ 2016/2017.
22. ***Empowering Rural Women in the Jordan Valley / Piloting a Cultivation of Indigo-Bearing Crops in Ghor el Safi***, UNESCO, Jordan, currently in progress. 2014/2015, 2015/2016, and 2016/2018.
23. ***Ministry Strategy and Restructuring for the period 2016-2025*** for the Ministry of Agriculture at the Kingdom of Saudi Arabia, Jordan Society for Scientific Research on subcontract with PricewaterhouseCoopers (PwC), KSA, 2015.
24. ***Senior National Sustainable Land Management expert*** to support the Agricultural Resource Management Project Phase II (ARMP-II) PMU staff in their preparation of knowledge documents, Ministry of Agriculture, Jordan, 2015.
25. ***Agricultural Survey Study for Promotion of Soil and Irrigation Good Agricultural Practices in the Jordan Valley.*** Environmental Sustainability of Irrigated Agricultural Production in Lebanon and Jordan (ENSIAP), Istituto per la Cooperazione Universitaria Onlus (ICU), Jordan.
26. ***Survey for Wells' Contamination at Hussein Thermal Power Station (HTPS).*** Central Electricity Generation Company (CEGCO), Jordan, 2015.
27. ***Evaluation of medicinal use of clay minerals isolated from Jordan's clay soil,*** funded by the Scientific Research Support Fund, the Ministry of Higher Education, Amman, Jordan, 2014-2016.
28. ***Development of Interdisciplinary Programmes on Climate Change & Sustainability Policy*** (CLIMASP), Funded by TEMPUS and directed by the Hashemite University, 2014/2015.
29. ***Climate modelling and projection using historic and "Dynamic Downscaling" for Jordan***. Vulnerability and adaptation chapter of Third National Communication Report of Jordan to UNFCCC. IUCN West Asia Regional Office, UNDP, Jordan, 2014.
30. ***Developing Policy-Oriented Research Guidelines, Procedures, and Tools to Support Implementing Rio Conventions in Jordan***, UNDP, 2011.
31. ***Development of Adaptation Measures to Climate Change and Formulation of Needed Strategy Implementation Plan Relevant to Climate Change and IWRM for the Zarqa River Basin***, UNDP, 2010.
32. ***Investigating the Potential of Groundwater Pollution in Jordanian Vertisols using Contaminant Transport Models***, funded by the Deanship of Research, Hashemite University, Zarqa-Jordan, 2009.
33. ***Characterization of Soil Physical Properties within the Hashemite University Landscape***, funded by the Deanship of Research, Hashemite University, Zarqa, Jordan, 2005.
34. ***Assessing efficiency and upgrading the performance of the wastewater plant system at Hamoudeh Diary Farm***, 2006.
35. ***Jordan Valley Preliminary Land Use Master Plan Project***. Consolidated Consultants Engineering and Environment. Ministry of Water & Irrigation, Jordan Valley Authority, United States Agency For International Development (USAID), 2004.
36. ***Impact Assessment of Past Irrigation Practices on Soil Properties***. University of Jordan Centre for Consultation, GTZ, 1997.

WORKSHOPS FACILITATION AND MODERATION

1. ***Agriculture and Water Sector and Opportunities.*** Aseer Development Agency (ASDA), KSA, 2025.
2. ***The Perspective of Future Technologies for Soil Amendments***. Supported by NEOM, The Palladium Group, 23rd October 2022, Tabuk, KSA.
3. ***Climate Change Partners' Coordination Meeting***. Supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), NDC Partnership, and Ministry of Environment. 16th November 2020, Chemisty Business Center, Amman, Jordan.
4. ***Innovative Sanitation Solutions and Reuse in Arid Regions (ISSRAR), Launching Ceremony.*** Bremen Overseas Research and Development Association (BORDA), Swiss Agency for Development and Cooperation (SDC). Held on 7th February, 2019 at Fairmont Hotel Amman, Jordan.
5. ***Mainstreaming of the Ecosystem Services Approach and Networking among Universities of Jordan***. Ministry of Environment supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH(GIZ), on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), by implementing the project Sustainable Use of Ecosystem Services in Jordan (EKF-ESS). Hashemite University, Zarqa, Jordan, 17th August 2017.
6. ***The Second International Conference of "WASH and Construction"***. Swiss Agency for Development and Cooperation (SDC), Amman, Jordan, 14th-18th May 2017.
7. ***The Seventh Conference on Scientific Research in Jordan***. Middle East University, Amman, Jordan, October 2015.
8. ***The Regional Knowledge Network on Systemic Approaches to Water Resources Management project.*** The European Union, and directed by the International Union for Conservation of Nature and Natural Resources for West Asia –ROWA, 2014.
9. ***Social, Ecological and Agricultural Resilience in the Face of Climate Change Project (SEARCH)*** funded by European Union (EU) and directed by the International Union for Conservation of Nature and Natural Resources for West Asia –ROWA, 2014.
10. ***Assessment of Drought and Flood at Partners Countries of Sustainable Water Integrated Management (SWIM)***, European Union (EU), 2013/2014.
11. ***Water Integrity in the Middle East and North Africa*** as a part of the "Regional capacity building programme promoting and developing water governance and integrity in the MENA region for Arab countries" funded by the UNDP Water Governance Facility at SIWI (WGF) and directed by the International Union for Conservation of Nature and Natural Resources for West Asia –ROWA, 2014.
12. ***Josco Award and exhibition for Applied Scientific Research***. Jordan Company for oil shale initiative (JOSCO) in partnership with the Engineering Consultant Company, University, Zarqa, Jordan, October 2015.
13. ***The Sixth Conference on Scientific Research in Jordan***. Al-Zaytoonah University of Jordan, Amman, Jordan, Nov 2013.

ADVANCE TRAININGS TAUGHT

1. ***On-farm Fertilizers, Pesticides and Waste Management***. 17th of March 2021. Organized by the International Center for Biosaline Agriculture (ICBA) in partnership with the HSBC Bank and Smart Labour.
2. ***Preparing Organic Fertilizer from Agricultural Waste.*** 5th of March 2021. Organized by Jordan Agricultural Engineers Association, Amman, Jordan.
3. ***Regional Water Auditing***. 3rd of February 2021. Organized by FAO and IWMI under the framework of the SIDA funded regional project 'Implementing the 2030 Agenda for water efficiency/productivity, and water sustainability in NENA countries".
4. ***Characterizing and Assessing Research Quality for Scaling the Impact for Innovation and Development.*** 23rd January 2021, Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA), Amman, Jordan.
5. ***Modular Competency based Training Programs.*** 27-28 November 2020. Organized by Jordan Agriculture Engineers Association. Online, Amman, Jordan.
6. ***Engineering Applications of Geomatics' Training Course.*** 2nd to 13th September 2019. GEO4D Erasmus + Project, Politecnico di Milano, Lecco Campus, Italy.
7. ***BSAFE***. 19 August 2019. UNDSS.
8. ***E-learning and PBL (Problem Based Learning) pedagogy.*** 1st to 6th April 2019. GEO4D Erasmus + Project, University of Leon, Ponferrada, Spain.
9. ***GIS Training Course***. 18th to 29th June 2018. GEO4D Erasmus + Project, Politecnico di Milano, Lecco, Italy.
10. ***Curricular Development***. 19th to 23rd February 2018. GEO4D Erasmus + Project, University of Leon, Leon, Spain.
11. ***Managing Corruption Risks in Development Cooperation.*** March 2017, Swiss Agency for Development and Cooperation (SDC), Anti-Corruption Resource Centre, http://www.u4.no.
12. ***Sequestering National Adaptation Plan (NAP) Process.*** 27 February to 1 March 2017, Ministry of Environment in cooperation with GIZ, Jordan.
13. ***Advanced Security In The Field***. 22 October 2016, UNDSS.
14. ***Basic Security In The Field II***. 17 October 2016, UNDSS.
15. ***UNESCO Field Security Awareness Training 2012.***02/12/2016, UNESCO.
16. ***Capacity Building Program for the National Desertification, including reporting on strategic and operational objectives as well in the framework of the 10-Years Strategy of the UNCCD.*** IUCN West Asia Regional Office, 4-7 September 2014, Sharm Al Shaikh, Egypt
17. ***Understanding the Science of Environmental Governance and Building Capacity of Skills of Development of Environmental Polices and Strategies Related to Implementation of Rio convention in Jordan and Integration of Conventions' Provisions into National Development Planning***. February 2012, UNDP, Amman, Jordan.
18. ***Learning Management System, Virtual Class Room Class Capturing System, Authoring Tool***. 2011. E-Learning Center, 2011, Hashemite University, Zarqa, Jordan.
19. ***Building Online Course Using Blackboard***. E-Learning Center, 2004. Hashemite University, Zarqa, Jordan.
20. ***GIS Training Course*** – Arc/Info. 21st March to 1st April 1998. Jordan Arid Zone Productivity Project, University of Jordan, Amman.

PROFESSIONAL TRAININGS GIVEN

1. ***Quality Assurance and Quality Control (QA/QC) for Weather and Climate Data,*** Jordan Department of Meteorology (JMD), Amman, Jordan, 2022.
2. ***International Quality Assurance and Control (ISO-Based QA/QC) for Environmental and Analytical Data,*** International Plant Nutrition Institute (INPI), Irbid, Jordan, 2024.
3. ***Water, Energy, Food Production, and Ecosystem Health Management and Interactions in Aseer.*** Aseer Development Agency (ASDA), KSA, 23rd March 2025.
4. ***Land-Water-Plant Management through Advanced Climate-Smart Technologies with emphasis on Soil Amendments.*** 20-30 May 2023, The Palladium Group, NEOM, Tabuk, KSA.
5. ***Smart Irrigation.*** 12th May 2020, Jordan Agricultural Engineers Association, Amman, Jordan.
6. ***Managerial and Planning Skills for Technical Officials at DOAs.*** 22nd to 26th of October 2017, National Center for Agricultural Research and Extension (NCARE) funded by Japan International Cooperation Agency (JICA), Amman, Jordan.
7. ***Scientific Research from Basics to Application and Innovation.*** September 2017, Abdul Hameed Foundation-Arabic Bank, Amman, Jordan.
8. ***Preparation of International Contracts, Documentary Credits and Letter of Guarantee.*** September 2017. The Regional Centre on Agrarian Reform and Rural Development for the Near East (CARDNE) funded by Japan International Cooperation Agency (JICA), Amman, Jordan.
9. ***Training of Trainers Course on "Establishing and Strengthening Irrigation Water Users Associations".*** Canada funded project implemented by FAO with the technical support of PHG, 23rd to 27th April 2017, Amman, Jordan.
10. ***Impacts of Climate Change on Agriculture Sector and Food Security.*** November 2016. The Regional Centre on Agrarian Reform and Rural Development for the Near East (CARDNE) funded by Japan International Cooperation Agency (JICA), Amman, Jordan.
11. ***Drafting and Writing Projects and Raise External Funding.*** October 2016. The Regional Centre on Agrarian Reform and Rural Development for the Near East (CARDNE) funded by Japan International Cooperation Agency (JICA), Amman, Jordan.
12. ***Nexus: Agriculture, Energy, and Environment. Media Training Program for Journalists.*** June 2016. Broadcasting Board of Governors, Voice of America, Jordan Radio and Television Corp., Amman, Jordan.
13. ***Impacts of Climate Change on Food Security (Challenges and Opportunities).*** October 2015. The Regional Centre on Agrarian Reform and Rural Development for the Near East (CARDNE)funded by Japan International Cooperation Agency (JICA), Amman, Jordan.
14. ***Soil, Plant and Water Characteristic Important for Fertigation, Irrigation Scheduling for Open and Protected Agriculture, and Technology Transfer of Fertigation***, September 2015. International Plant Nutrition Institute (INPI), Irbid, Jordan.
15. ***Irrigation Management under Saline and Sodic Conditions*** September 2014. International Plant Nutrition Institute (INPI), Irbid, Jordan.
16. ***Irrigation Management at Farm Level.*** January 2014. Jordanian Association of Agricultural Engineers, Amman, Jordan.
17. ***Irrigation Management***. December 2013. Capacity Building through Training Modules for National Center for Agricultural Research and Extension (NCARE) Extension Agents & Staff. Held in the framework of the project ENSIAP - Improving the Environmental Sustainability of Irrigated Agricultural Production in Lebanon and Jordan. Istituto per la Cooperazione Universitaria Onlus (ICU), Jordan.
18. ***Plant Water Requirements***. September 2013. International Plant Nutrition Institute (INPI), Irbid, Jordan.
19. ***Arid Land Management& Climate Change.*** September 2013. International Plant Nutrition Institute, Irbid, Jordan.
20. ***Assessment of the Risks from Climate Change and Water Scarcity on Food Productivity***. 2012. FAO. Science Triangle for Research, Training and Management (STRTM).
21. ***Soil-Plant-Water Relationship, Evapotranspiration, Irrigation Scheduling and Estimation of Consumptive Use***. 2012. International Plant Nutrition Institute (INPI), Irbid, Jordan.
22. ***IWRM as an Adaptive System for Agricultural Production.***2012. UNESCO, Amman, Jordan.

23. ***Climate Change***. 2012. Jordanian Association of Agricultural Engineers, Amman, Jordan.
24. ***Micro-Irrigation Design Computer Applications.*** 2011. International Plant Nutrition Institute (INPI), Irbid, Jordan.
25. ***Advanced Irrigation Design***. 2010. Arabic Organization for Agriculture Development, Amman, Jordan.
26. ***Training in Soil Science for Ministry of Education***. 2010. Centre for Studies, Consultation and Community Services (CSCCS), Hashemite University, Zarqa, Jordan.
27. ***Methods of Irrigation: Open and Pressurized***. 2010. International Plant Nutrition Institute (INPI), Irbid, Jordan.
28. ***Evapotranspiration and Crop Coefficients.*** 2010. International Plant Nutrition Institute (INPI), Irbid, Jordan.
29. ***Irrigation Scheduling.*** 2010. International Plant Nutrition Institute (INPI), Irbid, Jordan.
30. ***Methods of irrigation: Open and pressurized***. 2009. International Plant Nutrition Institute (INPI), Irbid, Jordan.
31. ***Evapotranspiration and crop coefficients***. 2009. International Plant Nutrition Institute (INPI), Irbid, Jordan.
32. ***Irrigation Scheduling***. 2009. International Plant Nutrition Institute (INPI), Irbid, Jordan.
33. ***Soil Physical Characterization for Irrigation Design***. 2008. Fertigation and Irrigation. Technology Workshop, International Plant Nutrition Institute (INPI), Irbid, Jordan.
34. ***Estimation of Plant Water Consumptive Requirements***. 2008. Fertigation and Irrigation. Technology Workshop, International Plant Nutrition Institute (INPI), Irbid, Jordan.
35. ***Monitoring of Soil Water Plant System***. 2008. Fertigation and Irrigation. Technology Workshop, International Plant Nutrition Institute (INPI), Irbid, Jordan.
36. ***Irrigation Systems Efficiencies Control***. 2008. Fertigation and Irrigation Technology Workshop, International Plant Nutrition Institute (INPI), Irbid, Jordan**.**

ATTENDED CONFERENCES & WORKSHOPS

1. ***Jordanian Youth Climate Conference***. 7-8 August 2021. Green Generation Foundation, Liwan Youth Space, Amman, Jordan. Presenting the "***Modeling and expected impacts on climate change***".
2. ***The Supervisory Role of Private Desalination Plants between the Standard and Reality.*** 18th March 2021, Jordan Agricultural Engineers Association, Amman, Jordan.
3. ***Renewables Readiness Assessment (RRA) Jordan***, 22 February 2021, organized by the International Renewable Energy Agency (IRENA) in partnership with the Ministry of Energy and Mineral Resources (MEMR).
4. ***Nexus - Energy Security***, within the context of the development of the National Environment Strategy 2030. 26 November 2020. Amman, Jordan.
5. ***Strategic Thinking with Scenarios: Using Scenario Planning Techniques for Understanding the Cause-Effect Relationship of Complex Systems***. 23- 26 November 2020. UNDP, Aqaba City, Jordan.
6. ***Organic Farming in Jordan.*** 14th November 2021, Jordan Agricultural Engineers Association, Amman, Jordan.
7. ***Climate Change and its Impact on Biodiversity.*** 12th November 2021, Jordan Agricultural Engineers Association, Amman, Jordan.
8. ***The Debate on Future Strategies to cope with Agricultural Water Scarcity and Climate Change.*** 5th November 2020. The Islamic World Academy of Sciences (IAS) and Association of Agricultural Research Institutions in the Near East & North Africa (AARINENA).
9. ***The publishing landscape in the Arab World***. 22 June, 2020. Researcher Academy On Campus. at AARU, Elsevier.
10. ***Airborne LiDAR Practical Applications.*** 8th March 2020. GEO4D Co-funded project, Erasmus +, Eurpean Union, The Hashemite University, Zarqa, Jordan.
11. ***Project for the preparation of the fourth national communications report and the second emission update. Project launch ceremony.*** 5th August 2019, Ministry of Environment and funded by UNDP and GEF, Amman, Jordan.

12. ***Building Capacity for International University Cooperation and Research Collaboration.*** 24-26 June 2019. International Conference and Workshop, U.S.- Jordanian University Cooperation Network (UCN), University of Jordan, Amman, Jordan.
13. ***National High Level Workshop for Supporting National Action and Planning on Short-Lived Climate Pollutants SNAP on (SLCPs) project***. 18th April 2019. Grand Hayat Hotel, UNEP, Ministry of Environment, Amman, Jordan.
14. ***First National Conference on Environment and Development in Jordan.*** 6-7 November 2018. GEF, UNDP, GoALWaSH, UNDP, Amman, Jordan.
15. ***The Eighth Scientific Agricultural Conference (ESAC).*** 15-17th October 2018. Mutah University, Karak, Jordan.
16. ***NAP Communication Plan Focus Group meeting.*** 11th October 2018. GIZ, Amman, Jordan.
17. ***First Jordanian International Agricultural Forum and Exhibition***. 25thApril 2018. King Hussein Bin Talal Convention Center, Dead Sea, Jordan.
18. ***Outline and Scope of the NAP Document for Jordan.*** Stakeholders' Consultation Workshop. (26th to 27th March 2018). Ministry of Environment in cooperation with GIZ, Movenpick Hotel, Dead Sea, Jordan.
19. ***Jordan Water Day*** (20th March 2018). Department of Water Management and Environment, Faculty of Natural Resources and Environment, The Hashemite University, Zarqa Jordan
20. ***Jordan Forest Week.***14th March 2018. Organized by the Alliance of Forests Societies and the Hashemite University, The Hashemite University, Zarqa Jordan.
21. ***Jordan Zero Hunger Strategic Review***. Stakeholders' Consultation Workshop. 8th February 2018. World Food Programme (WFP) in corporation with Higher Council for Science and Technology, Amman, Jordan.
22. ***Enhancing the Capacities for Disaster Risks Reduction and for National Crisis Management Including the Coordination of International Response in Jordan*** (December 2017 – May 2019). 5th February 2018. Twinning Project "Towards a Resilient Society" between Ministry of Planning and International Cooperation of the Hashemite Kingdom of Jordan and the Administration of the Republic of France (Ministry of Interior – General Directorate for Civil Protection and Crises Management) and the final recipient of the action in Jordan Civil Defence General Directorate, Amman, Jordan.
23. ***National Adaptation Planning in Jordan: Current Situation and Future Areas of GIZ Support***. 29th August 2017, Ministry of Environment in cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), Amman, Jordan.
24. ***NAP Training and Stocktaking Workshop for the National Adaptation Plan (NAP) Process in Jordan.*** 27thFebruary to 1stMarch 2017, Ministry of Environment in cooperation with the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH(GIZ), Dead Sea, Jordan.
25. ***National Workshop on NDCs Review and Implementation: Prioritizes and Future Steps. February*** 7th 2017. GIZ, Ministry of Environment, Amman, Jordan.
26. ***Setting National Land Degradation Neutrality Targets for Jordan, Inception Workshop.*** January 19th 2017, Ministry of Environment, Amman, Jordan.
27. ***Climate Change Technology Needs Assessment (TNA), National Workshop no. IV (TAPs Development).*** 18-19 December, 2016, AlMakan, Ministry of Env., UNEP DTU, Dead Sea, Jordan.
28. ***Jordan NDCs review and prioritization and the Climate Action Road After COP 22.*** November 28th, 2016. GIZ, Ministry of Environment, Amman, Jordan.
29. ***Climate Change COP22: Jordan's investment and private sector opportunities.*** October 27th, 2016. EDAMA, GIZ, Amman, Jordan.
30. ***From Paris to Marrakech: Expectations from COP 22 and Jordanian Perspectives***. 9th October 2016. Ministry of Environment, GIZ, Amman, Jordan.
31. ***Yarmouk River Hydropolitical Baseline***. 28th May 2016. Swiss Development. Swiss Development Corporation, Water Security Research Centre / School of International Development at the University of East Anglia. Amman, Jordan.
32. ***Climate Change Technology Needs Assessment (TNA),*** National Workshop no. III (Barrier Analyses and Enabling Framework). 10-11 May, 2016, AlMakan, Ministry of Env., UNEP DTU, Dead Sea, Jordan.
33. ***Rio Conventions in the Development Sectors Project – (RIO).*** Consultive Workshop with National Rio Committees' Members. 20th April 2016. Ministry of Env., GEF, UNDP.

34. ***Climate Change and Paris Agreement "From Paris to Amman"***, 15th Feb. 2016, UNDP, MoEnv, Amman, Jordan.
35. ***INDCs Implementation in Jordan and the Post Paris Roadmap***. 9th Feb. 2016, GIZ, Amman, Jordan.
36. ***Climate Change Technology Need Assessment (TNA) Project***. 17th November 2015. Ministry of Environment, UNEP DTU Partnership, AlMakan, Amman, Jordan.
37. ***Quality Assurance Standards Guide for Agriculture Science Program***. January 2016. Higher Education Accreditation Commission, Amman, Jordan.
38. ***Predicting Future Climate Change at the Hashemite Kingdom of Jordan***. Within Conference titled "Climate Change: Status and Challenges". Jordanian Agriculture Engineering Association, Amman, Jordan, 2/9/2015.
39. ***Jordanian Experience with Climate Change Studies***, within MAPEC annual workshop, University of Jordan, Amman, Jordan, 1/9/2015.
40. ***National Conference for National Master Plan to Rehabilitate the Jordan River Valley***. 9th May, 2015. Ministry of Water and Irrigation, Royal Haskoning DHV, EcoPeace Middle East, SIWI, GNF, EU. Crown Plaza Hotel, Dead Sea, Jordan.
41. Dynamic Downscaling of climate change scenarios for Jordan, within ***Workshop on Development Of Statistical Downscaling of Climate Change Scenarios***, Corp Executive Hotel, Amman, Jordan, 14-16/12/2014.
42. ***Workshop for Advisory Studies to update the national strategy and action plan to combat desertification and the update of the national strategy and the action plan for biodiversity in Jordan.*** Including the preparation of the Fifth National Report (2014) of the United Nations Convention on biodiversity (UNCBD), and Preparation of Fourth National Report (2012) and Fifth National Report (2014) of the United Nations Convention to Combat Desertification (UNCCD). 14th of August, 2014. Ministry of Environment, Amman, Jordan.
43. ***Third National Communication Project "Vulnerability and Adaptation" Chapter, Results Dissemination Workshop.*** June 2014, Ministry of Environment, Amman, Jordan.
44. ***Third National Communication Project "GHG Inventory", Results Dissemination Workshop.*** August 2013, Ministry of Environment, Amman, Jordan.
45. A workshop to present the results of a public opinion titled "***Measuring knowledge of climate in Jordan***". Ministry of Environment in cooperation with Royal Scientific Society and UNDP, September 2013, Amman, Jordan.
46. The launch workshop for "***National Climate Change Policy for the Hashemite Kingdom of Jordan***". Ministry of Environment in cooperation with National Energy Research Center and UNDP, May 2013, Amman, Jordan.
47. ***Climate Change Impacts on Ecosystems Biodiversity.*** The Royal Society for Conservation of Nature. February 2013, Amman, Jordan.
48. ***The integrated Ecosystem Management in the Jordan Rift Valley Project***, 2012, RSCN, Amman, Jordan.
49. ***Developing a National Climate Change Policy for the Hashemite Kingdom of Jordan***, Developing Policy-relevant Capacity for Implementation of the Global Environmental Conventions in Jordan "CB2" Project, November 2012, UNDP, Amman, Jordan.
50. ***Enabling Activities for the Preparation of Jordan's 3rd National Communication Report to UNFCCC***, 2012, UNDP, Amman, Jordan.
51. ***Protoype Display Workshop for CB-2 Project's Virtual Platform and Jordan Environmental Information System (JEIS)***, 2012, UNDP, Amman, Jordan.
52. ***Developing Policy-Oriented Research Guidelines, Procedures, and Tools to Support Implementing Rio Conventions in Jordan***, 2012, FAO, Amman, Jordan.
53. ***Strategy of Adaptation of Biodiversity to Climate Change in Jordan***, 2012, RSCN, Amman, Jordan.
54. ***Assessment of the risks from Climate Change and Water Scarcity on Food Productivity***. 2012, FAO, Amman, Jordan.
55. ***Development of Adaptation Measures to Climate Change and Formulation of Needed Strategy Implementation Plan Relevant to Climate Change and IWRM for the Zarqa River Basin***, 2011, UNDP, Amman, Jordan.

Preparatory and Scientific Organizing Committees for Conferences and Workshops

1. Preparatory Committee Member of the Scientific Day titled "***The Mainstreaming of the Ecosystem Services Approach and Networking among Universities of Jordan***", 17th August 2017, Ministry of Environment, supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ), on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), Hosted at the Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
2. Preparatory Committee Member of the Scientific Day for the Faculty of Natural Resources and Environment titled "***GIS and RS Applications in Natural Resources Management***", 13 April 2017, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
3. Preparatory Committee Member of the Seventh Scientific Day for the Faculty of Natural Resources and Environment titled "***Petroleum Resources in Jordan***", 9thApril 2013, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
4. Preparatory Committee Member of the Sixth Scientific Day for the Faculty of Natural Resources and Environment titled "***Climate Change in Jordan and its impacts on Human and Environment***", 24-25thMarch 2012, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
5. Preparatory Committee Member of the conference "***Fifteenth World Conference of Vulcanospeleogy***", 15thMarch 2012, Center for Environmental Studies (CES), Hashemite University, Zarqa, Jordan.
6. Scientific Evaluation Committee Member of "***The Second Zarqa Scientific Engineering***" Workshop, 24-25 November 2010, Engineering Association, Private Zarqa University, Zarqa, Jordan.
7. Preparatory Committee Member of the Fifth Scientific Day for the Faculty of Natural Resources and Environment titled "***Recycling in Jordan: a National Need***", 14-15 April 2009, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
8. Preparatory Committee Member of the Workshop "***Jojoba Trees-The Golden Green***", 26 October 2008, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
9. Preparatory Committee Member of the Fourth Scientific Day for the Faculty of Natural Resources and Environment titled "***Sustaining and Developing Water Resources in Jordan***", 22 April 2008, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
10. Preparatory Committee Member of the Third Scientific Day for the Faculty of Natural Resources and Environment titled "***The GIS Role in Planning Cities and Land Use***", 11-13 December 2007, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
11. Preparatory Committee Member of the Workshop "***Renewable Energy in Jordan***", 8-12 May 2007, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
12. Preparatory Committee Member of the Workshop "***The 6th Agricultural Scientific Conference***", 9-12 April 2007, Faculty of Agricultural, University of Jordan, Amman, Jordan.
13. Preparatory Committee Member of the Workshop "***Environment and Sustainable Development***", May 24th 2006, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
14. Preparatory Committee Member of the Second Scientific Day for the Faculty of Natural Resources and Environment titled "***The Role of Environmental Geological Sciences in Sustaining the Economy of Jordan***", 3-5 December 2006, Hashemite University, Zarqa, Jordan.
15. Preparatory Committee Member of the Workshop "***The Energy in Jordan, Current and Future***", 1 November 2005, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
16. Preparatory Committee Member of the 5th Agricultural Scientific Conference, (12 – 15) May 2005, Under the theme: "***Towards Sustainable Agriculture in the Arabic World***", The Faculty of Agricultural Technology, At Al-Balqa' Applied University, Al-Salt, Jordan.
17. Preparatory Committee Member of the "***Environmental Week***", 3-6 May 2004, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.

PUBLICATIONS

1. Mohammed A. Tabieh, Emad K. Al-Karablieh, Amer Z. Salman, Tala Qtaishat, Nael Thaher, Mohammed Al-Qinna, Nehaya Al-Karablieh, Madi Al-Jaghbir, Khaleda Al-Ghazawi, Haitham Aladaileh, Ahmad Jamrah. ***An Economic Assessment of Fresh Water Reallocation by Treated Wastewater for Irrigation in Northern Jordan Valley***. 2024. Preprints Organization. doi: 10.20944/preprints202408.1260.v2(An Economic Assessment of Fresh Water Reallocation by Treated Wastewater for Irrigation in Northern Jordan Valley[v2] | Preprints.org)
2. Al-Qawasmi, O., Alrousan, D., Al-Qinna, M., and Masad, M. 2025. Exposure effect of magnetic field on olive mill wastewater properties. Int. J. Environ. Sci. Technol. https://doi.org/10.1007/s13762-024-05756-9
3. Hasan Salem Alkhaza'leh, Ahmad Moh'd Abu-Awwad, and Mohammed Ibrahim Al-Qinna. 2023. ***Effect of Irrigation with Treated Wastewater on Squash Yields, Soil Chemical and Microbial Properties***. Jordan Journal of Agricultural Sciences, Volume 19, No. 2, 2023, DOI: https://doi.org/10.35516/jjas.v19i2.164.
4. Ibrahim Al-Hasani, Mohammed Al-Qinna, and Nezar Atalla Hammouri. 2023. ***Potential Impacts of Climate Change on Surface Water Resources in Arid Regions Using Downscaled Regional Circulation Model and Soil Water Assessment Tool, A Case Study of Amman-Zerqa Basin, Jordan***. Climate 2023, 11, 51. https://doi.org/10.3390/cli11030051
5. Nabeel Bani Hani, Fakher J. Aukour, and Mohammed I. Al-Qinna. 2022. ***Investigating the Pearl Millet (Pennisetum glaucum) as a Climate-Smart Drought-Tolerant Crop under Jordanian Arid Environments***. Sustainability 2022, 14, 12249. https://doi.org/10.3390/ su141912249.
6. Mashal, K.; Ali, Y.; Al-Qinna, M.; Salahat, M.; Al-Degs, Y.S. 2022. ***Spatial distribution of sulfur accumulation in urban dust and its societal implications in Al Hashemiya, Jordan.*** Environmental Quality Management, 31(3): 79-87. DOI: 10.1002/tqem.21755.
7. Jawad Al-Bakri, Ibrahim Farhan, Mohammed Al-Qinna, Emad Al-Karablieh, Karim Bergouli, Rachael McDonnell. 2021. ***Assessment of Climate Changes and Their Impact on Barley Yield in Mediterranean Environment Using NEX-GDDP Downscaled GCMs and DSSAT***. Earth Systems and Environment, Springer. Accepted: 11 June 2021, Published online 16 June 2021, https://doi.org/10.1007/s41748-021-00238-1
8. Ayat Al Qudah, Munir J. Rusan, Mohammed I. Al-Qinna, and Fayez A. Abdulla. 2021. ***Climate change vulnerability assessment for selected agricultural responses at Yarmouk River Basin Area, Jordan***. Mitigation and Adaptation Strategies for Global Change, (2021) 26:3. https://doi.org/10.1007/s11027-021-09944-7
9. Qtaishat, T. H., AlAdaileh, H., El-Habbab, M. S., Al-Qinna, M., and Emad K. Al-Karablieh. 2019. ***Drought Management Policies and Institutional Mandate in Jordan.*** 1st International Conference on Sustainable Energy-Water-Environment Nexus in Desert Climate – QEERI, December 2019.
10. Haitham AlAdaileh, Mohammed Al-Qinna, Károly Barta, Emad Al-Karablieh, János Rakonczai, Adel Alobeiaat. 2019. ***A Drought Adaptation Management System for Groundwater Resources Based on Combined Drought Index and Vulnerability Analysis.*** Earth Systems and Environment, 3:445–461. https://doi.org/10.1007/s41748-019-00118-9
11. Haitham AlAdaileh, Mohammed Al-Qinna, Károly Barta, Emad Al-Karablieh, Jawad Al Bakri, János Rakonczai. 2019. ***Applicability of a Combined Drought Index to Monitoring Drought in Jordan.*** Journal of Engineering Research and Application, 9(7) (Series -VI) July 2019, pp 20-39. DOI: 10.9790/9622- 0907062039.
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13. Jafar S.A. Abu-Rajab, Ali R.A. El-Naqa, Mohammed I. Al-Qinna. 2018. ***Hydrogeophysical characterization of shallow LNAPL contamination at a karst aquifer.*** Near Surface Geophysics, 16: 643-662. Doi: 10.1002/nsg.12021

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15. Mohammed I. Al-Qinna. 2018. ***Analyses of Climate Variability in Jordan using Topographic Auxiliary Variables by the Cokriging Technique.*** Jordan Journal of Earth and Environmental Sciences (JJEES), 9(1):67-74.
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18. Salahuddin M. Jaber and Mohammed I. Al-Qinna. 2017. ***TM-Based SOC Models Augmented by Auxiliary Data for Carbon Crediting Programs in Semi-Arid Environments.*** Journal of Photogrammetric Engineering and Remote Sensing, 83(6): 447-457
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20. Taiseer Aljazzar, and Mohammed Al-Qinna. 2016. ***Assessment of nitrate transport parameters using the advection-diffusion cell***. Environ Sci. Pollut Res., 23(22):23145–23157. DOI 10.1007/s11356-016-7457-8.
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37. Mohammed I. Al-Qinna, Nezar A. Hammouri, Mutewekil M. Obeidat, Fayez Y. Ahmad. 2011. ***Drought Analysis in Jordan under Current and Future Climates.*** Journal of Climatic Change, 106(3):421-440.

38. Mohammed I. Al-Qinna. 2010.***The Main Structure and Land Use in Plant-Agricultural Holdings*.** Analysis Results of the Agricultural Census, 2007, Department of Statistics.

39. Abeer Salman, Khalil M. Ibrahim, Ghazi Saffarini, and Mohammad Al-Qinna. 2009. ***Geostatistical Calculation for Clay Reserve in Azraq Basin in Jordan.*** Journal of Geography and Regional Planning, 2(5):144-153.

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44. Mohammed I. Al-Qinna. 2005. ***Potential of Groundwater Contamination of Karstic Aquifer: A Case Study.*** Proceeding of the workshop of Aquifer Vulnerability & Risk in Jordan, UNESCO, Hashemite University, Zarqa, Jordan, 158-212.

45. M. Al-Qinna, H.D. Scott and V. Brahana, 2005.***Characterization of Solute Transport in Pedons within Mantled Karst Landscape.*** The 5th Agricultural Scientific Conference, (12 – 15) May 2005, Under the theme: "*Towards Sustainable Agriculture in the Arabic World*", The Faculty of Agricultural Technology, At Al-Balqa' Applied University, Al-Salt, Jordan.

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48. M. Al-Qinna, A. Mauromoustakos, and H.D. Scott. 2002. ***Use of JMP Version 5 for Teaching and Research of Applied Stat/Math Methods in Life Sciences.*** Annual Meetings Abstracts. ASA-CSSA-SSSA. Indianapolis, USA.
49. Mohammed Qinna and A.M. Abu-Awwad. 2001. ***Wetting Patterns under Trickle Source in Arid Soils with Surface Crust.*** J of Agriculture Engineering Research. 80(3):301-305.
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51. Mohammed Qinna and A.M. Abu-Awwad. 1998. ***Infiltration Rate Measurements in Arid Soils with Surface Crust.*** Irrigation Science. 18: 83-89.

BOOKS' AUTHOR AND COAUTHER

1. Mohammed I. AL-Qinna. Data Mining**,** developed for the *GEO4D Master Program in Geodesy and Land Management*, Erasmus+ 2021.
2. Mohammed Al-Qinna. ***Geospatial Strategy for Ministry of Environment, Water, and Agriculture***, Ministry of Environment, Water, and Agriculture, Riyadh, KSA.
3. Mohammed Al-Qinna. ***Soil Amending Manual***. NEOM, KSA.
4. Mohammed Al-Qinna. ***Jordans' Fourth National Communication on Climate Change***. July 2023. Submitted to UNFCCC, MoEnv, Funded by UNDP, Amman, Jordan.
5. Mohammed Al-Qinna. April 2022. ***National Climate Change Policy of The Hashemite Kingdom Jordan 2022-2050***. MoEnv, Funded by UNDP, Amman, Jordan.
6. Mohammed Al-Qinna. April 2017. Training Manual in ***Establishing and Strengthening Irrigation Water Users Associations.*** Part of the Canada funded project: "Support economic growth through optimized agricultural value chains in the West Bank" implemented by FAO with the technical support of PHG, Amman, Jordan.
7. Mohammed Al-Qinna. October 2016. Training Manual in ***Drafting and Writing Projects and Raise External Funding.*** Third Country Training Programme (TCTP), Capacity Development for Agriculture and Rural Development in the Republic of IRAQ, Extension of Modern Agriculture Technology in Iraq, Ministry of Agriculture, Republic of IRAQ, CARDNE and JICA, Amman, Jordan.
8. Mohammed Al-Qinna. October 2015. Training Manual in ***Impacts of Climate Change on Food Security (Challenges and Opportunities).*** Third Country Training Programme (TCTP), Capacity Development for Agriculture and Rural Development in the Republic of IRAQ, Extension of Modern Agriculture Technology in Iraq, Ministry of Agriculture, Republic of IRAQ, CARDNE and JICA, Amman, Jordan.
9. Mohammad Al Qinna, Downscaling and Climate Projections at the Vulnerability and Adaptation chapter within the ***Jordan's Third National Communication on Climate Change*** (2014). Submitted to The United Nations Framework Convention on Climate Change (UNFCCC). The Hashemite Kingdom of Jordan the Deposit Number at the National Library (2014/11/5178). Ministry of Environment and United Nations Development Programme, Amman, Jordan.
10. Mohammad Al Qinna, Climate Change component expert within ***Policy-oriented National Priority Research Topics in Climate Change, Biodiversity, and Combating Desertification (2013-2020) with Guidelines, Procedures, Tools and Potential Funding Sources to Support their Implementation in the Hashemite Kingdome of Jordan.*** A Knowledge Product of "Developing Policy-relevant Capacity for Implementation of the Global Environmental Conventions in Jordan" "The CB-2 Project" February 2013. The Hashemite Kingdom of Jordan the Deposit Number at the National Library (2013/2/466). Ministry of Environment and United Nations Development Programme, Amman, Jordan.
11. Mohammed Al-Qinna. December 2013. Training Manual in ***Irrigation Management***. Capacity Building through Training Modules For NCARE Extension Agents & Staff. Held in the framework of the project ENSIAP - Improving the Environmental Sustainability of Irrigated Agricultural Production in Lebanon and Jordan. Istituto per la Cooperazione Universitaria Onlus (ICU), Jordan.

12. Mohammed Al-Qinna, Climate Change component expert within ***Adaptation to Climate Change in The Zarqa River basin: Development of policy options for adaptation to Climate Change and Integrated water resources management (IWRM)***. December, 2012. Ministry of Environment and United Nations Development Programme, Amman, Jordan.
13. Abu-Awwad and Mohammed Al-Qinna. 2001. ***Soil and Irrigation Laboratory Manual***. High School Textbook for Agriculture Sector. Ministry of Education, Amman, Jordan.

Journal Reviewing & Evaluation Experience

1. Assistant Editor of the Jordan Journal of Earth and Environmental Sciences (JJEES)
2. Peer reviewer for the following Journals:
   - Soil Science Society of America
   - Soil Research
   - Journal of Arid Environments
   - Arabian Journal of Geosciences
   - Journal of Applied Sciences
   - Journal of Atmosphere
   - Journal of Hydrology and Earth System Sciences
   - Journal of Environmental Management
   - Jordan Journal for Agricultural Sciences
   - Jordan Journal of Earth and Environmental Sciences
   - Mutah Lil -Buhuth Wad-Dirasat

Supervised M.Sc. & Ph.D. Thesis

1. ***Assessing The Hydrologic Vulnerability to Climate Change Impacts at Amman- Zarqa Basin, Jordan (Committee member).*** By M.Sc. Rihan Ahmad Al Saodi. January 2022. Master Degree of Environmental Technology and Climate Changes, Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
2. ***Measurements of the Aerosol Particles Concentrations Emitted from Indoor Kerosene Heaters (Committee member).*** By M.Sc. Nezar Maher Albqour. August 2021. Degree of (Master of Science) in Physics, Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
3. ***Soil Erosion Assessment and Control in Wadi Mujib Using GIS and Remote Sensing (Co-advisor).*** By M.Sc. Heba Saleh Tayseer AL-Malkawi. August 2021. Degree of (Master of Science) in Applied Geology, Faculty of Graduate Studies, the Hashemite University, Zarqa, Jordan.
4. ***Impact of TWW on Soil and Crops Irrigated Using Drip and Sprinkler Systems (Committee member).*** By Ph.D. Rola N. Rawashdeh. July 2021. Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
5. ***An Investigation for Aerosols Concentrations inside Selected Jordanian Indoor Environments (Committee member).*** By M.Sc. Ali Ameer Hisham Alwahsh. April 2021. Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
6. ***Assessment of Nitrate Leaching to Zarga River by Soil Water Assessment Tool (SWAT) Model (Committee member).*** By Ph.D. Rafa'a Khaled M. Abu Qaoud, December, 2020. Doctor of Philosophy Degree in Agriculture, Faculty of Graduate Studies, The University of Jordan, Amman, Jordan.
7. ***Spatial evaluation of soil texture using remote sensing techniques in Al Mafraq area- Jordan (Committee member).*** By M.Sc. Anas Ahmad Al-Yamani, August 2020. Master Program in Applied Geology, Deanship of Graduate Studies, Alalbayt University, Mafraq, Jordan.
8. ***Sequential fractionation of inorganic phosphorus of calcareous soils in Jordan. (Committee member).*** By M.Sc. Faris Fayyad Kamel AlShayeb, July 2020. Master in Climate Change and Dry Land Sustainability, Faculty of Graduate Studies, Hashemite University, Zarqa, Jordan.
9. ***An Environmental Study for the Effect of Sodium Adsorption Ratio with Flocculation-Dispersion on the Infiltration Capacity in North West Irbid of Jordan (Committee member).*** By M.Sc. Faten Khalife Abdel

Qader, December 2019. Master Program of Water Resources and Environment, Deanship of Graduate Studies, Alalbayt University, Mafraq, Jordan.

