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PARSONS

REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN FOR THE GARY DEVELOPMENT LANDFILL SUPERFUND SITE GARY, INDIANA

Prepared on behalf of the Gary Development Landfill Notice Parties Group for:

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 5

JANUARY 2016

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January 26, 2016

Ms. Leslie Blake (2 copies)
Remedial Project Manager
U.S. EPA, Superfund Division
Mail Code SR-6J
77 W. Jackson Blvd., Suite 1317
Chicago, IL 60604

Re: Gary Development Landfill Superfund Site
Revised Final RI/FS Work Plan

Dear Ms. Blake:

On behalf of the Gary Development Landfill Site Group ("Respondents"), attached is the revised, final RI/FS Work Plan (Work Plan) for your approval. The revised Work Plan addresses EPA's comment, dated January 14, 2016, in their conditional approval letter. For your convenience, and ease of reviewing the Work Plan revisions, EPA's comment and the Respondents' response are shown below:

EPA Comment:

It is not clear how the soil samples for VOC analysis will be collected. EPA Method 5035a should be used for the collection of soil/solid samples for VOC analysis. The FSP and the QAPP text and related tables should be updated to conform to EPA Method 5035 for VOC sampling and analysis (see Appendix A, Worksheet #19/30; Appendix B: SOP No. 8, Section 3.3C, SOP No. 9 Section 3.2 C and SOP No. 19 Table 1).

Response:

Soil samples will be collected from the Geoprobe^{tm} sleeve, split-spoon sampler, or other sampling tools (i.e., for surface soil samples) at the soil boring location. For samples being analyzed for VOCs, a portion of the soil sample (5 grams) will be collected with a Terra Core® coring tool, or equivalent device, provided by the laboratory, and immediately placed in multiple laboratory-cleaned and preservative-prepared 40mL glass vials with PTFE faced silicone septa (per Section 6.0 of Method 5035A, July 2002). Preservatives will include Sodium Bisulfate, methanol and an unpreserved vial (for the determination of moisture content). This methodology is consistent with USEPA Method 5035A for sample collection. Laboratory analysis for VOCs will be conducted by USEPA Method 8260.

The FSP and the QAPP have been modified accordingly (Appendix A, Worksheet #19/30; Appendix B: SOP No. 8, Section 3.3C, SOP No. 9 Section 3.2 C and SOP No. 19 Table 1). The reference to En Core samplers in SOP 9 has been deleted.

If you have any questions regarding this final Work Plan submittal, please contact me at (865) 691-5052.

Sincerely,
de maximis, inc.

Michael H. Samples
Alternate Project Coordinator

MHS/akw
Attachment

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PAPER

Remedial Investigation/Feasibility Study Work Plan

Gary Development Landfill Superfund Site
Gary, Indiana

PREPARED FOR:

THE U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION V

PREPARED ON BEHALF OF:

THE GARY DEVELOPMENT LANDFILL NOTICE PARTIES GROUP

PREPARED BY:

PARSONS

January 2016

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ABBREVIATIONS AND ACRONYMS

°C	Degrees Celsius
°F	Degrees Fahrenheit
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
µg/m^3	Micrograms per Cubic Meter
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
BERA	Baseline Ecological Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Constituent of Concern
CSM	Conceptual Site Model
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DQO	Data Quality Objective
EDD	Electronic Data Deliverables
ERA	Ecological Risk Assessment
FS	Feasibility Study
FSP	Field Sampling Plan
ft	Feet
g	Grams
GDL	Gary Landfill Development
GIS	Geographic Information System
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
IDW	Investigation Derived Waste
L	Liter
LNAPL	Light Non-aqueous Phase Liquid
m	Meter
MCL	Maximum Concentration Level
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
msl	Mean Sea Level
NAPL	Non-aqueous Phase Liquid
NPL	National Priorities List
NWI	National Wetland Inventory
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PDF	Portable Document Format
PID	Photoionization Detector

ABBREVIATIONS AND ACRONYMS (CONTINUED)

PPE	Personal Protective Equipment
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SOP	Standard Operating Procedure
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
USACE	United States Army Corps of Engineers
USCS	United Soil Classification System
USDHHS	United States Department of Health and Human Services
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound

SECTION 1
INTRODUCTION

1.1 RATIONALE

The purpose of this Remedial Investigation/Feasibility Study (RI/FS) Work Plan is to review existing data, develop a Conceptual Site Model (CSM), identify data gaps, design a data collection program to address the identified data gaps, and document the planned RI/FS activities. The Work Plan also presents information on project organization and schedule.

Based on the United States Environmental Protection Agency (USEPA) documents "Presumptive Remedy for CERCLA Municipal Landfill Sites" (EPA 540-F-93-035, September 1993) and "Landfill Presumptive Remedy Saves Time and Cost" (EPA 540-F-96-017, Page 2, January 1997), presumptive remedies are preferred technologies for common categories of sites. These documents establish containment by capping as the presumptive remedy for CERCLA municipal landfills.

The proposed approach for completion of the RI/FS is consistent with an anticipated containment remedy. The presumptive remedy approach was approved by the USEPA in a letter dated August 21, 2015.

1.2 SITE BACKGROUND AND SETTING

1.2.1 Physical Setting

The Site is the former Gary Development Landfill (GDL) is located at 479 N. Cline Avenue, Gary, Lake County, Indiana. The GDL can be found on the U.S.G.S. Highland, Indiana Quadrangle Topographic Map, in the southwest corner of Section 35 in Township 37 North, Range 9 West (Figure 1-1). The GDL lies adjacent to the Grand Calumet River about 500 feet west of the Gary Airport, south of Lake Michigan. The Site is also bounded on the north and east by the E & J Railroad, to the east by the Indiana Tollway, to the south by the Grand Calumet River, and to the west by AMG Resources Corporation (AMG), a metal recycling facility. Wetland areas are present on the southeastern portion of the property.

The GDL property consists of 62 total acres, of which approximately 55 acres were utilized for solid and hazardous waste disposal (Figure 1-2).

The surrounding area is heavily industrialized and includes numerous environmentally impacted sites (Figure 1-3).

1.2.2 Environmental Setting

1.2.2.1 Geology

The landfill lies within the Lake Michigan Border physiographic division of the Northern Lake and Moraine Region of Indiana. This region is characterized by the presence of beach ridges, dunes, moraines, numerous lakes and peat bogs. The landscape surrounding the site has been altered by industrial and urban development.

Predominant soil types include the Oakville-Adrian soil complex, Houghton muck and Urban land.

Rosenshein (1962) used the expression of surface deposits and subsurface geologic information to develop a tentative glacial stratigraphy and chronology of the unconsolidated deposits in Lake County. In the area of the landfill, Rosenshein identified the presence of two distinct unconsolidated lithologies. The uppermost unit was determined to be Holocene, or late Wisconsinan eolian and glaciolacustrine sand and gravel. The lower unit an early Wisconsinan, or pre-Wisconsinan clay till.

Brown and Thompson (2005) later compiled and summarized earlier work and continued the investigation of the surficial geology of the northern third of Lake County. They concluded that multiple water level fluctuations of Lake Michigan over the past 13,500 years, culminated in the formation of three distinct successions of deposits named the Lake Michigan, Lake Border and Wheeler Sequences. Beneath the unconsolidated deposits of the Wheeler Sequence, carbonate bedrock of the Wabash Formation was encountered. Soil boring logs from the immediate vicinity (ATEC Associates, 1981) demonstrate that sand and gravel deposits extend from the surface to an average depth of approximately 25-40 feet. Deeper boring logs describe the occurrence of soft silty clay transitioning to gray, hard silty clay till. At this location, the till is approximately 50 feet (ft) thick, where it contacts the upper bedrock surface. The bedrock is described as hard, gray and finely crystalline dolomitic limestone containing closely spaced solution joints and tar-filled cavities (Figure 1-4).

1.2.2.2 Hydrogeology

The GDL is located in the Lake Michigan Basin water management area of Indiana. The uppermost eolian and glaciolacustrine deposits form the surficial, water table Calumet aquifer. Although surface water in the Grand Calumet River continuously flows east to west, the hydraulic gradient of the river relative to the water table determines whether surface water recharges the aquifer, or base flow from the aquifer discharges as surface water.

The uppermost eolian and glaciolacustrine deposits form the surficial Calumet aquifer, which extends as much as 10 miles inland from the shore of Lake Michigan. Soil borings adjacent to the site show the shallow sand aquifer extends to a depth of 40 ft where it comes into contact with the upper surface of the lower till. Since 1985, water levels have fluctuated between 582 and 584 feet above mean sea level (msl). Recharge to the aquifer occurs principally by the infiltration of precipitation from above. The till serves as a confining unit to both the upper sand and lower bedrock aquifers. Together, the sand aquifer and confining till have a combined thickness of 90 to 110 ft above bedrock. Beneath the unconsolidated deposits, bedrock of the Wabash formation consists of various carbonate lithologies up to 250 ft thick.

No additional site-specific information has been obtained. Further site specific investigation is warranted to determine the impact of the GDL on the quality of ground water contained in the sand and bedrock aquifers below it.

1.2.3 Site Use History and Ownership

The GDL (CERCLIS ID No. IND077005916) was a former permitted solid waste landfill, located at 479 N. Cline Avenue, Gary, Lake County, Indiana (Figure 1-2). It is located in an industrial area of the City of Gary, Indiana.

The landfill began as an aggregate borrow pit during the early 1950s, and was later approved by the State of Indiana in September 1974 for operation primarily as a solid waste landfill, prior to the promulgation of RCRA rules regarding management of hazardous waste disposal (October 1976). The pit was approved for dewatering in 1973, and a landfill constructed, with operations starting in September 1974. The landfill never received a RCRA permit. An industrial/sanitary landfill was operated at the Site from 1974 to 1989. Because of the de-watering activities, an inward groundwater gradient existed during this period, from the Grand Calumet River towards the Site.

The Site is comprised of three (3) parcels. The first parcel to the east contains 40 acres, with the Gary Development Co. Inc. listed as the owner. The second parcel consists of 5.9 acres. This parcel was originally owned by the Gary Development Co. Inc., but was sold on August 8, 2003 to Non-Responsive of Gary, Indiana. The third parcel consists of approximately 15 acres. The parcel is currently owned by the Lake County Board of Commissioners.

The Site is situated in a heavily industrialized area. Therefore, a search of the adjacent properties within a 2-mile radius was completed using the USEPA Cleanups List (http://www2.epa.gov/cleanups). A total of 17 sites were identified (Brownfield's, RCRA, Superfund's, and Emergency Responses) as sources of hazardous substances. Figure 1-3 provides the locations of the findings.

1.2.4 Historical Data Summary

The GDL Site was the subject of multiple investigations conducted by the USEPA and the Indiana Department of Environmental Management (IDEM) from 1990 to 2014. In addition, multiple site inspections were conducted prior to 1990. These investigations included sampling of groundwater, surface water, liquid waste, and sediments within the site, and extensive sampling within the Grand Calumet River.

The historical data (refer to Section 6 for references) were presented to USEPA in a meeting on April 22, 2014, and a Historical Data Summary Technical Memorandum was prepared and submitted following the meeting.

In addition, the August 2014 Draft Data Summary Report (CDM Smith, 2014) was reviewed. This summary indicated that sampling was conducted within an approximately 2.5 mile-long reach of the Grand Calumet River that extends from the downstream terminus of the US Steel sediment project to Cline Avenue. The evaluation of these recent data sets, in conjunction with the proposed remedial investigation, will be included in the Remedial Investigation Report.

Conclusions from a thorough review of these large data sets are as follows:

1. Based on the large volume of historical data and the ongoing remediation by USEPA under a Great Lakes Legacy Act Project Agreement, additional assessment of the Grand Calumet River is not warranted at this time.
2. Although the southern wetlands area of the GDL Site exhibits some impacts, particularly from PAHs, data from the river shows that periodic flooding of the wetlands from the river is likely responsible for the observed impacts.
3. Environmental sampling conducted in the waste disposal area of the Site indicates that USEPA Maximum Concentration Level (MCLs) were not exceeded in either groundwater or surface water, including the northern pond.
4. Adequate data are already available to identify and limit the remedial investigation analyte list. The primary chemical groups detected in previous investigations were PAHs, PCBs, and metals.
5. The approach of this RI/FS for the GDL relies upon containment/capping as the preferred remediation strategy. The historical data set supports this approach as being appropriate.

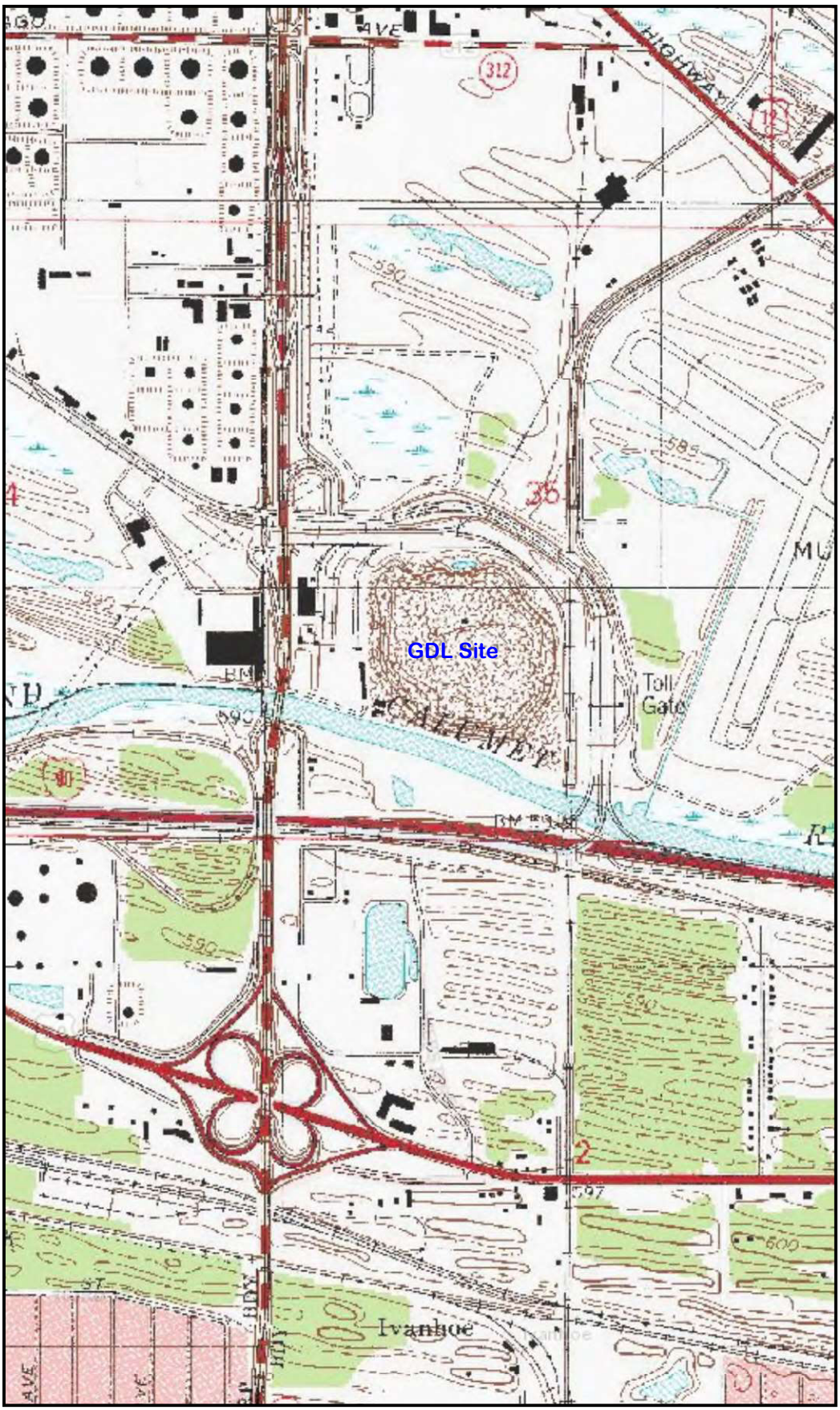
1.2.5 Current Site Conditions

The GDL Site includes four abandoned buildings, the landfill, a wetland area located on the southeastern portion of the Site, and a pond located north of the landfill.

A preliminary water wells search was completed. Indiana Department of Natural Resources (DNR) maps (http://www.in.gov/dnr/water/6604.htm) were researched for information concerning private, municipal, and industrial water wells within a 2-mile radius. According to information provided in this survey, no private drinking water wells were identified within a 1,000 feet radius of the site. The closest water well is located 1,350 feet to the south (Figure 1-5), across the Grand Calumet River. The Grand Calumet River is impacted by upstream sources and is subject to ongoing remediation unrelated to the GDL Site. A detailed water well survey will be conducted by reviewing various databases using an Environmental Data Resources (EDR), Government Agencies, or similar online resources.

FIGURE 1-1 SITE LOCATION MAP

Date: 9/9/2014



Legend

State Boundary

Gary Landfill Boundary

Author:

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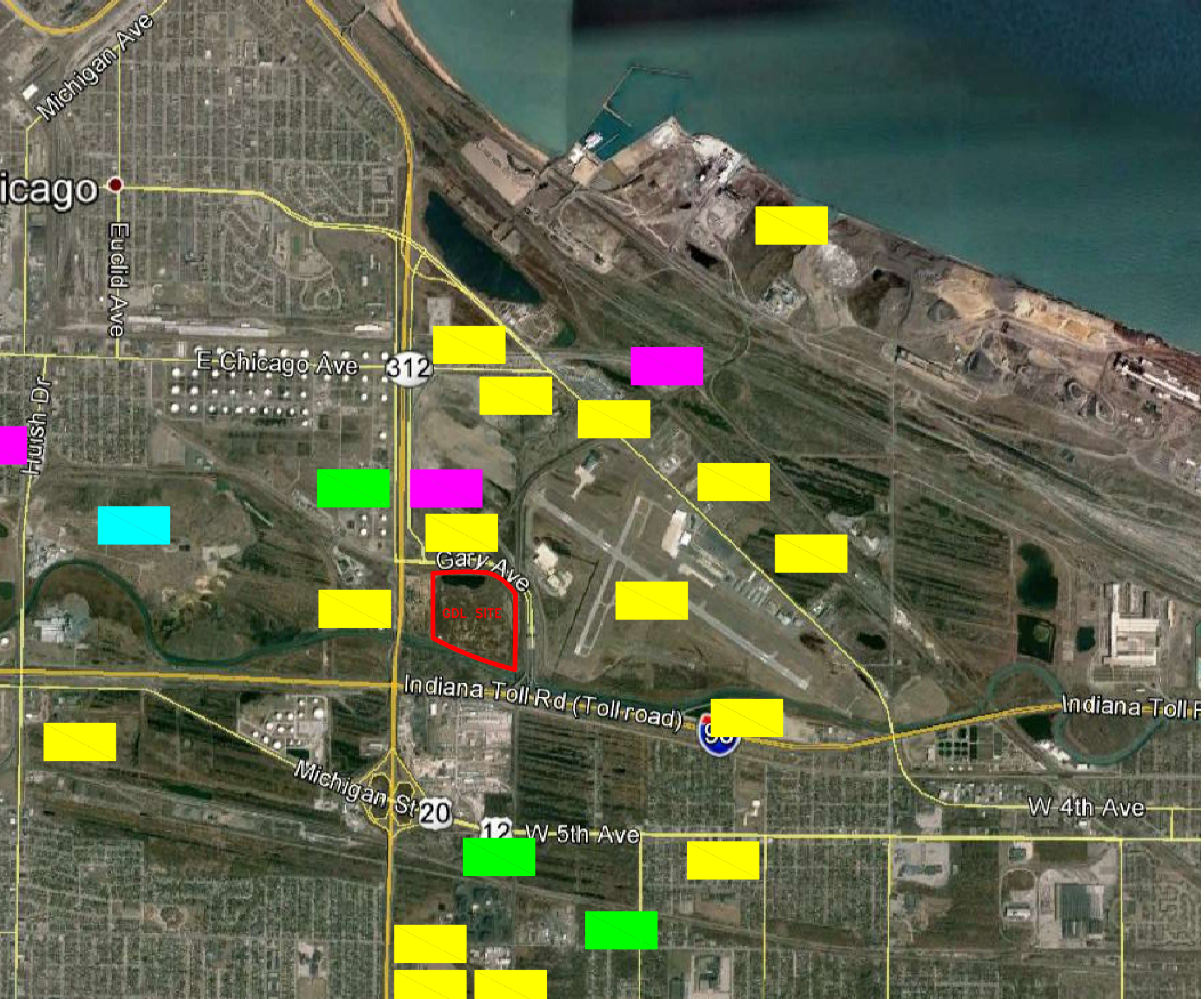
IndianaMAP

Northern Pond
Approximate Property Boundary
3. Approximate Waste Disposal Area
te Buildings
2. The Southern Wetlands
1. Grand Calumet River
Grand Calumet River
Gary Ave



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REFERENCE

1. EPA SEA
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2. EPA CLE
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3. Indiana S
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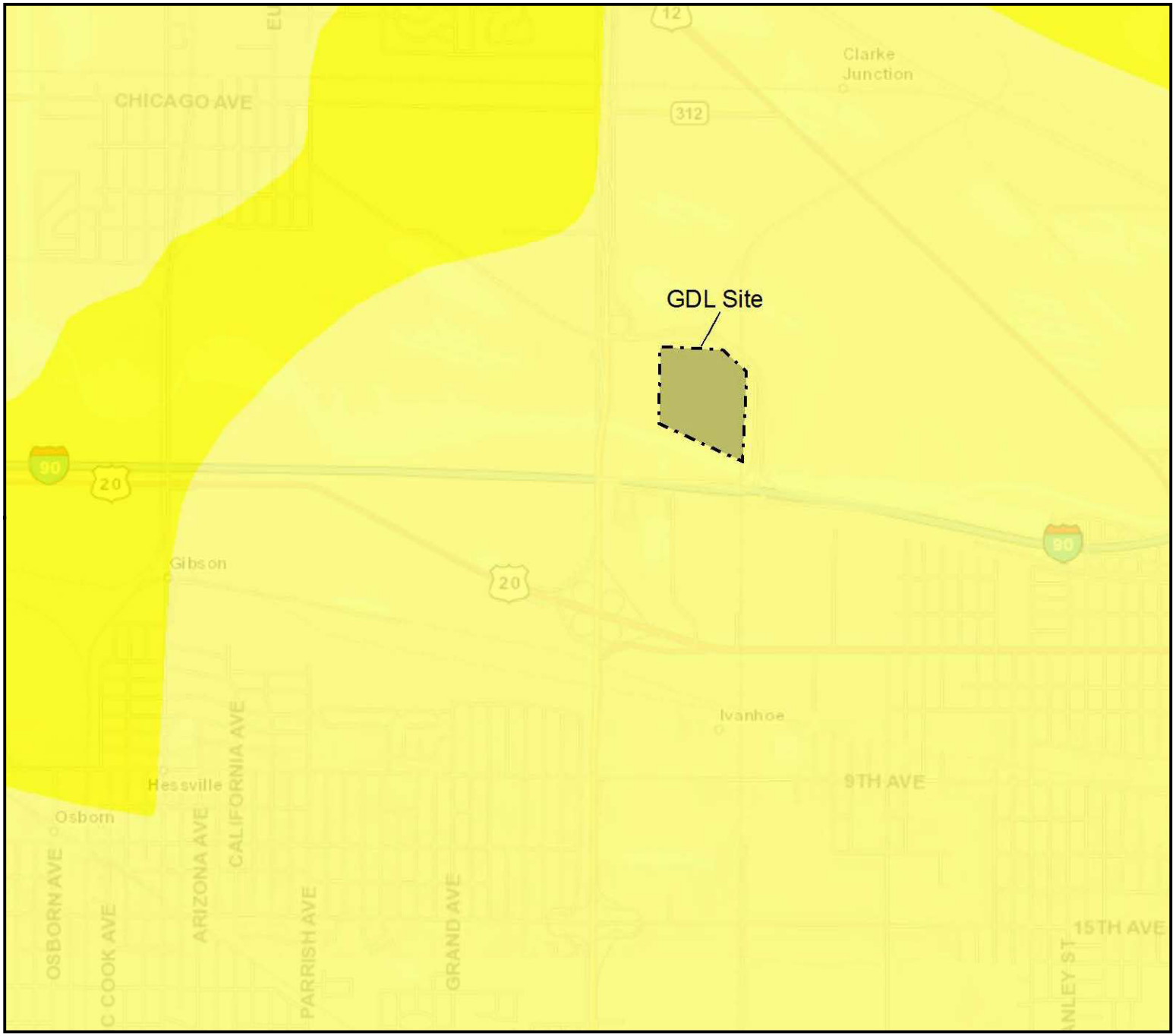
Figure 1-4 Regional Geology Map

Date: 9/4/2014



Legend

- Holocene
- Wisconsinan to Holocene
- Wisconsinan
- Pre-Wisconsinan
- Middle Pennsylvanian
- Late Mississippian and Early Penns
- Middle Mississippian
- Early to Middle Mississippian
- Middle Devonian to Early Mississipp
- Silurian and Devonian
- Late Ordovician
- n.a.

Author:

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IndianaMAP

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SECTION 2
INITIAL EVALUATION

2.1 CONCEPTUAL SITE MODEL

This Conceptual Site Model (CSM) presents the current understanding of the Site. The CSM is a representation of the physical, chemical, and biological processes that affect the potential transport of any constituents of concern from sources to receptors within the system.

Based on a review of the historical data, background information, and an initial visit, a preliminary CSM has been developed. Figures 2-1 through 2-4 present the ecological and human health CSMs for both current conditions and for a scenario in which capping has been implemented as a remedy. Capping is anticipated to remove many of the current exposure pathways. This CSM will be updated after the initial Remedial Investigation (RI) data have been obtained. If needed, it will be updated again following completion of the risk assessment.

2.2 IDENTIFICATION OF DATA NEEDS AND DATA QUALITY OBJECTIVE

Data Quality Objectives (DQOs) were developed using the USEPA's DQO process, a multi-step, iterative process that ensures that the type, quantity, and quality of environmental data used in the decision making process are appropriate for its intended application. The DQOs for this investigation are:

- To characterize environmental conditions and refine the CSM;
- To collect additional data to define the landfill limits;
- To collect additional data to update existing datasets from previous investigations so that the nature and extent of impacts can be defined;
- To collect hydraulic data to better understand the site-specific hydrogeology;
- To collect data to support performance of Human Health and Ecological Risk Assessments;
- To collect data to support development and evaluation of remedial alternatives.

2.3 PRELIMINARY REMEDIAL ACTION GOALS AND ARARS

Based on current information, the over-riding preliminary remedial action objective is to contain the waste within the landfill by capping.

As shown in the post-remedy CSM figures, containment would remove several exposure pathways by preventing contact of precipitation with the underlying waste. This objective is particularly important in light of the planned remediation of the Grand Calumet River adjacent to the Site.

As stated in the Historical Data Summary Technical Memorandum, a review of the sampling and analysis conducted over multiple investigations, the list of chemical analytes for the RI can be limited. The primary analytes observed in previous

investigations of Site groundwater, surface water, and sediments are PAHs, Metals, and PCBs. Although these analyte groups were most prevalent in the existing data sets, a more extensive suite of analytes will be included in the initial RI, and will be reduced at a later time, if appropriate. These will include: VOCs, SVOCs, metals, mercury, cyanide, PCBs, and pesticides.

Although remediation goals will be established later in the project, preliminary goals may be used as screening levels during the RI/FS. A few potential screening level goals are shown below.

1) Soil: IDEM Direct Contact Soil Exposure for Industrial/Commercial Properties;
2) Groundwater: IDEM "Tap Water" screening levels;
3) Surface water: IDEM "Tap Water";
4) USEPA Region 5, RCRA Ecological Screening Levels (ESLs), August 23, 2003;
5) EPA Regional Screening Levels;
6) Illinois EPA Background Values for the Chicago Metropolitan Area.

For the initial screening, a 10^{-6} risk level will be used for the human health evaluation, for carcinogenic compounds.

Applicable or Relevant and Appropriate Requirements (ARARs) will be developed in detail during the feasibility study. Below is a preliminary list of regulatory programs that may provide substantive standards which may be useful in establishing ARARs:

1) Clean Water Act (drinking water standards);
2) Rivers and Harbors Act (Section 1);
3) Toxic Substances Control Act (TSCA);
4) Endangered Species Act;
5) Fish and Wildlife Coordination Act;
6) Indiana Administrative Code Title 329 Article 10 – Solid Waste Land Disposal Facilities;
7) Other Relevant State Regulations and Laws;
8) FAA Regulations.

2.4 PRELIMINARY REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) will be developed to take into account relative risks of Constituents of Concern (COCs), as well as ensure that cleanup objectives are tied to overall risk management goals. As appropriate, RAOs will specify the COCs, exposure route(s) and receptor(s), and an acceptable COC level or range of levels that may be numerical or narrative, recognizing that protectiveness may be achieved by reducing exposure as well as by reducing COC levels. These RAOs will be developed as part of

the feasibility study, following completion of the RI, Ecological Risk Assessment (ERA), and HHRA.

Figure 2-1

Ecological Conceptual Site Model – Current Conditions

Site Name: **Gary Development Landfill**

Completed By: **PARSONS** ***Date Completed:*** September 2015

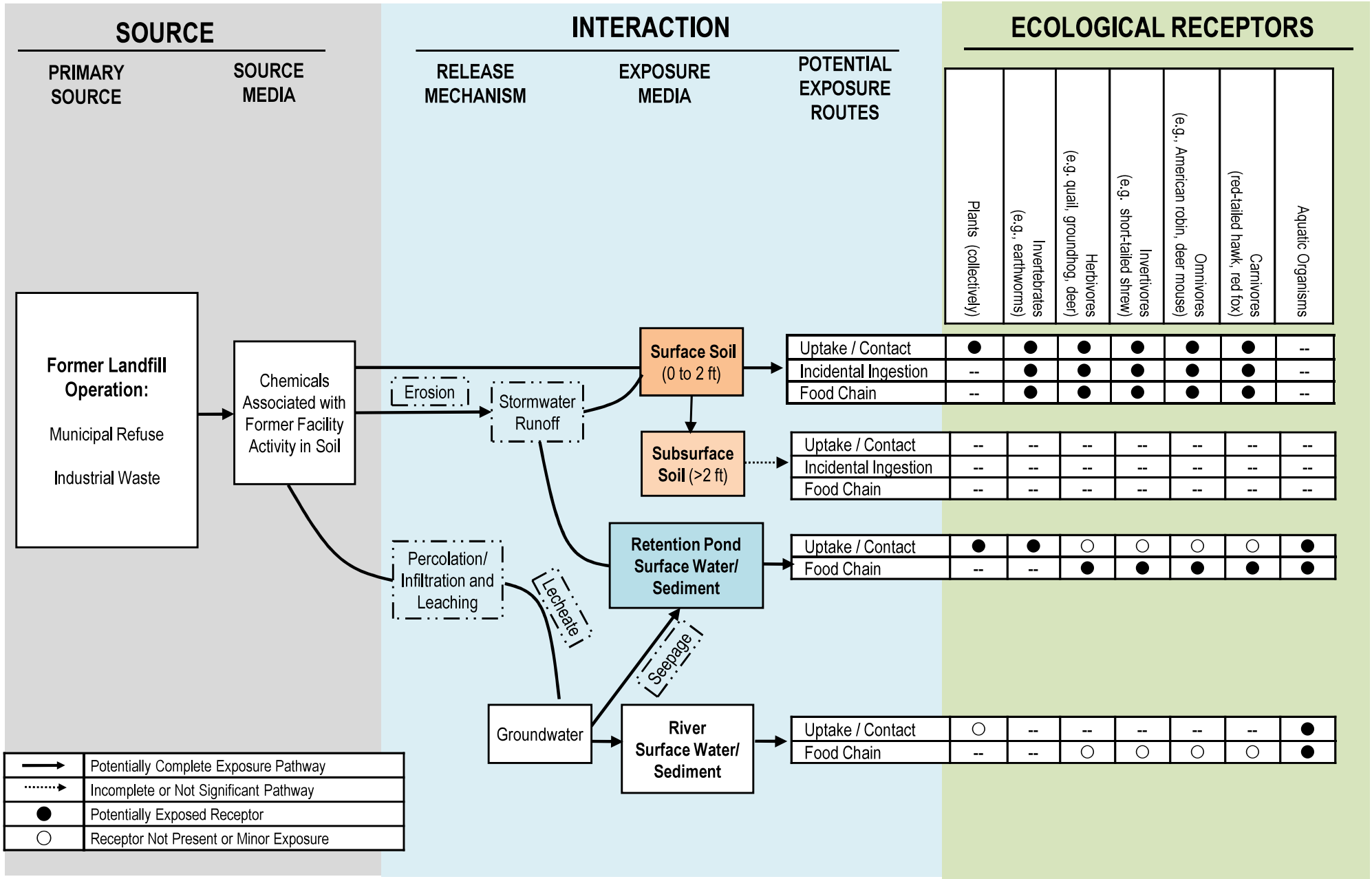


Figure 2-2

Ecological Conceptual Site Model – Future Conditions. Presumptive Remedy: Landfill Cap Placement

Site Name: **Gary Development Landfill**

Completed By: **PARSONS** ***Date Completed:*** September 2015

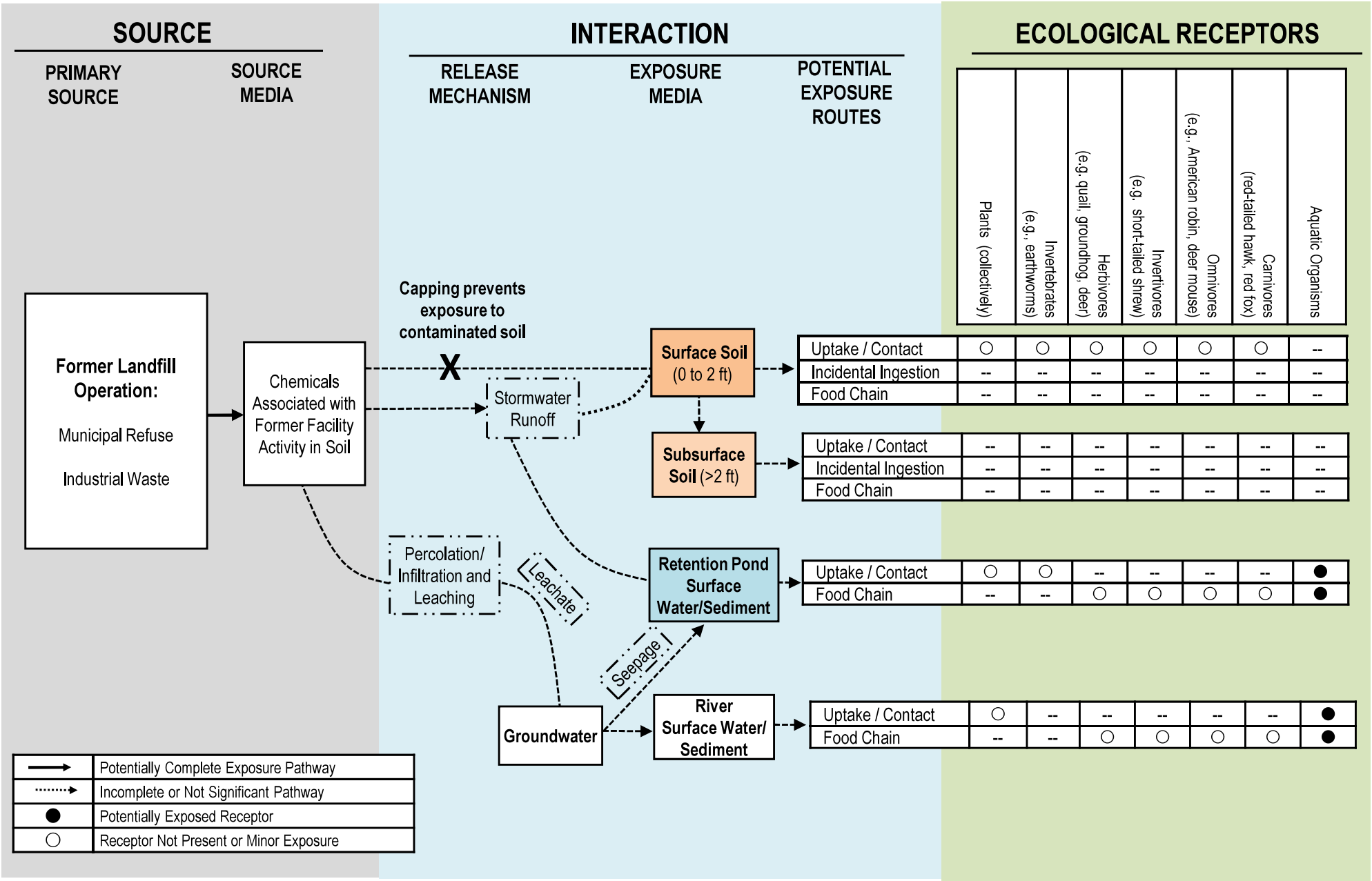


Figure 2-3

Human Health Conceptual Site Model – Current Conditions

Site Name: **Gary Development Landfill – Current Conditions**

Completed By: **PARSONS** ***Date Completed:*** September 2015

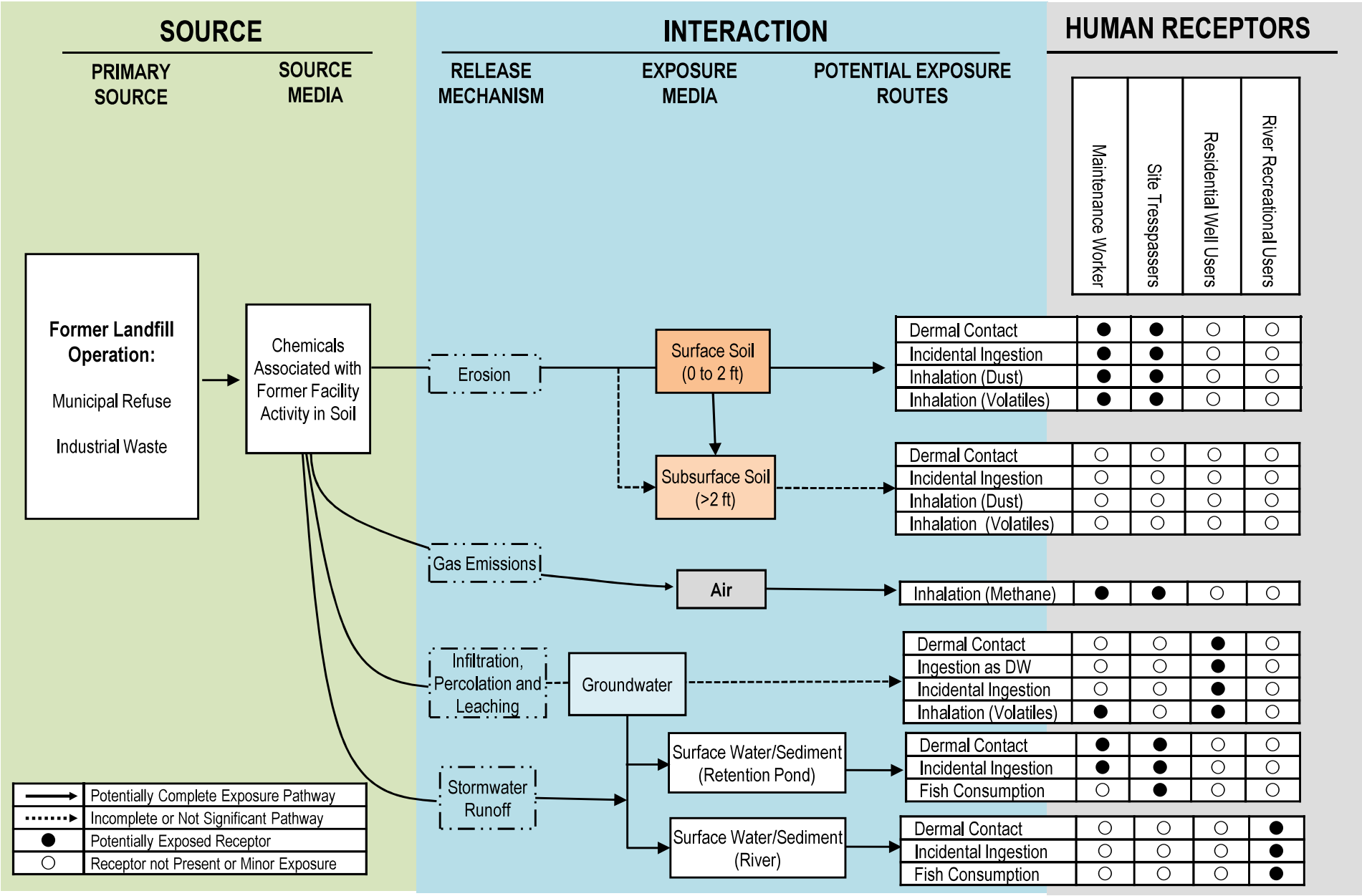
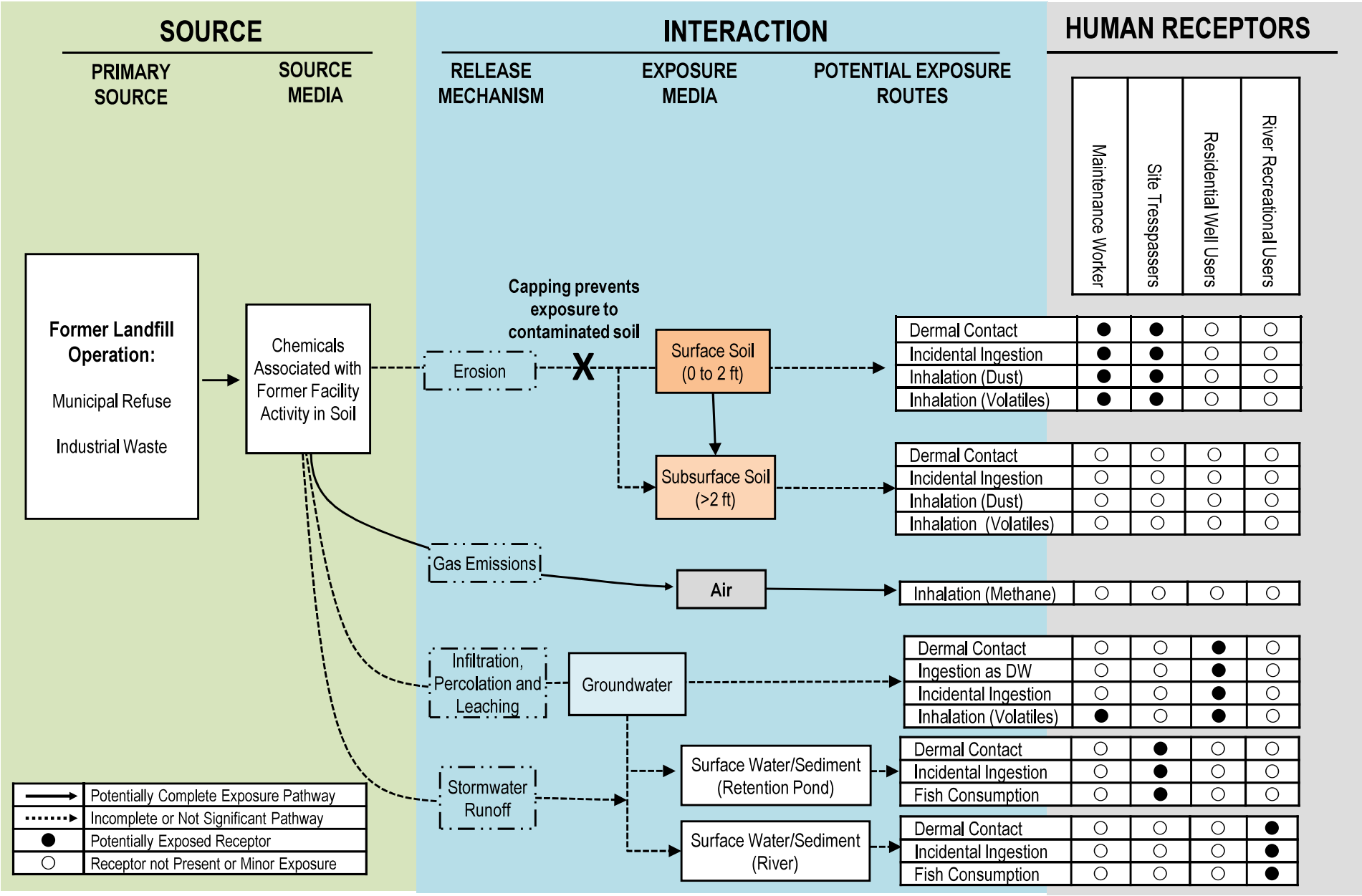


Figure 2-4

Human Health Conceptual Site Model – Future Conditions. Presumptive Remedy: Landfill Cap Placement

Site Name: **Gary Development Landfill**

Completed By: **PARSONS** ***Date Completed:*** September 2015



SECTION 3
SITE CHARACTERIZATION

3.1 INTRODUCTION AND APPROACH

This section outlines the planned characterization approach and proposed tasks for the remedial investigation. A summary of the proposed sampling plan is provided in Table 3-1. Details of the proposed sampling plan by matrix are provided in Table 3-2.

3.1.1 Investigation Approach

The majority of the investigation will be outside the presumed limits of the landfill area. The field program will be based in part on the previously completed investigations, and will include collection of subsurface soil, surface soil, sediment, surface water, gas, and groundwater samples. It will also include physical, ecological, and wetland area surveys. This work is intended to characterize the chemical and physical characteristics of the Site and define impacts outside the landfill area. Shallow surface soil samples will be used to characterize direct contact risks for both human and ecological receptors. Direct push borings will be used to collect groundwater samples and to facilitate selection of monitoring well locations. The landfill limits will be delineated by digging test pits. Gas sampling will evaluate concentrations of specific airborne chemicals for current conditions within the existing landfill vents, and at locations outside the limits of waste.

3.1.2 Supplemental Delineation

Data may be collected during the RI that indicate the need for specific or localized delineation of the extent of impacts to various media. The need for further delineation will be evaluated based on multiple lines of evidence suggesting the presence of non-aqueous phase liquid (NAPL), either light (LNAPL) or dense (DNAPL). Figure 3-1 is a flow chart that provides direction on how positive observations of NAPL will be used to evaluate the potential need for further action.

This screening flow-chart for evaluation of the potential presence of NAPL does not preclude the normal evaluation of all the RI data (metals, etc.). All data will be evaluated in context with ecological and human health risk assessments and comparison of environmental sample results to various regulatory criteria.

3.2 QUALITY ASSURANCE PROJECT PLAN

A Quality Assurance Project Plan (QAPP) has been prepared to support activities and specify the quality assurance/quality control (QA/QC) procedures for field and laboratory sampling and measurements. The specific objectives of the QAPP are:

- Foster data quality that is appropriate to meet the investigation objectives and to support the decision-making process.
- Provide a standard for control and review of measurement data to confirm that the data are scientifically sound, representative, comparable, defensible, and of known quality.

The QAPP has been prepared in accordance with "EPA Requirements of Quality Assurance Project Plans" (QA/R-5) (EPA/240/B-01/003, March 2001), "EPA Guidance for Quality Assurance Project Plans" (QA/G-5) (EPA/600/R-02/009, December 2002) and the "Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) Manual" (EPA/505/B-04/900A, March 2005). The "Intergovernmental Data Quality Task Force Uniform Federal Policy for Quality Assurance Project Plans Optimized UFP-QAPP Worksheets," March 2012, has also been utilized in the preparation of the QAPP.

The complete QAPP is presented in Appendix A.

3.3 FIELD SAMPLING PLAN

The Field Sampling Plan (FSP) provides detailed procedures related to the collection and analysis of environmental samples. The FSP is presented in Appendix B.

3.4 HEALTH AND SAFETY PLAN

A Health and Safety Plan (HASP) has been prepared in conjunction with the RI/FS Work Plan to ensure safety of Site workers during the investigation activities. The HASP is presented in Appendix C.

The HASP was prepared in accordance with the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) and the Construction Industry Standard (29 CFR 1926). The HASP addresses task-specific hazard analyses, air monitoring for personnel safety, personal protective equipment recommendations, site controls, equipment and personnel decontamination, medical monitoring and training requirements, and emergency response procedures. All field activities will be conducted in accordance with the approved HASP.

3.5 INVESTIGATION TASKS

3.5.1 Site Preparation

3.5.1.1 Access Agreements

The USEPA facilitated onsite access via an administrative warrant. The GDL PRP Group obtained a non-exclusive limited right of access with the adjacent AMG property for the purpose of ingress/egress to the Site, along the southern boundary near the Grand Calumet River.

3.5.1.2 Onsite Building Evaluation

The onsite buildings in the southwestern corner of the Site will be inspected, with the intent to demolish and recycle them. The evaluation of the onsite buildings will include an asbestos survey and a hazardous materials survey. If present, asbestos and/or hazardous materials will be properly managed in accordance with applicable laws and regulations prior to, or as part of, the building demolition.

3.5.1.3 Brush Removal/ Roads/Sampling Path Installation

The Site has re-vegetated significantly over time, minimizing surface runoff, but limiting access. Paths will be created through brush removal or mowing to the existing gas vents and wells, planned sampling locations, and around the perimeter for new direct push points and monitoring wells. Efforts will be made to identify the culvert/drainage underneath the former access road (presented in the HRS records). Efforts will be made to minimize the amount of clearing and grubbing, which will continue to provide interim erosion control. The primary route of access will be the road adjacent to the river. In addition, the entry of the access road will be secured with a gate and proper signage.

3.5.1.4 Scrap Metal and Debris Removal

Based on the aerial photographs and an initial Site visit, abandoned pieces of heavy equipment were preliminarily identified. Two trucks, one excavator, and one tanker appear to be located in the southwestern area. A second excavator is located centrally. Furthermore, unknown equipment/debris is located in the northern pond (Figure 3-2). Following a site reconnaissance visit, arrangements will be made for inventory of the metal/scrap debris. Options for handling the debris will include offsite disposal, recycling, or placement under a future landfill cap. Offsite disposal or recycling of waste identified onsite will be disposed in accordance with applicable laws.

3.5.1.5 Underground Utility Location

Utility clearance will be performed at each location of intrusive work (drilling, excavating, etc.) prior to conducting the intrusive activities. Subsurface clearance will be conducted in the top four feet below ground surface (bgs) using a hand auger/air knife combination. Appropriate protocols will be followed to identify the locations of buried utilities and to confirm the absence of such utilities prior to intrusive activities.

3.5.1.6 Access Control/Fencing

A gate and proper signage will be installed along the southern access road to restrict and control access. Enclosure of the perimeter is not needed due to natural barriers such as the Grand Calumet River, thick vegetation, and manmade restrictions such as the Tollway, and railways. If, during the course of the remedial investigation work, evidence of trespassing is observed, additional access measures, such as fencing or other gates, will be considered.

3.5.1.7 Topographic Survey

A topographic map is presented in Figure 3-3 and is based on the 2013 LiDAR topography survey, using five foot contour lines. The LiDAR survey was conducted at sufficient resolution for the production of one-foot contours. Thus, a topographic survey is not needed during the RI/FS phase of work. The LIDAR survey will be spot checked during the survey of the sampling points and monitoring wells.

3.5.1.8 Onsite Well Inventory

Based on previous investigations, there are four monitoring wells (1W, 1S, 1E, and 1N) located at the Site; however, no boring logs have been located. The locations and condition of the existing wells will be assessed during a reconnaissance visit. If identified, the existing monitoring wells (1W, 1S, 1E, and 1N) will be properly abandoned in accordance with 312IAC 13-10-2, State of Indiana.

3.5.1.9 Soil Gas Evaluation

There are no human receptors in the landfill, and therefore no complete risk pathway. The existing gas vents and air sampling task (Section 3.5.5.3) with up to 14 gas vents within the landfill, and up to seven (7) perimeter gas probes, will provide sufficient information for evaluating the potential for a completed vapor intrusion pathway. The vapor intrusion pathway will be further evaluated following the investigation activities, if warranted, based on the gas vent, gas probe, and groundwater sampling results.

3.5.2 Southern Wetlands Investigation

3.5.2.1 Wetlands Delineation

A wetland delineation will be performed to confirm the limits of the existing southern wetlands within the Site boundaries. The wetland delineation will be conducted by a certified wetland specialist and using the techniques outlined by United States Army Corps of Engineers (USACE) Field Guide for Wetlands Delineation Manual (USACE 1987) and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: North central and Northeast Region (USACE 2009). The overall quality of the wetlands is currently poor and degraded due to the predominance of invasive phragmites. Quality will be evaluated as part of the delineation process. Note that the southern wetland is not documented by U.S. Fish and Wildlife Service on the National Wetlands Inventory.

3.5.2.2 Sediment Sampling

A total of 15 locations will be sampled for sediments (SD07 through SD21) in the southern wetlands (Figure 3-4). Two (2) samples per location will be collected, one (1) at zero (0) to one (1) foot and a second at one (1) to two (2) feet below the sediment/water interface or ground surface. The samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. If, following completion of the RI, additional sampling is considered necessary to delineate the vertical extent of wetland sediments, a supplemental investigation activity will be proposed to USEPA. The proposed sample analyses are presented in Table 3-1.

Because of potential impacts to the Site from the river, and from former pumping operations, two locations (SD20 and SD21) will be sampled at multiple depths (to approximately five (5) feet below the sediment/water interface or ground surface) to evaluate whether PCBs are present only in surface sediment samples or are present in a vertical profile.

If standing water or seeps are found in the vicinity of these sediment sample locations in this area, or along the toe of the landfill, a surface water or seep sample will be collected and analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide (see Table 3-2). A single seep was observed during a September 9, 2015 Site visit. Although it did not appear to be leachate from the landfill, the location of this seep has been documented, and if found during the RI, it will be sampled.

3.5.3 Northern Pond Investigation

3.5.3.1 Inspect Vegetation and Habitat

An ecological characterization will be undertaken, including the Northern Pond area. This survey will include the documentation of both plant and wildlife species.

3.5.3.2 Surface Water Sampling

Based on historical results, very few chemical parameters were detected in surface water. Several metals were detected in each sample, but MCLs were not exceeded for metals or the other parameters. To confirm the absence of impacts and to assess existing conditions, six (6) surface water samples (SW02 through SW07) will be collected from the northern pond (Figure 3-5), at depths of approximately zero (0) to two (2) feet below the water surface. Surface water samples will be field screened for water quality parameters such as pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential. Each sample will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide.

In addition, the deeper water column will be evaluated at a maximum of three (3) locations by sampling at depths (approximately zero (0) to two (2) feet below the water surface and (if the water column is greater than 10 feet) an additional sample will be collected approximately 10 to 12 feet below the water surface.

The proposed samples analyses are presented in Table 3-1.

3.5.3.3 Perimeter/Shallow Sediment Sampling

A total of 10 shallow sediment samples (SD22 through SD31) will be advanced (Figure 3-5).

Two locations (SD23 and SD24) will be in the interior of the pond. One (1) sample will be collected from each location, at zero (0) to one (1) foot below the sediment/water interface.

At the remaining locations (SD22, SD25 through SD31), sampling will be conducted to a maximum depth of two (2) feet below the sediment/water interface around the perimeter of the northern pond (Figure 3-5). Two (2) samples will be collected from each location: zero (0) to one (1) foot below the interface and a second sample from one (1) to two (2) feet below the interface.

The samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The proposed pond sediment sample analyses are presented in Table 3-1.

If, following completion of the RI, additional sampling is considered necessary to delineate the vertical extent of pond sediment, a supplemental investigation task will be proposed to USEPA.