10. ***GIS and DRASTIC Model for Mapping and Assessment Groundwater Vulnerability to Contamination in Wadi Shuaib Basin, Jordan (Committee member).*** By Ph.D. Hassan Thabet Mohammed Khrisat, December 2019. Faculty of Graduate Studies, University of Jordan, Amman, Jordan
11. ***Simulation of Radioactive Pollution Emission Transport and Human Impacts during Hypothetical Accident Scenarios in a Nuclear Power Plant according to Jordanian Environmental Conditions (Committee member).*** By Ph.D. Marwan Mohammad Al-Kloub, December 2019. Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
12. ***Climate Change Vulnerability Index for Agriculture Sector in Yarmouk River Basin Area (committee member).*** By M.Sc. Ayat Said AL Qudah. November, 2019. Department of Natural Resources and Environment, Faculty of Agriculture, Jordan University of Science and Technology, Irbid, Jordan.
13. ***Improvement of Engineering Properties of Lightweight Concrete Using Geopolymers (Committee member).*** By By M.Sc. Farah Mahmoud Mousa Washah, November 2019. Department of Water Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
14. ***Effect of Using Raw Olive Wastewater (OMW) and Olive Solid Waste (OSW) on Selected Soil Properties (Co-advisor).*** By M.Sc. Entethar Ali Salem Al-Shakhatrah, November 2019. Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
15. ***Influence of Different Irrigation Water Types and Levels on Panicum Maximum (guinea grass) Germination and Yield as a Climate Change Mitigation Measure (committee member).*** By M.Sc. Khadija Sameh Shaker Khamish, November 2019. Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
16. ***Deforestation Effects on Physical and Chemical Properties in Ajloun, Northwestern Jordan (committee member).*** By M.Sc. Lima Mryan. August, 2019. Department of Natural Resources and Environment, Faculty of Agriculture, Jordan University of Science and Technology, Irbid, Jordan.
17. ***Study of the efficiency of the use of irrigation water in the district of Sarhan Governorate Mafraq (Co-advisor).*** By M.Sc. Nasser Mostafa Mohammed Hassan, July 2019. Master Program of Water Resources and Environment, Deanship of Graduate Studies, Alalbayt University, Mafraq, Jordan.
18. ***Investigating the potential use of the Dimensionless Temperature as a new drought index (Committee member).*** By Ph.D. Sfa'a Ayyash, July 2019. Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
19. ***Particulate matter concentrations in Amman and Zarqa based on mobile setup (Committee member).*** By Ph.D. Shatha Suleiman Ahmad Ali Saleh, July 2019. Department of Physics, Faculty of Sciences, University of Jordan, Amman, Jordan.
20. ***Investigating Amman's residential landscape plant diversity: implications for conservation of valuable plant species (Committee member).*** M.Sc. Amani Muhammed Al-Kafawin, July 2019. Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
21. ***Development of a Geospatial- Based Combined Index for Drought Over Jordan (Committee member).*** By Ph.D. Maram Jameel Al Naimat, April 2019. Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
22. ***Investigating Spatial and Temporal Variability of Selected Climatic Variables in Jordan Using Advanced Mathematical Modeling Techniques (Advisor).*** By M.Sc. Lana Bassam Al-Fraihat, February 2019. Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan. 2.
23. ***Reclamation of Saline-Sodic Soils by Gypsum and Compost (Committee member).*** By M.Sc. Areen Salah Sharaf, February 2019. Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
24. ***Fine Aerosol Concentrations Daily Pattern Differences Between Spring and Autumn in the Urban Background Atmosphere of Amman (Committee member).*** By M.Sc. Zain M.H. Shelbayeh, December, 2018. Department of Physics, Faculty of Sciences, University of Jordan, Amman, Jordan.

25. ***Effectiveness of Continuous Contour Ridges and Intermittent Trenches Constructed Using the Vallerani in Water Harvesting in Arid Lands (Committee member).*** By Ph.D. Kifah, December, 2018. Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
26. ***Changes in Land Productivity as A Parameter for Achieving Land Degradation Neutrality in Jordan (committee member).*** By M.Sc. Shadi Awni Abdelrahman Al-Shawabkah, July, 2018. Department of Natural Resources and Environment, Faculty of Agriculture, Jordan University of Science and Technology, Irbid, Jordan.
27. ***Assessment of Remote Sensing Indices for Drought Monitoring in North of Jordan*** (***committee member).*** By Ph.D. Ibrahim A. Farhan, May 2018. Department of Land, Water and Environment, Faculty of Agriculture, University of Jordan, Amman, Jordan.
28. ***Potential Impacts of Climate Change on Surface Water Resources of Amman-Zarqa Basin using Downscaled Regional Circulation Model and Soil Water Assessment Tool (Co-advisor).*** By M.Sc. Ibrahim Khalil Al-Hassani, April 2018. Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
29. ***Phytoremediation of Contaminated Soil with Polycyclic Aromatic Hydrocarbons Using Helianthus annuus (Committee member).*** By M.Sc. Ismail Ahmad Alhuniti, January 2018. Master Program of Climate Change and Dry Lands Sustainability, Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
30. ***Simulation and adaptation measures of the impact of climate change on barley productivity in Jordan (committee member).*** By Ph.D. Hiba Mashhour AL-Kharabsheh, August 2017. Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
31. ***Investigation for Spatial Distribution of Some Soil Chemical Elements at al Hashimeyeh Municipality (Co-advisor).*** By M.Sc. Imran Mahmoud Al - Harrahsheh, July 2017. Master Program of Climate Change and Dry Lands Sustainability, Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
32. ***Climate Change Vulnerability Analysis of "Al Salt Village" based on Community Assessment (Co-Advisor)***. By M.Sc. Hala Mohammed Jamil Abdallat, April 2017. Master Program of Climate Change and Dry Lands Sustainability, Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
33. ***Vegetation Responses in Open Access Areas and Exclosure Areas at Yarmouk Protected Area in Northern Jordan*** (committee member). By M.Sc. Aladdin Omar Abdallah Al-Hiyasat, April 2017. Master Program of Climate Change and Dry Lands Sustainability, Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
34. ***Investigation the Surface Water Contamination and Fate in the Eastern Region of Lower Jordan River (Advisor).*** By M.Sc. Zainab S. Abu Zaid, 2016. Master Program of Climate Change and Dry Lands Sustainability, Department of Land Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
35. ***Future prediction of Climate Variables Using Advanced Statistical Methods (Advisor).*** By M.Sc. Mostafa Shokri Al-Sawalhah, 2016. Department of Earth & Environment Sciences, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
36. ***Investigating the Spatio-Temporal Changes of NDVI with relationship of some climatic variables using Remote Sensing and Geographical Information System techniques at Yarmouk Basin (Co-Advisor).*** By M.Sc. Heba Mohammed Amin Abu Alassal, 2016. Department of Earth & Environment Sciences, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
37. ***Evaluation and Conform the Treated Greywater from Different Systems to Jordan Reclaimed Greywater Standards JS1776:2013*** (committee member), by M.Sc. Ola T. Al-Qawasmi. December 2015. Environmental Science and Management Master Program, Department of Water Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
38. ***Developing a Forecast Model to Estimate Instantaneous Troposphere Ozone Based on Air Temperature*** (committee member), by M.Sc. Khitam Mansour Edibat. December 2015. Environmental Science and Management Master Program, Department of Water Management and Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.

39. ***Impacts of Climate Change on Water Resources in Mujib Basin Using Statistical Downscaling Techniques Based on Various General Circulation Models (GCMS) Experiments*** (committee member), by M.Sc. Moh'd Kotaiba Mohammad Abugazleh. August 2015. Faculty of Graduate Studies, University of Jordan, Amman, Jordan.
40. ***An Integrative Approach for Modeling Surficial Uranium Deposits at Central of Jordan, Siwaqa Area*** (committee member), by M.Sc. Samer Hmoud. May2015. Department of Earth & Environment Sciences, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
41. ***Impacts of Treated Wastewater on Some Soil Properties and Production of Gladiolus communis*** (committee member), by M.Sc. Heba Ibrahim Hasan. December 2012. Department of Land, Water and Environment, Faculty of Agriculture, University of Jordan, Amman, Jordan.
42. ***Assessment of Climate Change Impacts on Water Resources in Mujib Basin (Central Jordan)*** (committee member), by M.Sc. Mohammed Jaber. July 2012. Department of Water Management & Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
43. ***Developing a National Environmental Management Plan for Controlling Leishmaniasis in Syria using GIS and Remote Sensing*** (committee member), by M.Sc. Nafan. May 2012. Department of Water Management & Environment, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
44. ***Measurement of Natural Radioctivity concentration levels in soil samples in Al Hashemyah-Asokhna Region*** (committee member), by M.Sc. Laith H. Al-Qudah. May 2012. Department of Earth & Environment Sciences, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
45. ***Evaluating Land Cover Changes In Zarqa River Basin Using GIS And Remote Sensing Techniques*** (Advisor), by M.Sc. Ansam Khaled Al-Khawaldeh. July 2011. Department of Earth & Environment Sciences, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
46. ***Spatial Variability Investigations of Selected Soil Physical Properties at the Central Jordan Valley*** (Co-Advisor), by M.Sc. Yousef Osama Al-Saleh. March 2011. Department of Land, Water and Environment, Faculty of Agriculture University of Jordan, Amman, Jordan.
47. ***Delineation of Groundwater Protection Zones and Vulnerability Mapping in WadiEs-Sir Area using GIS and Isotope Techniques*** (committee member), by M.Sc. Farah Abbas Mushrif Al Efan. May 2010. Department of Geology, Faculty of Sciences, University of Jordan, Amman, Jordan.
48. ***Drought Assessment at Wadi Mujib Basin Using Advanced GIS & Remote Sensing Techniques*** (Co-Advisor), by M.Sc. Amena Hesham Abazeed. May 2010, Department of Earth & Environment Sciences, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
49. ***Optimization Water Use Efficiency of Green House Cucumber Growing Under Deficit Irrigation in Jordan Valley*** (Co-Advisor), by M.Sc. Tareq M. Najdat Kandaji. April 2010. Department of Land, Water and Environment, Faculty of Agriculture, University of Jordan, Amman, Jordan.
50. ***Assessing and Modelling Tomato Yield and Water Saving Under Water Deficit in Jordan Valley*** (committee member), by M.Sc. Rami Al-Qerem. December 2009. Department of Land, Water and Environment, Faculty of Agriculture, University of Jordan, Amman, Jordan.
51. ***Geo-Environmental Quality Assessment of Wadi El-Mujib Groundwater Resources Using Advanced Statistical and Geographical Information System*** (Co-Advisor), by Ph.D. Abeer Sh. Salman. May 2009. Department of Geology, Faculty of Sciences, University of Jordan, Amman, Jordan.
52. ***An Integrated Approach to Groundwater Exploration in Khan EzZabib Area Using Remote Sensing and Geographic Information System*** (committee member), by M.Sc. Mohammed Issam Barakat, May 2008. Department of Earth & Environment Sciences, Faculty of Natural Resources and Environment, Hashemite University, Zarqa, Jordan.
53. ***Estimating Grass Reference Evapotranspiration Using a Soil Water Dynamic Model and Soil Moisture Measurements*** (committee member), by M.Sc. Ala'a Hamad Homaidan. May 2008. Department of Land, Water and Environment, Faculty of Agriculture, University of Jordan, Amman, Jordan.
54. ***Effect of Sludge Type and Application Rate on the Physical Properties of Dry Soils***, (committee member), by M.Sc. Nesreen Ameen Abu-Aisheh, May 2008. Department of Land, Water and Environment, Faculty of Agriculture, University of Jordan, Amman, Jordan.

55. ***Removal of Heavy Metals from Industrial Wastewater*** (committee member), by Using Zeolite, by M.Sc. Nivin Al-Dahodia, April, 2007. Department of Land, Water and Environment, Faculty of Agriculture, University of Jordan, Amman, Jordan.
56. ***Studying of Soil Spatial Variability from Soil Data and Remotely Sensed Data*** (Co-Advisor), by M.Sc. Zeinah Waleed Al-Haj Baddar, January 2007. Department of Land, Water and Environment, Faculty of Agriculture, University of Jordan, Amman, Jordan.
57. ***Reserve Calculations of Clays and Diatomite in Azraq Area*** (committee member), by M.Sc. Abeer Sh. Salman. May, 2005, Department of Earth & Environment Sciences, Faculty of Natural Resources and Environment, Hashemite University, Jordan.

Awards & Acknowledgements

1. ***Certification of Participation in the "Applications of Lab Biosafety and Biosecurity Workshop"*** (5th December 2018). The Hashemite University, Zarqa, Jordan.
2. ***Certification of Participation in the Eighth Scientific Agricultural Conference*** (15-17 October 2018). Mu'ta University, Karak, Jordan.
3. ***Certification of acknowledgement for Cooperation on Succeeding the Fifth Scientific Agricultural Conference*** (9-12 May 2005). Balqa University, Salt, Jordan.
4. ***Certification of Appreciation for Cooperation on Succeeding the Event Climate March from Balqa to Aqaba holding a great message "Stop Changing the Climate"*** (2nd November, 2017). Green Generation Foundation (GGF), Amman, Jordan.
5. ***Irrigation Systems Design and Installation Expert***. (10th October, 2017). Agriculture Engineers Association, Amman, Jordan.
6. ***Expert Science Fair Evaluator***. Mayar International Schools. Science Fair 2014.
7. ***Role Model***. The First National Conference on Science Education Project based on the survey "Interactive Series", coordinated by Jordanian Society for Scientific Research, funded by the European Commission, FP7 2014.
8. ***Brilliant Professor***. Faculty of Natural Resource & Environment, Graduate Students Award, Hashemite University, Zarqa, Jordan, 2013.
9. ***Acknowledged Vice Dean***, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan, 2011.
10. ***Acknowledged Dean Assistant***, Faculty of Natural Resource & Environment, Hashemite University, Zarqa, Jordan, 2010.

SKILLS

a. Long and advanced experience in **project management**, including designing, implementing, monitoring, reporting, assessing, and evaluating national and international projects using advanced methodologies to provide technical guidelines, scientific findings, gap analyses, and lessons learned.
b. Extensive experience in **community engagement and capacity building**, serving as a lecturer, trainer, and facilitator with strong communication skills across multidisciplinary environmental and agricultural sectors.
c. Long experience in **organizing workshops, technical meetings, and international conferences**, ensuring high scientific quality, interaction, and audience engagement.
d. Advanced experience in **developing Geospatial Data Models** (conceptual, logical, and physical), **Data Dictionaries**, and **Data Registers** using enterprise architecture frameworks for environment–water–agriculture sectors.
e. Experienced in designing and implementing **Problem-Based Learning (PBL)** and other active learning techniques in academic and professional settings.

f. Long and advanced experience in **mathematical, statistical modelling, and data mining**, using analytical software such as **JMP, SAS, SPSS**, Python, and R for environmental, agricultural, climate, and hydrological datasets.
g. Strong expertise in **climate change modelling and impact assessment**, using tools such as **LEAP, SWAT, DSSAT**, and other sectoral modelling systems for vulnerability and adaptation analysis.
h. Extensive experience in **spatial environmental modelling**, including soil and land degradation assessments using **GS+, ArcMap, ArcGIS Pro, QGIS, and GSLib**.
i. Long experience in **solute transport and groundwater modelling**, using **Chemflux, ChemFlow, MODFLOW, HYDRUS (1D/2D)**, and related analytical packages.
j. Long experience in **irrigation system design, evaluation, and management**, using software such as **CropWat, AquaCrop, WaterMark, IrriPro, and IrriCAD**, with strong emphasis on smart irrigation, fertigation, and water-use efficiency.
k. Long and advanced experience in **field and laboratory experimental design**, environmental sampling, data analysis, and interpretation for soil, water, crop, and climate assessments.
l. Solid experience in **online, e-learning, and digital training tools** (Moodle, Microsoft Teams, Zoom, Webex, Google Suite, Kahoot, Slideshare, etc.) for professional and academic capacity development.
m. Strong expertise in **environmental QA/QC and data validation** for water, soil, dust, wastewater, and groundwater datasets, applying international frameworks such as **USEPA SW-846**, **USEPA National Functional Guidelines**, **USEPA CLP**, **NYSDEC DER-10**, and **ISO/IEC 17025**, as well as **ISO 5667** (water sampling), **ISO 18400** (soil sampling), and **ISO 18512** (dust/inorganic sampling). This experience ensures that environmental datasets are reliable, traceable, and fit for modelling, reporting, and decision-making.

LANGUAGES

Arabic : Mother Language
English : Excellent, read, write and speak.
Russian : Good, read, write and speak.

PROFESSIONAL SOCIETY MEMBERSHIP

- *Soil Science Society of America.*
- *Sigma Xi (The Scientific Research Society).*
- *Gamma Sigma Delta (The Honour Society of Agriculture).*
- *Soil and Water Conservation Society.*
- *Jordanian Association of Agricultural Engineers.*
- *Jordanian Society for Scientific Research.*
- *Jordanian Environmental Society.*
- *The Jordanian Society for Desertification Control & Badia Development.*
- *Association of Agricultural Research Institutions in the Near East & North Africa / Water Use Efficiency Network*
- *Member of community 'Water Accounting & Water for Food" and "FAO" (Dgroups)*

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3. **H.E. Dr. Ayman Sulaiman,** Minister of the Ministry of Environment, Amman, Jordan, Mobile +962797377792.
4. **Prof. Fayez Ahmad**, Dean of the Prince El-Hassan bin Talal Faculty for Natural Resources & Environment / Hashemite University, Zarqa, Jordan, Mobile +962795964502, email: fayeza@hu.edu.jo
5. **Mr. Bater Wardam**, GIZ Jordan Environment & Climate Programme Project Manager (AV), c/o Ministry of Environment, Amman- Jordan, Mobile +962799866644, email: batir.wardam@giz.de

YORK
ANALYTICAL LABORATORIES, INC.

Teresa V. Weikel

Quality Assurance Officer

As an analytical chemist, Ms. Weikel has had over 10 years of experience in environmental laboratories with specialized expertise in Organics Analysis including organic extractions, Gas Chromatography/Mass Spectrometry and Gas Chromatography methods. She also experienced in metals analysis by ICP, and classical chemistry methods. She has also been heavily involved with QA/QC protocols for all disciplines in the Laboratory. She is fully versed in all NELAC(TNI) and ISO-17025 protocols for Quality Systems.

In the capacities of Chemist and Senior Chemist at various environmental testing laboratories, she performed and was frequently solely responsible for a wide variety of both organic and inorganic analyses and extractions in varying environmental matrices following EPA, WA State and occasional self-designed methods.

In addition to chemist responsibilities, Ms. Weikel also was responsible for setup and use of specific programs and appropriate record keeping for various governm ent/state certifications, organization and delegation of incoming laboratory work and as a Quality Control Specialist at a biotechnology company, she wrote raw material specifications and standard operating procedures according to FDA document traceability standards.

She has had QA specific training on Internal Audit Procedures and Understanding and Implementing ISO-17025 in laboratories. She is familiar with the requirements of the NELAC 2003 standard.

At York, she holds full responsibility for the in-house Quality Systems.

Her current responsibilities focus on quality systems monitoring and implementation, technical training, data review, SOP preparation and revision, new procedure review and approval, data package review, and ethics training.

Education: B.S. Chemistry, Pacific Lutheran University Tacoma, WA

ATTACHMENT E
SAMPLE CHAIN OF CUSTODY FORM

York Analytical Laboratories, Inc.
120 Research Drive, Stratford, CT 06615
132-02 89th Ave Queens, NY 11418
clientservices@yorklab.com
www.yorklab.com

Field Chain-of-Custody Record - AIR

YORK Project No.

NOTE: YORK's Standard Terms & Conditions are listed on the back side of this document.
This document serves as your written authorization for YORK to proceed with the analyses requested below. Your signature binds you to YORK's Standard Terms & Conditions.

YOUR Information	Report To:	Invoice To:	YOUR Project Number	Turn-Around Time
Company:	Company:	Company:		RUSH - Next Day ☐
Address:	Address:	Address:		RUSH - Two Day ☐
Phone.:	Phone.:	Phone.:	YOUR Project Name	RUSH - Three Day ☐
Contact:	Contact:	Contact:		RUSH - Four Day ☐
E-mail:	E-mail:	E-mail:	YOUR PO#:	**Standard (5-7 Day)** ☐

Please print clearly and legibly. All information must be complete. Samples will not be logged in and the turn-around-time clock will not begin until any questions by YORK are resolved.

Samples Collected by: (print your name above and sign below)

Air Matrix Codes

- AI - Indoor Ambient Air
- AO - Outdoor Amb. Air
- AE - Vapor Extraction Well/ Process Gas/Effluent
- AS - Soil Vapor/Sub-Slab

Samples From

- New York ☐
- New Jersey ☐
- Connecticut ☐
- Pennsylvania ☐
- Other ☐

Report / EDD Type (circle selections)

Summary Report	CT RCP	Standard Excel EDD
QA Report	CT RCP DQA/DUE	EQuIS (Standard)
NY ASP A Package	NJDEP Reduced Deliv.	NYSDEC EQuIS
NY ASP B Package	NJDKQP	NJDEP SRP HazSite
Other:		

YORK Reg. Comp.

Compared to the following Regulation(s): (please fill in)

Certified Canisters: Batch ___ Individual ___

Please enter the following REQUIRED Field Data

Reporting Units: ug/m^3 ___ ppbv ___ ppmv ___

Sample Identification	Date/Time Sampled	Air Matrix	Canister Vacuum Before Sampling (in Hg)	Canister Vacuum After Sampling (in Hg)	Canister ID	Flow Cont. ID	Analysis Requested

Comments:

Detection Limits Required

≤ 1 ug/m^3 _____ NYSDEC V1 Limits _____
Routine Survey _____ Other _____

Sampling Media

- 6 Liter Canister ☐
- Tedlar Bag ☐

Samples Relinquished by / Company	Date/Time	Samples Received by / Company	Date/Time	Samples Relinquished by / Company	Date/Time
Samples Received by / Company	**Date/Time**	**Samples Relinquished by / Company**	**Date/Time**	**Samples Received by / Company**	**Date/Time**
Samples Relinquished by / Company	**Date/Time**	**Samples Received by / Company**	**Date/Time**	**Samples Received in LAB by**	**Date/Time**

York Analytical Laboratories, Inc.
120 Research Drive, Stratford, CT 06615
132-02 89th Ave, Queens, NY 11418
clientservices@yorklab.com
www.yorklab.com

Field Chain-of-Custody Record

YORK Project No.

NOTE: YORK's Standard Terms & Conditions are listed on the back side of this document.
This document serves as your written authorization for YORK to proceed with the analyses requested below.
Your signature binds you to YORK's Standard Terms & Conditions.

Page _____ of _____

YOUR Information	Report To:	Invoice To:	YOUR Project Number	Turn-Around Time
Company:	Company:	Company:		RUSH - Next Day
Address:	Address:	Address:		RUSH - Two Day
Phone.:	Phone.:	Phone.:	YOUR Project Name	RUSH - Three Day
Contact:	Contact:	Contact:		RUSH - Four Day
E-mail:	E-mail:	E-mail:		**Standard (5-7 Day)**
			YOUR PO#:	

Please print clearly and legibly. All information must be complete. Samples will not be logged in and the turn-around-time clock will not begin until any questions by YORK are resolved.

Samples Collected by: (print your name above and sign below)

Matrix Codes	Samples From	Report / EDD Type (circle selections)			YORK Reg. Comp.
S - soil / solid	New York	Summary Report	CT RCP	Standard Excel EDD	Compared to the following Regulation(s): (please fill in)
GW - groundwater	New Jersey	QA Report	CT RCP DQA/DUE	EQuIS (Standard)	
DW - drinking water	Connecticut	NY ASP A Package	NJDEP Reduced Deliverables	NYSDEC EQuIS	
WW - wastewater	Pennsylvania	NY ASP B Package		NJDEP SRP HazSite	
O - Oil ⋮ Other	Other		NJDKQP	Other:	

Sample Identification	Sample Matrix	Date/Time Sampled	Analysis Requested	Container Description

Comments:

Preservation: (check all that apply)

HCl ___ MeOH ___ HNO_3 ___ H_2SO_4 ___ NaOH ___ ZnAc ___
Ascorbic Acid ___ Other: _____

Special Instruction

Field Filtered ____
Lab to Filter _____

Samples Relinquished by / Company	Date/Time	Samples Received by / Company	Date/Time	Samples Relinquished by / Company	Date/Time
Samples Received by / Company	**Date/Time**	**Samples Relinquished by / Company**	**Date/Time**	**Samples Received by / Company**	**Date/Time**
Samples Relinquished by / Company	**Date/Time**	**Samples Received by / Company**	**Date/Time**	**Samples Received in LAB by** Date/Time	**Temp. Received at Lab**
					Degrees C

ATTACHMENT F
CONVENTIONAL LABORATORY QA/QC

balQUALITY ASSURANCE MANUAL for ALS ENVIRONMENTAL – STRATFORD

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Stratford, Connecticut, 06615
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www.alsglobal.com

Reference Method:	TNI EL-V1M1, M2, and M4: 2016	Implementation Date:	01 December 2025
Document Control #:	QualityManual	Approved Date:	17 November 2025
Revision (Legacy) Number:	3.4	Approved By:	Corey Olsewski **Laboratory Director**
eQMS Issue Number:	25		Cassie Mosher **Operations Manager**
			Zachary Scott **Quality Assurance Manager**

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2. Use the appropriate filters to locate the document.
3. Find the column on the far right titled "Audit Trail".
4. Open the "Audit Trail" document to view approvals.

CONTROLLED DOCUMENT

Only the version stored on the US Environmental eQMS Document Control intranet site is controlled.

Change History:100

Revision	Date Revision Completed	Change Description	Training Required
25	15 Nov 2025	Complete rewrite to align with ALS format, policies, and procedures. Updated cover-page to incorporate eQMS features.	Yes
3.3	4 Dec 2023	Added change history and table of contents. Updated preface to redefine organization. Added and updated regulatory references. Revised Sections 5.3.u, 5.3v and Ethics Policy in 5.3.t.	Yes

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Quality Assurance Manual (QAM) Cross Reference Table

ALS Laboratories have developed their quality management systems to align with several regulatory requirements. This document has been written to align with the ISO/IEC 17025:2017 organization of topics. The following cross-reference table indicates how this (QAM) aligns to TNI EL-V1M2:2016 and ISO/IEC 17025:2017 with regards to section content and organization. Of note, the Preventive Action section 4.12 from ISO/IEC 17025:2005 has been revised into a new risk management and improvement section in ISO/IEC 17025:2017 (sections 8.5 and 8.6 respectively).

ALS QAM	Section Content	ISO/IEC 17025:2005 TNI EL-V1M2 2016	ISO/IEC 17025:2017
1	Scope	1.1, 1.2	1
2	Normative References	2.0	2
3	Terms and Definitions	3.0	3
4	General Requirements	4.1	4
4.1	Impartiality	4.1.4, 4.1.5b, 4.1.5d	4.1
4.2	Confidentiality	4.1.5c	4.2
5	Structural Requirements	4.1.5, 4.2.6, 4.2.1, 4.2.3, 4.1.6, 4.2.2, 4.2.7	5
6 and 7	Resource Requirements	4.0	6
6.1 and 7.1	General	4.1.5a, 5.3.1, 5.5.1	6.1
6.2 and 7.2	Personnel	4.1.5, 5.2	6.2
8	Facilities and Environmental Conditions	5.3	6.3
9	Equipment	5.5, 5.6.1	6.4
10	Metrological Traceability	5.6, 5.9.1.1	6.5
11	Externally Provided Products and Services	4.5, 4.6, 5.10.6	6.6
12	Review of Requests, Tenders, and Contracts	4.4, 4.5.2, 5.4.2	7.1
13	Selection, Verification, and Validation of Methods	5.4	7.2
14	Sampling	5.7	7.3
15	Handling of Test or Calibration Items	5.8	7.4
16	Technical Records	4.13.2	7.5
17	Evaluation of Measurement Uncertainty	5.4.6	7.6
18	Ensuring the Validity of Results	5.9, 5.5.6, 5.5.10	7.7
19	Reporting of Results	5.10	7.8
20	Complaints	4.8	7.9
21	Nonconforming Work	4.9	7.10
22	Control of Data and Information Management	5.4.7	7.11
23	Management System Requirements	4.0	8
23	Options	NS	8.1
24	Management System Documentation (Option A)	4.2	8.2
25	Control of Management System Documents (Option A)	4.3	8.3
26	Control of Records (Option A)	4.13	8.4
27	Actions to Address Risks and Opportunities (Option A)	some of 4.12	8.5
28	Improvement (Option A)	4.10, 4.7.2	8.6
29	Corrective Actions (Option A)	4.11	8.7
30	Internal Audits (Option A)	4.14	8.8
31	Management Review (Option A)	4.15	8.9

1. Scope, Application, Overview, Commitments, and Implementation

ALS Environmental – Stratford (ALS) was formerly known as York Analytical Laboratories Inc. (YAL). It was purchased by ALS Group USA, Corp. on 1 April 2024. The legal entity of YAL is in the process of being retired (completion goal early 2026). Until this happens, the name of the laboratory as registered with the Accreditation Bodies and found on the Scope of Accreditations and Client Reports will remain as YAL. Internal documentation will be transferred to ALS branding requirements as the documents become due for review or are revised.

Footnotes are used through this quality manual and contain information to further explain a requirement. When instructions are contained within a footnote, it is required procedure.

The abbreviation "ALS" refers to the regional and/or global company and "ALS-Stratford" refers to the single laboratory.

1.1. Scope and Application

This Quality Assurance Manual (QAM) describes the policies, procedures and accountabilities established by the Laboratory of ALS Environmental - Stratford (ALS-Stratford) to ensure that the test results reported from analysis of water, soil, waste, and other matrices are reliable and of known and documented quality. This document describes the quality assurance and quality control procedures followed to generate reliable analytical data.

This QAM is designed to be an overview of ALS-Stratford operations. Detailed methodologies and practices are written in Standard Operating Procedures (SOPs). Where appropriate, corporate ALS SOPs are referenced in this document to direct the reader to more complete information. A complete listing of SOPs is available by Excel export of the Document Register within the Document Control module of eQMS. This is the centralized SharePoint library Document Control system utilized by all USA ALS Environmental laboratories. SOP references within this document will include the eQMS legacy ID to facilitate simplified navigation.

ALS-Stratford maintains certifications pertaining to various commercial and government entities[1]. Each certification requires that the laboratory continue to perform at levels specified by the programs issuing certification. Program requirements can be rigorous. They include proficiency evaluations as well as regular audits of the laboratory to verify compliance.

1.2. Overview of the Organization

ALS Environmental – Stratford (ALS-Stratford) is part of ALS Group USA which is in turn part of ALS Limited global operations, an ASX100[2] company. There are several policies and procedures maintained by the Chief Executive Officers, ALS committees, and other Regional Managers that lay the foundation for all ALS Laboratories. Since ALS Limited is a Public Company registered on the Australia Stock Exchange, there is a Board of Shareholders that review and approve these policies and procedures together with ALS Executive Managers. Current and controlled versions of these documents are maintained on a secure intranet SharePoint site (Policies - Grouped By Language (alsglobal.com)), and APPENDIX E – STANDARD OPERATING PROCEDURES lists a summary of the specific documents, their content and to which section of the QAM they are applied.

The current goals, values, and objectives of the company are:

VISION		To be the global leader in the discipline of scientific analysis in pursuit of a better world for all.
MISSION		ALS is using the power of testing to solve complex challenges. With a passion for science, we serve clients with data-driven insights for a safer and healthier world.
PURPOSE	Science	We aim to relentlessly expand the way our science is deployed across all areas of human endeavor.
	Assurance	Our effort for the clients we serve must be quality without exception as the most trusted in the world.
	Sustainability	Promote principles that we know to be beneficial and engage in authentic ways with the world around us.
VALUES	Safety	More than a policy, safety is our DNA. Managing risk and protecting the well-being of our people guides every aspect of the way we do business.
	Resilient	Nothing worthwhile is ever easy. It is precisely our ability to overcome obstacles and self-belief that brings value to the task-at-hand.

[1] A client accessible portal is available through ALS Solutions. Contact the Laboratory to be setup with access.

[2] ASX is the Australia Stock Exchange and 100 means that ALS is one of the 100 top companies in Australia as per that Stock Exchange rating. ALS is a publicly traded company that is held accountable to a Shareholder Board.

Curious	Innovation is drawn from the eagerness of doing things better. To be open-minded means we will give new ideas their proper measure before rendering judgement.
Committed	We are part of a team that relies on one another to deliver our best. Each time we perform a task remember that a client or colleague is counting on our continued effort towards improvement as well as our unrivalled hard work.
Caring	Our enduring focus is on diverse people and their ideas. We encourage a culture of freethinking and problem-solving. We are part of the greater good, so let's celebrate the wins together and make the world just a little better.
Honest	Truth is the precursor to knowledge. There can be no science built on falsity. Be honest in what you know and don't know. Speak simply and with integrity so that others can appreciate both.

1.3. Quality Assurance Policy

ALS-Stratford is committed to producing legally defensible analytical data of known and documented quality acceptable for its intended use and in compliance with applicable regulatory programs. This QAM is designed to satisfy the applicable requirements of the various States, United States Environmental Protection Agency (EPA), TNI EL-V1:2016 Modules 1, 2, and 4, and ISO/IEC 17025:2017, and other normative references listed in Section 2.

ALS Corporate Management has committed its full support to provide the personnel, facilities, equipment, and procedures required by this QAM and other client and project related requirements (refer to ALS Corporate Quality Management policy on ALSNET).

ALS management reviews its operations on an ongoing basis and seeks input from staff and clients to make improvements. ALS is committed to good professional practice and a high standard of service.

It is the policy of ALS that all employees be familiar with all quality documentation.

1.4. Quality System

This QAM and SOPs referenced in this document (available on ALSNET eQMS Document Register) combined with the Corporate Polices on ALSNET comprise the ALS-Stratford management system. This management system includes all quality assurance policies and quality control procedures. SOP references within this document will include the eQMS legacy ID to facilitate simplified navigation.

Although verbal communication with employees is essential, written and visual communication through email and computer systems is the cornerstone of effective communication at ALS. Computer workstations throughout the lab provide access to LIMS, procedures and email systems. All information essential for effective and consistent communication of analytical requirements and details affecting quality is available through these computerized systems.

1.5. Ethics and Data Integrity

It is the policy of ALS to perform work for clients in the most efficient manner possible, avoiding waste of resources. It is the role of both ALS management and employees to ensure that work for clients is performed most efficiently and effectively by properly utilizing ALS purchased materials, equipment, and the time and ability of personnel.

It is the policy of ALS to generate accurate and reliable data in accordance with contractual and regulatory requirements.

The ALS SOP Education and Training in Data Integrity – Ethics and Legal Responsibilities (found on eQMS; ADMINEthics) includes procedures, policy, and definitions on these topics:

- Any undue pressure applied to employees in the performance of their duties must be reported.
- It is against ALS policy to improperly manipulate or falsify data or to engage in any other unethical conduct.
- Prevention and detection of improper, unethical or illegal actions.
- Reporting and investigation of data manipulation, falsification of data, waste of resources, or other unethical practice or misconduct.

The Corporate ALS SOP *Code of Conduct* (found on ALSNET under Global Corporate Polices) covers such topics as:

- responsibilities and authorities for all ALS Employees
- consequences of Code Conduct violations
- explanation of ALS Core Values and Commitments

- expectations for conducting business at all role levels including data integrity, confidentiality, use of information, insider information, privacy and protection of personal information, and protection and use of company assets and resources
- interacting with 3rd parties including competing fairly and lawfully, working with suppliers and business partners, conflicts of interest, bribery and corruption, gifts and hospitality, trade sanctions and export controls and public comment and social media
- reporting violations to the Code of Conduct emphasizes the need to speak up when something occurs either directly to other ALS roles or through the ALS Business Integrity Helpline hotline.

Laboratory Required Data Integrity and Ethics and Code of Conduct training for all staff:

Initial and annual refresher training on Ethics and Data Integrity and Code of Conduct is performed for all employees through a nationally maintained ALSTAR[3] training portal. Key topics covered are the critical need for honesty and full disclosure in all analytical reporting, how and when to report data integrity issues, and record keeping. Training includes discussion regarding all data integrity procedures (corporate and site), data integrity training documentation, in-depth data monitoring, and examples of improper actions. It covers the topics indicated in the SOPs in the previous section.

1.6. Permitting Departures from Policies and Procedures

Permitting departures from documented policies and procedures or from standard specifications may be allowed and is dependent on project contractual requirements and technical feasibility. Approval by ALS Management and the client is required. In addition, ALS requires that deviations from contractual requirements that might affect data quality be reported to clients with the sample results.

The pertinent ALS Project Manager (PM) must approve deviations from contractual requirements. The PM obtains approval for any such deviations, either in writing by email or by phone (documented in a phone log) from pertinent contract authorities. In addition, ALS requires that deviations from contractual requirements that might affect data quality be reported to clients. Any employee who knowingly manipulates and/or falsifies data or documents or engages in any unethical conduct is subject to immediate release from employment.

1.7. Consequences for Unauthorized Violations

Any employee who knowingly manipulates and/or falsifies data or records or engages in any unethical conduct is subject to immediate release from employment. ALS employees who are aware of, or reasonably suspicious of, any case of data manipulation, falsification of data, waste of resources, or other unethical practice or misconduct shall notify any manager. Under the direction of the laboratory director, every allegation of unethical conduct will be fully investigated.

1.8. ALS Whistleblower Procedure

The ALS Whistleblower document is found on ALSNET under Global Corporate Polices and the ALS Business Integrity Helpline hotline information is posted in a visible site at the Laboratory. This procedure explains the roles and responsibilities of all Employees with regards to reporting or receiving a report of questionable action and the subsequent investigation, including the protections offered for those involved.

Employees have the option of reporting questionable actions either internally or externally as follows:

Internal reporting:

- Chief Executive Officer
- General Counsel and Company Secretary
- Business Stream Executive General Manager
- Chief Financial Officer
- Chief People Officer
- Chief Strategy Officer
- Chief Digital
- Director Group Assurance
- Fraud & Forensic Manager
- a Business Stream General Manager
- a Senior Site Supervisor or Senior Site Manager

[3] USA Environmental *Ethics and Data Integrity* training is found under ALSTAR course ID 0000033239. This course if maintained by the National Quality Manager for USA Environmental. ALS Corporate *Code of Conduct* training is found under ALSTAR course ID 0000032657. This course is maintained by Corporate ALS Audit and Risk Committee.

- a member of the ALS Limited Board.

External reporting is through a helpline operated by an independent 3rd party service provider: Deloitte. Access to the hotline is through several means:

ONLINE	via smartphones, desktops, laptops and tablets by visiting www.alshelplines.deloitte.com.au to complete a report form online in your preferred language.
BY PHONE	by calling the dedicated toll-free number +61 3 9667 3788. You will be connected to a Helpline forensic analyst who will ask you a series of questions to record the details of the Notifiable Conduct. Alternatively, you will be given the opportunity to make a report via a recorded message in the local language of your office.
BY EMAIL	by emailing alshelplines@deloitte.com.au
BY POST	by sending a letter to: **ALS Business Integrity Helpline** Reply paid 12628 A'Beckett Street Melbourne VIC 8006

1.9. ALS Commitment to Health, Safety, and the Environment

ALS is committed to ensuring a safe and healthy workplace is provided for all employees, contractors, and visitors. "WE ARE SAFE" is one of the core values and the Corporate HSE policy is available on ALSNET under Global Corporate Polices. HSE related policies and procedures are maintained by the Global HSE group and have separate manuals, policies, and procedures that are distributed to all Employees. As this document focuses on the quality management systems, please contact your local site HSE representative for more information and training requirements.

2. Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 17025:2017, *General requirements for the competence of testing and calibration laboratories*

TNI 2016, VOLUME 1, *Management and Technical Requirements for Laboratories Performing Environmental Analysis*

specifically Modules 1, *Proficiency Testing*, 2, *Quality Systems General Requirements*, and 4, *Quality Systems for Chemical Testing*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms* (VIM1)

ISO/IEC 17000, *Conformity assessment — Vocabulary and general principles*

3. Terms and Definitions

Common abbreviations, terms, definitions and unit descriptions can be found in APPENDIX A – ABBREVIATIONS, TERMS, DEFINITIONS AND UNITS.

4. General Requirements

4.1. Impartiality and Conflicts of Interest

The following agreements and procedures ensure ALS-Stratford staff are free from undue internal and external commercial, financial, and other pressures or influences that could adversely affect the quality of work. They protect customers' confidential information and ALS' proprietary rights. They ensure avoidance of activities that could diminish confidence in the competence, impartiality, judgment or integrity of any ALS laboratory and staff. Refer to Section **1.5** for additional information, especially training requirements. Additional Corporate policies and procedures that relate to the Code of Conduct are summarized in APPENDIX E – STANDARD OPERATING PROCEDURES.

Code of Conduct Agreement

Provides a framework for decisions and actions in relation to conduct in employment. The agreement covers a wide range of topics including personal and professional behavior, conflicts of interest, gifts and favors, confidentiality, legal compliance, security of information, among others. This agreement is administered and maintained by the USA HR Department and is provided to the employee during the hiring and induction process.