In addition to the surface water and sediment samples described above, an attempt will be made to collect two (2) to three (3) surface water and sediment samples from a pond located east of the Site (see insert in Figure 3-5) to evaluate current background conditions. Based on the aerial photographs and ownership (Indiana DNR) it appears that this pond is natural and not located immediately adjacent to contaminated sites (refer to Figure 3-5). Also, prior to initiating the field work, a site visit to the pond will be conducted to obtain additional information, which will be provided to USEPA. The selected pond proposed for background sampling is hydraulically disconnected from the landfill and consequentially possible leachate seeps (if encountered) from the landfill are not a concern. Collection of these samples is contingent upon gaining permission to sample the pond, reportedly owned by the Indiana Department of Natural Resources, and identifying accessible sampling locations. Samples, if collected, will be analyzed for the list of parameters shown in Table 3-1 for surface water and sediment samples.

3.5.4 Perimeter Groundwater Evaluation

3.5.4.1 Water Wells Survey

A preliminary water wells search was completed (Figure 1-5). A detailed water wells survey will be conducted by reviewing various databases using an Environmental Data Resources (EDR) or similar online resources. Municipal, private potable and industrial process wells will be searched. Local ordinances (such as those prohibiting private wells for potable use) will be reviewed. Identified wells will be mapped and information regarding their construction details will be provided to EPA. In addition, pertinent information in IDEM's Virtual File Cabinet will be reviewed to supplement the onsite data.

3.5.4.2 Direct Push Investigation

A Geoprobe® or comparable direct push unit will be used to advance a total of 21 borings (GP01 through GP21) (refer to Figure 3-6). The direct push borings will be used to collect groundwater samples and to facilitate selection of monitoring well locations. Based on the surrounding geology and information obtained from soil borings completed during construction of the neighboring Indiana toll road east of the Site, borings will be advanced to maximum depths of approximately 25 to 40 feet bgs. Borings will be terminated when the glacial till layer is encountered, or when refusal is encountered at a shallower depth after two attempts. If refusal occurs after drilling attempts at two locations, then a decision will be made to either make another attempt, or alternative drilling methods will be evaluated and proposed for EPA approval. Although the approximate planned locations are shown on Figure 3-6, these locations may be adjusted in the field based upon information obtained during the investigation tasks. Of the 21 borings, ten direct push locations (GP01, GP03, GP05, GP08, GP09, GP11, GP12, GP13, GP14, and GP20) have been selected for groundwater vertical profiling. Vertical profile samples will be collected at the following approximate intervals: 5 to10 feet bgs; 15 to 20 feet bgs; and 25 to 30 feet bgs. The target depth for the upper

interval will be at or near the water table to provide information on potential LNAPL/floating chemicals, and the target depth for the deepest interval will be at or near the interface between the sandy zone and clay/till to provide information on potential DNAPL/sinking chemicals.

Because of the anticipated local geology (sand overlying clay), the remaining 13 borings will be sampled at only one subsurface interval of approximately 25 to 30 feet bgs. Those selected locations and intervals will be sufficient to evaluate the vertical distribution of the groundwater and achieve the RI objectives. Based on the information available at the time of this work plan, such as the reported former activities, the age of the landfill, and the length of time since operations ceased, discrete zones within the landfill are not expected to have a significant impact on the vertical distribution of dissolved chemical constituents in groundwater outside the landfill footprint.

Groundwater samples will be collected using methods such as pre-packed screens, temporary piping with screens, or retractable screens. Typical direct push profiles (with pre-packed screens) are shown in Figure 3-7. Groundwater samples will be field screened for water quality parameters such as pH, conductivity, dissolved oxygen (DO), turbidity, and oxidation-reduction potential. Samples will be submitted to a laboratory for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The proposed sample analyses are presented in Table 3-1. Accelerated turnaround will be requested from the laboratory in order to utilize the laboratory analytical results from these samples to assist with guiding the direct push investigation and with selecting locations of the permanent groundwater monitoring wells. Decisions regarding monitoring well placement or retaining temporary direct push locations will be made in consultation with EPA and IDEM. In general, monitoring wells will be placed at locations where concentrations of COCs greater than RAOs are observed, but may also include locations where no detections or minimal impacts are observed.

3.5.4.3 Monitoring Well Installation

It is anticipated that up to 10 permanent groundwater monitoring wells (MW01 through MW10) will be installed. Installation of any additional wells will be dependent upon analytical results of the initial investigation, and would be proposed as supplemental investigation work, if warranted. Locations will be based on the direct push field screening and groundwater analytical results from the direct push investigation and results from usable existing wells.

Hollow-stem augers will be used to install the monitoring wells. The anticipated depth of each well is 25 to 40 feet bgs. Final depths and screen placement will be based in part upon information gained during the direct push investigation.

Details for monitoring well construction and installation are presented in Figure 3-8 and in Appendix B.

Four (4) rounds of groundwater samples will be collected for laboratory analysis from the entire monitoring well network. The groundwater samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The proposed sample analyses are presented in Table 3-1. The sampling events will be spaced approximately three (3) months apart to account for seasonal variations. Monthly water

level measurements will be collected from the monitoring well network during the remediation investigation, with the last event conducted concurrently with the second groundwater sampling event. The frequency of the groundwater sampling is sufficient to satisfy the technical requirements of the Remedial Investigation Report, and any additional rounds of sampling will be proposed in later phases of the project prior to the remedial design. Additionally, data from the Grand Cal USGS Report (June 2002), and from multiple years of water elevation data at an adjacent property indicate that over a period of several years, water levels in wells typically only fluctuate three (3) to five (5) feet with even smaller seasonal fluctuations.

3.5.4.4 Surface Soil Sampling

A total of 10 surface soil samples (SS01 through SS10) will be collected either from the direct push unit or using hand augers (Figure 3-9). Two (2) samples per location will be collected, one at zero (0) to six (6) inches and a second sample at six (6) inches to two (2) feet bgs. The surface soil samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The surface soil samples will be used to evaluate the ecological and human health risk assessment. The proposed samples analyses are presented in Table 3-1.

In addition, one (1) composite sample at each location (SS01 through SS10) will be collected from zero (0) to two (2) feet bgs and will be analyzed for asbestos. If asbestos is found to be present in the surface soil samples, then additional sampling may be needed prior to remedial activities to evaluate potential risks to remedial workers.

Illinois EPA's background values for the Chicago metropolitan area will be used as screening levels.

3.5.4.5 Soil Sampling (During Well installation)

Soil samples will be collected from an interval within the well boring, above the water table, with the highest Photoionization Detector (PID) screening levels, or from the mid-point of the vadose zone interval. The rationale for the soil sample intervals is based on the shallow depth to groundwater (approximately five (5) feet bgs) and collection of the surface samples from a zero (0) to two (2) foot bgs interval. Consequently, the only additional sampling interval available above the groundwater surface is anticipated to be two (2) to five (5) feet bgs. If the depth to groundwater is greater than anticipated, then additional soil samples will be collected at five (5) foot intervals above the water table. The soil samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The proposed sample analyses are presented in Table 3-1. Note that collecting soil samples at depth from the direct push sampling effort will not be attempted due to the potential for running/heaving sands.

In addition, six (6) subsurface samples (GP02, GP04, GP10, GP15, GP17, and GP19) will be collected for geotechnical analysis to characterize soil types located within the boundaries of the landfill (refer to Figure 3-10). The samples will be collected using a Shelby tube or comparable equipment and tested for the following geotechnical parameters:

- Soil Classification by United Soil Classification System (USCS): (D2487)

- Moisture Content and Dry Density (D2216)
- Bulk Density (D4292 / D2937)
- Porosity, Water Filled Porosity and Air Filled Porosity
- Fraction Organic Carbon (D2974)
- Specific Gravity

3.5.4.6 Hydrogeologic Evaluation (Groundwater Flow and Slug Tests)

In-situ permeability testing (slug testing), will be performed on five (5) monitoring wells to determine the horizontal conductivity of the aquifer in the vicinity of the well. The wells will be selected to provide even coverage and spacing around the landfill perimeter, to the extent possible. Slug tests will be conducted utilizing both the rising and falling head slug test techniques.

Groundwater flow direction will be evaluated using groundwater elevation data from the monitoring well network. Monthly water level measurements will be collected from the monitoring well network during the remediation investigation, with the final event conducted concurrently with the second groundwater sampling event.

3.5.5 Landfill Evaluation

3.5.5.1 Existing Landfill Cover Evaluation

Historical topography will be reviewed, if available, to evaluate settling over time. In addition, a total of 12 hand borings (GT01 through GT12) will be advanced within the footprint of the former landfill to assist with preliminary cap design. Soil borings will be advanced by hand from ground surface through the cover soil until waste material is encountered using Shelby tubes. Based on historical reports, the existing cover material is anticipated to be approximately two (2) feet deep. Locations of the proposed borings are provided in Figure 3-11. Samples will be collected and tested for:

- Atterberg limits
- Shear stress
- Specific gravity
- Permeability

3.5.5.2 Waste Boundary Evaluation

Initially, the anticipated limits of the landfill will be estimated through review of topographic maps, historical air photos, and visual inspection. The total depth of the landfill (depth to glacial till) has been reported as 25 to 30 feet below the natural land surface (Palin, 2010).

Approximately 25 to 30 test pits will be installed at approximately 200 foot intervals (see Figure 3-10 for approximate landfill limits). Each test pit will start between 10 and 50 feet from the estimated limits of waste. Each pit will then be excavated toward the landfill until waste is identified. It is anticipated that the test pits will be limited to five (5)

to six (6) feet in depth. No landfill waste will be removed from the excavation. Efforts will be made to ensure that waste is not disturbed or removed from each test pit during exploratory excavation activities. The limit of waste will be marked and the test pit backfilled with the existing soils that were removed from the excavation. After the location of the physical landfill limit is identified (based on visual evidence obtained from the test pits), the boundary will be marked with a surveyor's stake. These stakes will then be surveyed and located on the Site map. Hand held GPS units may also be used to document locations of the test pits.

Note that the well installation and direct push sampling tasks will be used to supplement this boundary evaluation.

3.5.5.3 Interior Landfill Investigation

Consistent with USEPA correspondence dated August 18, 2015, three (3) Landfill Evaluation Areas have been identified for subsurface investigation. Two (2) additional areas have been identified by USEPA, which will only be considered for evaluation if the initial three interior landfill evaluation areas, in conjunction with the other data generated during this Remedial Investigation (RI), indicate a need.

In general, investigation of the three areas will consist of the installation of borings utilizing hollow stem augers with rotary drilling methods. A split-spoon sampler will be continuously advanced to review and record soil or waste descriptions. Each boring will be advanced until the first occurrence of 1) un-impacted native sand; 2) native glacial till; 3) auger refusal. In the event that NAPL is encountered in any of the borings, the methodologies for screening for NAPL previously outlined and presented in Figure 3-1 will be employed. A maximum of three soil samples will be collected from each boring location. One sample will be collected from above the water table; one sample will be collected at the water table; and one sample will be collected from the terminus of the boring. The soil samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. Additionally, a single grab sample of water encountered (if any) in each boring will be collected for laboratory analysis of the previously identified analyte list. Upon completion, the borings (that are not converted to monitoring wells) will be backfilled with bentonite chips employing the same methodology identified in this Work Plan. All other techniques and methodologies employed in the installation and sampling of these borings will be in conformance with this Work Plan, the QAPP, and the FSP.

<u>Landfill Evaluation Area 1</u>

Evaluation Area 1 is the former area identified in historical aerial photographs and referenced in audit records, appearing to have been water filled. Two borings will be advanced in the general locations identified in Figure 3-12. One of the borings will be converted to a 2-inch diameter monitoring well. The well will be screened the entire length of the water column unless field observations identify conditions that warrant otherwise.

<u>Landfill Evaluation Area 2</u>

Evaluation Area 2 is the former location of an east/west oriented trench identified in historical aerial photographs and referenced in audit records. Two borings will be advanced in the general locations identified in Figure 3-12. One of the borings will be

converted to a 2-inch diameter monitoring well. The well will be screened the entire length of the water column unless field observations identify conditions that warrant otherwise.

Landfill Evaluation Area 3

Evaluation Area 3 is the former location of water collection and pumping operations identified in historical aerial photographs and referenced in audit records. Two borings will be advanced in the general locations identified on Figure 3-12. One of the borings will be converted to a 2-inch diameter monitoring well. The well will be screened the entire length of the water column unless field observations identify conditions that warrant otherwise. In addition, direct push sampling point GP-18 is located within this Evaluation Area (see Section 3.5.4.2 for details).

3.5.5.4 Air Investigation

Based on existing information, there are reportedly 14 landfill gas vents located in a central area of the landfill (see Figure 3-12 for approximate area). The locations of each vent (if present) will be determined and each assigned a unique vent number.

Two types of air sampling will be conducted: a screening method utilizing portable hand-held instruments; and air sampling with subsequent laboratory analysis for VOCs (EPA method TO-15) via a sampling device such as a Summa canister. Pressure or velocity from the vents will be measured for use in emission rate calculations. Using results from the field screening, six (6) individual vents (those with the highest field screening readings), assuming they can be found, will be identified for further sampling and laboratory analysis. Each vent will be field screened using handheld screening instruments sensitive to VOCs and methane, including a combustible gas analyzer and PID. Additional field screening measurements for VOCs and methane will be taken in the ambient air in the potential worker breathing zone nearby and downwind of the vents.

In addition, up to seven (7) air monitoring points (AS01 through AS07) are proposed near the Grand Calumet River and the Site boundaries by installing probes or vents, and soil gas sampling (Figure 3-13).

Figure 3-14 is a flow chart showing criteria that will be used to determine whether all seven (7) or only two (2) perimeter monitoring points for soil gas collection are needed. Similar to the existing vents, these will be field screened for VOCs and methane, and samples submitted to the laboratory for analysis.

Samples specified for laboratory analysis will be shipped to a qualified laboratory for analysis of methane and individual VOCs by EPA Method TO-15. See Appendix B for detailed procedures.

3.5.6 Ecological Investigation (Biota/Habitat)

An ecological survey will be undertaken to document the status of current existing ecological conditions. The survey will include a documentation of habitats from the northern pond area to the southern portion of the Site boundary, concluding adjacent to the northern bank of the Grand Calumet River. This survey will include observations of

plant and wildlife species. In addition, a literature search will be conducted on the potential presence of state and federally listed threatened and endangered species within a one-half mile radius from the Site property boundary. Furthermore, locations of invasive species, such as phragmites, will be documented. Species will be characterized to the lowest practical level in the field.

3.6 POST SAMPLING ACTIVITIES

3.6.1 Survey Wells and Sampling Locations

Direct push and monitoring wells will be surveyed by a certified land surveyor and tied to a reference location and to the state plane coordinate system. Surface water, sediment, existing gas vents, air monitoring, and shallow soil sample locations will be documented by hand held GPS. The elevation of all newly installed wells will be surveyed at the water level measuring point (notch) on the riser pipe. Surveyed elevations will be referenced to mean sea level.

3.6.2 Investigative Waste Disposal and Materials Management

Investigation derived waste (IDW) generated during the investigations include the following:

- Drill cuttings;
- Disposable material as Geoprobe liners, personal protective equipment, plastic sheeting;
- Excess soil and sediments from sampling activities;
- Monitoring well development, purge, and decontamination water.

IDW will be containerized in 55-gallon drums. Soil and water drums generated during installation of the on-site soil borings and monitoring wells will be placed in a defined storage area onsite. The drums will be stored safely and securely, on temporary pads providing containment. The soil and groundwater drums will be filled to a maximum of 75% capacity to limit the weight of the drums for handling. The solid IDW materials in drums will be either removed from the drums and placed under the new landfill cap during the remediation activities or will be transported and disposed off-site at an approved facility. If transported off-site, the waste media (soil and groundwater) will have an approved waste profile established prior to transport and disposal. Upon arrival, the transporter will be provided with a signed waste manifest by the Parsons Field Team Leader. A copy of the manifest will be kept by Parsons for record-keeping purposes, while the original will be retained by the transporter. The drum(s) will be picked up and transported for off-site disposal at an approved landfill.

The IDW management is described in more detail in Appendix B.

3.7 SAMPLE ANALYSIS AND VALIDATION

3.7.1 Sample Management

All laboratory analytical data will be provided by the supporting laboratories in electronic formats, both Portable Document Format (PDF) and electronic data deliverables (EDD). The PDF format deliverable will include sample results and all quality control (QC) results in standardized contract format and provided to EPA within 45 days following the receipt of analytical data. The PDF report will be searchable (embedded text) to facilitate data review. The associated EDD will be provided in a Region 5 EQuIS™ file format.

The sample management procedures are described in more detail in the QAPP (Appendix A) and the FSP (Appendix B).

3.7.2 Data Validation

Data generated from activities under this RI/FS Work Plan will be subjected to assessment of data quality and usability per methodology provided in the QAPP (Appendix A). This assessment will include 10% Level 4 data validation and 100% Level 3 data validation of chemical analytical data in accordance with USEPA National Functional Guidelines. Data qualifiers consistent with USEPA guidelines will be applied to results in the database.

Minor deviations from approved field and laboratory procedures and sampling approach will likely not affect the adequacy of the data as a whole in meeting the project objectives. The assessment will also require the identification of any remaining data gaps and an assessment of the need to re-evaluate project decision rules.

3.8 RISK ASSESSMENT

Both human health and ecological risk assessments will be conducted following completion of the remedial investigation tasks shown above. Under a presumptive remedy approach, a complete baseline risk assessment may not be needed. Per the EPA February 1991 Guidance “Conducting RI/FS for CERCLA Municipal Landfill Sites,” it may be possible to streamline or limit the scope of the baseline risk assessment by (1) using the conceptual site model and RI-generated data to perform a qualitative risk assessment that identifies the contaminants of concern in the affected media, their concentrations, and their hazardous properties that may pose a risk through the various routes of exposure; and (2) identifying pathways that are an obvious threat to human health or the environment by comparing RI-derived contaminant levels to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs) for the action. When potential ARARs do not exist for a specific contaminant, risk-based chemical concentrations will be used.

Prior to conducting the human health and ecological risk assessments, a human health and ecological risk assessment memorandum will be submitted that specifies the risk assessment approach. The memorandum will indicate the primary guidance, assumptions, and methods, as well as the updated conceptual site models as warranted. The memorandum will indicate that remaining potential exposure pathways following implementation of the presumptive remedy will be evaluated per IDEM and EPA risk assessment guidance.

The sediment and surface soil samples described in the investigation tasks above will be used to support both the ecological and human health risk assessments.

3.8.1 Human Health Risk Assessment

The human health risk assessment may streamlined because a presumed containment remedy will address migration pathways from the former landfill and eliminate direct contact exposure (see CSM figures). This approach is consistent with "Landfill Presumptive Remedy Saves Time and Cost," USEPA 540/F-96/017 (January 1997).

3.8.2 Ecological Risk Assessment

Initially, a screening level ecological risk assessment (EPA-540-R-97-006, June 1997), will be undertaken. The focus of this initial screening will be on the southern wetlands area. The February 1991 Document "Conducting RI/FS for CERCLA Municipal Landfill Sites" also mentions that the risk assessment may be streamlined or qualitative based on the conceptual site model and RI-generated data.

3.9 DATA EVALUATION AND REPORTING

3.9.1 Data Reduction and Tabulation

Data management is critical to the success of the assessment. Automation of data collection, transmission, and processing will be integral to the performance of the project. Data will be managed in an electronic database that can be used to produce tabular reports, and output for plotting, graphing, or mapping within the project Geographic Information System (GIS).

3.9.2 Database Management

A relational database (EQuIS™) has been established to organize and store project information and data. Current and historical data will be stored in the project database. This will enable the efficient storage, updating, and retrieval of data, and the implementation of quality assurance procedures.

The RI/FS activities will use spatial data sets and analyses for planning, data interpretation, decision support, and data presentation. GIS data will be stored in ESRI-compatible file formats.

3.9.3 Fate and Transport Evaluation

Data collected during the investigations will be used to develop fate and transport evaluation. If needed, analytical and/or numerical modeling will be used as a diagnostic tool to further develop portions of the CSM and as a predictive tool.

The primary fate and transport processes include:

- Leaching of contaminants from waste landfill by infiltrating precipitation;
- Leaching of contaminants by groundwater in direct contact with waste landfill;
- Migration of affected groundwater to potential receptors;

- Migration of soil gas (methane and petroleum hydrocarbon vapors).

3.9.4 Remedial Investigation Report

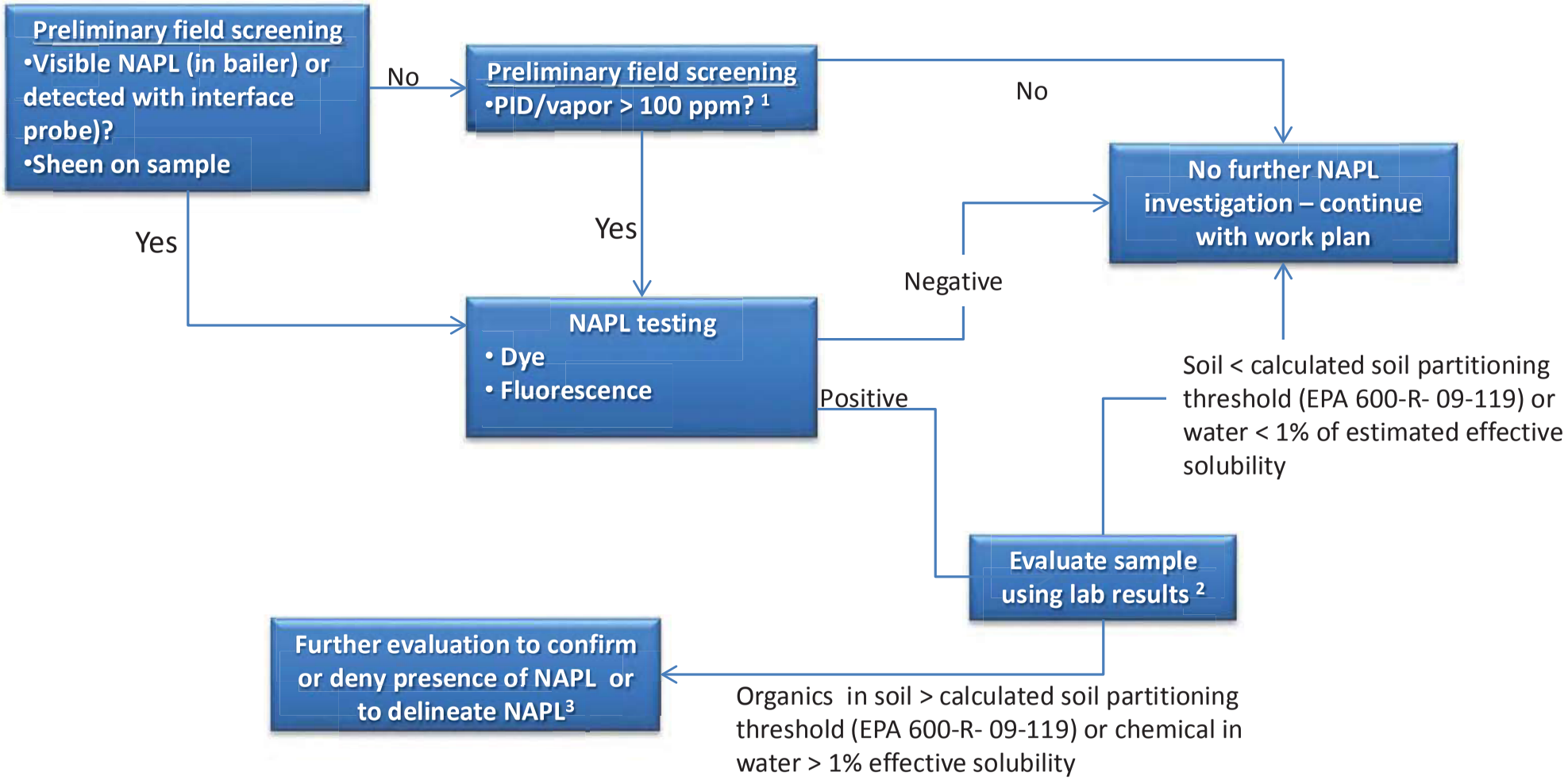
A remedial investigation report will be prepared in accordance with USEPA guidance, and based on information gained from the investigative tasks described herein.

At a minimum, the report will include the following elements:

- Executive Summary;
- Site description;
- Site history and previous investigations/remedial actions;
- Description of field activities;
- Nature and extent of impacts;
- Environmental fate and transport;
- Results of the HHRA and ERA;
- Findings and conclusions;
- Geologic logs, cross sections, aquifer test results, laboratory data, validation reports, and relevant field data logs will be included as appendices.

A memorandum will also be prepared as an attachment to the RI Report that evaluates the current and anticipated future land uses. This memorandum will identify information including past land uses, owner's plans, if any, zoning and ordinance information, groundwater use determinations, and other applicable information.

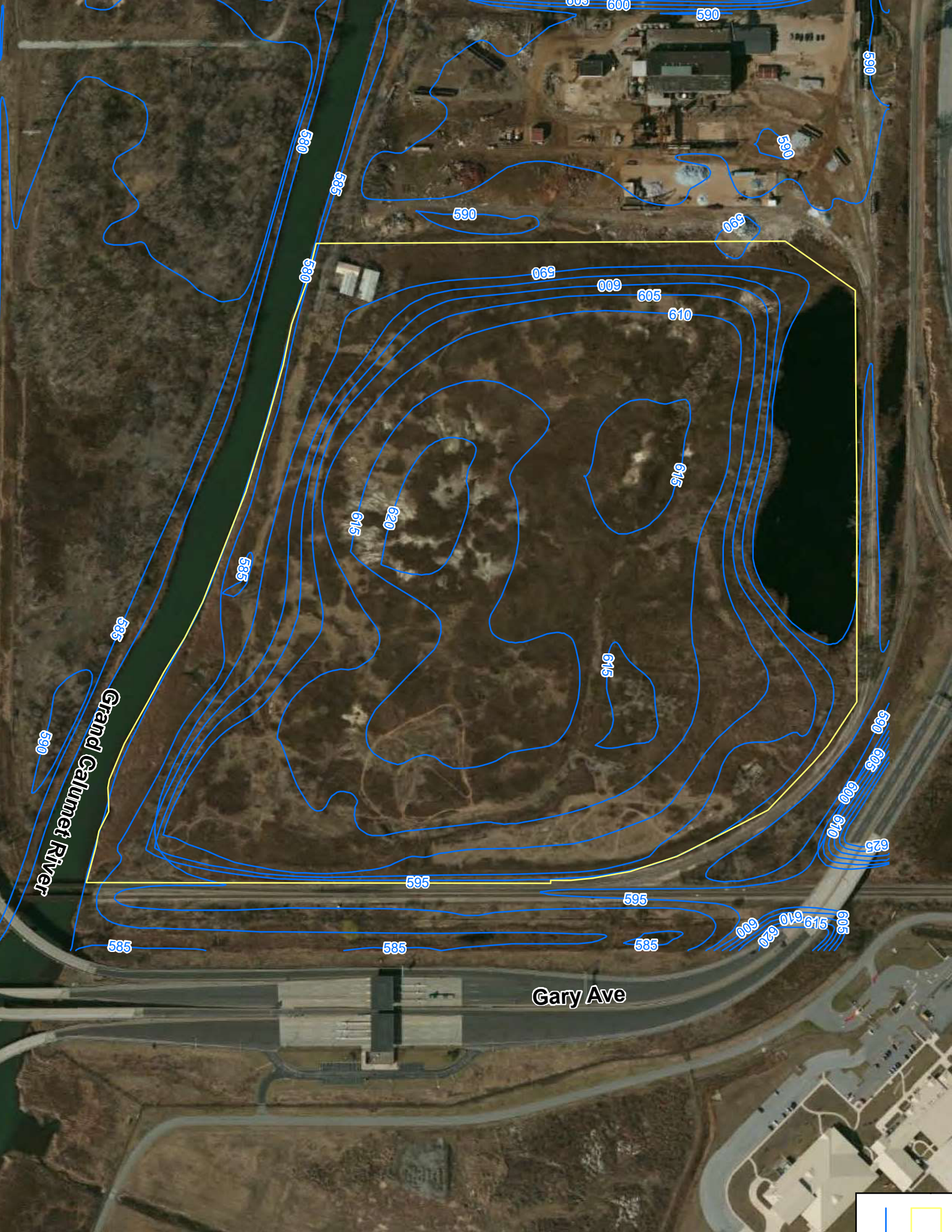
Figure 3-1
Location Specific NAPL Screening Flow Chart

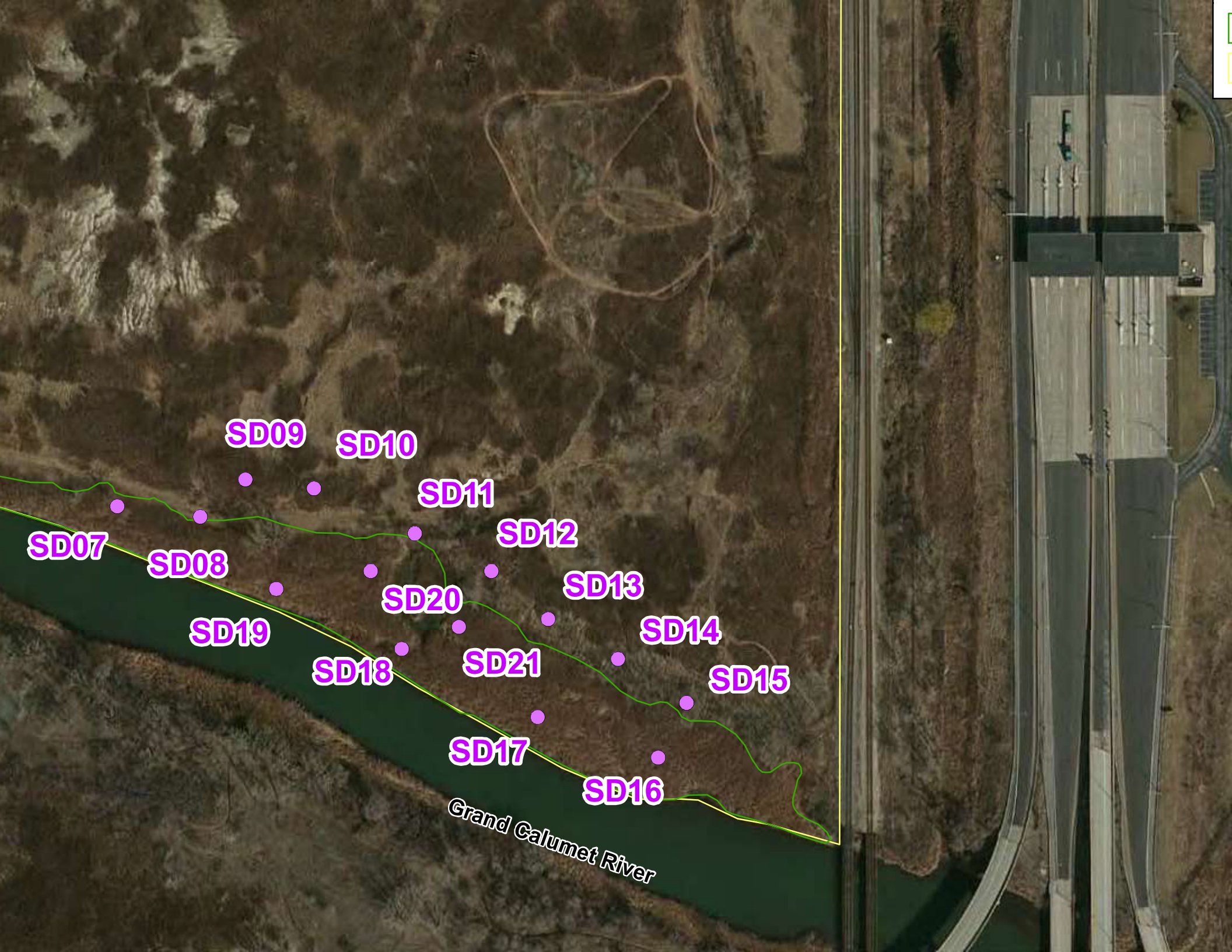


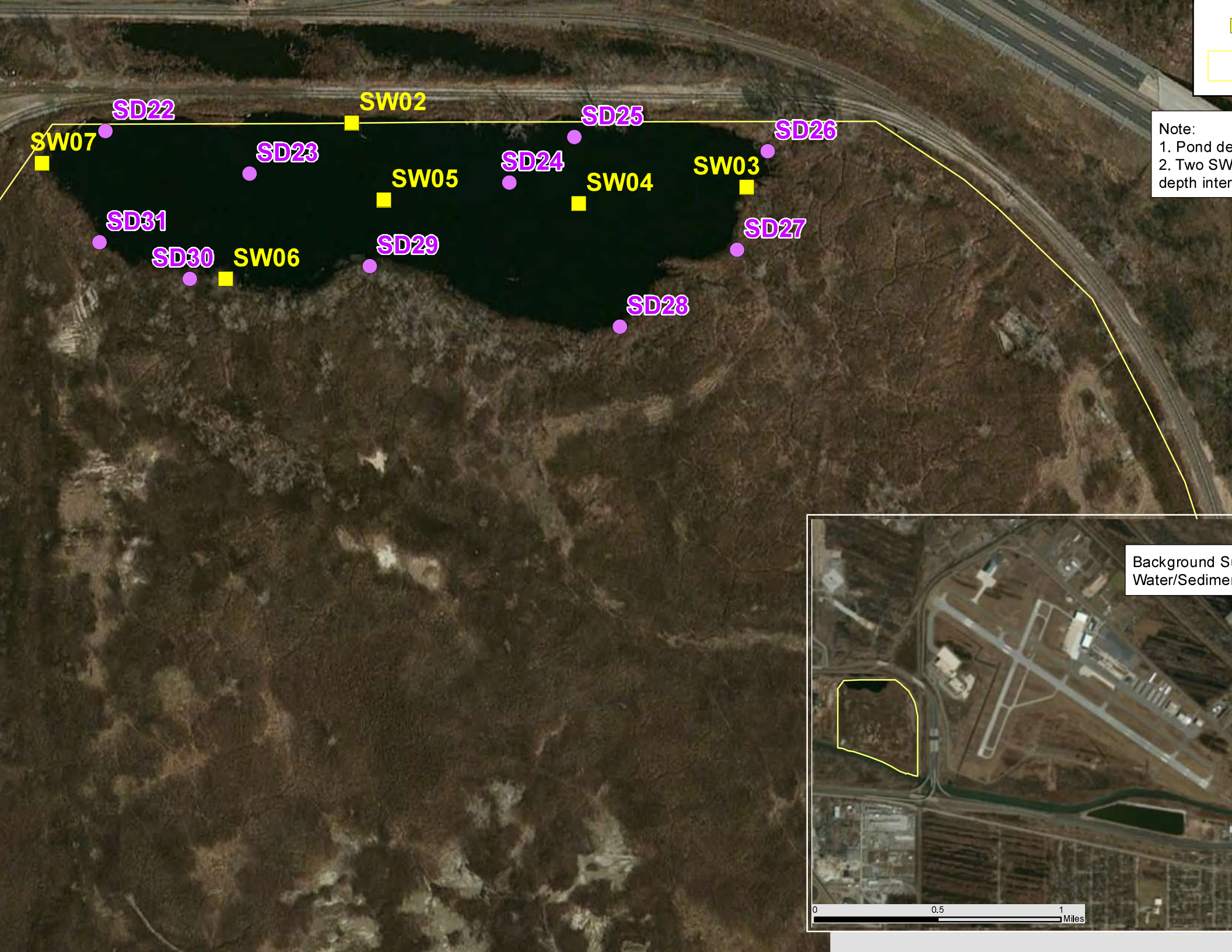
Notes:

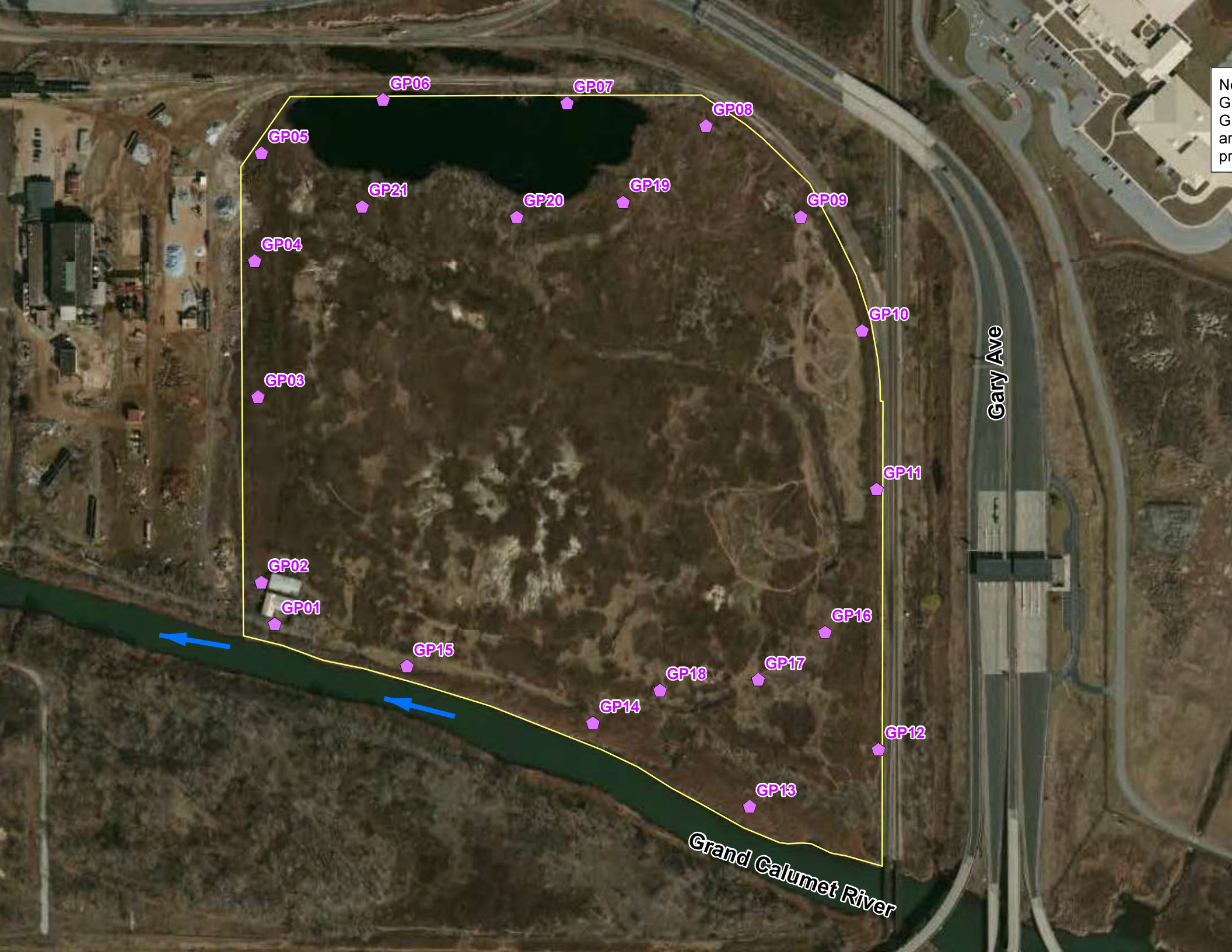
1. PID reading directly adjacent to/above a soil sample or split spoon.
2. Compare total organic concentration in soil to calculated soil partitioning threshold value (EPA 600-R- 09-119) and compare chemicals in water to estimated effective solubility. If no NAPL is present for determining solubility ratios, then the estimate will use detected compounds.
3. Collaborative decision with EPA based on field and laboratory data. Additional work will be guided by a multiple lines of evidence approach and the presumptive remedy. Additional work may include re-sampling, and/or additional samples to determine if NAPL exists. If NAPL is found, it will be sampled, and tentatively identified compound will be included in the laboratory analysis.

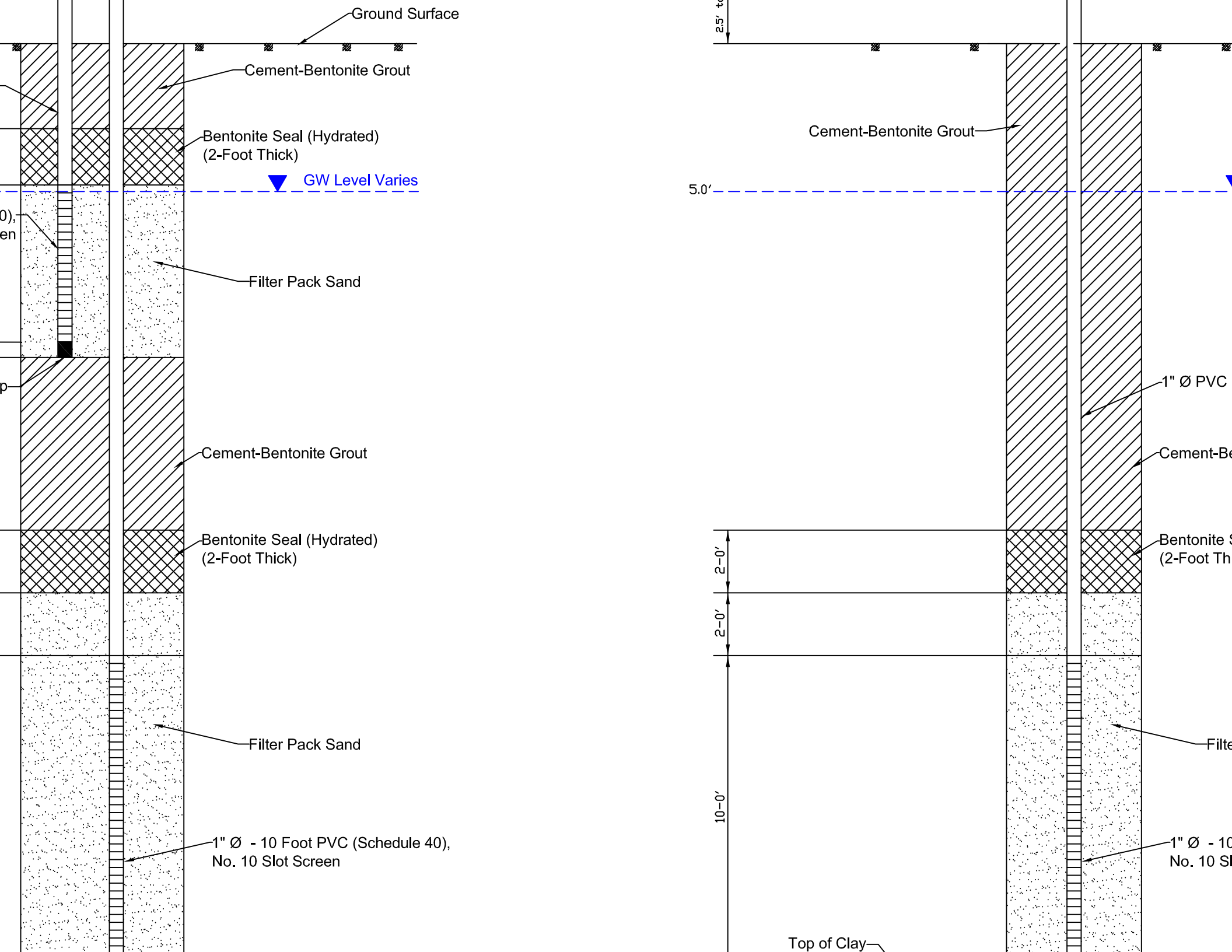
Northern Pond
UNKNOWN EQUIPMENT/DEBRIS IN THE POND
Site Buildings
TRUCK
EXCAVATOR
TRUCK
EXCAVATOR
TANKER
Gary Ave
Grand Calumet River

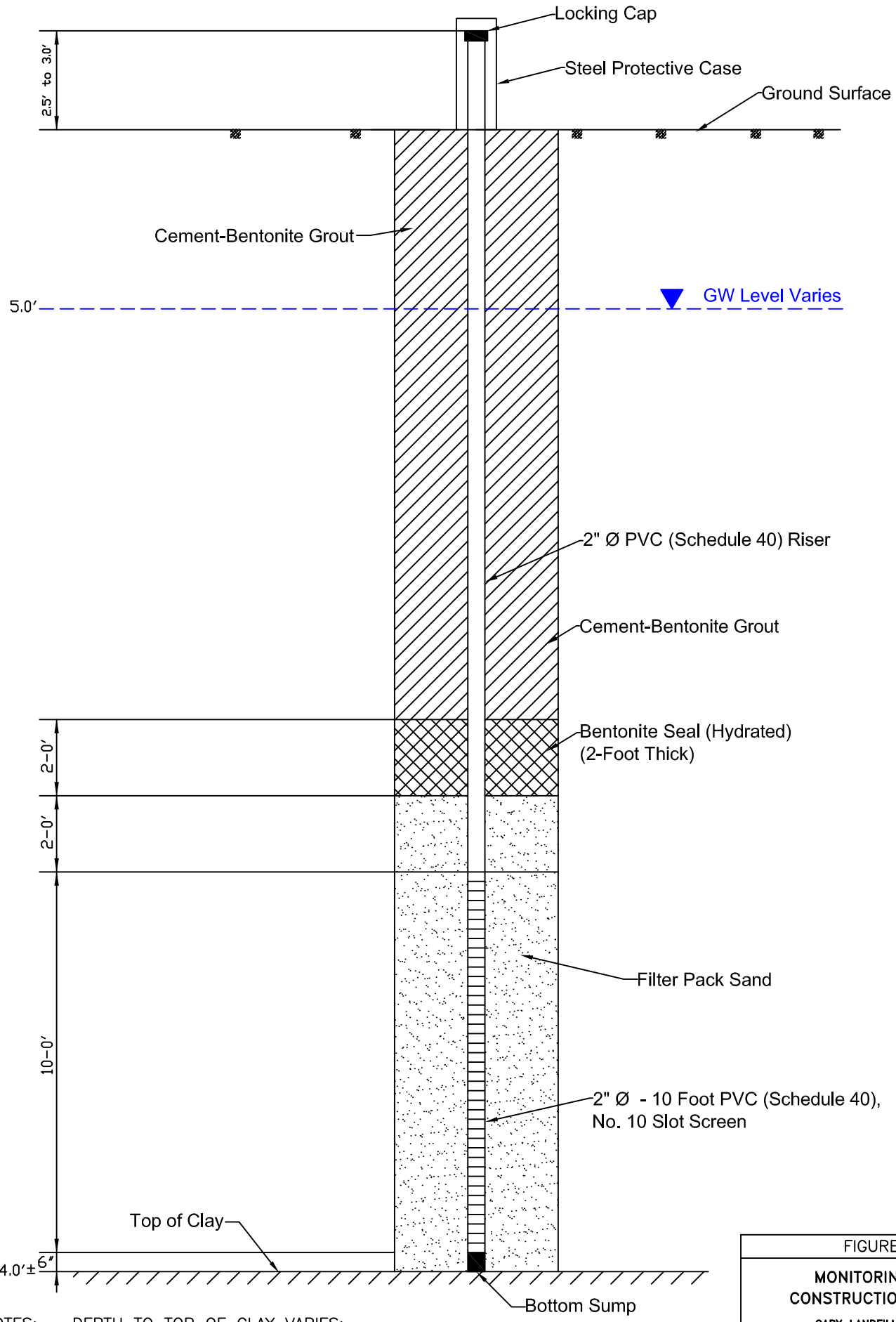

Grand Calumet River
Gary Ave
590
585
580
600
605
610
615
620
625
595


SD09
SD10
SD11
SD12
SD13
SD14
SD15
SD16
SD17
SD18
SD19
SD20
SD21
SD07
SD08
Grand Calumet River


SD22
SW02
SD25
SD26
SW07
SD23
SD24
SW03
SW05
SW04
SD31
SD27
SD29
SD30
SW06
SD28
Note:
1. Pond de
2. Two SW
depth inter
Background S
Water/Sedimen
0
0.5
1
Miles


GP06
GP07
GP08
GP05
GP21
GP20
GP19
GP09
GP04
GP10
GP03
GP11
GP02
GP01
GP16
GP15
GP18
GP17
GP14
GP12
GP13
Gary Ave
Grand Calumet River


Ground Surface
Cement-Bentonite Grout
Bentonite Seal (Hydrated)
(2-Foot Thick)
GW Level Varies
Filter Pack Sand
Cement-Bentonite Grout
Bentonite Seal (Hydrated)
(2-Foot Thick)
Filter Pack Sand
1" Ø - 10 Foot PVC (Schedule 40),
No. 10 Slot Screen
2.5′
Cement-Bentonite Grout
5.0′
1" Ø PVC
2-0′
2-0′
10-0′
Top of Clay



NOTES: – DEPTH TO TOP OF CLAY VARIES;
– BOTTOM OF THE WELL TO BE DETERMINED IN THE FIELD.

NOT TO SCALE

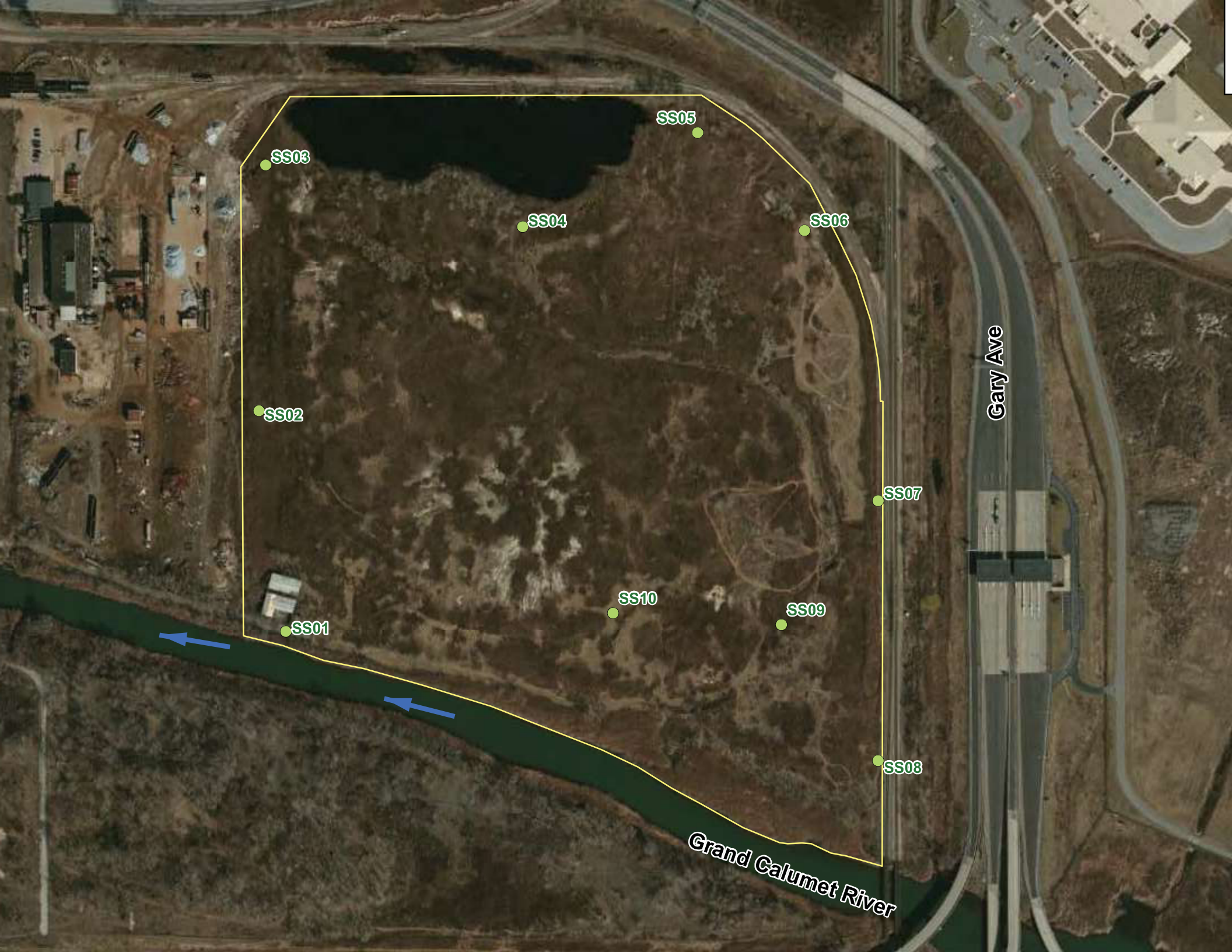
FIGURE 3–8

MONITORING WELL
CONSTRUCTION DIAGRAM

GARY LANDFILL DEVELOPMENT
GARY, INDIANA

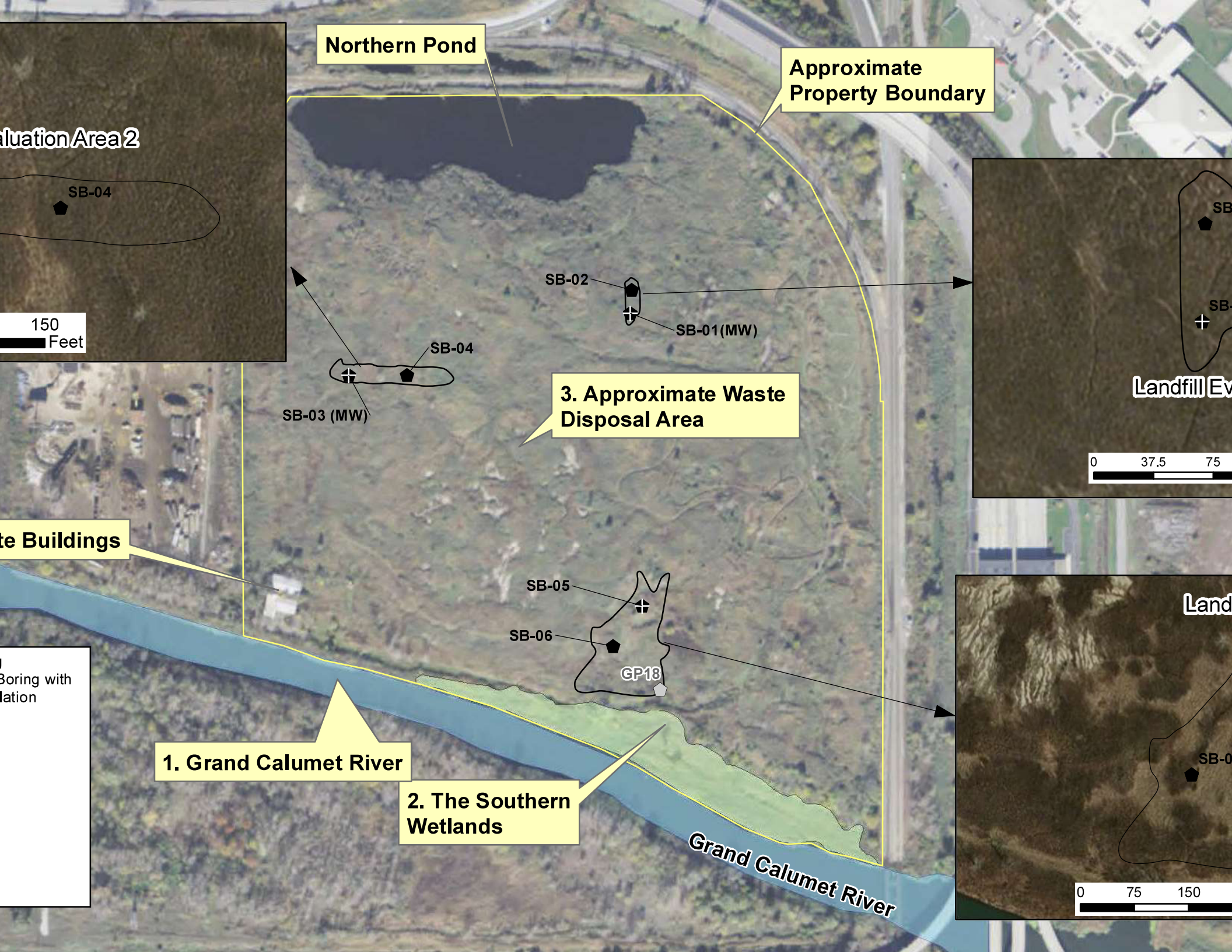
PARSONS 10/31/2014
DESIGN * RESEARCH * PLANNING
10 SOUTH RIVERSIDE PLAZA * CHICAGO, IL * 312.930.5100

P:\Gary Landfill Project\Figures\2014\06 2014 MW Construction Well


SS05
SS03
SS04
SS06
SS02
SS07
SS10
SS09
SS01
SS08
Gary Ave
Grand Calumet River

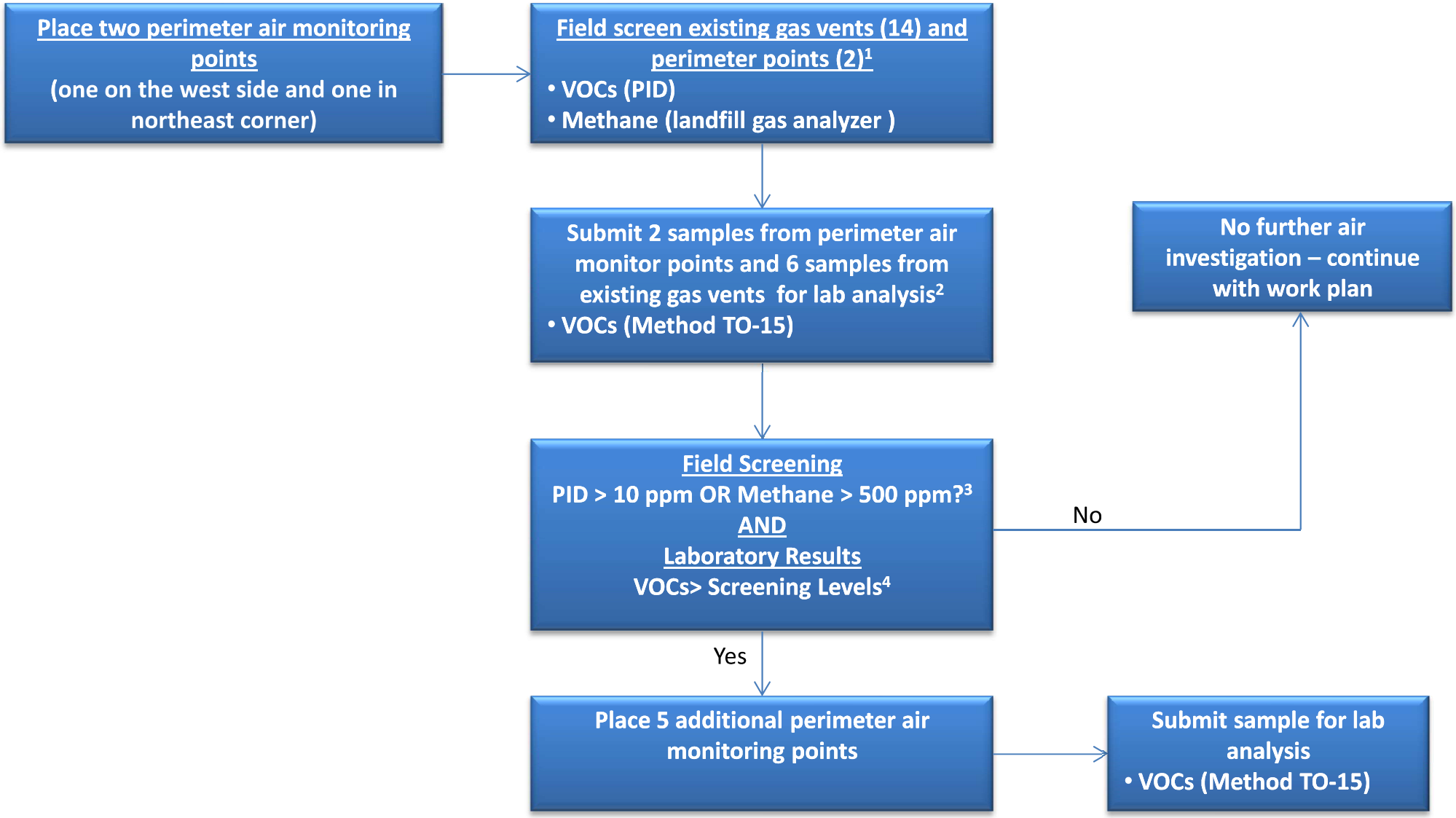
GP06
GP07
GP08
GP05
GP21
GP20
GP19
GP09
GP04
GP10
GP03
Gary Ave
GP11
GP02
GP01
GP16
GP15
GP17
GP18
GP14
GP12
GP13
Grand Calumet River

GT01
GT02
GT03
GT04
GT11
GT10
GT12
GT08
GT09
GT05
GT07
GT06
Gary Ave
Grand Calumet River


Northern Pond
Approximate Property Boundary
luation Area 2
SB-04
150
Feet
SB-02
SB-01(MW)
SB-04
SB-03 (MW)
3. Approximate Waste Disposal Area
te Buildings
SB-05
SB-06
GP18
1. Grand Calumet River
2. The Southern Wetlands
Grand Calumet River
Landfill Ev
0
37.5
75
Land
SB-0
0
75
150
Boring with
lation

AS04
AS05
AS03
AS02
AS01
Gas Vent Area
AS06
AS07
Gary Ave
Grand Calumet River

Figure 3-14
Air Investigation Flow Chart



Notes:

1. PID/Landfill Gas Analyzer readings directly adjacent to the vents
2. Vents with the 6 highest VOC screening levels will be selected for laboratory analyses
3. U.S. EPA Guidance For Evaluating Landfill Gas Emissions From Closed Or Abandoned Facilities, September 2005
4. Any individual compound exceeding the Indiana Department of Environmental Management (IDEM) screening levels for indoor air, commercial/industrial properties, March 2014 by more than 3 orders of magnitude.