Ethics and Data Integrity Agreement

Provided to the employee as part of the hiring and induction process and reviewed during periodic ethics refresher training. This is coordinated between the Human Resources and Quality Assurance (QA) departments. All employees are required to take annual ethics and data integrity refresher training. A template of the agreement is included in APPENDIX C – ETHICS AND DATA INTEGRITY ATTESTATION STATEMENT.

In addition to these agreements, PMs act as a firewall to insulate the analysts from clients so that the lab personnel have no direct contact with clients. Lab IDs are assigned to samples and used throughout preparation and analysis to make the samples ambiguous to lab personnel. Together these agreements and procedures ensure freedom from undue internal and external commercial, financial, and other pressures or influences that could adversely affect the quality of work.

It is the responsibility of all staff to comply with all procedures, be familiar with current management systems and policies, and to record all data as established by management. This and the peer review of all data will ensure that all testing is objective, and conflicts of interest do not exist. As a commercial laboratory, the decision-making using test results, opinions and interpretation of data is outside the scope of the laboratory activities.

4.2. Confidentiality

All employees sign a confidentiality statement upon employment. These are maintained by and available from Human Resources (HR).

Documents provided to the laboratory are held in strict confidence by project management staff. Documents pertaining to quality assurance and analytical requirements are reviewed with appropriate managers and staff through the project specific meetings and LIMS. Project related information provided by clients is securely archived using procedures described in the ALS-Stratford SOP *Control and Retention of Records* (see eQMS; ADMINRECORDS).

It is the responsibility of all ALS employees to safeguard sensitive company information, client data, records, and information; and matters of national security concern should they arise. All information, data, and reports collected or assembled on behalf of a client is treated as confidential. Information may not be given to third parties without the consent of the client.

The transmittal of final results is specified by clients and follows those requirements unless specific changes are made by the ALS PM(s) assigned to the client/project.

5. Structural Requirements

The laboratory is a legal entity that is part of ALS USA Corp (registration number 76-0606679). Since ALS is a global company, there are 3 levels of management: location, regional (USA), and global. The reporting structure is as follows:

Laboratory Director → Regional Manager Eastern USA → USA General Manager (indirect to the National Operations Manager)

USA General Manager → Executive General Manager, Environmental → CEO and Managing Director ALS

This reporting organization with other key roles included is demonstrated through the organization charts found in APPENDIX B – ORGANIZATION CHARTS.

There are other support functions such as quality, technical, HSE, HR, accounting, procurement, and information technology that are provided to the laboratory by corporate or regional entities but none of whom are responsible for managing laboratory activities directly. The laboratory director is responsible for all aspects of the lab and for ensuring that activities comply with both ALS, legal and applicable regulatory requirements. Any onsite personnel that have support functions for this laboratory that are involved with testing and/or client services are under the direction of the laboratory director.

Refer to Sections 6 and 7.2 for additional information regarding key roles, responsibilities, and authorities.

This laboratory performs a range of inorganic and organic analyses using approved methods promulgated in the Code of Federal Regulations (40 CFR Parts 136 and 141). This QAM is designed to be an overview of ALS operations. Detailed methodologies and practices are written in ALS Standard Operating Procedures (SOPs). Where appropriate, ALS SOPs are referenced in this document to direct the reader to more complete information and include the eQMS link with document legacy ID to facilitate simplified navigation.

ALS management is committed to improvements of the management systems through compliance with its own policies and procedures. When changes are planned and implemented, the integrity of the management system is maintained.

Changes must be recorded in SOPs signed by management that minimally includes the QA Manager and the Technical Director.

6. Organizational Chart and Key Personnel

Refer to APPENDIX B – ORGANIZATION CHARTS for overall structure and direct and indirect reporting relationships for the various key roles.

Of note, the Technical Director at ALS-Stratford may not serve as a Technical Director at another laboratory without authorization from the primary accrediting bodies.

Specific sections of this document may assign additional responsibilities to these roles and other staff roles as needed for those specific section activities.

ALS-Stratford Laboratory Director Responsibilities:

- ✓ implementation of the quality and safety management systems and applicable standards, including communicating to the staff the importance of meeting customer, statutory, regulatory and ALS regional and global requirements;
- ✓ ensure employees have sufficient experience and training to perform QAM-related duties and procedures;
- ✓ supply the necessary facilities and equipment required to meet the commitments of the laboratory and ensuring that supplied facilities and equipment comply with regulatory specifications and tolerances;
- ✓ ensure the testing capabilities of the laboratory can meet contractual obligations;
- ✓ ensure that all testing activities, including field sampling, sample handling and receiving are conducted and records retained as described in this QAM, its related Standard Operating Procedures (SOPs), and its referenced methods;
- ✓ ensure that routine QC samples are prepared, analyzed, and reviewed as required by this QAM;
- ✓ ensure that at regular intervals audits are conducted and documented to monitor compliance with this QAM;
- ✓ ensure that control of nonconforming work is initiated and completed to remedy discrepancies or problems identified in any laboratory process, including the appropriate escalation to corrective action when nonconformities have the possibility to recur and/or there is impact to data integrity;
- ✓ conduct an annual management review of all processes and procedures associated with the management system to ensure compliance and identify improvements; and use this information to develop ongoing laboratory strategic plans.

ALS-Stratford Laboratory Supervisor Responsibilities

The Laboratory Supervisor is responsible to ensure the directives of the Laboratory Director are carried out.

ALS-Stratford Quality Manager Responsibilities

- ✓ supply regular reports on the performance of the laboratory in meeting quality system objectives to location and regional management, especially with regards to any requested metrics and format;
- ✓ ensure implementation of this QAM and relevant corporate ALS policies and procedures and applicable external standards;
- ✓ retain records demonstrating compliance with qualification and training requirements for laboratory roles (both initial and ongoing) that are necessary for the QAM-related activities;
- ✓ understand, monitor, and evaluate the quality assurance (QA) and quality control (QC) activities described in this QAM and its references, and report deficiencies and/or resource requirements to the Laboratory Director;
- ✓ plan and implement an annual internal audit schedule of laboratory activities that meets the frequency requirements of external regulations, oversee its completion to ensure compliance with this QAM and its references[4], and retain records generated from internal auditing activities;
- ✓ oversee the control of nonconforming work process for any deficiencies identified from internal and/or external sources and ensure the correct escalation to corrective action;
- ✓ participate in root cause analysis and approve corrective action reports;
- ✓ evaluate data in an objective manner, free of outside or managerial influence, including monitoring trends in various quality systems activities;

[4] The Quality Manager is not the only role that may conduct internal audits. All staff trained to be internal auditors and that have the necessary technical experience as defined by the qualifications in the specific activity SOP can conduct internal audits.

- ✓ oversee the continuous improvement process for any improvements identified from internal and/or external sources;
- ✓ ensure staff have the necessary instructions captured in controlled documents to enable the successful and consistent performance of laboratory activities and that all controlled documents used by the laboratory are maintained on the ALSNET eQMS Document Register (internal and external);
- ✓ maintain records that are generated by the laboratory activities that are defined in this QAM as per the requirements of section **16**.
- ✓ conduct or delegate to a responsible role an annual review or update of this QAM and related internal controlled documents as hosted on ALSNET eQMS Document Register;
- ✓ create an annual participation schedule and arrange the purchase of external performance evaluation (PE) samples that comply with external proficiency testing (PT) requirements as needed for maintaining the desired scope of accreditation for the laboratory[5] and for ensuring measuring system performance is aligned with industry standards.

ALS-Stratford Technical Manager Responsibilities

- ✓ ensure implementation of regulatory requirements and any applicable requirements from this document as they relate to testing activities;
- ✓ read, understand and follow this QAM, including identified external references;
- ✓ ensure that each set of reported results meets the requirements specified in this QAM and meets the client's requirements as defined in the applicable project requirements or contracts.
- ✓ ensure that personnel conducting testing activities are trained, authorized and competent;
- ✓ ensure that facilities and equipment are maintained and operating within required specifications;
- ✓ ensure that supplies are available and utilized effectively.
- ✓ immediately report technical and quality problems to the Laboratory Director or Quality Manager.

ALS-Stratford Project Manager Responsibilities

- ✓ ensure implementation of the requirements of this document and any applicable references as they relate to client activities;
- ✓ complete and distribute project related information for each project before the laboratory starts work on the project to the appropriate laboratory roles;
- ✓ immediately communicate to the laboratory changes made to projects in progress and record these changes as per the appropriate procedures;
- ✓ respond to client requests for information as quickly as possible[6];
- ✓ ensure LIMS work orders are reviewed and meet client project requirements before release to the laboratory;
- ✓ perform a review of results to verify that data reports submitted to the client meet project requirements;
- ✓ issue test reports.

ALS-Stratford Support Role Responsibilities (Sample Management, IT, Procurement, HSE, HR)

- ✓ ensure implementation of the requirements of this document and any applicable references as they relate to the support activities;
- ✓ read, understand and follow this QAM, including identified external references;
- ✓ ensure that procedures are followed and meet the client's requirements as defined in the applicable project requirements as appropriate to the support activities;
- ✓ ensure that personnel are trained, authorized and utilized effectively;

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[5] External PT participation requirements are defined by the EPA for the potable water program, within TNI EL-V1M1:2016 for TNI accredited analytes captured by FoPT tables, and State regulatory requirements.

[6] Ideally the PM should respond to the client within 1-3 hours or less of a request being submitted. It is understood this is not always possible. If the PM will be unable to reply within this time period, an automated response is required for emails and phone messages indicating that there may be a delay. When an absence is known, the PM will arrange an alternate role to ensure client queries are received and addressed.

- ✓ ensure that facilities and equipment are maintained and utilized effectively;
- ✓ ensure that supplies are available and utilized effectively;
- ✓ immediately report technical and quality problems to the Laboratory Director or Quality Assurance Manager;

6.1. Deputies

In the case of absence of the Laboratory Director, Technical Director or QA Manager, deputies are assigned to act in that role. Deputies are identified on the current laboratory organization chart (see APPENDIX B – ORGANIZATION CHARTS). It is expected that anytime any of these roles is absent for more than 1 hour, the indicated deputies will cover the role responsibilities.

Deputies must meet the qualification requirements of the role(s) they are covering (see Section 7.2).

As per TNI EL-V1M2:2016, deputies must be assigned when Technical Directors are absent for more than 15 consecutive calendar days. If a Technical Director is absent for more than 35 consecutive calendar days, the accreditation authorities must be notified. It is the responsibility of the QA Manager to ensure these requirements are followed and notification is provided when needed.

6.2. All Staff Responsibilities

It is the responsibility of all staff to comply with all laboratory internal and external procedures as defined by this document, and as applicable to their role activities, and to:

- ✓ follow project requirements as delineated by PMs to ensure analyses and commitments, including TAT, are performed as requested;
- ✓ develop knowledge and understanding of the QAM requirements under which samples are handled and tested;
- ✓ notify the leadership team and/or QA Manager when QA problems arise;
- ✓ follow QA requirements as outlined in the QAM and SOPs;
- ✓ follow appropriate channels regarding modification of existing SOPs;
- ✓ maintain accurate electronic and written records that ensure full traceability of testing events
- ✓ follow record modification rules when corrections are needed to ensure the retention of original data;
- ✓ ensure that applicable data are included in each process in accordance with applicable SOPs;
- ✓ report all nonconformance to the leadership team and/or QA Manager and follow their instructions for resolution;
- ✓ follow appropriate protocols when the handling and testing does not meet criteria;
- ✓ apply integrity and professional judgment when dealing with analytical processes and laboratory operations;
- ✓ actively participate in and assist with nonconformance and/or corrective action investigations.

7. Resource Requirements

7.1. General

ALS - Stratford management has committed its full support to provide the personnel, facilities, equipment, and procedures required by this QAM. Staffing resources include chemists, technicians and support personnel. This represents a diverse group with varied educational backgrounds and experience but provides the comprehensive skills that the laboratory requires. During seasonal workload increases, additional temporary employees may be hired to perform specific tasks.

7.2. Personnel

Refer to ALS Corporate policy *Recruitment Management Guidelines* (Global Policies & Forms) for information on how hiring is conducted at ALS-Stratford.

The ALS - Stratford training program is defined in the SOP - *Training of Personal* (eQMS; ADMINTraining) and includes quality, technical, safety, computer security awareness and other training as described in this QAM.

ALS - Stratford managers are responsible to ensure that all staff training is initiated, completed, verified, and the proper training records are completed timely and submitted to the QA Manager for review and retention. All training events have records but the form required may vary, as defined in SOP - Training of Personal (eQMS; ADMINTraining).

Management communicates to personnel their duties, responsibilities, and authorities through the HR maintained job descriptions, this document, and additional roles, responsibilities, and qualifications found in SOPs or other internal communications (i.e. memos). Job Descriptions include requirements for education, qualification, training, technical knowledge, skills and experience and are available upon request to HR.

Records are maintained that contain a certification that the employee has read, understands, and is using the latest version of the management system documents relating to the employee's job responsibilities. These are called Change Acknowledgements and are stored either within the eQMS system or on the ALS - Stratford server.

The specific training and experience of laboratory personnel is documented in individual training files maintained in accordance with SOP - Training of Personal (eQMS; ADMINTraining) and includes records of analytical proficiency through the analysis of QC samples (also called demonstration of capability or DOC).

All ALS - Stratford staff assigned to perform tasks affecting or relating to testing receive training relative to pertinent areas of responsibility, both prior to performing work on client samples and on an ongoing basis. Such training comes from internal and external sources. Each employee is supervised to the extent required to ensure adherence to the management system and ALS policies. It is the responsibility of the supervisor to authorize staff to perform specific laboratory activities, prior to handling and/or testing client samples. The supervisor monitors the competence of personnel throughout the course of work and performs an annual performance review.

Position	Education	Experience
Lead Technical Director[7] (may be named Laboratory Director or Laboratory Supervisor for state requirements)	Bachelors degree in biology, chemistry, or closely related field plus 30 college credits in chemistry.	3 years in an environmental lab, 24 months chemical analysis of representative organic and inorganic methods supervised
Technical Director - Chemistry	Bachelors degree in biology, chemistry, or closely related field plus 30 college credits in chemistry.	2 years in an environmental lab, 12 months chemical analysis of representative organic and inorganic methods supervised
Quality Manager	Bachelors degree preferred	Have documented training and/or experience in QA/QC procedures and the laboratory quality system. Have a general knowledge of analytical methods in use in the lab.
Instrumentation Analysts	High school diploma plus 8 college credits in chemistry	none
Analysts	High School diploma	none

[7] May be named Laboratory Director or Laboratory Supervisor for state requirements.

8. Facilities and Environmental Conditions

The ALS-Stratford facility features over 23,000 square feet of laboratory and administrative workspace (see APPENDIX D – LABORATORY FLOOR PLAN).

To maintain facility security and thus sample security, entrance to the ALS - Stratford facility can be attained only through security access using a key-tag proximity reader. The exception is the sample receiving entrance, where the doors are unlocked during normal business hours (approximately 8AM to 5PM EST). Entrance is monitored by Sample Receipt Technicians at the sample receiving entrance. All non-employees are required to sign-in at the main entrance and complete a HSE introduction to the site.

Refer to ALS Corporate Policies *Facilities Fit Out and Refurbishment Minimum Sustainability Standards*, *Environmental Policy*, and *Physical Security and Asset Management Standard* (Global Policies & Forms) for additional requirements.

The laboratory accommodations and environmental condition design provides safeguards against cross-contamination of samples and is arranged according to work function, which enhances the efficiency of analytical operations.

The ventilation system has been specially designed to meet the needs of the analyses performed in each workspace. The organics extraction area is physically separated from the Volatile instrument area and the Volatiles instrument room is positively pressured to minimize cross contamination. Samples suspected of containing high concentrations of analytes are isolated from other samples. Standards and reference materials are stored separately from samples, extracts, and digestates. ALS - Stratford further minimizes laboratory contamination sources by employing janitorial staff to ensure good housekeeping. Facilities maintenance is performed by qualified contractors.

Each area in the laboratory has adequate lighting, temperature control, bench space, access to sinks, hot and cold water, reagent water, gasses, suction, electrical outlets, chemical storage, fume hoods, ventilation, eyewashes, fire extinguishers, and aisle space as needed for instrumentation, safety, and for the processes assigned to that area.

Room temperature is monitored through digital temperature recording devices capable of sending alert notifications for results that are out of compliance to designated roles. These devices take measurements every minute and upload to a cloud storage where results are retained and can be graphically displayed over any desired time period and evaluated.

Fume hoods have visual indicators to ensure flow is maintained during use and are performance tested semi-annually.

All safety inspection records are kept on file for a minimum of five years.

Records are maintained for the requirements and conditions necessary for method and regulatory compliance in the facility.

Records are retained with analytical data for monitoring and control of environmental conditions relevant to method and regulatory specifications.

9. Equipment

The term “equipment” includes but is not limited to measuring instruments (also called analytical instruments), software, reference standards, reference data, consumables, and auxiliary apparatus that are required for the correct performance of laboratory activities and that can influence the client testing activities.[8]

A comprehensive list of major instrumentation, support equipment, and associated computer hardware and software utilized at ALS can be found on the laboratory’s intranet at \\nastrws003.corp.alsglobal.org\007 - Quality Assurance\Stratford QA\9000 - Admin\Equipment List and Records\Stratford Equipment List. The date of last update is included in the file name. This is a secure location that is only accessible by authorized roles and is maintained by the QA Manager.

The testing SOPs detail the equipment, reagents, standards, and consumables needed for performing the testing activity. These include specific requirements for instrument configuration and specification tolerances and include requirements for initial demonstration of capability (DOC). Most support equipment procedures are defined in this document, but additional requirements for specific testing activities are defined in the related testing SOPs. In cases where the instructions in this document may contradict each other, the testing SOP is followed.

All equipment must be verified to meet the specifications prior to being used for client testing activities. Only roles trained to conduct equipment verification, calibration, and/or maintenance are required to be familiar with those procedures listed in this section and require training records prior to completing these activities.

[8] The ISO/IEC 17025:2017 standard includes reference materials and reagents in “equipment”. This quality manual separates the reference material and reagent requirements as these are usually in liquid form and have different requirements.

Equipment received from other ALS laboratories or other second-hand sources must be treated as new to the site and undergo the same requirements for initial use and setup as new equipment.

Reference material and other solution requirements are indicated in Section **10.**

9.1. Equipment Labelling

All equipment is labelled with the unique ID and the following as appropriate:

- date of last calibration and/ or 3rd party service,
- expiry date for current calibration and/or 3rd party service,
- restrictions on use to a specific testing application or department,
- frequency of calibration verification (critical for support equipment), and
- initials for person creating and applying the label.

If a full ID is not possible, then at least the label must contain the unique equipment ID. The calibration, verification, or service information must be placed on the case for the item or in a prominent location in either the testing area (as a poster for example) or maintenance log. Analytical roles must be trained in where to find the information and alerted to the need to verify non-expired condition prior to each daily use.

9.2. Initial Set-Up and First Time Use

Upon arrival to the site, and prior to first time use, all equipment is assigned a unique laboratory ID and added to the equipment list. This is done by the QA Manager or designated alternate roles.

The following information is entered into the equipment list according to the column headings. Some information is optional and for User information purposes only:

- Equipment ID
- Equipment Name
- Description
- Equipment Type (selected from a drop down list of options)
- Department that will be responsible for maintaining the equipment
- Location
- Serial Number
- Manufacturer
- Model Number
- Receipt type (new, relocated internally, used, internal transfer)
- group type (A = basic equipment with measuring capability but not requiring calibration or verification; B = support equipment requiring calibration / verification; C = analytical equipment that requires full demonstration of capability)
- received date
- used for description (optional)
- commissioning requirements (associated with group type but opportunity to include specific testing SOP reference or additional User instruction)
- commissioned date
- commissioned by
- cleaning, maintenance, and hazard instructions (optional)
- other requirements (optional)
- equipment manual reference, manual date, and location (optional; also found on the eQMS External Documents)
- software version information
- formation version information
- service contract and agent information (optional)

All equipment must be verified to meet in-use specification tolerances after accounting for measurement uncertainty prior to use in client testing activities.

Where metrological traceability is required for linking calibrations to the International System of Units (SI), reference standards with ISO/IEC 17025 certificates or reference materials with ISO/IEC 17034 certificates are used.

Analytical instruments must meet SOP demonstration of capability requirements for first time use prior to testing client samples. Where appropriate, analytical instruments must have an initial MDL/LOQ study completed prior to use in testing client samples.[9] Assessment of capability can be done by the QA Manager, appropriate Department Lead, Technical Director, or other qualified role as demonstrated by training records. Specific acceptance criteria and method settings are defined in the testing SOPs.

Support equipment calibration and verification procedures are found within this document in the following sections.

At a minimum all equipment must be shown to operate satisfactorily through the successful analysis of a method blank made in the matrices that will be used by the equipment (demonstrates no contamination) and a spiked matrix blank (demonstrates ability to identify the analyte(s) of interest). Acceptance criteria for the spiked matrix blank are defined in the testing SOPs.

9.3. Equipment Manuals

The instrument manuals are provided in electronic format usually in the software programs, CDs, and available on network drives.

Software is controlled through licensing and is the responsibility of computer support to maintain licenses required.

Hardcopy manuals for older instruments are kept near the instrument or on a shelf designated for equipment manuals and are controlled by the QA Manager.

External references are maintained and available on the eQMS External Document Library.

9.4. Safe Handling, Transport and Storage of Equipment

All equipment is handled, transported, and stored as per the manufacturer's instructions.

When this is unclear than the Technical Director, QA Manager or Laboratory Director are consulted.

If it is desired to use equipment outside its intended use or specification, permission must be obtained by the Technical Director or Laboratory Director. This permission must be recorded in the maintenance log for the equipment with justification and conditions of use and acceptability defined.

9.5. Out of Service

Equipment that has been subjected to overloading or mishandling, gives unsatisfactory results, or has been shown to be defective or consistently outside specified tolerances must be taken out of service.

All out of service equipment must have an "out of service" label that includes the date and initial of the person authorizing the out of service condition.

This condition is recorded in the equipment maintenance log.

If the equipment was used while out of service for client testing activities, the Technical Director or designee is responsible for conducting a review of data to ensure that client results were not impacted. The control of nonconforming work is initiated.

Equipment must pass requirements for first time use before it can be returned to service for client testing activities.

If method settings changed, calibration was updated, or other changes were made that impact the determination of client results, initial MDL/LOQ studies are required.

9.6. Equipment and Maintenance Records

Records of equipment are retained through the equipment list (see Section **9.2** for list of information retained).

All equipment that is critical to the generation of client results must have a maintenance log to record:

- routine maintenance as defined in the testing SOPs,
- changes to equipment settings, methods, or operating firmware (including software updates),
- error messages and successful correction,
- nonroutine maintenance and troubleshooting,
- out of service status and resolution actions,
- changes to equipment components and accessories including part and lot numbers and vendor information, and
- 3rd party service, re-calibration, and/or re-verification visits.

[9] ALS-Stratford follows the EPA *Definition and Procedure for the Determination of the Method Detection Limit, Revision 2* for all MDL studies.

It is the responsibility of the Testing Analyst to ensure that all maintenance is recorded in the appropriate maintenance log on the same day that the maintenance happens.

For **3rd party maintenance**, the Testing Analyst or Department Supervisor is responsible for reviewing the report and adding key information to the maintenance log such as:

- changes to parts and/or components and associated part/component[10] number and lots,
- method or firmware setting changes,
- re-calibration or re-verification date and associated expiry, which is also updated on the equipment label as appropriate, and
- software updates.

Retain the service report that is provided by the vendor. If this is provided on paper, submit the paper records to the QA Manager. If this is provided electronically, forward the electronic records to the QA Manager. The QA Manager will retain all 3rd party maintenance records in dedicated equipment folders on the secure quality network.

Maintenance logs are periodically reviewed for completion by the appropriate Department Leads. A full review is conducted during the method internal audit.

9.7. Calibrations and Verifications

All equipment verifications and/or calibrations are conducted by either 3rd party ISO/IEC 17025 accredited vendors or by trained internal staff.

All verifications and calibrations conducted internally use ISO/IEC 17034 certified reference materials or ISO/IEC 17025 calibrated reference standards and must be conducted by trained staff who have demonstrated capability.

Calibration and/or verification records are maintained by the QA Manager or through the testing activity data retention procedures (i.e. instrument data files) as defined by the testing SOPs.

Specific calibration and verification requirements for support equipment type are defined below.

When support or reference equipment is purchased with a 3rd party calibration certificate, these are reviewed and retained by the QA Manager, who ensures the following:

- calibration certificates must be provided from ISO/IEC 17025 accredited vendors,
- calibration certificates contain sufficient information to satisfy ISO/IEC 17025 reporting criteria for calibrations, especially metrological traceability,
- any correction factors must be noted and communicated to the users or information added to laboratory bench sheets and forms, and
- the provided measurement uncertainty must be evaluated to ensure that the equipment is still able to meet in-use specification tolerances.

9.8. Temperature Control Devices

Temperatures are monitored and recorded at least daily for all temperature-critical support equipment such as refrigerators, freezers, ovens, and incubators. Thermometers used for monitoring support equipment are called **working thermometers**.

Fridges, freezers, and incubators are equipped with a centralized temperature monitoring system from the 3rd party vendor TandD. This system uses digital temperature probes attached to display units that automatically record the temperature at periodic intervals and upload through wireless capability to a central server location. Authorized roles have access to the data. The unit display allows lab personnel to see the real-time temperature. The device thermometer probes are immersed in glycol / glycerin when used in refrigerators, freezers, ovens, and incubators.

Only the designated Administrator has rights to modify the alarm limits, add units and Users, and edit notification lists and schedules. Acceptance criteria:

Refrigerators	0 to 6 °C
Freezers	≤ -10 °C
BOD incubator	19 – 21 °C

[10] Component changes such as new autosampler, pump, injector, syringe, etc. must be updated and/or added to the ALS-Stratford equipment list. Similarly, software and firmware updates must also be retained on the ALS-Stratford equipment list. Notify the QA Manager of these component changes.

Out of specification condition alerts are monitored and actioned by the QA Manager, who is also responsible for alerting the impacted department(s) and initiating corrections to bring the impacted unit back into specification as per Section **9.7.4**. Customers are notified of catastrophic failure of storage equipment when their samples were potentially impacted by the PM.

Where the operating temperature is specified as a test condition for the testing activity, the temperature at time of testing is recorded on the batch testing bench sheets.

DAILY, all analysts must visually verify that the temperatures used with their testing activities are in working order and are operating within required specifications. Any deviations must be brought to the immediate attention of the Department Supervisor, QA Manager, and Technical Director and the control of nonconforming work initiated.

Thermometers in daily use to monitor support equipment and room temperature are verified annually. Verifications are conducted by trained staff using the site-maintained reference thermometers and records are reviewed and maintained by the QA Manager.

Whenever possible, working thermometers are purchased with calibration certificates with at least three calibration points covering the range of use (the mid-point should be within 10 degrees of the value of primary use). If working thermometers are purchased without calibration certificates, they must be verified against the appropriate reference thermometer prior to first use.

9.9. Reference Thermometers

The laboratory maintains reference thermometers specific to certain temperature ranges for the internal verification of all thermometers. These can be digital or liquid in glass. If using liquid in glass, there must be sufficient graduations in the range of use to allow measurements to the correct tolerance of the thermometer being verified.

Reference thermometers are purchased and calibrated by 3rd party ISO/IEC 17025 accredited vendors. Reference thermometers are re-calibrated every 3 years and are kept in the QA Manager's office to ensure they are not used for routine temperature monitoring. They are only used for thermometer verification and troubleshooting purposes at the discretion of the QA Manager.

The QA Manager is responsible for ordering and requesting the correct calibration conditions from the 3rd party vendor when ordering initial or re-calibration reference thermometers. The reference thermometer must be calibrated using at least 3 or more points to cover the range of the thermometer and have sufficient points within the range of use. At a minimum include the low and high point on the thermometer range plus at least one point in the range used for thermometer verifications at the lab. If there are multiple temperature points used for thermometer verifications by a single reference thermometer, then add a calibration point for each value that is more than 10 degrees from a point already used in the calibration.

If the reference thermometer certificate indicates that there is a correction factor, this value is applied to all subsequent verifications. The temperature of the verified thermometers will be evaluated after incorporating the correction factor into the original observation and applying the appropriate acceptance criteria as defined by the testing activity.

9.10. Support Thermometer Verifications

Thermometers used for monitoring support equipment (called working thermometers) are verified annually using the appropriate reference thermometer[11]. Verifications are performed by trained staff and records are maintained by the QA Manager.

Prior to conducting the working thermometer verifications, the reference thermometer is verified to still be in working order with an ice point check[12]. Follow these steps:

- Prepare a bucket of ice with just enough reagent water to reach the immersion point of the thermometer.
- Immerse the reference thermometer as per manufacturer's instructions and allow sufficient time for it to equilibrate until the reading has stabilized (no change for at least 1 min).
  - It is ok to agitate as long as the reference thermometer is not compromised and taking a measurement is possible.
- Record the reading on the thermometer verification log.
  - Only a single reading is necessary.
- The difference between 0°C ice water and the reading of the reference thermometer must be zero or corrections must be conducted prior to repeating the verification procedure.
  - Corrections are recorded on the verification log and the verification is repeated.
  - If the verification has been repeated 3 times with failing results, the reference thermometer must be placed out of service and sent for re-calibration or replaced.

[11] Working thermometers may be liquid in glass, digital probes, Sensor Push devices, or infra-red (IR) devices.

[12] Reagent water is considered a pure material and is a reference material with metrological traceability by definition.

Support equipment thermometers are verified at the temperatures of use as follows:

1. Determine the number of readings required as follows:
   - Single point thermometers require verification at the temperature of use.
   - Thermometers used over a range of ≤10 °C are verified at a single mid-range point.
   - Thermometers used over a range > 10 °C require at least 2 points at the low and high range of use. A 3rd point in the mid-range is optional but recommended.
   - Freezers used for storage of samples and standards only need to ensure the temperature is freezing and therefore only a single point verification is required.

2. Inspect the working thermometer for any defects such as bubbles within the liquid-in-glass column, breaks, bends in the digital probe that compromise function, display issues, etc.
   - If there is separation in the liquid, attempt to correct by slowly heating or freezing the thermometer, being sure not to exceed the maximum range of the device, which can cause breakage.
   - If separation cannot be resolved, the working thermometer must be placed out of service. The Department Supervisor, QA Manager, and Technical Director must be notified and must conduct an impact to data quality and the control of nonconforming work process initiated.

3. Set up a common vessel for conducting the verification depending on thermometer type:

   - For **electronic thermometers** verify the batter charge (if possible) and replace the battery.

   - Immersible thermometers are placed in a liquid (reagent water, oil, or solvent) at a temperature similar to the one for which the thermometer will be used to the correct immersion depth. The reference thermometer must also be immersed in the liquid to the correct immersion depth.

   - For **digital thermometers on the TandD system**, place another vial of glycol in the fridge immediately next to the sealed glycol working probe. Place the reference thermometer in the vial.

   - For **IR devices**, fill bottles with reagent water adjusted to the appropriate test temperature and place the reference thermometer in the bottle.

   - For **oven or muffle furnace thermometers**, place the working and reference thermometer in the same vial of glass beads in the oven of use.

4. In all cases, allow sufficient time for the working and reference thermometers to equilibrate until the readings do not change for at least 30 seconds.

5. Record the readings from both the working and reference thermometers in the log. Complete all other required information for record traceability as per log fields. At a minimum this must include date, initials, thermometer IDs, identification of measuring medium (including Lot # if applicable) and associated equipment ID, results, and evaluation of pass/fail with indication of corrective action for failures.

6. Assign any correction factors from the reference thermometer to the working thermometer and record adjusted readings in the log.

7. Calculate the difference in results between the reference thermometer and the working thermometer.

8. Apply the following acceptance criteria:

   - If the difference is <2 °C, and the devices allows the application of an offset, adjust the offset so that the working thermometer reads the same as the reference thermometer. The thermometer is re-calibrated. Record this action.

   - If the device does not allow offsets, determine the correction factor needed to get the working thermometer to make it match the reference thermometer. The thermometer is re-verified. Record this value on the log.

   - If the difference is >2 °C the working thermometer requires correction to bring it into alignment with the reference thermometer. Repeat the verification procedure after corrections completed.
     - If after 3 repeated verification attempts the results are the same, the working thermometer must be placed out of service and either sent to 3rd party for repair or replaced.

9. Create a new equipment label for the working thermometer. Ensure it includes the thermometer ID, date of verification, verification expiry, and the correction factor (if any). Apply the label to the working thermometer.

10. Submit records and reference thermometer to the QA Manager for review and retention.

9.11. Verification of Equipment with Integrated Temperature Controls

This section only applies to equipment in which temperature controls are integrated in equipment used for sample preparation such as soxtherns, evaporators, cyanide blocks, muffle furnace, ovens, etc. It does not apply if the testing activities are already being monitored with an externally calibrated thermometer, such as those placed in the heat block for sample digestion (i.e. metals), if the oven / incubator has an internal separate thermometer, some COD blocks, etc.

Such equipment must be calibrated or verified annual at the temperature of use or immediately if the equipment is thought to be out of tolerance.

Place the reference thermometer in the same vessel used for samples but in a different matrix (reagent water, oil, sand) to avoid damage to the thermometer. If the reference thermometer cannot be used due to potential damage, a verified IR device may be substituted. Conduct the verification as per Section **9.7.2**, making appropriate modifications for the different testing setup and doing the same record retention process.

For equipment such as the muffle furnace or kiln that have very high temperatures, verify these equipment with certified temperature indicating fluid or devices. Use the same record retention process as Section **9.7.2.**

When verification is not possible, due to extreme temperature or possible damage to the reference thermometer, or the device is closed preventing use of IR devices, the verification is done indirectly through the successful analysis of appropriate spiked quality control samples or certified reference material of known value. The acceptance criteria for success is defined in the testing SOP.

9.12. Corrective Action for Out of Specification Alerts from the TandD or Sensor Push Devices

The QA Manager is responsible for monitoring the temperature data for the support equipment using the TandD digital system. When there is an out of specification event the following is done:

Scenario	Correction	Required Record (done by QA Manager)
temperature returns to control in ≤ 2 hours	• observe the long-term trends for the unit 1. If it is likely that this is due to usual day use (door open for sample input / removal or regular cycling to prevent icing of the coils) do not make adjustments to unit settings. This is concluded if the temperature failures are always during working hours. No corrections are necessary. 2. If there is indication of long-term trends outside of normal working hours or other unusual failures, re-verify the device as per Section 9.7.2. Place another device on the equipment requiring temperature monitoring.	• Option 1: enter comment on the log indicating the failure was recognized and deemed not-significant. • Option 2: initiate control of nonconforming work and enter the CAR number on the log. Ensure the equipment lists and maintenance logs are updated with the change in temperature monitoring device and any out of service conditions.
temperature fails to return to control in ≤ 2 hours	• Lab personnel must confirm that the door is firmly closed and that there is power to the unit. • Lab personnel must confirm that the regulator coils are not frozen or clogged with dust and that drains are working properly. • Lab personnel must confirm that the failure is not due to a faulty thermometer. If the unit appears to be operating as expected, replace the thermometer with another verified thermometer and allow the temperature to stabilize so that the reading does not change for at least 30 seconds. If the temperature meets acceptance criteria, no impact to samples or standards has occurred. Continue using the replaced thermometer while the failed thermometer is re-calibrated as per Section **9.7.2**. Update appropriate equipment maintenance logs and equipment lists and notify the QA Manager. • If failure is confirmed to be non-thermometer related, samples or standards are immediately removed to other in-control units. • In all instances of non-thermometer failure, the Department Supervisor or Technical Director or designee assess impact to any client samples or standards. If the samples have been out of temperature for long enough to impact data integrity, the PM is responsible for alerting the client and getting client direction for next steps. Compromised standards are disposed and replaced with in-control lots.	• If the failure was due to faulty thermometer, enter a comment on the log to capture the change in thermometer to the working one and initiate control of nonconforming work for the faulty thermometer. Enter the CAR number on the log. • If the failure was due to faulty unit, enter a comment on the log indicating the out of service condition of the equipment and what was done to client samples or standards potentially impacted. Initiate the control of nonconforming work and enter the CAR number on the log • In both cases, update impacted equipment lists and ensure the maintenance log has been updated to reflect the change.

Scenario	Correction	Required Record (done by QA Manager)
	• Trained personnel may make changes to the unit's temperature settings if appropriate. If the temperature returns to acceptable range within 2 hours, no further correction is needed. If samples or standards were moved, they may be returned. • If after adjustments or other corrections the unit still remains out of control, it must be placed out of service while more aggressive corrections are attempted (3rd party maintenance or replacement).	

9.13. Balances

Balances are calibrated annually by 3rd party ISO/IEC 17025 accredited vendors. These Vendors conduct annual maintenance on the balances at the same time since it is required that calibration and maintenance be conducted on site. Balances are not shipped away for these activities. When balances are initially purchased and set-up at the site, the 3rd party vendor also performs initial calibration.

3rd party calibration and maintenance records are retained by the QA Manager. All records are reviewed to ensure that:

- accreditation to ISO/IEC 17025 for the vendor is current;
- scope of accreditation covers the calibration of the balances at ALS-Stratford;
- weights used in the calibration have metrological traceability and are of the appropriate type (ASTM Class 1 or better);
- sufficient measurements have been recorded to bracket the range of use for the balance with sufficient measurements taken in where sample measurements are determined (at least one);
- review the measurements for "as found" and/or "as left" failures. If identified, initiate control of nonconforming work as defined below; and
- initial and date the record to capture the review was completed and deemed acceptable.

"**As found**" failures require initiation of control of nonconforming work and investigation is conducted to determine possible impact to testing activities[13]. The QA Manager is responsible for conducting these investigations. Record the CAR number on the calibration record. Review the failure against ALS-Stratford acceptance criteria, and:

- If the as found failure passes ALS-Stratford criteria, then there was no impact, and no additional correction is required.
- If the as found failure fails ALS-Stratford criteria, then the Technical Director or designee must conduct an impact to client testing activities that were performed in the past. A review of the daily verification records is required. Observations and conclusions are captured in the CAR. If the "as left" condition passes, the balance may continue to be used. However, refresher training on the use of the balance may be required at the discretion of the Technical Director or designee. If the "as left" condition fails, the balance must be immediately removed from service until the condition is resolved.

The acceptance criteria for the weight measurements are the same as those used for the daily balance verifications and are found in Section **9.9.**

9.14. Daily Balance Verification and Verification Weights

Verification weights are ASTM Class 1 weights purchased from a 3rd party ISO/IEC 17025 accredited vendor and are purchased with metrological traceability certificates that are retained by the QA Manager. The QA Manager is responsible for reviewing the weight certificate by:

- ensuring the accreditation to ISO/IEC 17025 for the vendor is current;
- ensuring the scope of accreditation covers the calibration of the weights;
- evaluating the measurement uncertainty of the weights to ensure they are still appropriate for use in testing activities;
- verifying the metrological traceability;
- adding an initial and date to the record to capture the review was completed and deemed acceptable. Any nonconformances are flagged and addressed through the control of nonconforming work process.

Calibration of all balances is verified DAILY by testing Analysts, prior to using the balance for client samples. The steps are:

[13] The acceptance criteria of 3rd party vendors is usually less tolerant than needed for environmental testing activities. If possible, request the vendor use ALS-Stratford acceptance criteria before calibrations are conducted.

1. Brush of the balance pan with a clean brush dedicated for that purpose.
2. Check the bubble level to insure the balance is levelled
3. Press the zero bar on the balance; make sure the readout indicates the balances is zeroed or tared.
4. For specific applications – if the critical weight of a test is always in a specific vessel (beaker, dish, etc.) the balance must be tared with a clean vessel on the pan and weight verifications should be made into the vessel.
5. Measure and record the ASTM Class-1 verification weights most appropriate for the balance capacity. This will be indicated in the Daily Balance Verification Log assigned to the balance. Be sure to complete all appropriate fields in the log.
6. Remove each weight and re-zero before performing the next measurement.
7. Repeat steps 5 and 6 for each required ASTM Class-1 verification weight. Required weight mass and number of verifications is indicated in the specific balance log.
8. Compare the measured weight to the acceptance criteria in the table below. If a failure occurs do the following as appropriate to the situation and record actions in the log:
    a. inspect the balance for foreign matter under the pan, outside air currents, or movement of the balance table that (both may cause interference with the readings)
    b. recalibrate the balance with internal ASTM Class-1 weights
    c. if neither steps a or b return the balance to service, take the balance out of service and arrange for 3rd party maintenance and initiate the control of non-conforming work process. The Technical Director or designee is required to determine potential impact to testing activities and include that in the CAR response.
    d. if a and/or b return the balance passing condition, record the corrections taken on the balance log and no further actions are needed.

Acceptance Criteria for Daily Balance Verification[14]:

Analytical Balance Resolution = 0.0001 g or - 0.00001 g	Tolerance	Acceptance Range
0.002 g	±0.0002 g	0.0018g – 0.0022 g
0.2 g	±0.0004 g	0.0996 – 0.1004 g
0.5 g	±0.0010 g	0.4990 - 0.5010 g
1.0 g	±0.0010 g	0.9990 – 1.0010 g
10 g	±0.0100 g	9.9900 – 10.0100 g
20 g	±0.0200 g	19.9800 – 20.0200 g
100 g	±0.1000 g	99.9000 – 100.1000 g
Top Loading Balance Resolution = 0.01 g or - 0.001 g	**Tolerance**	**Acceptance Range**
0.1 g	±0.02 g	0.08 – 0.12 g
0.2 g	±0.02 g	0.18 g – 0.22 g
1.0 g	±0.02 g	0.98 – 1.02 g
10 g	±0.20 g	9.80 – 10.20 g
20 g	±0.40 g	19.60 – 20.40 g
100 g	±2.00 g	98.00 – 100.20 g

The calibration of the weights is verified annually immediately after the balance calibration is completed by the QA Manager or designee. This enables comparison to the same NIST traceable weights that were used in the balance calibration. The balance used for this

[14] The acceptance criteria on the balances that have higher resolution then displayed in the acceptance criteria will add a zero at the end of the number to account for the significant figures.

verification must have at least 0.0001 g resolution. For the heavier weights, do not exceed the max range of the 0.0001 g balance and instead use a balance with 0.001 g or 0.01 g resolution as appropriate.