Table 3-1
Gary Development Landfill
Sampling Matrix Summary

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	pH	Asbestos (NIOSH 9002)	VOC (TO-15)	Methane
Southern Wetlands Investigation													
Sediment (15)	0 - 1	SED	15	15	15	15	15	15	15	15			
Sediment (15)	1 - 2	SED	15	15	15	15	15	15	15	15			
Sediment (2)	2 - 5	SED				2							
Surface Water (1)		SW	1	1	1	1	1	1	1				
Northern Pond Investigation													
Sediments (10)	0 - 1	SED	10	10	10	10	10	10	10	10			
Sediments (8)	1 - 2	SED	8	8	8	8	8	8	8	8			
Surface Water (6)		SW	6	6	6	6	6	6	6	6			
Perimeter Groundwater Evaluation*													
Direct Push (10)	5 - 10	GW	10	10	10	10	10	10	10	10			
Direct Push (10)	15 - 20	GW	10	10	10	10	10	10	10	10			
Direct Push (21)	25 - 30	GW	21	21	21	21	21	21	21	21			
Monitoring Well (10)	25 - 30	GW	10	10	10	10	10	10	10	10			
Monitoring Well (10)	2 - 5	SOIL	10	10	10	10	10	10	10	10			
Surface Soil (10)	0-0.5	SS	10	10	10	10	10	10	10	10			
Surface Soil (10)	0.5-2	SS	10	10	10	10	10	10	10	10			
Surface Soil (10)	0-2	SS									10		
Landfill Evaluation													
Gas Vents/Probes (12)		Air										12	12
Soil Borings (6)	above water table	SOIL	6	6	6	6	6	6	6	6			
Soil Borings (6)	at water table	SOIL	6	6	6	6	6	6	6	6			
Soil Borings (6)	terminus of boring	SOIL	6	6	6	6	6	6	6	6			
Soil Borings (6)		GW	6	6	6	6	6	6	6	6			
Monitoring Well (3)	25-30	GW	3	3	3	3	3	3	3	3			
Total			**163**	**163**	**163**	**165**	**163**	**163**	**163**	**162**	**10**	**12**	**12**

Table 3-1
Gary Development Landfill
Sampling Matrix Summary

Geotechnical Samples													
Sample Location	Sample Depths (ft)	Matrix	Soil Class: (USCS): (D2487)	Moisture Content and Dry Density (D2216)	Bulk Density (D4292 / D2937)	Water Filled and Air Filled Porosity	Fraction Organic Carbon (D2974)	Specific Gravity	Atterburg Limits	Sheer Stress	Permeability		
Soil Sampling from Direct Push Points													
Geotechnical	0 - 5	GT	6	6	6	6	6	6					
Landfill Evaluation													
Geotechnical	0 - 2	GT						12	12	12	12		

* 10 equally spaced locations were selected for groundwater vertical profiling.

* Four rounds of groundwater sampling are planned (13 wells per round of sampling).

NOTE: Total number of air samples depends on field screening results.

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Sediment Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	pH
Southern Wetlands Investigation										
SD07	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD07	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD08	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD08	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD09	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD09	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD10	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD10	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD11	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD11	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD12	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD12	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD13	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD13	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD14	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD14	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD15	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD15	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD16	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD16	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD17	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD17	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD18	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD18	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD19	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD19	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD20	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD20	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD20	2 - 5 ft	SED				X				
SD21	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD21	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD21	2 - 5 ft	SED				X				
Northern Pond Investigation										
SD22	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD22	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD23	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD24	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD25	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD25	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD26	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD26	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD27	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD27	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD28	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD28	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD29	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD29	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD30	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD30	1 - 2 ft	SED	X	X	X	X	X	X	X	X
SD31	0 - 1 ft	SED	X	X	X	X	X	X	X	X
SD31	1 - 2 ft	SED	X	X	X	X	X	X	X	X

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Groundwater Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	Field Parameters				
										pH	Conductivity	Dissolved Oxygen	Turbidity	Oxidation-Reduction Potential
Soil Sampling from Direct Push Points														
1) Direct Push*														
GP01	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP02	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP03	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP04	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP05	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP06	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP07	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP08	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP09	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP10	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP11	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP12	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP13	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Groundwater Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	Field Parameters				
										pH	Conductivity	Dissolved Oxygen	Turbidity	Oxidation-Reduction Potential
GP14	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP15	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP16	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP17	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP18	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP19	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP20	5 - 10 ft 15-20 ft 25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP21	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Groundwater Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	Field Parameters				
										pH	Conductivity	Dissolved Oxygen	Turbidity	Oxidation-Reduction Potential
2) Monitoring Wells*														
MW01	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW02	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW03	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW04	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW05	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW06	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW07	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW08	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW09	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW10	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
Landfill Evaluation														
1) Monitoring Wells														
MW11	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW12	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW13	25 - 30 ft	GW	X	X	X	X	X	X	X	X	X	X	X	X

NOTES: * 10 equally spaced locations were selected for groundwater vertical profiling.
Low detection limits required for Mercury, Cyanide, and Metals
Filtered and Unfiltered samples will be collected for Mercury, Cyanide, and Metals from monitoring wells.
Only filtered samples will be collected for Mercury, Cyanide, and Metals from direct push samples,
as these may contain suspended sediment, biasing the results high.

ASSUMPTION: Geology identified during geoprobe investigation is simple (sand and clay). If geology is complex, then nested monitoring wells will be considered.

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Surface Water Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	Field Parameters				
										pH	Conductivity	Dissolved Oxygen	Turbidity	Oxidation-Reduction Potential
Southern Wetlands Investigation														
SWS01*		SW	X	X	X	X	X	X	X	X	X	X	X	X
Northern Pond Investigation**														
SW02		SW	X	X	X	X	X	X	X	X	X	X	X	X
SW03		SW	X	X	X	X	X	X	X	X	X	X	X	X
SW04		SW	X	X	X	X	X	X	X	X	X	X	X	X
SW05		SW	X	X	X	X	X	X	X	X	X	X	X	X
SW06		SW	X	X	X	X	X	X	X	X	X	X	X	X
SW07		SW	X	X	X	X	X	X	X	X	X	X	X	X

NOTES: * Surface water seeps sample (SWS01) will be collected if seepage is present.
** If pond is greater than 10 feet deep, then the vertical profiling will be completed.
Low detection limits required for Mercury, Cyanide, and Metals
Filtered and Unfiltered samples will be collected for Mercury, Cyanide, and Metals

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Soil Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	pH
Perimeter Groundwater Evaluation										
1) Monitoring Wells										
MW01	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW02	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW03	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW04	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW05	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW06	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW07	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW08	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW09	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
MW10	2 - 5 ft	Soil	X	X	X	X	X	X	X	X
Landfill Evaluation										
1) Soil Borings										
SB01	above water table	Soil	X	X	X	X	X	X	X	X
SB01	at water table	Soil	X	X	X	X	X	X	X	X
SB01	terminus of boring	Soil	X	X	X	X	X	X	X	X
SB01		GW	X	X	X	X	X	X	X	X
SB02	above water table	Soil	X	X	X	X	X	X	X	X
SB02	at water table	Soil	X	X	X	X	X	X	X	X
SB02	terminus of boring	Soil	X	X	X	X	X	X	X	X
SB02		GW	X	X	X	X	X	X	X	X
SB03	above water table	Soil	X	X	X	X	X	X	X	X
SB03	at water table	Soil	X	X	X	X	X	X	X	X
SB03	terminus of boring	Soil	X	X	X	X	X	X	X	X
SB03		GW	X	X	X	X	X	X	X	X
SB04	above water table	Soil	X	X	X	X	X	X	X	X
SB04	at water table	Soil	X	X	X	X	X	X	X	X

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Soil Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	pH
SB04	terminus of boring	Soil	X	X	X	X	X	X	X	X
SB04		GW	X	X	X	X	X	X	X	X
SB05	above water table	Soil	X	X	X	X	X	X	X	X
SB05	at water table	Soil	X	X	X	X	X	X	X	X
SB05	terminus of boring	Soil	X	X	X	X	X	X	X	X
SB05		GW	X	X	X	X	X	X	X	X
SB06	above water table	Soil	X	X	X	X	X	X	X	X
SB06	at water table	Soil	X	X	X	X	X	X	X	X
SB06	terminus of boring	Soil	X	X	X	X	X	X	X	X
SB06		GW	X	X	X	X	X	X	X	X

NOTE: Soil samples will be collected from 0 - 5 ft during direct push in lieu of collecting during monitoring well installation, if site conditions allows

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Surface Soil Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	pH	Asbestos (NIOSH 9002)
Perimeter Groundwater Evaluation											
1) Direct Push											
SS01	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS01	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS01	0-2 ft	SS									X
SS02	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS02	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS02	0-2 ft	SS									X
SS03	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS03	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS03	0-2 ft	SS									X
SS04	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS04	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS04	0-2 ft	SS									X
SS05	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS05	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS05	0-2 ft	SS									X
SS06	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS06	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS06	0-2 ft	SS									X
SS07	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS07	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS07	0-2 ft	SS									X
SS08	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS08	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS08	0-2 ft	SS									X
SS09	0-0.5 ft	SS	X	X	X	X	X	X	X	X	
SS09	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS09	0-2 ft	SS									X
SS10	0-0.5 ft	SS	X	X	X	X	X	X	X	X	

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Surface Soil Samples)

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	PEST (8081B)	PCB AROCLORS (8082A)	METALS (6010C)	Mercury (7470A / 7471B)	Cyanide (9010C)	pH	Asbestos (NIOSH 9002)
SS10	0.5-2 ft	SS	X	X	X	X	X	X	X	X	
SS10	0-2 ft	SS									X

NOTES: 10 equally spaced locations were selected for surface sampling: SS01, SS02, SS03, SS04, SS05, SS06, SS07, SS08, SS09, SS10

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Geotechnical Samples)

Sample Location	Sample Depths (ft)	Matrix	Soil Classification (USCS): (D2487)	Moisture Content and Dry Density (D2216)	Bulk Density (D4292 / D2937)	Porosity, Water Filled Porosity and Air Filled Porosity	Fraction Organic Carbon (D2974)	Specific Gravity	Atterburg Limits	Sheer Stress	Permeability
Perimeter Groundwater Evaluation*											
GP02	0 - 5 ft	GT	X	X	X	X	X	X			
GP04	0 - 5 ft	GT	X	X	X	X	X	X			
GP10	0 - 5 ft	GT	X	X	X	X	X	X			
GP15	0 - 5 ft	GT	X	X	X	X	X	X			
GP17	0 - 5 ft	GT	X	X	X	X	X	X			
GP19	0 - 5 ft	GT	X	X	X	X	X	X			
Landfill Evaluation**											
GT01	0 - 2 ft	GT						X	X	X	X
GT02	0 - 2 ft	GT						X	X	X	X
GT03	0 - 2 ft	GT						X	X	X	X
GT04	0 - 2 ft	GT						X	X	X	X
GT05	0 - 2 ft	GT						X	X	X	X
GT06	0 - 2 ft	GT						X	X	X	X
GT07	0 - 2 ft	GT						X	X	X	X
GT08	0 - 2 ft	GT						X	X	X	X
GT09	0 - 2 ft	GT						X	X	X	X
GT10	0 - 2 ft	GT						X	X	X	X
GT11	0 - 2 ft	GT						X	X	X	X
GT12	0 - 2 ft	GT						X	X	X	X

NOTES: * 6 equally spaced locations were selected for geotechnical sampling
** GT borings will be advanced from ground surface until waste material is encountered or 2 feet below ground surface, whichever comes first.

Table 3-2
Gary Development Landfill
Master Sampling Matrix (Air Samples)

Sample Location	Matrix	Field Screening (VOCs/Methane)	VOC (TO-15)
Landfill Evaluation			
Existing Gas Vents (GV01 through GV14)	Air	X	X
Perimeter Gas Probes (AS01 through AS07)	Air	X	X
Downwind Ambient Air	Air	X	X

NOTE: 1. All air samples will be field screened
2. Up to a total of 12 air samples willl be sent to the laboratory analysis based on field screening results and the number of existing gas vents located

SECTION 4
FEASIBILITY STUDY

Following completion and approval of the Remedial Investigation report, a Feasibility Study will be conducted (see Section 5.3 for schedule details).

The initial steps, Technologies, Alternatives Development and Screening will be applied to impacted areas with media containing COCs above screening criteria at areas outside the former landfill and within the Site property boundaries. The Detailed Alternatives Analysis will focus on institutional controls and capping/containing the landfill. The analysis will also address the existing southern wetlands and the northern pond. Pending the remedial investigation results, preliminary alternatives for consideration will be discussed with EPA.

4.1 FEASIBILITY STUDY REPORT

Upon completion of the detailed evaluation of alternatives, an FS Report will be prepared for submittal to USEPA. The report will include the following elements:

- Document the location and extent of media requiring remediation and describe the associated cleanup levels and RAOs;
- Describe the results of the identification and screening of alternatives, and the detailed evaluation of alternatives;
- Identify a preferred alternative for remedial action.

SECTION 5
PROJECT MANAGEMENT

5.1 ORGANIZATION

Parsons is the selected contractor for executing the RI/FS work, and de maximis is designated as the Project Coordinator.

A project organization chart showing key personnel and their roles is provided in Figure 5-1. Key project contacts are shown below.

5.2 KEY CONTACTS

The key project contacts are presented in Table 5-1.

5.3 PROJECT SCHEDULE

An anticipated project schedule has been prepared (Figure 5-2), showing the schedule for primary tasks that will be triggered by the approval of this work plan. The schedule is based on the Exhibit A of the Statement of Work. Some of the tasks are seasonal and weather dependent.

A more detailed project schedule will be developed following final approval of the RIFS Work Plan by the USEPA.

5.4 PROGRESS REPORTS

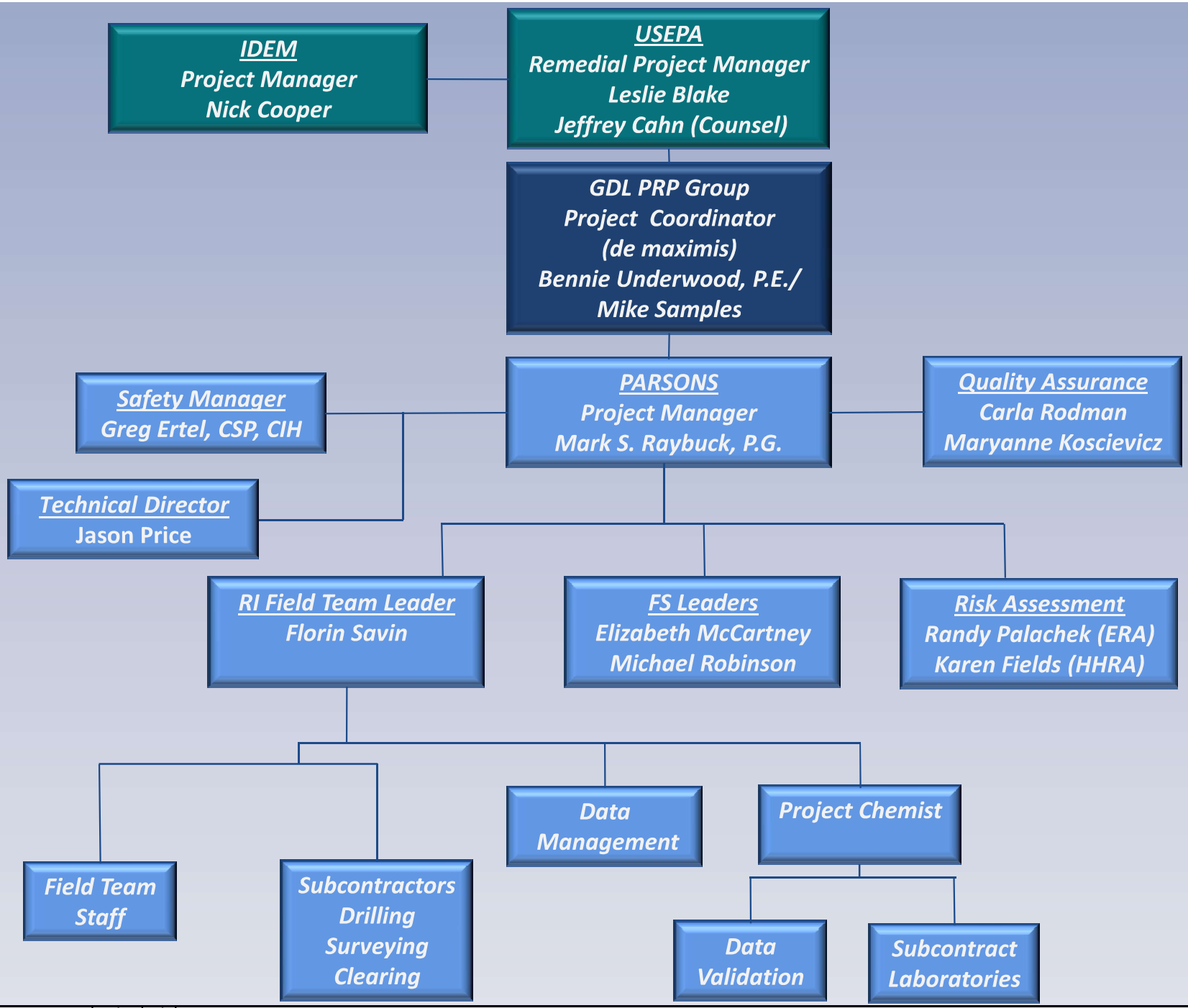
Monthly progress reports will provide updates on implementation of the RI/FS Work Plan to the USEPA.

The progress reports will discuss activities that have been undertaken during the previous reporting period. In addition, the progress reports will identify any delays, and the anticipated schedule for the next period.

5.5 COMMUNITY RELATIONS (USEPA LEAD)

The PRP Group will provide ongoing support to USEPA's Community Involvement Plan during both the RI and FS phases of work. Support may include such activities as preparation of meeting materials and attendance at public meetings.

Figure 5-1 Project Organization Chart
Gary Landfill Development, Gary, Indiana



ERA = Ecological Risk Assessment
HHRA = Human Health Risk Assessment

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Figure 5-2 Project Schedule
Gary Landfill Development, Gary, Indiana

Deliverable	Completion
• ***Monthly Progress Reports***	***15th day of each month per AOC***
• ***Field Investigations*** ○ Procurement, mobilization, EDR database search: 8 weeks ○ Site Preparation (clearing, fencing, debris clearing): 4 weeks ○ Direct push sampling, southern wetlands investigation, north pond investigation, landfill evaluation, well installation, groundwater sampling: 24 weeks ○ Additional round of groundwater sampling: 1 week, conducted four months after initial sampling event.	***45 weeks after USEPA approval of RI/FS Work Plan****
• ***Remedial Investigation Report***	***90 Days after Lab Results per AOC***
• ***Alternatives Screening Technical Memorandum***	***30 Days after USEPA Approval of Remedial Action Objectives Memorandum per AOC***
• ***Comparative Analysis of Alternatives Technical Memorandum***	***60 Days after USEPA Approval of Alternatives Screening Technical Memorandum per AOC***
• ***Feasibility Study Report***	***60 days after USEPA comments on Comparative Analysis of Alternatives Technical Memo, if required by EPA, or 90 days after receipt of comments on Alternatives Screening Technical Memorandum***

Notes:
AOC = Administrative Settlement Agreement and Order on Consent
RI = Remedial Investigation
FS = Feasibility Study
FSP = Field Sampling Plan
QAPP = Quality Assurance Project Plan
HASP = Health and Safety Plan
RAO= Remedial Action Objectives
* Field investigation start date and duration may vary depending on seasonal weather conditions and other factors. 4 week winter shutdown anticipated.

Table 5-1
Gary Development Landfill
Key Project Contacts

Name	Title	Contact Information
Leslie Blake	USEPA - Remedial Project Manager	U.S. EPA Region 5, Superfund Division 77 West Jacson Boulevard Mail Code SR-6J Chicago, IL 60604-3590 Phone Number: (312) 353-7921 Email: blake.leslie@epa.gov
Jeffrey Cahn	USEPA - Counsel	U.S. EPA Region 5, Superfund Division 77 West Jacson Boulevard Mail Code SR-6J Chicago, IL 60604-3590 Phone Number: (312) 886-6670 Email: cahn.jeff@epa.gov
Nick Cooper	IDEM - Environmental Manager	IDEM, Office of Land Quality/Remediation Branch Division 100 North Senate Avenue IGCN 1101 Indianapolis, IN 46204 Phone Number: (317) 234-3505 Email: NCooper1@idem.IN.gov
Bennie Underwood	de maximis, inc - Project Coordinator	450 Montbrook Lane West Knoxville, TN 37919 Phone Number: (865) 691-5052 Email: bennie@demaximis.com
Mike Samples	de maximis, inc - Alternate Project Coordinator	450 Montbrook Lane West Knoxville, TN 37919 Phone Number: (865) 691-5052 Email: mikes@demaximis.com
Mark Raybuck	Parsons - Project Manager	40 La Riviere Drive Buffalo, NY 14202 Phone Number: (716) 541-0752 Email: Mark.Raybuck@parsons.com

SECTION 6
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APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

Gary Development Landfill Superfund Site
Quality Assurance Project Plan (QAPP)

Prepared For:

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

Prepared on Behalf of:

THE GARY DEVELOPMENT LANDFILL NOTICE PARTIES GROUP

Prepared By:

PARSONS

January 2016

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INTRODUCTION

This Quality Assurance Project Plan supports the Gary Development Landfill remedial investigation/feasibility study (RI/FS). It is an appendix to the main work plan. The work plan provides a Site history, background information, conceptual site model, scope of work, and project organization. The former Gary Development Landfill (GDL) is located at 479 N. Cline Avenue, Gary, Lake County, Indiana. The GDL Site includes four abandoned buildings, the former landfill, a wetland area located on the southeastern portion of the property, and a pond located north of the landfill. This QAPP is to be used to guide quality control and sampling activities which produce data in support of the characterization of the nature and extent of environmental impacts associated with the GDL site in accordance with United States Environmental Protection Agency (USEPA) Region 5 recommendations.

WORKSHEET #1/2: TITLE AND APPROVAL PAGE

(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

Project Identifying Information

- Site name/project name: Gary Development Landfill
- Site location/number: CERCLIS ID No. IND077005916
- Contract/Work assignment number: NA

Lead Organization

- Project Coordinator (name/title/signature/date):

  de maximis Project Coordinator Bennie Underwood, P.E.

  _____

- Project Manager (name/title/signature/date):

  Parsons Project Manager, Mark S. Raybuck, P.G.

  _____

- Quality Manager (name/title/signature/date):

  Parsons Quality Manager, Maryanne Kosciewicz

  _____

Federal Regulatory Agency (name/title/signature/date)

Leslie Blake
Remedial Project Manager
U.S. EPA – Region 5 Superfund Division (SR-6J)
77 W. Jackson Blvd., Chicago, IL 60604-3590
Tel: (312) 353-7921
E-mail: blake.leslie@epa.gov

_____

State Regulatory Agency (name/title/signature/date)

IDEM Project Manager, Nick Cooper

_____

List of plans and reports from previous investigations relevant to this project

- 1985 US EPA Aerial Photographic Analysis of GDL
- 1993 IDEM Memorandum
- 2002 Tetra Tech EM, Inc. Site Assessment Report for GDL
- 2005 IDEM Reassessment for GDL
- 2009 IDEM Expanded Site Inspection for GDL
- 2011 IDEM Hydrogeologic Assessment of GDL
- 2011 US EPA Region 5 HRS Documentation Record for GDL
- 2012 US Department of Health and Human Services Health Consultation

WORKSHEET #3/5: PROJECT ORGANIZATION AND QAPP DISTRIBUTION

A project organization chart is provided in the work plan.

Distribution List:

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address	Document Control Number
Leslie Blake	Project Manager	USEPA Region 5	(312) 353-7921	Blake.leslie@epa.gov	
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Nick Cooper	Project Manager	IDEM	(317) 234-3505	NCooper1@idem.IN.gov	
Bennie Underwood, P.E.	Project Coordinator	de maximis	(865) 691-5052	bennie@demaximis.com	
Michael Samples	Alt. Project Coordinator	de maximis	(865) 691-5052	mikes@demaximis.com	
Mark S. Raybuck, P.G.	Project Manager	Parsons	(716) 541-0752	Mark.Raybuck@Parsons.com	
Maryanne Kosciewicz	Quality Assurance Manager	Parsons	(315) 552-9703	Maryanne.Kosciewicz@Parsons.com	
Carla Rodman	Quality Assurance	Parsons	(315) 552-9762	Carla.Rodman@Parsons.com	
Jason Price	Technical Director	Parsons	(312) 930-5122	Jason.Price@Parsons.com	
Florin Savin	RI Field Team Leader	Parsons	(312) 930-5104	Florin.Savin@Parsons.com	

WORKSHEET #4,7,8: PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

ORGANIZATION: Parsons

Name	Project Title/Role	Education/Experience	Signature/Date
Mark S. Raybuck, P.G.	Project Manager	MA Geology, 31 yrs exp	
Maryanne Kosciewicz	Quality Assurance Manager	BS Chemistry/Math, 25 yrs exp	
Carla Rodman	Quality Assurance	MAT, BS Chemistry, 9 yrs exp	
Greg Ertel, CSP, CIH	Safety Manager	MS Environmental Studies, 25 yrs exp	
Jason Price	Technical Director	BA Geology/Chemistry, 20 yrs exp	
Florin Savin	RI Field Team Leader	MS Geophysical and Geological Engineering, 24 yrs exp	
Randy M. Palachek (ERA)	Risk Assessment	MS Aquatic Toxicology, 31 yrs exp	
Karen Fields (HHRA)	Risk Assessment	MA Environmental Management, 26 yrs exp	
Beth McCartney	FS Leader	MSCE Environmental, 33 yrs exp	

ORGANIZATION: TestAmerica Laboratories

Name	Project Title/Role	Education/Experience	Signature/Date
Michael J Healy	Laboratory Director	BS Environmental Biology, 34 yrs exp	
Therese Hargraves	Project Manager	BS Food Science, 17 yrs exp	
Terese Preston	Quality Assurance Officer	BA Biology, 30 yrs exp	

*Signatures indicate personnel have read and agree to implement this QAPP as written.

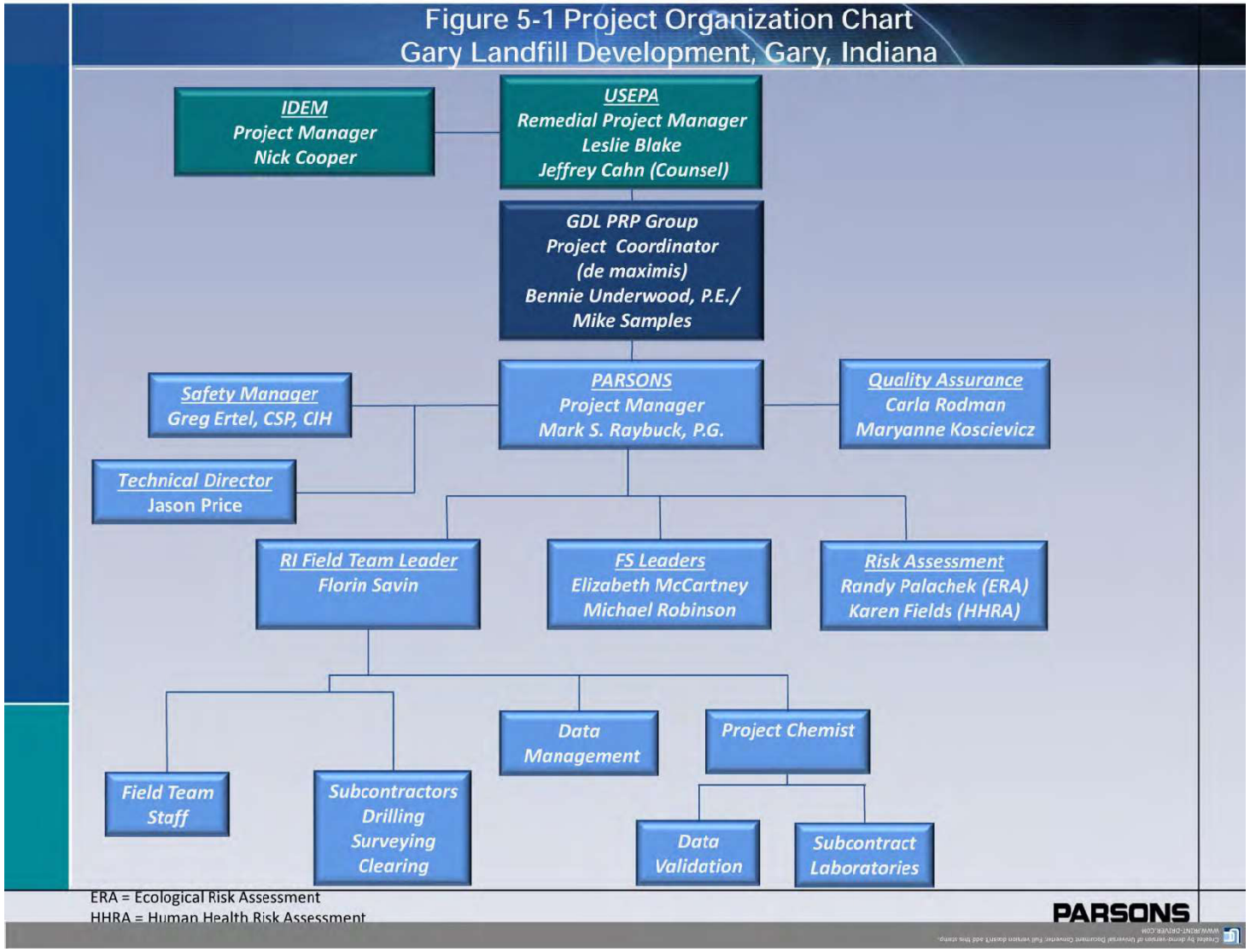
Figure 5-1 Project Organization Chart
Gary Landfill Development, Gary, Indiana
IDEM
Project Manager
Nick Cooper
USEPA
Remedial Project Manager
Leslie Blake
Jeffrey Cahn (Counsel)
GDL PRP Group
Project Coordinator
(de maximis)
Bennie Underwood, P.E./
Mike Samples
Safety Manager
Greg Ertel, CSP, CIH
PARSONS
Project Manager
Mark S. Raybuck, P.G.
Quality Assurance
Carla Rodman
Maryanne Koscievicz
Technical Director
Jason Price
RI Field Team Leader
Florin Savin
FS Leaders
Elizabeth McCartney
Michael Robinson
Risk Assessment
Randy Palachek (ERA)
Karen Fields (HHRA)
Data Management
Project Chemist
Field Team Staff
Subcontractors
Drilling
Surveying
Clearing
Data Validation
Subcontract Laboratories
ERA = Ecological Risk Assessment
HHRA = Human Health Risk Assessment
PARSONS

WORKSHEET #6: COMMUNICATION PATHWAYS

Communication Driver	Organization	Name	Contact Information
Regulatory agency interface	de maximis	Bennie Underwood, P.E./Michael Samples	(865) 691-5052
Field progress reports	Parsons	Mark S. Raybuck, P.G.	(716) 541-0752
Stop work due to safety issues	Parsons	Greg Ertel, CSP, CIH	(585) 353-2574
QAPP changes prior to field work	Parsons	Carla Rodman	(315) 552-9762
QAPP changes during project execution	Parsons	Carla Rodman	(315) 552-9762
Field corrective actions	Parsons	Florin Savin	(312) 930-5104
Sample receipt variances	Parsons	Lorraine Weber	(312) 552-9745
Laboratory quality control variances	Parsons	Maryanne Kosciewicz	(312) 552-9703
Analytical corrective actions	Parsons	Maryanne Kosciewicz	(312) 552-9703
Data verification issues, e.g., incomplete records	Parsons	Florin Savin	(312) 930-5104
Data validation issues, e.g., non-compliance with procedures	Parsons	Carla Rodman	(315) 552-9762
Data review corrective actions	Parsons	Carla Rodman	(315) 552-9762

WORKSHEET #9: PROJECT PLANNING SESSION SUMMARY

The project planning session summary follows:

Date of Session	Participants		Summary
December 16, 2013 at USEPA office, Chicago, Illinois	**Name**	**Organization**	Purpose: meeting with EPA to discuss the AOC and SOW for the Gary Development Landfill Superfund Site Discussed: • Statement of Work and consideration of a phased approach to the planned work • AOC – site access and finances Key Action Items: 1. Prepare a technical evaluation of existing data as justification for the presumptive remedy approach by early January 2014. 2. Group to provide a markup version of the AOC to EPA.
	Tim Prendiville	USEPA Section Chief	
	Jeff Kahn	USEPA Attorney	
	Karen Cibulskis	USEPA Interim RPM	
	Bennie Underwood, P,E,	*de maximis*	
	Mike Samples	*de maximis*	
	David Rieser	GDL Group	
	Rick Mueller	GDL Group	
	Bob Casselberry	GDL Group	
	Shell Bleiwess	GDL Group	
	Mark S. Raybuck.	Parsons Representing Respondents	
	Various members	GDL Group	
June 24, 2014 by phone	**Name**	**Organization**	Purpose: Discuss EPA Comments on RI/FS Scoping Document Gary Development Landfill Discussed: • Analyte lists • vertical aquifer profiling; DNAPL investigation; nested wells • resolving issues in ASTDR health consultation (2012) • Sample center of northern pond sediment/ sound/ gauge pond/ vertical profile • Investigate actual depth of waste of landfill • Surface soil sampling for risk assessment • Additional landfill gas evaluation/ methane • Geophysical investigation over waste • Leachate evaluation (surface seeps) • Prove no principal threat wastes • ARARS Action Items: 1. Inquire about GLNPO's most recent river data. 2. Coordinate follow-up call w/ EPA to discuss Group evaluation and response to EPA comments regarding draft RI/FS scoping document.
	Stephanie Andrews	IDEM	
	Leslie Blake	USEPA	
	Bob Casselberry	DOW Representing Union Carbide	
	Nick Cooper	IDEM	
	William Earle	SulTREK Representing USEPA	
	Aaron Klug	SulTREK Representing USEPA	
	Mark S. Raybuck, P.G.	Parsons Representing Respondents	
	Mike Samples	*de maximis* Representing Respondents	
	Rod Stipe	WM	
	Bennie Underwood, PE	*de maximis* Representing Respondents	

Date of Session	Participants		Summary
April 22, 2014 historical data presentation at the offices of US EPA in Chicago, IL	**Name**	**Organization**	Purpose: Present the Historical Data Summary Technical Memorandum that was prepared by Parsons on behalf of the GDL Group. Discussed: • Grand Calumet River prior studies/evaluation • Southern wetland area relative to river contamination • Existing data does not show MCL exceedances in surface water or groundwater • Focus RI on perimeter of the waste area • Parameter list • Sampling locations Action Items: 1. Parsons will search for historical well logs 2. The GDL Group will initiate action to attempt and gain access to the Site via the access road along the southern boundary of the AMG Resources facility. 3. US EPA will provide an update concerning property access. 4. A Site visit, attended by representatives of the US EPA and the GDL group will be scheduled as soon as site access is secured.
	Leslie Blake	US EPA	
	Bob Casselberry	DOW	
	Scott Ireland	GLNPO (via phone)	
	Tim Prendiville	US EPA Section Chief	
	Mark Raybuck	Parsons representing GDL Group	
	Mike Samples	*de maximis*	
	Bennie Underwood	*de maximis*	
July 15, 2014 Teleconference /Webex Meeting	**Name**	**Organization**	Purpose: Further discuss the scoping of RI/FS planning documents. Discussed: • Extension of Time – RI/FS Planning Documents • Analyte List • Aquifer Profiling / Nested Wells • NAPL Investigation / Waste Characterization / Geophysics / Principal Threat Waste • Surface Soil Sampling • Northern Pond • Landfill Gas • Health Consultation Report Issues
	Eric Ballanger	Republic Services	
	Leslie Blake	US EPA	
	Bob Casselberry	DOW	
	Nick Cooper	IDEM	
	William Earle	SulTREK	
	Tom Froman	ACS	
	Gary Griffith	GP	
	Sampath Kumar	IDEM	
	Mark Raybuck	Parsons	
	Steven Roach	Ashland	
	Mike Samples	*de maximis*	
	Rod Stipe	WM	
	Bennie Underwood	*de maximis*	
	Sathya Yalvigi	DuPont	

WORKSHEET #10: CONCEPTUAL SITE MODEL

SITE BACKGROUND AND SETTING

Physical Setting

The former Gary Development Landfill (GDL) is located at 479 N. Cline Avenue, Gary, Lake County, Indiana. The GDL can be found on the U.S.G.S. Highland, Ind. Quadrangle Topographic Map, in the southwest corner of Section 35 in Township 37 North, Range 9 West. The GDL lies adjacent to the Grand Calumet River about 500 feet west of the Gary Airport south of Lake Michigan. The Site is also bounded on the north and east by the E & J Railroad, to the east by the Indiana Toll way, to the south by the Grand Calumet River, and to the west by AMG Resources Corporation (AMG), a metal recycling facility. Wetland areas are present on the southeastern portion of the property.

The GDL property consists of 62 total acres, of which approximately 55 acres were utilized for solid and hazardous waste disposal.

The surrounding area is heavily industrialized and includes numerous environmentally impacted sites.

Environmental Setting

Geology

The landfill lies within the Lake Michigan Border physiographic division of the Northern Lake and Moraine Region of Indiana. This region is characterized by the presence of beach ridges, dunes, moraines, numerous lakes and peat bogs. The landscape surrounding the site has been altered by industrial and urban development. Predominant soil types include the Oakville-Adrian soil complex, Houghton muck and Urban land.

Rosenshein (1962) used the expression of surface deposits and subsurface geologic information to develop a tentative glacial stratigraphy and chronology of the unconsolidated deposits in Lake County. In the area of the landfill, Rosenshein identified the presence of two distinct unconsolidated lithologies. The uppermost unit was determined to be Holocene, or late Wisconsinan eolian and glaciolacustrine sand and gravel. The lower unit an early Wisconsinan, or pre-Wisconsinan clay till.

Brown and Thompson (2005) later compiled and summarized earlier work and continued the investigation of the surficial geology of the northern third of Lake County. They concluded that multiple water level fluctuations of Lake Michigan over the past 13,500 years, culminated in the formation of three distinct successions of deposits named the Lake Michigan, Lake Border and Wheeler Sequences. Beneath the unconsolidated deposits of the Wheeler Sequence, carbonate bedrock of the Wabash Formation was encountered.

Soil boring logs from the immediate vicinity (ATEC Associates, 1981) demonstrate that sand and gravel deposits extend from the surface to an average depth of approximately 25-40 feet. Deeper boring logs describe the occurrence of soft silty clay transitioning to gray, hard silty clay till. At this location, the till is approximately 50 feet (ft) thick, where it contacts the upper bedrock surface. The bedrock is described as hard, gray and finely crystalline dolomitic limestone containing closely spaced solution joints and tar-filled cavities.

Hydrogeology

The GDL is located in the Lake Michigan Basin water management area of Indiana. The uppermost eolian and glaciolacustrine deposits form the surficial, water table Calumet aquifer. Although surface water in the Grand Calumet River continuously flows east to west, the hydraulic gradient of the river relative to the water table determines whether surface water recharges the aquifer, or base flow from the aquifer discharges as surface water.

The uppermost eolian and glaciolacustrine deposits form the surficial Calumet aquifer, which extends as much as 10 miles inland from the shore of Lake Michigan. Soil borings adjacent to the site show the shallow sand aquifer extends to a depth of 40 ft where it comes into contact with the upper surface of the lower till. Since 1985, water levels have fluctuated between 584 to 582 ft above mean sea level (msl). Recharge to the aquifer occurs principally by the infiltration of precipitation from above. The till serves as a confining unit to both the upper sand and lower bedrock aquifers. Together, the sand aquifer and confining till have a combined thickness of 90 to 110 ft above bedrock. Beneath the unconsolidated deposits, bedrock of the Wabash formation consists of various carbonate lithologies up to 250 ft thick.

No additional site-specific information has been obtained. Further site specific investigation is warranted to determine the impact of the GDL on the quality of ground water contained in the sand and bedrock aquifers below it.

Site Use History and Ownership

The GDL (CERCLIS ID No. IND077005916) was a former permitted solid waste landfill, located at 479 N. Cline Avenue, Gary, Lake County, Indiana. It is located in an industrial area of the City of Gary, Indiana.

The landfill began as an aggregate borrow pit during the early 1950s, and was later approved by the State of Indiana in September 1974 for operation primarily as a solid waste landfill, prior to the promulgation of RCRA rules regarding management of hazardous waste disposal (October 1976). The pit was approved for dewatering in 1973, and a landfill constructed, with operations starting in September 1974. The landfill never received a RCRA permit. An industrial/sanitary landfill was operated at the Site from 1974 to 1989. Because of the de-watering activities, an inward groundwater gradient existed during this period, from the Grand Calumet River towards the Site.

The Site is comprised of three (3) parcels. The first parcel to the east contains 40 acres, with the Gary Development Co. Inc. listed as the owner. The second parcel consists of 5.9 acres. This parcel was originally owned by the Gary Development Co. Inc., but was sold on August 8, 2003 to Non-Responsive of Gary, Indiana. The third parcel consists of approximately 15 acres. The parcel is currently owned by the Lake County Board of Commissioners.

The Site is situated in a heavily industrialized area. Therefore, a search of the adjacent properties within a 2-mile radius was completed using the USEPA Cleanups List (http://www2.epa.gov/cleanups). A total of 17 sites were identified (Brownfield's, RCRA, Superfund's, and Emergency Responses) as sources of hazardous substances.

Historical Data Summary

The GDL Site was the subject of multiple investigations conducted by the USEPA and the Indiana Department of Environmental Management (IDEM) from 1990 to 2012. In addition, multiple site inspections were conducted prior to 1990. These investigations included sampling of groundwater, surface water, liquid waste, and sediments within the site, and extensive sampling within the Grand Calumet River.

The historical data were presented to USEPA in a meeting on April 22, 2014, and a historical data technical memorandum was prepared and submitted following the meeting. Conclusions from a thorough review of these large data sets are as follows:

1. Based on the large volume of historical data and the ongoing remediation by USEPA under a GLLA Project Agreement, additional assessment of the Grand Calumet River is not warranted.
2. Although the southern wetlands area of the GDL Site exhibits some impacts, particularly from PAHs, data from the river shows that periodic flooding of the wetlands from the river is likely responsible for the observed impacts.
3. Environmental sampling conducted in the waste disposal area of the Site indicates that USEPA Maximum Concentration Level (MCLs) were not exceeded in either groundwater or surface water, including the northern pond.

4. Adequate data are already available to identify and limit the remedial investigation analyte list. The primary chemical groups detected in previous investigations were PAHs, PCBs, and metals.
5. The approach of this RI/FS for the GDL relies upon containment/capping as the preferred remediation strategy. The historical data set supports this approach as being appropriate.

Current Site Conditions

The GDL Site includes four abandoned buildings, the landfill, a wetland area located on the southeastern portion of the Site, and a pond located north of the landfill.

A preliminary water wells search was completed. Indiana Department of Natural Resources (DNR) maps (http://www.in.gov/dnr/water/6604.htm) were researched for information concerning private, municipal, and industrial water wells within a 2-mile radius. According to information provided in this survey, no private drinking water wells were identified within a 1,000 feet radius of the site. The closest water well is located 1,350 feet to the south, across the Grand Calumet River. The Grand Calumet River is impacted by upstream sources and is subject to ongoing remediation unrelated to the GDL Site. A detailed water well survey will be conducted by reviewing various databases using an Environmental Data Resources (EDR), Government Agencies, or similar online resources.

CONCEPTUAL SITE MODEL

This Conceptual Site Model (CSM) presents the current understanding of the Site. The CSM is a representation of the physical, chemical, and biological processes that affect the potential transport of any constituents of concern from sources to receptors within the system.

Based on a review of the historical data, background information, and an initial visit, a preliminary CSM has been developed. Figures 2-1 through 2-4 in the GDL RIFS Work Plan (see Appendix 1) present the ecological and human health CSMs for both current conditions and for a scenario in which capping has been implemented as a remedy. Capping is anticipated to remove many of the current exposure pathways. This CSM will be updated after the initial Remedial Investigation (RI) data have been obtained. If needed, it will be updated again following completion of the risk assessment.

IDENTIFICATION OF DATA NEEDS AND DATA QUALITY OBJECTIVE

Data Quality Objectives (DQOs) were developed using the USEPA's DQO process, a multi-step, iterative process that ensures that the type, quantity, and quality of environmental data used in the decision making process are appropriate for its intended application. The DQOs for this investigation are:

- To characterize environmental conditions and refine the CSM;
- To collect additional data to define the landfill limits;

- To collect additional data to update existing datasets from previous investigations so that the nature and extent of impacts can be defined;
- To collect hydraulic data to better understand the site-specific hydrogeology;
- To collect data to support performance of Human Health and Ecological Risk Assessments;
- To collect data to support development and evaluation of remedial alternatives.

PRELIMINARY REMEDIAL ACTION GOALS AND ARARS

Based on current information, the over-riding preliminary remedial action objective is to contain the waste within the landfill by capping.

As shown in the post-remedy CSM figures, containment would remove several exposure pathways by preventing contact of precipitation with the underlying waste. This objective is particularly important in light of the planned remediation of the Grand Calumet River adjacent to the Site.

As stated in the Historical Data Summary Technical Memorandum, a review of the sampling and analysis conducted over multiple investigations, the list of chemical analytes for the RI can be limited. The primary analytes observed in previous investigations of Site groundwater, surface water, and sediments are PAHs, Metals, and PCBs. Although these analyte groups were most prevalent in the existing data sets, a more extensive suite of analytes will be included in the initial RI, and will be reduced at a later time, if appropriate. These will include: VOCs, SVOCs, metals, mercury, cyanide, PCBs, and pesticides.

Although remediation goals will be established later in the project, preliminary goals may be used as screening levels during the RI/FS. A few potential screening level goals are shown below.

- Soil: IDEM Direct Contact Soil Exposure for Industrial/Commercial Properties;
- Groundwater: IDEM “Tap Water” screening levels;
- Surface water: IDEM “Tap Water”;
- USEPA Region 5, RCRA Ecological Screening Levels (ESLs), August 23, 2003;
- EPA Regional Screening Levels;
- Illinois EPA Background Values for the Chicago Metropolitan Area.

For the initial screening, a 10^{-6} risk level will be used for the human health evaluation, for carcinogenic compounds.

Applicable or Relevant and Appropriate Requirements (ARARs) will be developed in detail during the feasibility study. Below is a preliminary list of regulatory programs that may provide substantive standards which may be useful in establishing ARARs:

1) Clean Water Act (drinking water standards);
2) Rivers and Harbors Act (Section 1);
3) Toxic Substances Control Act (TSCA);
4) Endangered Species Act;
5) Fish and Wildlife Coordination Act;
6) Indiana Administrative Code Title 329 Article 10 – Solid Waste Land Disposal Facilities;
7) Other Relevant State Regulations and Laws;
8) FAA Regulations.

PRELIMINARY REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) will be developed to take into account relative risks of Constituents of Concern (COCs), as well as ensure that cleanup objectives are tied to overall risk management goals. As appropriate, RAOs will specify the COCs, exposure route(s) and receptor(s), and an acceptable COC level or range of levels that may be numerical or narrative, recognizing that protectiveness may be achieved by reducing exposure as well as by reducing COC levels. These RAOs will be developed as part of the feasibility study, following completion of the RI, Ecological Risk Assessment (ERA), and HHRA.

WORKSHEET #11: PROJECT/DATA QUALITY OBJECTIVES

INTRODUCTION

Data Quality Objectives (DQOs) for the GDL Site are based on EPA Region V Data Validation guidelines for Superfund sites using the National Functional Guidelines for Superfund Organic/Inorganic Methods Data Review, October 2013. These parameters will be the basis for establishing the quality and quantity of data needed to support the utility of the data. This section was prepared in accordance with USEPA Guidance for the Data Quality Objectives Process (USEPA, August 2000).

Data quality objectives specify the underlying reason for collecting the data and the data type, quality, quantity, and uses needed to make decision, and they provide the basis for designing data collection activities. DQOs and quality assurance objectives are related data quality planning and evaluation tools for all sampling and analysis tools.

The purpose of this QAPP is to provide a standard for control and review of measurement data to ensure they are scientifically sound, representative, comparable, defensible, and of known quality. The data will be used to evaluate the physical and chemical attributes of samples collected. The project objective for analytical testing is to

characterize the physical characteristics and chemical constituents and to provide data to support the decision-making process.

The data produced during sampling activities will be compared with the defined QA objectives and criteria for precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS) to see that the data reported are representative of actual conditions at the site.

This data assessment activity is an on-going coordinated process with data production and is intended to assure that data produced during the project are acceptable for use in subsequent evaluations. Both statistical and qualitative evaluations will be used to assess the quality of the data. The primary evaluation of the data will be based upon the field quality control samples described in Section 8.1.1 and the laboratory quality control samples described in Section 8.1.2. The “blank” samples (laboratory QC blank samples and field QC blank samples) will be used to evaluate whether or not the laboratory and/or field sample handling represent a possible source of sample contamination. Laboratory duplicate sample results will be used to evaluate analytical precision. Field duplicate sample results will be used to evaluate the overall precision of the sampling and analysis process, as well as sample representativeness and site heterogeneity. Laboratory control samples will be used to evaluate the accuracy of analytical results for organics, metals, and cyanide, as will other analysis-specific criteria, such as surrogate compound recoveries for organics. Matrix spike/matrix spike duplicate (MS/MSD) analysis of project samples will be used to evaluate potential sample matrix effects on the analytical results (both of the sample utilized for MS/MSD and of other samples collected from the site). For all sample results, the impact of sample-specific, analysis-specific, and site-specific factors will be evaluated and an assessment will be made as to their impact, if any, on the data. Duplicate sample (field and laboratory QC samples) results will be used to evaluate data precision.

Data Use Objectives

Data use objectives define why analyses are being conducted and how ultimately the data will be used to meet the overall project objectives. For the project activities, these objectives are stated in the Work Plan.