The QA manager completes and retains the annual weight verification records.

If a weight fails verification, the control of nonconforming work is initiated, and an impact to testing activities is conducted by the Technical Director or designee. The QA Manager will implement immediate correction by cleaning the weight with an appropriate solvent to remove any oils or residue and will attempt re-verification[15]. If the re-verification passes, the weight is cleared for subsequent use. If the re-verification fails, then the weight is removed from service and additional corrections are required.

Acceptance Criteria for the ASTM Class-1 Weights[16] Annual Verification:

mass	Tolerance	Acceptance Range
0.002 g	±0.0005 g	0.0015g – 0.0025 g
0.1 g	±0.0005 g	0.0995 – 0.1005 g
1.0 g	±0.0010 g	0.9990 – 1.0010 g
10 g	±0.0100 g	9.9900 – 10.0100 g
20 g	±0.0200 g	19.9800 – 20.0200 g
100 g	±0.1000 g	99.9000 – 100.1000 g
200 g	±0.2000 g	199.8000 – 200.2000 g

9.15. Volumetric Devices

The procedures for volumetric devices, including the calibration verification, are found in the external reference from ALS-Rochester *Mechanical Volumetric Dispensing Devices, Volumetric Labware, and Non-Volumetric Labware* found on eQMS; RS-ADM-PCAL. Only those processes that differ slightly due to site differences are explained. All record keeping, maintenance, and training procedures described in RS-ADM-PCAL apply to ALS-Stratford. LIMS practices will differ since ALS-Rochester uses StarLIMS and ALS-Stratford uses Element, and ALS-Stratford is not maintaining equipment information in Element.

The QA Manager is responsible for retaining all suppled certificates of accuracy. When not supplied in paper format, the certificates must be downloaded for the appropriate lot numbers in use at the laboratory from the vendor websites and retained.

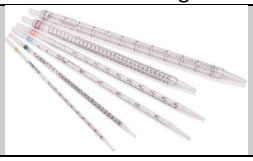
Frequency of calibration verification for volumetric Devices[17]:

Volumetric Device	Description	Verification Frequency	Procedure
Class A Glassware	must have an "A" clearly displayed on the glassware and reference to ASTM E694.	before first time use and then for troubleshooting purposes only	• routinely check glassware for any scratches or corrosion that will impact the accuracy of the volume • first time verification follow RS-ADM-PCAL
Class A glass microliter syringes		must come with certificate of accuracy for Class A status and then are exempt	• routinely check glassware for bubbles within column, bent plunger, or corrosion that may impact the accuracy of the volume • damaged syringes are immediately put out of service
Pipettor	may be fixed single volume or adjustable, single or multi-channel	quarterly	follow RS-ADM-PCAL

[15] It is critical that the correction happens immediately prior to alerting the Technical Director of the failure to ensure that the balance conditions do not change.

[16] The acceptance range for the weights is listed to 4 decimal places assuming a 4 resolution balance is used. If a top loading balance with less resolution is used, then the values are adjusted accordingly, as long as only zeros are removed. The top loading balance must have sufficient resolution to measure to the non-zero numbers after the decimal.

[17] The devices used at ALS-Stratford may have a different manufacture brand and appearance.

Volumetric Device	Description	Verification Frequency	Procedure
Re-pipettor Dispenser	may be fixed or adjustable volume	quarterly	follow RS-ADM-PCAL
Repeater	has different syringe attachments	quarterly	follow RS-ADM-PCAL
Class B glassware, volumetric[18]	Has a "B" on the glassware or no label letter at all. Anything without an "A" label. Will have volume graduations indicated.	prior to first use by lot (one per lot) annually thereafter	follow RS-ADM-PCAL
Single use or disposable pipettes		prior to first use by lot (one per lot)	follow RS-ADM-PCAL
Non-volumetric	may or may not have volume graduations present examples include: disposable pipettes, specimen cups, scintillation vials, GC vials, Nessler tubes, etc.	prior to first use by lot (one per lot) annually thereafter	follow RS-ADM-PCAL

9.16. Water Purification System

ALS - STRATFORD uses **Hydro Service and Supplies** water purification system to produce reagent water meeting method specifications. The system consists of a series of pumps, filters, and resin beds designed to yield water meeting the specifications of ASTM Type II water, and *Standard Methods for the Examination of Water and Wastewater* (SM1080, 20th Ed.) *High Quality* water. The system is maintained by Hydro.

9.17. Reagent Water Daily Verification

Daily, the conductivity and pH of the ALS-Stratford reagent water are measured by a trained Analyst. The results are recorded in a dedicated log.

The Analyst must alert the Wet Chem Department Supervisor, Technical Director, or QA Manager if the conductivity is > 1 $\mu\Omega/\mathrm{cm}$ or pH is outside 4.4 – 7.5. Such instances require initiation of control of nonconforming work and the Technical Director or designee must conduct an evaluation of impact to testing activities.

9.18. Spectrophotometers

The calibration of the spectrophotometers is checked annually by a 3rd party. These records are reviewed and maintained by the QA Manager. Any deviations for "as found" conditions must be escalated to control of nonconforming work. The event is logged in the equipment maintenance log.

9.19. Timers

Timers are purchased with ISO/IEC 17025 calibration certificates to ensure traceability to the SI through NIST.

[18] The use of Class B graduated cylinders and volumetric flasks are not allowed at ALS-Stratford when such use is critical to the client testing activity. Such glassware is appropriate only for use as a holding or transfer of material that is not being volumetrically measured.

Since timers are used in the laboratory to alert testing Analysts when the required amount of time has elapsed for a step in a test, or other support activity, the exact seconds are not critical for any activities conducted at ALS-Stratford.

As decreasing battery strength is known to cause time drift, the Timer labels are made to include the date of last battery replacement. Batteries are replaced at least annually to prevent such drift. Labels are updated with the new battery replacement due date.

When it is noted that a timer is behaving oddly and replacing the battery does not fix this, it is removed from service and replaced with a new certified timer.

Through measurement uncertainty assessment, time differences of seconds do not have impact on the outcome of the result for any testing activity conducted at ALS-Stratford. For this reason, timers are not calibrated after they are put into service and do not have a defined expiration period. If a timer is received with an expiration date, the sticker is removed.

10. Metrological Traceability

All measurements made by the laboratory require traceability to SI through national metrology institutes such as NMI or NIST. This is accomplished through the use of Reference Standards or Reference Materials.

a) Reference Standards

Reference standards used by the laboratory are calibrated at determined intervals by outside vendors for the following equipment. These reference standards are maintained under the control of the QA Manager and are used for verifying intermediate materials used by the laboratory. The QA Manager is responsible for maintaining records and schedules of calibration. Additional procedures are described in the previous section.

- Reference Thermometers
- Reference Weights
- Intermediate checks are used in the laboratory to verify performance of support equipment and are verified to traceable reference standards. Records of such verifications are retained by Quality Assurance.

b) Reference Materials

Reference materials used at ALS - STRATFORD must be of the grade or quality specified by the pertinent analytical procedure or methodology. This is defined in the applicable testing SOPs.

Purchased reference materials must be traceable to the SI through NMI or NIST where possible and have a certificate indicating compliance to ISO/IEC 17034 whenever applicable.

All reference materials must be labelled with (some may be already on the label supplied by the manufacturer):

- standard name,
- analyte concentration,
- solvent,
- date received, prepared, and/or opened,
- storage conditions,
- preparer initials, and
- expiration date;

At time of receipt this information is entered into LIMS and LIMS assigns are reagent unique ID. This is printed and applied to the original container.

All working standards prepared from reference materials are required to have this information and are also logged into LIMS and assigned unique reagent ID from LIMS that is printed and applied to the container. When an amount is prepared that is split into separate aliquots, these are also assigned IDs by LIMS so that the tracking is specific to the lot and aliquot. Preparation information is entered and retained in LIMS.

Internally prepared reagents and chemicals are labelled with the LIMS generated label and must include:

- date of preparation
- expiration date
- preparer's initials
- unique assigned LIMS ID

Any paper received certificates are forwarded to the QA Manager who is responsible for retaining them. When only digital ones are available, these are downloaded from the vendor and retained by the QA Manager.

Second source reference materials are purchased and used in the testing process as an independent verification of primary reference materials. The secondary reference material does not require accredited vendors.

Prior to introduction into the analytical system/process, reference materials are verified for accuracy with a second, independent source of the material. In addition, the independent source of reference material is also used to check the calibration standards for signs of deterioration.

All standards, reagents and reference materials shall be stored per analytical SOP requirements to ensure their integrity. Safe handling and transportation of these materials are discussed in the respective analytical SOP and/or Laboratory Safety Manual.

Standards and reference materials are stored separately from samples, extracts, and digestates.

Any reagents, standards, reference materials, or chemicals that are not stored as per requirements or look otherwise compromised or degraded must be verified by a second source prior to continued use or discarded. Acceptance criteria are defined by the appropriate testing SOP. Once re-verified a new label is applied.

No reagents or chemicals are used past the expiration date. The expiration date of a reagent or standard cannot be extended by preparing a dilution of it or combining it with other standards or reagents.

The expiration date of any prepared reagent cannot exceed the expiration date of the parent stock. Any prepared solutions that are from multiple stocks must use the expiry date that occurs the earliest.

When the expiration date is not provided by the manufacturer, first check the appropriate testing SOP and implement that requirement. If there is no expiration guidance in the testing SOP apply the following:

Reagent / Chemical Description	Expiration Date
purchased neat reagents	5 years after receipt
inorganic reagent solutions	1 year from preparation or receipt
organic reagent solutions	6 months from preparation or receipt
purchased neat standards	5 years from receipt
titrants	30 days from preparation or receipt or sooner if specified in testing SOPs
metal stock standards solutions	10 years from preparation or receipt
metals secondary, intermediate, or working standard solutions	1 year from preparation or receipt
mercury stock standard solutions	1 year from preparation or receipt
mercury secondary, intermediate, or working standard solutions	1 month from preparation (note calibration standards are prepared daily)
inorganic stock standard solutions	1 year from preparation or receipt
inorganic secondary, intermediate, or working standard solutions	6 months from preparation or receipt
volatile organic stock standards (lab prepared)	1 year from preparation
volatile organic stock standards (purchased unopened ampules)	1 year from receipt
volatile organic stock standards (purchased opened ampules)	3 months from opening date
all volatile organics secondary intermediate or working standards	• common “gases” = 7 days • ≤ 200 mg/L = 1 month • > 300 mg/L = 3 months Standards used for calibration should not be older than 7 days
purchased semivolatile organic stock standard solutions	1 year from receipt
prepared semivolatile organics stock standards	1 year from preparation
semivolatile organic secondary, intermediate, or working standard solutions	6 months from preparation or receipt

If a standard or reagent is used beyond its expiration due to accident or unforeseen circumstances:

- implement the control of nonconforming work procedure
- note the discrepancy on the applicable batch bench sheet and in LIMS
- For standards, verify the standard against a second source (this can be a newly prepared standard).
    - analyze both old and second source on the same instrument within the same analytical batch and sequence
    - if the results are within 20 RPD, data associated with the expired standard is acceptable
    - if the results are not within 20 RPD, reanalyse all samples associated with the expired standard if possible

- For reagents, review the batch QC and check the LCS or other positive QC.
    - if results are within acceptance criteria, no further action is required
    - if results are not within acceptance criteria immediate halt sample analysis and re-analyze samples if possible
- In both cases:
    - If data is already released, client notification is required by the PM.
    - If reanalysis is not possible, client must be notified by the PM and if data is released it must be qualified.

11. Externally Provided Products and Services

11.1. Subcontracting

Although ALS has a network of laboratories with overlapping accreditations, each location is considered "external" for the purposes of subcontracting. Therefore all internal transfer of samples is considered "subcontracting" and must follow the requirements of this document.

Analytical services are subcontracted when the laboratory needs to balance workload, when the requested analyses are not performed by the laboratory, or the requested analyses are currently under internal suspension due to unsatisfactory PT performance.

Subcontracting is only done with the knowledge and approval of the client and to qualified laboratories[19]. Subcontracting to another ALS laboratory is preferred over external-laboratory subcontracting. The PM is responsible for ensuring the client testing is covered under the subcontracting lab's scope of accreditation.

ALS - Stratford accepts responsibility to the customer for the subcontractor's work unless the customer or a regulatory authority specified which subcontractor was to be used.

Turnaround is the responsibility of ALS-Stratford and all efforts must be made to rapidly facilitate subcontracting to maximize client service and meet client needs. This includes requesting the subcontracting analysis under "rush" priority and doing what is necessary to facilitate this with the subcontracted laboratory, including advance communication and sending CoCs ahead of the samples to facilitate pre-login.

PMs are responsible for notifying clients in writing that a portion or all of their sample analysis will be subcontracted and which laboratory will be performing what analysis. The PM must contain the written consent from the client PRIOR to sending samples to the subcontracted lab.

The PM or designee is responsible for contacting the subcontract laboratory and communicating the client project requirements and for establishing contractual terms and conditions as necessary, including required turnaround time. Any client specific testing and/or handling requirements must be communicated.

The PM or designee is responsible for ensuring that the external, non-ALS, subcontract laboratory has the required insurance coverage as specified by ALS Corporate. This is demonstrated by the subcontract laboratory providing a certificate of insurance indicating proper levels of coverage. The laboratory will represent that it now carries and it will continue during the terms of the contract to carry insurance in the minimum amounts required by ALS. This typically is:

- worker's compensation – statutory
- employer's liability
- providing a waiver of carriers subrogation rights against ALS, its officers, directors, employees, and affiliated companies
- commercial general liability bodily injury/property damage
- endorsement naming ALS as additional insured
- comprehensive automobile liability
- professional liability

The subcontracted laboratory must carry any additional insurance coverage in necessary amounts which may be required of statutory or other requirements.

ALS-Stratford client reports containing subcontracted information must clearly identify what results were generated by the subcontracted laboratory.

11.2. Procurement

[19] Qualified laboratories are those that have the required accreditation as required by the client for the analysis of the subcontracted samples.

ALS - Stratford SOP *Purchasing* (eQMS ADMIN PURCHASING) defines the process, evaluation, criteria and records maintained from the evaluation and re-evaluation of supplies and services.

Refer to ALS Corporate Policy Supplier Code of Conduct Policy (Global Policies & Forms) for information about expectations for our Vendors.

ALS - Stratford uses vendors which supply the level of quality required to perform testing activities and maintains a relationship with multiple vendors and uses vendors with comparable certifications or accreditations.

The quality level of reagents and materials (grade, traceability, etc.) required is specified in testing SOPs.

Refer to previous sections for requirements for supplies and ordering.

ALS-Stratford uses the network of vendors approved by the ALS Procurement support department. This department maintains a vendor list, negotiates contracts and pricing, and conducts vendor approvals.

12. Review of Requests Tenders and Contracts

ALS-Stratford SOP *Contract Review* (eQMS, ADMINCONTRACT) defines the procedures employees supply quotations and proposals to clients must follow. It ensures that:

- the client's requirements including the methods to be used are adequately defined, recorded, and understood,
- the laboratory has the licensing, capability, and resources to meet the clients requirements and testing needs, and
- the appropriate test method is selected and capable of meeting the client's requirements.

It defines the procedures for reviewing client requests and contracts and procedures for amendment of such items when required.

13. Selection, Verification, and Validation of Methods

13.1. Selection

Selection of methods is covered in the ALS-Stratford SOP *Contract Review* (eQMS, ADMINCONTRACT).

ALS - STRATFORD employs methods and analytical procedures from a variety of external sources such as ASTM, EPA, and Standard Methods (SM). The specific methods are defined on the maintained Scope of Accreditations (see APPENDIX F - Laboratory Accreditations).

Other published procedures, such as state-specific methods, program-specific methods, or in-house methods may also be used. When such methods are used for client testing activities, a qualifier is included with the result to clarify the testing is not accredited.

The implementation of methods by ALS - STRATFORD is described in the testing SOPs specific to each method.

ALS - STRATFORD maintains SOPs for use in both technical and administrative functions. An SOP is available for each accredited method. SOPs are written following standardized format and content requirements as described in the ALS-Stratford SOP *Document Management and Control* (eQMS, ADMINDOC). Refer to Section 25 Control of Management System Documents for more information.

All SOPs must be compliant with the related reference method or standard. When several methods are referenced in an SOP, all procedures must be compliant with all referenced methods. When there is a discrepancy in requirements, the more stringent requirement is implemented.

13.2. Modifications

Published methods may be modified as a result of the request of the client or operational conditions prevailing in the laboratory. Operational conditions might relate to, for example, the availability of equipment or the performance of the method as determined by calibration processes, detection limits, or the results obtained for quality control samples.

All allowed method modifications are outlined in the SOP and are based on reference method indicated allowances. In the event that an analytical method is modified to an allowed modification, the SOP documentation must include:

- a description of the modification,
- any justification for the modification, including method performance, recovery data, and any other supporting data, and
- approval from the Technical Managers, Quality Manager, and Laboratory Director through approval of the SOP as a whole.

In the event that an analytical method must be modified or is modified from the SOP to perform testing on specific sample matrices, the modification and reason must be stated in the case narrative.

When a customer requests a modification to an SOP (such as a change in reporting limit, addition or deletion of target analyte(s), etc.), the PM handling that project must discuss the proposed deviation with the Technical Director or designee and obtain their approval to accept the project. The PM is responsible for documenting the approved or allowed deviation from the SOP by placing a detailed

description of the deviation attached to the quotation or in the project file and also providing an appropriate comment on the service request when the samples are received.

For circumstances when a deviation or departure from company policies or procedures involving any non-technical function is found necessary, approval must be obtained from the Technical Director or designee.

All method modifications, regardless if they are allowed by the reference method, require validation.

13.3. Validation

The policy of ALS - STRATFORD is to apply analytical methods that have been approved, validated, and published by government agencies, professional societies, and organizations, respected private entities, and other recognized authorities. These methods have been validated for their intended use and ALS - STRATFORD uses the demonstration of competency procedures as indicated in the testing SOP to ensure the laboratory is capable.

Validation procedures describe three different classifications of validations for method modification:

1. new methods that have no existing alternate reference method (internally created)
2. permanent modifications to a published method which will be used in subsequent laboratory determinations
3. temporary modifications applied only to immediate analytical projects.

Such modified methods can only be used with written approval from the clients.

The essential quality control elements for modification and validation include:

Calibration - Performance and acceptance criteria must meet or exceed requirements specified in the reference method or SOP. The initial calibration demonstrates a concentration range where the analyte response is proportional to concentration.

Demonstration of Capability (Precision and Bias) - QC samples prepared in the specific matrix, are assessed. If possible, the recoveries are compared to method or historical control limits used for the reference method. All analytical methods and preparatory method combinations are routinely evaluated statistical control limits and reporting limits.

Sensitivity - Method Detection Limits (MDL) for methods performed at ALS - STRATFORD are determined during initial method set up and are verified or reestablished annually. The MDL will also be verified or reestablished if any significant changes are made to the analytical system. MDL procedures follow 40 CFR 136 Appendix B using the simplified EPA procedure (**32**). Limit of detection (LOD) verification and Limit of quantitation (LOQ) verification is performed on every instrument used in the analysis. The sensitivity procedures are found in the ALS-Stratford SOP *Limit of Detection and Limits of Quantitation Determination and Verification* (eQMS, GL-LODLOQ).

The Method Reporting Limit (MRL) is the lowest amount of an analyte in a sample that can be quantitatively determined with stated, acceptable precision and accuracy under stated analytical conditions (i.e. limit of quantitation- LOQ). The MRL cannot be lower than the lowest calibration standard.

Current MDLs and MRLs are available from the laboratory by request.

14. Sampling

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve, and store samples. ALS - STRATFORD recommends that clients follow sampling guidelines described in 40 CFR 136, 40 CFR 141, EPA SW-846, and state-specific sampling guidelines, as applicable. Sampling factors that must be taken into account to insure accurate, defensible analytical results include:

- Amount of sample taken
- Type of container used
- Type of sample preservation
- Sample storage time
- Proper custodial documentation

ALS - STRATFORD uses the sample preservation, container, and holding-time recommendations published in a the reference method for the desired testing method. The primary documents of reference are listed in Section 25 Control of Management System Documents.

ALS - STRATFORD routinely provides sample containers with appropriate preservatives for our clients. Containers are purchased precleaned and conform to the requirements for samples established by the USEPA.

Certificates of analysis for the sample containers are available to clients if requested.

Reagent water used for sampling blanks (trip blanks, etc.) and chemical preservation reagents are pretested by the laboratory to ensure that they are free of interferences and documented.

Our sample kits typically consist of:

- foam-lined, precleaned shipping coolers (cleaned inside and out, rinsed thoroughly and air-dried),
- specially prepared and labeled sample containers individually wrapped in protective material,
    - The proper preservative is typically added to the sample containers prior to shipment, unless otherwise instructed by the client.
- chain-of-custody (COC) forms,
- and custody seals.
    - Container labels and custody seals are provided for each container.

See ALS-Stratford SOP *Sample Control Procedures* (eQMS, SC-Proc) for the laboratory's Sample Acceptance Policy and more detailed instructions regarding sample receipt, log-in, storage, and disposal.

ALS - Stratford keeps client-specific shipping requirements on file and utilizes and internally managed courier system to guarantee that sample shipping requirements (same-day, overnight, etc.) are met.

ALS - Startford performs limited field sampling for drinking water samples. The detailed instructions are found in SOP Sample Collection Drinking Water (eQMS, SOP SC DW).

15. Handling of Test Items

ALS-Stratford SOP *Sample Control Procedures* (eQMS, SC-Proc) contains detailed instructions for sample handling, receipt, storage, archival, retention, and disposal.

During the login process, each sample container is given a unique laboratory code (e.g. 25B0001-01). The laboratory code is automatically assigned by Element LIMS and consists of a work order number followed by a sample number. The format is as follows:

YEAR-MONTH-SEQUENTIAL WORK ORDER NUMBER-SEQUENTIAL SAMPLE NUMBER

Where: *YEAR = Current year*
MONTH = Current month (January=A, February=B, March=C, etc.)
WORK ORDER NUMBER = sequential starting at 0001 at the beginning of each month
SAMPLE NUMBER = sequential starting at 01 for the first sample

16. Technical Records

The generation, compilation, reporting, and archiving of data is a critical component of laboratory operations. ALS - STRATFORD ensures that amendments to technical records are tracked to previous versions or to original observations. Both the original and amended data and files are retained, including the date of alteration, an indication of the altered aspects and the personnel responsible for the alterations.

Original raw data is obtained electronically, whenever possible. When manual recording of data is necessary, direct manual entry to a spreadsheet is preferable to handwritten records. When handwritten records are used, it is typically for entries to logbooks for support equipment, maintenance logs, or standard and reagent preparation logs.

Laboratory notebook entries are standardized following the guidelines in the ALS-Stratford SOP *Laboratory Notebook Control and Use* (eQMS, ADMIN-LabNote). Entries made into laboratory notebooks are reviewed and approved by the appropriate supervisor at a regular interval and annually during the internal auditing activity.

The ALS-Stratford SOP *Control and Retention of Records* (eQMS, ADMIN-Records) describes what records are maintained, how and where they are maintained, how long they are maintained, and how they are disposed. In general, all records are retained for a minimum of five years from generation of the last entry in the records. The laboratory maintains all information necessary for the historical reconstruction of data. Records stored only on electronic media are supported by the hardware and software necessary for their retrieval. For potable water records are retained for 10 years and lead and copper data in potable water are retained for 12 years.

In the event that the laboratory transfers ownership or goes out of business, laboratory records shall be retained for the contracted period and clients shall be notified prior to early destruction or disposal of samples or data. Samples may be shipped to another network location under client approval. Accrediting authorities shall be notified as soon as possible.

The control of electronic records are described in the following:

16.1. Information Management Systems

ALS - STRATFORD uses Element LIMS throughout the laboratory. Element is used to manage:

- sample information,
- sample tracking,
- sample workload projections,
- sample result storage,
- reporting,
- invoicing,
- tracking the status of a sample, and
- maintains internal chain of custody.

Access is controlled by user specific passwords. Periods of inactivity are monitored. The system will automatically log out inactive accounts.

The laboratory will notify the customer prior to changes in LIMS software or hardware configuration if the change will adversely affect customer electronic data.

The LIMS is inspected annually by the Quality Manager or designee to ensure the integrity of electronic data.

16.2. Backup and Security

ALS - STRATFORD laboratory data is acquired directly to the centralized acquisition server. All backups are performed using CommVault Simpana software to an offsite SAN in one of the ALS data centers. These disk backups are then archived to tape for long-term storage.

Incremental backups are performed daily, and a full backup is performed weekly**.** Weekly backups are stored for a month. The last of the month is stored for one year. The last backup of the year is stored for 10 years**.**

All installed software, software versions, and software changes are managed via ServiceNow (ALS service management software). The server is also locally mirrored to a hard drive to provide quick restoration of the server should the server need to be replaced.

The external e-mail system and Internet access is established via a single gateway to discourage unauthorized entry. ALS - Stratford uses a closed system for company e-mail. Files, such as electronic deliverables, are sent through the external e-mail system only via a trusted agent. The external messaging system operates through a single secure gateway. Email attachments sent in and out of the gateway are subject to a virus scan. Because the Internet is not regulated, we use a limited access approach to provide a firewall for added security. Virus screening is performed continuously on all network systems.

Refer to ALS Corporate Standard Physical Security and Asset Management (Global Policies & Forms) for additional information and requirements. The Laboratory Director is responsible for ensuring compliance to this referenced document.

17. Evaluation of Measurement Uncertainty

Refer to the ALS-Stratford SOP *Estimation of Measurement Uncertainty* (eQMS, ADMINESTUNCERT) for detailed information on how the laboratory has evaluated uncertainty and how it is determined for quantitative measurements. This SOP also provides instruction for how to determine and report the uncertainty associated with a reported result. Such information is only provided upon client request and is not included in usual reporting activities.

Estimation of measurement uncertainty is not required for qualitative measurements.

18. Ensuring the Validity of Results

Before samples are analyzed, the analytical system must be in a controlled, reproducible state from which results of known and acceptable quality can be obtained. That state is verified through the use of Quality Control (QC) procedures intended to ensure accuracy, precision, selectivity, sensitivity, freedom from interference, and freedom from contamination. The QC procedures performed at ALS - STRATFORD are defined in the testing SOPs and include:

- calibration and calibration verification;
- analysis and comparison of resultant data to predetermined control limits for method blanks, laboratory control samples, spiked matrix samples, duplicate matrix samples, and surrogates added to samples;
- analysis of performance evaluation samples;
- determination of Reporting Limits; and
- the tracking and evaluation of precision and accuracy.

The standard lab limits for these QA objectives are described below. For specific analytical methods, other QC procedures are implemented as required by the method (see method-specific SOP).

These QC procedures are performed and evaluated on a batch basis. The samples in a batch are processed together, through each step of the preparation and analysis, to ensure that all samples receive consistent and equal treatment. Consequently, results from the batch QC samples, not including field sample QC, are used to evaluate the results for all samples in the batch.

All QC parameters set by the applicable ALS - STRATFORD SOP or method reference shall not be exceeded without proper qualification and case narrative explanation in the client report.

The hierarchy of quality control requirements begins with:

- Client Requirements (if specified and documented)
- Method and/or SOP requirements
- Guidance from QAM and other general SOPs

18.1. Calibration and Calibration Verification

Instrument calibration is a QC measure taken to verify selectivity and sensitivity.

Calibration of instruments at ALS - STRATFORD is accomplished through the use of high quality reference materials (Section **10**).

In general, analytical instruments are initially calibrated with standard solutions made from the reference materials at different levels appropriate for the analysis. This is called the **initial calibration** (ICAL). The ICAL is verified with a standard solution prepared from a different lot of the reference material, preferably from a different vendor, prepared at a concentration within the ICAL. This step is called **initial calibration verification** (ICV).

At specified intervals throughout the analytical sequence, the calibration is re-verified again through the analysis of a calibration check solution, usually the mid-point standard solution. This process is called the **continuing calibration verification** (CCV). The frequency of CCV analysis is defined by the testing SOP.

If the ICAL, the ICV, or any CCV fails criteria in the analytical method, the system is recalibrated and impacted samples are reanalyzed. It is ALS - STRATFORD' policy to only report results generated under acceptable calibration conditions. Specific calibration procedures are found in the SOPs associated with each method of analysis.

Calibration blanks are analyzed at designated frequencies for some methods. These **calibration blanks** (CCBs) are solutions of either analyte-free water, reagent, or solvent that are analyzed in order to verify the analytical system is contamination-free. The frequency of CCB analysis is specified in the testing SOPs. Additional project-specific requirements may also apply to CCBs.

Alternative calibration sequences or procedures will be discussed with clients.

18.2. Analysis of Method Blanks

The **method blank** (MB) is an analyte-free matrix (water, soil, etc.) subjected to the entire preparation and analytical process. When analyte-free soil is not available, organic-free sand (called Ottawa sand), glass beads, Teflon chips or an acceptable substitute is used. The method blank is analyzed to demonstrate that the analytical system itself does not introduce contamination. The method blank results should be below the **Method Reporting Limit** (MRL). Unless otherwise specified in the method, general guidelines for qualifying sample results with regard to method blank quality are as follows:

- If method blank is <MDL and sample results are >MRL, then no qualification is required.
- If method blank is >1/2 MRL but <MRL and sample results are >MRL, then qualify results to indicate that analyte was detected in the reagent blank.
- If method blank is >MRL, then further corrective action and qualification is required.

A method blank is included with the analysis of every sample preparation batch, every 20 samples, or as stated in the method, whichever is more frequent.

18.3. Analysis of Laboratory Control Samples

The **laboratory control sample** (LCS) is an aliquot of analyte-free water or analyte-free solid (Ottawa sand) to which known amounts of the method analyte(s) is (are) added. A reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. An LCS is prepared and analyzed at a minimum frequency of one LCS per 20 samples, with every analytical batch or as stated in the method, whichever is more frequent. The LCS sample is prepared and analyzed in exactly the same manner as the field samples.

The percent recovery of the target analytes in the LCS is compared to established control limits and assists in determining whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required reporting limit. Comparison of batch-to-batch LCS analyses enables the laboratory to evaluate batch-to-batch precision and accuracy.

The results of the LCS are reported as **percent recovery**:

$$\%\ Recovery\ =\ \frac{X}{K}\ x\ 100$$

Where: X = Measured value and K = Expected value

18.4. Analysis of Spiked Matrix Samples

Matrix QC samples are generally used to determine acceptability of methods chosen on a field sample and are therefore not used to determine batch acceptability. If the analysis of **matrix spike** (MS) is not possible, a duplicate LCS or QC should be analyzed in the batch.

Matrix spiked samples are aliquots of samples to which a known amount of the target analyte (or analytes) is (are) added. The samples are then prepared and analyzed in the same analytical batch, and in exactly the same manner as are routine samples. For the appropriate methods, matrix spiked samples are prepared and analyzed and at a minimum frequency of one spiked sample (and one duplicate spiked sample, if appropriate) per twenty samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. The results are reported as **percent recovery**.

$$\%\ Recovery\ =\ \frac{(Xs\ -\ Xu)}{K}\ x\ 100$$

Where Xs = Measured value in the spiked sample, Xu = Measured value in the unspiked sample, and K= Expected value

Laboratory criteria will be used in the absence of client-specified criteria. Failure to meet these criteria will be noted in the report.

18.5. Analysis of Duplicate Matrix Samples

Matrix QC samples are generally used to determine acceptability of methods chosen on a field sample and are therefore not used to determine batch acceptability. If the analysis of matrix spike is not possible, a duplicate LCS or QC should be analyzed in the batch.

A **duplicate matrix spike** sample or **duplicate matrix sample** is used to monitor the precision (repeatability) of the method chosen on a field sample. If a sufficient amount of the analyte(s) of interest is present in the field sample, a matrix duplicate sample is analyzed directly. If the analyte(s) of interest are not present in a sufficient amount, two additional portions of field sample are spiked with the analyte(s) of interest to ensure that meaningful results are obtained. A pair of duplicate samples (matrix/matrix duplicate or matrix spike/matrix spike duplicate) is analyzed with every analytical batch of environmental samples. The results of the analysis of duplicate samples are reported as **relative percent difference** (RPD).

$$RPD\ =\ \frac{|X_1\ -\ X_2|}{\left[\frac{(X_1\ +\ X_2)}{2}\right]}\ x\ 100$$

Where: $|X_1 - X_2|$ = The absolute value of the difference between the two sample values, $[(X_1 + X_2)/2]$= The average of the two sample values

Laboratory criteria will be used in the absence of client-specified criteria. Failure to meet these criteria will be noted in the report.

18.6. Analysis of Surrogates Added to Samples

Surrogates are organic compounds which are similar in chemical composition and chromatographic behavior to the analytes of interest, but which are not normally found in environmental samples. Depending on the analytical method, one or more of these compounds is added to method blanks, calibration and check standards, and samples (including duplicates, matrix spike samples, duplicate matrix spike samples and laboratory control samples) prior to extraction and analysis in order to monitor the method performance on each sample. **Surrogate recovery** is a measure of the accuracy and selectivity of the method in the sample matrix. Surrogate results are reported as percent recovery.

$$\%\ Recovery\ =\ \frac{X}{K}\ x\ 100$$

Where: X = Measured value and K = Expected value

18.7. Analysis of Internal Standards

Internal standards (IS) are known amounts of specific compounds that are added to each sample prior to instrument analysis. Internal standards are generally used for GC/MS and ICP-MS procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by matrix effects. The requirements for evaluation of internal standards are specified in each testing SOP.

18.8. Analysis of Interference Check Samples

An **interference check sample** (ICS) is a solution containing both interfering and analyte elements of known concentration that can be analyzed to verify background and interelement correction factors in metals analyses. The ICS is prepared to contain known concentrations (method or program specific) of elements that will provide an adequate test of the correction factors. The ICS is analyzed at the beginning and end of an analytical run or at a method-specified frequency. Results must meet method criteria (defined in the testing SOPs) and any project-specific criteria.

18.9. Analysis of Post Digestion Spikes

Post digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method-specified minimum concentration above the method reporting limit. A post digestion spike is analyzed with each batch of samples and recovery criteria are specified for each method.

18.10. Analysis of MRL Standards (CRDL, LFB)

A **laboratory blank fortified** (LFB) at the method reporting limit (MRL) is used to verify the minimum reporting limit. The LFB is carried through the entire extraction and analytical procedure. An LFB is required with every batch of drinking water samples.

18.11. Marginal Exceedances

When the acceptance criteria for a positive control are exceeded high (i.e., **high bias**) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes, since it is unlikely there is any of the analyte of interest in the impacted samples.

The laboratory does not employ acceptance of positive controls that are exceeded low if they exceed a maximum regulatory limit, since the laboratory is rarely informed of the purpose nor limits of the testing.

The laboratory does not employ acceptance of the LCS if a small number of analytes fail in a large list of analytes. The laboratory reprepares and re-analyses samples when any target analytes fail in the LCS.

18.12. Determination of Method Detection Limits (MDLs) and Reporting Limits

See EPA 2016 MDL procedure and ALS-Stratford SOP *Limit of Detection and Limit of Quantitation Determination and Verification* (eQMS, GL LODLOQ) for detailed instructions for how initial and ongoing MDLs and reporting limits are determined.

18.13. Analysis of Performance Evaluation Samples (PT)

Proficiency testing (PT) samples are prepared by an independent organization outside the laboratory, called PT Providers.

PT providers are evaluated as per the requirements for External Suppliers (Section **11.2**). For client work that is covered under TNI accreditation, and the analytes of interest are listed on the TNI maintained FoPT tables, the PT Provider must be a TNI recognized organization. It is recommended that these same PT providers be used for non-TNI related PT testing, but if unavailable, at a minimum, PT Providers must have ISO/IEC 17043 accreditation, and the testing requested must fall under the PT providers scope of accreditation. When this is not possible PT Providers are evaluated based on their accreditations (ISO/IEC 17025 and ISO/IEC 17034 are valid alternatives).

PT samples are received directly from the PT provider and analyzed at regular intervals to monitor laboratory accuracy. PT samples are introduced into the regular sample stream of the laboratory and analyzed as routine samples by analysts who regularly perform the method. Laboratory personnel follow all instructions provided by the PT provider.

The laboratory sections submit results to the QA Manager for subsequent reporting to the appropriate agencies or study provider by the indicated reporting deadline. Information for PT rounds is captured on the ALS-Stratford CERTS_PT Results_STRATFORD hosted on the US Environmental SharePoint site.

Results of the performance evaluation samples and audits are reviewed by the QA Manager or designee and entered into the CERTS_PT_Results_STRATFORD spreadsheet for historic performance tracking. Any results outside that are identified as outside acceptance criteria, the control of nonconforming work is initiated and corrective action is taken.

When there is a repeat failure (either F/F/P, F/P/F, F/F/F, or P/F/F pattern for the last 3 rounds) testing for the impacted analyte and/or method is internally suspended as per the procedures defined in ALS memo *Actions PT Double Failure* (eQMS, CORP – Actions PT Double Failure).

ALS - STRATFORD routinely participates in the following studies:

- Water Pollution (WP) and additional water parameters, 2 per year.

- Water Supply (WS) PT studies, 2 per year.
- Hazardous Waste/Soil PT studies, 2 per year.
- AIHA ELPAT for lead in dust and paint and lead in wipes analysis, 4 per year
- Other studies as required for specific certifications, accreditations, or validations.

The following guidelines are followed by ALS - Stratford:

- Averaging results is prohibited.
- Only qualified ALS - Stratford laboratory employees analyze PT samples.
- Results are not discussed with outside entities or other ALS laboratories prior to the deadline for receipt of the results.
- ALS does not subcontract to other laboratories or receive from other laboratories any PT samples.

The Laboratory Director, Technical Managers or the Quality Manager can institute the analysis of additional PT samples or modify the performance evaluation program as appropriate.

18.14. Data Review of Batch

The integrity of the data generated is assessed through the evaluation of the sample results, initial calibrations, and QC samples. The criteria for evaluation of QC samples are listed within each testing SOP. Review of data is accomplished at three levels: Analyst, Group Leader and Lab Management.

- **Analyst QC Review and Evaluation**: The analyst has full responsibility for data entry into the LIMS system. All hand written data are entered manually into the system and immediately given a second review for accuracy for transcription and calculation. All instrumental data is automatically uploaded using the **Data Tool Module** of Element LIMS. Strict adherence to the analysis-specific SOP in terms of QC acceptance criteria is requried before entry of any data into the LIMS system. The analyst also will review the data from a logic perspective. For example, if one sample is an influent and the other an effluent, the data should be reflective of this (i.e. the Influent should be higher than the effluent). If the data is illogical, this fact is brought to the attention of the supervisor for resolution.
    - **The primary testing Analyst is directly responsible for ensuring the data reported in Element reflects original observation and is associated with passing QC**. Any data not associated with passing QC or of questionable data integrity must be discussed with the Analyst Supervisor or Technical Director prior to upload to Element. If reported, it is this Analyst that must ensure the data is correctly qualified.
- **Department Leader QC Review and Evaluation**: The Department Leader or designee performs a secondary review, and if the data is found to be acceptable approves the data in LIMS.
- **Management QC Review and Evaluation**: The Managing Director or his designee reviews every laboratory report with respect to completeness and data logic.
    - In addition, random projects are selected for full review of raw data associated with the project to ensure adherence to SOPs and project QA objectives, where known. The review encompasses examination of transcription errors from log-in and analysis, chain-of-custody, raw data for VOA, SVOC, etc. and limited QC data review including holding times, surrogate recoveries and linear ranges. This full review is conducted by the Quality Assurance Officer and usually coincides with internal auditing activities.
- **Holding Times** – Holding times assigned as follows:
    - by hours = tracked from the minute of sampling to the minute of analysis
    - by days = tracked by the day, holding time ends at midnight of the last day
    - longer units (weeks, months, years) are handled in the same manner as a holding time defined in days, after converting the holding time to days.
        - Weeks are defined as 7 days;
        - months are defined as 30 days;
    - years are defined as 365 days.

When a time of sampling is not provided by the client, ALS - STRATFORD uses the first minute of the sampling day (00:00) in the calculation of holding time. Examples:

48 hour holding time: Sampled May 1 09:32. Holding time is exceeded if not analyzed by May 3 09:32.

5 day holding time: Sampled May 1 09:32. Holding time is exceeded if not analyzed by May 6 at 23:59.

6 month holding time: Sampled May 1 09:32. Holding time is exceeded if not analyzed by Oct 28 23:59.

- **Sample Results (Inorganic)** – Following sample analysis and calculations (including any dilutions made due to the sample matrix) the result is verified to fall within the calibration range. If the result is above the calibration range, the sample is diluted and analyzed to bring the result into calibration range. When sample and sample duplicates are analyzed for precision, the calculated RPD is compared to the specified limits. The sample and duplicate are reanalyzed if the criteria are exceeded. The samples may require re-preparation and reanalysis.
- **Sample Results (Organic)** – For GC/MS analyses, it is verified that the analysis was within the prescribed tune window. If not, the sample is reanalyzed. Following sample analysis and calculations (including any dilutions made due to the sample matrix) peak integrations, retention times, and spectra are evaluated to confirm qualitative identification. Internal standard responses and surrogate recoveries are evaluated against specified criteria. If internal standard response does not meet criteria, the sample is diluted and reanalyzed. Results outside of the calibration range are diluted to within the calibration range. For GC and HPLC tests, results from confirmation analysis are evaluated to confirm positive results and to determine the reported value. The procedure to determine which result to report is described in the SOP for the applicable method. If obvious matrix interferences are present, additional cleanup of the sample using appropriate procedures may be necessary and the sample is reanalyzed. When dilutions are performed, the MRL is elevated accordingly and qualified.

18.15. Tracking, Trending, and Evaluation of Long-Term Accuracy and Precision

In addition to evaluating individual batch QC results against control limits, QC results from successive batches are also evaluated for possible trends. While a trend is not necessarily an out-of-control situation in itself, it can provide an early warning of a condition that can cause the system to go out of control.

ALS - STRATFORD analytical staff identify trends in analytical systems through the routine evaluation of data. The QA Manager or designee produces control charts as requested to assess trends. The occurrence of a trend does not invalidate data that are otherwise in control. If a trend is observed, the preventive action procedure is initiated.

The generation of control charts is routinely performed at ALS - Stratford. Surrogate and LCS recoveries are monitored and charted using in-house software to produce **control charts** (results vs time). Control charts are used to monitor the data and to identify various trends in the analytical results. Evaluation of long-term trends is performed annually for all LCS and surrogates using average and standard deviation, and typically coincides with internal auditing activities. The QA Manager or designee compares the newly generated statistical limits to the old and determines whether the new acceptance criteria is to replace the previous criteria. Investigative action may be taken if charts reveal a potential problem with data quality through the preventive action procedure.

19. Reporting of Results

When all of the data in the LIMS has been approved by the analytical departments, the system indicates that report is ready for generation. A report writer generates the applicable report from the LIMS and assembles the package based upon the package level.

The instructions for generation of a report and package assembly are given in the ALS-Stratford SOP *Generating EDDs and Reports for All Clients and Data Port Web Portal* (eQMS, ADMIN-EDDRptCC).

19.1. Report Requirements

The report identifies the method used. If the method is modified, it is noted as “modified” in the report.

Any abnormal sample conditions, deviation from hold time, irregularities in preservation or other situations that might affect the analytical results are noted in the report and associated with the analytical results.

The contents of the report include:

- The report title with a unique report number
- the name, address, and telephone number of the laboratory
- The name and address of the client or project
- Sample description and associated unique laboratory identification numbers
- The dates of sample collection, sample receipt, sample preparation, and analysis
- The time of sample preparation and/or analysis if the required hold time for either activity is 48 hours or less
- A method identifier for each method, including methods for preparation steps
- The MDL or minimum reporting limit for the analytical results
- The analytical results with units and qualifiers as required

- A description of any quality control failures and deviations from the accepted method
- The name and title of the individual(s) who accepts responsibility for the content of the report.
- The date the report is issued
- Clear identification of any results generated by a subcontract laboratory
- If sampling activities are performed by ALS - Stratford personnel, a reference to the sampling procedures.
- Page numbers and total number of pages

Prior to release of the report to the client, the PM reviews the entire report for completeness. The PM ensures that any and all client-specified objectives were successfully achieved. All data are reported in units consistent with project specifications to enable easy comparison of data from report to report.

For subcontracted analyses, the PM verifies that the report received from the subcontractor is complete. This includes checking that the correct analyses were performed, the analyses were performed for each sample as requested, a report is provided for each analysis, and the report is signed. The PM accepts the report if all verification items are complete. Acceptance is demonstrated by forwarding the report to the client.

ALS - Stratford provides results objectively and does not interpret results or state opinions.

ALS - Stratford does not perform calibration services.

The laboratory reports results based on the sample provided by the customer.

19.2. Qualifiers

Qualifiers used by the laboratory are retained within the LIMS and are included with all client reports as an abbreviation with description in a summary table that is included with all client reports. Only the qualifiers used are included. They can be exported from LIMS upon request and are maintained by the LIMS Administrator.

19.3. Amended Reports

Amended reports of analytical results are issued to correct errors that are identified either by clients or internally. Amendments to analytical reports will only be made in supplemental documents that are clearly identified as amended.

Amended Reports are stored with the original report, are uniquely identified, and make reference to original reports. All amended reports must meet the same requirements as the original report. A peer review process is used to ensure amended results are accurate.

Periodically the QA Manager reviews the frequency and reason for amended report. If there is evidence of a chronic trend either with higher than usual frequency in general or for a specific type of error, then the control of nonconforming work is initiated.

Amended reports require the following items:

- the date amended,
- commentary in the case narrative identifying that this is an amended report and reason for the amendment, and
- qualifier or other means of clearly identifying changed results.

19.4. Deliverables

In order to meet individual project needs, ALS – Stratford provides several levels of analytical reports. Standard specifications for each level of deliverable are described below[20]. Variations may be provided based on client or project specifications.

When requested, ALS - Stratford provides **Electronic Data Deliverables** (EDDs) in the format specified by client need or project specification. ALS - Stratford is capable of generating EDDs with many different formats and specifications. Refer to the ALS-Stratford SOP *Generating EDDs and Reports for All Clients and Data Por Web Portal* (eQMS, ADMINEDDRptCC) for additional instructions.

Level	Specifications
Tier I	cover letter
	Sample analytical Results
	Sample Hold Time Summary
Tier II	Transmittal letter
	Case Narrative
	Sample Detection Summary

[20] The order of items may vary in actual client reports.

Level	Specifications
	Sample Cross Reference
	Chain of custody documents and sample/cooler receipt documentation
	Report Qualifiers and Definitions, Acronyms, Accreditation IDs, Analyst Summary
	Sample analytical results
	Method blank results
	Surrogate recovery results and acceptance criteria for applicable organic methods
	Matrix spike result(s) with calculated recovery and including associated acceptance criteria
	Duplicate or duplicate matrix spike result(s) (as appropriate to method), with calculated relative percent difference
	Laboratory Control Sample result(s) with calculated recovery and including associated acceptance criteria
	Dates of sample preparation and analysis for all samples and QC
	Sample Hold Time Summary
Tier III **Tier IV**	Tier III varies from Tier IV in that slightly less information is provided but include essentially the same information.
	Tier I, and II specifications
	All raw data including preparation and analysis bench sheets and instrument printouts, all applicable chromatograms, spectral, confirmation, and manual integration raw data (for organics analyses this includes GC/MS tuning results, mass spectra of all positive hits, and the results and spectra of TIC compounds when requested), QC data, calibration data (initial, verification, continuing, etc), calibration blanks or instrument blanks (as appropriate to method).

20. Complaints

ALS - Stratford has a documented process for how complaints are received, recorded, and evaluated (see SOP *Handling Client Complaints*, eQMS ADMINComplaints). This documentation is available upon request.

21. Nonconforming Work

When sample results do not conform to established quality control procedures, responsible management will evaluate the significance of the nonconforming work and address the nonconformance according to the procedures in the ALS-Stratford SOP *Control of Nonconforming Work* (eQMS, ADMINControlNCWork).

Most non-conformances are random events and can be addressed on the analytical report with standard qualifiers and statements prior to the release of the report. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed quality control measure shall be reported with the appropriate data qualifier(s).

When a nonconformance or other quality issue occurs that casts doubt on the validity of reported test results or additional client instructions are needed, the PM notifies the client within 10 business days of the discovery[21].

22. Control of Data and Information Management

Refer to Section **16** for additional information on retention of electronic records.

The laboratory has access to all data and information through the internet, intranet, network locations and hard copy.

Refer to the ALS Corporate policy *Data and IT Usage Policy* and *Information Management Policy* (Global Policies & Forms) for information on how ALS manages, secures, and controls data.

A continuing effort is made at ALS - Stratford to increase the use of automated data handling, improve efficiency, and minimize human error, through uploads of information to LIMS.

All raw data or original observations are retained. Handwritten data is verified for transcription errors by the secondary reviewer.

Software errors are treated as a nonconformances. If these occur for analytical instruments, the event and resolution is recorded in the applicable maintenance log. If it occurred for general laboratory systems, then the event is recorded through the control of nonconforming work process.

[21] In certain cases where there is a risk of legal response, a longer time period may be required to ensure that the proper authorities are notified prior to alerting the impacted clients. In such instances the ALS Legal team is consulted prior to taking any actions with clients and notification is at the discretion of ALS Legal.

Access to ALS intranet and servers are controlled through passwords and windows security. ALS passwords change every 90 days. User roles are assigned and restrict access to certain functions within the ALS intranet.

Access to LIMS is controlled through usernames and passwords. LIMS passwords are changed at a minimum of once per year. Computer security awareness training is provided upon hiring and on an annual basis. Records of the training are maintained. Inspections of the LIMS is performed at least annually by the QA Manager or designee to ensure integrity of electronic data, as part of internal auditing activities

23. Management System Requirements

The laboratory has implemented **Option A** from the ISO/IEC 17025:2017 standard as a management system, meaning that ALS-Stratford does not maintain ISO 9001 certification. The following sections address the required elements of Option A, as defined by ISO/IEC 17025:2017.

24. Management System Documentation

This manual describes or references the policies and objectives of the ALS - Stratford management system. The laboratory SOPs hosted on eQMS Document Register describe the details on how objectives are accomplished. Additional minimal expectations are defined in ALS Corporate policies and procedures maintained on the Global Policies & Forms SharePoint library.

Evidence of commitment is the review of this manual annually and the records of reading by all employees. Additionally, employees are assigned pertinent procedures as needed to ensure objectivity and consistency.

The policies are supported in this management system with references to the procedures as appropriate.

All employees have access to the Quality Assurance Manual and the supporting procedures, documents, and forms.

25. Control of Management System Documents

Procedures for control and maintenance of documents are described in ALS - Stratford SOP *Document Control* (eQMS, ADMINDOC).

External documents, such as reference methods, accreditation policies and requirements, and reference manuals are maintained under document control through the eQMS external document library.

SOPs that are no longer in use are archived. The eQMS system ensures that Users have access to only Current documents. Access to other status documents is restricted to specific role types.

Paper logbooks are scanned and retained on the ALS-Stratford server.

Historical versions of the SOPs hosted on eQMS are retained on the ALS-Stratford server.

26. Control of Records

Refer to Section **16** for additional information.

All records are stored in accordance with ALS-Stratford SOP *Control and Retention of Records* (eQMS, ADMINRECORDS).

Logbook entries are standardized following the ALS-Stratford SOP *Laboratory Notebook Control and Use* (eQMS, ADMIN LabNote).

ALS - Stratford personnel are responsible for retention, retrieval, and disposition of final records of laboratory data and activities. This includes[22]:

- sample receipt including original COC forms and any related receipt checklist,
- data packages,
- laboratory notebooks,
- instrument maintenance logs,
- training records,
- internal audits and external assessment records,
- management reviews,
- PT reports,

[22] Some of these records are maintained by ALS Support functions including HR, Financial, IT, and Procurement.

- QC charts,
- MDL/LOQ calculations,
- accreditation certificates and associated scope of accreditations, including notice of change letters and other critical communication with Accreditation Bodies,
- subcontractor accreditations[23],
- controlled documents including withdrawn and superseded versions,
- metrology data including any records associated with metrological traceability,
- data investigations,
- client complaints and queries,
- non-conformances,
- corrective and preventive actions,
- vendor approvals,
- purchasing documents,
- receipt records,
- and certificates of analysis, including calibration certificates and certificates of compliance or authenticity.

Changes made to data, including electronic data, must clearly identify the date and the person making the change.

All records are available to the accreditation bodies. Whenever possible, electronic instrument records are stored on the ALS-Stratford network, which is backed up remotely to prevent data loss due to hardware failure (refer to Section **16.2**).

Software and computers or instruments capable of using it is retained for as long as the original data needing that version is retained by the Laboratory Director.

27. Actions to Address Risks and Opportunities

Refer to previous sections as appropriate for detailed instructions on the processes mentioned in this section.

Multiple Quality System tools are used with the goal of identifying trends and preventing non-conformance with pro-active systems. These tools include the use of:

- preventive maintenance (defined in the routine maintenance requirements of testing SOPs),
- data review procedures, purchasing from approved vendors,
- second source standards and batch QC,
- interlaboratory comparison through participation in the Proficiency Testing programs,
- QC Charting for precision and bias evaluation,
- customer feedback as collected through the annual survey and through regular communication between the PMs and clients,
- internal auditing,
- management review,
- electronic data backup and computer security procedures,
- initial, ongoing, and refresher training procedures,
- monthly risk reporting through various required management reports for internal and regional review,
- document control including annual SOP review, which controls instructions provided to Employees, and
- initial and annual ethics training,

When systematic non-conformances are identified in one area, prevalence review is conducted to determine if implementation in other lab areas and other ALS labs is needed.

All bench level personnel are responsible to continually detect short-term trends in QC data and respond appropriately (instrument maintenance, check of extraction or instrument conditions, check of standards, etc.). Long Term trends are identified with QC Charting, review of Holding Time exceedances, and review of recurring non-conformances by the QA Manager or designee.

ALS - Stratford views risk management as a key component of its corporate governance responsibilities and an essential process in achieving and mandating a viable organization. ALS - Stratford is committed to enterprise wide risk management to ensure its corporate governance responsibilities are met and its strategic goals are realized.

Refer to ALS Corporate documents Risk Management Policy and Risk Appetite and Tolerance Policy (Global Policies & Forms) for details.

Risks to our business and how we address them include:

[23] ALS network laboratories have accreditations maintained on ALS Solutions and the ALS Group Sustainability site.

- **Impartiality by Employees**

  Analytical testing is completed without undue pressure to modify results to meet client objectives. ALS does not view this as a risk. There are many firewalls in the lab process to prevent occurrence.
  PMs are in contact with clients but there is no ability to influence testing results
  A data generated must be peer reviewed by a second party
  Lab operations only see samples, sample names and numbers. They do not have direct contact with clients.
  Annual Ethics and Data Integrity Training for all employees
  ALS Code of Conduct, ALS Whistleblower Policy, ALS Integrity Hotline, and Integrity and Compliance Helpline.

- **Chemical Exposure**

  Failure to practice procedures as trained, issues with the facility, and poor engineering controls can result in injury to employees, lost time, med/hospital situation, contamination, and can close the site.
  ALS has policies, chemical exposure training, and readily available SDS sheets. Employees are expected to offer suggestions for improvement and formally report any conditions where concern for safety is recognized.

- **Explosion/Chemical Fire**

  Improper chemical storage and usage along with lack of equipment and facility upkeep can result in loss of life, loss of property, and laboratory down time.
  ALS performs inspections and training, keeps an inventory of chemicals, establishes storage locations, and maintains minimal quantities of chemicals.

- **Supply Disruption**

  Natural disaster and vendors unable to provide needed supplies can disrupt the business, increase expenses, and result in lost production and lost clients.
  ALS maintains multiple sources for supplies, develops relationships with our vendors, and emphasizes communication between analysts, managers, purchasing and vendors.

- **Loss of Key Employees**

  Resignation, leave for personal reasons or for other employment can negatively impact the business. Communication, cross-training, designated backups, and having a pool of potential replacements minimizes this risk. We provide a positive atmosphere for employees and provide small perks to reward dedication.

- **Computer and Instrument Issues**

  Computer, instrument, or other IT failures can result in loss of revenue, loss of service, and loss of data.
  ALS provides necessary IT resources for instruments and computers including replacing older computers, keeping related systems in good repair, and replacing when necessary. ALS continues to build robust data systems and make provisions for stellar back-up storage for all data.

- **Reputation**

  Falsifying test results can result in loss of credibility, loss of clients, loss of revenue, and loss of accreditation.
  All new employees must sign an ethics agreement and have initial ethics and data integrity training. Annually, all employees must take ethics and data integrity refresher training. All data undergoes a proper peer review. ALS maintains a strong quality system.

- **Legal Ramifications**

  Not following workplace and environmental laws and failure to practice procedures as trained can result in license revocation, fines, and disruption of the business.
  Targeted and ongoing training, inspections, and having established procedures minimizes this risk. ALS continues to follow all laws and regulations.

- **Loss Time Injury**

  Failure to practice procedures as trained and not having proper safeguards in place can result in injury to employees, lost time, med/hospital situation, contamination, and can close the site.
  Policies, specific task related training, targeted and ongoing training, inspections, workplace safeguards, cross training, and designated backups, minimize this risk. ALS continues to grow the safety program and culture.

- **Loss of Revenue**

  Can be caused by various audit fines and contract penalties for late data resulting in loss of revenue and disruption in business.

Policies, specific quality training, targeted and ongoing training, inspections, workplace safeguards, and internal audits minimize these risks.

28. Improvement

ALS management is committed to continually improving the effectiveness of the management and quality systems by implementing the requirements of this quality manual. ALS is committed to improvements of the management systems through compliance with its own policies and procedures, including the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review.

ALS surveys clients and gains feedback on services provided. This input to management is managed at a corporate level and is reviewed during the management review processes. Customer feedback provides important information to allow the company to continually improve. The laboratory maintains and documents timely communication with the client for the purposes of seeking feedback and clarifying customer requests. Feedback is used and analyzed to improve the quality of services.

29. Corrective Actions

ALS Laboratory operations are governed by documented procedures, requirements, quality assurance plans, project plans, and contracts. When any operation, for any reason, does not conform to the requirements of the governing documents, the aberrant event, item, or situation must be properly documented and evaluated. If the evaluation indicates a systematic problem, root cause evaluation is undertaken, and corrective action is initiated.

Procedures for the documentation and resolution of corrective action are detailed in the ALS-Stratford SOP *Control of Nonconforming Work* (eQMS, ADMINContorlNCWork).

30. Internal Audits and External Assessments

Internal audits are conducted in accordance with ALS-Stratfod SOP *Internal Audit of Laboratory Testing Activities* (eQMS, ADMIN LAB Audit) and *Internal Quality Audit* (eQMS, ADMIN IntAudit).

When internal and external audits or data assessments reveal a cause for concern with the quality of the data an investigation is initiated by quality assurance personnel to determine the extent of the problem.

Internal audits include examination of laboratory practice, the use of data handling systems, documentation and document control, personnel qualification and training records, procurement activities, and other systems that support and augment the laboratory analytical function.

Audit and external assessment findings and any event that casts doubt on the validity of the testing results requires client notification within 15 business days of the discovery of the issue and proposed corrective actions to resolve nonconformance submitted to the customer within 30 business days of the discovery[24].

31. Management Review

ALS-Stratford has regular operations, technical, quality, and other support function meetings to review performance and ensure strategic goals are met. Regional ALS require regular monthly updates and quarterly strategic updates on ALS-Stratford performance in meeting objectives defined in the ALS Balance Scorecards and annual strategic plan. There are also other monthly performance reports required for safety, quality, and technology. This continuous monitoring helps to mitigate risks and opportunities.

It is the responsibility of the Laboratory Director to annually review the success of ALS-Stratford in meeting its objectives and compliance to the requirements of this management system. Trending the monthly and quarterly reports is used in the annual review including other inputs such as:

a. Changes in internal and external issues that are relevant to the laboratory; including risks to the laboratory's impartiality and any plan to minimize risks
b. Fulfilment of objectives;
c. Suitability of policies and procedures;

[24] In certain cases where there is a risk of legal response, a longer time period may be required to ensure that the proper authorities are notified prior to alerting the impacted clients. In such instances the ALS Legal team is consulted prior to taking any actions with clients and notification is at the discretion of ALS Legal.

d. Status of actions from previous management reviews;
e. Outcome of recent internal audits;
f. Corrective actions; Preventive Actions
g. Assessments by external bodies;
h. Changes in the volume and type of the work or in the range of laboratory activities;
i. Customer and personnel feedback;
j. Complaints;
k. Effectiveness of any implemented improvements;
l. Adequacy of resources;
m. Results of risk and opportunity identification;
n. Outcome of the assurance of the validity of results (interlaboratory comparisons or proficiency tests);
o. Other relevant factors, such as monitoring activities, quality control activities, and training.
p. Reports from managerial and supervisory personnel
q. Certifications, Accreditations, Licenses, Permits
r. Recommendations for improvement
s. Facility Control

Inputs may be gathered by roles as designated by the Laboratory Director and may include regional role involvement.

The outputs from the management review shall record all decisions and actions related to at least:

a. The effectiveness of the management system and its processes;
b. Improvement of the laboratory activities related to the fulfilment of the requirements of this document;
c. Provision of required resources;
d. Any need for change.

A summary of these outputs is generated annually and retained for year to year tracking of performance. Items that have a decreasing performance trend are flagged for more aggressive corrective action and those that are improving are reviewed to identify "what worked" to share that information within the ALS network or for future reference.

32. References

In addition to the normative references indicated in Section **2**, the following external references were used in this document:

- *Mechanical Volumetric Dispensing Devices, Volumetric Labware, and Non-Volumetric Labware,* hosted on eQMS under Site Rochester and Legacy ID RS-ADM-PCAL.
- *Definition and Procedure for the Determination of the Method Detection Limit, rv 2, EPA, Dec 2016*
- *Good Automated Laboratory Practices, Principles and Guidance to Regulations For Ensuring Data Integrity In Automated Laboratory Operations*, EPA 2185 (August 1995).
- *Manual for the Certification of Laboratories Analyzing Drinking Water*, 5th Edition, EPA 815-R-05- 004 (2005).
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, (September 1986)
  - and Updates I (July 1992), II (September 1994), IIA (August 1993), IIB (January 1995), III (December 1996), Final Update IV (February 2007), Final Update V (August 2015)
  - and updates posted online at http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm. See Chapters 1, 2, 3, and 4.
- *Methods for Chemical Analysis of Water and Wastes,* EPA-600/4-79-020, (Revised March 1983).
- *Methods for the Determination of Inorganic Substances in Environmental Samples,* EPA/600/R-93/100 (August 1993).
- *Methods for the Determination of Metals in Environmental Samples,* EPA/600/4-91/010 (June 1991) and Supplements.
- *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater,* EPA 600/4-82-057 (July 1982) and 40 CFR Part 136, Appendix A.
- *Methods for the Determination of Organic Compounds in Drinking Water*, EPA/600/4-88/039 (December 1988) and Supplements.
- *Standard Methods for the Examination of Water and Wastewater,* on-line Edition (various years).
- *40 CFR Part 141, National Primary Drinking Water Regulations.*
- Annual Book of ASTM Standards, Part 31, *Water.*

- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review,* EPA-540/R-94/012 (February 1993).
- *U. S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* EPA-540/R-94/013 (February 1994)

APPENDIX A – ABBREVIATIONS, TERMS, DEFINITIONS AND UNITS

Acronym / Term	Definition
ACS	American Chemical Society
ALS	Australia Laboratory Services
ANSI/ASQC	American National Standards Institute / American Society for Quality Control
ASTM	American Society for Testing and Materials
BFB	4-Bromofluorobenzene
BNA	Base Neutral Acid organic compounds (aka SOC or SVOCs)
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAS	Chemical Abstract Service Registry Number
CCV	Continuing Calibration Verification
CCB	Continuing Calibration Blank
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program (through EPA)
CoC	Chain of Custody
COD	Chemical Oxygen Demand
CFR	Code of Federal Regulations
CT	Connecticut
CV	Coefficient of Variation
DCM	Dichloromethane (also Methylene Chloride)
DEC	Department of Environmental Conservation
DEP	Department of Environmental Protection
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DO	Dissolved Oxygen
DOC (or ODOC)	Demonstration of Capability / Ongoing Demonstration of Capability
DoD/DOE	Department of Defense / Department of Energy
DOH	Department of Health
DQO	Data Quality Objective
DW (or PW)	Drinking Water / Potable Water
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
EPCRA	Emergency Planning & Community Right-to-Know Act
eQMS	electronic Quality Management System
ERA	Environmental Resource Associates
FDA	Food & Drug Administration
FIA	Flow Injection Analysis
FID	Flame Ionization Detector
FIFRA	Federal Insecticide, Fungicide & Rodenticide Act
FR	Federal Register
GC	Gas Chromatography
GC/MS	Gas Chromatography / Mass Spectrometry
HECD / ELCE	Hall Electrolytic Conductivity Detector
HR	Human Resources
IC	Ion Chromatography
ICB	Initial Calibration Blank
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectrometry (aka ICPAES)
ICP/MS (or ICP-MS)	Inductively Coupled Plasma / Mass Spectrometer (aka ICPMS)
ICV	Initial Calibration Verification
ID	Identifier
IDOC	Initial Demonstration of Capability
IR	Infrared Spectrophotometer
ISE	Ion Selective Electrode
ISO/IEC	Internal Organization for Standardization / International Electrotechnical Commission

Acronym / Term	Definition
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LOQ	Limit of Quantitation
LOR	Limit of Reporting
M (or MOD)	Modified (or MOD)
MB	Method Blank
MCL	Maximum Contaminant The highset permissible concentration of a substance allowed in drinking water as established by the EPA.
MDL	Method Detection Limit
ME	Marginal Exceedance
MPN	Most Probably Number
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	Not applicable or North America depending on context
NAS	National Academy of Sciences
NCASI	National Council for Air and Stream Improvement (for the Paper Industry)
NCI	National Cancer Institute
ND	Not Detected (at or above MRL)
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NIH	National Institute of Health
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPW	Non-Potable Water
NTIS	National Technical Information System
NTP	National Toxicology Program
ODOC (or DOC)	Ongoing Demonstration of Capability / Demonstration of Capability
OSHA	Occupational Safety and Health Administration
PBMS	Performance Based Measurement System
PCBs	Polychlorinated Biphenyls
PE	Performance Evaluation Sample (aka PT sample)
PID	Photoionization Detector
PM	Project Manager includes the Project Manager Assistant (PMA)
PMA	Project Manager Assistant
PQL	Practical Quantitation Limit
PT	Proficiency Testing
PW (or DW)	Potable Water or Drinking water
QA	Quality Assurance
QAM / QSM	Quality Assurance Manual / Quality Systems Manual
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RL	Reporting Limit
RPD	Relative Percent Difference (absolute difference between values) / (average of the values) x 100%
RSD	Relative Standard Deviation (standard deviation / absolute value of mean) x 100%
S (or SC)	Solid (or Solid / Chemical; also Soil or Soil / Chemical)
SD	Serial Dilutions and Standard Deviation depending on context
SIM	Selected Ion Monitoring
SOC	Semi-Volatile Organic Compound
SMO	Sample Management Office (aka Sample Receiving)
SOQ	Statement of Qualifications
SOW	Statement of Work

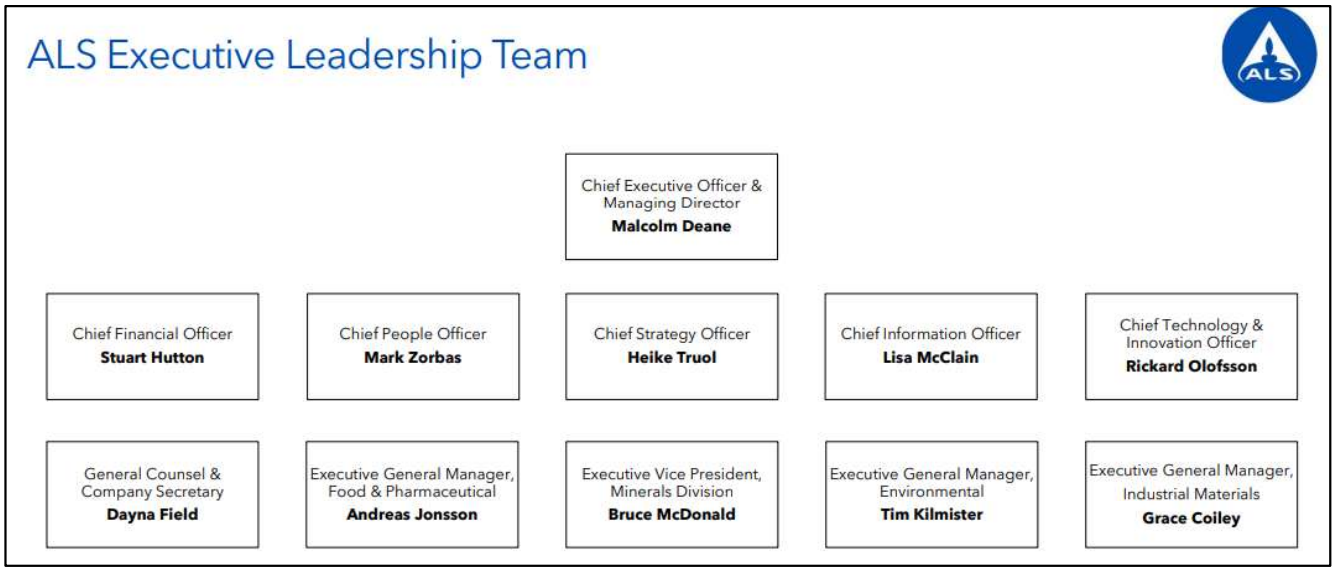
Acronym / Term	Definition
SVOA / SVOC	Semi-Volatile Organic Analyte / Compound
SW-846	Test Methods for Evaluating Solid Waste, Physical / Chemical Methods
TOC	Total Organic Carbon
TOX	Total Organic Halides
TNI	The NELAC Institute
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
TSS	Total Suspend Solids
TVS	Total Volatile Solids
UST	Underground Storage Tank
UV	Ultraviolet Spectrophotometer
VOA / VOC	Volatile Organic Analyte / Compound
WP	Water Pollution (references testing on non-potable water samples)
WS	Water Supply (references testing on drinking water or potable water samples)
YAL	York Analytical Laboratories Inc.

Units

Unit Symbol	Definition
g/L	grams per Liter
mg/kg	milligrams per Kilogram (same as ppm)
mg/L	milligrams per Liter (same as ppm)
µg/L	micrograms per Liter (same as ppb); sometimes written ug/L
ppb	parts per billion
ppm	parts per million
°C	degrees Celsius (sometimes abbreviated to a “C” next to a number)
°F	degrees Fahrenheit

APPENDIX B – ORGANIZATION CHARTS

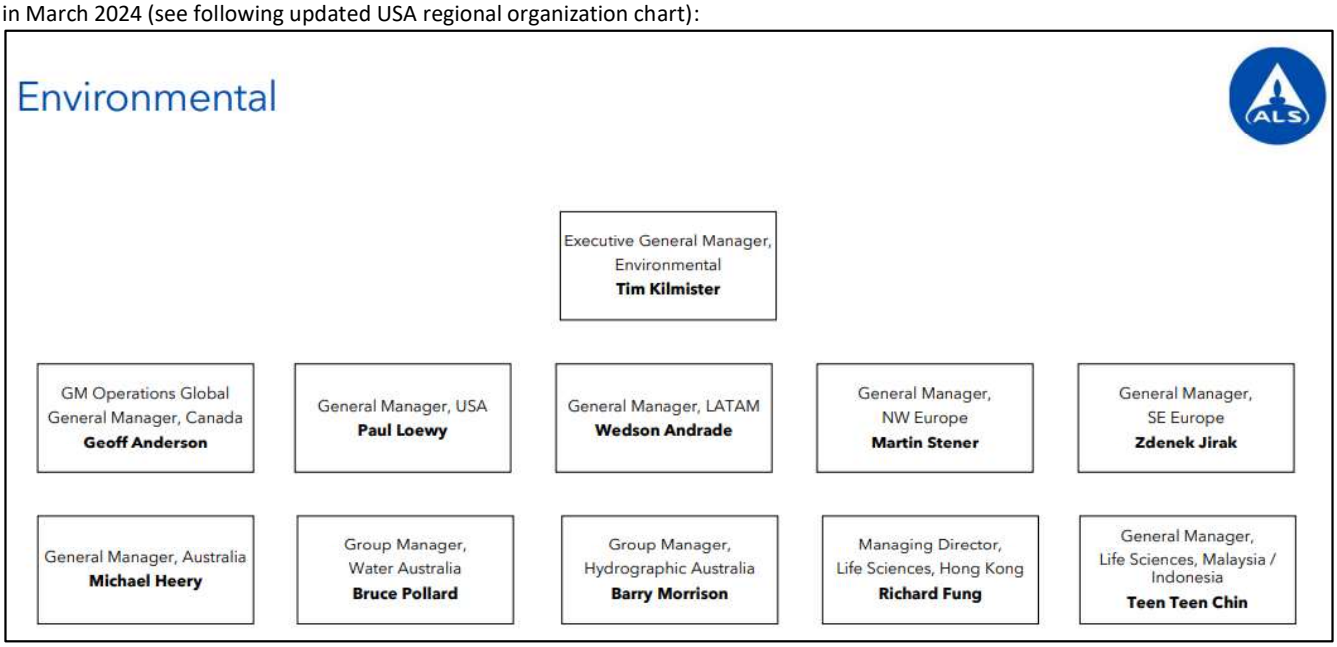
ALS Group Organization (Corporate) effective 10 October 2024:



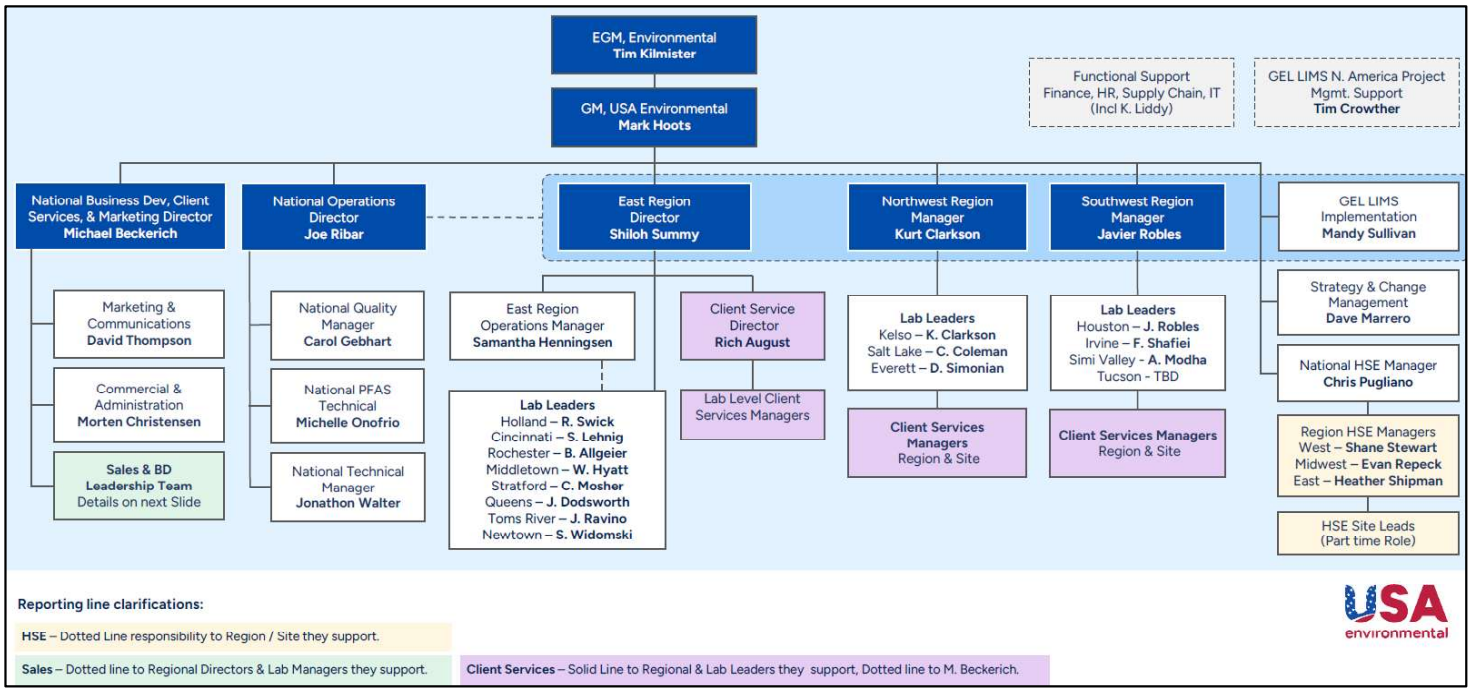
Other organization charts exist for the following Corporate Groups and provide support functions to USA Environmental. The current organization charts are maintained by HR and found on ALSNET under the HR portal for Organisation Structures - All Documents:

- finance
- human resources
- strategy
- information technology
- technology and innovation
- legal

The ALS Environmental Group is global and has the following structure as of 10 October 2024. Paul Loewy was replaced by Mark Hoots in March 2024 (see following updated USA regional organization chart):



National US Environmental Leadership and Business development organization, effective 7 April 2025:



USA Environmental - Business development organization

Roles & responsibilities for maximizing results from our sales focused professionals

Michael Beckerich
National Business Development, Client Services, Marketing & Communication Director

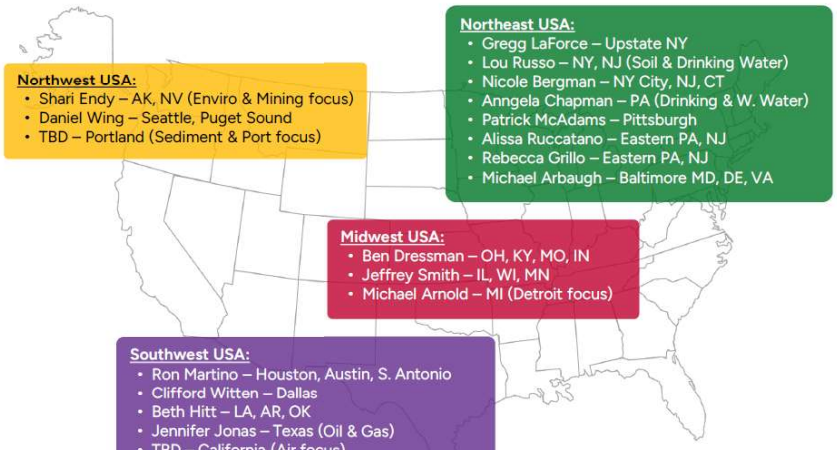
- Direct reporting line with all Regional BD Account Managers, unified to accelerate growth, while remaining synchronized with the Regional Leaders they support.
- Sales strategy development, training, and consistency of execution – aligned between BD, Client Services, and Operations Regional & local Lab Leaders
- Coordinated external-facing strategy for marketing, website, communications & CRM software.
- Development and adjustment of focused strategies for Top Clients, Federal Programs, Products, & Markets.

Morten Christensen
Commercial & Sales Administration Manager

- National Client Relationship Management & assignments.
- CRM Implementation, training, and management
- MSA's - Securing, Managing, & Maximizing.
- RFP Strategy and tracking – Finding and winning large RFPs in target areas & clients.
- Bid Documentation – Supporting sales needs for insurance, commercial questionnaires, licenses, etc.
- Administering Sales measurement & metrics program.

Business Development Account Management Team:

All-Star team of dynamic technical sales leaders who act as a unified force across the USA to develop and expand clients and markets; focused on their assigned region and clients, but optimizing sales growth for all services in USA. Each reports directly to M. Beckerich, dotted line to Regional Business Leader they support.



USA environmental

Stratford Location Organization, effective 14 November 2025:

York Analytical Laboratories, Inc.
Part of ALS Limited

Stratford, CT Laboratory
Reporting Structure

Updated 14 November 2025

Cassie Mosher, Technical Director
reports to Shiloh Summy (East Region Director)
reports indirect to Samantha Henningsen (East Region Operations Manager)
reports indirect to Jonathon Walter (National Technical Manager)

Corey Olsewski, Laboratory Director
reports to Shiloh Summy (East Region Director)
indirect to Samantha Henningsen (East Region operations Manag
and indirect to Jonathon Walter (National Technical manager)

Zachary Scott, Quality Assurance Officer
reports to Cassie Mosher
reports indirect to Carol Gebhart (National Quality Manager) and Anngela Chapman (Assistant National Quality Manager)

Anthony DeCarlo, Wet Chemistry Supervisor

Taylor Dauphinais	***Stacey Lecza****
Sienne Matregrano (W, Th, F)	*Ali Akbar*
Sam West	*Jackson Forlenza*
James Macisco	*Drhuvil Patel*
Jomar Morales	*Jack Storm*
Buanna Francois (Th, F)	
Christian DiMatteo	

Tom Jenkins, TCLP/SPLP Supervisor

	Jason O'Neill+
	Matthew Domagala++

Jason Tom, Metals Supervisor

Catherine Weed	*Kristina Qubick+*
Danielle Trant	
Ariana Ruffner	

Stephanie Brathwaite, Organics Manager

****Jaycen Munro**, Extractions Supervisor**

John Macdonald	*Joline Alisa*
Andrew Dunning	*Ronnel Brockett+*
Natalie Roadas Palencia	*Nicholas Blanco++*
Alexander Fernandes+	*Matt McGovern++*
Yang Li+	*Alexia Medina++*
Morrigan Timothy	*Danny Devissiere++*

Ben Johnson, GC Supervisor

Gillian Brogan*	*Tarek Abouel-Hassan*
Romanya Joseph	*Nick Fasnakis+*

Sal Rianna, SVOA Supervisor

Ali Lindberg	*Michael Alisa++*

Stephanie Brathwaite, VOA Supervisor

Paige Dostie	*Palak Bhasvar++*
Pruthvi Solanki	
Sarah Ferrante+ (10:00 - 18:30)	

Disposal
Claire Mora
Frazier Achundia

Lea Sherman, Login Supervisor

Noah Soriano^	***Daniel Corales^***
Tom Gabrielson	*McKenzie Elliot*
Lindsay Plude	*Jenny Fogle*
Jorge Cardona	

Key:	
**	*Second Shift Supervisor*
*	*Weekend Supervisor*
^	*Shift Lead*
Name not italicized	*First Shift (8:30-17:00)*
Name Italicized	*Second Shift (M-F 14:30-23:00)*
[Name]	*Site Safety Rep*
+	*Sunday - Thursday*
++	*Tuesday - Saturday*

Deputies:
Laboratory/Technical Director Stephanie Brathwaite
Quality Assurance Officer Cassie Mosher

APPENDIX C – ETHICS AND DATA INTEGRITY ATTESTATION STATEMENT

This is a copy of the Ethics and Data Integrity Attestation Statement that is signed electronically by all Employees after completion of the annual ALSTAR Ethics and Data Integrity Training. Records are maintained in ALSTAR.