DATA QUALITY OBJECTIVES (PARCCS PARAMETERS)

Introduction

DQOs are based on the premise that different data uses require different levels of data quality. The term *data quality* refers to a degree of uncertainty with respect to PARCCS data quality indicators. Specific objectives are established to develop sampling protocols and identify applicable documentation, sample handling procedures, and measurement system procedures. These DQOs are established by onsite conditions, objectives of the project, and knowledge of available measurement systems. Overall work assignment DQOs are presented and discussed in detail in this QAPP. A wide range of data quality is achieved through the use of various analytical methods. The

following data quality levels are widely accepted as descriptions of the different kinds of data that can be generated for various purposes:

- **Level I, Field screening or analysis using portable instruments (e.g., photoionization detector [PID]):** Results are often not compound-specific but results are available in real time. Depending on the analysis being performed and the instrumentation used, the results may be considered qualitative, semi-quantitative, or quantitative.
- **Level II, Field analysis using more sophisticated portable analytical instruments (e.g., on-site mobile laboratory):** There is a wide range in the quality of data that can be generated depending on the use of suitable calibration standards, reference materials, and sample preparation equipment. Results are available in real-time or typically within hours of sample collection.
- **Level III, All analyses performed in an off-site analytical laboratory using methods other than USEPA-approved analytical methods**: These data generally do not include the level of formal documentation required under Level IV and are not subject to formal data validation. These data are typically used for engineering studies (e.g., treatability testing), site investigations and remedial design.
- **Level IV, Data generated using USEPA methods and enhanced by a rigorous QA program, supporting documentation, and data validation procedures:** These data are typically used for engineering studies (e.g., treatability testing), risk assessment, site investigations, and remedial design, and may be suitable for litigation/enforcement activities. Results are both qualitative and quantitative.

Project Objectives

The data generated for the GDL Site will be used by the client and EPA Region 5 for a remedial investigation and feasibility study (RI/FS). Level IV analytical data are needed for VOC, SVOC, Pest, PCB, Metals, and Mercury in water, soil, and sediment samples. Level IV analytical data are needed for VOCs and Methane in air samples. Level III data are needed for geotechnical analyses. Level II data are needed for Asbestos in soil for health and safety screening.

Level IV data deliverables, including a PDF and EPA Region 5 format EDD are required from the laboratory.

WORKSHEET #12: MEASUREMENT PERFORMANCE CRITERIA

PARCCS PARAMETERS (DATA QUALITY INDICATORS)

Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), absolute difference (D), range (maximum value minus minimum value), relative range, and relative percent difference (RPD) are common.

The objectives for precision for each chemical are based on the capabilities of the approved EPA analytical method with respect to laboratory performance. For this project, field-sampling precision will be determined by analyzing coded (blind) duplicate samples for the same parameters, and then, during data validation, calculating the %RPD for duplicate sample results. The laboratory will determine analytical precision by calculating the %RPD or %D, as applicable to the analytical method being used, e.g., pH will be evaluated using %D.

The laboratory will determine analytical precision by calculating the RPD for the results of the analysis of the laboratory duplicates and matrix spike duplicates. The formula for calculating %RPD is as follows:

$$\%RPD = \frac{|V1-V2|}{(V1+V2)/2}$$

where:

RPD	=	Relative percent difference
V1, V2	=	Values to be compared
|V1 - V2|	=	Absolute value of the difference between the two values
(V1 + V2)/2	=	Average of the two values

For data evaluation purposes, in instances where both sample concentrations are less than five times (<5x) the RL, duplicate precision will be evaluated using the calculated %D result. In this instance, the applicable precision criterion will be two times the RL (2xRL). If a value is not detected, the %RPD criterion will be considered to be not applicable and the %RPD will not be calculated (i.e. precision will not be quantitatively

determined). Field duplicate precision will be evaluated using 30%RPD for water or air samples and 50%RPD for soil/sediment samples.

Accuracy

Accuracy is a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern (Taylor, 1987) or the difference between a measured value and the true or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material and is expressed as the percent of the known quantity that is recovered or measured. The recovery of a given analyte depends on the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes that are less than the quantitation limits are less accurate because they are more affected by such factors as instrument "noise." Higher concentrations will not be as affected by instrument noise or other variables and, thus, will be more accurate.

The objectives for accuracy for each chemical are based on the capabilities of the approved USEPA analytical method with respect to laboratory performance. Analytical accuracy is typically assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), the percent recoveries of matrix spike compounds added to selected samples, and the percent recoveries of spike compounds added to laboratory control samples (LCS), or matrix spike blanks (MSB). An LCS (or MSB) will be analyzed to provide additional information on analytical accuracy. Additionally, initial and continuing calibrations must be performed and accomplished within the established method control limits to define the instrument accuracy before analytical accuracy can be determined for any sample set.

Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a *spike*, added to a sample (matrix spike or laboratory control). The accuracy on a per sample basis will be measured using surrogates for the organics analyses. Positive detects from the PCB analysis will be confirmed using second column confirmation. The laboratory will report the lower of the two values with respect to the dual GC column analysis performed. When the percent difference (%D) between the results for the two columns exceeds 25%, the laboratory will qualify the reported result with the *P* qualifier. The %R is calculated as follows:

Matrix Spike Recovery:

$$\%\ Recovery = \frac{SSR - SR}{SA} \times 100$$

where:

% Recovery	=	Percent recovery
SSR	=	Spike sample result: concentration of analyte obtained by analyzing the sample with the spike added
SR	=	Sample result: the background value; *i.e.,* the concentration of the analyte obtained by analyzing the sample
SA	=	Spiked analyte: concentration of the analyte spike added to the sample

Surrogate Recovery:

$$\% \text{ Recovery} = \frac{\text{Concentration (or amount) found}}{\text{Concentration (or amount) spiked}} \times 100$$

LCS (or MSB) Recovery:

$$\% \text{ Recovery} = \frac{\text{Concentration (or amount) found}}{\text{Concentration (or amount) spiked}} \times 100$$

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point or an environmental condition. Representativeness is a qualitative parameter and is most concerned with the proper design of the sampling program (USEPA, 1987). Samples must be representative of the environmental media being sampled. An important factor in the selection of sample locations and sampling procedures will be obtaining representative samples.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree technically possible, that the data derived represents the in-place quality of the material sampled. Care will be exercised to see that chemical compounds are not introduced to the sample from sample containers, handling, and analysis. Field blanks, trip blanks, and laboratory method/prep blanks will be analyzed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated during data validation through the analysis of coded (blind) field duplicate samples. The analytical laboratory will also follow acceptable procedures to assure the samples are adequately homogenized prior to taking aliquots for analysis such that the reported results are representative of the sample received. Chain-of-custody

procedures will be followed to document the possession of sample containers from the time of container preparation through sample collection and receipt back at the laboratory. Field QC samples will be collected and analyzed to provide information to evaluate sample representativeness. Details of field QC sample collection (rinse blanks, trip blanks, temperature blanks, field duplicates) and chain-of-custody procedures are presented in Section 4.2 and Section 8.1.1.

Completeness

Completeness is defined as the percentage of measurements that meet the project's data quality objectives (USEPA, 1987). Completeness is calculated for each method (or analyte) and sample matrix for an assigned group of samples. Completeness for a data set represents the results usable for data interpretation and decision making. The completeness objective for the analytical and field data is 90%. Completeness is defined as follows for all sample measurements:

$$\% \, C = \frac{V}{T} \times 100$$

where:

%C = Percent completeness

V = Number of measurements judged valid (not rejected during data validation)

T = Total number of measurements

Completeness, which is expressed as a percentage, is calculated by subtracting the number of rejected and unreported results from the total planned results and dividing by the total number of results. Results rejected because of out-of-control analytical conditions, severe matrix effects, broken or spilled samples, or samples that could not be analyzed for any other reason, negatively affect influence completeness and are subtracted from the total number of results to calculate completeness.

Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another (USEPA, 1987). The comparability of all data collected for this project will be managed by:

- Using identified standard methods (including laboratory standard operating procedures) for both sampling and analysis phases of this project
- Requiring traceability of all analytical standards and/or source materials to the USEPA or National Institute of Standards and Technology (NIST)

- Requiring that calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable)
- Using standard reporting units and reporting formats including the reporting of QC data
- Performing data validation on the analytical results, including the use of data qualifiers in all cases where appropriate
- Evaluating the sample collection information and analytical QC sample results
- Requiring that the significance of all validation qualifiers be assessed any time an analytical result is used for any purpose.

By taking these steps during the investigation, future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

Sensitivity and Quantitation Limits

When selecting an analytical method during the DQO process, the achievable detection limit (MDL) and method reporting limit (RL) must be evaluated to verify that the method will meet the project quantitation limits necessary to support project decision making requirements. This process ensures that the analytical method sensitivity has been considered and that the methods used can produce data that satisfy users' needs while making the most effective use of resources. The concentration of any one target compound that can be detected and/or quantified is a measure of sensitivity for that compound. Sensitivity is instrument-, compound-, method-, and matrix-specific and achieving the required project quantitation limit (PQL) and/or method detection limit (MDL) objectives depends on instrument sensitivity and potential matrix effects. With regard to instrument sensitivity, it is important to monitor the instrument performance to ensure consistent instrument performance at the low end of the calibration range. Instrument sensitivity will be monitored through the analysis of method/prep blanks, calibration check samples, and low standard evaluations.

Laboratories generally establish limits that are reported with the analytical results; these results may be called reporting limits, detection limits, quantitation limits, or other terms. These laboratory-specific limits, apply undiluted analyses and must be less than or equal to the project RLs. The RL, also known as the practical quantitation limit (PQL), represents the concentration of an analyte that can be routinely measured in the sampled matrix within stated limits and with confidence in both identification and quantitation. Throughout various documents RL and PQL may be interchanged, but they effectively have the same meaning. The RLs are established based on specific knowledge about the analyte, sample matrix, project specific requirements, and regulatory requirements. The RL is typically established by the laboratory at the level of the lowest calibration standard and is generally in the range of two to ten times the MDL.

The method detection limit (MDL) is defined as "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero" (40 CFR 136 Appendix B). The MDL is the lowest concentration at which a specific analyte in a matrix can be measured and reported with 99% confidence that the analyte concentration is greater than zero. MDLs are experimentally determined and verified for each target analyte of the methods in the sampling program. The laboratory will determine MDLs for each analyte and matrix type prior to analysis of project samples. In addition, when multiple instruments are employed for the analysis of the same method, each individual instrument will maintain a current MDL study. MDLs are based on the results of seven matrix spikes at the estimated MDL, and are statistically calculated in accordance with the Title 40, Code of Federal Regulations Part 136 (40 CFR 136) Appendix B. The standard deviation of the seven replicates is determined and multiplied by 3.14 (i.e., the 99% confidence interval from the one-sided student t-test). If risk-based project objectives are developed, then where practicable, MDLs must be lower than the risk-based criteria determined for the project.

The MDLs to be used are intended to allow that both non-detected and detected target compound results will be usable to the fullest extent possible for the project. An MDL check sample an (interference-free MS with all method target compounds) must be analyzed following the MDL study to determine if reasonable MDL concentrations have been achieved. The MDL check sample should be at a concentration in the range of two to four times the MDL. If any target compound is not recovered, the MDL study must be repeated. In this case, the repeated MDL should be performed with a higher concentration, based on the analyst's judgment, of the target compounds that failed in the MDL check sample. MDLs must be determined annually at a minimum, and verified by analyzing an MDL check sample on each instrument used for the applicable method.

Laboratory RLs and MDLs for all analyses will meet at a minimum the standards criteria specified in the U.S. EPA, Region 5, RCRA 2003 Ecological Screening Levels for Soil, Sediment, and Air samples and the U.S. EPA, Region 5 2013 Screening Levels for Residential Tap Water for Water samples.

All analytical results will be reported to the MDL. Analytical results below the MDL will be flagged with a *U* at the RL for organics and MDL for metals to indicate the data are non-detect. However, the laboratory will flag analytes detected at a level less than the RL but greater than the MDL (or the laboratory's determined minimum reportable concentration) with a *J* to denote an estimated concentration.

When results are corrected for dry weight, the reporting limits are then elevated accordingly. To compensate for the low solids, modifications are made either to increase the initial volume extracted/digested or to reduce the final volume of extract/digestate.

For samples that do not meet the project-specified RLs or MDLs, (taking into consideration elevated detection limits due to percent solids or percent moisture and aliquots used for the designated analysis), the laboratory must make available

compelling documentation (e.g., screening data) and a justifiable explanation for its inability to meet the specified limits using the project protocols. It must also provide an appropriate, justifiable explanation of the issues and resolution in the analytical report/data package (dilution factor, interference, etc.). Excessive, unnecessary dilutions on any sample for a project are unacceptable. The laboratory will analyze all samples initially undiluted, unless for GC/MS analyses (i.e., SW8260B and SW8270D), a preliminary GC-screen is performed and indicates that GC/MS instrument damage or compromise may occur if the sample is not analyzed initially at dilution. In this instance, the sample will be analyzed at the lowest possible dilution factor. If multiple extractions/ analyses are performed (such as undiluted and diluted analyses), resulting in several data sets for the same sample, the laboratory will report all data and results from each of the multiple analyses in the data package.

Quantitation limits for all definitive data quality level laboratory analytical methods, compounds, and matrices are to be addressed for each work assignment in the Work Assignment Scoping Documents. Individual soil sample RLs and MDLs will be adjusted accordingly based on moisture and aliquots used for analysis.

Quality Control Limits for Water Samples[1]

Analytical Parameter	Analytical Method	Matrix Spike (MS) Compounds	MS/MSD % Recovery	Duplicate RPD	LCS % Recovery	Surrogate	Surrogate % Recovery
Volatiles	8260B	1,1-Dichloroethene	61-145	≤14	Laboratory determined QC limits	Vinyl chloride-d3	60-135
		Trichloroethene	71-120	≤14		Chloroethane-d5	70-130
		Benzene	76-127	≤11		1,1-Dichloroethene-d2	60-125
		Toluene	76-125	≤13		2-Butanone-d5	40-130
		Chlorobenzene	75-130	≤13		Chloroform-d	70-125
						1,2-Dichloroethane-d4	70-125
						Benzene-d6	70-125
						1,2-Dichloropropane-d6	70-120
						Toluene-d8	80-120
						trans-1,3-Dichloropropene-d4	60-125
						2-Hexanone-d5	45-130
						1,1,2,2-Tetrachloroethane-d2	65-120
						1,2-Dichlorobenzene-d4	80-120
Semivolatiles	8270D	Phenol	12-110	≤42	Laboratory determined QC limits	1,4-Dioxane-d8	40-110
		2-Chlorophenol	27-123	≤40		Phenol-d5	10-130
		n-Nitroso-di-n-propylamine	41-116	≤38		Bis(2-chloroethyl)ether-d8	25-120
		4-Chloro-3-methylphenol	23-97	≤42		2-Chlorophenol-d4	20-130
		Acenaphthene	46-118	≤31		4-Methylphenol-d8	25-125
		4-Nitrophenol	10-80	≤50		Nitrobenzene-d5	20-125
		2,4-Dinitrotoluene	24-96	≤38		2-Nitrophenol-d4	20-130
		Pentachlorophenol	9-103	≤50		2,4-Dichlorophenol-d3	20-120
		Pyrene	26-127	≤31		Dimethylphthalate-d6	25-130
						Acenaphthylene-d8	10-130
						4-Nitrophenol-d4	10-150
						Fluorene-d10	25-125
						4,6-Dinitro-2-methylphenol-d2	10-130

[1] US EPA National Functional Guidelines for Superfund Organic/Inorganic Methods Data Review, October 2013.

Quality Control Limits for Water Samples[1]

Analytical Parameter	Analytical Method	Matrix Spike (MS) Compounds	MS/MSD % Recovery	Duplicate RPD	LCS % Recovery	Surrogate	Surrogate % Recovery
Semivolatiles, cont'd	8270D					Anthracene-d10 Pyrene-d10 Benzo(a)pyrene-d12	25-130 15-130 20-130
PCBs as Aroclors	8082A	AR 1016 AR 1260	29-135 29-135	≤15 ≤20	50-150 50-150	TCX DCB	30-150 30-150
Pesticides	8081B	gamma-BHC (Lindane) Heptachlor Aldrin Dieldrin Endrin 4,4'-DDT Heptachlor epoxide 4,4'-DDE Endosulfan sulfate trans-Chlordane	56-123 40-131 40-120 52-126 56-121 38-127 NA NA NA NA	≤15 ≤20 ≤22 ≤18 ≤21 ≤27 NA NA NA NA	50-120 NA NA 30-130 50-120 NA 50-150 50-150 50-120 30-130	TCX DCB	30-150 30-150
Metals	6020A	All Metals except Ag and Sb Silver Antimony	75-125 75-125 75-125	≤20	70-130 50-150 50-150	Serial Dilution	%D ≤ 10%
Mercury	7470A	Mercury	75-125	≤20	75-125		NA
Cyanide	9010C/9014	Cyanide	75-125	≤20	75-125		NA

[1] US EPA National Functional Guidelines for Superfund Organic/Inorganic Methods Data Review, October 2013.
Analytical Methods: USEPA SW-846, 3rd edition, revised March 2009; subsequent revisions supersede this information
MS/MSD: Matrix Spike/Matrix Spike Duplicate
RPD: Relative Percent Difference
LCS: Laboratory Control Sample
NA: Not Applicable

Quality Control Limits for Soil/Sediment Samples[1]

Analytical Parameter	Analytical Method	Matrix Spike (MS) Compounds	MS/MSD % Recovery	Duplicate RPD	LCS % Recovery	Surrogates	Surrogate % Recovery
Volatiles	8260B	1,1-Dichloroethene	59-172	≤22	Laboratory determined QC limits	Vinyl chloride-d3	30-150
		Trichloroethene	62-137	≤24		Chloroethane-d5	30-150
		Benzene	66-142	≤21		1,1-Dichloroethene-d2	45-110
		Toluene	59-139	≤21		2-Butanone-d5	20-135
		Chlorobenzene	60-133	≤21		Chloroform-d	40-150
						1,2-Dichloroethane-d4	70-130
						Benzene-d6	20-135
						1,2-Dichloropropane-d6	70-120
						Toluene-d8	30-130
						trans-1,3-Dichloropropene-d4	30-135
						2-Hexanone-d5	20-135
						1,1,2,2-Tetrachloroethane-d2	45-120
						1,2-Dichlorobenzene-d4	75-120
Semivolatiles	8270D	Phenol	26-90	≤35	Laboratory determined QC limits	1,4-Dioxane-d8	40-110
		2-Chlorophenol	25-102	≤50		Phenol-d5	10-130
		n-Nitroso-di-n-propylamine	41-126	≤38		Bis(2-chloroethyl)ether-d8	10-150
		4-Chloro-3-methylphenol	26-103	≤33		2-Chlorophenol-d4	15-120
		Acenaphthene	31-137	≤19		4-Methylphenol-d8	10-140
		4-Nitrophenol	11-114	≤50		Nitrobenzene-d5	10-135
		2,4-Dinitrotoluene	28-89	≤47		2-Nitrophenol-d4	10-120
		Pentachlorophenol	17-109	≤47		2,4-Dichlorophenol-d3	10-140
		Pyrene	35-142	≤36		Dimethylphthalate-d6	10-145
						Acenaphthylene-d8	15-120
						4-Nitrophenol-d4	10-150
						Fluorene-d10	20-140
						4,6-Dinitro-2-methylphenol-d2	10-130

[1] US EPA National Functional Guidelines for Superfund Organic/Inorganic Methods Data Review, October 2013.

Quality Control Limits for Soil/Sediment Samples[1]

Analytical Parameter	Analytical Method	Matrix Spike (MS) Compounds	MS/MSD % Recovery	Duplicate RPD	LCS % Recovery	Surrogates	Surrogate % Recovery
Semivolatiles, cont'd	8270D					Anthracene-d10	10-150
						Pyrene-d10	10-130
						Benzo(a)pyrene-d12	10-140
PCBs as Aroclors	8082A	Aroclor 1016	50-150	≤50	50-150	TCX	30-150
		Aroclor 1260	50-150	≤50	50-150	DCB	30-150
Pesticides	8081B	gamma-BHC (Lindane)	46-127	≤50	50-120	TCX	30-150
		Heptachlor	35-130	≤31	NA	DCB	30-150
		Aldrin	34-132	≤43	NA		
		Dieldrin	31-134	≤38	30-130		
		Endrin	42-139	≤45	50-120		
		4,4'-DDT	23-134	≤50	NA		
		Heptachlor epoxide	NA	NA	50-150		
		4,4'-DDE	NA	NA	50-150		
		Endosulfan sulfate	NA	NA	50-120		
		trans-Chlordane	NA	NA	30-130		
Metals	6010C	All Metals except Ag and Sb	75-125	≤20	70-130	Serial Dilution	%D ≤ 10%
		Silver	75-125		50-150		
		Antimony	75-125		50-150		
Mercury	7471B	Mercury	75-125	≤20	75-125		NA
Cyanide	9010C/9014	Cyanide	75-125	≤20	75-125		NA
Asbestos	NIOSH 9002	Asbestos	NA	NA	NA		NA

[1] US EPA National Functional Guidelines for Superfund Organic/Inorganic Methods Data Review, October 2013.

Analytical Methods: USEPA SW-846, 3rd edition, revised March 2009, subsequent revisions supersede this information
MS/MSD : Matrix Spike/Matrix Spike Duplicate
RPD: Relative Percent Difference
LCS: Laboratory Control Sample
NA: Not Applicable

Analytical Parameter	Analytical Method	Duplicate RPD
Volatiles	TO-15	≤30
Methane	ASTM D1946	≤50

Analytical Methods: Compendium Methods for the Determination of Toxic Organic Compounds in Ambient Air.
MS/MSD : Matrix Spike/Matrix Spike Duplicate
RPD: Relative Percent Difference
LCS: Laboratory Control Sample
NA: Not Applicable

WORKSHEET #13: SECONDARY DATA USES AND LIMITATIONS

Secondary Data Uses

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Locations	2002 Tetra Tech EM, Inc. Site Assessment Report for GDL.	Historical Locations	The historical location information was determined using historical reports and topographical maps.
Historical Data	2002 Tetra Tech EM, Inc. Site Assessment Report for GDL.	Historical data	The samples were analyzed using SW846 methods. The analytical data were validated by Tetra Tech START for EPA Region 5. The data are acceptable for use as qualified.
Historical Data	2005 Indiana Department of Environmental Management (IDEM) Reassessment for GDL	Historical data	The samples were analyzed using CLP methods and had a Level 2 data validation by CADRE. There was no review of the raw data, laboratory narrative, laboratory forms, or chain-of-custody. CADRE flagged any analytes that were outside the calibration criteria. The data are useable.
Historical Data	2009 Indiana Department of Environmental Management (IDEM) Expanded Site Inspection for GDL.	Historical data	The samples were analyzed using EPA CLP methods for organics and inorganics. US EPA Region 5 approved the data as suitable for its intended purpose.

WORKSHEET #14/16: PROJECT TASKS AND SCHEDULE[1]

Activity	Responsible party	Planned completion date	Deliverable(s)	Deliverable due date
Monthly Progress Reports	de maximis	Monthly, beginning 30 days after AOC	Progress Report	15th Day of each month
Field Investigations	Parsons	45 weeks after USEPA approval of RI/FS Work Plan*	○ Procurement, mobilization, EDR database search: 8 weeks ○ Site Preparation (clearing, fencing, debris clearing): 4 weeks ○ Direct push sampling, southern wetlands investigation, north pond investigation, landfill evaluation, well installation, groundwater sampling: 24 weeks ○ Additional round of groundwater sampling: 1 week, conducted four months after initial sampling event	TBD
Remedial Investigation Report	Parsons	90 days after lab results per AOC	Report	TBD
Alternatives Screening Technical Memorandum	Parsons	30 days after USEPA approval of Remedial Action Objectives Memorandum per AOC	Technical Memorandum	TBD
Comparative Analysis of Alternatives Technical Memorandum	Parsons	30 days after USEPA approval of Alternatives Screening Technical Memorandum	Technical Memorandum	TBD

[1] Gary Development Landfill Remedial Investigation/Feasibility Study Work Plan Figure 5-2, October 2015

Activity	Responsible party	Planned completion date	Deliverable(s)	Deliverable due date
		per AOC		
Feasibility Study Report	Parsons	60 days after USEPA comments on Comparative Analysis of Alternatives Memo, if required by EPA, or 90 days after receipt of comments on Alternatives Screening Technical Memorandum	Report	TBD

Notes:
AOC = Administrative Settlement Agreement and Order on Consent
RI = Remedial Investigation
FS = Feasibility Study
FSP = Field Sampling Plan
QAPP = Quality Assurance Project Plan
HASP = Health and Safety Plan
RAO = Remedial Action Objective
*Field investigation start date and duration may vary depending on seasonal weather conditions and other factors. 4 week winter shutdown anticipated.

WORKSHEET #15: PROJECT ACTION LIMITS AND LAB DETECTION/QUANTITATION LIMITS

Project Quantitation Limits for Aqueous Volatiles

Analytical Method: 8260B Matrix: Aqueous				
Analyte	CAS No	Laboratory Quantitation Limit (ug/L)[2]	Project Quantitation Limit Goal[3] (ug/L)	Method Detection Limit (ug/L)[1]
1,1,1-TRICHLOROETHANE	71-55-6	1.00	200	0.200
1,1,2,2-TETRACHLOROETHANE	79-34-5	1.00	1.0*	0.230
1,1,2-TRICHLOROETHANE	79-00-5	1.00	5	0.280
1,1,2-TRICHLOROTRIFLUORO-ETHANE	76-13-1	1.00	53000	0.220
1,1-DICHLOROETHANE	75-34-3	1.00	24	0.190
1,1-DICHLOROETHENE	75-35-4	1.00	7	0.310
1,2-DICHLOROETHANE	107-06-2	1.00	5	0.280
1,2-DICHLOROPROPANE	78-87-5	1.00	5	0.200
2-BUTANONE	78-93-3	5.00	4900	1.47
2-HEXANONE	591-78-6	5.00	31000	0.560
2-PROPENAL	107-02-8	100	100*	10.9
4-METHYL-2-PENTANONE	108-10-1	5.00	1000	0.330
ACETONE	67-64-1	5.00	12000	1.29
ACRYLONITRILE	107-13-1	20.0	20*	2.60
BENZENE	71-43-2	0.500	5	0.0740
BROMODICHLOROMETHANE	75-27-4	1.00	80	0.170
BROMOFORM	75-25-2	1.00	80	0.280
BROMOMETHANE	74-83-9	1.00	7	0.310
CARBON DISULFIDE	75-15-0	5.00	720	0.430
CARBON TETRACHLORIDE	56-23-5	1.00	5	0.260
CHLOROBENZENE	108-90-7	1.00	100	0.140
CHLOROETHANE	75-00-3	1.00	21000	0.340
CHLOROETHYL VINYL ETHER	110-75-8	2.00	NA	0.780
CHLOROFORM	67-66-3	1.00	80	0.200
CHLOROMETHANE	74-87-3	1.00	190	0.180
CIS-1,3-DICHLOROPROPENE	10061-01-5	1.00	4.1	0.180
DIBROMOCHLOROMETHANE	124-48-1	1.00	80	0.320
ETHYL ACETATE	141-78-6	10.0	14000	3.17
ETHYL ETHER	60-29-7	1.00	3100	0.310
ETHYLBENZENE	100-41-4	0.500	700	0.130
METHYLENE CHLORIDE	75-09-2	5.00	5	0.680
m.p-XYLENE	179601-23-1	1	190	0.26
o-XYLENE	95-47-6	0.500	190	0.0680

[2] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[3] US EPA Region 5 2013 Screening Levels for Tap Water Residential.
*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

Project Quantitation Limits for Aqueous Volatiles

Analytical Method: 8260B Matrix: Aqueous				
Analyte	CAS No	Laboratory Quantitation Limit (ug/L)[2]	Project Quantitation Limit Goal[3] (ug/L)	Method Detection Limit (ug/L)[1]
STYRENE	100-42-5	1.00	100	0.100
TETRACHLOROETHENE	127-18-4	1.00	5	0.170
TETRAHYDROFURAN	109-99-9	5.00	3200	1.20
TOLUENE	108-88-3	0.500	1000	0.110
trans-1,2-DICHLOROETHENE	540-59-0	1.00	100	0.250
trans-1,3-DICHLOROPROPENE	10061-02-6	1.00	4.1	0.210
TRICHLOROETHENE	79-01-6	0.500	5	0.190
TRICHLOROFLUOROMETHANE	75-69-4	1.00	1100	0.190
VINYL ACETATE	108-05-4	2.00	410	0.330
VINYL CHLORIDE	75-01-4	0.500	2	0.100

[1] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[2] US EPA Region 5 2013 Screening Levels for Tap Water Residential.

Project Quantitation Limits for Aqueous Semivolatiles

Analytical Method: 8270D
Matrix: Aqueous

Analyte	CAS No	Laboratory Quantitation Limit (ug/L)[4]	Project Quantitation Limit Goal[5] (ug/L)	Method Detection Limit (ug/L)[3]
1,2,4,5-TETRACHLOROBENZENE	95-94-3	4.00	4.0*	0.457
1,2,4-TRICHLOROBENZENE	120-82-1	1.60	70	0.189
1,2-DICHLOROBENZENE	95-50-1	1.60	600	0.197
1,3-DICHLOROBENZENE	541-73-1	1.60	NA	0.167
1,3-DINITROBENZENE	99-65-0	4.00	4.0*	1.06
1,4-DICHLOROBENZENE	106-46-7	1.60	75	0.167
2,3,4,6-TETRACHLOROPHENOL	58-90-2	4.00	170	0.597
2,4,5-TRICHLOROPHENOL	95-95-4	8.00	890	2.05
2,4,6-TRICHLOROPHENOL	88-06-2	4.00	9	0.573
2,4-DICHLOROPHENOL	120-83-2	8.00	35	2.08
2,4-DIMETHYLPHENOL	105-67-9	8.00	270	1.44
2,4-DINITROPHENOL	51-28-5	16.0	30	6.87
2,4-DINITROTOLUENE	121-14-2	0.800	2	0.196
2,6-DINITROTOLUENE	606-20-2	0.400	15	0.0590
2-CHLORONAPHTHALENE	91-58-7	1.60	550	0.188
2-CHLOROPHENOL	95-57-8	4.00	71	0.447
2-METHYLNAPHTHALENE	91-57-6	0.400	27	0.0521
2-METHYLPHENOL (O-CRESOL)	95-48-7	1.60	720	0.244
2-NITROANILINE	88-74-4	4.00	150	1.03
2-NITROPHENOL	88-75-5	8.00	NA	2.00
2-PICOLINE	109-06-8	32.0	NA	11.4
3&4 METHYLPHENOL	15831-10-4	1.6	1400	0.359
3,3'-DICHLOROBENZIDINE	91-94-1	4.00	4.0*	1.37
3-NITROANILINE	99-09-2	8.00	NA	1.43
4,6-DINITRO-2-METHYLPHENOL	534-52-1	16.0	16.0*	4.72
4-BROMOPHENYL PHENYL ETHER	101-55-3	4.00	NA	0.432
4-CHLORO-3-METHYLPHENOL	59-50-7	8.00	1100	1.84
4-CHLOROANILINE	106-47-8	8.00	8.0*	1.61
4-CHLOROPHENYL PHENYL ETHER	7005-72-3	4.00	NA	0.508
4-NITROANILINE	100-01-6	8.00	33	1.33
4-NITROPHENOL	100-02-7	16.0	NA	5.94
ACENAPHTHENE	83-32-9	0.800	400	0.247
ACENAPHTHYLENE	208-96-8	0.800	NA	0.214
ANILINE	62-53-3	16.0	110	4.21
ANTHRACENE	120-12-7	0.800	1300	0.267
BENZO(A)ANTHRACENE	56-55-3	0.160	0.29	0.0453
BENZO(A)PYRENE	50-32-8	0.160	0.2	0.0791
BENZO(B)FLUORANTHENE	205-99-2	0.160	0.29	0.0645

[4] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[5] US EPA Region 5 2013 Screening Levels for Tap Water Residential.
*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

Project Quantitation Limits for Aqueous Semivolatiles

Analytical Method: 8270D
Matrix: Aqueous

Analyte	CAS No	Laboratory Quantitation Limit (ug/L)[4]	Project Quantitation Limit Goal[5] (ug/L)	Method Detection Limit (ug/L)[3]
BENZO(G,H,I)PERYLENE	191-24-2	0.800	NA	0.300
BENZO(K)FLUORANTHENE	207-08-9	0.160	2.9	0.0512
BENZOIC ACID	65-85-0	16.0	58000	4.61
BENZYL ALCOHOL	100-51-6	16.0	1500	4.83
BIS(2-CHLOROETHOXY) METHANE	111-91-1	1.60	46	0.227
BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	111-44-4	1.60	1.6*	0.234
BIS(2-CHLOROISOPROPYL) ETHER	108-60-1	1.60	3.1	0.304
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	8.00	8.0*	1.37
BUTYLBENZYLPHTHALATE	85-68-7	1.60	140	0.384
CARBAZOLE	86-74-8	4.00	NA	0.283
CHRYSENE	218-01-9	0.400	29	0.0545
DIBENZ(A,H)ANTHRACENE	53-70-3	0.240	0.240*	0.0406
DIBENZOFURAN	132-64-9	1.60	5.8	0.210
DIETHYL PHTHALATE	84-66-2	1.60	11000	0.289
DIMETHYL PHTHALATE	131-11-3	1.60	NA	0.251
DI-N-BUTYL PHTHALATE	84-74-2	4.00	670	0.584
DI-N-OCTYLPHTHALATE	117-84-0	8.00	190	0.840
FLUORANTHENE	206-44-0	0.800	630	0.363
FLUORENE	86-73-7	0.800	220	0.195
HEXACHLOROBENZENE	118-74-1	0.400	1	0.0635
HEXACHLOROBUTADIENE	87-68-3	4.00	4.0*	0.412
HEXACHLOROCYCLOPENTADIENE	77-47-4	16.0	50	5.10
HEXACHLOROETHANE	67-72-1	4.00	5.1	0.479
INDENO(1,2,3-C,D)PYRENE	193-39-5	0.160	0.29	0.0598
ISOPHORONE	78-59-1	1.60	670	0.300
NAPHTHALENE	91-20-3	0.800	1.4	0.247
NITROBENZENE	98-95-3	0.800	1.2	0.359
n-NITROSODIMETHYLAMINE	62-75-9	8.00	8.0*	3.80
n-NITROSODI-N-PROPYLAMINE	621-64-7	0.400	0.40*	0.123
n-NITROSODIPHENYLAMINE	86-30-6	0.800	100	0.296
PENTACHLOROPHENOL	87-86-5	16.0	16*	3.15
PHENANTHRENE	85-01-8	0.800	NA	0.241
PHENOL	108-95-2	4.00	4500	0.537
PYRENE	129-00-0	0.800	87	0.341
PYRIDINE	110-86-1	16.0	16*	4.00

[3] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[4] US EPA Region 5 2013 Screening Levels for Tap Water Residential.
*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

Project Quantitation Limits for Aqueous Pesticides

Analytical Method: 8081B
Matrix: Aqueous

Analyte	CAS No	Laboratory Quantitation Limit (ug/L)[6]	Project Quantitation Limit Goal[7] (ug/L)	Method Detection Limit (ug/L)
ALDRIN	309-00-2	0.0400	0.04	0.00530
ALPHA BHC	319-84-6	0.0400	0.062	0.00260
ALPHA CHLORDANE	5103-71-9	0.0400	2	0.00440
ALPHA ENDOSULFAN	959-98-8	0.0400	78	0.00410
BETA BHC	319-85-7	0.0400	0.22	0.0102
BETA ENDOSULFAN	33213-65-9	0.0400	78	0.00280
DELTA BHC	319-86-8	0.0400	NA	0.0103
DIELDRIN	60-57-1	0.0400	0.04*	0.0129
ENDOSULFAN SULFATE	1031-07-8	0.0400	78	0.0117
ENDRIN	72-20-8	0.0400	2	0.0142
ENDRIN KETONE	53494-70-5	0.0400	NA	0.0170
ENDRIN ALDEHYDE	7421-93-4	0.0400	NA	0.00820
GAMMA BHC (LINDANE)	58-89-9	0.0400	0.2	0.00560
GAMMA CHLORDANE	5103-74-2	0.0400	2	0.00720
HEPTACHLOR	76-44-8	0.0400	0.4	0.0135
HEPTACHLOR EPOXIDE	1024-57-3	0.0400	0.2	0.0138
METHOXYCHLOR	72-43-5	0.0800	40	0.0230
p,p'-DDD	72-54-8	0.0400	0.27	0.0133
p,p'-DDE	72-55-9	0.0400	2	0.00380
p,p'-DDT	50-29-3	0.0400	2	0.00320
TOXAPHENE	8001-35-2	0.400	3	0.200

*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

[6] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[7] US EPA Region 5 2013 Screening Levels for Tap Water Residential.

Project Quantitation Limits for Aqueous PCBs as Aroclors

Analytical Method: 8082A Matrix: Aqueous				
Analyte	CAS No	Laboratory Quantitation Limit (ug/L)[8]	Project Quantitation Limit Goal[9] (ug/L)	Method Detection Limit (ug/L)[7]
PCB-1016 (AROCLOR 1016)	12674-11-2	0.400	1.1	0.0670
PCB-1221 (AROCLOR 1221)	11104-28-2	0.400	0. 4*	0.200
PCB-1232 (AROCLOR 1232)	11141-16-5	0.400	0.4*	0.200
PCB-1242 (AROCLOR 1242)	53469-21-9	0.400	0. 4*	0.200
PCB-1248 (AROCLOR 1248)	12672-29-6	0.400	0. 4*	0.200
PCB-1254 (AROCLOR 1254)	11097-69-1	0.400	0.4*	0.200
PCB-1260 (AROCLOR 1260)	11096-82-5	0.400	0. 4*	0.0700

*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

[8] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[9] US EPA Region 5 2013 Screening Levels for Tap Water Residential.

Project Quantitation Limits for Aqueous Metals, Mercury, and Cyanide

Analytical Method: Metals by 6020A / Mercury by 7470A/ Cyanide by 9010C/9014 Matrix: Aqueous				
Analyte	CAS No	Laboratory Quantitation Limit (ug/L)[10]	Project Quantitation Limit Goal[11] (ug/L)	Method Detection Limit (ug/L)[9]
ALUMINUM	7429-90-5	100	16000	53.9
ANTIMONY	7440-36-0	3.00	6	1.01
ARSENIC	7440-38-2	1.00	10	0.439
BARIUM	7440-39-3	2.50	2000	0.841
BERYLLIUM	7440-41-7	1.00	4	0.237
CADMIUM	7440-43-9	0.500	5	0.190
CALCIUM	7440-70-2	200	NA	106
CHROMIUM	7440-47-3	5.00	100	2.18
COBALT	7440-48-4	1.00	4.7	0.189
COPPER	7440-50-8	2.00	1300	0.962
IRON	7439-89-6	100	11000	26.2
LEAD	7439-92-1	0.500	15	0.141
MAGNESIUM	7439-95-4	200	NA	83.3
MANGANESE	7439-96-5	2.50	320	0.990
NICKEL	7440-02-0	2.00	300	0.528
POTASSIUM	7440-09-7	500	NA	189
SELENIUM	7782-49-2	2.50	50	0.834
SILVER	7440-22-4	0.500	71	0.0803
SODIUM	7440-23-5	200	NA	88.4
THALLIUM	7440-28-0	2.00	2	0.591
VANADIUM	7440-62-2	5.00	78	2.16
ZINC	7440-66-6	20.0	4700	15.4
MERCURY	7439-97-6	0.200	2	0.0720
CYANIDE	57-12-5	10.0	200	2.10

[10] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[11] US EPA Region 5 2013 Screening Levels for Tap Water Residential.

Project Quantitation Limits for Soil and Sediment Volatiles

Analytical Method: 8260B
Matrix: Soil/Sediment

Analyte	CAS No	Laboratory Quantitation Limit (ug/Kg)[12]	Project Quantitation Limit Goal[13] (ug/Kg)	Method Detection Limit(ug/Kg)[11]
1,1,1-TRICHLOROETHANE	71-55-6	5.00	213	0.747
1,1,2,2-TETRACHLOROETHANE	79-34-5	5.00	850	1.01
1,1,2-TRICHLOROETHANE	79-00-5	5.00	518	0.682
1,1,2-TRICHLOROTRIFLUORO-ETHANE	76-13-1	5.00	NA	1.00
1,1-DICHLOROETHANE	75-34-3	5.00	5.0*	0.791
1,1-DICHLOROETHENE	75-35-4	5.00	19.4	0.808
1,2-DICHLOROETHANE	107-06-2	5.00	260	0.741
1,2-DICHLOROPROPANE	78-87-5	5.00	333	0.759
2-BUTANONE	78-93-3	5.00	42.4	1.81
2-HEXANONE	591-78-6	5.00	NA	1.44
2-PROPENAL (ACROLEIN)	107-02-8	400	400*	39.8
4-METHYL-2-PENTANONE	108-10-1	5.00	25.1	1.31
ACETONE	67-64-1	5.00	9.9	2.16
ACRYLONITRILE	107-13-1	80.0	80*	11.0
BENZENE	71-43-2	5.00	142	0.685
BROMODICHLOROMETHANE	75-27-4	5.00	NA	0.861
BROMOFORM	75-25-2	5.00	492	1.15
BROMOMETHANE	74-83-9	5.00	NA	1.51
CARBON DISULFIDE	75-15-0	5.00	23.9	0.747
CARBON TETRACHLORIDE	56-23-5	5.00	1450	0.910
CHLOROBENZENE	108-90-7	5.00	291	0.507
CHLOROETHANE	75-00-3	5.00	NA	1.36
CHLOROETHYL VINYL ETHER	110-75-8	5.00	NA	1.15
CHLOROFORM	67-66-3	5.00	121	0.575
CHLOROMETHANE	74-87-3	5.00	NA	1.05
CIS-1,3-DICHLOROPROPENE	10061-01-5	5.00	NA	0.656
DIBROMOCHLOROMETHANE	124-48-1	5.00	NA	0.870
ETHYL ACETATE	141-78-6	50.0	NA	12.8
ETHYL ETHER	60-29-7	5.00	NA	0.955
ETHYLBENZENE	100-41-4	5.00	175	1.01
METHYLENE CHLORIDE	75-09-2	5.00	159	1.35
m,p-XYLENE	179601-23-1	10.0	433 (total)	**1.23**
o-XYLENE	95-47-6	5.00	433 (total)	**0.453**
STYRENE	100-42-5	5.00	254	0.656
TETRACHLOROETHENE	127-18-4	5.00	990	0.764
TETRAHYDROFURAN	109-99-9	5.00	NA	1.43
TOLUENE	108-88-3	5.00	1220	0.700
trans-1,2-DICHLOROETHENE	540-59-0	5.00	NA	0.688

[12] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[13] US EPA Region 5 RCRA Ecological Screening Levels for Sediments, August, 2003.
*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

Project Quantitation Limits for Soil and Sediment Volatiles

Analytical Method: 8260B Matrix: Soil/Sediment				
Analyte	CAS No	Laboratory Quantitation Limit (ug/Kg)[12]	Project Quantitation Limit Goal[13] (ug/Kg)	Method Detection Limit(ug/Kg)[11]
trans-1,3-DICHLOROPROPENE	10061-02-6	5.00	NA	0.896
TRICHLOROETHENE	79-01-6	5.00	112	0.825
TRICHLOROFLUOROMETHANE	75-69-4	5.00	NA	0.778
VINYL ACETATE	108-05-4	5.00	13	0.786
VINYL CHLORIDE	75-01-4	5.00	202	1.05

[6] US EPA Region 5 RCRA Ecological Screening Levels for Sediments, August, 2003.

Project Quantitation Limits for Soil and Sediment Semivolatiles

Analytical Method: 8270D
Matrix: Soil/Sediment

Analyte	CAS No	Laboratory Quantitation Limit (ug/Kg)[14]	Project Quantitation Limit Goal[15] (ug/Kg)	Method Detection Limit (ug/Kg)
1,2,4,5-TETRACHLOROBENZENE	95-94-3	167	1252	40.8
1,2,4-TRICHLOROBENZENE	120-82-1	167	5062	35.8
1,2-DICHLOROBENZENE	95-50-1	167	1315	39.7
1,3-DICHLOROBENZENE	541-73-1	167	294	37.4
1,3-DINITROBENZENE	99-65-0	167	167*	44.9
1,4-DICHLOROBENZENE	106-46-7	167	318	42.6
2,3,4,6-TETRACHLOROPHENOL	58-90-2	167	167*	59.5
2,4,5-TRICHLOROPHENOL	95-95-4	330	NA	75.8
2,4,6-TRICHLOROPHENOL	88-06-2	330	330*	114
2,4-DICHLOROPHENOL	120-83-2	330	330*	78.9
2,4-DIMETHYLPHENOL	105-67-9	330	330*	126
2,4-DINITROPHENOL	51-28-5	670	670*	585
2,4-DINITROTOLUENE	121-14-2	167	167*	52.8
2,6-DINITROTOLUENE	606-20-2	167	167*	65.3
2-CHLORONAPHTHALENE	91-58-7	167	417	36.7
2-CHLOROPHENOL	95-57-8	167	167*	56.7
2-METHYLNAPHTHALENE	91-57-6	33.0	33*	6.11
2-METHYLPHENOL (O-CRESOL)	95-48-7	167	167*	53.3
2-NITROANILINE	88-74-4	167	NA	44.7
2-NITROPHENOL	88-75-5	330	NA	78.5
2-PICOLINE	109-06-8	330	NA	125
3&4-METHYLPHENOL	15831-10-4	167	167*	55.4
3,3'-DICHLOROBENZIDINE	91-94-1	167	167*	46.5
3-NITROANILINE	99-09-2	330	NA	103
4,6-DINITRO-2-METHYLPHENOL	534-52-1	330	330*	267
4-BROMOPHENYL PHENYL ETHER	101-55-3	167	1550	43.8
4-CHLORO-3-METHYLPHENOL	59-50-7	330	388	113
4-CHLOROANILINE	106-47-8	670	670*	156
4-CHLOROPHENYL PHENYL ETHER	7005-72-3	167	NA	38.8
4-NITROANILINE	100-01-6	330	NA	139
4-NITROPHENOL	100-02-7	670	670*	316
ACENAPHTHENE	83-32-9	33.0	33*	5.97
ACENAPHTHYLENE	208-96-8	33.0	33*	4.38
ANILINE	62-53-3	670	670*	181
ANTHRACENE	120-12-7	33.0	57.2	5.55
BENZO(A)ANTHRACENE	56-55-3	33.0	108	4.47
BENZO(A)PYRENE	50-32-8	33.0	150	6.43
BENZO(B)FLUORANTHENE	205-99-2	33.0	10400	7.17

[14] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[15] US EPA Region 5 RCRA Ecological Screening Levels for Sediments, August, 2003.
*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

Project Quantitation Limits for Soil and Sediment Semivolatiles

Analytical Method: 8270D
Matrix: Soil/Sediment

Analyte	CAS No	Laboratory Quantitation Limit (ug/Kg)[14]	Project Quantitation Limit Goal[15] (ug/Kg)	Method Detection Limit (ug/Kg)
BENZO(G,H,I)PERYLENE	191-24-2	33.0	170	10.7
BENZO(K)FLUORANTHENE	207-08-9	33.0	240	9.79
BENZOIC ACID	65-85-0	1670	NA	373
BENZYL ALCOHOL	100-51-6	330	330*	99.6
BIS(2-CHLOROETHOXY) METHANE	111-91-1	167	NA	33.9
BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	111-44-4	167	3520	49.8
BIS(2-CHLOROISOPROPYL) ETHER	108-60-1	167	NA	38.5
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	167	182	60.7
BUTYLBENZYLPHTHALATE	85-68-7	167	1970	63.2
CARBAZOLE	86-74-8	167	NA	85.8
CHRYSENE	218-01-9	33.0	166	9.06
DIBENZ(A,H)ANTHRACENE	53-70-3	33.0	33	6.42
DIBENZOFURAN	132-64-9	167	449	38.9
DIETHYL PHTHALATE	84-66-2	167	295	56.3
DIMETHYL PHTHALATE	131-11-3	167	NA	43.4
DI-N-BUTYL PHTHALATE	84-74-2	167	1114	50.6
DI-N-OCTYLPHTHALATE	117-84-0	167	40600	54.2
FLUORANTHENE	206-44-0	33.0	423	6.16
FLUORENE	86-73-7	33.0	77.4	4.67
HEXACHLOROBENZENE	118-74-1	67.0	67*	7.70
HEXACHLOROBUTADIENE	87-68-3	167	167*	52.2
HEXACHLOROCYCLOPENTADIENE	77-47-4	670	901	191
HEXACHLOROETHANE	67-72-1	167	584	50.5
INDENO(1,2,3-C,D)PYRENE	193-39-5	33.0	200	8.61
ISOPHORONE	78-59-1	167	432	37.3
NAPHTHALENE	91-20-3	33.0	176	5.11
NITROBENZENE	98-95-3	33.0	145	8.29
n-NITROSODIMETHYLAMINE	62-75-9	670	NA	264
n-NITROSODI-N-PROPYLAMINE	621-64-7	167	NA	40.6
n-NITROSODIPHENYLAMINE	86-30-6	167	NA	39.2
PENTACHLOROPHENOL	87-86-5	670	23000	533
PHENANTHRENE	85-01-8	33.0	204	4.63
PHENOL	108-95-2	167	167*	73.8
PYRENE	129-00-0	33.0	195	6.60
PYRIDINE	110-86-1	670	106	278

[7] US EPA Region 5 RCRA Ecological Screening Levels for Sediments, August, 2003.

*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

Project Quantitation Limits for Soil and Sediment Pesticides

Analytical Method: 8081B
Matrix: Soil/Sediment

Analyte	CAS No	Laboratory Quantitation Limit (ug/Kg)[16]	Project Quantitation Limit Goal[17] (ug/Kg)	Method Detection Limit
ALDRIN	309-00-2	1.70	2	0.693
ALPHA BHC	319-84-6	1.70	6	0.424
ALPHA CHLORDANE	5103-71-9	1.70	3.24	0.845
ALPHA ENDOSULFAN	959-98-8	1.70	3.26	0.731
BETA BHC	319-85-7	1.70	5	0.518
BETA ENDOSULFAN	33213-65-9	1.70	1.94	0.271
DELTA BHC	319-86-8	1.70	71500	0.526
DIELDRIN	60-57-1	1.70	1.9	0.229
ENDOSULFAN SULFATE	1031-07-8	1.70	34.6	0.305
ENDRIN	72-20-8	1.70	2.22	0.231
ENDRIN KETONE	53494-70-5	1.70	NA	0.378
ENDRIN ALDEHYDE	7421-93-4	1.70	480	0.281
GAMMA BHC (LINDANE)	58-89-9	1.70	2.37	0.362
GAMMA CHLORDANE	5103-74-2	1.70	3.24	0.438
HEPTACHLOR	76-44-8	1.70	1.7*	0.701
HEPTACHLOR EPOXIDE	1024-57-3	1.70	2.47	0.594
METHOXYCHLOR	72-43-5	8.30	13.6	0.324
p,p'-DDD	72-54-8	1.70	4.88	0.333
p,p'-DDE	72-55-9	1.70	3.16	0.277
p,p'-DDT	50-29-3	1.70	4.16	0.880
TOXAPHENE	8001-35-2	16.7	16.7*	7.04

*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

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[16] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[17] US EPA Region 5 RCRA Ecological Screening Levels for Sediments, August, 2003.

Project Quantitation Limits for Soil and Sediment PCBs as Aroclors

Analytical Method: 8082A Matrix: Soil/Sediment				
Analyte	CAS No	Laboratory Quantitation Limit (ug/Kg)[18]	Project Quantitation Limit Goal[19] (ug/Kg)	Method Detection Limit
PCB-1016 (AROCLOR 1016)	12674-11-2	16.7	59.8	5.90
PCB-1221 (AROCLOR 1221)	11104-28-2	16.7	59.8	7.34
PCB-1232 (AROCLOR 1232)	11141-16-5	16.7	59.8	7.27
PCB-1242 (AROCLOR 1242)	53469-21-9	16.7	59.8	5.48
PCB-1248 (AROCLOR 1248)	12672-29-6	16.7	59.8	6.57
PCB-1254 (AROCLOR 1254)	11097-69-1	16.7	59.8	3.60
PCB-1260 (AROCLOR 1260)	11096-82-5	16.7	59.8	8.19

[18] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[19] US EPA Region 5 RCRA Ecological Screening Levels for Sediments, August, 2003.

Project Quantitation Limits for Soil and Sediment Metals, Mercury, Cyanide, and Asbestos

Analytical Method: Metals by 6010C / Mercury by 7471B / Cyanide by 9010C/9014 / Asbestos by NIOSH 9002
Matrix: Soil/Sediment

Analyte	CAS No	Laboratory Quantitation Limit (mg/Kg)[20]	Project Quantitation Limit Goal[21] (mg/Kg)	Method Detection Limit (mg/Kg)[16]
ALUMINUM	7429-90-5	20.0	NA	4.00
ANTIMONY	7440-36-0	2.00	NA	0.804
ARSENIC	7440-38-2	1.00	9.79	0.199
BARIUM	7440-39-3	1.00	NA	0.107
BERYLIIUM	7440-41-7	0.400	NA	0.0800
CADMIUM	7440-43-9	0.200	0.99	0.0254
CALCIUM	7440-70-2	20.0	NA	5.42
CHROMIUM	7440-47-3	1.00	43.4	0.116
COBALT	7440-48-4	0.500	50	0.100
COPPER	7440-50-8	1.00	31.6	0.200
IRON	7439-89-6	20.0	NA	8.22
LEAD	7439-92-1	0.500	35.8	0.149
MAGNESIUM	7439-95-4	10.0	NA	2.06
MANGANESE	7439-96-5	1.00	NA	0.200
NICKEL	7440-02-0	1.00	22.7	0.200
POTASSIUM	7440-09-7	50.0	NA	3.01
SELENIUM	7782-49-2	1.00	NA	0.355
SILVER	7440-22-4	0.500	0.5*	0.0362
SODIUM	7440-23-5	100	NA	13.4
THALLIUM	7440-28-0	1.00	NA	0.422
VANADIUM	7440-62-2	0.500	NA	0.0740
ZINC	7440-66-6	2.00	121	0.404
MERCURY	7439-97-6	0.0167	0.174	0.00655
CYANIDE	57-12-5	0.500	0.5*	0.165
ASBESTOS	1332-21-4	1%	1%[22]	NA

*where US EPA Region 5 standards cannot be reached with currently available analytical laboratory technology, the PQL has been raised to the lowest achievable laboratory reporting limit.