ETHICS AND DATA INTEGRITY AGREEMENT

When this document is closed, a message asking that you understood the contents will appear. By selecting "YES" you are indicating that you have understood the Ethics and Data Integrity training course and agree to, and are committed to following each statement. If you disagree select "NO" and discuss further with your Site Leadership team.

I agree that in the performance of my duties at ALS:

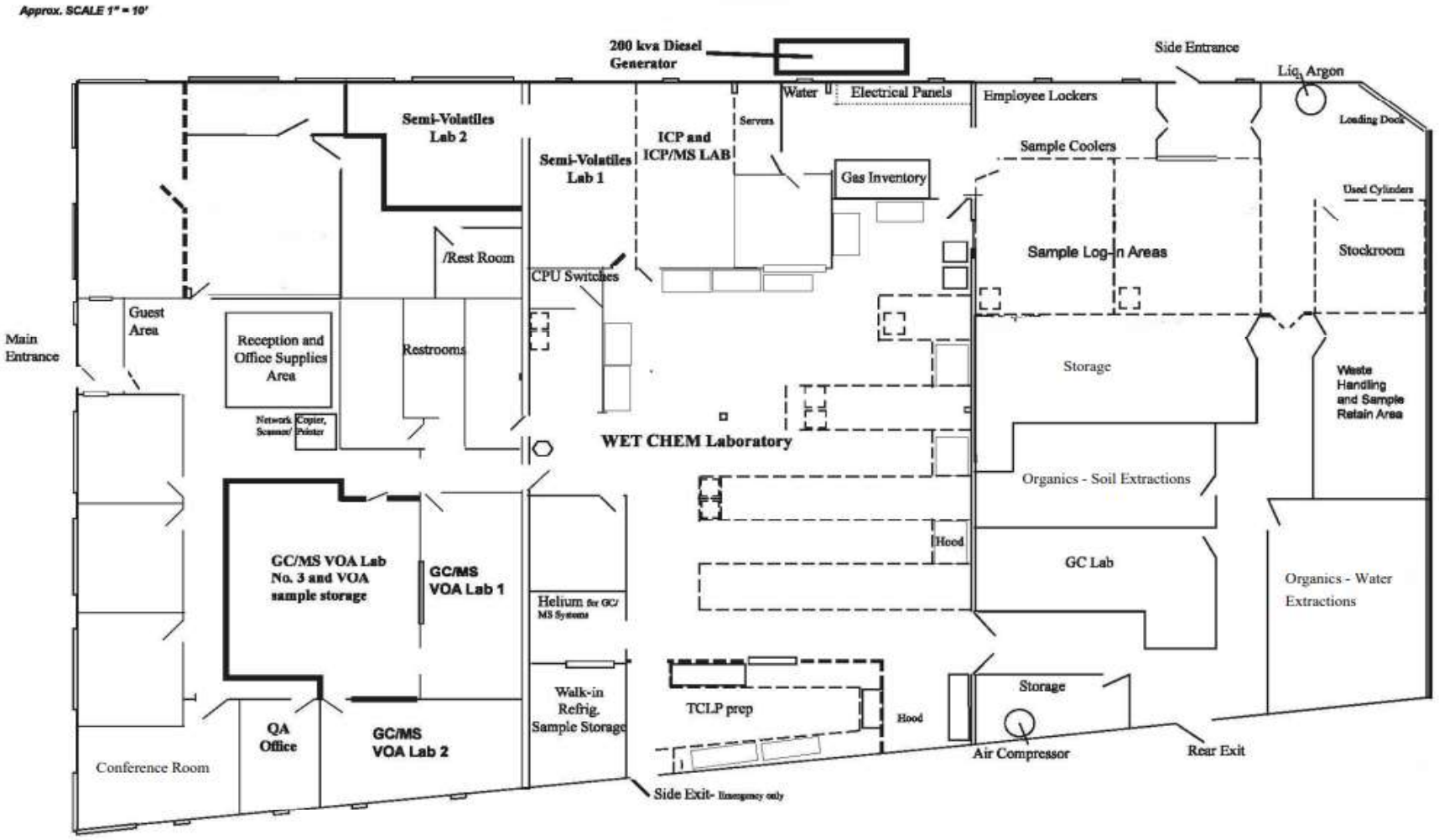
1. I shall not intentionally report data values that are not actual values obtained, including but not limited to results, dates, times, and method citations, and data values that do not meet established quality control criteria as set forth in the Method and/or SOP or as defined by company policy or client contract;
2. I shall not intentionally falsify through acts of commission, omission, erasure, or destruction, nor improperly manipulate any sample or QC data in any manner, unless the modification can be technically justified through a measurable analytical process or method acceptable to ALS. All such modifications and their justifications shall be clearly and thoroughly documented in the raw data and/or appropriate laboratory record, and will include my initials or signature and a date (either electronic or hardcopy as appropriate). The original data shall not be obscured but be retained through electronic version history, original save fail, single line cross out, or other appropriate retention method;
3. I shall not intentionally represent another individual's work as my own;
4. I agree to inform ALS of any accidental or intentional reporting of non-authentic data by other employees;
5. I have read and understood this Ethics and Data Integrity training and understand that failure to comply with the conditions stated within will result in disciplinary action, up to and including termination and possible criminal prosecution;
6. I am committed to performing all work assigned to me following ALS approved methods and procedures. I shall not follow hand-written notes or unapproved modifications. If I become aware of such unauthorized documents, I will bring these to the attention of my Supervisor, Lab Director, or Quality Manager immediately;
7. I shall not make false statements to, or seek to otherwise deceive ALS Staff or Clients;
8. I shall not condone any accidental or intentional reporting of unauthentic data by other ALS Staff and will immediately report such occurrences to my Supervisor, Lab Director, Quality Manager, Human Resources, or other ALS Whistleblower options. I understand that failure to report such occurrences may subject me to immediate disciplinary actions, up to and including termination and possible criminal prosecution;
9. If a Supervisor, Manager, Director, or other member of the ALS Leadership Group requests me to engage in or perform an activity that I feel is compromising data integrity, I acknowledge I have the right to refuse the request. I also have the right to appeal this action to other Supervisors, Lab Director, Quality Manager, Human Resources, or ALS Whistleblower options;
10. If my role within ALS includes supervisory or leadership responsibilities, I shall not instruct, request, or direct any subordinate to perform any unethical or non-defensible laboratory practice, nor shall I discourage, intimidate, or inhibit a staff member who may choose to appropriately appeal my instruction, request, or directive;
11. I understand that Employees who report violations of this policy will be kept free from intimidation and recrimination arising from such reporting.

Released Feb 2024 alsglobal.com | 1 of 1

APPENDIX D – LABORATORY FLOOR PLAN

ALS Laboratory - Stratford

120 Research Drive, Stratford, CT 06512



APPENDIX E – STANDARD OPERATING PROCEDURES

The following table summarizes the **ALS Limited Policies and Procedures** that form the foundation of all quality management systems within ALS Environmental USA. These documents are available on the internal secured intranet site (Policies - Grouped By Language (alsglobal.com)). This list is not all inclusive as some ALS Limited Corporate Policies apply to Support Departments such as Financial more than Quality Assurance. These documents are maintained by ALS Corporate.

Document Title	Document Number	Key Topics	Applicable To
ALS Code of Conduct	HR-GL-GRP-POL-001	• ALS commitments and Employee conduct expectations • guidelines for conducting business and interacting with 3rd parties • reporting code of conduct violations and consequences of such violations	All Employees
Anti-Bribery and Anti-Corruption Policy	CAR-GL-GRP-POL-008	ALS tolerance and procedures for: • accepting gifts and entertainment • facilitation of payments • donations and sponsorship • guidelines of interacting with 3rd parties • record keeping • reporting violations or suspicious behavior	ALS employees Sub-Contractors Consultants Agents Business partners of ALS Group
Guidelines for the Prevention of Bribery and Corruption	CAR-GL-GRP-GUI-001	• additional information to support CAR-GL-GRP-POL-008 • defines a series of general rules to avoid bribery and corruption • use of ALS Gift Register	ALS employees Sub-Contractors Consultants Agents Business partners of ALS Group
Business Partner Due Diligence Process	CAR-GL-GRP-PRO-001	• procedure to initiate prior to ALS entering into joint business association (excludes suppliers, contractors, and subcontractors) • expectations and monitoring	General Managers, Corporate Legal, ALS Compliance and Risk Committee, ALS CEO
Charitable Giving Procedure	FIN-GL-GRP-POL-004	• defines the *ALS Charitable Giving Committee* and causes that are supported globally • defines *ALS Cares* program • procedures for due diligence prior to donation, excluding giving, budgets and payments, records, reporting, and monitoring	Senior Roles responsible for authorizing Donations Members of the ALS Charitable Giving Committee
Compliance Policy	CAR-GL-GRP-POL-002	• defines Group Compliance Management program • examples of laws and regulations that could have compliance expectations for ALS • procedures to follow when non-compliance is discovered and reporting requirements	all ALS Employees (role responsibilities in document)
Continuous Disclosure Policy	CAR-GL-GRP-POL-003	• defines policies and procedures that the Board of ALS Limited follows in order to comply with Corporations Act 2001 and ASX Listing Rules	Board of ALS Limited Chief Executive Officers Regional Managers
Data and IT Usage Policy	IT-GL-GRP-POL-001	• compliance and reporting expectations • procedures and expectations for confidentiality, privacy, use of company assets, allocation of username and password, network and system access, use of email and internet services, use of standard hardware and software, remote access	all ALS Employees (role responsibilities in document)

Document Title	Document Number	Key Topics	Applicable To
Delegation of Authority (several)	FIN-GL-GRP-POL-006 (Corporate) FIN-GL-GRP-POL-006B (Corporate + B) FIN-FL-GRP-POL-006C (Corporate + C) FIN-FL-GRP-POL-006D (Corporate + D) FIN-GL-FRP-POL-014 (MARC Tech)	• defines the limits of authority and approval within the ALS Corporate Group for all internal and external transactions • defines the Level A, B, C, and D categories of authority • applies to capital items, operational expenses, property leases, customer tenders / quotations / contractions, formal agreements, credits or write offs, supplier contracts, engagement of contractors / consultants, recruitment, salary, termination, leave approval, personal expense reimbursement, company credit card and travel expenses, charitable donations and sponsorships, etc.	all ALS Employees with spending authorities
Fraud Risk Management Policy	CAR-GL-GRP-POL-023	• defines ALS no tolerance position for fraud • provides overview of control measures to prevent, detect, and respond to fraud	all ALS Employees (role responsibilities in document)
Fraud Control Plan	CAR-GL-GRP-PLN-001	• supplements CAR-GL-GRP-POL-023 • outlines ALS awareness and training plan and internal controls • detection and surveillance requirements • procedures for responding to fraud incidents	all ALS Employees (role responsibilities in document)
Information Management Policy	IT-GL-GRP-POL-002	• Part 1 = confidentiality, security of information, privacy, protection, proper use of company assets • Part 2 = protection and proper use of computer assets, allocation of usernames and passwords, appropriate use of email and internet including installation of software, access control and authorization, remote access • Part 3 = guidance to Business Streams for meeting ISO/IEC 27002:2013	Part 1 = all ALS Employees Part 2 = all ALS Employees who access computer systems Part 3 = all ALS Employees who administer or manage IT systems
Physical Security and Asset Management Standard	HSE-GL-GRP-ST-001	• defines physical security governance program (detect, delay, respond, mitigate, deter) • outlines common threats and risks • procedures for perimeter security, security zones within a facility, key requirements, visitor management, and reporting or responding to suspicious activity and incidents	all ALS Employees (role responsibilities in document)
Privacy Policy	CAR-GL-GRP-POL-001	• details how ALS collects, processes, and manages personal data • defines Employee rights	all ALS Employees (role responsibilities in document)
Procurement Supply Chain Policy	FIN-GL-GRP-POL-019	• expected protocol in dealing with vendors • requirement for vendor consolidation and use of negotiated pricing agreements • inventory management requirements • monitoring compliance	ALS Employees with procurement as part of their role
Quality Management Policy	CAR-GL-GRP-POL-012	• defines 11 processes for ensuring data integrity, confidentiality, and professional ethics	all ALS Employees

Document Title	Document Number	Key Topics	Applicable To
Recruitment Management Guidelines	HR-GL-GRp-GUI-001	• procedures for ensuring the right people are selected for the right positions in a timely manner • defines role of HR • procedures for vacancy assessment, recruitment approval, and job options • guidelines for sourcing options, selection, essential checks, offers, induction, and probationary period	all ALS Employees involved in hiring processes
Risk Appetite and Tolerance Policy	CAR-GL-GRP-POL-011	• defines the appetite for risk and articulates the boundaries around seeking opportunities • minimum requirements for management of risk within ALS	ALS Board, Executive, and Senior Management (regional and local)
Risk Management Policy	CAR-GL-GRP-POL-007	• outlines a risk management strategy considering the appetite and tolerance of ALS • complies with ISO 31000:2018	all ALS Employees involved in business decision making processes
Sanctions Policy	CAR-GL-GRP-POL-015	• outlines ALS commitments to complying with economic and trade sanctions applicable in the conduct of business	ALS Employees with procurement as part of their role
Securities Trading Policy	CAR-GL-GRP-POL-006	• guidelines and procedures to be adopted whenever company personnel intend to trade in ALS securities	all ALS Employees
Social Media Policy	HR-GL-GRP-POL-005	• provides 8 criteria for Employees to follow in using Social Media • consequences for violations • expectations when making reference to ALS on social media	all ALS Employees
Supplier Code of Conduct Policy	CAR-GL-GRP-POL-019	• defines expectations for ALS Vendors to ensure alignment to the ALS Code of Conduct • outlines 5 key requirements for Vendors • how to obtain Vendor acceptance and commitment	ALS Employees with procurement as part of their role
Whistleblower Policy	CAR-GL-GRP-POL-005	• explains how to report instances of suspicious, unethical, or fraudulent behavior without fear of retaliation • includes use of a 3rd party hotline • how genuine and false reports are handled and procedure for investigation and reporting to the Board and Risk Committee	all ALS Employees

APPENDIX F - Laboratory Accreditations

Scope of Program	Accreditation Body	AB Assigned Lab ID	General Scope of Program
State	Connecticut	PH-0840	Primary accreditation for DW, NPW, and SCM through NY
State	NELAP – New York	10854	Primary accreditation for DW, NPW, and SCM through NY
State	NELAP – New Jersey	CT005	Primary accreditation for DW, NPW, and SCM through NY; secondary through NJ
State	NELAP – Pennsylvania	68-04440	Primary accreditation for NPW and SCM through NY; secondary through PA.
State	ELAP	10854	Primary accreditation for Total Organic Carbon and Lead in Paint and Wipes through NY

DW = Drinking Water
NPW = Non-potable Water
SCM = Solid and Chemical Materials

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2026
Issued April 01, 2025
Revised January 27, 2026

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CATHERINE L. MOSHER
ALS ENVIRONMENTAL - STRATFORD
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Fuel Additives

Methyl tert-butyl ether	EPA 524.2
Naphthalene	EPA 524.2

Metals I

Arsenic, Total	EPA 200.8 Rev. 5.4
Barium, Total	EPA 200.7 Rev. 4.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4

Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Molybdenum, Total	EPA 200.8 Rev. 5.4

Serial No.: 71590

Property of the New York State Department of Health. Certificates are valid only at the address shown and must be conspicuously posted by the laboratory. Continued accreditation depends on the laboratory's successful ongoing participation in the Program. Consumers may verify a laboratory's accreditation status online at https://apps.health.ny.gov/pubdoh/applinks/wc/elappublicweb/, by phone (518) 485-5570 or by email to elap@health.ny.gov.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2026
Issued April 01, 2025
Revised January 27, 2026

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CATHERINE L. MOSHER
ALS ENVIRONMENTAL - STRATFORD
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Metals II

Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Metals III

Calcium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4
Potassium, Total	EPA 200.7 Rev. 4.4
Sodium, Total	EPA 200.7 Rev. 4.4

Miscellaneous

1,4-Dioxane	EPA 522
Turbidity	EPA 180.1 Rev. 2.0

Non-Metals

Alkalinity	SM 21-23 2320B (-97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Color	SM 21-23 2120B (-01)
Fluoride, Total	EPA 300.0 Rev. 2.1
Orthophosphate (as P)	EPA 300.0 Rev. 2.1
	SM 19, 21-23 4500-P E (-99)
Solids, Total Dissolved	SM 21-23 2540C (-97)
Specific Conductance	EPA 120.1 Rev. 1982
Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Trihalomethanes

Bromodichloromethane	EPA 524.2

Serial No.: 71590

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WADSWORTH CENTER

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Revised January 27, 2026

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CATHERINE L. MOSHER
ALS ENVIRONMENTAL - STRATFORD
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Trihalomethanes

Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2
Total Trihalomethanes	EPA 524.2

Volatile Aromatics

1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
2-Chlorotoluene	EPA 524.2
4-Chlorotoluene	EPA 524.2
Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2
n-Butylbenzene	EPA 524.2
n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	EPA 524.2
sec-Butylbenzene	EPA 524.2
Styrene	EPA 524.2
tert-Butylbenzene	EPA 524.2
Toluene	EPA 524.2

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Volatile Aromatics	
Total Xylenes	EPA 524.2
Volatile Halocarbons	
1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloroethene	EPA 524.2
1,1-Dichloropropene	EPA 524.2
1,2,3-Trichloropropane	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2
1,3-Dichloropropane	EPA 524.2
2,2-Dichloropropane	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Carbon tetrachloride	EPA 524.2
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2
cis-1,2-Dichloroethene	EPA 524.2
cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2
Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,2-Dichloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2

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Volatile Halocarbons

Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

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Acrylates

Acrolein (Propenal)	EPA 8260D
	EPA 624.1
Acrylonitrile	EPA 8260D
	EPA 624.1
Methyl methacrylate	EPA 8260D

Amines

1,2-Diphenylhydrazine	EPA 8270E
2-Nitroaniline	EPA 8270E
3-Nitroaniline	EPA 8270E
4-Chloroaniline	EPA 8270E
4-Nitroaniline	EPA 8270E
Aniline	EPA 625.1
	EPA 8270E
Carbazole	EPA 625.1
	EPA 8270E
Diphenylamine	EPA 8270E
Pyridine	EPA 625.1
	EPA 8270E

Benzidines

3,3'-Dichlorobenzidine	EPA 625.1
	EPA 8270E
Benzidine	EPA 625.1
	EPA 8270E

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 8081B
	EPA 608.3

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Chlorinated Hydrocarbon Pesticides

4,4'-DDE	EPA 8081B
	EPA 608.3
4,4'-DDT	EPA 8081B
	EPA 608.3
Aldrin	EPA 8081B
	EPA 608.3
alpha-BHC	EPA 8081B
	EPA 608.3
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 8081B
	EPA 608.3
Chlordane Total	EPA 8081B
	EPA 608.3
delta-BHC	EPA 8081B
	EPA 608.3
Dieldrin	EPA 8081B
	EPA 608.3
Endosulfan I	EPA 8081B
	EPA 608.3
Endosulfan II	EPA 8081B
	EPA 608.3
Endosulfan sulfate	EPA 8081B
	EPA 608.3
Endrin	EPA 8081B
	EPA 608.3
Endrin aldehyde	EPA 8081B
	EPA 608.3

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Chlorinated Hydrocarbon Pesticides

Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
	EPA 608.3
Heptachlor epoxide	EPA 8081B
	EPA 608.3
Lindane	EPA 8081B
	EPA 608.3
Methoxychlor	EPA 8081B
	EPA 608.3
Mirex	EPA 8081B
Toxaphene	EPA 8081B
	EPA 608.3

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260D
1,2,4,5-Tetrachlorobenzene	EPA 8270E
1,2,4-Trichlorobenzene	EPA 625.1
	EPA 8270E
2-Chloronaphthalene	EPA 625.1
	EPA 8270E
Hexachlorobenzene	EPA 8270E
Hexachlorobutadiene	EPA 625.1
	EPA 8270E
Hexachlorocyclopentadiene	EPA 625.1
	EPA 8270E
Hexachloroethane	EPA 625.1
	EPA 8270E

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Chlorinated Hydrocarbons	
Pentachlorobenzene	EPA 8270E
Chlorophenoxy Acid Pesticides	
2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
	SM 6640B-2006
2,4-D	EPA 8151A
Dicamba	EPA 8151A
Demand	
Biochemical Oxygen Demand	SM 5210B-2016
Carbonaceous BOD	SM 5210B-2016
Chemical Oxygen Demand	SM 5220D-2011
Fuel Oxygenates	
Di-isopropyl ether	EPA 8260D
Ethanol	EPA 8260D
Methyl tert-butyl ether	EPA 8260D
tert-amyl alcohol	EPA 8260D
tert-amyl methyl ether (TAME)	EPA 8260D
tert-butyl alcohol	EPA 8260D
tert-butyl ethyl ether (ETBE)	EPA 8260D
Haloethers	
2,2'-Oxybis(1-chloropropane)	EPA 625.1
	EPA 8270E
4-Bromophenylphenyl ether	EPA 625.1
	EPA 8270E
4-Chlorophenylphenyl ether	EPA 625.1
	EPA 8270E

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Haloethers

Bis(2-chloroethoxy)methane	EPA 625.1
	EPA 8270E
Bis(2-chloroethyl)ether	EPA 625.1
	EPA 8270E

Low Level Polynuclear Aromatics

Acenaphthene Low Level	EPA 8270E
	EPA 8270E SIM
Acenaphthylene Low Level	EPA 8270E
	EPA 8270E SIM
Anthracene Low Level	EPA 8270E
	EPA 8270E SIM
Benzo(a)anthracene Low Level	EPA 8270E
	EPA 8270E SIM
Benzo(a)pyrene Low Level	EPA 8270E
	EPA 8270E SIM
Benzo(b)fluoranthene Low Level	EPA 8270E
	EPA 8270E SIM
Benzo(g,h,i)perylene Low Level	EPA 8270E
	EPA 8270E SIM
Benzo(k)fluoranthene Low Level	EPA 8270E
	EPA 8270E SIM
Chrysene Low Level	EPA 8270E
	EPA 8270E SIM
Dibenzo(a,h)anthracene Low Level	EPA 8270E
	EPA 8270E SIM
Fluoranthene Low Level	EPA 8270E
	EPA 8270E SIM

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Low Level Polynuclear Aromatics

Fluorene Low Level	EPA 8270E
	EPA 8270E SIM
Indeno(1,2,3-cd)pyrene Low Level	EPA 8270E
	EPA 8270E SIM
Naphthalene Low Level	EPA 8270E
	EPA 8270E SIM
Phenanthrene Low Level	EPA 8270E
	EPA 8270E SIM
Pyrene Low Level	EPA 8270E
	EPA 8270E SIM

Metals I

Barium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Cadmium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Calcium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
Chromium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Copper, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D

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Metals I

Copper, Total	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Iron, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Lead, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Magnesium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
Manganese, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Nickel, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Potassium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
Silver, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Sodium, Total	EPA 200.7, Rev. 4.4 (1994)

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Metals I

Sodium, Total	EPA 6010D

Metals II

Aluminum, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Antimony, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Arsenic, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Beryllium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Chromium VI	EPA 7196A
	SM 3500-Cr B-2011
Mercury, Total	EPA 245.1, Rev. 3.0 (1994)
	EPA 7470A
	EPA 7473
Selenium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
Vanadium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D

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Metals II

Vanadium, Total	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Zinc, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)

Metals III

Cobalt, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Molybdenum, Total	EPA 200.8, Rev. 5.4 (1994)
Thallium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010D
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Tin, Total	EPA 200.8, Rev. 5.4 (1994)
Titanium, Total	EPA 200.8, Rev. 5.4 (1994)

Mineral

Alkalinity	SM 2320B-2011
Calcium Hardness	EPA 200.7, Rev. 4.4 (1994)
Chloride	EPA 300.0, Rev. 2.1 (1993)
Fluoride, Total	EPA 300.0, Rev. 2.1 (1993)
Hardness, Total	SM 2340B-2011
Sulfate (as SO4)	EPA 300.0, Rev. 2.1 (1993)

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Miscellaneous

Boron, Total	EPA 200.8, Rev. 5.4 (1994)
Bromide	EPA 300.0, Rev. 2.1 (1993)
Color	SM 2120B-2011
Cyanide, Total	SM 4500-CN E-2016
non-Polar Extractable Material (TPH)	EPA 1664A
Oil and Grease Total Recoverable	EPA 1664A
Phenols	EPA 420.1 (Rev. 1978)
Specific Conductance	EPA 120.1 (Rev. 1982)
Sulfide (as S)	SM 4500-S2- F-2011
Surfactant (MBAS)	SM 5540C-2011
Turbidity	EPA 180.1, Rev. 2.0 (1993)

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 625.1
	EPA 8270E
2,6-Dinitrotoluene	EPA 625.1
	EPA 8270E
Isophorone	EPA 625.1
	EPA 8270E
Nitrobenzene	EPA 625.1
	EPA 8270E

Nitrosoamines

N-Nitrosodimethylamine	EPA 625.1
	EPA 8270E
N-Nitrosodi-n-propylamine	EPA 625.1
	EPA 8270E
N-Nitrosodiphenylamine	EPA 625.1

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Revised December 15, 2025

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CATHERINE L. MOSHER
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Nitrosoamines	
N-Nitrosodiphenylamine	EPA 8270E
Nutrient	
Ammonia (as N)	SM 4500-NH3 D-2011 or E-2011
Kjeldahl Nitrogen, Total	SM 4500-N Org D-2011
	SM 4500-NH3 D-2011 or E-2011
Nitrate (as N)	EPA 300.0, Rev. 2.1 (1993)
Nitrate-Nitrite (as N)	EPA 300.0, Rev. 2.1 (1993)
Nitrite (as N)	EPA 300.0, Rev. 2.1 (1993)
Orthophosphate (as P)	EPA 300.0, Rev. 2.1 (1993)
	SM 4500-P E-2011
Phosphorus, Total	SM 4500-P E-2011
Organophosphate Pesticides	
Atrazine	EPA 8270E
Parathion ethyl	EPA 8270E
Petroleum Hydrocarbons	
Diesel Range Organics	EPA 8015D
Gasoline Range Organics	EPA 8015D
Phthalate Esters	
Benzyl butyl phthalate	EPA 625.1
	EPA 8270E
Bis(2-ethylhexyl) phthalate	EPA 625.1
	EPA 8270E
Diethyl phthalate	EPA 625.1
	EPA 8270E
Dimethyl phthalate	EPA 625.1
	EPA 8270E

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Phthalate Esters

Di-n-butyl phthalate	EPA 625.1
	EPA 8270E
Di-n-octyl phthalate	EPA 625.1
	EPA 8270E

Polychlorinated Biphenyls

Aroclor 1016 (PCB-1016)	EPA 8082A
	EPA 608.3
Aroclor 1221 (PCB-1221)	EPA 8082A
	EPA 608.3
Aroclor 1232 (PCB-1232)	EPA 8082A
	EPA 608.3
Aroclor 1242 (PCB-1242)	EPA 8082A
	EPA 608.3
Aroclor 1248 (PCB-1248)	EPA 8082A
	EPA 608.3
Aroclor 1254 (PCB-1254)	EPA 8082A
	EPA 608.3
Aroclor 1260 (PCB-1260)	EPA 8082A
	EPA 608.3
Aroclor 1262 (PCB-1262)	EPA 8082A
Aroclor 1268 (PCB-1268)	EPA 8082A

Polynuclear Aromatics

Acenaphthene	EPA 625.1
	EPA 8270E
Acenaphthylene	EPA 625.1
	EPA 8270E

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Polynuclear Aromatics

Anthracene	EPA 625.1
	EPA 8270E
Benzo(a)anthracene	EPA 625.1
	EPA 8270E
Benzo(a)pyrene	EPA 625.1
	EPA 8270E
Benzo(b)fluoranthene	EPA 625.1
	EPA 8270E
Benzo(g,h,i)perylene	EPA 625.1
	EPA 8270E
Benzo(k)fluoranthene	EPA 625.1
	EPA 8270E
Chrysene	EPA 625.1
	EPA 8270E
Dibenzo(a,h)anthracene	EPA 625.1
	EPA 8270E
Fluoranthene	EPA 625.1
	EPA 8270E
Fluorene	EPA 625.1
	EPA 8270E
Indeno(1,2,3-cd)pyrene	EPA 625.1
	EPA 8270E
Naphthalene	EPA 625.1
	EPA 8270E
Phenanthrene	EPA 8270E
Pyrene	EPA 625.1
	EPA 8270E

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Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270E
2,4,5-Trichlorophenol	EPA 625.1
	EPA 8270E
2,4,6-Trichlorophenol	EPA 625.1
	EPA 8270E
2,4-Dichlorophenol	EPA 625.1
	EPA 8270E
2,4-Dimethylphenol	EPA 625.1
	EPA 8270E
2,4-Dinitrophenol	EPA 8270E
2-Chlorophenol	EPA 625.1
	EPA 8270E
2-Methyl-4,6-dinitrophenol	EPA 625.1
	EPA 8270E
2-Methylphenol	EPA 625.1
	EPA 8270E
2-Nitrophenol	EPA 625.1
	EPA 8270E
4-Chloro-3-methylphenol	EPA 625.1
	EPA 8270E
4-Methylphenol	EPA 625.1
	EPA 8270E
4-Nitrophenol	EPA 625.1
	EPA 8270E
Cresols, Total	EPA 8270E
Pentachlorophenol	EPA 625.1
	EPA 8270E

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Priority Pollutant Phenols

Phenol	EPA 625.1
	EPA 8270E

Residue

Settleable Solids	SM 2540 F-2015
Solids, Total	SM 2540 B-2015
Solids, Total Dissolved	SM 2540 C-2015
Solids, Total Suspended	SM 2540 D-2015

Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270E
1,2-Dichlorobenzene, Semi-volatile	EPA 8270E
1,3-Dichlorobenzene, Semi-volatile	EPA 8270E
1,4-Dichlorobenzene, Semi-volatile	EPA 8270E
2-Methylnaphthalene	EPA 8270E
Acetophenone	EPA 8270E
alpha-Terpineol	EPA 625.1
	EPA 8270E
Benzaldehyde	EPA 8270E
Benzoic Acid	EPA 8270E
Benzyl alcohol	EPA 8270E
Caprolactam	EPA 8270E
Dibenzofuran	EPA 8270E

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260D
1,2,4-Trimethylbenzene	EPA 8260D
1,2-Dichlorobenzene	EPA 8260D
	EPA 624.1

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Volatile Aromatics

1,3,5-Trimethylbenzene	EPA 8260D
1,3-Dichlorobenzene	EPA 8260D
	EPA 624.1
1,4-Dichlorobenzene	EPA 8260D
	EPA 624.1
2-Chlorotoluene	EPA 8260D
4-Chlorotoluene	EPA 8260D
Benzene	EPA 8260D
	EPA 624.1
Bromobenzene	EPA 8260D
Chlorobenzene	EPA 8260D
	EPA 624.1
Ethyl benzene	EPA 8260D
	EPA 624.1
Isopropylbenzene	EPA 8260D
m/p-Xylenes	EPA 8260D
	EPA 624.1
Naphthalene, Volatile	EPA 8260D
n-Butylbenzene	EPA 8260D
n-Propylbenzene	EPA 8260D
o-Xylene	EPA 8260D
	EPA 624.1
p-Isopropyltoluene (P-Cymene)	EPA 8260D
sec-Butylbenzene	EPA 8260D
Styrene	EPA 8260D
	EPA 624.1
tert-Butylbenzene	EPA 8260D

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Volatile Aromatics

Toluene	EPA 8260D
	EPA 624.1
Total Xylenes	EPA 8260D
	EPA 624.1

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260D
1,1,1-Trichloroethane	EPA 8260D
	EPA 624.1
1,1,2,2-Tetrachloroethane	EPA 8260D
	EPA 624.1
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260D
1,1,2-Trichloroethane	EPA 8260D
	EPA 624.1
1,1-Dichloroethane	EPA 8260D
	EPA 624.1
1,1-Dichloroethene	EPA 8260D
	EPA 624.1
1,1-Dichloropropene	EPA 8260D
1,2,3-Trichloropropane	EPA 8260D
1,2-Dibromo-3-chloropropane	EPA 8260D
1,2-Dibromoethane	EPA 8260D
1,2-Dichloroethane	EPA 8260D
	EPA 624.1
1,2-Dichloropropane	EPA 8260D
	EPA 624.1
1,3-Dichloropropane	EPA 8260D
2,2-Dichloropropane	EPA 8260D

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Volatile Halocarbons

2-Chloroethylvinyl ether	EPA 8260D
	EPA 624.1
Bromochloromethane	EPA 8260D
Bromodichloromethane	EPA 8260D
	EPA 624.1
Bromoform	EPA 8260D
	EPA 624.1
Bromomethane	EPA 8260D
	EPA 624.1
Carbon tetrachloride	EPA 8260D
	EPA 624.1
Chloroethane	EPA 8260D
	EPA 624.1
Chloroform	EPA 8260D
	EPA 624.1
Chloromethane	EPA 8260D
	EPA 624.1
cis-1,2-Dichloroethene	EPA 8260D
	EPA 624.1
cis-1,3-Dichloropropene	EPA 8260D
	EPA 624.1
Dibromochloromethane	EPA 8260D
	EPA 624.1
Dibromomethane	EPA 8260D
Dichlorodifluoromethane	EPA 8260D
	EPA 624.1
Hexachlorobutadiene, Volatile	EPA 8260D

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Volatile Halocarbons

Methylene chloride	EPA 8260D
	EPA 624.1
Tetrachloroethene	EPA 8260D
	EPA 624.1
trans-1,2-Dichloroethene	EPA 8260D
	EPA 624.1
trans-1,3-Dichloropropene	EPA 8260D
	EPA 624.1
trans-1,4-Dichloro-2-butene	EPA 8260D
Trichloroethene	EPA 8260D
	EPA 624.1
Trichlorofluoromethane	EPA 8260D
	EPA 624.1
Vinyl chloride	EPA 8260D
	EPA 624.1

Volatiles Organics

1,4-Dioxane	EPA 8260D
	EPA 8270E
	EPA 8270E SIM
2-Butanone (Methylethyl ketone)	EPA 8260D
2-Hexanone	EPA 8260D
4-Methyl-2-Pentanone	EPA 8260D
Acetone	EPA 8260D
Carbon Disulfide	EPA 8260D
Cyclohexane	EPA 8260D
Methyl acetate	EPA 8260D
Methyl cyclohexane	EPA 8260D

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All approved analytes are listed below:

Volatiles Organics

Vinyl acetate	EPA 8260D

Sample Preparation Methods

SM 4500-P B(5)-2011
EPA 5030C
SM 4500-CN B-2016 and C-2016
EPA 3015A
EPA 3010A
EPA 3510C
SM 4500-N Org B-2011 or C-2011

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All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 8260D
Acrylonitrile	EPA 8260D
Methyl methacrylate	EPA 8260D

Amines

1,2-Diphenylhydrazine	EPA 8270E
2-Nitroaniline	EPA 8270E
3-Nitroaniline	EPA 8270E
4-Chloroaniline	EPA 8270E
4-Nitroaniline	EPA 8270E
Aniline	EPA 8270E
Carbazole	EPA 8270E
Diphenylamine	EPA 8270E

Benzidines

3,3'-Dichlorobenzidine	EPA 8270E
Benzidine	EPA 8270E

Characteristic Testing

Corrosivity (pH)	EPA 9045D
Free Liquids	EPA 9095B
Ignitability	EPA 1010A
Synthetic Precipitation Leaching Proc.	EPA 1312
TCLP	EPA 1311

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 8081B
4,4'-DDE	EPA 8081B
4,4'-DDT	EPA 8081B
Aldrin	EPA 8081B

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Chlorinated Hydrocarbon Pesticides

alpha-BHC	EPA 8081B
alpha-Chlordane	EPA 8081B
Atrazine	EPA 8270E
beta-BHC	EPA 8081B
Chlordane Total	EPA 8081B
delta-BHC	EPA 8081B
Dieldrin	EPA 8081B
Endosulfan I	EPA 8081B
Endosulfan II	EPA 8081B
Endosulfan sulfate	EPA 8081B
Endrin	EPA 8081B
Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
Heptachlor epoxide	EPA 8081B
Lindane	EPA 8081B
Methoxychlor	EPA 8081B
Mirex	EPA 8081B
Toxaphene	EPA 8081B

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260D
1,2,4,5-Tetrachlorobenzene	EPA 8270D
	EPA 8270E
1,2,4-Trichlorobenzene	EPA 8270E
2-Chloronaphthalene	EPA 8270E
Hexachlorobenzene	EPA 8270E

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Revised December 15, 2025

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. CATHERINE L. MOSHER
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2016) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Chlorinated Hydrocarbons

Hexachlorobutadiene	EPA 8270E
Hexachlorocyclopentadiene	EPA 8270E
Hexachloroethane	EPA 8270E

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dicamba	EPA 8151A

Haloethers

2,2'-Oxybis(1-chloropropane)	EPA 8270E
4-Bromophenylphenyl ether	EPA 8270E
4-Chlorophenylphenyl ether	EPA 8270E
Bis(2-chloroethoxy)methane	EPA 8270E
Bis(2-chloroethyl)ether	EPA 8270E

Metals I

Barium, Total	EPA 6010D
	EPA 6020B
Cadmium, Total	EPA 6010D
	EPA 6020B
Calcium, Total	EPA 6010D
Chromium, Total	EPA 6010D
	EPA 6020B
Copper, Total	EPA 6010D
	EPA 6020B
Iron, Total	EPA 6010D
Lead, Total	EPA 6010D

Serial No.: 71481

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Metals I

Lead, Total	EPA 6020B
Magnesium, Total	EPA 6010D
Manganese, Total	EPA 6010D
	EPA 6020B
Nickel, Total	EPA 6010D
	EPA 6020B
Potassium, Total	EPA 6010D
Silver, Total	EPA 6010D
	EPA 6020B
Sodium, Total	EPA 6010D

Metals II

Aluminum, Total	EPA 6010D
	EPA 6020B
Antimony, Total	EPA 6010D
	EPA 6020B
Arsenic, Total	EPA 6010D
	EPA 6020B
Beryllium, Total	EPA 6010D
Chromium VI	EPA 7196A
Mercury, Total	EPA 7471B
	EPA 7473
Selenium, Total	EPA 6010D
	EPA 6020B
Vanadium, Total	EPA 6010D
	EPA 6020B
Zinc, Total	EPA 6010D
	EPA 6020B

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Metals III	
Cobalt, Total	EPA 6010D
	EPA 6020B
Thallium, Total	EPA 6010D
	EPA 6020B
Tin, Total	EPA 6020B
Miscellaneous	
Boron, Total	EPA 6020B
Cyanide, Total	EPA 9014
Nitroaromatics and Isophorone	
2,4-Dinitrotoluene	EPA 8270E
2,6-Dinitrotoluene	EPA 8270E
Isophorone	EPA 8270E
Nitrobenzene	EPA 8270E
Pyridine	EPA 8270E
Nitrosoamines	
N-Nitrosodimethylamine	EPA 8270E
N-Nitrosodi-n-propylamine	EPA 8270E
N-Nitrosodiphenylamine	EPA 8270E
Organophosphate Pesticides	
Parathion ethyl	EPA 8270E
Petroleum Hydrocarbons	
Diesel Range Organics	EPA 8015D
Gasoline Range Organics	EPA 8015D
Phthalate Esters	
Benzyl butyl phthalate	EPA 8270E

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Phthalate Esters

Bis(2-ethylhexyl) phthalate	EPA 8270E
Diethyl phthalate	EPA 8270E
Dimethyl phthalate	EPA 8270E
Di-n-butyl phthalate	EPA 8270E
Di-n-octyl phthalate	EPA 8270E

Polychlorinated Biphenyls

Aroclor 1016 (PCB-1016)	EPA 8082A
Aroclor 1016 (PCB-1016) in Oil	EPA 8082A
Aroclor 1221 (PCB-1221)	EPA 8082A
Aroclor 1221 (PCB-1221) in Oil	EPA 8082A
Aroclor 1232 (PCB-1232)	EPA 8082A
Aroclor 1232 (PCB-1232) in Oil	EPA 8082A
Aroclor 1242 (PCB-1242)	EPA 8082A
Aroclor 1242 (PCB-1242) in Oil	EPA 8082A
Aroclor 1248 (PCB-1248)	EPA 8082A
Aroclor 1248 (PCB-1248) in Oil	EPA 8082A
Aroclor 1254 (PCB-1254)	EPA 8082A
Aroclor 1254 (PCB-1254) in Oil	EPA 8082A
Aroclor 1260 (PCB-1260)	EPA 8082A
Aroclor 1260 (PCB-1260) in Oil	EPA 8082A
Aroclor 1262 (PCB-1262)	EPA 8082A
Aroclor 1262 (PCB-1262) in Oil	EPA 8082A
Aroclor 1268 (PCB-1268)	EPA 8082A
Aroclor 1268 (PCB-1268) in Oil	EPA 8082A

Polynuclear Aromatic Hydrocarbons

Acenaphthene	EPA 8270E

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Polynuclear Aromatic Hydrocarbons

Acenaphthylene	EPA 8270E
Anthracene	EPA 8270E
Benzo(a)anthracene	EPA 8270E
Benzo(a)pyrene	EPA 8270E
Benzo(b)fluoranthene	EPA 8270E
Benzo(g,h,i)perylene	EPA 8270E
Benzo(k)fluoranthene	EPA 8270E
Chrysene	EPA 8270E
Dibenzo(a,h)anthracene	EPA 8270E
Fluoranthene	EPA 8270E
Fluorene	EPA 8270E
Indeno(1,2,3-cd)pyrene	EPA 8270E
Naphthalene	EPA 8270E
Phenanthrene	EPA 8270E
Pyrene	EPA 8270E

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270E
2,4,5-Trichlorophenol	EPA 8270E
2,4,6-Trichlorophenol	EPA 8270E
2,4-Dichlorophenol	EPA 8270E
2,4-Dimethylphenol	EPA 8270E
2,4-Dinitrophenol	EPA 8270E
2-Chlorophenol	EPA 8270E
2-Methyl-4,6-dinitrophenol	EPA 8270E
2-Methylphenol	EPA 8270E
2-Nitrophenol	EPA 8270E
4-Chloro-3-methylphenol	EPA 8270E

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Priority Pollutant Phenols

4-Methylphenol	EPA 8270E
4-Nitrophenol	EPA 8270E
Pentachlorophenol	EPA 8270E
Phenol	EPA 8270E

Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270E
1,2-Dichlorobenzene, Semi-volatile	EPA 8270E
1,3-Dichlorobenzene, Semi-volatile	EPA 8270E
1,4-Dichlorobenzene, Semi-volatile	EPA 8270E
2-Methylnaphthalene	EPA 8270E
Acetophenone	EPA 8270E
Benzaldehyde	EPA 8270E
Benzoic Acid	EPA 8270E
Benzyl alcohol	EPA 8270E
Caprolactam	EPA 8270E
Dibenzofuran	EPA 8270E

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260D
1,2,4-Trimethylbenzene	EPA 8260D
1,2-Dichlorobenzene	EPA 8260D
1,3,5-Trimethylbenzene	EPA 8260D
1,3-Dichlorobenzene	EPA 8260D
1,4-Dichlorobenzene	EPA 8260D
2-Chlorotoluene	EPA 8260D
4-Chlorotoluene	EPA 8260D
Benzene	EPA 8260D

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Volatile Aromatics

Bromobenzene	EPA 8260D
Chlorobenzene	EPA 8260D
Ethyl benzene	EPA 8260D
Isopropylbenzene	EPA 8260D
m/p-Xylenes	EPA 8260D
Naphthalene, Volatile	EPA 8260D
n-Butylbenzene	EPA 8260D
n-Propylbenzene	EPA 8260D
o-Xylene	EPA 8260D
p-Isopropyltoluene (P-Cymene)	EPA 8260D
sec-Butylbenzene	EPA 8260D
Styrene	EPA 8260D
tert-Butylbenzene	EPA 8260D
Toluene	EPA 8260D
Total Xylenes	EPA 8260D

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260D
1,1,1-Trichloroethane	EPA 8260D
1,1,2,2-Tetrachloroethane	EPA 8260D
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260D
1,1,2-Trichloroethane	EPA 8260D
1,1-Dichloroethane	EPA 8260D
1,1-Dichloroethene	EPA 8260D
1,1-Dichloropropene	EPA 8260D
1,2,3-Trichloropropane	EPA 8260D
1,2-Dibromo-3-chloropropane	EPA 8260D
1,2-Dibromoethane	EPA 8260D

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Volatile Halocarbons

1,2-Dichloroethane	EPA 8260D
1,2-Dichloropropane	EPA 8260D
1,3-Dichloropropane	EPA 8260D
2,2-Dichloropropane	EPA 8260D
2-Chloroethylvinyl ether	EPA 8260D
Bromochloromethane	EPA 8260D
Bromodichloromethane	EPA 8260D
Bromoform	EPA 8260D
Bromomethane	EPA 8260D
Carbon tetrachloride	EPA 8260D
Chloroethane	EPA 8260D
Chloroform	EPA 8260D
Chloromethane	EPA 8260D
cis-1,2-Dichloroethene	EPA 8260D
cis-1,3-Dichloropropene	EPA 8260D
Dibromochloromethane	EPA 8260D
Dibromomethane	EPA 8260D
Dichlorodifluoromethane	EPA 8260D
Hexachlorobutadiene, Volatile	EPA 8260D
Methylene chloride	EPA 8260D
Tetrachloroethene	EPA 8260D
trans-1,2-Dichloroethene	EPA 8260D
trans-1,3-Dichloropropene	EPA 8260D
Trichloroethene	EPA 8260D
Trichlorofluoromethane	EPA 8260D
Vinyl chloride	EPA 8260D

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Volatile Organics

1,4-Dioxane	EPA 8260D
	EPA 8270E
	EPA 8270E SIM
2-Butanone (Methylethyl ketone)	EPA 8260D
2-Hexanone	EPA 8260D
4-Methyl-2-Pentanone	EPA 8260D
Acetone	EPA 8260D
Carbon Disulfide	EPA 8260D
Cyclohexane	EPA 8260D
Methyl acetate	EPA 8260D
Methyl cyclohexane	EPA 8260D
Methyl tert-butyl ether	EPA 8260D
tert-butyl alcohol	EPA 8260D
Vinyl acetate	EPA 8260D

Sample Preparation Methods

	EPA 5035A-L
	EPA 5035A-H
	EPA 3580A
	EPA 3010A
	EPA 3050B
	EPA 3550C
	EPA 3546
	EPA 3060A
	EPA 9010C

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APPENDIX F: CLIMATE SCREENING CHECKLIST

Climate Screening Checklist

Background Information

- Project Manager: Andre A. Obligado
- Site Name: Former Bictos Webster Cleaners
- Site Number: C203186
- Site Location: 1321 Webster Avenue, Bronx, NY
- Site Elevation (average above sea level): Appr. 35 feet above mean sea level
- ClimAID Region (Responding Climate Change in New York State (ClimAID) - NYSERDA): Region 4 - New York City and Long Island
- Remedial Stage/site classification: Pending BCP Acceptance
- Contamination - Media Impacted/ Contaminants of Concern: Soil, Groundwater, Soil Vapor
- Proposed/Current Remedy: Investigation/Design Phase
- What is the predicted timeframe of the remedy? Will components of the remedy still be in place in 10+ years?