[20] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[21] US EPA Region 5 RCRA Ecological Screening Levels for Sediments, August, 2003.
[22] http://www.epa.gov/superfund/asbestos/

Project Quantitation Limits for Air Volatiles and Methane

Analytical Method: TO-15/ASTM D1946
Matrix: Air

Analyte	CAS No	Laboratory Quantitation Limit (ug/m3)[23]	Project Quantitation Limit Goal[24] (ug/m3)	Method Detection Limit (ug/m3)
1,1,1-TRICHLOROETHANE	71-55-6	1.09	4170000	0.164
1,1,2,2-TETRACHLOROETHANE	79-34-5	1.37	353000	0.419
1,1,2-TRICHLOROETHANE	79-00-5	1.09	11600	0.295
1,1-DICHLOROETHANE	75-34-3	0.809	1240000	0.105
1,1-DICHLOROETHENE	75-35-4	0.793	303	0.135
1,2,3-TRICHLOROPROPANE	96-18-4	3.01	3320	0.301
1,2,4-TRIMETHYLBENZENE	95-63-6	0.983	NA	0.310
1,2-DIBROMOETHANE	106-93-4	1.54	176000	0.338
1,2-DICHLOROBENZENE	95-50-1	1.20	270000	0.421
1,2-DICHLOROETHANE	107-06-2	0.809	29700	0.190
1,2-DICHLOROPROPANE	78-87-5	0.924	70600	0.240
1,3,5-TRIMETHYLBENZENE	108-67-8	0.983	NA	0.320
1,3-BUTADIENE	106-99-0	0.885	NA	0.142
1,3-DICHLOROBENZENE	541-73-1	1.20	273000	0.391
1,4-DICHLOROBENZENE	106-46-7	1.20	275000	0.385
2-BUTANONE	78-93-3	2.95	NA	0.590
2-HEXANONE	591-78-6	2.05	105000	0.238
3-CHLOROPROPENE	107-05-1	0.626	NA	0.150
4-ETHYLTOLUENE	622-96-8	1.97	NA	0.324
4-METHYL-2-PENTANONE	108-10-1	2.05	45900	0.184
ACETONE	67-64-1	11.9	959000	3.33
BENZENE	71-43-2	0.639	9760	0.179
BROMODICHLOROMETHANE	75-27-4	1.34	NA	0.295
BROMOFORM	75-25-2	2.07	9110	0.496
BROMOMETHANE	74-83-9	0.777	NA	0.124
CARBON DISULFIDE	75-15-0	1.56	3670	0.0965
CARBON TETRACHLORIDE	56-23-5	1.26	1410	0.239
CHLOROBENZENE	108-90-7	0.921	120000	0.226
CHLORODIFLUOROMETHANE	75-45-6	0.707	NA	0.131
CHLOROETHANE	75-00-3	0.528	20000	0.0924
CHLOROFORM	67-66-3	0.977	1340	0.186
CHLOROMETHANE	74-87-3	1.03	NA	0.330
cis-1,2-DICHLOROETHENE	156-59-2	0.793	NA	0.238
cis-1,3-DICHLOROPROPENE	10061-01-5	0.908	5890	0.336
CUMENE	98-82-8	1.97	NA	0.295
DIBROMOCHLOROMETHANE	124-48-1	1.70	NA	0.358
DIBROMOMETHANE	74-95-3	2.84	NA	0.284
DICHLORODIFLUOROMETHANE	75-71-8	0.989	1550000	0.336
ETHYLBENZENE	100-41-4	0.868	304000	0.295
FREON 113	76-13-1	1.53	NA	0.238
FREON 114	76-14-2	1.40	NA	0.224

[23] Laboratory Quantitation and Detection Limits from TestAmerica Laboratories 2014.
[24] US EPA Region 5 RCRA Ecological Screening Levels for Air, August, 2003.

Project Quantitation Limits for Air Volatiles and Methane

Analytical Method: TO-15/ASTM D1946 Matrix: Air				
Analyte	CAS No	Laboratory Quantitation Limit (ug/m3)[23]	Project Quantitation Limit Goal[24] (ug/m3)	Method Detection Limit (ug/m3)
HEPTANE	142-82-5	2.05	NA	0.193
HEXANE	110-54-3	1.76	NA	0.113
ISOOCTANE	540-84-1	2.34	NA	0.182
m&p-XYLENE	179601-23-1	0.868	135000 (total)	0.521
METHANE	74-82-8	0.10%	NA	NA
METHYL t-BUTYL ETHER	1634-04-4	3.61	NA	0.613
METHYLENE CHLORIDE	75-09-2	1.74	4780000	0.452
OCTANE	111-65-9	1.87	NA	0.168
o-XYLENE	95-47-6	0.868	135000 (total)	0.265
PENTANE	109-66-0	2.95	NA	0.177
STYRENE	100-42-5	0.852	946	0.247
TETRACHLOROETHENE	127-18-4	1.36	69000	0.271
TOLUENE	108-88-3	0.754	1040000	0.452
trans-1,2-DICHLOROETHENE	156-60-5	0.793	29100	0.198
trans-1,3-DICHLOROPROPENE	10061-02-6	0.908	5890	0.218
TRICHLOROETHENE	79-01-6	1.07	1220000	0.193
TRICHLOROFLUOROMETHANE	75-69-4	1.12	5150000	0.135
VINYL CHLORIDE	75-01-4	0.511	221	0.181

[12]US EPA Region 5 RCRA Ecological Screening Levels for Air, August, 2003.

WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

INTRODUCTION AND APPROACH

This section outlines the planned characterization approach and proposed tasks for the remedial investigation. A summary of the proposed sampling plan is provided in Worksheet #18. Details of the proposed sampling plan by matrix are provided in Worksheet #18.

Investigation Approach

The majority of the investigation will be outside the presumed limits of the landfill area. The field program will be based in part on the previously completed investigations, and will include collection of subsurface soil, surface soil, sediment, surface water, gas, and groundwater samples. It will also include physical, ecological, and wetland area surveys. This work is intended to characterize the chemical and physical characteristics of the Site and define impacts outside the landfill area. Shallow surface soil samples will be used to characterize direct contact risks for both human and ecological receptors. Direct push borings will be used to collect groundwater samples and to facilitate selection of monitoring well locations. The landfill limits will be delineated by digging test pits. Gas sampling will evaluate concentrations of specific airborne chemicals for current conditions within the existing landfill vents, and at locations outside the limits of waste.

Supplemental Delineation

Data may be collected during the RI that indicate the need for specific or localized delineation of the extent of impacts to various media. The need for further delineation will be evaluated based on multiple lines of evidence suggesting the presence of non-aqueous phase liquid (NAPL), either light (LNAPL) or dense (DNAPL). Figure 3-1 of the GDL RIFS Work Plan (see Appendix 1) is a flow chart that provides direction on how positive observations of NAPL will be used to evaluate the potential need for further action.

This screening flow-chart for evaluation of the potential presence of NAPL does not preclude the normal evaluation of all the RI data (metals, etc.). All data will be evaluated in context with ecological and human health risk assessments and comparison of environmental sample results to various regulatory criteria.

INVESTIGATION TASKS

Site Preparation

Access Agreements

The USEPA facilitated onsite access via an administrative warrant. The GDL PRP Group obtained a non-exclusive limited right of access with the adjacent AMG property

for the purpose of ingress/egress to the Site, along the southern boundary near the Grand Calumet River.

Onsite Building Evaluation

The onsite buildings in the southwestern corner of the Site will be inspected, with the intent to demolish and recycle them. The evaluation of the onsite buildings will include an asbestos survey and a hazardous materials survey. If present, asbestos and/or hazardous materials will be properly managed in accordance with applicable laws and regulations prior to, or as part of, the building demolition

Brush Hog/Clear Roads/Sampling Path Installation

The Site has re-vegetated significantly over time, minimizing surface runoff, but limiting access. Paths will be created through brush removal or mowing to the existing gas vents and wells, planned sampling locations, and around the perimeter for new direct push points and monitoring wells. Efforts will be made to identify the culvert/drainage underneath the former access road (presented in the HRS records). Efforts will be made to minimize the amount of clearing and grubbing, which will continue to provide interim erosion control. The primary route of access will be the road adjacent to the river. In addition, the entry of the access road will be secured with a gate and proper signage.

Scrap Metal and Debris Removal

Based on the aerial photographs and an initial Site visit, abandoned pieces of heavy equipment were preliminarily identified. Two trucks, one excavator, and one tanker appear to be located in the southwestern area. A second excavator is located centrally. Furthermore, unknown equipment/debris is located in the northern pond. Following a site reconnaissance visit, arrangements will be made for inventory of the metal/scrap debris. Options for handling the debris will include offsite disposal, recycling, or placement under a future landfill cap. Offsite disposal or recycling of waste identified onsite will be disposed in accordance with applicable laws.

Underground Utility Location

Utility clearance will be performed at each location of intrusive work (drilling, excavating, etc.) prior to conducting the intrusive activities. Subsurface clearance will be conducted in the top four feet below ground surface (bgs) using a hand auger/air knife combination. Appropriate protocols will be followed to identify the locations of buried utilities and to confirm the absence of such utilities prior to intrusive activities.

Access Control/Fencing

A gate and proper signage will be installed along the southern access road to restrict and control access. Enclosure of the perimeter is not needed due to natural barriers such as the Grand Calumet River, thick vegetation, and manmade restrictions such as the Tollway, and railways. If, during the course of the remedial investigation work,

evidence of trespassing is observed, additional access measures, such as fencing or other gates, will be considered.

Topographic Survey

A topographic map is presented in the GDL RIFS Work Plan and is based on the 2013 LiDAR topography survey, using five foot contour lines. The LiDAR survey was conducted at sufficient resolution for the production of one-foot contours. Thus, a topographic survey is not needed during the RI/FS phase of work. The LIDAR survey will be spot checked during the survey of the sampling points and monitoring wells.

Onsite Well Inventory

Based on previous investigations, there are four monitoring wells (1W, 1S, 1E, and 1N) located at the Site; however, no boring logs have been located. The locations and condition of the existing wells will be assessed during a reconnaissance visit. If identified, the existing monitoring wells (1W, 1S, 1E, and 1N) will be properly abandoned in accordance with 312IAC 13-10-2, State of Indiana.

Soil Gas Evaluation

There are no human receptors in the landfill, and therefore no complete risk pathway. The existing gas vents and air sampling task (see Interior Landfill Investigation) with up to 14 gas vents within the landfill, and up to seven (7) perimeter gas probes, will provide sufficient information for evaluating the potential for a completed vapor intrusion pathway. The vapor intrusion pathway will be further evaluated following the investigation activities, if warranted, based on the gas vent, gas probe, and groundwater sampling results.

Southern Wetlands Investigation

Wetlands Delineation

A wetland delineation will be performed to confirm the limits of the existing southern wetlands within the Site boundaries. The wetland delineation will be conducted by a certified wetland specialist and using the techniques outlined by United States Army Corps of Engineers (USACE) Field Guide for Wetlands Delineation Manual (USACE 1987) and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: North central and Northeast Region (USACE 2009). The overall quality of the wetlands is currently poor and degraded due to the predominance of invasive phragmites. Quality will be evaluated as part of the delineation process. Note that the southern wetland is not documented by U.S. Fish and Wildlife Service on the National Wetlands Inventory.

Sediment Sampling

A total of 15 locations will be sampled for sediments (SD07 through SD21) in the southern wetlands. Two (2) samples per location will be collected, one (1) at zero (0) to one (1) foot and a second at one (1) to two (2) feet below the sediment/water interface

or ground surface. The samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. If, following completion of the RI, additional sampling is considered necessary to delineate the vertical extent of wetland sediments, a supplemental investigation activity will be proposed to USEPA. The proposed sample analyses are presented in Worksheet #18.

Because of potential impacts to the Site from the river, and from former pumping operations, two locations (SD20 and SD21) will be sampled at multiple depths (to approximately five (5) feet below the sediment/water interface or ground surface) to evaluate whether PCBs are present only in surface sediment samples or are present in a vertical profile.

If standing water or seeps are found in the vicinity of these sediment sample locations in this area, or along the toe of the landfill, a surface water or seep sample will be collected and analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide (see Worksheet #18). A single seep was observed during a September 9, 2015 Site visit. Although it did not appear to be leachate from the landfill, the location of this seep has been documented, and if found during the RI, it will be sampled.

Northern Pond Investigation

Inspect Vegetation and Habitat

An ecological characterization will be undertaken, including the Northern Pond area. This survey will include the documentation of both plant and wildlife species.

Surface Water Sampling

Based on historical results, very few chemical parameters were detected in surface water. Several metals were detected in each sample, but MCLs were not exceeded for metals or the other parameters. To confirm the absence of impacts and to assess existing conditions, six (6) surface water samples (SW02 through SW07) will be collected from the northern pond, at depths of approximately zero (0) to two (2) feet below the water surface. Surface water samples will be field screened for water quality parameters such as pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential. Each sample will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide.

In addition, the deeper water column will be evaluated at a maximum of three (3) locations by sampling at depths (approximately zero (0) to two (2) feet below the water surface and (if the water column is greater than 10 feet) an additional sample will be collected approximately 10 to 12 feet below the water surface.

The proposed samples analyses are presented in Worksheet #18.

Perimeter/Shallow Sediment Sampling

A total of 10 shallow sediment samples (SD22 through SD31) will be advanced.

Two locations (SD23 and SD24) will be in the interior of the pond. One (1) sample will be collected from each location, at zero (0) to one (1) foot below the sediment/water interface.

At the remaining locations (SD22, SD25 through SD31), sampling will be conducted to a maximum depth of two (2) feet below the sediment/water interface around the perimeter of the northern pond. Two (2) samples will be collected from each location: zero (0) to one (1) foot below the interface and a second sample from one (1) to two (2) feet below the interface.

The samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The proposed pond sediment sample analyses are presented in Worksheet #18.

If, following completion of the RI, additional sampling is considered necessary to delineate the vertical extent of pond sediment, a supplemental investigation task will be proposed to USEPA.

In addition to the surface water and sediment samples described above, an attempt will be made to collect two (2) to three (3) surface water and sediment samples from a pond located east of the Site to evaluate current background conditions. Based on the aerial photographs and ownership (Indiana DNR) it appears that this pond is natural and not located immediately adjacent to contaminated sites. Also, prior to initiating the field work, a site visit to the pond will be conducted to obtain additional information, which will be provided to USEPA. The selected pond proposed for background sampling is hydraulically disconnected from the landfill and consequentially possible leachate seeps (if encountered) from the landfill are not a concern. Collection of these samples is contingent upon gaining permission to sample the pond, reportedly owned by the Indiana Department of Natural Resources, and identifying accessible sampling locations. Samples, if collected, will be analyzed for the list of parameters shown in Worksheet #18 for surface water and sediment samples.

Perimeter Groundwater Evaluation

Water Wells Survey

A preliminary water wells search was completed. A detailed water wells survey will be conducted by reviewing various databases using an Environmental Data Resources (EDR) or similar online resources. Municipal, private potable and industrial process wells will be searched. Local ordinances (such as those prohibiting private wells for potable use) will be reviewed. Identified wells will be mapped and information regarding their construction details will be provided to EPA. In addition, pertinent information in IDEM's Virtual File Cabinet will be reviewed to supplement the onsite data.

Direct Push Investigation

A Geoprobe® or comparable direct push unit will be used to advance a total of 21 borings (GP01 through GP21). The direct push borings will be used to collect groundwater samples and to facilitate selection of monitoring well locations. Based on

the surrounding geology and information obtained from soil borings completed during construction of the neighboring Indiana toll road east of the Site, borings will be advanced to maximum depths of approximately 25 to 40 feet bgs. Borings will be terminated when the glacial till layer is encountered, or when refusal is encountered at a shallower depth after two attempts. If refusal occurs after drilling attempts at two locations, then a decision will be made to either make another attempt, or alternative drilling methods will be evaluated and proposed for EPA approval. Although the approximate planned locations are shown in the GDL RIFS Work Plan, these locations may be adjusted in the field based upon information obtained during the investigation tasks. Of the 21 borings, ten direct push locations (GP01, GP03, GP05, GP08, GP09, GP11, GP12, GP13, GP14, and GP20) have been selected for groundwater vertical profiling. Vertical profile samples will be collected at the following approximate intervals: 5 to10 feet bgs; 15 to 20 feet bgs; and 25 to 30 feet bgs. The target depth for the upper interval will be at or near the water table to provide information on potential LNAPL/floating chemicals, and the target depth for the deepest interval will be at or near the interface between the sandy zone and clay/till to provide information on potential DNAPL/sinking chemicals.

Because of the anticipated local geology (sand overlying clay), the remaining 13 borings will be sampled at only one subsurface interval of approximately 25 to 30 feet bgs. Those selected locations and intervals will be sufficient to evaluate the vertical distribution of the groundwater and achieve the RI objectives. Based on the information available at the time of this work plan, such as the reported former activities, the age of the landfill, and the length of time since operations ceased, discrete zones within the landfill are not expected to have a significant impact on the vertical distribution of dissolved chemical constituents in groundwater outside the landfill footprint.

Groundwater samples will be collected using methods such as pre-packed screens, temporary piping with screens, or retractable screens. Typical direct push profiles (with pre-packed screens) are shown in the GDL RIFS Work Plan. Groundwater samples will be field screened for water quality parameters such as pH, conductivity, dissolved oxygen (DO), turbidity, and oxidation-reduction potential. Samples will be submitted to a laboratory for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The proposed sample analyses are presented in Worksheet #18. Accelerated turnaround will be requested from the laboratory in order to utilize the laboratory analytical results from these samples to assist with guiding the direct push investigation and with selecting locations of the permanent groundwater monitoring wells. Decisions regarding monitoring well placement or retaining temporary direct push locations will be made in consultation with EPA and IDEM. In general, monitoring wells will be placed at locations where concentrations of COCs greater than RAOs are observed, but may also include locations where no detections or minimal impacts are observed.

Monitoring Well Installation

It is anticipated that up to 10 permanent groundwater monitoring wells (MW01 through MW10) will be installed. Installation of any additional wells will be dependent upon analytical results of the initial investigation, and would be proposed as supplemental

investigation work, if warranted. Locations will be based on the direct push field screening and groundwater analytical results from the direct push investigation and results from usable existing wells.

Hollow-stem augers will be used to install the monitoring wells. The anticipated depth of each well is 25 to 40 feet bgs. Final depths and screen placement will be based in part upon information gained during the direct push investigation.

Details for monitoring well construction and installation are presented in the GDL RIFS Work Plan.

Four (4) rounds of groundwater samples will be collected for laboratory analysis from the entire monitoring well network. The groundwater samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The proposed sample analyses are presented in Worksheet #18. The sampling events will be spaced approximately three (3) months apart to account for seasonal variations. Monthly water level measurements will be collected from the monitoring well network during the remediation investigation, with the last event conducted concurrently with the second groundwater sampling event. The frequency of the groundwater sampling is sufficient to satisfy the technical requirements of the Remedial Investigation Report, and any additional rounds of sampling will be proposed in later phases of the project prior to the remedial design. Additionally, data from the Grand Cal USGS Report (June 2002), and from multiple years of water elevation data at an adjacent property indicate that over a period of several years, water levels in wells typically only fluctuate three (3) to five (5) feet with even smaller seasonal fluctuations.

Surface Soil Sampling

A total of 10 surface soil samples (SS01 through SS10) will be collected either from the direct push unit or using hand augers. Two (2) samples per location will be collected, one at zero (0) to six (6) inches and a second sample at six (6) inches to two (2) feet bgs. The surface soil samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The surface soil samples will be used to evaluate the ecological and human health risk assessment. The proposed samples analyses are presented in Worksheet #18.

In addition, one (1) composite sample at each location (SS01 through SS10) will be collected from zero (0) to two (2) feet bgs and will be analyzed for asbestos. If asbestos is found to be present in the surface soil samples, then additional sampling may be needed prior to remedial activities to evaluate potential risks to remedial workers.

Illinois EPA's background values for the Chicago metropolitan area will be used as screening levels.

Soil Sampling (During Well installation)

Soil samples will be collected from an interval within the well boring, above the water table, with the highest Photoionization Detector (PID) screening levels, or from the mid-point of the vadose zone interval. The rationale for the soil sample intervals is based on the shallow depth to groundwater (approximately five (5) feet bgs) and collection of the

surface samples from a zero (0) to two (2) foot bgs interval. Consequently, the only additional sampling interval available above the groundwater surface is anticipated to be two (2) to five (5) feet bgs. If the depth to groundwater is greater than anticipated, then additional soil samples will be collected at five (5) foot intervals above the water table. The soil samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. The proposed sample analyses are presented in Worksheet #18. Note that collecting soil samples at depth from the direct push sampling effort will not be attempted due to the potential for running/heaving sands.

In addition, six (6) subsurface samples (GP02, GP04, GP10, GP15, GP17, and GP19) will be collected for geotechnical analysis to characterize soil types located within the boundaries of the landfill. The samples will be collected using a Shelby tube or comparable equipment and tested for the following geotechnical parameters:

- Soil Classification by United Soil Classification System (USCS): (D2487)
- Moisture Content and Dry Density (D2216)
- Bulk Density (D4292 / D2937)
- Porosity, Water Filled Porosity and Air Filled Porosity
- Fraction Organic Carbon (D2974)
- Specific Gravity

Hydrogeologic Evaluation (Groundwater Flow and Slug and Tracer Tests)

In-situ permeability testing (slug testing), will be performed on five (5) monitoring wells to determine the horizontal conductivity of the aquifer in the vicinity of the well. The wells will be selected to provide even coverage and spacing around the landfill perimeter, to the extent possible. Slug tests will be conducted utilizing both the rising and falling head slug test techniques.

Groundwater flow direction will be evaluated using groundwater elevation data from the monitoring well network. Monthly water level measurements will be collected from the monitoring well network during the remediation investigation, with the final event conducted concurrently with the second groundwater sampling event.

Landfill Evaluation

Existing Landfill Cover Evaluation

Historical topography will be reviewed, if available, to evaluate settling over time. In addition, a total of 12 hand borings (GT01 through GT12) will be advanced within the footprint of the former landfill to assist with preliminary cap design. Soil borings will be advanced by hand from ground surface through the cover soil until waste material is encountered using Shelby tubes. Based on historical reports, the existing cover material is anticipated to be approximately two (2) feet deep. Locations of the proposed borings are provided in the GDL RIFS Work Plan. Samples will be collected and tested for:

- Atterberg limits
- Shear stress
- Specific gravity
- Permeability

Waste Boundary Evaluation

Initially, the anticipated limits of the landfill will be estimated through review of topographic maps, historical air photos, and visual inspection. The total depth of the landfill (depth to glacial till) has been reported as 25 to 30 feet below the natural land surface (Palin, 2010).

Approximately 25 to 30 test pits will be installed at approximately 200 foot intervals (see the GDL RIFS Work Plan for approximate landfill limits). Each test pit will start between 10 and 50 feet from the estimated limits of waste. Each pit will then be excavated toward the landfill until waste is identified. It is anticipated that the test pits will be limited to five (5) to six (6) feet in depth. No landfill waste will be removed from the excavation. Efforts will be made to ensure that waste is not disturbed or removed from each test pit during exploratory excavation activities. The limit of waste will be marked and the test pit backfilled with the existing soils that were removed from the excavation. After the location of the physical landfill limit is identified (based on visual evidence obtained from the test pits), the boundary will be marked with a surveyor's stake. These stakes will then be surveyed and located on the Site map. Hand held GPS units may also be used to document locations of the test pits.

Note that the well installation and direct push sampling tasks will be used to supplement this boundary evaluation.

Interior Landfill Investigation

Consistent with USEPA correspondence dated August 18, 2015, three (3) Landfill Evaluation Areas have been identified for subsurface investigation. Two (2) additional areas have been identified by USEPA, which will only be considered for evaluation if the initial three interior landfill evaluation areas, in conjunction with the other data generated during this Remedial Investigation (RI), indicate a need.

In general, investigation of the three areas will consist of the installation of borings utilizing hollow stem augers with rotary drilling methods. A split-spoon sampler will be continuously advanced to review and record soil or waste descriptions. Each boring will be advanced until the first occurrence of 1) un-impacted native sand; 2) native glacial till; 3) auger refusal. In the event that NAPL is encountered in any of the borings, the methodologies for screening for NAPL previously outlined and presented in Figure 3-1of the GDL RIFS Work Plan (see Appendix 1) will be employed. A maximum of three soil samples will be collected from each boring location. One sample will be collected from above the water table; one sample will be collected at the water table; and one sample will be collected from the terminus of the boring. The soil samples will be analyzed for VOCs, SVOCs, pesticides, PCBs, metals, mercury, and cyanide. Additionally, a single

grab sample of water encountered (if any) in each boring will be collected for laboratory analysis of the previously identified analyte list. Upon completion, the borings (that are not converted to monitoring wells) will be backfilled with bentonite chips employing the same methodology identified in this Work Plan. All other techniques and methodologies employed in the installation and sampling of these borings will be in conformance with this Work Plan, the QAPP, and the FSP.

Landfill Evaluation Area 1

Evaluation Area 1 is the former area identified in historical aerial photographs and referenced in audit records, appearing to have been water filled. Two borings will be advanced in the general locations identified in the GDL RIFS Work Plan. One of the borings will be converted to a 2-inch diameter monitoring well. The well will be screened the entire length of the water column unless field observations identify conditions that warrant otherwise.

Landfill Evaluation Area 2

Evaluation Area 2 is the former location of an east/west oriented trench identified in historical aerial photographs and referenced in audit records. Two borings will be advanced in the general locations identified in the GDL RIFS Work Plan . One of the borings will be converted to a 2-inch diameter monitoring well. The well will be screened the entire length of the water column unless field observations identify conditions that warrant otherwise.

Landfill Evaluation Area 3

Evaluation Area 3 is the former location of water collection and pumping operations identified in historical aerial photographs and referenced in audit records. Two borings will be advanced in the general locations identified in the GDL RIFS Work Plan. One of the borings will be converted to a 2-inch diameter monitoring well. The well will be screened the entire length of the water column unless field observations identify conditions that warrant otherwise. In addition, direct push sampling point GP-18 is located within this Evaluation Area (see Direct Push Investigation section for details).

Air Investigation

There are reportedly 14 landfill gas vents located in a central area of the landfill, identified in the GDL RIFS Work Plan. The locations of each vent (if present) will be determined and each assigned a unique vent number.

Two types of air sampling will be conducted: a screening method utilizing portable hand-held instruments; and air sampling with subsequent laboratory analysis for VOCs (EPA method TO-15) via a sampling device such as a Summa canister. Pressure or velocity from the vents will be measured for use in emission rate calculations. Using results from the field screening, six individual vents, assuming they can be found (those with the highest field screening readings) will be identified for further sampling and analysis by a laboratory. Each vent will be field screened using handheld screening instruments sensitive to VOCs and methane, including a combustible gas analyzer and PID.

Additional field screening measurements for VOCs and methane will be taken in the ambient air in the potential worker breathing zone nearby and downwind of the vents.

In addition, up to seven air monitoring points (AS01 through AS07) are proposed near the river and the property boundaries by installing probes or vents, and sampling soil gas.

Criteria described in the GDL RIFS Work Plan will be used to determine whether all seven or only two perimeter monitoring points for soil gas collection are needed. Similar to the existing vents, these will be field screened for VOCs and methane, and samples submitted to the laboratory for analysis.

Samples specified for laboratory analysis will be shipped to a qualified laboratory for analysis of methane and individual VOCs by EPA Method TO-15.

Ecological Investigation (Biota/Habitat)

An ecological survey will be undertaken to document the status of current existing ecological conditions. The survey will include a documentation of habitats from the northern pond area to the southern portion of the Site boundary, concluding adjacent to the northern bank of the Grand Calumet River. This survey will include observations of plant and wildlife species. In addition, a literature search will be conducted on the potential presence of state and federally listed threatened and endangered species within a one-half mile radius from the Site property boundary. Furthermore, locations of invasive species, such as phragmites, will be documented. Species will be characterized to the lowest practical level in the field.

POST SAMPLING ACTIVITIES

Survey Wells and Sampling Locations

Direct push and monitoring wells will be surveyed by a certified land surveyor and tied to a reference location and to the state plane coordinate system. Surface water, sediment, existing gas vents, air monitoring, and shallow soil sample locations will be documented by hand held GPS. The elevation of all newly installed wells will be surveyed at the water level measuring point (notch) on the riser pipe. Surveyed elevations will be referenced to mean sea level.

Investigative Waste Disposal and Materials Management

Investigation derived waste (IDW) generated during the investigations include the following:

- Drill cuttings;
- Disposable material as Geoprobe liners, personal protective equipment, plastic sheeting;
- Excess soil and sediments from sampling activities;

- Monitoring well development, purge, and decontamination water.

IDW will be containerized in 55-gallon drums. Soil and water drums generated during installation of the on-site soil borings and monitoring wells will be placed in a defined storage area onsite. The drums will be stored safely and securely, on temporary pads providing containment. The soil and groundwater drums will be filled to a maximum of 75% capacity to limit the weight of the drums for handling. The solid IDW materials in drums will be either removed from the drums and placed under the new landfill cap during the remediation activities or will be transported and disposed off-site at an approved facility. If transported off-site, the waste media (soil and groundwater) will have an approved waste profile established prior to transport and disposal. Upon arrival, the transporter will be provided with a signed waste manifest by the Parsons Field Team Leader. A copy of the manifest will be kept by Parsons for record-keeping purposes, while the original will be retained by the transporter. The drum(s) will be picked up and transported for off-site disposal at an approved landfill.

RISK ASSESSMENT

Both human health and ecological risk assessments will be conducted following completion of the remedial investigation tasks shown above. A complete baseline risk assessment is not needed, as the remedial investigation is assuming a presumptive remedy approach.

The sediment and surface soil samples described in the investigation tasks above will be used to support both the ecological and human health risk assessments.

Human Health Risk Assessment

The human health risk assessment will be streamlined because a presumed containment remedy will address migration pathways from the former landfill and eliminate direct contact exposure (see CSM figures). This approach is consistent with “Landfill Presumptive Remedy Saves Time and Cost,” (USEPA 540/F-96/017, September 1997).

Ecological Risk Assessment

Initially, a screening level ecological risk assessment (EPA-540-R-97-006, June 1997), will be undertaken. The focus will be on the southern wetlands area. The February 1991 Document “Conducting RI/FS for CERCLA Municipal Landfill Sites” also mentions that the risk assessment may be streamlined or qualitative based on the conceptual site model and RI-generated data.

WORKSHEET #18: SAMPLING LOCATIONS AND METHODS

Sampling methods are described in the Field Sampling Plan (FSP). Sampling locations are described in Worksheet #17 with associated analyses and methods listed below. Analytical laboratory SOPs attached.

Master Sampling Matrix – Sediment Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH
Southern Wetlands Investigation										
SD07	0 - 1	SED	X	X	X	X	X	X	X	X
SD07	1 - 2	SED	X	X	X	X	X	X	X	X
SD08	0 - 1	SED	X	X	X	X	X	X	X	X
SD08	1 - 2	SED	X	X	X	X	X	X	X	X
SD09	0 - 1	SED	X	X	X	X	X	X	X	X
SD09	1 - 2	SED	X	X	X	X	X	X	X	X
SD10	0 - 1	SED	X	X	X	X	X	X	X	X
SD10	1 - 2	SED	X	X	X	X	X	X	X	X
SD11	0 - 1	SED	X	X	X	X	X	X	X	X
SD11	1 - 2	SED	X	X	X	X	X	X	X	X
SD12	0 - 1	SED	X	X	X	X	X	X	X	X
SD12	1 - 2	SED	X	X	X	X	X	X	X	X
SD13	0 - 1	SED	X	X	X	X	X	X	X	X
SD13	1 - 2	SED	X	X	X	X	X	X	X	X
SD14	0 - 1	SED	X	X	X	X	X	X	X	X
SD14	1 - 2	SED	X	X	X	X	X	X	X	X
SD15	0 - 1	SED	X	X	X	X	X	X	X	X
SD15	1 - 2	SED	X	X	X	X	X	X	X	X
SD16	0 - 1	SED	X	X	X	X	X	X	X	X

Master Sampling Matrix – Sediment Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH
SD16	1 - 2	SED	X	X	X	X	X	X	X	X
SD17	0 - 1	SED	X	X	X	X	X	X	X	X
SD17	1 - 2	SED	X	X	X	X	X	X	X	X
SD18	0 - 1	SED	X	X	X	X	X	X	X	X
SD18	1 - 2	SED	X	X	X	X	X	X	X	X
SD19	0 - 1	SED	X	X	X	X	X	X	X	X
SD19	1 - 2	SED	X	X	X	X	X	X	X	X
SD20	0 - 1	SED	X	X	X	X	X	X	X	X
SD20	1 - 2	SED	X	X	X	X	X	X	X	X
SD20	2 - 5	SED				X				
SD21	0 - 1	SED	X	X	X	X	X	X	X	X
SD21	1 - 2	SED	X	X	X	X	X	X	X	X
SD21	2 - 5	SED				X				
Field Duplicate 1		SED	X	X	X	X	X	X	X	X
Field Duplicate 2		SED	X	X	X	X	X	X	X	X
Northern Pond Investigation										
SD22	0 - 1	SED	X	X	X	X	X	X	X	X
SD22	1 - 2	SED	X	X	X	X	X	X	X	X
SD23	0 - 1	SED	X	X	X	X	X	X	X	X
SD24	0 - 1	SED	X	X	X	X	X	X	X	X
SD25	0 - 1	SED	X	X	X	X	X	X	X	X
SD25	1 - 2	SED	X	X	X	X	X	X	X	X
SD26	0 - 1	SED	X	X	X	X	X	X	X	X
SD26	1 - 2	SED	X	X	X	X	X	X	X	X
SD27	0 - 1	SED	X	X	X	X	X	X	X	X

Master Sampling Matrix – Sediment Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH
SD27	1 - 2	SED	X	X	X	X	X	X	X	X
SD28	0 - 1	SED	X	X	X	X	X	X	X	X
SD28	1 - 2	SED	X	X	X	X	X	X	X	X
SD29	0 - 1	SED	X	X	X	X	X	X	X	X
SD29	1 - 2	SED	X	X	X	X	X	X	X	X
SD30	0 - 1	SED	X	X	X	X	X	X	X	X
SD30	1 - 2	SED	X	X	X	X	X	X	X	X
SD31	0 - 1	SED	X	X	X	X	X	X	X	X
SD31	1 - 2	SED	X	X	X	X	X	X	X	X
Field Duplicate 3		SED	X	X	X	X	X	X	X	X

Master Sampling Matrix – Groundwater Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6020A)	Mercury (7470A)	Cyanide (9010C/ 9014)	Field Parameters				
										pH	Conductivity	Dissolved Oxygen	Turbidity	Oxidation-Reduction Potential
Perimeter Groundwater Evaluation														
1) Direct Push*														
GP01	5-10 25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP02	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP03	5-10 25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP04	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP05	5-10 25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP06	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP07	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP08	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP09	5-10 25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP10	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP11	5-10 25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP12	5-10 25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP13	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP14	5-10 25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP15	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP16	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X

Master Sampling Matrix – Groundwater Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6020A)	Mercury (7470A)	Cyanide (9010C/ 9014)	Field Parameters				
										pH	Conductivity	Dissolved Oxygen	Turbidity	Oxidation-Reduction Potential
GP17	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP18	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP19	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP20	5-10 25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
GP21	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
Field Dup 4		GW	X	X	X	X	X	X	X	X	X	X	X	X
2) Monitoring Wells														
MW01	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW02	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW03	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW04	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW05	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW06	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW07	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW08	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW09	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW10	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
Field Dup 5		GW	X	X	X	X	X	X	X	X	X	X	X	X
Landfill Groundwater Evaluation **1) Monitoring Wells**														
MW11	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW12	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X
MW13	25-30	GW	X	X	X	X	X	X	X	X	X	X	X	X

Filtered and Unfiltered samples will be collected for Mercury, Cyanide, and Metals from monitoring wells.
Only filtered samples will be collected for Mercury, Cyanide, and Metals from direct push samples, as these may contain suspended sediment, biasing the results high.

Sampling Matrix – Surface Water Samples

Sample Location	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6020A)	Mercury (7470A)	Cyanide (9010C/ 9014)	Field Parameters				
									pH	Conductivity	Dissolved Oxygen	Turbidity	Oxidation-Reduction Potential
SWS01*	SW	X	X	X	X	X	X	X					
SW02	SW	X	X	X	X	X	X	X	X	X	X	X	X
SW03	SW	X	X	X	X	X	X	X	X	X	X	X	X
SW04	SW	X	X	X	X	X	X	X	X	X	X	X	X
SW05	SW	X	X	X	X	X	X	X	X	X	X	X	X
SW06	SW	X	X	X	X	X	X	X	X	X	X	X	X
SW07	SW	X	X	X	X	X	X	X	X	X	X	X	X
Field Dup 6	SW	X	X	X	X	X	X	X	X	X	X	X	X

* Surface water seeps sample (SWS01) will be collected if seepage is present. Presence of seepage will be determined by visual observation of water flowing at slopes of landfill. Flowing water will be collected directly into a clean canister or laboratory bottle, similar to surface water samples.

Master Sampling Matrix Soil Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH
Perimeter Groundwater Evaluation										
1) Monitoring Wells										
MW01	2 - 5	Soil	X	X	X	X	X	X	X	X
MW02	2 - 5	Soil	X	X	X	X	X	X	X	X
MW03	2 - 5	Soil	X	X	X	X	X	X	X	X
MW04	2 - 5	Soil	X	X	X	X	X	X	X	X
MW05	2 - 5	Soil	X	X	X	X	X	X	X	X
MW06	2 - 5	Soil	X	X	X	X	X	X	X	X
MW07	2 - 5	Soil	X	X	X	X	X	X	X	X
MW08	2 - 5	Soil	X	X	X	X	X	X	X	X
MW09	2 - 5	Soil	X	X	X	X	X	X	X	X
MW10	2 - 5	Soil	X	X	X	X	X	X	X	X
Field Dup 7		Soil	X	X	X	X	X	X	X	X
Landfill Evaluation										
1) Soil Borings										
SB01	Above water table	Soil	X	X	X	X	X	X	X	X
SB01	At water table	Soil	X	X	X	X	X	X	X	X
SB01	Terminus of boring	Soil	X	X	X	X	X	X	X	X
SB01		GW	X	X	X	X	X	X	X	X
SB02	Above water table	Soil	X	X	X	X	X	X	X	X

Master Sampling Matrix Soil Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH
SB02	At water table	Soil	X	X	X	X	X	X	X	X
SB02	Terminus of boring	Soil	X	X	X	X	X	X	X	X
SB02		GW	X	X	X	X	X	X	X	X
SB03	Above water table	Soil	X	X	X	X	X	X	X	X
SB03	At water table	Soil	X	X	X	X	X	X	X	X
SB03	Terminus of boring	Soil	X	X	X	X	X	X	X	X
SB03		GW	X	X	X	X	X	X	X	X
SB04	Above water table	Soil	X	X	X	X	X	X	X	X
SB04	At water table	Soil	X	X	X	X	X	X	X	X
SB04	Terminus of boring	Soil	X	X	X	X	X	X	X	X
SB04		GW	X	X	X	X	X	X	X	X
SB05	Above water table	Soil	X	X	X	X	X	X	X	X
SB05	At water table	Soil	X	X	X	X	X	X	X	X
SB05	Terminus of boring	Soil	X	X	X	X	X	X	X	X
SB05		GW	X	X	X	X	X	X	X	X
SB06	Above water table	Soil	X	X	X	X	X	X	X	X
SB06	At water table	Soil	X	X	X	X	X	X	X	X
SB06	Terminus of boring	Soil	X	X	X	X	X	X	X	X
SB06		GW	X	X	X	X	X	X	X	X

Master Sampling Matrix Soil Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH
Field Dup 11		Soil	X	X	X	X	X	X	X	X
Field Dup 12		GW	X	X	X	X	X	X	X	X

Master Sampling Matrix Surface Soil Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH	Asbestos (NIOSH 9002)
Perimeter Groundwater Evaluation											
1) Direct Push											
SS01	0-0.5	SS	X	X	X	X	X	X	X	X	
SS01	0.5-2	SS	X	X	X	X	X	X	X	X	
SS01	0-2	SS									X
SS02	0-0.5	SS	X	X	X	X	X	X	X	X	
SS02	0.5-2	SS	X	X	X	X	X	X	X	X	
SS02	0-2	SS									X
SS03	0-0.5	SS	X	X	X	X	X	X	X	X	
SS03	0.5-2	SS	X	X	X	X	X	X	X	X	
SS03	0-2	SS									X
SS04	0-0.5	SS	X	X	X	X	X	X	X	X	
SS04	0.5-2	SS	X	X	X	X	X	X	X	X	
SS04	0-2	SS									X
SS05	0-0.5	SS	X	X	X	X	X	X	X	X	

Master Sampling Matrix Surface Soil Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH	Asbestos (NIOSH 9002)
SS05	0.5-2	SS	X	X	X	X	X	X	X	X	
SS05	0-2	SS									X
SS06	0-0.5	SS	X	X	X	X	X	X	X	X	
SS06	0.5-2	SS	X	X	X	X	X	X	X	X	
SS06	0-2	SS									X
SS07	0-0.5	SS	X	X	X	X	X	X	X	X	
SS07	0.5-2	SS	X	X	X	X	X	X	X	X	
SS07	0-2	SS									X
SS08	0-0.5	SS	X	X	X	X	X	X	X	X	
SS08	0.5-2	SS	X	X	X	X	X	X	X	X	
SS08	0-2	SS									X
SS09	0-0.5	SS	X	X	X	X	X	X	X	X	
SS09	0.5-2	SS	X	X	X	X	X	X	X	X	
SS09	0-2	SS									X

Master Sampling Matrix Surface Soil Samples

Sample Location	Sample Depths (ft)	Matrix	VOC (8260B)	SVOC (8270D)	Pesticides (8081B)	PCB Aroclors (8082A)	Metals (6010C)	Mercury (7471B)	Cyanide (9010C/ 9014)	pH	Asbestos (NIOSH 9002)
SS10	0-0.5	SS	X	X	X	X	X	X	X	X	
SS10	0.5-2	SS	X	X	X	X	X	X	X	X	
SS10	0-2	SS									X
Field Dup 8		SS	X	X	X	X	X	X	X	X	X

Master Sampling Matrix Geotechnical Samples

Sample Location	Sample Depths (ft)	Matrix	Soil Classification (USCS): (D2487)	Moisture Content and Dry Density (D2216)	Bulk Density (D4292/ D2937)	Porosity, Water Filled Porosity and Air Filled Porosity[1]	Fraction Organic Carbon (D2974)	Specific Gravity	Atterburg Limits (ASTM D4318)	Shear Strength (ASTM D3080/ D2850)	Permeability (ASTM D5084)
Perimeter Groundwater Evaluation											
GP02	0 - 5	GT	X	X	X	X	X	X			
GP04	0 - 5	GT	X	X	X	X	X	X			
GP10	0 - 5	GT	X	X	X	X	X	X			
GP15	0 - 5	GT	X	X	X	X	X	X			
GP17	0 - 5	GT	X	X	X	X	X	X			
GP19	0 - 5	GT	X	X	X	X	X	X			
Landfill Evaluation											
GT01	0 - 2	GT						X	X	X	X
GT02	0 - 2	GT						X	X	X	X
GT03	0 - 2	GT						X	X	X	X
GT04	0 - 2	GT						X	X	X	X
GT05	0 - 2	GT						X	X	X	X
GT06	0 - 2	GT						X	X	X	X
GT07	0 - 2	GT						X	X	X	X
GT08	0 - 2	GT						X	X	X	X

[1] Calculated from moisture content (ASTM D2216) and/or dry density.

Master Sampling Matrix Geotechnical Samples

Sample Location	Sample Depths (ft)	Matrix	Soil Classification (USCS): (D2487)	Moisture Content and Dry Density (D2216)	Bulk Density (D4292/ D2937)	Porosity, Water Filled Porosity and Air Filled Porosity[1]	Fraction Organic Carbon (D2974)	Specific Gravity	Atterburg Limits (ASTM D4318)	Shear Strength (ASTM D3080/ D2850)	Permeability (ASTM D5084)
GT09	0 - 2	GT						X	X	X	X
GT10	0 - 2	GT						X	X	X	X
GT11	0 - 2	GT						X	X	X	X
GT12	0 - 2	GT						X	X	X	X

Master Sampling Matrix Air Samples

Sample Location	Matrix	Field Screening (VOCs/Methane)	VOC (TO-15)
Landfill Evaluation			
Existing Gas Vents (GV01 through GV14)[2]	Air	X	X
Field Duplicate 9	Air	X	X
Perimeter Gas Probes (AS01 through AS07)[3]	Air	X	X
Field Duplicate 10	Air	X	X
Downwind Ambient Air	Air	X	X

[2] Up to six (6) gas vents will be sampled for lab analysis for VOCs.
[3] Initially, two (2) perimeter probes will be analyzed, with remaining five (5) contingent upon the results of these two probes.

WORKSHEET #19/30: SAMPLE CONTAINERS, PRESERVATIONS, AND HOLD TIMES

Water Sample Containers, Preservation, and Holding Times

Analyte Group	Method/ SOP	NELAP Expiration Date	Container(s)	Preservation[a]	Holding Time[b]	Data Package Turn Around Time[b]
VOCs	8260B	4/30/2015 TAL CHI	2 x 40-ml glass vials with PTFE-lined septum caps	HCl to pH<2 Cool to 4±2°C	14 days	28 days
SVOCs Pesticides PCBs	8270D 8081B 8082A	4/30/2015 TAL CHI	2 1-Liter amber glass containers with Teflon-lined lid for **each analysis** (an additional 2 1-Liter containers required every 20 samples for MS/MSD for **each analysis**.)	Cool to 4±2°C	7 days for extraction 40 days for analysis	28 days
Metals (except Mercury)	6020A	4/30/2015 TAL CHI	1000 ml plastic bottle	Nitric Acid to pH<2. Cool to 4±2°C	6 months	28 days
Mercury	7470A	4/30/2015 TAL CHI	1000 ml plastic bottle	Nitric Acid to pH<2. Cool to 4±2°C	28 days	28 days
Cyanide	9010C/9014	4/30/2015 TAL CHI	1000 ml plastic bottle	NaOH to pH>12, plus 0.6 g Ascorbic Acid Cool to 4±2°C	14 days	28 days

[a]All samples to be preserved in ice during collection and transport.
[b]Days from date sampled.
TAL CHI = TestAmerica Laboratories Chicago.

Soil/Sediment Sample Containers, Preservation, and Holding Times

Analyte Group	Method / SOP	NELAP Expiration Date	Container(s)	Preservation[a]	Holding Time[b]	Data Package Turn Around Time[b]
VOCs	8260B	4/30/2015 TAL CHI	2 x 40-ml glass vials with PTFE-lined septum caps 1 x 2 oz jar for moisture	Cool to 4±2°C Sodium bisulfate, methanol (per Method 5035A)	14 days	28 days
SVOCs Pesticides PCBs as Aroclors	8270D 8081B 8082A	4/30/2015 TAL CHI	250-ml wide-mouth amber glass container with Teflon-lined lid. (2 additional 250-ml wide-mouth glass containers every 20 samples for MS/MSD).	Cool to 4±2°C	14 days for extraction 40 days for analysis (Soxhlet extraction must be completed within 14 days from date sampled.)	28 days
Metals (except Mercury)	6010C	4/30/2015 TAL CHI	250-ml wide-mouth plastic or glass container.	Cool to 4±2°C	6 months	28 days
Mercury	7471B	4/30/2015 TAL CHI	250-ml wide-mouth plastic or glass container.	Cool to 4±2°C	28 days	28 days
Cyanide	9010C/9014	4/30/2015 TAL CHI	250-ml wide-mouth plastic or glass container.	Cool to 4±2°C	14 days	28 days
Asbestos	NIOSH 9002	3/31/2015 EMSL	10 to 50-ml plastic or glass container.	None	Indefinite	28 days

[a]All samples to be preserved in ice during collection and transport.
[b]Days from date sampled.
TAL CHI = TestAmerica Laboratories Chicago.
EMSL = EMSL Analytical, Inc.

Air Sample Containers, Preservation, and Holding Times

Analysis	Method/SOP	NELAP Expiration Date	Container(s)	Preservation	Holding Time[a]	Data Package Turn Around Time[a]
VOCs	TO-15	6/30/2015 TAL KNO	Summa canister	Ambient	30 days	28 Days
Methane	ASTM D1946	6/30/2015 TAL KNO	Summa canister	Ambient	30 days	28 Days

[a]Days from date sampled.
TAL KNO = TestAmerica Laboratories Knoxville.

Analytical Services Table

Analytical Group	Matrix	Lab/Organization
VOC, SVOC, Pest, PCB, Metals, Mercury, Cyanide	Soil/Sediment, Aqueous	TestAmerica Laboratories, Chicago, IL Project Manager: Therese Hargraves
VOC, Methane	Air	TestAmerica Laboratories, Knoxville, TN
Asbestos	Soil/Sediment	EMSL Analytical, Inc., Chicago, IL
Soil Classification, Moisture Content, Dry Density, Bulk Density, Porosity, Fraction Organic Carbon, Atterberg Limits, Specific Gravity	Geotechnical	TestAmerica Laboratories, Burlington, VT
Shear Strength, Permeability	Geotechnical	GeoTesting Express, Acton, MA

TestAmerica Laboratories, Chicago, IL is the primary laboratory and will subcontract noted analyses to the listed laboratories. Therese Hargraves is the project manager and laboratory contact for all of the analyses.

WORKSHEET #20: FIELD QUALITY CONTROL SUMMARY

Field QC will be taken in accordance with the GDL Field Sampling Plan (FSP), 2014 at a minimum of 5% of field samples collected per matrix/analysis.

Field Quality Control Sample Summary

Matrix	Analyte / Analytical Group	Field Samples	FD	MS	MSD	FB	EB	TB	Total
Aqueous	VOCs	46	3	3	3	3	3	3	64
Aqueous	SVOCs	46	3	3	3	3	3	0	61
Aqueous	Pest	46	3	3	3	3	3	0	61
Aqueous	PCBs	46	3	3	3	3	3	0	61
Aqueous	Metals	46	3	3	3	3	3	0	61
Aqueous	Cyanide	46	3	3	3	3	3	0	61
Soil	VOCs	30	2	2	2	2	2	2	42
Soil	SVOCs	30	2	2	2	2	2	0	40
Soil	Pest	30	2	2	2	2	2	0	40
Soil	PCBs	30	2	2	2	2	2	0	40
Soil	Metals	30	2	2	2	2	2	0	40
Soil	Cyanide	30	2	2	2	2	2	0	40
Soil	Asbestos	10	1	1	1	1	1	0	15
Sediment	VOCs	48	3	3	3	3	3	3	66
Sediment	SVOCs	48	3	3	3	3	3	0	63

Field QC will be taken in accordance with the GDL Field Sampling Plan (FSP), 2014 at a minimum of 5% of field samples collected per matrix/analysis.

Field Quality Control Sample Summary

Matrix	Analyte / Analytical Group	Field Samples	FD	MS	MSD	FB	EB	TB	Total
Sediment	Pest	48	3	3	3	3	3	0	63
Sediment	PCBs	50	3	3	3	3	3	0	65
Sediment	Metals	48	3	3	3	3	3	0	63
Sediment	Cyanide	48	3	3	3	3	3	0	63
Air	Methane	22	2	0	0	2	2	2	30
Air	VOCs	22	2	0	0	2	2	2	30

FD = Field Duplicate
MS = Matrix Spike
MSD = Matrix Spike Duplicate
FB = Field Blank
EB = Equipment Blank
TB = Trip blank

WORKSHEET #21: FIELD SOPS

Field SOPs are documented in the GDL Field Sampling Plan, 2014.

Parsons Field SOP #	Title, Revision, Date, and URL (if available)	Originating Organization
1	Site Mobilization and Demobilization	Parsons
2	Heavy Equipment Decontamination	Parsons
3	Sampling Equipment Decontamination	Parsons
4	Brush Removal and Road Clearance	Parsons
5	Utility Location and Clearance	Parsons
6	Test Pit Installation	Parsons
7	Geotechnical Soil Sampling	Parsons
8	Soil Boring and Temporary Monitoring Well Installation	Parsons
9	Soil Sampling	Parsons
10	Monitoring Well Installation	Parsons
11	Well Development	Parsons
12	Low-Flow Purging and Groundwater Sampling	Parsons
13	Vertical Aquifer Profiling	Parsons
14	Surface Water Sampling	Parsons
15	Sediment Sampling	Parsons
16	Air Sampling	Parsons
17	Single-Well Well Aquifer Tests (Slug Tests)	Parsons
18	Land Surveying and Monitoring Wells Survey	Parsons
19	Sample Containers, Preservation, and Holding Times	Parsons
20	Sample Storage, Packaging, and Shipment	Parsons
21	Sample Control and Custody Procedures	Parsons
22	Investigation Derived Waste (IDW) Handling	Parsons

WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

The field equipment and instruments (other than analytical instrumentation) that require calibration, maintenance, testing, or inspection are summarized below.

General Field Equipment and Calibration Procedures

Instrument or Equipment	Description[a]	Field Calibration Procedure	Acceptability/ Performance Criteria	Responsible Personnel
Organic Vapor Meter (photo-ionization detector)	The PID is a portable, non-destructive trace gas analyzer. Units for site characterization must have a range of 0 to >2,000 ppm and a 10.6 or 11.7 eV lamp (e.g., MiniRAE 2000). Calibration check gas (e.g., isobutylene) must be provided with unit if field calibration is required.	In the field, PIDs will be calibrated at the start of each day if a significant change in weather occurs during the day (i.e., change in humidity or temperature) or if the unit is turned off for an extended period. When a PID is used to screen samples in the field, periodic ambient readings will also be recorded in the logbook. The calibration procedure is described in the instrument operations manual that must be supplied with each unit. Initial calibration must be verified by a certificate of calibration from the rental company or field calibration is required.	Meter must give consistent background readings.	Site Safety Officer, Project Geologist, Sampler

General Field Equipment and Calibration Procedures

Instrument or Equipment	Description[a]	Field Calibration Procedure	Acceptability/ Performance Criteria	Responsible Personnel
Landfill Gas Meter	The landfill gas analyzer is a portable, non-destructive trace gas analyzer. Measures flow and calculates the calorific values of the gas as well as being a useful tool for balancing the gas field. (e.g., GEM2000 plus, GEM5000). Measures CH4, CO2 , CO, H2S, and O2 percent by volume, static pressure and differential pressure. Calculates balance gas, flow (SCFM) and energy.	The gas analyzers can be checked against a known concentration of gas, to give confidence that the analyzer is operating as expected at the time and conditions in which it is being used. A field calibration should be performed if the ambient temperature changes by more than 20° Fahrenheit over the course of a monitoring since the last field calibration. It is recommended that the instrument is regularly serviced and calibrated by LANDTEC. Please refer to the instrument's calibration certificate for the last date of calibration. Zeroing of the gas analyzer should be undertaken at the start of each day's monitoring. If there is no historical data a good starting point for a daily monitoring round is performing a calibration daily at the beginning of a monitoring event. The calibration procedure is described in the instrument operations manual that must be supplied with each unit. Initial calibration must be verified by a certificate of calibration from the rental company or field calibration is required.	Meter must give consistent ambient air readings.	Site Safety Officer, Project Geologist, Sampler

General Field Equipment and Calibration Procedures

Instrument or Equipment	Description[a]	Field Calibration Procedure	Acceptability/ Performance Criteria	Responsible Personnel
pH, Conductivity, Dissolved Oxygen, Redox potential, Temperature Meter	QED Model MP20 meter or equivalent designed for field use with battery operation. The unit contains separate pH, temperature, and conductivity probes in one unit.	Before use, the pH, conductivity, dissolved oxygen (DO), and redox potential (ORP) probes need to be calibrated or tested for responsiveness. The pH probe will be calibrated first. This is done by placing the probe in standard solutions (pH 7 and then pH 4) and adjusting the pH calibration until the correct measurement is obtained. The ORP probe is then calibrated with the ORP standard solution (Zobell), the DO probe is calibrated with water-saturated air, and the calibration is checked with a zero DO solution (solution of 20 mL of deionized water, 20 ml of sodium sulfite, and a trace of cobalt chloride). The probes should be rinsed with deionized water between each calibration solution and following calibration. Used calibration solution is to be discarded. Finally, the conductivity probe is checked with a solution of known conductivity.	pH ± 0.01 pH Conductivity at ± 2% FSD The instrument will be checked with a pH standard every 4 hours and at the end of the sampling day. If the response is greater than 0.2 units more or less than the standard, complete calibration will be conducted.	Project Geologist, Sampler
Turbidity Meter	HACH 2100P Turbidity Meter or equivalent designed for field use with battery operation. Range 0.01 to 1,000 NTU.	The unit is factory-calibrated. Field procedures involve checking the unit's responsiveness at least once a day using factory-supplied standards. The responsiveness should be checked on the 0 to 10 range, 0 to 100 range, and 0 to 1,000 range.	Turbidity ± 10%	Sampler

[a] Description is for typical equipment; equivalent units may be used.