  Remedy is anticipated to be completed in 3 years as part of the redevelopment of the Site. If required, engineering controls will remain in place, be maintained or replaced as needed for duration of requirement under future site management.

- Is the site in proximity to any sensitive receptors? (e.g. wetlands, waterbodies, residential properties, hospitals, schools, drinking water supplies, etc.)

  Yes, three sensitive receptors (Wildflower New York Charter School, Early Scholars Group Family Daycare and William Hodson Community Center) are located within 500 feet of the Site.

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

☒ **Yes** ☐ **No**

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

☐ **Yes** ☒ **No**

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

☐ **Yes** ☒ **No**

Climate Screening Table*

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

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

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

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

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

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

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

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

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

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

FEMA- National Flood Hazard Layer | FEMA.gov

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

Department of Agriculture Forest Service Wildfire Risk to Communities

EPA Climate Change Indicators in the United States

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

EPA National Stormwater Calculator

National Integrated Drought Information System U.S. Drought Portal

National Interagency Coordination Center National Interagency Fire Center

National Oceanic and Atmospheric Administration Coastal Services Digital Coast

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

National Oceanic and Atmospheric Administration National Centers for Environmental Information website

National Oceanic and Atmospheric Administration Sea Level Trends

National Weather Service Climate Prediction Center

National Weather Service National Hurricane Center

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

National Weather Service Storm Surge Hazard Maps

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

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

U.S. Geological Survey Coastal Change Hazards Portal

U.S. Geological Survey Landslide Hazards Program

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

U.S. Geological Survey National Climate Change Viewer

U.S. Geological Survey National Water Dashboard

U.S. Geological Survey StreamStats

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

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

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

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

APPENDIX G: ENVIRONMENTAL FOOTPRINT ANALYSIS

ENVIRONMENTAL FOOTPRINT ANALYSIS

Former Bictos Webster Cleaners
1321 Webster Avenue
Bronx, New York

Block 2887, Lot 179

HydroTech Environmental, Engineering and Geology, DPC has conducted the following Environmental Footprint Analysis in accordance with EPA 542-R-12-002 for Remedial Investigation Work Plan (RIWP) at 1321 Webster Avenue, Bronx (Site).

As presented in the results of the Environmental Footprint Analysis, the proposed investigation scope will potentially result in the following energy usage and emissions:

- 204.4 Metric Million British Thermal Unit (MMBtus) of total energy for potential on-site and off-site activities;
- 16.1 tons of total greenhouse gas (GHG) emissions in CO2e include consideration of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions;
- 427.4 pounds of nitrogen oxide (NO_x), sulfur oxides (SO_x) and particulate matter (PM) emissions; and
- 15.6 pounds of hazardous air pollutant (HAP) emissions.

The energy usage is anticipated to be resulted from the following activities:

- 7.5 MMBtus used for on-site activities;
- 1.2 MMBtus used for grid electricity generation;
- 147.8 MMBtus used for transportation of personnel and materials; and
- 48 MMBtus used for off-site activities.

The GHG emissions is anticipated to be resulted from the following activities:

- 0.6 tons from on-site activities;
- 0.1 tons from grid electricity generation;
- 12 tons from transportation of personnel and materials; and
- 3.5 tons from off-site activities.

In sum, the footprint of the investigation is anticipated to be dominated by the projected on-site activities, which are anticipated taking up to 76.5% of the total energy usage and 78.1% of the total GHG emissions.

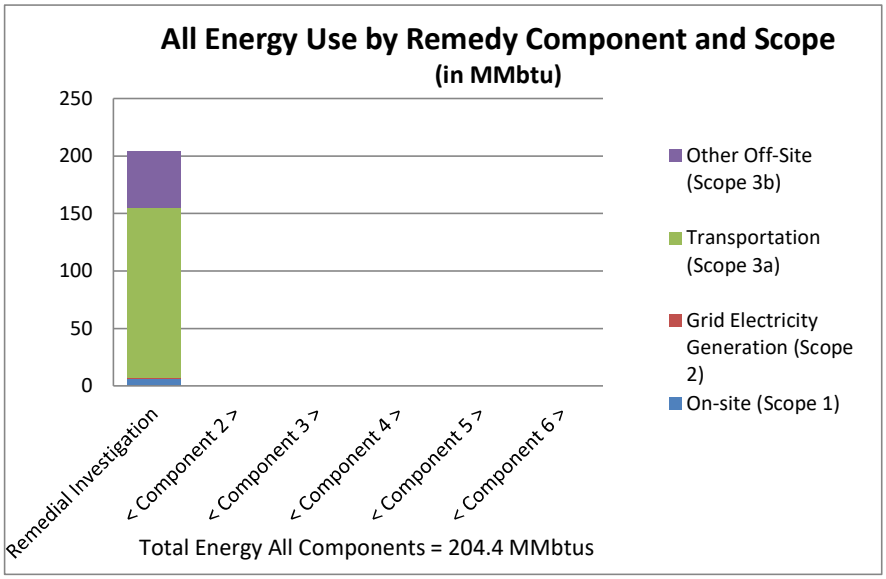
Environmental Footprint Summary

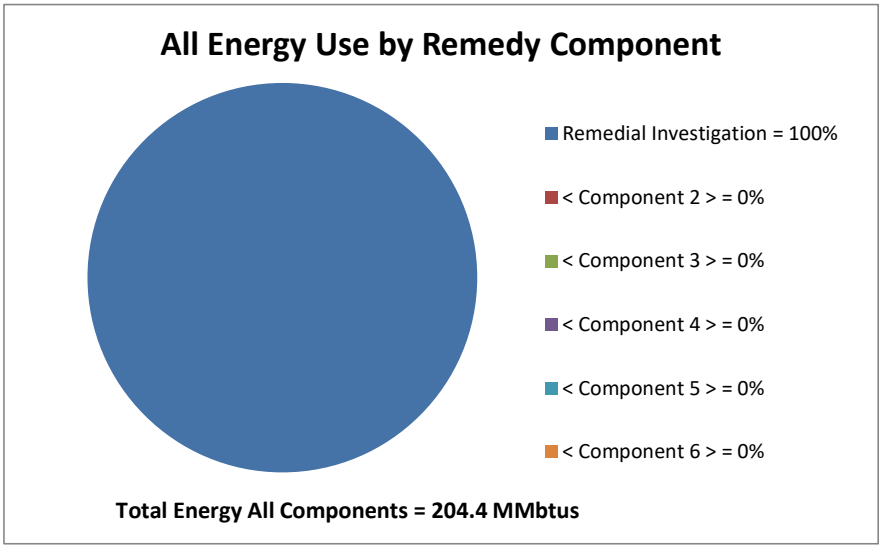
Core Element	Metric		Unit of Measure	Footprint						
				Remedial Investigation	< Component 2 >	< Component 3 >	< Component 4 >	< Component 5 >	< Component 6 >	Total
Materials & Waste	M&W-1	Refined materials used on-site	Tons	0.9	0.0	0.0	0.0	0.0	0.0	0.9
	M&W-2	% of refined materials from recycled or reused material	%	0.0%						0.0%
	M&W-3	Unrefined materials used on-site	Tons	0.000	0.000	0.000	0.000	0.000	0.000	0.0
	M&W-4	% of unrefined materials from recycled or reused material	%							
	M&W-5	On-site hazardous waste disposed of off-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-6	On-site non-hazardous waste disposed of off-site	Tons	1.2	0.0	0.0	0.0	0.0	0.0	1.2
	M&W-7	Recycled or reused waste	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-8	% of total potential waste recycled or reused	%	0.0%						0.0%
Water (used on-site)	W-1	Public water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-2	Groundwater use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-3	Surface water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-4	Reclaimed water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-5	Storm water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-6	User-defined water resource #1	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-7	User-defined water resource #2	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-8	Wastewater generated	MG	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Energy	E-1	Total energy used (on-site and off-site)	MMBtu	204.4	0.0	0.0	0.0	0.0	0.0	204.4
	E-2	Energy voluntarily derived from renewable resources								
	E-2A	On-site renewable energy generation or use + on-site biodiesel use + biodiesel and other renewable resource use for transportation	MMBtu	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-2B	Voluntary purchase of renewable electricity	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-3	Voluntary purchase of RECs	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-4	On-site grid electricity use	MWh	0.168	0.000	0.000	0.000	0.000	0.000	0.2
Air	A-1	On-site NOx, SOx, and PM emissions	Pounds	8.5	0.0	0.0	0.0	0.0	0.0	8.5
	A-2	On-site HAP emissions	Pounds	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	A-3	Total NOx, SOx, and PM emissions	Pounds	427.4	0.0	0.0	0.0	0.0	0.0	427.4
	A-3A	Total NOx emissions	Pounds	253.2	0.0	0.0	0.0	0.0	0.0	253.2
	A-3B	Total SOx emissions	Pounds	147.8	0.0	0.0	0.0	0.0	0.0	147.8
	A-3C	Total PM emissions	Pounds	26.4	0.0	0.0	0.0	0.0	0.0	26.4
	A-4	Total HAP emissions	Pounds	15.6	0.0	0.0	0.0	0.0	0.0	15.6
	A-5	Total greenhouse gas emissions	Tons CO2e*	16.1	0.0	0.0	0.0	0.0	0.0	16.1
Land & Ecosystems	Qualitative Description									

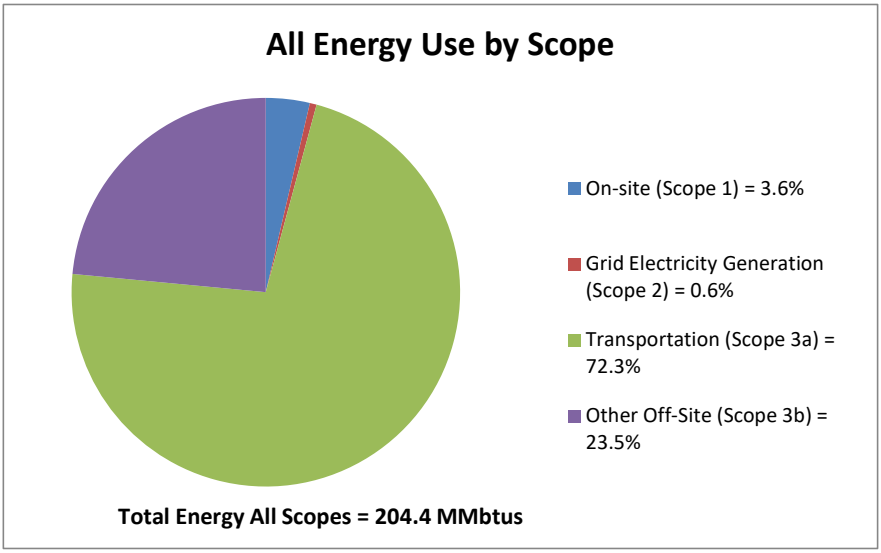
** Total greenhouse gases emissions (in CO2e) include consideration of CO2, CH4, and N2O (Nitrous oxide) emissions.*
"MMBtu" = millions of Btus
"MG" = millions of gallons
"CO2e" = carbon dioxide equivalents of global warming potential
"MWh" = megawatt hours (i.e., thousands of kilowatt-hours or millions of Watt-hours)
"Tons" = short tons (2,000 pounds)

The above metrics are consistent with EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint (EPA 542-R-12-002), February 2012

Notes:


All Energy Use by Remedy Component and Scope
(in MMbtu)
250
200
150
100
50
0
Remedial Investigation
< Component 2 >
< Component 3 >
< Component 4 >
< Component 5 >
< Component 6 >
Other Off-Site (Scope 3b)
Transportation (Scope 3a)
Grid Electricity Generation (Scope 2)
On-site (Scope 1)
Total Energy All Components = 204.4 MMbtus


All Energy Use by Remedy Component
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%
Total Energy All Components = 204.4 MMbtus

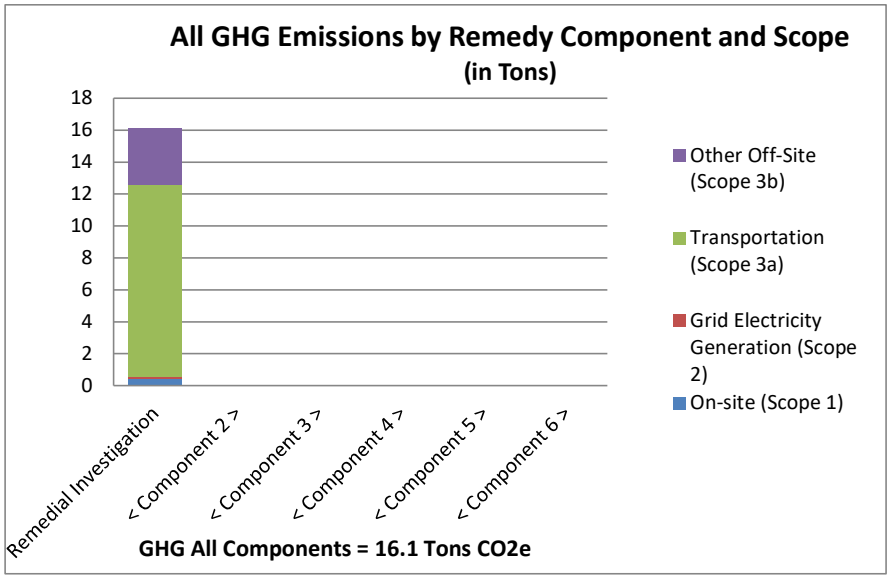

All Energy Use by Scope
On-site (Scope 1) = 3.6%
Grid Electricity Generation (Scope 2) = 0.6%
Transportation (Scope 3a) = 72.3%
Other Off-Site (Scope 3b) = 23.5%
Total Energy All Scopes = 204.4 MMbtus

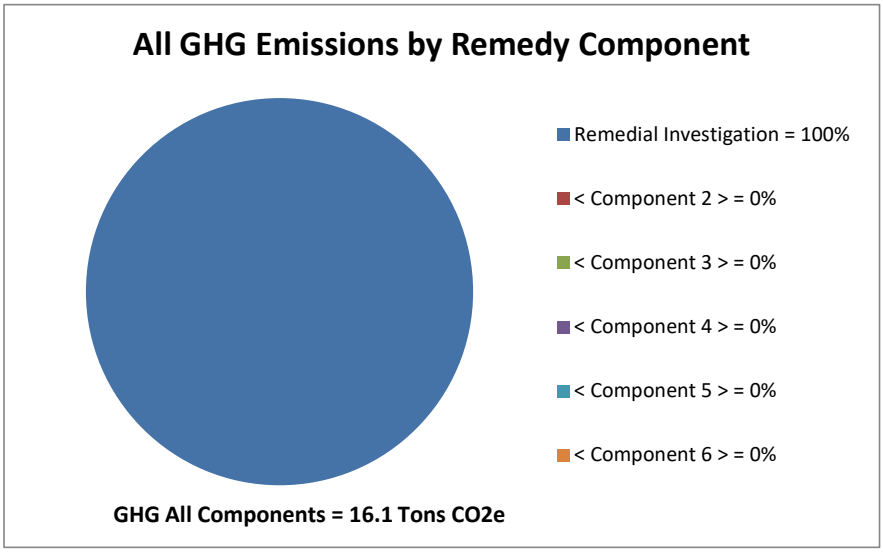
Total Energy MMbtus	Remedial I	< Compon	< Compon	< Compon	< Compon	< Compon	Total	
On-site (Scope 1)	7.5	0.0	0.0	0.0	0.0	0.0	7.5	
Generation (Scope 2)	1.2	0.0	0.0	0.0	0.0	0.0	1.2	Electricity
nsportation (Scope 3a)	147.8	0.0	0.0	0.0	0.0	0.0	147.8	Tran
ner Off-Site (Scope 3b)	48.0	0.0	0.0	0.0	0.0	0.0	48.0	Oth
Total	204.4	0.0	0.0	0.0	0.0	0.0	204.4	

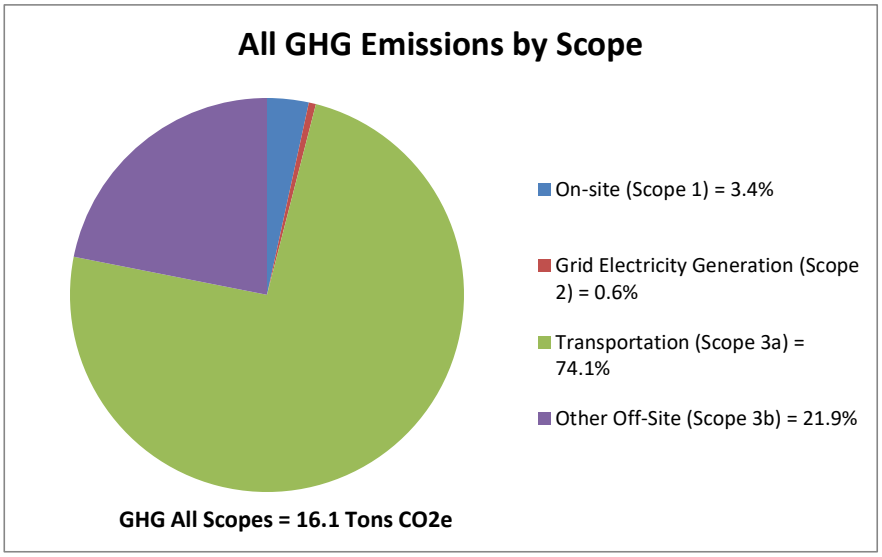
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%

On-site (Scope 1) = 3.6%
Grid Electricity Generation (Scope 2) = 0.6%
Transportation (Scope 3a) = 72.3%
Other Off-Site (Scope 3b) = 23.5%

Total Energy All Components = 204.4 MMbtus
Total Energy All Scopes = 204.4 MMbtus


All GHG Emissions by Remedy Component and Scope
(in Tons)
18
16
14
12
10
8
6
4
2
0
Remedial Investigation
< Component 2 >
< Component 3 >
< Component 4 >
< Component 5 >
< Component 6 >
Other Off-Site (Scope 3b)
Transportation (Scope 3a)
Grid Electricity Generation (Scope 2)
On-site (Scope 1)
GHG All Components = 16.1 Tons CO2e


All GHG Emissions by Remedy Component
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%
GHG All Components = 16.1 Tons CO2e

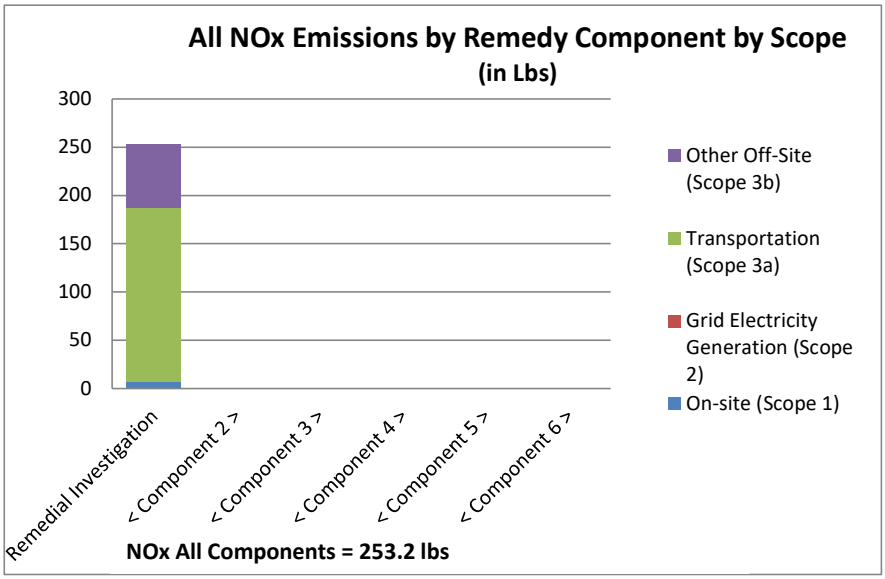

All GHG Emissions by Scope
On-site (Scope 1) = 3.4%
Grid Electricity Generation (Scope 2) = 0.6%
Transportation (Scope 3a) = 74.1%
Other Off-Site (Scope 3b) = 21.9%
GHG All Scopes = 16.1 Tons CO2e

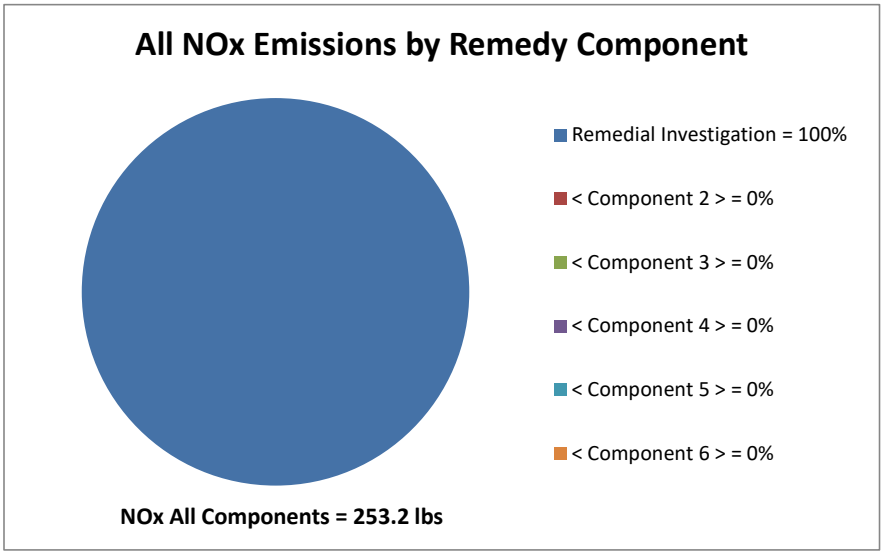
GHG Tons CO2e	Remedial I	< Compon	< Compon	< Compon	< Compon	< Compon	Total	
On-site (Scope 1)	0.6	0.0	0.0	0.0	0.0	0.0	0.6	
Generation (Scope 2)	0.1	0.0	0.0	0.0	0.0	0.0	0.1	Electricity
sportation (Scope 3a)	12.0	0.0	0.0	0.0	0.0	0.0	12.0	Tran
er Off-Site (Scope 3b)	3.5	0.0	0.0	0.0	0.0	0.0	3.5	Oth
Total	16.1	0.0	0.0	0.0	0.0	0.0	16.1	

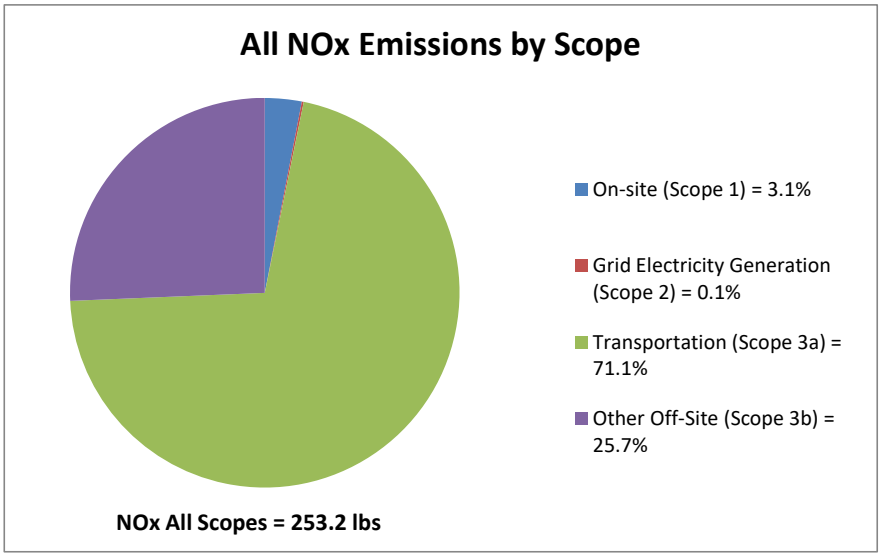
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%

GHG All Components = 16.1 Tons CO2e
GHG All Scopes = 16.1 Tons CO2e

On-site (Scope 1) = 3.4%
Grid Electricity Generation (Scope 2) = 0.6%
Transportation (Scope 3a) = 74.1%
Other Off-Site (Scope 3b) = 21.9%


All NOx Emissions by Remedy Component by Scope
(in Lbs)
300
250
200
150
100
50
0
Remedial Investigation
< Component 2 >
< Component 3 >
< Component 4 >
< Component 5 >
< Component 6 >
Other Off-Site (Scope 3b)
Transportation (Scope 3a)
Grid Electricity Generation (Scope 2)
On-site (Scope 1)
NOx All Components = 253.2 lbs


All NOx Emissions by Remedy Component
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%
NOx All Components = 253.2 lbs

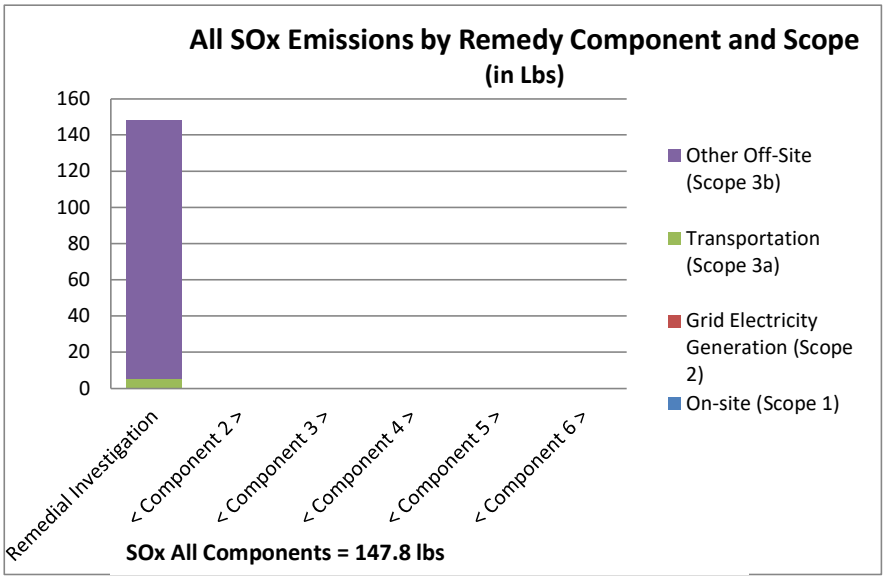

All NOx Emissions by Scope
On-site (Scope 1) = 3.1%
Grid Electricity Generation (Scope 2) = 0.1%
Transportation (Scope 3a) = 71.1%
Other Off-Site (Scope 3b) = 25.7%
NOx All Scopes = 253.2 lbs

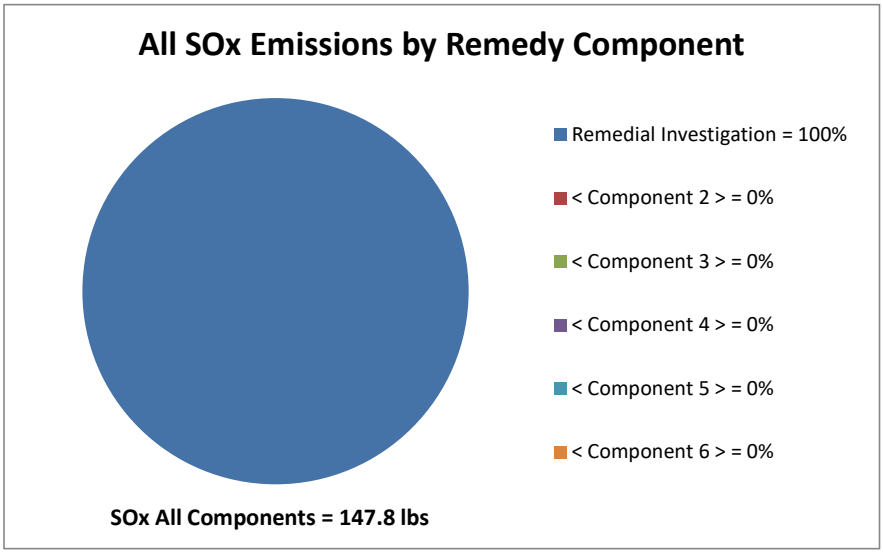
NOx lbs	Remedial I	< Compon	< Compon	< Compon	< Compon	< Compon	Total	
On-site (Scope 1)	7.8	0.0	0.0	0.0	0.0	0.0	7.8	
Generation (Scope 2)	0.4	0.0	0.0	0.0	0.0	0.0	0.4	Electricity
sportation (Scope 3a)	180.1	0.0	0.0	0.0	0.0	0.0	180.1	Tran
er Off-Site (Scope 3b)	65.0	0.0	0.0	0.0	0.0	0.0	65.0	Oth
Total	253.2	0.0	0.0	0.0	0.0	0.0	253.2	

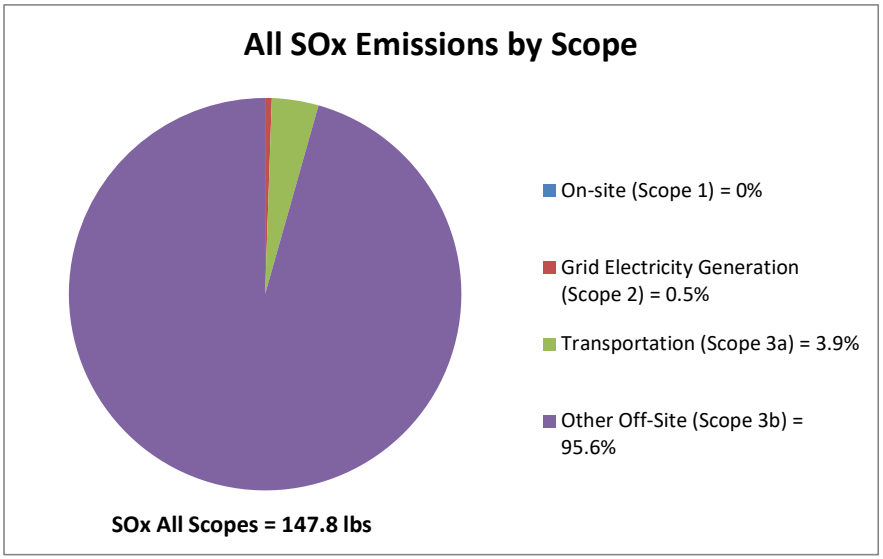
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%

NOx All Components = 253.2 lbs
NOx All Scopes = 253.2 lbs

On-site (Scope 1) = 3.1%
Grid Electricity Generation (Scope 2) = 0.1%
Transportation (Scope 3a) = 71.1%
Other Off-Site (Scope 3b) = 25.7%


All SOx Emissions by Remedy Component and Scope
(in Lbs)
160
140
120
100
80
60
40
20
0
Remedial Investigation
< Component 2 >
< Component 3 >
< Component 4 >
< Component 5 >
< Component 6 >
Other Off-Site (Scope 3b)
Transportation (Scope 3a)
Grid Electricity Generation (Scope 2)
On-site (Scope 1)
SOx All Components = 147.8 lbs


All SOx Emissions by Remedy Component
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%
SOx All Components = 147.8 lbs

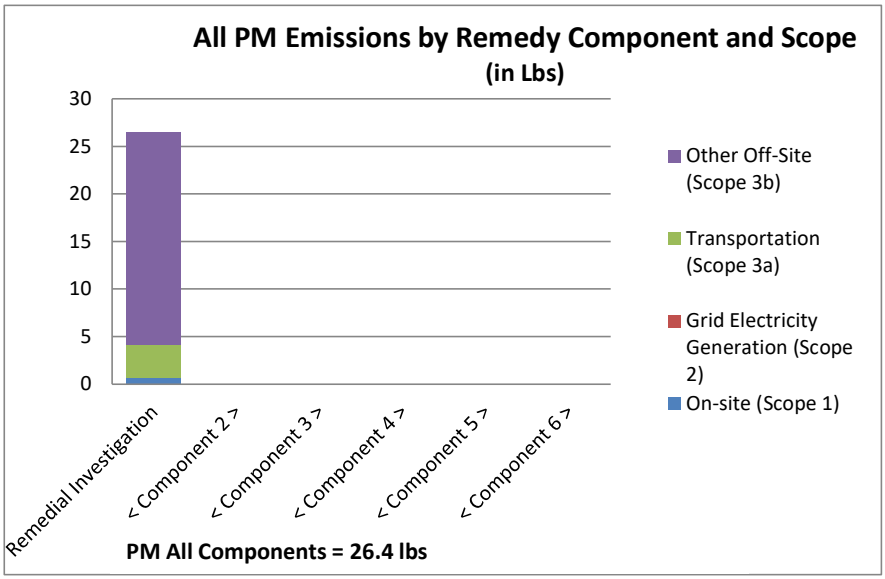

All SOx Emissions by Scope
On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0.5%
Transportation (Scope 3a) = 3.9%
Other Off-Site (Scope 3b) = 95.6%
SOx All Scopes = 147.8 lbs

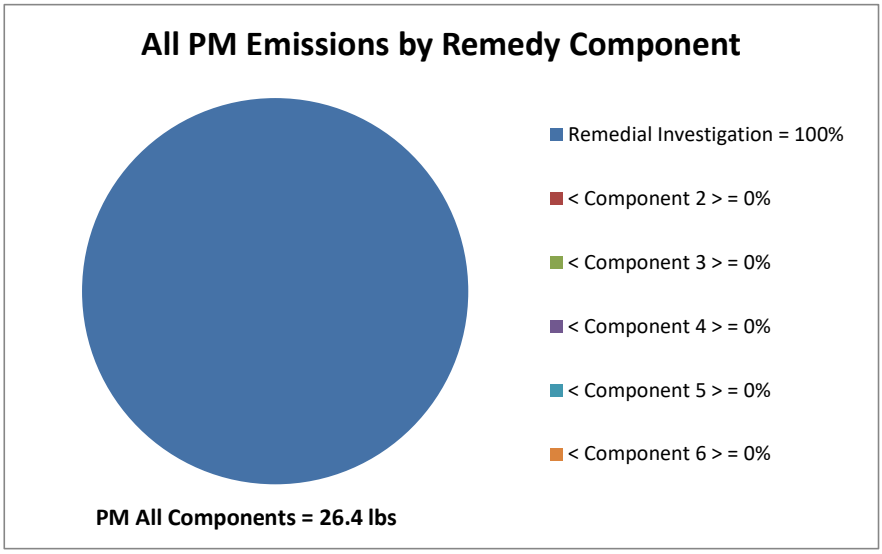
SOx lbs	Remedial I	< Compon	< Compon	< Compon	< Compon	< Compon	Total	
On-site (Scope 1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Generation (Scope 2)	0.8	0.0	0.0	0.0	0.0	0.0	0.8	Electricity
ısportation (Scope 3a)	5.7	0.0	0.0	0.0	0.0	0.0	5.7	Tran
ıer Off-Site (Scope 3b)	141.3	0.0	0.0	0.0	0.0	0.0	141.3	Oth
Total	147.8	0.0	0.0	0.0	0.0	0.0	147.8	

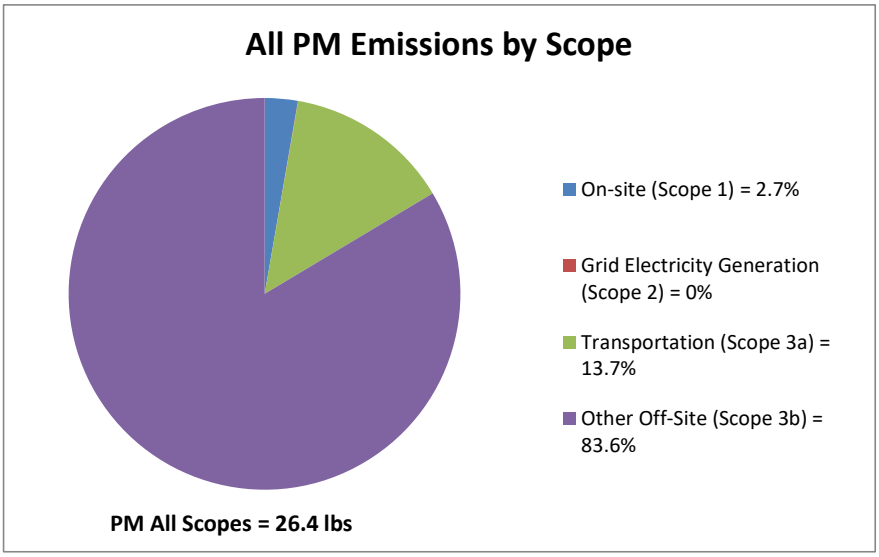
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0.5%
Transportation (Scope 3a) = 3.9%
Other Off-Site (Scope 3b) = 95.6%

SOx All Components = 147.8 lbs
SOx All Scopes = 147.8 lbs


All PM Emissions by Remedy Component and Scope
(in Lbs)
30
25
20
15
10
5
0
Remedial Investigation
< Component 2 >
< Component 3 >
< Component 4 >
< Component 5 >
< Component 6 >
Other Off-Site (Scope 3b)
Transportation (Scope 3a)
Grid Electricity Generation (Scope 2)
On-site (Scope 1)
PM All Components = 26.4 lbs


All PM Emissions by Remedy Component
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%
PM All Components = 26.4 lbs

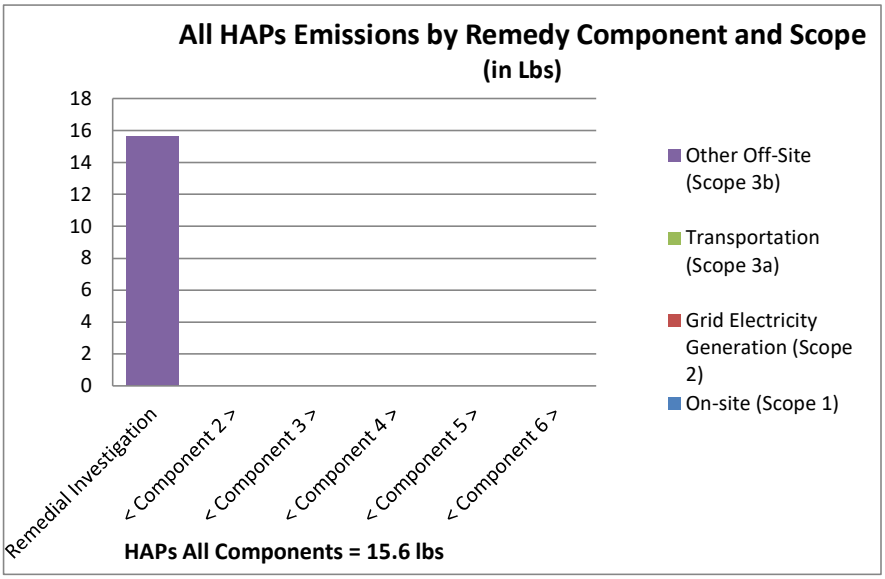

All PM Emissions by Scope
On-site (Scope 1) = 2.7%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 13.7%
Other Off-Site (Scope 3b) = 83.6%
PM All Scopes = 26.4 lbs

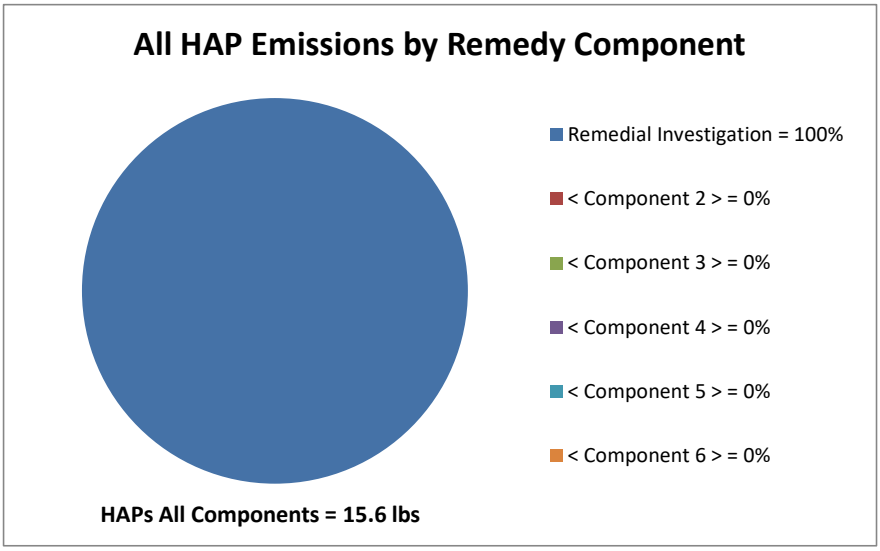
PM lbs	Remedial I	< Compon	< Compon	< Compon	< Compon	< Compon	Total	
On-site (Scope 1)	0.7	0.0	0.0	0.0	0.0	0.0	0.7	
Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	l Electricity
ısportation (Scope 3a)	3.6	0.0	0.0	0.0	0.0	0.0	3.6	Tran
ıer Off-Site (Scope 3b)	22.1	0.0	0.0	0.0	0.0	0.0	22.1	Oth
Total	26.4	0.0	0.0	0.0	0.0	0.0	26.4	

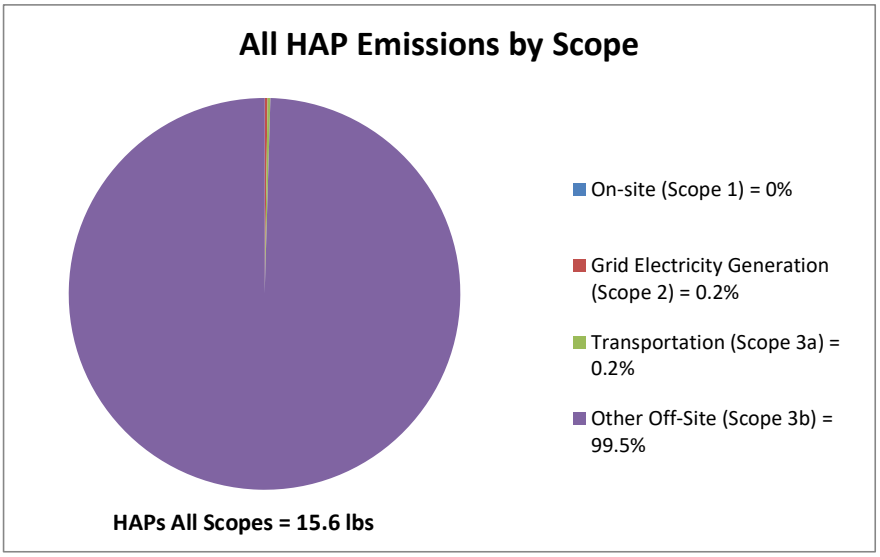
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%

PM All Components = 26.4 lbs
PM All Scopes = 26.4 lbs

On-site (Scope 1) = 2.7%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 13.7%
Other Off-Site (Scope 3b) = 83.6%


All HAPs Emissions by Remedy Component and Scope
(in Lbs)
18
16
14
12
10
8
6
4
2
0
Remedial Investigation
< Component 2 >
< Component 3 >
< Component 4 >
< Component 5 >
< Component 6 >
Other Off-Site (Scope 3b)
Transportation (Scope 3a)
Grid Electricity Generation (Scope 2)
On-site (Scope 1)
HAPs All Components = 15.6 lbs


All HAP Emissions by Remedy Component
Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%
HAPs All Components = 15.6 lbs


All HAP Emissions by Scope
On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0.2%
Transportation (Scope 3a) = 0.2%
Other Off-Site (Scope 3b) = 99.5%
HAPs All Scopes = 15.6 lbs

HAPs
lbs

	Remedial I	< Compon	< Compon	< Compon	< Compon	< Compon	Total
On-site (Scope 1)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ısportation (Scope 3a)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ıer Off-Site (Scope 3b)	15.6	0.0	0.0	0.0	0.0	0.0	15.6
Total	15.6	0.0	0.0	0.0	0.0	0.0	15.6

Remedial Investigation = 100%
< Component 2 > = 0%
< Component 3 > = 0%
< Component 4 > = 0%
< Component 5 > = 0%
< Component 6 > = 0%

HAPs All Components = 15.6 lbs
HAPs All Scopes = 15.6 lbs

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0.2%
Transportation (Scope 3a) = 0.2%
Other Off-Site (Scope 3b) = 99.5%

Remedial Investigation - Energy & Air Compiled Results

Category	Total Energy	GHG	NOx	SOx	PM	NOx + SOx + PM	HAPs
	MMbtus	lbs CO2e	lbs	lbs	lbs	lbs	lbs
On-site (Scope 1)	**7**	**1,100**	**8**	**0**	**1**	**8**	**0**
Grid Electricity Generation (Scope 2)	**1.163**	**189**	**0**	**1**	**0**	**1**	**0**
Transportation (Scope 3a)	**148**	**23,920**	**180**	**6**	**4**	**189**	**0**
Other Off-Site (Scope 3b)	**48**	**7,062**	**65**	**141**	**22**	**228**	**16**
Remedy Totals	**204**	**32,271**	**253**	**148**	**26**	**427**	**16**

Values that are forwarded to the "Summary" tab are indicated in orange.

Voluntary Renewable Energy Use	Unit	Quantity	
On-site renewable energy generation or use	MMBtu	**0**	
On-site biodiesel use	MMBtu	**0**	
Biodiesel and other renewable resource use for transportation	MMBtu	**0**	
On-site renewable energy generation or use + on-site biodiesel use + biodiesel and other renewable resource use for transportation	MMBtu	**0**	*(This value is the sum of the three rows above)*
Voluntary purchase of renewable electricity	MWh	**0**	
Voluntary purchase of RECs	MWh	**0**	

This worksheet is not intended for user input. Values on this worksheet are obtained from the following file: SEFA_calculations_(121718)_Bictos.xlsx

All Components - On-Site Footprint (Scope 1)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
On-Site														
On-site Renewable Energy														
Renewable electricity generated on-site	MWh	0	3.413	0										
Landfill gas combusted on-site for energy use	ccf CH4	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined on-site renewable energy use #1	gal	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined on-site renewable energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
On-site Conventional Energy														
On-site grid electricity	MWh	0.16785	3.413	0.5728721										
On-site diesel use - Other	Gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
On-site diesel use <75 hp	Gal	49.541284	0.139	6.8862385	22.21	1100.3119	0.1565	7.753211	0.000145	0.0071835	0.0145	0.7183486	0.00004	0.0019817
On-site diesel use 75<hp<750	Gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	Gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
On-site gasoline use - Other	Gal	0.009	0.124	0.001116	19.6	0.1764	0.11	0.00099	0.0045	0.0000405	0.00054	4.86E-06	0.000039	3.51E-07
On-site gasoline use <25 hp	Gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	Gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site compressed natural gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed natural gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site liquified petroleum gas use - Other	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Other forms of on-site conventional energy use #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Conventional Energy Subtotals				**7**		**1,100**		**8**		**0**		**1**		**0**
Notes:														
Other On-site Emissions														
On-site HAP process emissions	lbs	0											1	0
On-site GHG emissions	lbs CO2e	0			1	0								
On-site carbon storage	lbs CO2e	0			1	0								
GHG avoided by flaring on-site landfill methane	Lbs	0			-262	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Other on-site NOx emissions or reductions	lbs	0					1	0						
Other on-site SOx emissions or reductions	lbs	0							1	0				
Other on-site PM emissions or reductions	lbs	0									1	0		
User-defined recycled/reused on-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused on-site #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
On-site Totals				**7.46**		**1,100**		**8**		**0**		**1**		**0**

All Components - Electricity Generation Footprint (Scope 2)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Electricity Generation														
Grid electricity	MWh	0.16785	6.929	1.1630327	N/A*	188.71376	N/A*	0.3763365	N/A*	0.7734339	N/A*	0.0096544	N/A*	0.0352883
**** Conversion factors are not applied to grid electricity in the "All Components" tab since multiple fuel mixes may be used. The value for each cell shaded yellow in Row 51 is the sum of values from Components 1 - 6.***														
Voluntary purchase of renewable electricity	MWh	0												
Voluntary purchase of RECs	MWh	0												
Notes:														

All Components - Transportation Footprint (Scope 3a)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Conventional Energy														
Transportation diesel use	gal	1058.7	0.139	147.1593	22.5	23820.75	0.17	179.979	0.0054	5.71698	0.0034	3.59958	0.0000052	0.0055052
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	5	0.124	0.62	19.77	98.85	0.027	0.135	0.00036	0.0018	0.003	0.015	0.0067	0.0335
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
User-defined conventional energy transportation #1	TBD	10	0	0	0	0	0	0	0	0	0	0	0	0
User-defined conventional energy transportation #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Energy Subtotals				**148**		**23,920**		**180**		**6**		**4**		**0**
Notes:														
Renewable Energy														
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined renewable energy transportation #1	TBD	0	Biodiesel		0	0	0	0	0	0	0	0	Ref.	
User-defined renewable energy transportation #2	TBD	0	mpg or pmp		0	0	0	0	0	0	0	0	0	0
Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Transportation Totals				**148**		**23920**		**180**		**6**		**4**		**0**

All Components - Off-Site Footprint (Scope 3b)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Construction Materials														
Aluminum, Rolled Sheet	lb	0	0.0633	0	9.15	0	0.0148	0	0.0283	0	0.0088	0	0.00102	0
Asphalt, mastic	lb	0	0.0412	0	0.85	0	0.00271	0	0.00798	0	0.000766	0	0.00107	0
Asphalt, paving-grade	lb	0	0.5	0	8.58	0	0.0299	0	0.0969	0	0.0091	0	0.0133	0
Ethanol, Corn, 95%	lb	0	0.0318	0	-0.0199	0	0.00425	0	0.00303	0	0.000469	0	0.0000846	0
Ethanol, Corn, 99.7%	lb	0	0.0324	0	0.0591	0	0.00431	0	0.0031	0	0.000472	0	0.000087	0
Ethanol, Petroleum, 99.7%	lb	0	0.0205	0	1.25	0	0.00199	0	0.00214	0	0.000277	0	0.0000589	0
Gravel/Sand Mix, 65% Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Gravel/sand/clay	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
HDPE	lb	6.5	0.0332	0.2158	1.94	12.61	0.00325	0.021125	0.00409	0.026585	0.000439	0.0028535	0.0000641	0.0004167
Photovoltaic system (installed)	W	0	0.0336	0	4.47	0	0.015	0	0.032	0	0.00063	0	0.0000029	0
PVC	lb	72	0.0262	1.8864	2.02	145.44	0.004	0.288	0.00274	0.19728	0.000372	0.026784	0.000375	0.027
Portland cement, US average	lb	0	0.0139	0	1.34	0	0.00654	0	0.0104	0	0.00378	0	0.00097	0
Ready-mixed concrete, 20 MPa	ft3	0	0.217	0	19.5	0	0.0975	0	0.154	0	0.057	0	0.0141	0
Round Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Sand	lb	1330	0.0000248	0.032984	0.0024	3.192	0.000018	0.02394	4.52E-06	0.0060116	2.61E-06	0.0034713	3.08E-07	0.0004096
Stainless Steel	lb	0	0.0116	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.000144	0
Steel	lb	0	0.0044	0	1.1	0	0.0014	0	0.0017	0	0.00056	0	0.000067	0
Other refined construction materials	lb	0	0.01885	0	2.115	0	0.0040375	0	0.0051325	0	0.0014428	0	0.0001625	0
Other unrefined construction materials	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0

Notes:

All Components - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Treatment Materials & Chemicals														
Cheese Whey	lbs	0	0.0025	0	0.031	0	0.000062	0	0.000033	0	0.000002	0	NP	
Emulsified vegetable oil	lbs	0	0.0077	0	3.44	0	0.0066	0	0.0019	0	0.000033	0	NP	
Granular activated carbon, primary	lbs	0	0.0356	0	4.82	0	0.0793	0	0.128	0	0.000987	0	0.000657	0
Granular activated carbon, regenerated	lbs	0	0.00873	0	1.7	0	0.00733	0	0.0129	0	0.000886	0	0.000671	0
Hydrogen Peroxide, 50% in H2O	lbs	0	0.00979	0	1.19	0	0.00142	0	0.0024	0	0.000308	0	0.0000629	0
Iron (II) Sulfate	lbs	0	0.00147	0	0.167	0	0.000316	0	0.000589	0	0.000103	0	0.000023	0
Lime, Hydrated, Packed	lbs	0	0.00206	0	0.762	0	0.000513	0	0.000358	0	0.00013	0	6.57E-06	0
Molasses	lbs	0	0.0044	0	0.48	0	0.0011	0	0.00024	0	0.0000041	0	NP	
Phosphoric Acid, 70% in H2O	lbs	0	0.0067	0	0.882	0	0.00282	0	0.0294	0	0.00171	0	0.000163	0
Potassium Permanganate	lbs	0	0.00981	0	1.16	0	0.00234	0	0.0032	0	0.000422	0	0.000122	0
Sodium Hydroxide, 50% in H2O	lbs	0	0.00977	0	1.09	0	0.00194	0	0.00352	0	0.000403	0	0.000129	0
Other Treatment Chemicals & Materials	lbs	0	0.015	0	1.67	0	0.003	0	0.0065	0	0.00061	0	0.000016	0
Notes:														
Fuel Processing														
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Diesel produced	gal	1108.2413	0.017	18.840102	3.02	3346.8887	0.0051	5.6520306	0.0062	6.871096	0.0017	1.8840102	0.0011	1.2190654
Gasoline produced	gal	5.009	0.033	0.165297	2.8	14.0252	0.0046	0.0230414	0.005	0.025045	0.0015	0.0075135	0.001	0.005009
Liquefied Petroleum Gas Produced	gal	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Natural Gas - Compressed Produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Natural Gas Produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Fuel Processing Subtotals				**19.005399**		**3360.9139**		**5.675072**		**6.896141**		**1.8915237**		**1.2240744**
Notes:														
Public water	gal x 1000	0.042	0.0092	0.0003864	5	0.21	0.0097	0.0004074	0.0059	0.0002478	0.016	0.000672	0.000015	6.3E-07
User-defined water resource #1	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined water resource #2	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														

All Components - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Off-Site Services														
Hazardous waste incineration	lb	0	0.00609	0	2.43	0	0.0016	0	0.00167	0	0.000209	0	0.000087	0
Off-site waste water treatment (POTW)	gal x 1000	120	0.015	1.8	4.4	528	0.016	1.92	0.015	1.8	NP		NP	
Off-site non-hazardous waste landfill	ton	1.16	0.16	0.1856	25	29	0.14	0.1624	0.075	0.087	0.4	0.464	0.0014	0.001624
Off-site hazardous waste landfill	ton	0	0.18	0	27.5	0	0.154	0	0.0825	0	0.44	0	0.00154	0
Off-site Laboratory Analysis - Other	sample	90	0.058071	5.2263926	6.8534384	616.80946	0.131402	11.826176	0.3038758	27.348819	0.0455698	4.1012842	0.0330165	2.9714876
Off-site Laboratory Analysis - Metals	sample	45	0.212	9.54	27.4693	1236.1185	0.6423	28.9035	1.5072	67.824	0.2264	10.188	0.1643	7.3935
Off-site Laboratory Analysis - Mercury	sample	0	0.0731715	0	9.325458	0	0.2127439	0	0.4982396	0	0.0747359	0	0.0542332	0
Off-site Laboratory Analysis - Inorganic Anions	sample	0	0.0074025	0	0.6459478	0	0.0067681	0	0.0147929	0	0.0022024	0	0.0015542	0
Off-site Laboratory Analysis - Alkalinity	sample	0	0.0174398	0	1.3381922	0	0.0070106	0	0.0132496	0	0.00194	0	0.0012831	0
Off-site Laboratory Analysis - Perchlorate	sample	0	0.023885	0	1.8717054	0	0.0079807	0	0.0141535	0	0.0020547	0	0.0012875	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample	0	0.0336475	0	4.29897	0	0.0954592	0	0.2226646	0	0.0335099	0	0.0242506	0
Off-site Laboratory Analysis - Sulfate	sample	0	0.0141225	0	1.4726728	0	0.0079807	0	0.0136024	0	0.0019797	0	0.0012015	0
Off-site Laboratory Analysis - PCBs	sample	45	0.0512769	2.3074605	5.224902	235.12059	0.0833339	3.7500246	0.1904774	8.5714848	0.0284393	1.2797703	0.0212083	0.9543713
Off-site Laboratory Analysis - VOCs	sample	55	0.0762045	4.1912468	9.016814	495.92477	0.104498	5.7473922	0.2270738	12.489059	0.0339508	1.8672962	0.0235892	1.2974071
Off-site Laboratory Analysis - SVOCs	sample	45	0.0715602	3.2202083	7.870422	354.16899	0.1459445	6.5675034	0.3373038	15.178671	0.0504853	2.2718403	0.0372577	1.6765983
Notes:														
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0.0511943	3.1	0.156337	180.0	9.214965	0.8	0.0394196	0.2	0.0076791	0.0	0.0009215	NP	
Natural gas extraction and processing	MWh	0.0569012	1.6	0.0928513	270.0	15.363311	0.2	0.0102422	13.0	0.739715	0.0	0.000404	NP	
Nuclear fuel extraction and processing	MWh	0.0332343	0.2	0.005167	25.0	0.8308575	0.2	0.0049851	0.5	0.0166172	0.0	4.985E-05	NP	
Oil extraction and processing	MWh	0.001175	2.3	0.002697	270.0	0.3172365	1.7	0.0019974	0.1	8.107E-05	0.0	4.935E-05	NP	
Other fuel extraction and processing	MWh	0.0001679	0	0	0	0	0	0	0	0	0	0	0	0
Resource Extraction Subtotals				**0.2570523**		**25.72637**		**0.0566443**		**0.7640923**		**0.0014247**		**0**
Notes:														
Electricity Transmission														
Transmission and distribution losses	MWh	0.16785	1.0342	0.1735905										
Notes:														

All Components - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv.		Conv.		Conv.		Conv.		Conv.		Conv.	
Category	Units	Usage	Factor	MMBtus	Factor	lbs CO2e	Factor	lbs	Factor	lbs	Factor	lbs	Factor	lbs
User-defined Materials														
User-defined material #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #6	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #7	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #8	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #9	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #10	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #11	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #12	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #13	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #14	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #15	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #16	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #17	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #18	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #19	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #20	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
User-defined Waste Destinations														
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #3	TBD	0	y(MMBtu/u		(lbs CO2e/u		Ox(lbs/unit)		Ox(lbs/unit)		M(lbs/unit)		APs(lbs/unit	
User-defined non-hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
Off-site Totals				**48.04252**		**7043.2346**		**64.942185**		**141.18939**		**22.09892**		**15.54689**

All Components - Intermediate Totals

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Total Grid Electricity Footprint														
On-site grid electricity	MWh	0.16785	3.413	0.5728721										
Electricity Generation														
Grid electricity	MWh	0.16785	6.929	1.1630327	1124.3	188.71376	2.2421	0.3763365	4.6078874	0.7734339	0.057518	0.0096544	0.2102371	0.0352883
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0.0511943	3.1	0.156337	180.0	9.214965	0.8	0.0394196	0.2	0.0076791	0.0	0.0009215	NP	
Natural gas extraction and processing	MWh	0.0569012	1.6	0.0928513	270.0	15.363311	0.2	0.0102422	13.0	0.739715	0.0	0.000404	NP	
Nuclear fuel extraction and processing	MWh	0.0332343	0.2	0.005167	25.0	0.8308575	0.2	0.0049851	0.5	0.0166172	0.0	4.985E-05	NP	
Oil extraction and processing	MWh	0.001175	2.3	0.002697	270.0	0.3172365	1.7	0.0019974	0.1	8.107E-05	0.0	4.935E-05	NP	
Other fuel extraction and processing	MWh	0.0001679	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Electricity Transmission														
Transmission and distribution losses	MWh	0.16785	1.0342	0.1735905	112.43	18.871376	0.22421	0.0376336	0.4607887	0.0773434	0.0057518	0.0009654	0.0210237	0.0035288
Total Grid Electricity Footprint				**2**		**233**		**0**		**2**		**0**		**0**
Total Fuel Footprints														
Total Gasoline Footprint														
On-site gasoline use - Other	gal	0.009	0.124	0.001116	19.6	0.1764	0.11	0.00099	0.0045	0.0000405	0.00054	4.86E-06	0.000039	3.51E-07
On-site gasoline use <25 hp	gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	5	0.124	0.62	19.77	98.85	0.027	0.135	0.00036	0.0018	0.003	0.015	0.0067	0.0335
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Gasoline produced	gal	5.009	0.033	0.165297	2.8	14.0252	0.0046	0.0230414	0.005	0.025045	0.0015	0.0075135	0.001	0.005009
Total Gasoline Footprint		**5.009**		**0.786413**		**113.0516**		**0.1590314**		**0.0268855**		**0.0225184**		**0.0385094**
Total Diesel Footprint														
On-site diesel use - Other	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
On-site diesel use <75 hp	gal	49.541284	0.139	6.8862385	22.21	1100.3119	0.1565	7.753211	0.000145	0.0071835	0.0145	0.7183486	0.00004	0.0019817
On-site diesel use 75<hp<750	gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
Transportation diesel use	gal	1058.7	0.139	147.1593	22.5	23820.75	0.17	179.979	0.0054	5.71698	0.0034	3.59958	0.0000052	0.0055052
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Diesel produced	gal	1108.2413	0.017	18.840102	3.02	3346.8887	0.0051	5.6520306	0.0062	6.871096	0.0017	1.8840102	0.0011	1.2190654
Total Diesel Footprint		**1108.2413**		**172.88564**		**28267.951**		**193.38424**		**12.595259**		**6.2019388**		**1.2265523**
Total Biodiesel Footprint														
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Total Biodiesel Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Natural Gas Footprint														
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Natural gas produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Liquified Petroleum Gas Footprint														
On-site liquified petroleum gas use - Other	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Liquified petroleum gas produced	ccf	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Compressed Gas Footprint														
On-site compressed gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
Compressed gas produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**

Notes:

Note: Please refer to the "Default Conversions" tab for references for the default conversion factors used on this calculation sheet.

Space below available for notes and calculations:

Spreadsheets for Environmental Footprint Analysis (SEFA) Version 3.0, November 2019
Former Bictos Webster Cleaners - NYSDEC BCP Remedial Investigation

Input Summary

Remedy Component Number →		1	2	3	4	5	6									Remedy Component Subtotals						
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Item		Input Template	Input Template (2)	Input Template (3)	Input Template (4)	Input Template (5)	Input Template (6)	Input Template (7)	Input Template (8)	Input Template (9)	Input Template (10)	Input Template (11)	Input Template (12)	Input Template (13)	Input Template (14)	1	2	3	4	5	6	Total
On-Site																						
On-site Renewable Energy																						
Renewable electricity generated on-site	MWh	0														0	0	0	0	0	0	0
Landfill gas combusted on-site for energy use	ccf CH_4	0														0	0	0	0	0	0	0
On-site biodiesel use	gal	0														0	0	0	0	0	0	0
On-site biodiesel use - Other	gal	0														0	0	0	0	0	0	0
User-defined on-site renewable energy use #1	TBD	0														0	0	0	0	0	0	0
User-defined on-site renewable energy use #2	TBD	0														0	0	0	0	0	0	0
On-Site Conventional Energy																						
Grid electricity	MWh	0.16785														0.16785	0	0	0	0	0	0.16785
On-site diesel use - Other	Gal	0														0	0	0	0	0	0	0
On-site diesel use <75 hp	Gal	49.541284														49.541284	0	0	0	0	0	49.541284
On-site diesel use 75<hp<750	Gal	0														0	0	0	0	0	0	0
On-site diesel use >750 hp	Gal	0														0	0	0	0	0	0	0
On-site gasoline use - Other	Gal	0.009														0.009	0	0	0	0	0	0.009
On-site gasoline use <25 hp	Gal	0														0	0	0	0	0	0	0
On-site gasoline use >25 hp	Gal	0														0	0	0	0	0	0	0
On-site natural gas use	ccf	0														0	0	0	0	0	0	0
On-site compressed natural gas use - Other	ccf	0														0	0	0	0	0	0	0
On-site compressed natural gas use	ccf	0														0	0	0	0	0	0	0
On-site liquified petroleum gas use - Other	gal	0														0	0	0	0	0	0	0
On-site liquified petroleum gas use	gal	0														0	0	0	0	0	0	0
Other forms of on-site conventional energy use #1	TBD	0														0	0	0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD	0														0	0	0	0	0	0	0
Other On-site Emissions																						
On-site HAP process emissions	Lbs	0														0	0	0	0	0	0	0
On-site GHG emissions	Lbs CO2e	0														0	0	0	0	0	0	0
On-site carbon storage	Lbs CO2e	0														0	0	0	0	0	0	0
GHG avoided by flaring on-site landfill methane	ccf CH4	0														0	0	0	0	0	0	0
Other on-site NOx emissions or reductions	Lbs	0														0	0	0	0	0	0	0
Other on-site SOx emissions or reductions	Lbs	0														0	0	0	0	0	0	0
Other on-site PM emissions or reductions	Lbs	0														0	0	0	0	0	0	0
Electricity Generation																						
Grid electricity	MWh	0.16785														0.16785	0	0	0	0	0	0.16785
Voluntary purchase of renewable electricity	MWh	0														0	0	0	0	0	0	0
Voluntary purchase of RECs	MWh	0														0	0	0	0	0	0	0
Transportation																						
Transportation Fuel Use Breakdown																						
Biodiesel use - Personnel Transport	gal	0														0	0	0	0	0	0	0
Biodiesel use - Personnel Transport - User Defined	gal	0														0	0	0	0	0	0	0
Biodiesel use - Equipment Transport	gal	0														0	0	0	0	0	0	0
Biodiesel use - Equipment Transport - User Defined	gal	0														0	0	0	0	0	0	0
Biodiesel use - Material Transport	gal	0														0	0	0	0	0	0	0
Biodiesel use - Material Transport - User Defined	gal	0														0	0	0	0	0	0	0
Biodiesel use - Waste Transport	gal	0														0	0	0	0	0	0	0
Biodiesel use - Waste Transport - User Defined	gal	0														0	0	0	0	0	0	0
Diesel use - Personnel Transport - other vehicles	gal	0														0	0	0	0	0	0	0
Diesel use - Personnel Transport - car	gal	0														0	0	0	0	0	0	0
Diesel use - Personnel Transport - passenger truck	gal	0														0	0	0	0	0	0	0
Diesel use - Personnel Transport - User Defined	gal	0														0	0	0	0	0	0	0
Diesel use - Equipment Transport	gal	68.3														68.3	0	0	0	0	0	68.3
Diesel use - Equipment Transport - User Defined	gal	0														0	0	0	0	0	0	0
Diesel use - Material Transport	gal	160														160	0	0	0	0	0	160
Diesel use - Material Transport - User Defined	gal	0														0	0	0	0	0	0	0
Diesel use - Waste Transport	gal	830.4														830.4	0	0	0	0	0	830.4
Diesel use - Waste Transport - User Defined	gal	0														0	0	0	0	0	0	0
Gasoline use - Personnel Transport - other vehicles	gal	0														0	0	0	0	0	0	0
Gasoline use - Personnel Transport - car	gal	5														5	0	0	0	0	0	5
Gasoline use - Personnel Transport - passenger truck	gal	0														0	0	0	0	0	0	0
Gasoline use - Personnel Transport - User Defined	gal	0														0	0	0	0	0	0	0
Gasoline use - Equipment Transport	gal	0														0	0	0	0	0	0	0
Gasoline use - Equipment Transport - User Defined	gal	0														0	0	0	0	0	0	0
Natural Gas use - Personnel Transport	ccf	0														0	0	0	0	0	0	0
Natural Gas use - Personnel Transport - User Defined	ccf	0														0	0	0	0	0	0	0
Natural Gas use - Equipment Transport	ccf	0														0	0	0	0	0	0	0

Input Summary

Remedy Component Number →		1	2	3	4	5	6									Remedy Component Subtotals						
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Conventional Energy																						
Transportation diesel use	gal	1058.7														1058.7	0	0	0	0	0	1058.7
Transportation gasoline use	gal	5														5	0	0	0	0	0	5
Transportation natural gas use	ccf	0														0	0	0	0	0	0	0
User-defined conventional energy transportation #1	TBD	10														10	0	0	0	0	0	10
User-defined conventional energy transportation #2	TBD	0														0	0	0	0	0	0	0
Renewable Energy																						
Transportation biodiesel use	gal	0														0	0	0	0	0	0	0
User-defined renewable energy transportation #1	TBD	0														0	0	0	0	0	0	0
User-defined renewable energy transportation #2	TBD	0														0	0	0	0	0	0	0
Off-Site																						
Construction Materials																						
Aluminum, Rolled Sheet	lb	0														0	0	0	0	0	0	0
Asphalt, mastic	lb	0														0	0	0	0	0	0	0
Asphalt, paving-grade	lb	0														0	0	0	0	0	0	0
Ethanol, Corn, 95%	lb	0														0	0	0	0	0	0	0
Ethanol, Corn, 99.7%	lb	0														0	0	0	0	0	0	0
Ethanol, Petroleum, 99.7%	lb	0														0	0	0	0	0	0	0
Gravel/Sand Mix, 65% Gravel	lb	0														0	0	0	0	0	0	0
Gravel/sand/clay	lb	0														0	0	0	0	0	0	0
HDPE	lb	6.5														6.5	0	0	0	0	0	6.5
Photovoltaic system (installed)	W	0														0	0	0	0	0	0	0
PVC	lb	72														72	0	0	0	0	0	72
Portland cement, US average	lb	455																				
Ready-mixed concrete, 20 MPa	ft3	0														0	0	0	0	0	0	0
Round Gravel	lb	0														0	0	0	0	0	0	0
Sand	lb	1330														1330	0	0	0	0	0	1330
Stainless Steel	lb	0														0	0	0	0	0	0	0
Steel	lb	0														0	0	0	0	0	0	0
Other refined construction materials	lb	0														0	0	0	0	0	0	0
Other unrefined construction materials	lb	0														0	0	0	0	0	0	0
Treatment Materials & Chemicals																						
Cheese Whey	lbs	0														0	0	0	0	0	0	0
Emulsified vegetable oil	lbs	0														0	0	0	0	0	0	0
Granular activated carbon, primary	lbs	0														0	0	0	0	0	0	0
Granular activated carbon, regenerated	lbs	0														0	0	0	0	0	0	0
Hydrogen Peroxide, 50% in H2O	lbs	0														0	0	0	0	0	0	0
Iron (II) Sulfate	lbs	0														0	0	0	0	0	0	0
Lime, Hydrated, Packed	lbs	0														0	0	0	0	0	0	0
Molasses	lbs	0														0	0	0	0	0	0	0
Phosphoric Acid, 70% in H2O	lbs	0														0	0	0	0	0	0	0
Potassium Permanganate	lbs	0														0	0	0	0	0	0	0
Sodium Hydroxide, 50% in H2O	lbs	0														0	0	0	0	0	0	0
Other Treatment Chemicals & Materials	lbs	0														0	0	0	0	0	0	0
Material Type																						
Total Virgin Refined Materials	tons	0.93175														0.93175	0	0	0	0	0	0.93175
Total Recycled Refined Materials	tons	0														0	0	0	0	0	0	0
Total Reused Refined Materials	tons	0														0	0	0	0	0	0	0
Total Refined Material	tons	0.93175														0.93175	0	0	0	0	0	0.93175
Total Virgin Unrefined Materials	tons	0														0	0	0	0	0	0	0
Total Recycled Unrefined Materials	tons	0														0	0	0	0	0	0	0
Total Reused Unrefined Materials	tons	0														0	0	0	0	0	0	0
Total Unrefined Material	tons	0														0	0	0	0	0	0	0
Fuel Processing																						
Biodiesel produced	gal	0														0	0	0	0	0	0	0
Diesel produced	gal	1108.2413														1108.2413	0	0	0	0	0	1108.2413
Gasoline produced	gal	5.009														5.009	0	0	0	0	0	5.009
Compressed natural gas produced	ccf	0														0	0	0	0	0	0	0
Liquified petroleum gas produced	gal	0														0	0	0	0	0	0	0
Natural gas produced	ccf	0														0	0	0	0	0	0	0
Water Use																						
Public Water Supply	gal x 1000	0.042														0.042	0	0	0	0	0	0.042
Extracted Groundwater	gal x 1000	0														0	0	0	0	0	0	0
Surface Water	gal x 1000	0														0	0	0	0	0	0	0
Reclaimed Water	gal x 1000	0														0	0	0	0	0	0	0
Collected/Diverted Storm Water	gal x 1000	0														0	0	0	0	0	0	0
User-defined water resource #1	gal x 1000	0														0	0	0	0	0	0	0
User-defined water resource #2	gal x 1000	0														0	0	0	0	0	0	0

Input Summary

Remedy Component Number →		1	2	3	4	5	6									Remedy Component Subtotals						
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Waste/Recycle Handling																						
Hazardous waste incineration	lbs	0														0	0	0	0	0	0	0
Off-site waste water treatment (POTW)	gal x 1000	120														120	0	0	0	0	0	120
Off-site non-hazardous waste landfill	tons	1.16														1.16	0	0	0	0	0	1.16
Off-site hazardous waste landfill	tons	0														0	0	0	0	0	0	0
Recycled/Reused On-Site	tons	0														0	0	0	0	0	0	0
Recycled/Reused Off-Site	tons	0														0	0	0	0	0	0	0
Solid Waste Totals																						
Total Non-Hazardous Waste	tons	1.16														1.16	0	0	0	0	0	1.16
Total Hazardous Waste	tons	0														0	0	0	0	0	0	0
Total Recycled/Reused	tons	0														0	0	0	0	0	0	0
Total Waste (all types)	tons	1.16														1.16	0	0	0	0	0	1.16
Lab Services																						
Off-site Laboratory Analysis - Other	sample	90														90	0	0	0	0	0	90
Off-site Laboratory Analysis - Metals	sample	45														45	0	0	0	0	0	45
Off-site Laboratory Analysis - Mercury	sample	0														0	0	0	0	0	0	0
Off-site Laboratory Analysis - Inorganic Anions	sample	0														0	0	0	0	0	0	0
Off-site Laboratory Analysis - Alkalinity	sample	0														0	0	0	0	0	0	0
Off-site Laboratory Analysis - Perchlorate	sample	0														0	0	0	0	0	0	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample	0														0	0	0	0	0	0	0
Off-site Laboratory Analysis - Sulfate	sample	0														0	0	0	0	0	0	0
Off-site Laboratory Analysis - PCBs	sample	45														45	0	0	0	0	0	45
Off-site Laboratory Analysis - VOCs	sample	55														55	0	0	0	0	0	55
Off-site Laboratory Analysis - SVOCs	sample	45														45	0	0	0	0	0	45
Resource Extraction for Electricity																						
Coal extraction and processing	MWh	0.0511943														0.0511943	0	0	0	0	0	0.0511943
Natural gas extraction and processing	MWh	0.0569012														0.0569012	0	0	0	0	0	0.0569012
Nuclear fuel extraction and processing	MWh	0.0332343														0.0332343	0	0	0	0	0	0.0332343
Oil extraction and processing	MWh	0.001175														0.001175	0	0	0	0	0	0.001175
Other fuel extraction and processing	MWh	0.0001679														0.0001679	0	0	0	0	0	0.0001679
Electricity Transmission																						
Transmission and distribution losses	MWh	0.16785														0.16785	0	0	0	0	0	0.16785

Input Summary

Remedy Component Number →		1	2	3	4	5	6									Remedy Component Subtotals						
		Column headings in Row 6 must match the name of "Input" tabs in this workbook for Columns C - P in this table to be populated ("0" in Row 4 means "Input" tab is turned Off and will not be grouped to a Remedy Component (Columns Q - V) or used in subsequent calculations)																				
Item		Input Template	Input Template (2)	Input Template (3)	Input Template (4)	Input Template (5)	Input Template (6)	Input Template (7)	Input Template (8)	Input Template (9)	Input Template (10)	Input Template (11)	Input Template (12)	Input Template (13)	Input Template (14)	1	2	3	4	5	6	Total
Other																						
User-defined material #1	TBD	0														0	0	0	0	0	0	0
User-defined material #2	TBD	0														0	0	0	0	0	0	0
User-defined material #3	TBD	0														0	0	0	0	0	0	0
User-defined material #4	TBD	0														0	0	0	0	0	0	0
User-defined material #5	TBD	0														0	0	0	0	0	0	0
User-defined material #6	TBD	0														0	0	0	0	0	0	0
User-defined material #7	TBD	0														0	0	0	0	0	0	0
User-defined material #8	TBD	0														0	0	0	0	0	0	0
User-defined material #9	TBD	0														0	0	0	0	0	0	0
User-defined material #10	TBD	0														0	0	0	0	0	0	0
User-defined material #11	TBD	0														0	0	0	0	0	0	0
User-defined material #12	TBD	0														0	0	0	0	0	0	0
User-defined material #13	TBD	0														0	0	0	0	0	0	0
User-defined material #14	TBD	0														0	0	0	0	0	0	0
User-defined material #15	TBD	0														0	0	0	0	0	0	0
User-defined material #16	TBD	0														0	0	0	0	0	0	0
User-defined material #17	TBD	0														0	0	0	0	0	0	0
User-defined material #18	TBD	0														0	0	0	0	0	0	0
User-defined material #19	TBD	0														0	0	0	0	0	0	0
User-defined material #20	TBD	0														0	0	0	0	0	0	0
User-defined Waste Destinations																						
User-defined recycled/reused on-site #1	TBD	0														0	0	0	0	0	0	0
User-defined recycled/reused on-site #2	TBD	0														0	0	0	0	0	0	0
User-defined recycled/reused on-site #3	TBD	0														0	0	0	0	0	0	0
User-defined recycled/reused off-site #1	TBD	0														0	0	0	0	0	0	0
User-defined recycled/reused off-site #2	TBD	0														0	0	0	0	0	0	0
User-defined recycled/reused off-site #3	TBD	0														0	0	0	0	0	0	0
User-defined non-hazardous waste destination #1	TBD	0														0	0	0	0	0	0	0
User-defined non-hazardous waste destination #2	TBD	0														0	0	0	0	0	0	0
User-defined non-hazardous waste destination #3	TBD	0														0	0	0	0	0	0	0
User-defined hazardous waste destination #1	TBD	0														0	0	0	0	0	0	0
User-defined hazardous waste destination #2	TBD	0														0	0	0	0	0	0	0
User-defined hazardous waste destination #3	TBD	0														0	0	0	0	0	0	0