WORKSHEET #23: ANALYTICAL SOPS

The analytical SOPs are summarized below:

TAL SOP #	Title, Date	Matrix / Analytical Group	Equipment Type
UP-MV-8260 Rev. 25	Gas Chromatography Mass Spectrometry Volatiles SW846 8260B, 11/28/2014	Aqueous VOCs	GC/MS
UP-MV-8260 Rev. 25	Gas Chromatography Mass Spectrometry Volatiles SW846 8260B, 11/28/2014	Solid VOCs	GC/MS
UP-MB-8270D Rev. 06	Gas Chromatography / Mass Spectrometry Semi-Volatiles SW846 Method 8270D, 7/21/2014	Aqueous SVOCs	GC/MS
UP-MB-8270D Rev. 06	Gas Chromatography / Mass Spectrometry Semi-Volatiles SW846 Method 8270D, 7/21/2014	Solid SVOCs	GC/MS
UP-GE-8081 Rev. 17	Gas Chromatography Semivolatiles Pesticides by SW846 Method 8081A and 8081B, 9/24/2014	Aqueous Pesticides	GC/ECD
UP-GE-8081 Rev. 17	Gas Chromatography Semivolatiles Pesticides by SW846 Method 8081A and 8081B, 9/24/2014	Solid Pesticides	GC/ECD
UP-GE-8082 Rev. 17	Gas Chromatography Semivolatiles Analysis of PCBs by SW846 Method 8082 and 8082A, 9/26/2014	Aqueous PCBs	GC/ECD
UP-GE-8082 Rev. 17	Gas Chromatography Semivolatiles Analysis of PCBs by SW846 Method 8082 and 8082A, 9/26/2014	Solid PCBs	GC/ECD
UP-ME-6020 Rev. 08	Metals Analysis Inductively Coupled Argon Plasma / Mass Spectrometry by SW846 6020/6020A (Update IV), 6/3/2014	Aqueous Metals	ICP/MS
UP-ME-6010C Rev. 05	Metals Analysis Inductively Coupled Argon Plasma by SW846 6010C (Simultaneous Operation), 11/3/2014	Solid Metals	ICP
UP-ME-245.1 Rev. 20	Metals Analysis: Mercury by EPA Methods 245.1/245.5; SW846 7470A/7471A/7471B, 6/12/2014	Aqueous Mercury	CVAA
UP-ME-245.1 Rev. 20	Metals Analysis: Mercury by EPA Methods 245.1/245.5; SW846 7470A/7471A/7471B, 6/12/2014	Solid Mercury	CVAA
UP-WC-CN Rev. 26	Wet Chemistry Cyanide (Total / Weak Acid Dissociable / Amenable / Reactive), 11/28/2014	Aqueous Cyanide	UV Spectro-photometer
UP-WC-CN Rev. 26	Wet Chemistry Cyanide (Total / Weak Acid Dissociable / Amenable / Reactive), 11/28/2014	Solid Cyanide	UV Spectro-photometer

TAL SOP #	Title, Date	Matrix / Analytical Group	Equipment Type
UP-WC-pH Rev. 17	Wet Chemistry pH, 8/22/2014	Aqueous pH Soil pH	-
KNOX-MS-0001 Rev. 15	VOA Canister Analysis, 5/19/2014	Air VOCs	GC/MS
KNOX-GC-0003 Rev. 9	Permanent and Selected Gas Analysis by GC/TCD, 3/12/2014	Air Methane	GC/TCD
BR-GT-016 Rev. 7	Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216-05, method B), 2/14/2014	Soil Moisture Content	-
BR-GT-016 Rev. 7	Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216-05, method B), 2/14/2014	Soil Dry Density	-
BR-GT-018 Rev. 6	Density in Soils by Drive Cylinder Method (ASTM D2937-04), 7/28/2014	Soil Bulk Density	-
BR-GT-016 Rev. 7	Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216-05, method B), 2/14/2014	Porosity	-
BR-GT-019 Rev. 7	Moisture, Ash, & Organic Matter of Peat & Other Organic Soils (ASTM D2974-07a – Methods A & C), 11/14/2013	Fraction Organic Carbon	-
BR-GT-004 Rev. 7	Specific Gravity of Soil Solids by Water Pycnometer (ASTM Method D854-06 Method B), 5/13/2014	Specific Gravity	-
BR-GT-011 Rev. 7	Liquid Limit, Plastic Limit, & Plasticity of Soils (ASTM D4318-05), 7/16/2014	Atterburg Limits	-
BR-GT-013 Rev. 3	Classification of Soils for Engineering Purposes (ASTM D2487-06)	Soil Classification	-
GeoTesting SOP ASTM D2850 Rev. 4	Test Method for Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils, 9/2010	Sheer Stress	-
GeoTesting SOP ASTM D3080 Rev. 5	Standard Test Method for Direct Shear Test of Soils under Consolidated Drained Condition, 9/2010	Sheer Stress	-
GeoTesting SOP ASTM D5084 Rev. 7	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeater, 9/2010	Permeability	-

‡ A brief summary of project-specific SOP modifications must be provided on this worksheet or referenced.

WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION

Specific analytical instrument calibration procedures, including calibration range, frequency, acceptance criteria, and corrective action procedures are method specific and documented in detail in the referenced SOP(s).

Instrument	Activity	Responsible Person	SOP Reference
GC/MS	Tune, Initial Calibration, Continuing Calibration Verification	Lab Analyst / Lab Supervisor	UP-MV-8260 Rev. 25 UP-MB-8270D Rev. 06 KNOX-MS-0001 Rev. 15
GC/ECD	Initial Calibration, Continuing Calibration Verification	Lab Analyst / Lab Supervisor	UP-GE-8081 Rev. 17 UP-GE-8082 Rev. 17
GC/TCD	Initial Calibration, Continuing Calibration Verification	Lab Analyst / Lab Supervisor	KNOX-GC-0003 Rev. 9
ICP	Initial Calibration Verification, Continuing Calibration Verification	Lab Analyst / Lab Supervisor	UP-ME-6010C Rev. 05
ICP/MS	Initial Calibration Verification, Continuing Calibration Verification	Lab Analyst / Lab Supervisor	UP-ME-6020 Rev. 08
CVAA	Initial Calibration Verification, Continuing Calibration Verification	Lab Analyst / Lab Supervisor	UP-ME-245.1 Rev. 20
UV Spectro-photometer	Initial Calibration Verification, Continuing Calibration Verification	Lab Analyst / Lab Supervisor	UP-WC-CN Rev. 26

WORKSHEET #25: ANALYTICAL INSTRUMENT MAINTENANCE, TESTING, AND INSPECTION

TestAmerica Laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. The maintenance program is described in detail in Section 21 of the attached Laboratory Quality Management Plan.

Instrument/ Equipment	Maintenance Activity	Frequency	Title/position responsible for corrective action	Reference
Mercury Analyzer	Check tubing for Wear Fill rinse tank with 10% HCl Fill reductant bottle with 10% Stannous Chloride	Daily Daily Daily	Lab Analyst	TAL Quality Management Plan (QMP)
ICP	Check pump tubing Check fluid level in waste container Check torch Check sample spray chamber for debris Check nebulizer Check entrance slit for debris Check/Refill recirculator	Daily Daily Daily Monthly Monthly Yearly Monthly	Lab Analyst Lab Analyst Lab Analyst Lab Analyst Lab Analyst Service Rep. Lab Analyst	TAL QMP
ICP MS	Check pump tubing Change pump tubing Check torch Check/clean nebulizer Clean cones Check air filters Check multiplier voltages & do cross calibration Check/change vacuum pump oil Check chiller water level/refill	Daily As required Weekly As required As required As required Weekly Monthly Monthly	Lab Analyst	TAL QMP

Instrument/ Equipment	Maintenance Activity	Frequency	Title/position responsible for corrective action	Reference
UV-Vis Spectro-photometer	Clean ambient flow cell Precision check/alignment of flow cell Wavelength verification check	As required As required Annually	Lab Analyst	TAL QMP
Auto Analyzers	Clean sampler Check all tubing Clean inside of colorimeter Clean pump well and pump rollers Clean wash fluid receptacle Clean optics and cells	As required	Lab Analyst	TAL QMP
HP / Agilient GC/MS	Pump oil-level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment Change multiplier Change filaments	Monthly Annually As Required As Required As Required As Required As Required	Lab Analyst	TAL QMP
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check temp. of detector, inlet, column oven Septum replacement Check system for gas leaks (with SNOOP-MS VOA) Check for loose/frayed wires and insulation Bake injector/column Change/remove sections of guard column Replace connectors/liners	Daily Daily As Required w/ cylinder change & as required As Required As Required As Required As Required	Lab Analyst	TAL QMP

Instrument/ Equipment	Maintenance Activity	Frequency	Title/position responsible for corrective action	Reference
	Change/replace column(s)	As Required		
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As Required	Lab Analyst	TAL QMP
Flame Ionization Detector (FID)	Detector cleaning	As Required	Lab Analyst	TAL QMP
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change frit Filter all samples Change autosampler rotor/stator	As Required As Required Semi-annually or as required As Required As Required Daily As Required	Lab Analyst	TAL QMP
Autosamplers (GC/MS Volatiles & GC Volatiles)	Check lines Change filters Replace Needles Check Gaskets Re-calibrate Replace Sensors	As Required	Lab Analyst	TAL QMP
Autosamplers (GC/MS Semivolatiles)	Replace syringe	As Required	Lab Analyst	TAL QMP
Concentrators (GC/MS Volatiles & GC Volatiles)	Change Trap Replace Lines	As Required	Lab Analyst	TAL QMP
Balances	Class 1 traceable weight check	Daily, when used	Lab Analyst	TAL QMP

Instrument/ Equipment	Maintenance Activity	Frequency	Title/position responsible for corrective action	Reference
	Clean pan and check if level Field service	Daily, when used At least Annually		
Conductivity Meter	KCl calibration Conductivity cell cleaning	Daily, applicable standards As Required	Lab Analyst	TAL QMP
Turbidimeter	Check light bulb	Daily, when used	Lab Analyst	TAL QMP
Deionized/ Distilled Water	Conductivity Point Sources Daily conductivity check Check deionizer light Monitor for VOA's System cleaning Replace cartridge & large mixed bed resins	As Required Daily Daily As Required As Required As Required	Lab Analyst	Water Quality SOP *UP-QA-035* TAL QMP
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required	Lab Analyst	TAL QMP
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As Required	Lab Analyst/ Sample Custodian	TAL QMP
Vacuum Pumps/ Air Compressor	Lubricate	As Required	Lab Analyst	TAL QMP
pH/ Specific Ion Meter	Calibration/check slope Clean electrode	Daily As Required	Lab Analyst	TAL QMP
BOD Incubator	Temperature monitoring Coil and incubator cleaning	Continuous As Required	Lab Analyst	TAL QMP
Centrifuge	None	Service as Required	Lab Analyst	TAL QMP
Water baths	Temperature monitoring Water replaced	Daily As Needed	Lab Analyst	TAL QMP

WORKSHEET #26/27: SAMPLE HANDLING, CUSTODY, AND DISPOSAL

This section identifies components of the project-specific sample handling system. All field samples will be disposed by the subcontract laboratory according to their internal procedures. Samples must be stored at the laboratory for a minimum of 30 days after the final report is submitted to a maximum of 90 days after the final report is submitted. Procedures for sample collection, labeling, containers, preservation, holding times, handling, packaging, and chain of custody are described in Parsons SOP No. 20.

SAMPLE COLLECTION

Site-specific investigation methodologies; sample types, numbers, and locations; and chemical constituents are identified in the Gary Development Work Plan and Parsons Field Sampling Plan (FSP).

In general, sampling at a site will progress from clean areas to contaminated areas. This minimizes the potential for cross-contamination of samples and, subsequently, eliminates data anomalies or misinterpretation of the extent of contamination.

The remainder of this section describes typical procedures for handling sample containers, preservatives, holding times, packing, and shipping. Overall, the field Team Leader will be responsible for ensuring correct methods are employed, documenting any problem and verifying required corrective actions. The Project Manager will approve corrective actions, in consultation with client personnel, if appropriate.

SAMPLE CONTAINERS

The volumes and containers required for sampling activities are indicated in Worksheet #19/30. Prewashed sample containers will be provided by the laboratory and will be wide-mouth jars with Teflon-lined caps unless otherwise indicated. The laboratory must use an approved specialty container supplier, which prepares containers in accordance with USEPA bottle-washing procedures. The laboratory must maintain a record of all sample bottle lot numbers shipped in the event of a contamination problem. Trip blanks will be transported to the site inside the same box as volatile organic analysis (VOA) vials. Any containers purchased for field analysis also will be from an approved supplier.

SAMPLE PRESERVATION AND HOLDING TIMES

All samples requiring preservation will be either collected in containers shipped from the laboratory pre-preserved or will be preserved in the field immediately after collection

and transported to the site office. A clean, disposable pipette or a premeasured, single-use, glass ampule will be used to transfer liquid preservatives to the sample container. Care will be taken to avoid contact between the pipette or ampule and the sample or sample container. Solid preservatives will be transferred to the sample container using a clean, stainless-steel spoon. If the laboratory supplies pre-preserved bottles, the samples will be carefully transferred to the container to avoid any loss of preservative.

After preservation, the sample will be gently shaken to mix the preservative and a small amount of the sample will be poured into a clean cup and tested with pH paper to determine if a sufficient amount of preservative has been used. The amount of preservative necessary to adjust the sample pH will be recorded. Field blanks, which require preservation, will be preserved with a volume of reagent equal to the volume of reagent used in the samples that the blanks represent. A list of preservatives and holding times for each type of analysis are indicated in Worksheet #19/30. Additional preservation requirements and holding times for non-target analyses are listed in 40 Code of Federal Regulations (CFR), Part 136, July 5, 1987.

Reagents used for preservation are reagent-grade and are supplied by the laboratory. The laboratory must maintain traceability records on preservatives in the event of potential field contamination of samples. Each bottle is received from the laboratory and must be clearly labeled with laboratory name, type of chemical, lot number, and expiration date. Field personnel should record the date used in the field, site name, and project number on the label or in the site logbook. Fresh sample preservatives will be obtained from laboratory stocks prior to mobilization for each sampling event. Preservatives stored on-site will be disposed of after use as noted above unless containers are sealed and stored under chain-of-custody in a secure area. No preservatives will be used past the expiration date.

Sample preservation will be verified at the laboratory at receipt or prior to analysis for VOCs. The preservation or pH will be recorded in the logbook. If samples are improperly preserved, a corrective action form will be submitted to the laboratory project manager for follow-up action. The laboratory will notify the Field Team Leader or Project Manager to implement corrective action in the field.

SAMPLE HANDLING

The transportation and handling of samples must be accomplished in a manner that not only protects the integrity of samples but also prevents any detrimental effects due to the possible hazardous nature of the samples. Regulations for packaging, marking, labeling, and shipping of hazardous materials are promulgated by the DOT in 49 CFR 171 through 177. Staff responsible for the shipment of samples will be trained in these regulations.

SAMPLE PACKAGING

Samples must be packaged carefully to avoid breakage or contamination and must be shipped to the laboratory at proper temperatures. The following sample packaging requirements will be followed:

- Sample bottle lids must never be mixed. All sample lids must stay with their original containers;
- Shipping coolers must be partially filled with packing materials and ice (when required) to prevent bottles from moving and breaking during shipping;
- Environmental samples are to be cooled. Wet ice packaged in sealable, plastic bags will be used to cool samples during shipping. Ice is not to be used as a substitute for packing materials;
- Any remaining space in the cooler should be filled with inert packing material such as bubble wrap. Under no circumstances should material such as sawdust or sand be used;
- A duplicate custody record must be placed in a plastic bag and taped to the inside of the cooler lid. Custody seals are affixed to the sample cooler; and
- All containers for a given sample will be shipped in the same cooler when possible. In cases where samples for volatile analysis would be shipped in several coolers on a single day, VOA vials will be consolidated into a single cooler to minimize the number of required trip blanks.

SHIPPING CONTAINERS

Environmental samples will be properly packaged and labeled for transport and dispatched to the laboratory facility. The SOP procedure will be followed to mark and label sample shipments. A separate chain-of-custody record must be prepared for each shipping container. The following requirements for shipping containers will be followed.

Sample shipping containers will generally be commercially purchased coolers (e.g., Coleman coolers). Each container will be custody-sealed for shipment as appropriate. The container custody seal will consist of filament tape wrapped around the package at least twice and custody seals affixed in such a way that access to the container can be gained only by cutting the filament tape and breaking a seal.

Field personnel will make arrangements for transportation of samples to the laboratory. In most cases, samples will be shipped using an overnight express carrier (e.g., Federal Express). Field personnel will provide the laboratory with a shipment schedule and notify them of deviations from planned activities. The field personnel will notify the laboratory of all of samples intended for Saturday delivery, no later than 3 p.m. (Eastern Standard Time) on Thursday.

A signed copy of the original COC will be emailed to the RSCC (Regional Sample Control Coordinator) at EPA Region 5: layne.warren@epa.gov.

Sampling Organization: Parsons
Laboratory: TestAmerica Laboratories
Method of sample delivery (shipper/carrier): TestAmerica courier
Number of days from reporting until sample disposal: 30 Days minimum/ 90 Days maximum for all matrices and analyses.

Sample Handling

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	Parsons Field Team Leader Florin Savin	SOP No. 20
Chain-of-custody form completion	Parsons Field Team Leader Florin Savin	SOP No. 20
Packaging	Parsons Field Team Leader Florin Savin	SOP No. 20
Shipping coordination	Parsons Field Team Leader Florin Savin	SOP No. 20
Sample receipt, inspection, & log-in	TestAmerica Laboratories (TAL) Sample Custodian	SOP No. 20; TAL QMP
Sample custody and storage	TestAmerica Laboratories (TAL) Sample Custodian	SOP No. 20; TAL QMP
Sample disposal	TestAmerica Laboratories (TAL) Sample Custodian	TAL QMP

An example Chain of Custody form, sample identification tag, custody seals, and laboratory sample receipt forms are in Section 24 of the attached TAL QMP.

WORKSHEET #28: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION

The QC sample criteria that will be used to perform off-site analysis are listed below. QAPP Worksheet #20 - Field Quality Control Sample Summary provides an overview of the field QC sample frequency. General project data quality indicators are highlighted below:

- Precision – Field duplicates will be collected to assess overall precision. The precision of the data is not critical for data usability. General criteria of 30% RPD for waters or air and 50% RPD for soils/sediment will be applied.
- Accuracy – Laboratory matrix spike/ matrix spike duplicates (MS/MSDs) will be used to assess accuracy. The primary data concern is to ensure analytical bias will not produce false negatives and that all potential contamination is accounted for in the baseline, performance, and long-term monitoring. Specific site contaminants need to be in the MS and should be within laboratory control limits.
- Representativeness – Data need to be representative of the areas of potential contamination at the site. Trip and laboratory blanks will be used to assess field and laboratory background. No project contaminants should be present.
- Completeness – A completeness objective of 90% is set for all samples except the site contaminants. The site contaminants have a completeness objective of 95%.
- Comparability – The ability to effectively compare data with historical results and clean-up criteria is important. Data need to be generated from the same analytical methods and have the same reporting limits. The ability to compare data with specific guidance values is critical for evaluating baseline, performance, and long-term monitoring data.

The following table is a general overview of the QC acceptance criteria.

Analytical QC and Corrective Action

Volatiles (8260B) Aqueous/Soil						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per batch of 20 or less.	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL.	Investigate source of contamination. Rerun method blank prior to analysis of samples if possible. Evaluate the samples and associated QC: if blank results are above QL, report sample results which are < QL or > 10X the blank concentration. Reanalyze blank and samples >QL and < 10X the blank.	Analyst, Laboratory Department Manager, and Data Validator	Bias/Contamination	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL
Surrogate	Every sample.	Laboratory statistically derived control limits.	If sample volume available, and within hold time reanalyze.	Analyst, Laboratory Department Manager and Data Validator	Accuracy/Bias	Laboratory statistically derived control limits.
Laboratory Control Sample (LCS)	One per batch of 20 or less.	Laboratory statistically derived control limits.	Evaluate and reanalyze if possible. If an MS/MSD was performed in the same 12-hour clock and is acceptable, narrate. If the LCS recoveries are high but the sample results are <QL, narrate; otherwise, re-prepare and reanalyze	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.

Analytical QC and Corrective Action

Volatiles (8260B) Aqueous/Soil						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Internal Standard	Every sample.	Retention times for internal standards must be ± 30 seconds and the responses within -50% to +100% of last calibration verification (12 hours) for each internal standard.	Inspect mass spectrometer or gas chromatograph for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Retention times for internal standards must be ± 30 seconds and the responses within -50% to +100% of last calibration verification (12 hours) for each internal standard.
Matrix Spike/ Matrix Spike Duplicate (MS/ MSD)	One per sample delivery group (SDG) or every 20 samples.	Laboratory statistically derived control limits. .	Corrective actions will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD are unacceptable, re-prepare the samples and QC.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.

Analytical QC and Corrective Action						
Semivolatiles (8270D) Aqueous/Soil						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per batch of 20 or less.	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL.	Investigate source of contamination. Rerun method blank prior to analysis of samples if possible. Evaluate the samples and associated QC: if blank results are above QL, report sample results which are < QL or > 10X the blank concentration. Reanalyze blank and samples >QL and < 10X the blank.	Analyst, Laboratory Department Manager, and Data Validator	Bias/Contamination	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL
Surrogate	Every sample.	Laboratory statistically derived control limits.	If sample volume available, and within hold time reanalyze.	Analyst, Laboratory Department Manager and Data Validator	Accuracy/Bias	Laboratory statistically derived control limits.
Laboratory Control Sample (LCS)	One per batch of 20 or less.	Laboratory statistically derived control limits.	Evaluate and reanalyze if possible. If an MS/MSD was performed in the same 12-hour clock and is acceptable, narrate. If the LCS recoveries are high but the sample results are <QL, narrate; otherwise, re-prepare and reanalyze	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.

Analytical QC and Corrective Action						
Semivolatiles (8270D) Aqueous/Soil						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Internal Standard	Every sample.	Retention times for internal standards must be ± 30 seconds and the responses within -50% to +100% of last calibration verification (12 hours) for each internal standard.	Inspect mass spectrometer or gas chromatograph for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Retention times for internal standards must be ± 30 seconds and the responses within -50% to +100% of last calibration verification (12 hours) for each internal standard.
Matrix Spike/ Matrix Spike Duplicate (MS/ MSD)	One per sample delivery group (SDG) or every 20 samples.	Laboratory statistically derived control limits.	Corrective actions will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD are unacceptable, re-prepare the samples and QC.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.

Analytical QC and Corrective Action						
Pesticides (8081B) Aqueous/Soil						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per batch of 20 or less.	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL.	Investigate source of contamination. Rerun method blank prior to analysis of samples if possible. Evaluate the samples and associated QC: if blank results are above QL, report sample results which are < QL or > 10X the blank concentration. Reanalyze blank and samples >QL and < 10X the blank.	Analyst, Laboratory Department Manager, and Data Validator	Bias/Contamination	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL
Surrogate	Every sample.	Laboratory statistically derived control limits.	If sample volume available, and within hold time reanalyze.	Analyst, Laboratory Department Manager and Data Validator	Accuracy/Bias	Laboratory statistically derived control limits.
Laboratory Control Sample (LCS)	One per batch of 20 or less.	Laboratory statistically derived control limits.	Evaluate and reanalyze if possible. If an MS/MSD was performed in the same 12-hour clock and is acceptable, narrate. If the LCS recoveries are high but the sample results are <QL, narrate; otherwise, re-prepare and reanalyze	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.

Analytical QC and Corrective Action						
Pesticides (8081B) Aqueous/Soil						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Matrix Spike/ Matrix Spike Duplicate (MS/ MSD)	One per sample delivery group (SDG) or every 20 samples.	Laboratory statistically derived control limits.	Corrective actions will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD are unacceptable, re-prepare the samples and QC.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.

Analytical QC and Corrective Action						
PCBs (8082A) Aqueous/Soil						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per batch of 20 or less.	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL.	Investigate source of contamination. Rerun method blank prior to analysis of samples if possible. Evaluate the samples and associated QC: if blank results are above QL, report sample results which are < QL or > 10X the blank concentration. Reanalyze blank and samples >QL and < 10X the blank.	Analyst, Laboratory Department Manager, and Data Validator	Bias/Contamination	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL
Surrogate	Every sample.	Laboratory statistically derived control limits.	If sample volume available, and within hold time reanalyze.	Analyst, Laboratory Department Manager and Data Validator	Accuracy/Bias	Laboratory statistically derived control limits.
Laboratory Control Sample (LCS)	One per batch of 20 or less.	Laboratory statistically derived control limits.	Evaluate and reanalyze if possible. If an MS/MSD was performed in the same 12-hour clock and is acceptable, narrate. If the LCS recoveries are high but the sample results are <QL, narrate; otherwise, re-prepare and reanalyze	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.
Matrix Spike/ Matrix Spike Duplicate (MS/ MSD)	One per sample delivery group (SDG) or every 20 samples.	Laboratory statistically derived control limits.	Corrective actions will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD are unacceptable, re-prepare the samples and QC.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.

Analytical QC and Corrective Action						
Metals (6020A), Mercury (7470A/7471B), Cyanide (9010C/9014) Aqueous/Soil						
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per batch of 20 or less.	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL.	Investigate source of contamination. Rerun method blank prior to analysis of samples if possible. Evaluate the samples and associated QC: if blank results are above QL, report sample results which are < QL or > 10X the blank concentration. Reanalyze blank and samples >QL and < 10X the blank.	Analyst, Laboratory Department Manager, and Data Validator	Bias/Contamination	No target compounds should be > ½ the QL except common lab contaminants, which should be, no target compounds should be > the QL
Laboratory Control Sample (LCS)	One per batch of 20 or less.	Laboratory statistically derived control limits.	Evaluate and reanalyze if possible. If the LCS recoveries are high but the sample results are <QL, narrate; otherwise, re-prepare and reanalyze	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.
Duplicate	One per sample delivery group (SDG) or every 20 samples.	Laboratory statistically derived control limits.		Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/Bias	Laboratory statistically derived control limits.
Spike	One per sample delivery group (SDG) or every 20 samples.	Laboratory statistically derived control limits.		Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Laboratory statistically derived control limits.

WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS

Project Documents and Records

Record	Generation	Verification	Storage location/archival
Field logbook	Field Task Leader	Project Manager	Project File
Daily Field Reports	Field Task Leader	Project Manager	Project File
Chain-of-Custody Forms	Field Task Leader	Project Manager	Project File
Air Bills	Field Task Leader	Project Manager	Laboratory Report
Contractor Daily QC Reports	Field Task Leader	Project Manager	Project File
Deviations	Field Task Leader	Project Manager	Project File
Corrective Action Reports	Field Task Leader	Project Manager	Project File
Correspondence	Field Task Leader	Project Manager	Project File
Sample Receipt Report	Lab Analyst	Lab Manager	Laboratory Report
Completed Chain of Custody	Lab Analyst	Lab Manager	Laboratory Report
Laboratory Report	Lab Analyst	Lab Manager	PDF file
Data Summary Reports	Parsons Data Manager	Parsons QA Chemist	Project File
Electronic Data	Lab Information Systems Specialist	Lab Manager	Project File
Raw Instrument Data	Lab Analyst	Lab Manager	Laboratory Report
Data Review Checklist	QA Chemist	Lead QA Chemist	Project File
Data Review Summary Reports	QA Chemist	Lead QA Chemist	Project Files
Data Usability Summary	Lead QA Chemist	Project Manager	Project File

Note: Project files will be maintained electronically on a Microsoft SharePoint Portal or similar system.

WORKSHEET #31/32/33: ASSESSMENTS AND CORRECTIVE ACTION

Assessments and Corrective Action

Assessment Type	Responsible Party & Organization	Number/ Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Readiness Review	Parsons PM	One assessment one week prior to mobilization	TBD	Readiness Review Memorandum and Checklist	48 hours following assessment
Field Inspection and Audit	Parsons PM	One each on first day of soil, biota, and groundwater sampling episodes	TBD	Audit Checklist and Report	48 hours following assessment
Project-specific PT samples	Parsons Project Chemist	One sample per medium sampled for organics and metals	Three weeks prior to start of field sampling	PT Deficiency Report	48 hours following receipt of PT results
Management Review	Parsons PM and QA Chemist	Interim Management Review following site mobilization. Final management review upon completion of field work.	TBD	QA Management Report	48 hours following Management Review

WORKSHEET #34: DATA VERIFICATION AND VALIDATION INPUTS

The following worksheet describes the data verification process.

Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	**X**	
2	Contract	**X**	
4	Field SOPs	**X**	
5	Laboratory SOPs	**X**	
Field Records			
6	Field logbooks	**X**	**X**
7	Equipment calibration records	**X**	**X**
8	Chain-of-Custody Forms	**X**	**X**
9	Sampling diagrams/surveys	**X**	**X**
10	Drilling logs	**X**	**X**
11	Geophysics reports	**X**	**X**
12	Relevant Correspondence	**X**	**X**
13	Change orders/deviations	**X**	**X**
14	Field audit reports	**X**	**X**
15	Field corrective action reports	**X**	**X**
Analytical Data Package			
16	Cover sheet (laboratory identifying information)	**X**	**X**
17	Case narrative	**X**	**X**
18	Internal laboratory chain-of-custody	**X**	**X**
19	Sample receipt records	**X**	**X**
20	Sample chronology (i.e. dates and times of receipt, preparation, & analysis)	**X**	**X**
21	Communication records	**X**	**X**
22	Project-specific PT sample results	**X**	**X**
23	LOD/LOQ establishment and verification	**X**	**X**
24	Standards Traceability	**X**	**X**
25	Instrument calibration records	**X**	**X**
26	Definition of laboratory qualifiers	**X**	**X**
27	Results reporting forms	**X**	**X**
28	QC sample results	**X**	**X**

Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications)
29	Corrective action reports	**X**	**X**
30	Raw data	**X**	**X**
31	Electronic data deliverable	**X**	**X**

WORKSHEET #35: DATA VERIFICATION PROCEDURES

This worksheet documents procedures that will be used to verify project data.

Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field logbook	QAPP, Field SOP No. 20	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed and results are documented.	Daily - Project Manager At conclusion of field activities - Project QA Manager
Chain-of-custody forms	QAPP, Field SOP No. 20	Verify the completeness of chain-of-custody records. Examine entries for consistency with the field logbook. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Daily - Field Crew Chief At conclusion of field activities - Project Chemist
Laboratory Deliverable	QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the CoCs to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Before release – Laboratory QAM Upon receipt - Project Chemist

Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Audit Reports, Corrective Action Reports	QAPP	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	Project QAM

WORKSHEET #36: DATA VALIDATION PROCEDURES

This worksheet documents procedures that will be used to validate project data.

Data Validator: Parsons Chemist

Data Validation Procedures

Analytical Group/Method:	**VOCs, SVOCs, PAHs, PCBs**	**Metals, Mercury, Inorganics**
Data deliverable requirements:	SEDD Stage 3	SEDD Stage 3
Analytical specifications:	Table 18.1	Table 18.1
Measurement performance criteria:	Tables 8.1, 8.2, 8.3	Tables 8.1, 8.2, 8.3
Percent of data packages to be validated:	100%	100%
Percent of raw data reviewed:	10%	10%
Percent of results to be recalculated:	10%	10%
Validation procedure:	EPA Contract Laboratory Program National Functional Guidelines for Organic Methods Data Review	EPA Contract Laboratory Program National Functional Guidelines For Inorganic Methods Data Review
Validation code (*see attached table):	S3VEM	SV3EM
Electronic validation program/version:	EPA Reg 5 Equis EDD v3	EPA Reg 5 Equis EDD v3

Validation Code and Label Identifier Table

Validation Code*	Validation Label	Description/Reference
S1VE	Stage 1 Validation Electronic	EPA 540-R-08-005
S1VM	Stage 1 Validation Manual	
S1VEM	Stage 1 Validation Electronic and Manual	
S2aVE	Stage 2a Validation Electronic	
S2aVM	Stage 2a Validation Manual	
S2aVEM	Stage 2a Validation Electronic and Manual	
S2bVE	Stage 2b Validation Electronic	
S2bVM	Stage 2b Validation Manual	
S2bVEM	Stage 2b Validation Electronic and Manual	
S3VE	Stage 3 Validation Electronic	
S3VM	Stage 3 Validation Manual	
S3VEM	Stage 3 Validation Electronic and Manual	
S4VE	Stage 4 Validation Electronic	
S4VM	Stage 4 Validation Manual	
S4VEM	Stage 4 Validation Electronic and Manual	
NV	Not Validated	

The following data qualifiers will be applied during data validation by a third party. Potential impacts on project-specific data quality objectives will be discussed in the data validation report.

Data Qualifiers and Definitions

Data Qualifier	Definition
U	The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
J	The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value is the estimated concentration in the sample.
UJ	The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
R	The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
C	The target Pesticide or Aroclor analyte identification has been confirmed by Gas Chromatograph/Mass Spectrometer (GC/MS).
X	The target Pesticide or Aroclor analyte identification was not confirmed when GC/MS analysis was performed.
NM	Measurement Performance Criteria contained in Section 8 were not met.

WORKSHEET #37: DATA USABILITY ASSESSMENT

This worksheet documents procedures that will be used to perform the data usability assessment.

The following personnel will be responsible for participating in the data usability assessment:

Parsons Project Manager
Parsons Quality Assurance Manager
Risk Assessor
Parsons Geologist/Hydrogeologist
Parsons Project Chemist
Parsons Field Task Leader
Statistician

The EEEPC and Parsons Project Chemists will work with the final users of the data in performing data quality assessments. The data quality assessment may include some or all the following steps:

- Data that are determined to be incomplete or not usable for the project will be discussed with the project team. If critical data points are involved that impact the ability to complete the project objectives, the data users will report immediately to the Project Manager. The Project Manager will discuss the resolution of the issue with USACE technical staff and implement the necessary corrective actions (for example, re-sampling);

- Data that are non-detect but have reporting limits elevated due to blank contamination or matrix interference will be compared with screening values. If reporting limits exceed the screening values, then the results will be handled as incomplete data as described above;

- Data that are qualified as estimated will be used for all project decision-making. If an estimated result is close to a screening value, then there is uncertainty in any conclusions as to whether the result exceeds the screening value. The data user must evaluate the potential uncertainty in developing recommendations for the site. If estimated results become critical data points in making final decisions on the site, the Project Manager and USACE technical staff should evaluate the use of the results and may consider the data point incomplete.

The assessment process involves comparing analytical results with screening values and background concentrations to determine whether the contamination present is site-related (i.e., above background levels) or significant (i.e., above screening values).

Usability Assessment Process Flow

Step 1	**Review the project's objectives and sampling design** The project team will review the sampling design for consistency with the project objectives. Data that is incomplete or not usable for the project will be evaluated by the team in order to determine the impact on meeting project objectives. In the event that critical data points necessary for meeting project objectives are incomplete, the Project Manager will be consulted for implementation of the necessary corrective actions.
Step 2	**Review the data verification and data validation outputs** The project team will review available QA reports, including the data verification and data validation reports. The project team will summarize the data and look for patterns, trends, and anomalies. The team will review deviations from planned activities and determine their impacts on data usability. They will evaluate implications of unacceptable QC sample results.
Step 3	**Document data usability and draw conclusions** The project team in conjunction with the Project Manager will determine if the data can be used as intended, considering implications of deviations and corrective actions. The team will discuss data quality indicators and assess the performance of the sampling design. They will identify limitations on data usage and update the conceptual site model as needed. The project team will document conclusions and prepare the data usability summary report.

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APPENDIX 1: FIGURES FROM GDL WORKPLAN

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INTRODUCTION

The Field Sampling Plan (FSP) for the Gary Development Landfill Superfund Site (Site) provides detailed procedures related to the collection and analysis of environmental samples, and other field activities to be conducted during the remedial investigation.

The focus of the investigation will be outside the presumed limits of the landfill area. The field program will be based in part on the previously completed investigations, and will include collection of subsurface soil, surface soil, sediment, surface water, gas samples, and groundwater samples. It will also include physical, ecological, and wetland area surveys. This work is intended to characterize the chemical and physical characteristics of the Site, and define impacts outside the landfill area. The direct push borings will be used to collect groundwater samples and to facilitate selection of the monitoring well locations. The landfill limits will be delineated by installation of test pits. Gas sampling will evaluate concentrations of specific airborne chemicals for current conditions within the existing landfill vents, and in areas outside the landfill.

Site preparation tasks will include the following:

- Access agreements
- Onsite building evaluation (SOP No. 1)
- Brush hog/clear roads/sampling paths (SOP No. 1, SOP No. 2, SOP No. 4)
- Scrap metal and debris removal (SOP No. 1, SOP No. 2)
- Underground utility location (SOP No. 1, SOP No. 5)
- Access control/fencing
- Topographic survey (SOP NO. 1, SOP No. 18)
- Onsite well inventory (SOP No. 1)

Data acquisition efforts will include the following:

Southern Wetlands

- Wetland delineation (SOP No. 1)
- Sediment sampling:SD07 through SD21 (SOP No. 1, SOP No. 3, SOP No. 15, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)

Perimeter Groundwater

- Water well survey (SOP No. 1, SOP No. 18)
- Groundwater sampling from direct push: GP01 through GP21 (SOP No. 1, SOP No. 3, SOP No. 8, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)
- Groundwater vertical profiling: GP01, GP03, GP05, GP08, GP09, GP11, GP12, GP13, GP14, and GP20 (SOP No. 1, SOP No. 3, SOP No. 12, SOP No. 13, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)
- Monitoring well installation and development: MW01 through MW10 (SOP No. 1, SOP No. 2, SOP No. 3, SOP No. 10, SOP No. 11)
- Surface soil samples:SS01 through SS10 (SOP No. 1, SOP No. 3, SOP No. 9, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)
- Soil samples: MW01 through MW10 (SOP No. 1, SOP No. 2, SOP No. 3, SOP No. 9, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)

- Geotechnical samples: GP02, GP04, GP10, GP15, GP17, and GP19 (SOP No. 1, SOP No. 2, SOP No. 3, SOP No. 7, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)
- Hydrogeological evaluation: Groundwater Flow and Slug (SOP No. 1, SOP No. 17)

Landfill Evaluation

- Geotechnical samples: GT01 through GT12 (SOP No. 1, SOP No. 2, SOP No. 3, SOP No. 7, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)
- Waste boundary evaluation with 25 to 30 test pits (SOP No. 1, SOP No. 2, SOP No. 3, SOP No. 6)
- Interior Landfill Investigation samples: SB-01 (MW), SB-02, SB-03 (MW), SB-04, SB-05, SB-06 (SOP No. 1, SOP No. 2, SOP No. 3, SOP No. 9, SOP No. 10, SOP No. 11, SOP No. 12, SOP No. 18, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)
- Air sampling from gas vents (GV01 through GV14) and additional air monitoring AS01 through AS07 (SOP No. 1, SOP No. 3, SOP No. 16, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)

Northern Pond Investigation

- Ecological survey and characterization (SOP No. 1)
- Surface water sampling: SW02 through SW07 (SOP No. 1, SOP No. 3, SOP No. 14, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)
- Sediment samples: SD22 through SD31 (SOP No. 1, SOP No. 3, SOP No. 15, SOP No. 19, SOP No. 20, SOP No. 21, SOP No. 22)

The soil, sediment, surface soil, surface water, and groundwater samples will be analyzed for VOCs, SVOCs, PCBs, metals, mercury, cyanide, pesticides, and pH. In addition, one composite surface soil sample at each location will be analyzed for asbestos.

The geotechnical samples collected from perimeter will be tested for: Soil Classification by United Soil Classification System, Moisture Content, Dry Density, Bulk Density, Porosity, Water Filled Porosity and Air Filled Porosity, Fraction Organic Carbon, and Specific Gravity. The geotechnical samples collected from landfill will be tested for: Atterberg Limits, Shear Stress, Specific Gravity, and Permeability.

The air samples will be screened for methane and VOCs and sample for VOCs (EPA method TO-15).

This FSP was developed to implement the remedy developed in the RIFS. The sampling and analysis activities described herein will be conducted in accordance with the QAPP and HASP.

STANDARD OPERATING PROCEDURE NO. 1
SITE MOBILIZATION AND DEMOBILIZATION

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 1 describes the guidelines for mobilization and demobilization of personnel and equipment during field activities as specified in the Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS

Mobilization and demobilization of personnel and equipment will be documented, as needed, to verify that proper procedures are followed.

3.0 MOBILIZATION ACTIVITIES

Prior to the commencement of on-site activities, the following arrangements will be made:

A. Notification requirements of work activities, in accordance with access agreements, will be coordinated by Parsons personnel. Access agreements are in place for the Site and with AMG Resources Corporation (AMG) for ingress/egress, along the southern boundary of the Site.;

B. A staging and decontamination area for equipment will be arranged; and

C. If applicable, underground utilities will be marked and utility maps obtained.

4.0 DEMOBILIZATION ACTIVITIES

After all activities are complete, the Site will be restored to pre-work conditions, under Parsons personnel supervision, to the extent possible. Demobilization will also include the removal and proper disposal of all drummed waste, removal of Parsons equipment, laboratory coolers and bottles, and other clean-up items as needed.

STANDARD OPERATING PROCEDURE NO. 2
HEAVY EQUIPMENT DECONTAMINATION

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 2 describes the guidelines for decontaminating drill rigs and other heavy equipment, as needed during field activities and specified in the Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS

Procedures for decontamination of field personnel are addressed in the Health and Safety Plan (HASP), or as listed below.

3.0 SITE FACILITIES AND SUPPLIES

3.1 Site Selection

A. The equipment decontamination pad will be in an area where contaminants can be controlled. The location will also be selected to prevent equipment from being exposed to additional or other contamination.

B. Due to the potential volume of wastewater generated, the equipment decontamination area will be located where decontamination fluids can be easily discharged into adequate storage containers, followed by characterization, and proper disposal based on the characterization to an approved disposal facility.

C. The decontamination area will have adequate area for storing unused drums, drums containing spent decontamination fluids and waste, and trash containers, until such time as they can be relocated or disposed offsite.

3.2 Water Supply

A. Large volumes of water, often exceeding 1,000 gallons per day, may be required for cleaning, especially for drill rigs and other large equipment. The water used for equipment decontamination will be clean, potable water; municipal water supplies are generally adequate.

B. Stainless steel tank trucks or plastic tanks can be used for on-site storage of the water supply.

C. Water may also be stored in open-top, watertight tanks or roll-off boxes located in the clean zone on the site. However, open-top tanks or box containers will not be used if airborne contaminants are present, unless a liner is used to cover the container. Only containers used to store fresh water or inert materials will be used. Never use containers previously used to store petroleum products or organic chemicals.

3.3 Cleaning Equipment and Supplies

A. A portable steam cleaner will be used to clean contaminated heavy machinery (e.g., drill rig, backhoe, etc.) as well as associated tools.

B. Miscellaneous items required for decontamination efforts include the following:

1) Potable water supply
2) Decontamination solution
   a) Potable water
   b) Distilled water
   c) Mild detergent (such as Alconox)
   d) Isopropanol
3) Brushes to remove heavy mud, dust, etc.
4) Buckets
5) Steam cleaner or high-pressure, hot water washer
6) Racks (normally metal, not wood) to hold miscellaneous equipment such as drill rods, sampling tools, etc.
7) Utility pump to collect fluids for containerizing
8) Drums to store contaminated materials (personal protective equipment, etc.)
9) Tables (not wood) to hold small items after/during cleaning
10) Plastic sheeting to wrap decontaminated equipment, racks, tools, etc., after cleaning.

4.0 EQUIPMENT AND VEHICLE DECONTAMINATION PROCEDURES

A. The following procedures are presented as a function of the level of contaminant concentration and are intended as general guidelines. Appropriate site procedures will be established based on the individual site characteristics and type of investigation prescribed.

B. Low to Moderate Contaminant Concentration (<10 ppm):

1) Steam or water rinse with potable water to remove mud or dirt
2) Steam or hot water washes with a mixture of detergent and potable water
3) Steam or hot water rinse with clean, potable water
4) Air dry

C. High Contaminant Concentration (> 10 ppm):

1) Steam rinse with potable water to remove mud or dirt.
2) Steam wash with a mixture of detergent and potable water or other type of decontamination solution.
3) Steam rinse with clean, potable water.
4) Air dry.

D. Generally, decontamination can be limited to the back portion of the drill rig and those parts that come in direct contact with samples or casing, or drilling equipment placed into or over the borehole. Extra care will be given during decontamination of downhole drilling equipment and accessories, drill rods, and drill bits (particularly roller bits), as well as couplings and threads.

E. Some drilling equipment items cannot typically be decontaminated; these include wood materials (planks, etc.), porous hoses, engine air filters, etc. These items will not be removed from the site until ready to dispose in an appropriate manner. Other drilling equipment (especially rotary drill rigs) that requires extensive decontamination includes water or grout pumps. Flushing may be sufficient to clean them. However, if high concentrations of constituents or visible product are known to exist, then disassembly and thorough cleaning of internal parts are required before removal of the equipment from the site.

F. The mud pumps, kelly, swivel, and suction hoses on rotary drill rigs should be cleaned by circulating a minimum of 1,000 gallons of clean water and cleaning solution through the system followed by a minimum of 200 gallons of clean water through the system, and finally rinsing with 50 gallons of clean water without recirculating the fluid.

STANDARD OPERATING PROCEDURE NO. 3
SAMPLING EQUIPMENT DECONTAMINATION

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 3 describes the guidelines for decontaminating of sampling equipment.

2.0 GENERAL REQUIREMENTS

A. Procedures for decontamination of field personnel will be specifically addressed in the Health and Safety Plan (HASP).

B. Decontamination activities will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 SAMPLING EQUIPMENT DECONTAMINATION PROCEDURES

A. All sampling equipment that may contribute to the contamination of a sample will be thoroughly decontaminated before its initial use, unless specific documentation exists that the sampling equipment has been decontaminated.

B. Generally, sampling equipment can be cleaned by hand. Delicate equipment, such as the submersible pump, will be cleaned by hand. The following procedure is given as a typical sequence that will be modified based on site conditions.

C. Other sampling equipment that can be cleaned by hand will be decontaminated as follows:

1) Wash and scrub with detergent (non-ionic)
2) Tap water rinse
3) DI water rinse
4) Isopropanol rinse
5) Air dry

D. Steel tapes, water probes, transducers, thermometers, and water quality meters will be rinsed in distilled water or cleaned in a detergent solution and rinsed in DI water after each use.

E. Pumps will be cleaned in water/detergent solution, followed by a tap water rinse, and flushed with DI water after each use.

F. Use of high-pressure steam or hot water washing may be substituted for hand scrubbing if it effectively removes contaminants and soil and can be done safely without burning or contaminating the personnel. Special racks will be used to hold equipment during high-pressure washing. High-pressure washing will not be conducted on delicate equipment.

G. More “complicated” samplers require more “complicated” decontamination procedures.

Piston and other samplers with numerous internal parts should be avoided.

H. To the extent possible, sample tubing shall be either dedicated to a particular well/location or disposed after each use. Tubing that cannot be dedicated to a particular well/location or disposed shall be cleaned in water/detergent solution, followed by a tap water rinse, followed by a DI water rinse. Sufficient rinse water shall be used to flush out all the wash water and tap water rinse.

I. Sampling and downhole equipment that has come into contact with non-aqueous phase liquids (NAPLs) or high concentration dissolved-phase contaminants (10 ppm range VOCs) will also undergo a rinse with isopropanol to ensure removal of organics. The decontamination steps for high concentration organics are:

1) Wash and scrub with detergent (non-ionic)
2) Tap water rinse
3) Isopropanol rinse
4) DI water rinse.
5) Air dry

4.0 WELL MATERIALS DECONTAMINATION PROCEDURES

Well-casing materials not received in their original packaging, whether constructed of PVC, carbon or low carbon steel, or other materials, will be cleaned with a steam cleaner or high-pressure hot-water washer before they are installed. Well construction materials will be handled while wearing clean gloves.

STANDARD OPERATING PROCEDURE NO. 4
BRUSH REMOVAL AND ROAD CLEARANCE

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 4 describes the guidelines for brush removal and road clearance.

2.0 GENERAL REQUIREMENTS

A. Procedures for brush removal will be specifically addressed in the Health and Safety Plan (HASP).

B. Brush removal will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Brush Hog
- Personnel protective equipment (PPE) in accordance with the Project Safety Plan (face mask, strong durable work clothing, shirts should be long sleeved, ear protection, etc…)

4.0 PROCEDURES METHODS

A. Ensure that personnel are not disturbing wildlife habitat, including nests and nesting areas, or removing endangered plants.

B. Employees will be properly trained before attempting to do any work with a Brush Hog.

C. Thoroughly inspect the brush hog every morning before each shifts starts.

D. Before starting the work:

- Make sure other staff members are kept at least 30 feet from the active brush cutter.
- Clear the work area of stones, sticks, wires, and other objects that could be flung up object at high speed by the clearing equipment.
- The rotation blade or cutting cord can cause serious injuries if comes in contact with face, hands, or legs.

E. To start the brush cutter:

- Place the brush cutter on firm ground.
- Clear any obstructions, especially near the front of the cutting blade.
- Place one hand on the machine and operate the starter with the other hand.

F. Don’t let your attention slip while using the brush cutter. Make sure to keep a firm grip on the machine with both hands and keep the cutting blade away from body. Make sure that safety harness fits so that your shoulders, arms, and hands are relaxed and the back is straight.

STANDARD OPERATING PROCEDURE NO. 5
UTILITY LOCATION AND CLEARANCE

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 5 describes the guidelines for utility location and clearance. Before beginning any intrusive subsurface activities the boring location must be cleared of above ground and underground utilities. Both public and privately owned utilities must be marked.

2.0 GENERAL REQUIREMENTS

A. Procedures for utility location and clearance will be specifically addressed in the Health and Safety Plan (HASP).

B. Utility location and clearance will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

C. The clearance will follow Parsons safety requirements as stated in the Health and Safety Plan (HASP).

3.0 PROCEDURES METHODS

3.1 Utility Location

Generally, the following steps will be conducted:

A. Contact the “Indiana 811” if working within the right-of-way or public areas served by such services. For work on private property or in areas not served by such services, utilize a reputable private utility locating company to locate and mark the utilities. Note that Indiana 811 can provide valuable information regarding locations and types of utilities entering the private property, even when not marking the actual intrusive work area.

B. Use of a private utility locator is encouraged for all projects with subsurface or submarine utility issues. The private utility locating service will be equipped to use electro-magnetic sensing, ground penetrating radar (GPR) and a detectable pipe snake/camera to locate metallic and non-metallic underground utilities.

C. In situations where the State Call system or equivalent service does not cover the area of proposed intrusive activities, then an additional line of evidence is required. The additional line of evidence should be pertinent to the area of intrusive activities.

D. Use detailed scaled site utility plans, preferably in the form of an “as-built” or “record” drawing, to identify and/or confirm utility locations. Document request and/or receipt of utility drawings from the property owner/client.

E. Conduct a detailed visual site inspection to identify and/or confirm utility locations. For underground utilities, conduct an inspection for structures that tend to indicate the presence and general location of such utilities, including, but

not limited to manholes, vaults, valve covers, valve markers, telephone, relief valves, backflow preventers, meters, downspouts going into the subsurface, power poles with wiring going into the subsurface and line markers. Saw cut lines and concrete /asphalt repairs often yield valuable information regarding utility locations. Discuss the presence of utilities with the site owner, operator and/or occupant to identify any potential utilities that might not be readily identified by non-intrusive clearing methods.

If one of the above lines of evidence cannot be utilized, or if using the above lines of evidence does not adequately identify utilities with reasonable certainty, one or more additional lines of evidence must be utilized.

3.2 Color Codes Used For Utility Marking

The following colors are used for marking utilities. Some government agencies or large industrial facilities may use additional colors not provided below. Parsons policy is to assume any paint marking or pin flag color not provided below is a subsurface utility marking until proven otherwise.

Red	electric power lines, cables, conduit, and lighting cables
Orange	telecommunication, alarm or signal lines, cables, or conduit
Yellow	natural gas, oil, steam, petroleum, or other gaseous or flammable material
Green	sewers and drain lines
Blue	drinking water
Purple	reclaimed water, irrigation, and slurry lines
Pink	temporary survey markings, unknown/unidentified facilities
White	proposed excavation limits or route

3.3 Clearance Methods

The following clearance methods are listed for invasive work:

- vacuum air knifing
- probing, and
- hand auguring/digging.

Manual clearing methods (e.g. shoveling, pick axes, digging bars) should be avoided completely or only used when absolutely necessary.

Surface cover (e.g., asphalt) removal methods that pose excessive down force such as Jack hammering, coring, and saw cutting should be used with extreme caution.

STANDARD OPERATING PROCEDURE NO. 6
TEST PIT INSTALLATION

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 6 describes the guidelines for test pits installation for the landfill delineation.

2.0 GENERAL REQUIREMENTS

A. Procedures for test pit installation will be specifically addressed in the Health and Safety Plan (HASP).

B. Test pit installation will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Tracked backhoe
- Small dozer
- Surveying stakes
- Digital camera
- Global Positioning System (GPS)
- Field notebook
- Personnel protective equipment (PPE) in accordance with the Project Safety Plan

4.0 PROCEDURES METHODS

A. Prior to sampling, the surficial organic layer material will be removed.

B. Approximately 25 to 30 test pits will be installed at approximately 200 foot interval. Each test pit will start between 10 and 50 feet from the visual limit of the landfill.

C. In areas with dense vegetative cover, a small dozer will be used to access the test pit location. A tracked backhoe will be used to remove natural soils from the excavation.

D. The boundaries of the proposed test pits will be surveyed and staked prior to excavation.

E. A sketch of the test pit will be recorded in the field notebook. Field notes and observations will also be recorded in the field notebook.

F. Digital photographs of each test pit will be collected to record the visual data obtained. The photographs will be identified by test pit number.

G. At this time, soil samples may not be collected from potential test pits.

H. The test pits will not exceed beyond 5-6 feet in depth.

I. The excavation will then be backfilled with the natural soils that were removed from the test pit. A small dozer will be used to compact the excavated material.

J. The tracked backhoe will be decontaminated between each test pit.

K. The test pit boundaries and sample locations will be staked or flagged upon completion, then surveyed.

STANDARD OPERATING PROCEDURE NO. 7
GEOTECHNICAL SOIL SAMPLING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 7 describes the methods used for the geotechnical sampling.

2.0 GENERAL REQUIREMENTS

A. Procedures for geotechnical sampling will be specifically addressed in the Health and Safety Plan (HASP).

B. Geotechnical sampling will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Field book and project plans
- Shelby Tubes
- Sample jars
- Tape measure
- Decon supplies
- Explosimeter
- Tape
- Coolers and ice
- Shipping supplies
- Personnel protective equipment (PPE) in accordance with the Project Safety Plan

4.0 PROCEDURES METHODS

A. Soil borings will be advanced at locations proposed in the Field Sampling Plan (FSP) after clearing potential underground utilities. Extra care will be taken to clear utilities in the proposed geotechnical soil boring locations because hand augering (or other soft dig methods) will compromise geotechnical data.

B. In order to collect intact geotechnical samples and geotechnical data, Shelby Tubes will need to be advanced within the first five feet of each borehole instead of using a hand auger.

C. Geotechnical samples may be collected using Shelby Tubes samplers, which consist of a connector head and a 2 or 3-inch ID; 30-inch or 36-inch long, thin-wall steel, aluminum, brass or stainless steel tube, or soil sample jars. The standard practice for collecting Shelby Tube samples is to place the sampler at the end of the drill rods. The sampler and rods are lowered to the bottom of the borehole. The weight of the drill rig is used to drive the sampler into the ground (ASTM D1587, 1993).

D. Shelby Tube samplers will be sealed with wax, a plastic end cap, and tape to prevent moisture from escaping from the intact soil sample.

E. In locations where a full size drill rig cannot access sampling locations, alternative methods such as a smaller direct push rig or manual slide hammer driver will be used to drive the Shelby Tube sampler into the ground.

F. Geotechnical samples will be collected at locations and depth intervals as described in the FSP.

G. Geotechnical samples may also be collected in a laboratory soil sample jar or bucket. Soil will be placed in an appropriately sized laboratory-grade jar or bucket without preservative.

H. Care shall be taken to ensure that the Shelby tube is driven into native soil free of roots and organic materials. Bulk soil samples will also be free of roots and organic materials.

I. Shelby Tube samplers will be kept vertical and vibrations will be kept at a minimum between sampling and delivery to the laboratory.

J. Chain-of-custody procedures will be followed.

K. The sampling equipment will be decontaminated between samples in accordance with procedures described in SOPs 2 and 3.The sample locations, descriptions, and depths will be recorded in the field book.

STANDARD OPERATING PROCEDURE NO. 8
SOIL BORING AND TEMPORARY MONITORING WELL INSTALLATION

1.0 PURPOSE OF PROCEDURE

This Standard Operating Procedure (SOP) No. 8 describes the guidelines for the installation of soil borings and temporary monitoring wells as described in the RI/FS Work Plan, or as otherwise specified. Monitoring wells are installed to determine depth to groundwater, monitor fluctuations in groundwater elevation, and obtain groundwater samples for laboratory analysis.

2.0 GENERAL REQUIREMENTS

A. Procedures for soil borings and temporary monitoring well installation will be specifically addressed in the Health and Safety Plan (HASP).

B. Soil borings and temporary monitoring wells installation will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 BOREHOLE ADVANCEMENT

3.1 General

A. Boreholes used to install monitoring wells/soil borings will be drilled with the following objectives:

- To provide geological data on subsurface conditions, namely stratigraphy, occurrence of groundwater, and depth to bedrock (if present).
- To obtain representative disturbed or undisturbed samples for identification and laboratory testing.

B. Prior to drilling, the following steps must be taken by Parsons personnel and subcontractors:

- If necessary, obtain permits from the appropriate state agency or agencies.
- Notify (verbally or in writing) the appropriate state authorities in advance of the date that drilling is scheduled to begin.
- Check for buried utility lines at all planned drilling locations, following Parsons protocols. For reasons of safety and liability, no drill hole will be advanced if this step has not been completed.
- Prepare and implement an approved Project Site Health and Safety Plan, adhering to all of its provisions for protection of the field crew.
- Make provisions for disposal of all cuttings and discharge water in accordance with regulations. Permits may be required.
- A field geologist/hydrogeologist will be present onsite during drilling.

3.2 Selection of Drilling Method

Drilling methods will be limited to hand auguring or vacuum extraction (through overburden) and direct-push technology methods.

3.3 Geologic Logging Method

A. Soil samples retrieved from the borehole will be visually described for:

- percent recovery
- soil type
- color
- moisture content
- texture
- grain size and shape
- consistency
- visible evidence of staining, and
- any other observations.

The descriptions will be in accordance with the Unified Soil Classification System (USCS).

B Soil samples will be immediately screened for the presence of organic vapors with a photoionization detector (PID).

C. Soil samples will be collected from the Geoprobe sleeve, split-spoon sampler, or other sampling tools (i.e., for surface soil samples) at the soil boring location. For samples being analyzed for VOCs, a portion of the soil sample (5 grams) will be collected with a Terra Core® coring tool, or equivalent device, provided by the laboratory, and immediately placed in multiple laboratory-cleaned and preservative-prepared 40mL glass vials with PTFE faced silicone septa (per Section 6.0 of Method 5035A, July 2002). Preservatives will include sodium bisulfate, methanol, and an unpreserved vial (for the determination of moisture content). This methodology is consistent with USEPA Method 5035A for sample collection. Laboratory analysis for VOCs will be conducted by USEPA Method 8260. Additional sample will be provided as required for QC analyses. For all other analyses, samples will be placed in jars as prepared and provided by the laboratory.

D. Jars, as prepared and provided by the laboratory will be filled with soil and placed in a cooler on ice for possible laboratory analysis.

E. All drilling equipment will be decontaminated between each boring in accordance with methods specified in SOP No. 3.

F. The field geologist will log borehole geology and headspace measurements in the field book and the Boring/Well Log.

4.0 TEMPORARY MONITORING WELL INSTALLATION

4.1 General Requirements

A. Well construction procedures will meet regulatory agency requirements.

B. A geologist/hydrogeologist will be present during well installation to document the subsurface stratigraphy and construction details for each well.

C. The well designs will meet two basic criteria:

- groundwater must move freely into the well, and
- vertical migration of surface water or undesired groundwater to the well intake zone must, to the extent possible, be eliminated.

D. Factors that influence the location of wells will be considered and include the following:

- Objectives of the RI/FS Work Plan.
- Location of potential source area or potential groundwater plume to be monitored.
- Hydraulic gradients.
- Location of aboveground and underground utilities and manmade features.
- Accessibility to desired areas.

4.2 Well Installation Materials Selection

A. PVC well casing are available in threaded or unthreaded sections and typically in lengths of 5, 10, and 20 feet. Threaded pipe joints may be wrapped with Teflon tape to facilitate joining and to improve the seal. Sections of casing will be assembled onsite to allow inspection immediately before installation. No solvents or adhesive compounds will be used on the threaded PVC pipe.

B. Well materials will be new and factory-clean before well installation. Drive point samplers, if used, will be decontaminated between samples. Decontamination procedures are presented in SOP No 3.

4.3 Monitoring Well Installation/Construction Specifications

A. Wells will be constructed with 1-inch, ID piping with flush-threaded couplings. The well risers will be constructed of PVC. Well screens, whose lengths will be determined by field conditions, will also be constructed of PVC with continuously slotted 0.010-inch openings.

B. The annulus around the screens will be filled with silica sand pack (20/40 silica sand or equivalent) to prevent the hole from collapsing and to prevent the well screen from becoming clogged with fine particles in the saturated strata.

C. A bentonite pellet or slurry seal with a minimum thickness of 2 feet will be placed in the annular space directly above the sand packs and allowed to settle.

D. The remainder of the annular space from the top of the bentonite seal to grade level shall be filled with neat-cement grout containing no more than 5 percent bentonite by weight. The grout will be allowed to set for a minimum of 24 hours before wells are developed.

E. The top of each well riser will be fitted with a secure cover to prevent the introduction of materials into the screened interval of the well.

F. Wells will be constructed with a riser pipe extending above the ground surface. Guard posts will be placed if there is the potential for vehicular traffic to damage the well.

G. To divert run-off water away from the well, a minimum 1-foot diameter concrete seal or pad will be installed at the ground surface around each of the monitoring wells. The pad will be sloped away from the well. The concrete pad will be deep enough to allow the well to remain stable during ground freeze and thaw.

H. Well construction details will be recorded in the field logbook.

The temporary/permanent monitoring wells will be installed in the same location as the soil borings. Refer to Figure 1 for direct push boring profile.

5.0 SOIL BORING INSTALLATION

5.1 Soil Boring Installation/Construction Specifications

A. The direct-push soil probe, or Geoprobe® technique is a method of drilling/soil sampling in which the sampling tool, or drive-point sampler, is driven down to the sampling depth using a hydraulic probe. The hydraulic probe is usually mounted onto the bed of a pick-up truck or similar vehicle. In probing configuration, the hydraulic hammer swings up to a vertical position and is controlled from the rear of the pick-up by the operator. The drive-point sampler is driven with approximately 15,000 to 40,000 pounds of downward force by the hydraulic hammer.

B. A disposable (i.e., acetate or Teflon®) tube liner will be fitted within the barrel of the sampling tool prior to it being pushed into the ground. After a sample is collected from the required subsurface interval, the sample tool will be hydraulically retrieved to the ground surface, and the Teflon® tube liner containing the soil core sample will be removed from the core barrel and placed on a clean surface (such as clean polypropylene sheeting). The liner will then be cut with a clean, decontaminated utility knife to allow for the collection of soil samples.

C. During the advancement of soil borings, existing cover materials will be segregated and set aside for restoration. When sampling is completed, each direct push boring will be backfilled with spoils. For cover soil borings, the surface soils will be mixed with powdered or granular bentonite and then replaced in order to avoid the possibility of creating pathways for infiltration in boring locations.

6.0 DOCUMENTATION

A. Documentation of monitoring well/soil boring installation in the field logbook will be the responsibility of the supervising geologist/hydrogeologist.

B. The drilling and well installation activities will be recorded in the field logbook and/or on appropriate forms. The following minimum information will be recorded during and upon completion of every well installation.

- Project name and number
- Well location identification
- Date of installation and time completed
- Drilling methods, crew names, and rig identification

- Drilling depths
- Generalized subsurface stratigraphy
- Total length of casing
- Depth to water and/or product
- Depth to and length of open interval
- Depth to and length of the screened interval, filter pack, and bentonite seal, if applicable
- Depth to top of grout
- Depth of surface casing (if necessary)
- Name of supervising geologist/hydrogeologist

STANDARD OPERATING PROCEDURE NO. 9
SOIL SAMPLING

1.0 PURPOSE OF PROCEDURE

This Standard Operating Procedure (SOP) No. 9 describes the guidelines for the soil sampling as described in the RI/FS Work Plan, or as otherwise specified.

2.0 GENERAL REQUIREMENTS

A. Procedures for soil sampling will be specifically addressed in the Health and Safety Plan (HASP).

B. Soil sampling will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Field book and project plans
- Personal protective equipment in accordance with the HASP
- Marker stakes, flagging, and paint
- Stainless steel hand tools (trowel, spoon, hand auger)
- Stainless steel bowl
- Soil sample containers
- Tape measure
- Decon supplies
- Water level indicator
- Tape
- Sample bottles
- Coolers and ice
- Shipping supplies

3.0 SAMPLING AND LOGGING PROCEDURES

3.1 Selection of Drilling Method

A. Drilling methods will be limited to hand auguring or vacuum extraction (through overburden, 4 feet below ground surface) and direct-push technology methods. Direct push soil sampling will start at 4 feet below ground surface and will utilize 4-foot long disposable acetate liners in a macro-core steel sampling rod with a steel cutting shoe driven by a direct push sampling rig.

B. The sampling tools will be decontaminated (as described in SOP 3) between each sampling interval.

3.2 Geologic Logging Method

A. Soil samples retrieved from the borehole will be visually described for:

- percent recovery

- soil type
- color
- moisture content
- texture
- grain size and shape
- consistency
- visible evidence of staining, and
- any other observations.

The descriptions will be in accordance with the Unified Soil Classification System (USCS).

B Soil samples will be immediately screened for the presence of organic vapors with a photoionization detector (PID).

C. Soil samples will be collected from the Geoprobe sleeve, split-spoon sampler, or other sampling tools (i.e., for surface soil samples) at the soil boring location. For samples being analyzed for VOCs, a portion of the soil sample (5 grams) will be collected with a Terra Core® coring tool, or equivalent device, provided by the laboratory, and immediately placed in multiple laboratory-cleaned and preservative-prepared 40mL glass vials with PTFE faced silicone septa (per Section 6.0 of Method 5035A, July 2002). Preservatives will include sodium bisulfate, methanol, and an unpreserved vial (for the determination of moisture content). This methodology is consistent with USEPA Method 5035A for sample collection. Laboratory analysis for VOCs will be conducted by USEPA Method 8260. Additional sample will be provided as required for QC analyses. For all other analyses, samples will be placed in jars as prepared and provided by the laboratory.

D. Soil samples collected from monitoring wells will be analyzed for multiple analytes. However, some sampling preparation requires special sampling containers such as a Terra Core® sample kit or equivalent device (method 5035A). If the soil is too stiff (tight clay), hard (coarse gravel or fill), or soft (saturated, loose soil), the soil may be collected using preparation method 5030 (clean glass jar supplied by laboratory).

E. To collect a Terra Core® sample:

- Step 1 - Have ready a 40ml glass VOA vial containing the appropriate preservative. With the plunger seated in the handle, push the Terra Core® into freshly exposed soil until the sample chamber is filled. A filled chamber will deliver approximately 5 or 10 grams of soil.
- Step 2 - Wipe all soil or debris from the outside of the Terra Core® sampler. The soil plug should be flush with the mouth of the sampler. Remove any excess soil that extends beyond the mouth of the sampler.
- Step 3 - Rotate the plunger that was seated in the handle top 90° until it is aligned with the slots in the body. Place the mouth of the sampler into the 40ml VOA vial containing the appropriate preservative and extrude the sample by pushing the plunger down. Quickly place the lid back on the 40ml

VOA vial. Note: When capping the 40ml VOA vial, be sure to remove any soil or debris from the top and/or threads of the vial.

F. The samples submitted for laboratory analysis will be handled according to SOP 19 under chain-of-custody procedures.

G. For field duplicates, and matrix spike/matrix spike duplicate samples, sufficient extra volume must be collected for the laboratory to perform these quality control analyses.

H. Jars, as prepared and provided by the laboratory will be filled with soil and placed in a cooler on ice for possible laboratory analysis.

I. All drilling equipment will be decontaminated between each boring in accordance with methods specified in SOP No. 3.

J. The field geologist will log borehole geology and headspace measurements in the field book and the Boring/Well Log.

K. Upon completion, each boring will be abandoned and backfilled with soil cuttings. Bentonite chips, hydrated with potable water, will be used to backfill boreholes deeper than five feet bgs, and no bentonite is to be used within the top two feet bgs. If additional backfill is required, clean topsoil will be used to backfill the upper portion of soil borings in unpaved areas. In paved areas, clean gravel will be used to fill the boreholes between the top of the soil cuttings to the bottom of pavement. Concrete or asphalt will be used to patch the surface of the boreholes in paved areas.

4.0 DOCUMENTATION

A. Documentation of soil samples in the field logbook will be the responsibility of the supervising geologist/hydrogeologist.

B. The following minimum information will be recorded during and upon completion of soil sampling.

- Project name and number
- Soil sample location identification
- Date of soil sample and time completed
- Generalized subsurface stratigraphy
- Depth to and length of sampling interval
- Name of supervising geologist/hydrogeologist

STANDARD OPERATING PROCEDURE NO. 10
MONITORING WELL INSTALLATION

1.0 PURPOSE OF PROCEDURE

This Standard Operating Procedure (SOP) No. 10 describes the guidelines for the installation of monitoring wells as described in the RI/FS Work Plan, or as otherwise specified. Monitoring wells are installed to determine depth to groundwater and monitor fluctuations in groundwater elevation, and obtain groundwater samples for laboratory analysis.

2.0 GENERAL REQUIREMENTS

A. Procedures for soil sampling will be specifically addressed in the Health and Safety Plan (HASP).

B. Soil sampling will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 DESIGN REQUIREMENTS

3.1 General

A. Well construction procedures will meet regulatory agency requirements.

B. A geologist/ hydrogeologist will be present during well installation to document the subsurface stratigraphy and construction details for each well.

C. The well designs will meet two basic criteria:

- groundwater must move freely into the well, and
- vertical migration of surface water or undesired groundwater to the well intake zone must, to the extent possible, be eliminated.

D. Factors that influence the location of wells will be considered and include the following:

- Objectives of the RI/FS Work Plan.
- Location of potential source area or potential groundwater plume to be monitored.
- Hydraulic gradients.
- Location of aboveground and underground utilities and manmade features.
- Accessibility to desired areas.

3.2 Well Installation Materials Selection

A. PVC, low carbon or carbon steel well casing are available in threaded or unthreaded sections and typically in lengths of 5, 10, and 20 feet. Threaded pipe joints may be wrapped with Teflon tape to facilitate joining and to improve the seal. Sections of casing will be assembled onsite to allow inspection immediately

before installation. No solvents or adhesive compounds will be used on the threaded PVC pipe. Carbon steel may be joined by welding.

B. Well materials will be new and factory-clean before well installation. Drive point samplers, if used, will be decontaminated between samples. Decontamination procedures are presented in SOP No. 3.

3.3 Monitoring Well Construction Specifications

A. The well will be constructed with schedule 40 polyvinyl chloride (PVC) two-inch ID-piping with flush-threaded coupling. A ten-foot well screen, which will be constructed of PVC with continuously slotted 0.010-inch openings, will be placed to screen across the water table. The well riser pipe will also be constructed of PVC.

B. A sand pack will be placed at the screened interval of the well. The sand pack will consist of a 20/40 silica sand or its equivalent. The sand pack will extend approximately two foot above the top of the well screen and one foot below the bottom.

C. Approximately two foot of bentonite chips will be placed and hydrated on top of the sand pack. This will insure a seal between the sand pack and the neat-bentonite grout.

D. The remainder of the annular space from the top of the bentonite chips, the annular space between the borehole and the PVC casing will be filled with neat-bentonite grout to within approximately 2 feet of grade level. The grout will be pumped into the annulus from the bottom of the hole and filled upward. The grout will be allowed to set for a minimum of 24 hours before wells are developed.

E. The top of each well riser will be fitted with a secure locking cover to prevent well tampering or the introduction of materials into the screened interval of the well. The wells will be constructed with a stickup configuration, and will be protected by metal casings, secured with padlocks.

F. To divert run-off water away from the well, a minimum two-foot diameter concrete seal or pad will be installed at the ground surface around each of the monitoring wells. The pad will be sloped away from the well. The concrete will be extended approximately 24 inches bgs.

Refer to Figure 2 for details of the monitoring well construction diagram.

4.0 BOREHOLE ADVANCEMENT

4.1 General

A. Boreholes used to install wells will be drilled with the following objectives:

- To provide geological data on subsurface conditions, namely stratigraphy, occurrence of groundwater, and depth to bedrock.
- To obtain representative disturbed or undisturbed samples for identification and laboratory testing.

- To install wells.

B. Prior to drilling, the following steps must be taken:

- If necessary, obtain permits from the appropriate state agency or agencies.
- Notify (verbally or in writing) the appropriate state (and federal, if required) authorities in advance of the date that drilling is scheduled to begin.
- Check for buried utility lines at all planned drilling locations. For reasons of safety and liability, no drill hole will be advanced if this step has not been completed.
- Prepare and implement an approved Project Site Health and Safety Plan, adhering to all of its provisions for protection of the field crew.
- Make provisions for disposal of all cuttings and discharge water in accordance with regulations. Permits may be required.
- A field geologist/hydrogeologist will be present onsite during drilling.

4.2 Selection of Drilling Method

A. Drilling methods will be limited to hollow stem methods.

B. Drilling methods will be selected based on the expected nature of the subsurface materials to be encountered in the boring.

5.0 MONITORING WELL INSTALLATION

5.1 Well Components

The well components in order of placement are as follows:

- Surface (outer) casing (if used)
- Well (inner) casing
- Casing grout
- Bentonite seal
- Filter pack sand
- Well head protector casing
- Well head apron

5.2 Installation Procedures

A. The well casing will be assembled while wearing clean gloves. Insert and lower the well casing into the borehole in segment. Hand-tighten connections or weld segments (steel) to prevent them from leaking or becoming loose.

B. The final section of casing will be measured and field cut, if necessary, before connecting to allow for a stick-up of 2.5 to 3.0 feet. The cut end will be rasped and/or sanded smooth, taking care not to let fillings of casing material cling to the inside.

C. Install the concrete plug around the outermost casing from 2.5 to 3 feet bgs up to the ground surface. Set the protective cover, if possible, such that at least 2.5 feet of its length is embedded in the concrete below the ground surface. It will also be set such that the top of the protective casing is 2 to 6 inches above the top of the well casing. A concrete pad will be 2 foot by 2 foot and approximately

6 inches thick will be formed around the base of the protective cover. The concrete pad will be sloped away from the protective cover to allow flow away from the well. Weep holes will be drilled through the protective cover nominally 1 inch above the top of the concrete apron.

D. The protective casing will be marked with identifying decals. A locking device will be installed to prevent unauthorized entry or vandalism of the well.

E. The top of the well casing will be notched with a file or marked in another fashion to provide a reference point in which to measure water and/or product levels. The elevation of the top of the well casing (reference point) and ground surface at the well will be surveyed relative to a benchmark. The location of the well will also be surveyed in reference to the site coordinate system.

F. Following installation and curing of the concrete pad, the monitoring wells will be developed in accordance with the well development procedures outlined in SOP 11.

6.0 DOCUMENTATION

A. Documentation of well installation in the field logbook will be the responsibility of the supervising geologist/hydrogeologist.

B. The drilling and well installation activities will be recorded in the field logbook or on appropriate forms. The following minimum information will be recorded during and upon completion of every well installation.

- Project name and number
- Well location identification
- Date of installation and time completed
- Drilling methods, crew names, and rig identification
- Drilling depths
- Generalized subsurface stratigraphy
- Total length of casing
- Depth to water and/or product
- Depth to and length of open interval
- Depth to and length of the screened interval, filter pack, and bentonite seal, if applicable
- Depth to top of grout
- Depth of surface casing (if necessary)
- Name of supervising geologist/hydrogeologist

FIGURE 1

DIRECT PUSH PROFILE BORING

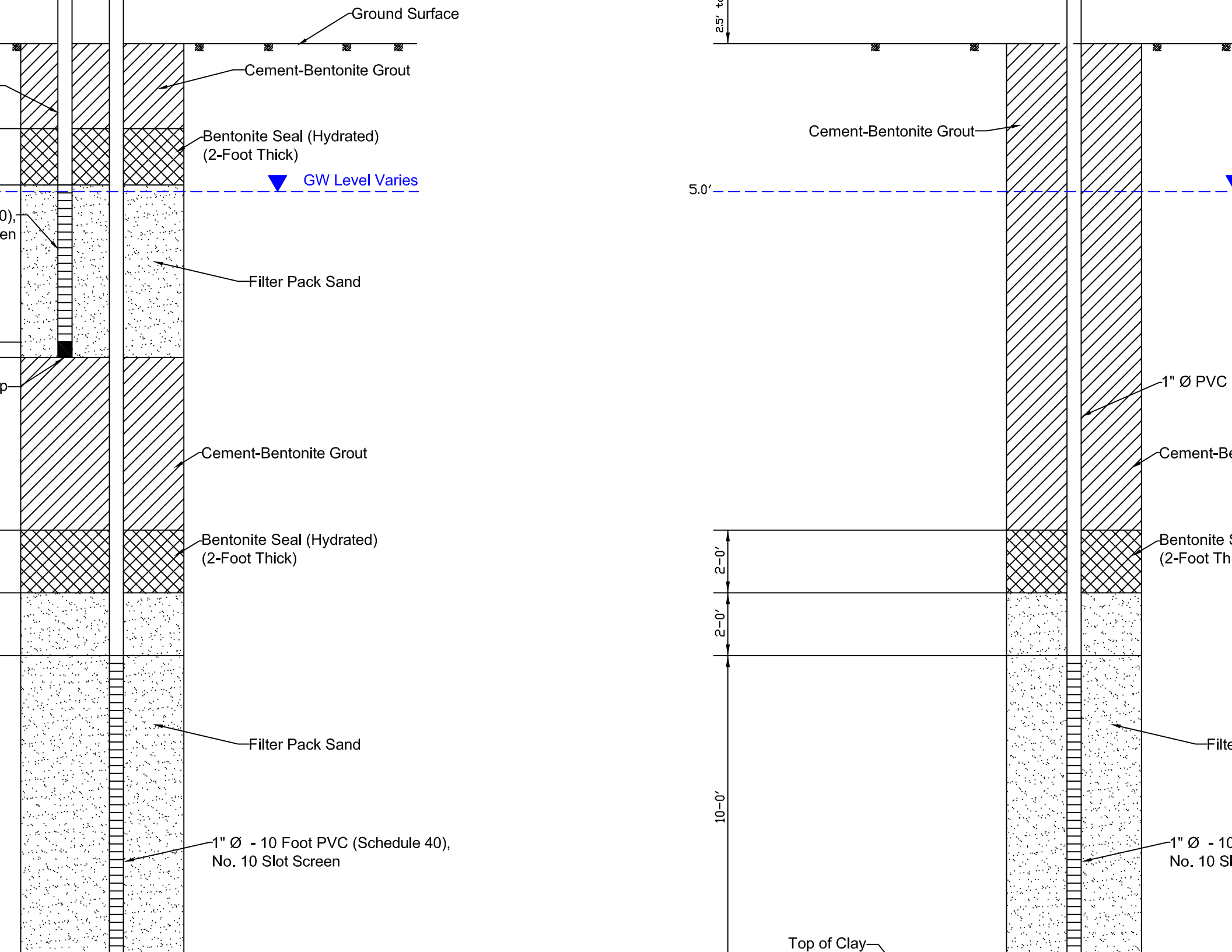
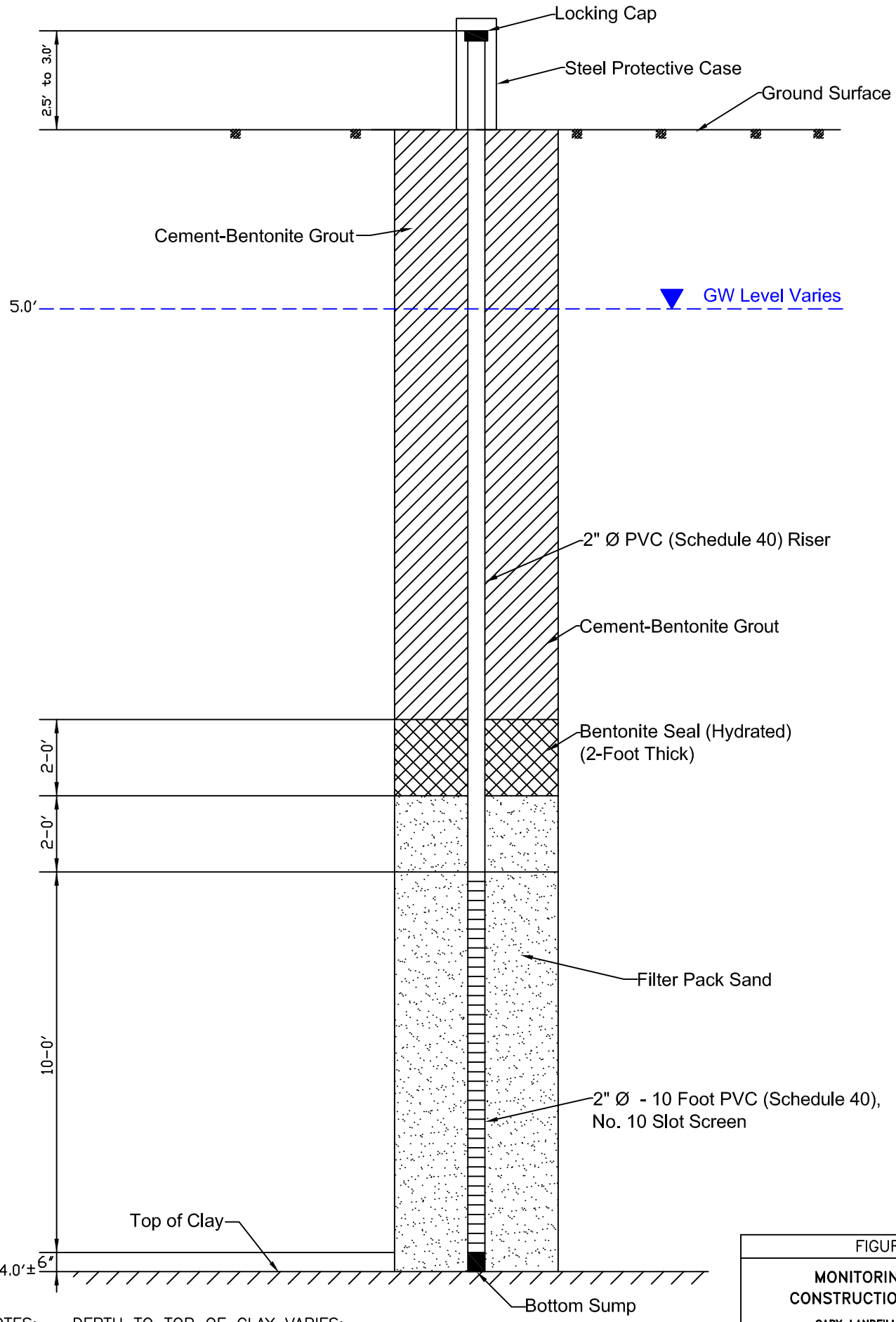

Ground Surface
Cement-Bentonite Grout
Bentonite Seal (Hydrated)
(2-Foot Thick)
GW Level Varies
Filter Pack Sand
Cement-Bentonite Grout
Bentonite Seal (Hydrated)
(2-Foot Thick)
Filter Pack Sand
1" Ø - 10 Foot PVC (Schedule 40),
No. 10 Slot Screen
2.5′
Cement-Bentonite Grout
5.0′
1" Ø PVC
2-0′
2-0′
10-0′
Top of Clay

FIGURE 2

MONITORING WELL CONSTRUCTION DIAGRAM



NOTES: – DEPTH TO TOP OF CLAY VARIES;
– BOTTOM OF THE WELL TO BE DETERMINED IN THE FIELD.

NOT TO SCALE

FIGURE 2

MONITORING WELL CONSTRUCTION DIAGRAM

GARY LANDFILL DEVELOPMENT
GARY, INDIANA

PARSONS 9/30/2014
DESIGN * RESEARCH * PLANNING
10 SOUTH RIVERSIDE PLAZA * CHICAGO, IL * 312.930.5100

P:\Gary Landfill Project\Figures\2014\06 2014 MW Construction Well

STANDARD OPERATING PROCEDURE NO. 11
WELL DEVELOPMENT

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 11 describes the guidelines for developing wells as described in the RI/FS Work Plan or as otherwise specified. Well development is conducted to remove drilling fluids and cutting/rock dust from the borehole wall and formation materials to enhance the flow of groundwater into the well. Well development removes any loose formation materials (i.e., fine sand and silt) from the borehole that may impact the integrity of groundwater and/or product samples.

2.0 GENERAL REQUIREMENTS AND CONSIDERATIONS

A. Well development will be conducted for all wells for the following reasons:

1) To restore the natural permeability of the formation adjacent to the borehole.

2). To remove clay, silt and other fines from the borehole so that water and/or product samples will not be abnormally turbid or contain undue suspended matter.

3). To remove remnant drilling fluids and other contaminants from the well and formation material introduced during drilling.

B. Equipment, including pumps, hoses, tubing, containers, and bailers will be decontaminated before and after introduction into wells to be developed. Decontamination will follow SOP No. 2.

C. Personnel involved in well development procedures will follow the prescribed procedures in the Health and Safety Plan (HASP).

D. Well development will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Field book and project plans
- Personal protective equipment in accordance with the Project Safety Plan
- Water level indicator
- Stainless steel beaker (or similar)
- Decon supplies
- Peristaltic pump (with higher flow rates than the low flow sampling values)

4.0 DEVELOPMENT METHODS

4.1 Bailing And Pumping

A. A bailer that is heavy enough to sink rapidly through the water can be raised and lowered through the water column to produce the surging action that is similar to

that caused by a surge block or well slug. The bailer, however, has the added capability of removing turbid water and fines each time it is brought to the surface. Bailers will be used for developing shallow and slow yielding wells (wells which run dry soon after pumping and are located in tight formations). Because of the difficulty in obtaining complete decontamination of non-metallic equipment, only metallic or disposable bailers should be used in wells.

B. Pumping can be used effectively in wells where recharge is rapid or where it is necessary to remove a large volume of water. The type and size of the pump used is contingent upon the well design. Pumps also allow removal of turbid water and fines. However, pumps are more difficult to decontaminate than a bailer.

5.0 PROCEDURES

A. Measure the depth to groundwater and calculate the standing water volume in the well to be developed. The standing well volume (V) is calculated using the following formula:

$$V = CD$$

where,
C = volume (in gallons per foot) of water in the well casing
D = height of the standing water column (in feet) in the well

Diameter (inches)	Casing Volume (gallons per foot)	Borehole Diameter (inches)			
		4.5	6	8	8.5
		Filter Pack Volume (gallons per foot)			
2	0.163	0.031	0.061	0.115	0.130
3	0.367	0.021	0.052	0.105	0.121
4	0.653	0.008	0.038	0.092	0.107
6	1.469	--	0.000	0.053	0.069

Note: Assumed porosity (n) = 0.35; Filter pack volume = n x 3.14159 x (Radius of borehole^2 – Radius of well^2)

The height of the standing water column is calculated by subtracting the static water level from the total depth of the well. The volume of water in the well and borehole will vary with diameter.

B. The data collected during development will be recorded on a well development/groundwater sampling form.

C. Water quality parameters will be measured before and during well development. The water quality parameters will include pH, specific conductance, temperature, dissolved oxygen, and turbidity. Visual clarity of the groundwater will be noted if observed.

D. Water quality parameters will be measured after each well volume is removed. The data will be recorded on a Well Development Record and field logbook.

E. The wells will be developed until the water quality parameters stabilize or 5 times the volume of the standing water is removed. Water levels will be recorded at the same interval as indicator parameters. The criteria for parameter stability are summarized below:

1)	pH:	+/- 0.5 standard pH unit
2)	Conductivity:	+/- 10%
3)	Temperature:	+/- 0.5^{o} C
4)	Turbidity:	+/- 10% or < 10NTU or in a 10 NTU range for 30 min
5)	DO	+/- 10 mg/L
6)	ORP	+/- 10% mV

F. If the well goes dry before five well volumes are purged or field parameters have stabilized the well must be allowed to recharge for at least 30 minutes and purging will resume.

G. Development is complete when field parameters have stabilized or when the well is purged dry three times as described above.

H. Development water will be contained in 55 gallon drums. A designated location for the drum(s) will be determined prior to well development activities. After sampling and review of the analytical data, the approved disposal facility will be consulted for discharge options.

J. Appropriate personal protection will be used when encountering product or strong product odors that exceed the action levels specified in the HASP.

6.0 DOCUMENTATION

A. Well development activities will be documented in the field logbook, describing the procedures used and any significant occurrences that are observed during development such as apparent recharge rates in the well, condition of the groundwater, and organic vapor readings. Well development data including the depth to static water, standing water volume in the well, total volume of water removed, number of well volumes removed, and water quality parameters will be recorded in the Well Development Record.

STANDARD OPERATING PROCEDURE NO. 12
LOW-FLOW PURGING AND GROUNDWATER SAMPLING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 12 describes the guidelines for low-flow purging and groundwater sampling as described in the RI/FS Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS AND CONSIDERATIONS

A. Personnel involved in well development procedures will follow the prescribed procedures in the Health and Safety Plan (HASP).

B. Well sampling will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Field book and project plans
- Personal protective equipment in accordance with the Project Safety Plan
- Water level indicator
- In-line multi-parameter water quality meter with flow-through cell (Horiba U-22, YSI 6-Series, or equivalent)
- Stainless steel beaker (or similar)
- Decon supplies
- Low flow (less than 0.1 – 0.5 L/min) pump (peristaltic)
- Teflon tubing (dedicated)
- Tape
- Coolers and ice
- Sample bottles
- Shipping supplies

4.0 LOW-FLOW PURGING

A. Prior to pumping each monitoring well, the static water level will be measured with a clean water level indicator to the nearest 0.01 foot.

B. Immediately prior to pumping each monitoring well, the static water level will be measured with a clean water level indicator to the nearest 0.01 foot.

C. A peristaltic pump or equivalent with disposable tubing will be set up next to the sampling location (table or cooler). In order to minimize interference and cross contamination, the dedicated tubing will be of polytetrafluoroethylene (PTFE, e.g., Teflon®) or equivalent. As noted in the U.S. Geological Survey Book 9, Handbooks for Water-Resources Investigations, National Field Manual for the Collection of Water-Quality Data, Chapter A2, Selection of Equipment for Water Sampling, (http://water.usgs.gov/owq/FieldManual/), fluorocarbon polymers

include materials such as Teflon®, Kynar®, and Tefzel® are relatively inert for sampling inorganic or organic analytes. Therefore, negative bias towards the proposed groundwater sample analyses for VOCs is not anticipated.

D. One end of dedicated tubing will be inserted into the well. The other end is attached to a short length of flexible dedicated tubing, which will be threaded around the rotor, out of the pump, and connected to a discharge tube. The liquid moves totally within the tubing, thus no part of the pump contacts the liquid. Teflon®-lined polyethylene tubing will be used for sampling. Silastic tubing will be used for tubing in contact with the rotors.

E. During the initial low-flow sampling event, the pump will be started at its lowest speed setting and slowly increased until discharge occurs. After start-up, the water level will be checked, and the pump speed will be adjusted until there is little or no water level drawdown (less than 0.3 feet). During pump start-up, drawdown may exceed the 0.3 foot target and then recover as pump flow adjustments are made. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, purging will continue until indicator parameters stabilize. During subsequent sampling events, the low-flow pumping rate established during the initial event will be used to purge each well. This rate will be adjusted as required to minimize drawdown.

F. The water level and pumping rate will be monitored and recorded every five to ten minutes during purging. The pumping rate will be adjusted to ensure minimal drawdown. Any pumping rate adjustments will also be recorded. Surging of water during pumping will be avoided. The pump intake will be kept submerged to avoid pump suction loss or air entrainment and to ensure that the sample tubing remains filled with water.

G. Purging will continue until indicator parameters stabilize.

H. If the well goes dry before three well volumes are purged or field parameters have stabilized, the well must be allowed to recharge for at least 30 minutes and purging will resume.

I. If parameters have not stabilized after one hour of initiation of purging, the Parsons Project Manager or their appropriate field representative will be notified and the sample will be collected. Full documentation of the efforts made to achieve stabilization will be recorded in the field notebook or sampling form.

J. All purge water will be placed in 55 gallon drum(s) or other appropriate containers, and a composite sample will be collected for applicable disposal parameters. A designated location for the drum(s) or containers will be determined prior to well development activities and communicated to the regulatory agencies. This same area will be used for purge water for groundwater sampling. After sampling and review of the analytical data, the approved disposal facility will be consulted for discharge options.

5.0 MONITORING OF INDICATOR PARAMETERS DURING PURGING

A. All groundwater quality monitoring equipment will be decontaminated by first rinsing with potable water and phosphate-free detergent, then with potable water and followed with an ASTM Type II Reagent Grade Deionized water rinse.

B. All groundwater quality monitoring equipment will be calibrated daily per the manufacturer's specifications.

C. Once an acceptable drawdown pumping rate is established and maintained, the designated field parameters will be monitored at 5-minute intervals using a flow-through cell. The required indicator parameters are pH, conductivity, dissolved oxygen (DO), temperature, turbidity, and oxidation-reduction potential (ORP). The water level will also continue to be monitored and recorded, as well as any changes to the pumping rate.

D. Purging is considered complete and sampling may begin when the indicator parameters listed above have stabilized. Stabilization has occurred when three consecutive readings, taken at 5 minute intervals, are within the following limits:

1) pH: +/- 0.5 standard pH unit
2) Conductivity: +/- 10%
3) Temperature: +/- 0.5^{o} C
4) Turbidity: +/- 10% or < 10NTU or in a 10 NTU range for 30 min
5) DO +/- 10 mg/L
6) ORP +/- 10% mV

E. Water quality parameter will be collected using in-line multi-parameter water quality meter with flow-through cell meter.

F. If sampling for total and filtered metals, a filtered and unfiltered sample will be collected. Filtered samples may be obtained using a 1.0-, 0.45-, or 0.1-micron disposable filter.

6.0 GROUNDWATER SAMPLING

A. Groundwater samples will be collected immediately after the indicator parameters have stabilized.

B. Comments regarding the color and any obvious odors associated with the water will be recorded in the field notebook.

C. Samples will be collected using Teflon-lined sample tubing. The sample tubing will be disconnected upstream (on the pump side) of the flow-through-cell prior to sample collection. Sample tubing will remain full during sampling.

D. Aeration of samples will be minimized.

E. Groundwater will be pumped slowly into the laboratory-supplied sample containers. VOA vials will be provided pre-preserved by the analytical laboratory. If natural effervescence is present in the samples, no preservative will be used for the VOC samples.

F. VOA vials will be filled and sealed in accordance with headspace requirements prescribed by the analytical laboratory and the analysis method. If degassing bubbles are evident in vials, fresh samples will be obtained. The pumping velocity will be reduced as needed. In addition, it may be necessary to collect VOC samples without preservation to minimize effervescing effects.

G. After sample collection, sample bottles will be labeled, and the appropriate chain-of-custody forms will be completed.

H. Samples will be placed in appropriate containers (e.g., ice-filled coolers), preserved to a minimum of $4^{O}C$, sealed (to maintain the proper COC), and transported expeditiously to the analytical laboratory.

I. Sample container, preservation, and holding times are detailed in SOP 19. Sample storage, packaging, and shipment are detailed in SOP 20. Sample control and custody procedures are detailed in SOP 21.

STANDARD OPERATING PROCEDURE NO. 13
Vertical Aquifer Profiling

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 13 describes the guidelines for vertical aquifer profiling as described in the RI/FS Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS AND CONSIDERATIONS

A. Personnel involved in well development procedures will follow the prescribed procedures in the Health and Safety Plan (HASP).

B. Well sampling will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Field book and project plans
- Personal protective equipment in accordance with the Project Safety Plan
- Water level indicator
- In-line multi-parameter water quality meter with flow-through cell (Horiba U-22, YSI 6-Series, or equivalent)
- Stainless steel beaker (or similar)
- Decon supplies
- Low flow (less than 0.1 – 0.5 L/min) pump (peristaltic)
- Teflon tubing (dedicated)
- Tape
- Coolers and ice
- Sample bottles
- Shipping supplies

4.0 Vertical Aquifer Profiling

A. Boreholes used to install temporary monitoring wells will be drilled with the following objectives:

- Groundwater samples will be collected every ten feet from the water table to the top of glacial till. The groundwater samples will be collected using low-flow procedures, where possible.

B. Prior to drilling, the following steps must be taken by Parsons personnel and subcontractors:

- If necessary, obtain permits from the appropriate state agency or agencies.
- Notify (verbally or in writing) the appropriate state authorities in advance of the date that drilling is scheduled to begin.

- Check for buried utility lines at all planned drilling locations, following Parsons protocols. For reasons of safety and liability, no drill hole will be advanced if this step has not been completed.
- Prepare and implement an approved Project Site Health and Safety Plan, adhering to all of its provisions for protection of the field crew.
- Make provisions for disposal of all cuttings and discharge water in accordance with regulations. Permits may be required.
- A field geologist/hydrogeologist will be present onsite during drilling.

C. At each boring location specified for profiling, a cluster of three temporary wells (10-feet, 20-feet, and 30-feet total depths) will be installed within five feet of the soil boring location using direct push drilling with 2.25-inch diameter drill-rods and an expendable tip. Once the desired depth is reached, the temporary well will be installed through the drill rods. As the rods are retrieved from the borehole the temporary well and expendable tip is left in place. Sand filter pack is placed in the borehole as the rods are retrieved from the borehole. The temporary wells are constructed of 1-inch diameter polyvinyl chloride (PVC) screen and riser. Screens are one foot in length with 0.010-inch slot size.

D. Groundwater samples will then be collected at each temporary well using low-flow sampling methods, if feasible. A peristaltic pump or equivalent with disposable tubing will be set up next to the sampling location (table or cooler). In order to minimize interference and cross contamination, the dedicated tubing will be polytetrafluoroethylene (PTFE, e.g., Teflon®) or equivalent. As noted in the U.S. Geological Survey Book 9, Handbooks for Water-Resources Investigations, National Field Manual for the Collection of Water-Quality Data, Chapter A2, Selection of Equipment for Water Sampling, (http://water.usgs.gov/owq/FieldManual/), fluorocarbon polymers including materials such as Teflon®, Kynar®, and Tefzel® are relatively inert for sampling inorganic or organic analytes. Therefore, negative bias towards the proposed groundwater sample analyses for VOCs is not anticipated.

E. One end of dedicated tubing will be inserted into the well. The other end is attached to a short length of flexible dedicated tubing, which will be threaded around the rotor, out of the pump, and connected to a discharge tube. The liquid moves totally within the tubing, thus no part of the pump contacts the liquid. Teflon®-lined polyethylene tubing will be used for sampling. Silastic tubing will be used for tubing in contact with the rotors.

F. During the initial low-flow sampling event, the pump will be started at its lowest speed setting and slowly increased until discharge occurs. After start-up, the water level will be checked, and the pump speed will be adjusted until there is little or no water level drawdown (less than 0.3 feet). During pump start-up, drawdown may exceed the 0.3 foot target and then recover as pump flow adjustments are made. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, purging will continue until indicator parameters stabilize. During subsequent sampling events, the low-flow pumping rate

established during the initial event will be used to purge each well. This rate will be adjusted as required to minimize drawdown.

G. The water level and pumping rate will be monitored and recorded every five to ten minutes during purging. The pumping rate will be adjusted to ensure minimal drawdown. Any pumping rate adjustments will also be recorded. Surging of water during pumping will be avoided. The pump intake will be kept submerged to avoid pump suction loss or air entrainment and to ensure that the sample tubing remains filled with water.

H. Purging will continue until indicator parameters stabilize.

I. If the well goes dry before three well volumes are purged or field parameters have stabilized the well must be allowed to recharge for at least 30-minutes and purging will resume.

J. If parameters have not stabilized after one hour of initiation of purging, the Parsons Project Manager or their appropriate field representative will be notified and the sample will be collected. Full documentation of the efforts made to achieve stabilization will be recorded in the field notebook.

K. Purge water will be placed in 55 gallon drum(s) or other appropriate containers, and a composite sample will be collected for applicable disposal parameters. A designated location for the drum(s) or containers will be determined prior to well development activities and communicated to the regulatory agencies. This same area will be used for purge water for groundwater sampling. After sampling and review of the analytical data, the approved disposal facility will be consulted for discharge options.

5.0 MONITORING OF INDICATOR PARAMETERS DURING PURGING

A. Groundwater quality monitoring equipment will be decontaminated by first rinsing with potable water and phosphate-free detergent, then with potable water and followed with an ASTM Type II Reagent Grade Deionized water rinse.

B. Groundwater quality monitoring equipment will be calibrated daily per the manufacturer's specifications.

C. Once an acceptable drawdown pumping rate is established and maintained, the designated field parameters will be monitored at 5-minute intervals using a flow-through cell. The required indicator parameters are pH, conductivity, dissolved oxygen (DO), temperature, turbidity, and oxidation-reduction potential (ORP). The water level will also continue to be monitored and recorded, as well as any changes to the pumping rate.

D. Purging is considered complete and sampling may begin when the indicator parameters listed above have stabilized. Stabilization has occurred when three consecutive readings, taken at 5 minute intervals, are within the following limits:

1) pH: +/- 0.5 standard pH unit
2) Conductivity: +/- 10%
3) Temperature: +/- 0.5^{o} C
4) Turbidity: +/- 10% or < 10NTU or in a 10 NTU range for 30 min

5) DO +/- 10 mg/L
6) ORP +/- 10% mV

E. Water quality parameters will be collected using an in-line multi-parameter water quality meter with flow-through cell meter.

F. If sampling for total and filtered metals, a filtered and unfiltered sample will be collected. Filtered samples may be obtained using a 1.0-, 0.45-, or 0.1-micron disposable filter.

6.0 GROUNDWATER SAMPLING

A. Groundwater samples will be collected immediately after the indicator parameters have stabilized.

B. Comments regarding the color and any obvious odors associated with the water will be recorded in the field notebook.

C. Samples will be collected using Teflon-lined sample tubing. The sample tubing will be disconnected upstream (on the pump side) of the flow-through-cell prior to sample collection. Sample tubing will remain full during sampling.

D. Aeration of samples will be minimized.

E. Groundwater will be pumped slowly into the laboratory-supplied sample containers. VOA vials will be provided pre-preserved by the analytical laboratory. If natural effervescence is present in the samples, no preservative will be used for the VOC samples.

F. VOA vials will be filled and sealed in accordance with headspace requirements prescribed by the analytical laboratory and the analysis method. If degassing bubbles are evident in vials, fresh samples will be obtained. The pumping velocity will be reduced as needed. In addition, it may be necessary to collect VOC samples without preservation to minimize effervescing effects.

G. After sample collection, sample bottles will be labeled, and the appropriate chain-of-custody forms will be completed.

H. Samples will be placed in appropriate containers (e.g., ice-filled coolers), preserved to a minimum of $4^{O}C$, sealed (to maintain the proper COC), and transported expeditiously to the analytical laboratory.

I. Sample container, preservation, and holding times are detailed in SOP 19. Sample storage, packaging, and shipment are detailed in SOP 20. Sample control and custody procedures are detailed in SOP 21.

STANDARD OPERATING PROCEDURE NO. 14
SURFACE WATER SAMPLING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 14 describes the guidelines for surface water sampling as described in the RI/FS Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS AND CONSIDERATIONS

A. Personnel involved in well development procedures will follow the prescribed procedures in the Health and Safety Plan (HASP).

B. Surface water sampling will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Field book and project plans
- Personal protective equipment in accordance with the Project Safety Plan (e.g. flotation vests, waders/hip boots)
- Tape measure
- Survey stakes, flags, or buoys and anchor
- Peristaltic pump
- Meters, probes and standards for in-situ measurements
- Waders, personal floatation device (as appropriate)
- Flat-bottom boat (if necessary)
- Digital camera;
- GPS Unit;
- Sample bottles
- Shipping supplies

4.0 PROCEDURES

The physical location of the investigator when collecting a sample may dictate the equipment to be used.

If surface water samples are required, direct dipping of the sample container into the stream is desirable. The deciding factors in the selection of a sampling device for sampling water in ponds are: the location of sample collection (from the shore or boat), the chemicals of concerns, desired depth sample. Based on the proposed sampling locations a direct method (from the shore) and/or peristaltic pump sampler will be used.

4.1 Direct Method

A. The surface water samples will be collected from the shore or a boat/floating platform using adequate protective clothing to access the sampling station.

B. The location of the sampling station should be identified and marked using a GPS receiver. The general location relative to permanent landmarks should also be recorded in a logbook and the location marked in the field where appropriate.

C. At each location, the following water quality parameters will be measured in the field: pH, conductivity, dissolved oxygen (DO), temperature, turbidity, and oxidation-reduction potential (ORP).

D. Water quality measurements will be made using a flow through cell meter (Horiba U-22, YSI 6-Series, or equivalent). Calibration of the meter will be completed following the instrument manufacturer calibration protocols. Measurements should be obtained in-situ when possible, otherwise measurements can be obtained by immersing the instrument probes in a container filled with water from each sampling location. The container used for field measurements will be decontaminated between sampling locations by rinsing the container three times with water obtained at the new sampling location prior to collecting the field measurements.

E. Samples will be obtained from the proposed sampling locations by direct grab from the shore. The sample bottle shall be inverted, and lowered to one-half the water depth, and held at about a 45° angle with the mouth of the bottle facing upstream. If the sample is unreachable then a telescoping pole with a clean poly dipper cup (laboratory supplied) and the water will be transferred to the appropriate container.

F. If the sampling location is unreachable with the pole and cup method, personnel may wade out into the water to collect the sample provided they have assessed the activity and are able to mitigate all hazards associated with this task. In this case, the waders will also be decontaminated between sample locations.

G. If water level is greater than 10 feet, then water samples will be collected from 10 to 12 feet using specialized equipment for vertical sampling.

H. Sampling personnel shall not collect turbid or sediment-containing water, which could bias the sample results. If a laboratory supplied sample container contains a preservative added at the laboratory, then the sample will be collected from the pond using a new, clean glass container to collect the sample and transfer it into the pre-preserved laboratory container.

I. Sampling containers and appropriate preservatives are based on the analyses to be performed on each sample. Appropriate sample containers will be used for the analyses to be performed on each sample collected during this task.

J. When sampling for total and filtered metals, a filtered and unfiltered sample will be collected. Filtered samples may be obtained using a 1.0-, 0.45-, or 0.1-micron disposable filter.

K. After sample collection, sample bottles will be labeled, and the appropriate chain-of-custody forms will be completed.

L. Samples will be placed in appropriate containers (e.g., ice-filled coolers), preserved to a minimum of 4°C, sealed (to maintain the proper COC), and transported expeditiously to the analytical laboratory.

M. Sample container, preservation, and holding times are detailed in SOP 18. Sample storage, packaging, and shipment are detailed in SOP 19. Sample control and custody procedures are detailed in SOP 20.

4.2 Peristaltic Pump Samplers Method

A. Another device that can be effectively used to sample a surface water is the peristaltic pump system. The use of a metal/PVC conduit to which the tubing is attached, allows for the collection of a surface water sample.

B. Peristaltic pumps vary in size and capability, with some being designed specifically for the simultaneous collection of multiple water samples.

C. At each location, the following water quality parameters will be measured in the field: pH, conductivity, DO, temperature, turbidity, and ORP. Water quality parameter will be collected using in-line multi-parameter water quality meter with flow-through cell meter.

D. When sampling for total and filtered metals, a filtered and unfiltered sample will be collected. Filtered samples may be obtained using a 1.0-, 0.45-, or 0.1-micron disposable filter.

E. After sample collection, sample bottles will be labeled, and the appropriate chain-of-custody forms will be completed.

F. Samples will be placed in appropriate containers (e.g., ice-filled coolers), preserved to a minimum of 4°C, sealed (to maintain the proper COC), and transported expeditiously to the analytical laboratory.

G. Sample container, preservation, and holding times are detailed in SOP 19. Sample storage, packaging, and shipment are detailed in SOP 20. Sample control and custody procedures are detailed in SOP 21.

4.0 DOCUMENTATION

A. All aspects of the surface water sampling will be recorded in a project field book. The following water quality parameters will be measured in the field: pH, conductivity, DO, temperature, turbidity, and ORP. In addition, sample location, site conditions, weather, any deviations from this SOP and any other pertinent information will be recorded.

STANDARD OPERATING PROCEDURE NO. 15
SEDIMENT SAMPLING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 15 describes the guidelines for sediment sampling as described in the RI/FS Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS AND CONSIDERATIONS

A. Personnel involved in sediment sampling procedures will follow the prescribed procedures in the Health and Safety Plan (HASP).

B. Sediment sampling will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 EQUIPMENT AND SUPPLIES

- Field book and project plans
- Personal protective equipment in accordance with the Project Safety Plan
- Hand auger
- Tape measure
- Survey stakes and flags
- Waders, personal floatation device (as appropriate)
- Digital camera;
- GPS Unit;
- Sample bottles
- Shipping supplies

4.0 PROCEDURES

The sediment sampling equipment and selected methodology depend on the depth of the water and the consistency of the bottom sediments (such as soft, hard, or rocky). The sediment sampling methods can be classified as : mechanical and manual.

Example mechanical methods (predominantly for deep waters) are:

- Petite Ponar Grab Sampler
- Ekman Grab Sampler
- Peterson Grab Sampler
- Ogeechee Sediment Corer

Based on the site conditions (shallow water) and the location of the proposed sediment samples (Southern Wetland and Northern Pond area) the appropriate method for the majority of the samples will be the manual sampling.

Since liquid flow and depth are minimal and sediment is easy to reach, manual methods, such as a hand auger, trowel or scoop may be used to collect sediment

samples. This sampling technique is applicable to shallow rivers/streams, wetlands, or shallow portions of ponds/lakes.

A. Locate sediment sampling locations based upon the project work control documents and mark the sediment sampling locations with pin flags or survey stakes, if possible and locate with a portable GPS unit.

B. Collect sediments at the appropriate depth intervals (0-1 feet and 1-2 feet) as specified in the RI/FS Work Plan, using a properly decontaminated or dedicated hand auger, trowel, push core, scoop, or similar device and a plastic or tempered glass container.

C. If necessary, subdivide the sample into appropriate depth intervals.

D. Log the sediment sample according to the Unified Soil Classification System (USCS).

E. Remove twigs, roots, leaves, rocks, and miscellaneous debris from the sample area using a decontaminated stainless-steel scoop/spatula or a dedicated, disposable plastic sampling scoop.

F. Once a consistent physical appearance over the entire sample has been obtained, transfer appropriate volumes of sediment into certified clean, laboratory-supplied, preserved (if necessary) pre-labeled bottle ware with either a decontaminated stainless steel or glass scoop/spatula or a dedicated, disposable plastic sampling scoop.

G. After sample collection, sample bottles will be labeled, and the appropriate chain-of-custody forms will be completed.

H. Samples will be placed in appropriate containers (e.g., ice-filled coolers), preserved to a minimum of $4^{O}C$, sealed (to maintain the proper COC), and transported expeditiously to the analytical laboratory.

I. Sample container, preservation, and holding times are detailed in SOP 19. Sample storage, packaging, and shipment are detailed in SOP 20. Sample control and custody procedures are detailed in SOP 21.

Two sediment samples (SD23 and SD24) will be collected in the interior of the pond in Northern Pond area. Mechanical sampling (Petit Ponar or Ekman Grab Sampler) will be used for those locations, along with a boat or floating platform.

Petit Ponar Grab Sampler (designed for rocky surfaces)

A. The Ponar grab sampler has been adapted with a top screen and side plates to prevent sample loss upon ascent.

B. Open the jaws and place the cross bar into the proper notch.

C. Lower the dredge to the bottom, making sure it settles flat.

D. When tension is removed from the line, the cross bar will drop, enabling the dredge to close as the line is pulled upward during retrieval.

E. Pull the sampler to the surface. Check to make sure the jaws are fully closed and that no sample was lost while lifting the dredge.

F. Carefully open the jaws, remove the sample with a clean, non-reactive utensil into a stainless steel bowl or tray and transfer into the appropriate sample container(s), label, preserve to 4°C with wet ice and complete field notes.

G. Sample container, preservation, and holding times are detailed in SOP 19. Sample storage, packaging, and shipment are detailed in SOP 20. Sample control and custody procedures are detailed in SOP 21.

Ekman Grab Sampler designed for soft substrates (sand, silt or mud)

A. Open the spring-loaded jaws and attach the chains to the pegs at the top of the sampler.

B. Lower the dredge to the bottom, making sure it settles flat.

C. Holding the line taut and send down the messenger to close the jaws of the dredge.

D. Pull the sampler to the surface. Check to make sure the jaws are fully closed and that no sample was lost while lifting the dredge.

E. Carefully open the jaws, remove the sample with a clean, non-reactive utensil into a stainless steel bowl or tray and transfer the sample into the appropriate sample container(s), label, preserve to 4°C with wet ice and complete field notes.

F. Sample container, preservation, and holding times are detailed in SOP 19. Sample storage, packaging, and shipment are detailed in SOP 20. Sample control and custody procedures are detailed in SOP 21.

5.0 DOCUMENTATION

A. Documentation of sediment samples in the field logbook will be the responsibility of the supervising geologist/hydrogeologist.

B. The following minimum information will be recorded during and upon completion of sediment sampling.

- Project name and number
- Sediment sample location identification
- Date of sediment sample and time completed
- Generalized subsurface stratigraphy
- Depth to and length of sampling interval
- Name of supervising geologist/hydrogeologist

STANDARD OPERATING PROCEDURE NO. 16
AIR SAMPLING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 16 describes the guidelines for air sampling as described in the RI/FS Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS AND CONSIDERATIONS

A. Personnel involved in air procedures will follow the prescribed procedures in the Health and Safety Plan (HASP).

B. Air sampling will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

C. Air sampling will be conducted to determine if existing landfill vents are a significant contributor of methane or other VOCs to ambient air. Two types of air sampling are conducted: a screening method utilizing portable hand-held instruments and; via a sampling device such as a Summa Canister. Exhaust velocity from the vents is measured for use in emission rate calculations.

D. Air sampling will be conducted in the potential breathing zone of site workers, in the downwind vicinity of landfill vents, and in perimeter monitoring points. The perimeter points will consist either of shallow probes or use of a surface flux chamber.

E. If the results of field screening (PID and Methane) and analytical (VOC) are elevated, then additional air monitoring points are proposed near the river and the property boundaries.

3.0 TEST METHODS

A. Air sampling conducted via screening methods is accomplished by using a handheld Landfill Gas Analyzer and a handheld Photoionization Detector (PID). The probe of each instrument is placed within the exit opening of the landfill vent for a short period of time (under 5 minutes). Attempts will be made and documented to minimize atmospheric air from diluting the sample. Methods such as placing a gasket around the vent opening will be considered. Readings from each instrument and attempts to minimize atmospheric air dilution are recorded on a sampling field form or in a field log book.

B. Air sampling conducted via a Summa Canister is accomplished by setting the inlet to the canister (with sample line if needed) within the exit opening of the landfill vent and opening the flow valve on the canister to initiate collection of the sample. Air is drawn into the evacuated 6-liter stainless steel canister at a controlled flow rate by means of a pneumatic flow controller. The interior wall of the canister is treated to prevent chemical reactions from occurring during and after the sampling sequence. The sample is collected over a known period of time and at a

known flow. The flow valve is closed after the requisite period of time and the canister is sent to a laboratory for analysis.

C. Breathing zone air samples are collected in similar manners to A. and B. above, however, collection is from a point five to ten feet downwind of the landfill vents. Upwind samples are collected in the same way.

D. Velocity measurements from vents are acquired via handheld vane anemometer. The vane is held in the vent exit perpendicular to the flow. These measurements are recorded for use in emission calculations. The diameter of each vent is measured by tape and recorded for flow rate calculations.

3.1 Screening with Landfill Gas Analyzer

A. Air monitoring in a screening method will be conducted with a Landtec GA5000 Portable Landfill Gas Analyzer or similar instrument. The analyzer is capable of measuring several gases including methane and percentage of methane gas. The measurements taken at each location will be recorded on a field form or in a field book.

B. The analyzer shall be calibrated daily. Calibration will be accomplished using a bottled calibration gas. Calibration data will be recorded on an instrument calibration report or form. If the analyzer fails to respond to the calibration gas, return the instrument to the factory for service.

C. Prior to use, the analyzer will be cleared and zeroed.

D. To measure gas levels in the gas vents, the analyzer sample line will be held within the exit opening of the landfill vent. Note the methane reading on the analyzer and record on a field form.

E. To measure gas levels for breathing zone readings, the analyzer sample line will be held at a specified distance (i.e. 10ft) upwind and downwind of the vents at a height ranging before 4 to 5 feet .

3.2 Screening with Photoionization Detector (PID)

A. Air monitoring in a screening method will be conducted using an RAE Systems MiniRAE 2000 or 3000 PID. The instrument displays total VOCs detected. The measurements taken at each location will be recorded on a field form or in a field book.

B. The PID shall be calibrated daily. Calibration will be accomplished using a bottled calibration gas (Isobutylene). The instrument should be subject to both a zero and high range (100ppm) calibration. Calibration data will be recorded on an instrument calibration report or form. If the PID does not respond to the calibration, return the instrument to the factory for service.

C. Prior to use at a source, the instrument should be reading zero. If not, note the reading on a field form or field book and proceed with monitoring at the source. Measurements will be accomplished by holding the meter directly adjacent to the top of the gas vent. Note the instrument reading on a field form or in the log book.

D. To measure gas levels for breathing zone readings, the PID will be held at a specified distance (i.e. 10 ft) upwind and downwind of the vents.

3.3 Velocity/Flow measurement with Handheld Vane Anemometer

A. Turn the anemometer unit on and note the units of measurement. Units should be feet/minute.

B. Hold the unit so the propeller is over the open end of the vent, perpendicular to the flow direction. Note the speeds displayed until relatively constant. If not constant, take 4-6 readings per minute at evenly spaced intervals and record them to determine average speed over a pre-determined time (i.e. 2 minutes). Note the instrument reading on a field form or in the log book.

3.4 Sampling with Summa Canister

Start of Sample:

A. Air sampling will be conducted using a stainless steel SUMMA® sampling canister, equipped with pneumatic flow controller (i.e., critical orifice) capable of a constant flow rate over a 1-, 8-, or 24-hour period.

B. Record site name/location on the canister identification tag and on the field data sheet.

C. Record the canister and sampler serial numbers on the canister identification tag and on the field data sheet.

D. Prior to setting canisters in sampling locations, obtain current and forecast meteorological data from nearest airport reporting station. This may be obtained from Weather Underground (wunderground.com) or the National Weather Service site (www.weather.gov). Temperature, wind speed and direction, and barometric pressure should be noted.

E. Set-up canister sampler securely on a stable platform. Remove the cap from the canister inlet valve and attach the sample line to the canister inlet.

F. Set the other end of the sample line directly within the exit opening of the landfill vent. Use a clip or other hardware as necessary to prevent movement of the sample line. For breathing zone samples, no sample line should be needed. Simply place canister in pre-determined upwind or downwind location.

G. Record current approximate wind speed, wind direction, and ambient air temperature on the field data sheet. If simultaneous meteorological data is being collected, this information can be recorded on the field data sheet after the fact.

H. Begin sampling by turning on the canister valve. This normally requires one and one-half (1.5) to two (2) complete turns of the valve knob. Record the sampling start time on the field data sheet.

I. Note the canister pressure via the gauge on the sampler and record this as the initial pressure on the field data sheet. The initial pressure should be between -25 to -30 inches of Hg gauge pressure. If it is not, then the canister may be

compromised**.**

J. Record any other pertinent information such as beginning-of-period ambient conditions that could influence VOC levels in the air sample (i.e. nearby construction, vehicular traffic, etc)

K. Verify that all pre-sampling information has been completed on the field data sheet.

L. Verify that the sampling equipment and site are properly secure upon departure.

Note: It is very important to check on each sample intermittently during the sample period. A flow controller or canister may malfunction but intermittent checks will allow the malfunction to be recognized and a replacement canister can be utilized.

During Sample:

A. Upon arrival, note the canister pressure via the gauge on the sampler and record this as the intermittent pressure on the field data sheet. The current pressure should be different than start pressure and not near zero.

B. Note the time and record on the field data sheet. Verify that the pressure is changing relative to total time of sample.

C. If the desired pressure is not present in the canister, note this on the field data sheet. Close the canister by shutting the canister valve. Remove the malfunctioning unit and replace with spare canister (if available) and repeat sample start procedure.

D. Record any other pertinent information such as current ambient conditions that could influence VOC levels in the air sample.

End of Sample:

A. Upon arrival, note the canister pressure via the gauge on the sampler and record this as the final pressure on the field data sheet. The final pressure should be near -5 inches of Hg.

B. Close the canister by shutting the canister valve. Make sure the valve is completely shut or the air sample will be compromised.

C. Note the end time for the sampling and record on the field data sheet. Verify that the correct number of sampling hours have been obtained.

D. Disconnect the air intake system from the canister and put the cap back on the canister inlet.

E. If the desired pressure is not present in the canister, note this on the field data sheet and on the laboratory chain-of-custody sheet. Any sample from a canister that is not properly pressurized will need to be assessed for validity.

F. Record current approximate wind speed, wind direction, and ambient air temperature on the field data sheet. If simultaneous meteorological data is being collected, this information can be recorded on the field data sheet after the fact.

G. Record any other pertinent information such as end-of-period ambient conditions that could influence VOC levels in the air sample.

H. Verify that all post-sampling information has been completed on the field data sheet.

I. Complete the chain-of-custody form(s) for the canisters.

J. Place chain-of-custody forms and the field data sheets in an envelope.

K. Package the canister(s) in the same box in which it was shipped from the laboratory and over-night the canister(s), along with a properly completed chain-of-custody form, to the analytical laboratory performing the VOC analysis.

STANDARD OPERATING PROCEDURE NO. 17
SINGLE-WELL WELL AQUIFER TESTS (SLUG TESTS)

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 17 describes the guidelines for single well aquifer tests as described in the RI/FS Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS AND CONSIDERATIONS

A. Personnel involved in well development procedures will follow the prescribed procedures in the Health and Safety Plan (HASP).

B. Well development will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

C.. A slug test is a single-well hydraulic test used to determine the transmissivity and hydraulic conductivity of an aquifer. This method can be used to determine estimates of transmissivity for an aquifer in the immediate vicinity of the tested well. The value of transmissivity determined from slug testing will apply only over the screened interval. The test can be performed using either a rising head or a falling head method.

D. Hydraulic Conductivity (K): This is the capacity of a porous medium to transmit water. It can be defined as the volume of water that will flow through a unit cross-sectional area of the medium per unit of time under a unit hydraulic gradient.

E. Transmissivity (T): This is the measure of an aquifer's ability to transmit water. It is the product of the hydraulic conductivity and the saturated thickness of the aquifer.

F. Slug Test: Two types of testing are possible; a rising head or falling head test. A slug test consists of adding a slug of water or a solid cylinder of known volume to the well to be tested or removing a known volume of water or cylinder and measuring the rate of water level recovery inside the well. The slug of a known volume acts to raise or lower the water level in the well.

- Rising Head Test: A test used in an individual well within the saturated zone to estimate the hydraulic conductivity of the surrounding formation by lowering the water level in the well and measuring the rate of water level recovery. The water level may be lowered by pumping, bailing or removing a submerged slug from the well.
- Falling Head Test: A test used in an individual well to estimate the hydraulic conductivity of the surrounding formation by raising the water level in the well by insertion of a slug or quantity of water, and then measuring the rate of drop in the water level.

3.0 TEST METHODS

A. Aquifer hydraulic conductivity tests (slug tests) are accomplished by either removal of a quantity of water (rising head) or introduction of a slug or quantity of water (falling head), and then allowing the water level to stabilize. Water level measurements are taken at closely spaced time intervals using a transducer (3.1 D, E, and F) and water level indicator.

B. Water introduced into the well as part of slug testing will be analyzed for the same parameters as water samples taken from the well. The slug testing water sample will be taken from the container used to introduce the water into the well. This is a quality control procedure designed to demonstrate that contaminants have not been introduced into the well.

C. Prior to testing, the well will be thoroughly developed and water levels allowed stabilizing. When water level measurements show that static water level equilibrium has been achieved, the slug test may proceed. During the slug test, the water level change will be influenced only by the introduction (or subtraction) of the slug volume. Other factors, such as inadequate well development, extended pumping, etc., may lead to inaccurate results.

3.1 Rising Head Tests

A. All equipment will be decontaminated prior to starting the slug testing (SOP 3).

B. The well will be opened. When wells are located within the 100-year flood plain, and equipped with water tight caps, the well will be unsealed at least 24 hours prior to testing to allow the water level to stabilize.

C. Measure the static water level in the well to the nearest 0.01 foot.

D. A decontaminated, automatic data recorder transducer will be placed one to two feet above the well bottom of the screened interval if the head of water in the well is within the pressure range of the transducer. A decontaminated slug (metal cylinder which replaces a known volume or water) is lowered into the well and the displaced water allowed returning to its static level. This will be determined by making periodic water level measurements until the static water level in the well is ± 0.01 foot of the original static water level.

E. Recording of data with the data logger is initiated and the slug quickly withdrawn from the well.

F. As verification, water levels will be manually obtained at time intervals (0, 1, 3, 5, 7, 9, 10, and 12 minutes and every three minutes thereafter through 60 elapsed minutes, then in 10-minute intervals for the next hour, and in 30-minute intervals for the next 3 hours) as necessary. The time between manual readings may be adjusted based on how quickly the well recharges. Data will be recorded in real time (i.e., 9:53, 9:55, 9:57, etc., rather than 2-minute intervals.)

G. Data recording will be stopped when the water level stabilizes in the well.

H. The transducer (and metal slug if used) will be decontaminated upon completion of the test.

I. Additional information to be collected for each test well location includes ground surface elevation, top of well casing elevation, diameter of borehole, and the diameter of monitoring well casing.

3.2 Fall Head Test

Falling head tests will not be performed where screened intervals straddle the water table.

A. All equipment will be decontaminated prior to starting the slug testing (SOP 3).

B. The well will be opened. When wells are located within the 100-year flood plain, and equipped with water tight caps, the well will be unsealed at least 24 hours prior to testing to allow the water level to stabilize.

C. Measure the static water level in the well to the nearest 0.01 foot.

D. The decontaminated, automatic data recorder transducer is lowered into the well and the displaced water allowed returning to its static level. This can be determined by making periodic water level measurements until the static water level in the well is 0.01 foot of the original static water level.

E. The decontaminated slug is lowered into the well to just above the water level in the well.

F. Recording of data with the data logger is initiated and the slug quickly lowered below the water table.

G. As verification, water levels will be manually obtained at time intervals (0, 1, 3, 5, 7, 9, 10, and 12 minutes and every three minutes thereafter through 60 elapsed minutes, then in 10-minute intervals for the next hour, and in 30-minute intervals for the next 3 hours) as necessary. The time between manual readings may be adjusted based on how quickly the well recharges. Data will be recorded in real time (i.e., 9:53, 9:55, 9:57, etc., rather than 2-minute intervals.)

H. Data recording will be stopped when the water level stabilizes in the well. The transducer and slug then will be removed from the well and decontaminated.

Additional information to be collected for each test well location includes ground surface elevation, top of well casing elevation, diameter of borehole, and the diameter of monitoring well casing.

STANDARD OPERATING PROCEDURE NO. 18
LAND SURVEYING AND MONITORING WELLS SURVEY

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 18 describes the guidelines for land surveying and monitoring wells survey as described in the RI/FS Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS AND CONSIDERATIONS

A. Personnel involved in well development procedures will follow the prescribed procedures in the Health and Environmental Plan (HASP).

B. Well development will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan.

3.0 PROCEDURES FOR FIELD SURVEYS AND DIFFERENTIAL LEVELING

3.1 Grade and Top of Casing (TOC) Elevation Surveys

A. Monitoring wells will be surveyed for grade and TOC elevations relative to within 0.01' using differential leveling techniques.

B. Typical surveying instruments include a laser level or differential level (optical) and rod.

C. Monitoring wells will be surveyed to an existing benchmark with a known elevation above mean sea level (msl) (if available).

D. The benchmark can include a registered survey point (USGS, State, City or County) or an existing monitoring well with a surveyed TOC elevation.

E. If a benchmark is not available or if all monitoring wells are being re-surveyed, the TOC of one monitoring well or the benchmark will be assigned an arbitrary value of 100.00 feet and will be documented in the field notes.

F. The grade elevation of a site feature such as: a concrete light post support, bolt of a fire hydrant or corner of a concrete pad will be added to the well survey for future reference.

G. Surveys may need to be performed twice to ensure accuracy by eliminating human error from misreading elevations or recording elevations incorrectly. Once the first survey is complete, the level will be moved an arbitrary distance (1 to 2-feet) and re-leveled. All wells will be re-surveyed and the difference between the first set of elevation values and the second set should be within 0.02-feet.

H. Elevation measurements will be recorded in the field notes.

I. If the survey cannot be completed by Parsons, a Professional Land Surveyor will be contracted to perform the survey for vertical elevations relative to msl and coordinates relative to the State Plane Coordinate System.

3.2 Professional Land Surveyor

The Land Surveyor will collect the land survey data according to this SOP. The subcontracted Field Surveyor must provide a Professional Land Surveyor license and be in good standing with the State of Indiana. It is the responsibility of the supervising Land Surveyor to verify that all work under this agreement complies with all state and local regulations. The Land Surveyor will document all land surveying activities in a field notes.

A. Surface water, sediment, existing gas vents, air monitoring, and shallow soil sample locations will be documented by hand held GPS.

B. A licensed land surveyor will measure all the direct push and monitoring wells locations as the distance in feet and meters from a reference location that is tied to the WGS84 coordinate system. The subcontractor will be responsible for identification of existing benchmarks and establishing temporary control points. The subcontractor will perform elevation (vertical) and positional (horizontal) surveying according to the following guidelines:

C. Survey instruments should be inspected and calibrated by an authorized manufacturer’s representative

D. Survey instruments should be inspected and calibrated by an authorized manufacturer’s representative in accordance with the manufacturer's specifications regarding procedures and frequencies.

E. An X, Y coordinate system will be used to identify locations.

F. The latitude coordinate will be the east-west axis; the longitude coordinate will be the north-south axis.

G. Coordinates of all points X, Y, and Z will be measured to the nearest 0.01 of a foot.

H. The units of measure should be U.S. Survey Feet.

I. Survey data should be provided in the Indiana State Plane coordinate system.

K. Vertical control networks should be verified between at least two published benchmarks.

L. All level and horizontal traverse networks should be closed to the starting point.

3.3 Survey Monitoring Wells

At each well location, measure the ground elevation, the measuring point elevation, and top of casing, if the location is a groundwater monitoring well. The measuring point elevation of all newly installed wells is the most critical measurement; survey the measuring point elevation at the water-level measuring point (notch) on the riser pipe. If the measuring point is not clearly marked, the surveyor should mark a location on the north side of the riser pipe and survey that location. The vertical accuracy of well

measuring point elevations should be 0.01 foot. The surveyors will report X, Y, and Z coordinates for the measuring point, ground surface, and top of casing at all monitoring wells.

3.4 Spatial Distribution of Wells and Site Features Grade

A. The spatial distribution of monitoring wells and borings will be measured with an engineer's tape or measuring wheel or with survey equipment. The spatial distribution or relative positions to site features and other wells or borings will be measured when new wells or borings are installed. Parsons will be notified if field staff notice discrepancies between existing site plans and current site layout.

B. The well positions will first be referenced from each other and then from permanent site features such as: a fire hydrant or a corner of the retail building.

C. A monitoring well should be measured relative to at least two other monitoring wells if possible. If this cannot be done, then the monitoring wells location must be measured relative to a site feature that can then be referenced by a different monitoring well. In one way or another, all of the wells must somehow be measured relative to one another, either directly (preferred) or indirectly.

D. A minimum of three measurements must be made for each well location to an adjacent well or site feature as described above.

E. An attempt will be made to acquire previously drawn site plans or an "As-Built" figure from the Group. If these are not available important site features such as but not limited to: utilities, signs, entrances, landscaping, roads, buildings and structures will be measured. Field staff will contact site and project managers to discuss the extent of detail necessary on a site by site basis when this is necessary.

F. Field staff will take photos of all wells relative to other wells and site features. Document photos with well ID, date and direction facing written on a dry erase board (whiteboard), and include object of known size for scale (can be whiteboard). Digital photos will be transferred to site files in .jpg format.

G. Spatial distribution measurements of site features will be documented in the field as revisions to an existing site plan (if available) or in a hand drawn map of the site in the field log book. Surveying of sediment sampling locations, surface water locations, and subsurface soil and groundwater boring locations only requires X and Y data, unless otherwise noted. Parsons will incorporate those measurements into a CAD/GIS figure as revisions to the existing site plans

STANDARD OPERATING PROCEDURE NO. 19
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 19 describes the procedures required for preparation of sample containers, preservation of samples, and sample holding times as required in the RI/FS Work Plan or as otherwise specified. This sampling protocol will be implemented to maintain the quality and integrity of the samples to be analyzed.

2.0 GENERAL REQUIREMENTS

A. Sample containers and preservation methods will be selected and used to ensure the accuracy and validity of chemical and physical analyses. Materials or procedures that might cause overt disturbance, contamination, oxidation or other chemical decomposition or reaction of the sample will be avoided. This SOP addresses only containers and preservation of chemical analytical samples.

B. Sample preservation methods will adequately meet the requirements established in the RI/FS Work Plan or QAPP.

C. Use of containers and preservation procedures will be consistent with the analytical procedures used by the analytical laboratory.

D. Preservation will be limited to pH control, addition of chemicals, and refrigeration.

These techniques are intended to retard biological action, retard hydrolysis of chemical compounds, keep metals in solution, and reduce volatility of constituents.

E. Environmental samples will be kept on ice or refrigerated to maintain the sample temperature at 4 +/- 2°C. Samples will not be frozen, and dry ice will not be used as the cooling agent (due to shipping restrictions). Any required chemical preservatives will be added to sample bottles in advance, either by the testing laboratory or by field personnel. The required preservatives for various constituents are presented in Table 1 of SOP 19.

F. The maximum holding times for many constituents are listed in Table 1.

G. The sample volumes required for each analysis are listed in Table 1.

H. Sample bottle lids will be hand-tightened.

3.0 CONTAINER TYPES

A. Containers in which sample water is collected will be constructed of materials that remain inert with respect to the suspected contaminants. The containers will have screw- type lids to assure adequate sealing of the bottles. Teflon inserts will be placed inside the lids of glass containers to prevent sample reaction to the lid and improve the quality of the seal.

B. The volumes of the containers used in sample collection are dependent upon the analytical requirements.

C. Sample containers will generally be supplied by the laboratory contracted to perform the analyses. In these cases, sample bottles will be cleaned before shipment to the field. Each bottle will be clearly labeled as to the type of sample it will contain (e.g., metals, VOCs, etc.).

4.0 CONTAINER, PRESERVATION REQUIREMENTS FOR ENVIRONMENTAL SAMPLES AND HOLDING TIMES

A. Table 1 (attached) presents sample container, preservation requirements, and holding times for environmental samples.

TABLE 1
SAMPLE PRESERVATION, HANDLING, AND HOLDING TIME
GARY LANDFILL DEVELOPMENT SUPERFUND SITE
GARY, INDIANA

Parameter	Matrix	Method	Container(s)	Preservation [a]	Holding Time
VOCs	Groundwater/ Surface Water	8260B	2 x 40-ml glass vials with PTFE-lined septum caps	Cool, 4±2°C, HCl	14 days
VOCs	Sediments/Soil	8260B	2 x 40-ml glass vials with PTFE-lined septum caps 1 x 2 oz jar for moisture	Cool, 4±2°C, HCl Sodium bisulfate, methanol (per Method 5035A)	14 days
Metals Dissolved/Total	Groundwater/ Surface Water	6010C	1000 ml plastic bottle	Cool, 4±2°C, HNO_3	6 months
Metals	Sediments/Soil	6010C	250-ml wide-mouth plastic or glass container.	Cool, 4±2°C	6 months
Mercury Dissolved/Total	Groundwater/ Surface Water	7470A/7471B	1000 ml plastic bottle	Cool, 4±2°C, HNO_3	28 days
Mercury	Sediments/Soil	7470A/7471B	250-ml wide-mouth plastic or glass container.	Cool, 4±2°C	28 days
Cyanide	Groundwater/ Surface Water	9010C/9014	1000 ml plastic bottle	NaOH to pH>12, plus 0.6 g Ascorbic Acid Cool to 4±2°C	14 days
Cyanide	Sediments/Soil	9010C/9014	250-ml wide-mouth plastic or glass container.	Cool, 4±2°C	14 days
SVOCs/PAHs Pesticides PCBs	Groundwater/ Surface Water	8270C 8081B 8082A	2 1-Liter amber glass containers with Teflon-lined lid for **each analysis** (an additional 2 1-Liter containers required every 20 samples for MS/MSD for **each analysis**.)	Cool, 4±2°C	7 days until extraction; 40 days after extraction
SVOCs/PAHs Pesticides PCBs	Sediments/Soil	8270C 8081B 8082A	250-ml wide-mouth amber glass container with Teflon-lined lid. (2 additional 250-ml wide-mouth glass containers every 20 samples for MS/MSD).	Cool, 4±2°C	14 days until extraction; 40 days after extraction

Notes: [a] All samples, with exception of the Geotechnical parameters, need to be kept at 4 degrees Celsius after sampling.

STANDARD OPERATING PROCEDURE NO. 20
SAMPLE STORAGE, PACKAGING, AND SHIPMENT

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 20 describes the guidelines for sample classification, storage, packaging, and shipment as described in the RI/FS Work Plan or as otherwise specified to ensure proper handling of samples.

2.0 SAMPLE STORAGE

A. Samples to be sent offsite will be stored in a manner consistent with the requirement for sample preservation to maintain the quality of the sample. All samples collected will be labeled and immediately placed on ice in a cooler. Samples preserved by cooling will be stored in such a way as to maintain the acceptable range of temperature for the duration of the holding time.

B. Samples will not be stored on site for extended periods and will be protected from environmental extremes. Shipment to the laboratory will be completed as soon as possible and within the specified holding times for each particular analysis to allow analysis within the holding time limits.

C. If temporary storage is necessary, samples will remain in an area that has been designated as the “sample storage area,” which will be locked and secured to maintain sample integrity and chain-of-custody requirements. Separate containers will be used to store or transport low, medium, and high concentration samples.

D. Samples will not be stored in refrigerators or other areas where food or drink may also be stored, and vice versa.

3.0 ENVIRONMENTAL SAMPLE PACKAGING

3.1 Regulatory Considerations

A. DOT regulations do not consider environmental samples hazardous. In addition, DOT has stated that dilute solutions of chemical preservatives are not subject to Hazardous Materials Regulations.

B. In accordance with 49 CFR 173.24(a), the following is required for all packages: “Each package used for shipping hazardous materials will be so designed and constructed, and its contents so limited, that under conditions normally incident to transportation:

1) There will be no significant release of the hazardous materials to the environment;

2) The effectiveness of the packaging will not be substantially reduced; and

3) There will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, or through an explosion, significantly reduce the effectiveness of the packaging.”

C. In accordance with 94 CFR 173.6(a), the following are required for all shipment by air: "Each package will be so designed and constructed, and its contents so limited, that under conditions normally incident to transportation:

1) There will be no significant release of materials to the environment.

2) Inner containers that are breakable (such as earthenware, glass, or brittle plastic) will be packaged to prevent breakage and leakage under conditions normally incident to transportation. Those completed packaging's will be capable of withstanding a 4-foot drop on solid concrete in the position most likely to cause damage. Cushioning and absorbent materials will not react dangerously with the contents.

3) For any packaging with a capacity of 110 gallons or less containing liquids, sufficient outage (ullage) will be provided to prevent liquid contents from completely filling the packaging at 130º F. The primary packaging (which may include composite packaging), for which retention of the liquid is the basic function, will be capable of withstanding, without leakage, an internal absolute pressure of not less than 26 pounds per square inch or no less than the sum of the absolute vapor pressure of the contents at 130º F (55º C) and the atmospheric pressure at sea level, whichever is greater.

4) Stoppers, corks, or other such friction-type closures will be held securely, tightly, and effectively in place with wire, tape, or other positive means. Each screw-type closure on any inside plastic packaging will be secured to prevent the closure from loosening due to vibration or substantial changes in temperature."

3.2 Shipping Containers

A. Sample containers will be placed inside a strong shipping container capable of withstanding a 4-foot drop on solid concrete in the position most likely to cause damage. A metal or plastic cooler (ice chest) with a hard plastic liner withstands this test. The drainage hole at the bottom of the cooler will be taped shut so that the contents from the broken containers or water from ice bags will not escape. The shipping container will be taped shut to form an adequate seal around the lid to prevent any leakage in the event that the cooler is turned over.

B. The shipping container will be marked "THIS END UP" with arrows indicating the proper upward position of the container affixed to all four sides. To prevent cross- contamination, the shipping container will be adequately cleaned between shipments.

3.3 Ice

A. Ice will be placed into 1-gallon size plastic bags (minimum 2-ml thick) and sealed tightly.

The amount of ice used will depend on the available space in the cooler, but 10 pounds per 20 quarts of cooler volume would be the minimum to assure sufficient

cooling to less than 4°C. Alternatively, gel freezer packs (blue ice) will be used to cool the samples. Dry ice (CO_2) will not be used.

3.4 Glass Containers

A. The lid of the container will be tightened to assure an adequate seal. The container may be placed into a clear plastic bag that has a minimum thickness of 2-ml (many 1-quart and 1-gallon size zip-lock bags are suitable) and this bag sealed. They will be wrapped and cushioned in an inert packing material such as bubble wrap or shredded paper.

3.5 Plastic Containers

A. Plastic containers do not require individual cushioning material, but will be packed to prevent movement during transport. Caps will be tightly screwed on. These bottles may also be placed into a 2-ml thick plastic bag and the bag sealed.

4.0 SHIPPING OF SAMPLES

4.1 Environmental Samples

A. Environmental samples may be shipped to the testing laboratory by commercial common carrier, bus, rental vehicle, or air cargo service.

STANDARD OPERATING PROCEDURE NO. 21
SAMPLE CONTROL AND CUSTODY PROCEDURES

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 21 describes the guidelines for controlling sample identification and chain-of-custody in order to maintain the quality and integrity of samples during collection, transportation, and storage for analysis as described in the Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS

A. Sample control and custody will be followed, without exception, by all persons involved in sampling and documentation activities as specified in the RI/FS Work Plan and/or QAPP.

B. Samples may be defined as any physical evidence collected for environmental measuring and monitoring.

C. Sample identification documentation will be prepared to maintain sample identification and chain of custody. The following are examples of sample identification documentation:

1) Sample identification labels
2) Chain-of-custody records
3) Custody seals
4) Field logbook

3.0 SAMPLE IDENTIFICATION LABELS

3.1 Label Forms

A. Sample labels will be provided to the sampling personnel by the site manager in a form appropriate for the sampling activity. Labels may be pre-printed with spaces for the appropriate sample identification and information requirements, or may be blank with lines provided for uniform recording. The label will be of the material type that ink will write, but not be so overly absorbent that ink will run. Labels will be self-adhesive on glass and polyethylene containers.

B. The following sample information should be entered on each sample label and tabulated in the field logbook.

1) Project identification number or code.
2) Date and time of the sample collection.
3) Sample station identification (boring number, well number, etc.).
4) Sample identification number or code that uniquely identifies the sample's location (including area location and depth), whether it is a replicate or blank (see exception below**).

5) Preservative(s) used.

6) Analysis code, indicating which general group of analyses is intended for that particular container of sample.

7) Serial number (if required).

8) Comments or notations to inform the laboratory of any special circumstances or warnings. Also, indicate if sample is a "grab" or "composite" sample.

9) Sampling personnel initials.

** Exception: If the quality assurance samples (replicates, blanks, etc.) are to be kept anonymous to the laboratory, then all samples should be identified by a code or numeric system that does not reference the sample as such.

B. Each sample will be identified by an alpha-code corresponding to the sample matrix/type. The alpha-code is as follows:

1) GW – Groundwater sample (from monitoring wells)

2) SW – Surface water sample

3) AS – Perimeter gas sample

4) GV – Landfill vent air sample

5) SB – Soil sample

6) GP – Direct push sample

7) SD – Sediment sample

8) SS – Surface soil sample

9) GT – Geotechnical soil sample

10) TB – Trip blank sample

11) EB – Equipment blank sample

12) MS – Matrix spike

13) MSD – Matrix spike duplicate

14) IDW - Investigation derived waste sample

The sample matrix/type will follow a sample location number, which will be identified as follows:

1) Monitoring Wells

- Monitoring wells will be identified as MW. If groundwater is obtained from a monitoring well at the specific depth, then the depth should be added.

2). Surface Water Sample

- Surface water sample will be identified as SW.

3). Soil Borings/Temporary Monitoring Wells

- Soil borings will be identified as GP. The sampling depth should be added. If groundwater is obtained from a soil boring then the temporary monitoring well should be identified as GP.

4) Sediment Sample

- Sediment sample will be identified as SD. The sampling depth should be added.

5) Geotechnical Borings

- Geotechnical soil borings will be identified as GT. The sampling depth should be added.

6) Duplicates

- Duplicates will be identified by a 1 before the sample number.

7) Depth

- A depth will be included when samples are taken from a specific interval.

8) Example Labels

- MWXX: Groundwater sample obtained from MWX.
- MW1XX: Field duplicate groundwater sample obtained from MWX.
- MWXX-MS Matrix spike sample collected from MWX.
- MWXX-MSD: Matrix spike duplicate sample collected from MWX.
- MWXX-XX.X: Monitoring well sample collected from the specific depth of XX.X feet below ground surface.
- GPXX-XX.X: Soil sample collected at soil boring GPX at a depth of XX.X feet below ground surface.
- GP1XX-XX.X: Field duplicate soil sample collected at soil boring GPX at a depth of XX.X feet below ground surface.
- GPXX-GW01-XX.X: Groundwater sample collected at soil boring GPXX at a depth of XX.X feet below ground surface.
- SWXX-SW01-XX.X: Surface water sample collected from Northern Pond.
- SDXX-SED01- XX.X: Sediment sample obtained from SDX at a depth of XXX.X feet below ground surface.
- MWXX-SB01- XX.X: Soil sample obtained from MWX at a depth of XXX.X feet below ground surface.
- SSXX-SS01- XX.X: Surface soil sample obtained from SSX at a depth of XX.X feet below ground surface.
- GVXX: Landfill vent air sample obtained from GVX vent location.
- ASXX: Perimeter air sample obtained from ASX location.
- TB-X: Trip blank in cooler X for the day.
- MWXX-EB: Equipment blank collected from equipment used for sampling MWX.

3.2 Labeling Procedure

A. Following collection of the sample and placement into the appropriate container, wipe excess soil, waste, or water from the exterior of the container. Affix adhesive label or tag to container.

B. Complete label information as prescribed above, using indelible ink. If a mistake is made, neatly mark through the mistake once and write in the correction, initialing the correction. If the label is too smudged or damaged to neatly correct, void it by writing "VOID" across it and initial it, then affix a new label onto the container, partially covering the voided label.

C. Cover the label with clear plastic adhesive tape to protect the label and prevent it from being subsequently written upon.

D. For custody control, a sample label will be considered to be in an individual's possession until it is filled out, attached to the sample, and transferred to another individual along with the corresponding chain-of-custody form.

4.0 CHAIN-OF-CUSTODY RECORD

4.1 Definition Of Custody

A. A sample is under custody if one or more of the following criteria are met:

1) The sample is in sampler's possession.

2) It is in the sampler's view after being in possession.

3) It was in the sampler's possession and then was locked up to prevent tampering.

4) It is in a designated secure area.

B. All samples submitted to the laboratory will use the above criteria to maintain custody while in possession of the sampler. Whenever the samples, or sample coolers, are not in the sampler's view they will be locked up (either in a vehicle or in a hotel room) to prevent tampering.

C. Because samples collected during an investigation could be used as evidence in litigation, possession of the samples will be traceable from the time each sample is collected until the sample is introduced as evidence in legal proceedings. To document sample possession for samples submitted to an offsite laboratory, chain-of- custody procedures and documentation are discussed below.

4.2 Chain Of Custody Documentation And Forms

A. Chain-of-custody documents are initiated by the sampling personnel in the field with the notation of sampling data and sample identification during the sampling activity. Generally, these data are collected in the field logbook in a tabulated form along with the description of the sample and sampling procedure and includes the following:

1) Project number

2) Sample station identification

3) Sample identification

4) Data and time sample was taken

5) Sample type

6) Number and type of container used

7) Whether sample was grab or composite

8) Preservation method used

9) Analysis requested

10) Name of sampling personnel involved

B. Each sample sent offsite would be recorded on a chain-of-custody form by the sampler or a field sample custodian at the site. The form will be filled out after returning the sample from the sampling locations.

C. The chain-of-custody form will be completed by the sampler or by the field sample custodian on behalf of the sampler. The information indicated on the chain-of- custody form will be reconciled with that in the field logbook used by the sampler personnel. The chain-of-custody form will be signed by the sampling personnel.

4.3 Custody Seals

A. When samples are shipped to the laboratory, they will be placed in containers sealed with tape, with custody seals affixed to the storage containers. Some custody seals are serially numbered. These numbers will appear in a cross-reference matrix of the field document and on the chain-of-custody report. Other types of custody seals include unnumbered seals and evidence tape.

B. When samples are shipped, two or more seals are to be placed on each shipping container (such as a cooler), with at least one at the back, located in a manner that would indicate if the container were opened in transit. Wide, clear tape will be placed over the seals to ensure that seals are not accidentally broken during shipment. Nylon packing tape may be used providing that it does not completely cover the custody seal. Completely covering the seal with this type of tape may allow the label to be peeled off. Alternatively, evidence tape may be substituted for custody seals.

C. If samples are subject to interim storage before shipment, custody seals or evidence tape may be placed across the opening of the storage box. Custody during shipment will be the same as described above. Evidence tape may also be used to seal the plastic bags or metal cans used to contain samples in the cooler or shipping container. Sealing individual sample containers assures that sample integrity will not be compromised if the outer container seals are accidentally broken.

4.4 Field Custody Procedures

A. Only enough of the sample will be collected to provide a good representation of the medium being sampled. To the extent possible, the quantity and types of

samples and the sample locations will be determined before the actual fieldwork. As few people as possible will handle the samples.

B. Field samplers are personally responsible for the care and custody of the samples collected by their teams until the samples are transferred or dispatched properly. A person will be designated to receive the samples from the field samplers after decontamination; this person maintains custody until the samples are dispatched.

C. The site manager will determine whether proper custody procedures were followed during the fieldwork and will decide if additional samples are required to make up for any deficiencies.

D. Samples submitted for offsite analysis will be accompanied by the designated chain- of-custody form or record for the laboratory receiving the samples. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the form. This form documents sample custody transfer from the sampler, often through another person, to the analyst at the laboratory.

E. Samples are packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate chain-of-custody record accompanying each shipment. Shipping containers are sealed with tape, and custody seals are affixed to the storage containers for shipment to the laboratory. The method for shipment, courier name(s), and other pertinent information such as the laboratory name and contact will be entered in the “Remarks” section of the chain-of-custody record.

F. When samples are split with an owner, operator, or government agency, the event is noted in the “Remarks” section of the chain-of-custody record. The note indicates with whom the samples are being split. The person relinquishing the samples to the facility or agency requests the signature of the receiving party on a receipt-for- samples form, thereby acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this situation is noted in the “Remarks” section of the chain-of-custody record. The samples will be secured if no one is present to receive them.

G. All shipments are accompanied by a record identifying their contents. The original form accompanies the shipment; the copies are retained by the sampler.

H. If no hazardous samples are sent by mail, the package is registered, and the return receipt is requested. (NOTE: Hazardous materials will not be sent by mail) If samples are sent by common carrier, a bill of lading is used. Airfreight shipments will be sent prepaid. Freight bills, postal service receipts, and bills of lading will be retained as part of the permanent documentation of the chain-of-custody records.

5.0 FIELD LOGBOOK

A. A bound field logbook will be maintained by the sampling team leader to provide daily records of significant events, observations, and measurements during field

investigations. All entries are to be signed and dated. Observations or measurements taken in an area where contamination of the field notebooks may occur may be recorded in separate bound and numbered logbooks before being transferred to the project logbook. The original records are retained, and the delayed entry is noted as such.

B. Field logbooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during projects and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. In a legal proceeding, notes, if referred to, are subject to cross-examination and are admissible as evidence. The field notebook entries will be factual, detailed, and objective.

5.1 Corrections To Documentation

A. Unless restricted by weather conditions, all original data recorded in field logbooks and on sample identification labels, chain-of-custody forms, and custody seal forms are written in waterproof ink. Accountable serialized documents are not to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

B. If an error is made on an accountable document assigned to one person, that individual may make corrections simply by crossing out the error and entering the correct information. The erroneous information will not be obliterated. Any error discovered on an accountable document will be corrected by the person who made the entry. All corrections will be initialed and dated.

C. For all photographs taken, a photographic log will be kept; the log records date, time, subject. Set digital camera to display the date on the photo, if needed. Otherwise, file properties will indicate date/time photo taken.

STANDARD OPERATING PROCEDURE NO. 22
INVESTIGATION DERIVED WASTE (IDW) HANDLING

1.0 PURPOSE OF PROCEDURE

Standard Operating Procedure (SOP) No. 22 describes the guidelines for investigation derived waste (IDW) handling as specified in the RI/FS Work Plan or as otherwise specified.

2.0 GENERAL REQUIREMENTS

A. Procedures for IDW handling will be specifically addressed in the Health and Safety Plan (HASP).

B. IDW activities will be documented to verify that proper procedures are followed. Documentation will be in accordance with the requirements specified in the RI/FS Work Plan, and/or the Quality Assurance Project Plan (QAPP).

3.0 EQUIPMENT AND SUPPLIES

- Field book and project plans
- Pumps (either air diaphragm with compressor or alternate)
- Appropriate hose and tubing
- Plastic sheeting
- Drums (as needed)
- Appropriate laboratory containers
- Coolers with ice
- Chain of Custody Form

4.0 DISPOSAL PRACTICES

4.1 Soil Cutting Disposal Method

During soil sampling (for delineation and lead evaluation), soil cuttings generated will be placed back into their respective boreholes. Additional soil cuttings that cannot fit into the borehole will be placed in drums, in a staging area. Soil cuttings from monitoring well borings and geotechnical soil borings will be placed in drums during drilling. The drums will be labeled and stored as follows:

- Record the volume of soil per drum (1/2, ¾, or full), the boring(s) from which the soil cuttings were generated, the location at which they will be stored and the drum label ID#.
- Soil cuttings will be containerized in new, or reconditioned, properly labeled, 55-gallon, DOT approved, steel, open-top/open-head, drums.
- Drums will be staged onsite in a discrete area if possible. The drum storage area needs to be easily accessible by the drum removal contactor (on level, solid ground). The preferred disposal contractor will be notified of the location, number and contents of the drums for disposal. The drums for soil

cuttings from the monitoring well and geotechnical soil borings will be staged near the respective boreholes.

4.2 Purge Water, Decontamination Water, And Development Water Disposal Method

Purge water derived from the sampling of monitoring wells, development water derived from developing the monitoring wells, and decontamination waters derived from decontaminating heavy equipment and sampling equipment will be containerized in drums for disposal, as follows:

- Record the volume of water per drum (1/2, ¾, or full), the boring(s) from which the water were generated, the location at which they will be stored and the drum label ID#.
- During well purging and development water generated from the new monitoring wells and existing monitoring wells will be placed into closed-top, steel drums, in a secure staging area. These drums will be disposed of in accordance with the Waste Management Plan to be developed for this site.
- Well development and purge water from existing monitoring wells with no COCs above MCLs will be discharged onto the ground surface near each monitoring well.

The solid materials in drums, generated during sampling events, will be either placed under cap during the remediation activities or will be transported and disposed off-site at an approved facility. If transported off-site, the waste media (soil and groundwater) will have an approved waste profile established prior to transport and disposal.

General uncontaminated trash and refuse, including personal protective equipment (PPE), plastic sheeting, packaging, etc. will be contained in trash bags and disposed as trash in a Subtitle D landfill.

APPENDIX C
HEALTH AND SAFETY PLAN

Gary Development Landfill Superfund Site

Health and Safety Plan

January 2016

All incidents/near misses	Enter into IndustrySafe within 4 hours
Worker injury or illness	Project SH&E Manager (312-930-5104)
Environmental spill/release	Enter into IndustrySafe within 4 hours
Medical (non-emergencies)	WorkCare (888-449-7787)
Site security (if applicable)	(716-541-0760)

Project Key Personnel

Company Executive responsible for Project	**Contact Information**
Bob Glenn	Direct Line: (678) 969-2324 Non-Responsive Email: Robert.Glenn@Parsons.com
Project Manager	**Contact Information.**
Mark Raybuck	Direct Line: (716) 541-0752 Non-Responsive Email: Mark.Raybuck@Parsons.com
Field Team Leader	**Contact Information.**
Florin Savin	Direct Line: (312) 930-5104 Non-Responsive Email: Florin.Savin@Parsons.com
Project SH&E Representative	**Contact Information**
Florin Savin	Direct Line: (312) 930-5104 Non-Responsive Email: Florin.Savin@Parsons.com
Client Project Management POC	**Contact Information**
Bennie Underwood/Mike Samples	Direct Line: (865) 691-5052 Non-Responsive Email: mikes@demaximis.com/bennie@demaximis.com

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SECTION 1 – INTRODUCTION

1.1 PARSONS SAFETY, HEALTH & ENVIRONMENT POLICY

Exhibit P-1 – Parsons Corporate SH&E Policy

PARSONS

Corporate Safety, Health & Environment Policy Statement

As an industry-leading engineering, construction, and technical services firm, Parsons is firmly committed to maintaining a safe, healthy, and environmentally compliant workplace at all its offices and project facilities, guided by the following tenets:

- Safety, Health and Environment (SH&E) is a core value.
- Executive management will lead the SH&E process.
- SH&E will be a responsibility shared by all.
- SH&E performance will be a key business performance indicator.
- SH&E performance will be communicated openly.
- Employees will be given the knowledge and skills necessary to perform their jobs in a high-performance SH&E manner.
- We will extend our SH&E efforts beyond the workplace to include travel, homes, and communities.
- We will continually strive to improve our SH&E processes.

To meet our SH&E objectives, all employees are expected to be actively engaged with regard to SH&E issues. This requires the combined efforts of a concerned management, responsible and knowledgeable supervision, and conscientious, well-trained employees.

Executive Management shall lead and monitor and improve the performance of the organization's Safety, Health and Environmental Management System, at regular intervals, to ensure its continuing suitability, adequacy, and effectiveness.

Parsons will meet or exceed the applicable SH&E legal and other requirements and will continuously monitor and improve operations, procedures, technologies, and programs that are conducive to maintaining a safe, healthy, and environmentally compliant workplace.

Charles L. Harrington

Chairman and Chief Executive Officer

January 2012

1.2 THE PROJECT SAFETY, HEALTH, AND ENVIRONMENTAL PLAN (PSHEP)

Parsons goal is zero incidents using control measures designed to minimize or eliminate hazards to personnel, processes, equipment, the general public and the environment. This PSHEP outlines safety, health, and environment (SH&E) requirements and guidelines developed by Parsons for client-specific work. When implemented, these requirements will help protect site personnel, visitors, the public, and the environment from incidents caused due to SH&E hazards. Parsons employees should never perform a task that may endanger their own safety and health, the safety and health of coworkers or the public, or damage the environment.

This plan should be updated as conditions change or situations change, usually by addenda to the PSHEP. All Parsons and subcontractor personnel must understand and implement the PSHEP and any addenda. Parsons documents this process by having employees sign an acknowledgement form stating that they understand the PSHEP and its requirements.

1.3 SUBCONTRACTOR SAFETY, HEALTH, AND ENVIRONMENTAL PLANS (SSHEPS)

Subcontractors must establish their own safety program for their work and employees. Contract specifications require all subcontractors to accept the Parsons' PSHEP and prepare their own subcontractor safety, health, and environment plan (SSHEP) for work activities the subcontractor has responsibility for performing. The subcontractor will present the SSHEP to the Parsons' Project Manager at least 10 days before site mobilization. At a minimum, subcontractor plans must meet the requirements of this PSHEP and provide SH&E equipment and safeguards suitable for the hazards involved. This PSHEP may not cover all potential hazards on every project, and subcontractors must ensure that appropriate SH&E information is available for all of the subcontractor's project tasks.

All PSHEP requirements for Parsons' personnel (e.g., training, substance abuse screening, incident reporting, etc.) also apply to subcontractor personnel, and do not need to be repeated in the SSHEP. Since the SSHEP is part of the PSHEP, subcontractor personnel will be required to receive an Orientation that covers information from both documents, and sign off accepting the PSHEP.

For this project, there will be subcontractors directly hired by Parsons.

1.4 MANAGEMENT OF CHANGE (MOC)

Modifications may be made to this PSHEP document after discussion and approval by the Parsons GBU/Division SH&E Manager. Insert a description of the changes in the table below (insert additional rows as necessary).

PSHEP Section	SH&E Initials	Date	Description/Comments

SECTION 2 – SCOPE OF WORK

2.1 SCOPE OF WORK

Parsons, in their contracted role with the Gary Development Landfill (GDL) Notice Parties Group is providing Remedial Investigation/Feasibility Study services for the work as specified in the Contract No. 19457-0001.

The Gary Development Landfill (CERCLIS ID No. IND077005916) Site was a former permitted solid waste landfill, consisting of 62 total acres, located in an industrial area of the City of Gary, Indiana.

The GDL site was the subject of multiple investigations conducted by the USEPA and the Indiana Department of Environmental Management (IDEM) from 1990 to 2012. In addition, multiple site inspections were conducted prior to 1990. These investigations included sampling of groundwater, surface water, liquid waste, and sediments within the site, and extensive sampling within the Grand Calumet River.

Based on a review of the historical data, background information, and a Site visit, a preliminary conceptual site model (CSM) has been developed. The over-riding preliminary remedial action objective is to contain the waste within the former landfill. Containment would remove several exposure pathways by preventing contact of stormwater with the underlying waste. Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs), and metals are the primary analytes observed in previous site investigations. Volatile Organic Compounds (VOCs), Semivolatile Organic Compounds (SVOCs), and pesticides will be monitored as well.

Remedial Investigation tasks at the GDL Site will include:

- Site Preparation
    - Onsite building evaluation
    - Brush hog/clear roads/sampling paths
    - Scrap metal and debris removal
    - Underground utility location
    - Access control/fencing
    - Onsite well inventory
- Southern Wetlands Investigation
    - Wetlands delineation
    - Sediment sampling
    - Ecological investigation (biota/habitat)
- Perimeter Groundwater Evaluation

    - Water wells survey
    - Direct push/Geoprobe investigation
    - Monitoring well installation
    - Soil sampling (during well installation)
    - Geotechnical sampling
    - Hydrogeologic evaluation (groundwater flow, slug tests)
- Landfill Evaluation
    - Existing landfill cover evaluation
    - Geotechnical sampling
    - Waste boundary evaluation (test pits)
    - Air investigation
- Northern Pond Investigation
    - Inspect vegetation and habitat
    - Surface water sampling
    - Perimeter/shallow sediment sampling
- Post Sampling Activities
    - Survey wells and sampling locations
- Investigate waste disposal and materials management

2.2 PROJECT SAFETY, HEALTH, AND ENVIRONMENTAL PLAN APPLICATION

This PSHEP and its referenced documents apply to all locations, facilities, operations, and projects associated with contract work performed by Parsons and its subcontractors. Locations/sites covered under this contract include the GDL Site and the Parsons Chicago Office.

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SECTION 3 – PROJECT SH&E MANAGEMENT RESPONSIBILITIES AND AUTHORITY

3.1 SH&E RESPONSIBILITY MATRIX

Exhibit 3-1 summarizes the responsibilities of selected roles related to the primary SH&E activities identified in the PSHEP.

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Exhibit 3-1 – Project Responsibility Matrix

Project Responsibility Matrix		Project												GBU							Corporate					
Phases	Work Elements	Project Manager	Safety & Health	Environmental	Construction/Site Management	Engineering	First Line Supervision	Facilities and Maintenance	Training	Contracts/Procurement	Security	Sustainability	Quality	President	Operations/Risk Management	Division Management	Sector Management	Safety, Health & Environment	Quality	Business Development	CEO	Operations/Risk Management	Safety, Health & Environment	Security	Workers' Compensation	Insurance
Introduction to ESHARP for Project	1. ESHARP Project Management	R	D	D	P	P	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
Business Development	2. Business Development	R	P	P	P	P				P				P	P	A	P	P	P	D	P	P	P	P		P
Startup	3. Initial Hazard Analysis and Planning	A	R	D	P	P					D							P					P	P		
	4. Project Safety Health, and Environmental Plan (PSHEP)	A	D	D	P										P	P	P	R					P	P		
	5. Stakeholder PSHEP Alignment Meeting	A	D	D	P													R								
Construction and/or Field	6. Preconstruction Safety, Health & Environment Activities	A	D	D	P		P						P				P	R	P					P		
	7. Project/Site Orientation, Training, and Recurring Field SH&E Meetings	A	D	D	P		P	P	P									R						P		
	8. SH&E Committee	A	D	D	P		P	P			P							R						P		
	9. Meet Building Trades, Safety, Health, Environmental Regulatory Agencies, & Others	A	D	D	P													R						P	P	
	10. Review Contractor/Subcontractor SH&E Programs	A	D	D	P					P								R						P		
	11. Subcontractor Premobilization Meeting	A	D	D	P	P				P	P							R						P		
	12. Risk Mitigation Planning (2-week look ahead)	A	D	D	R													D						P		
	13. Activity Hazards Analysis	A	D	D	P	P	P	P										R						P		
	14. Project Management Site Safety, Health, & Environmental Inspections	A	D	D	P											P	P	R	P					P		
	15. Audits, Inspections, and Recordkeeping	A	D	D	P		P						P			P	P	R	P					P		
	16. Incident Management Process	A	D	D	P		P						P		P	P	P	R	P					P		P
Testing, Commissioning, Operations, and Decommissioning	17. Management Systems and Transition	A	R	R	D	P	P	P	P		P	P	P	P	P	P	P	P	P		P	P	P	P		P
	18. Equipment and Systems Integrity	A	P	P	R	P	P	D	P				P					P	P				P			
	19. Operations Training and Education	A	D	D	P	P	P	P	P		P		P					R					P			
	20. Assessments and Corrective Action	A	D	D	P	P	P	P	P		P		P					R					P			
	21. Operations Emergency Management	A	P	P	P	P	P	P	P	P	D		P					R					P	P		
	22. Safe and Environmentally Compliant Work Practices	A	D	D	P	R	R	P	P									P					P			
Closeout	23. Lessons Learned and Final SH&E Report	A	D	D	P											P	P	R	P				P			
	24. Records Retention	A	P	P					P		D		P					R	P				P			

R – Responsible and accountable for ensuring the project develops and implements the work element.
D – Develops the plan, tool, training, document, or other item needed for the work element.
P – Participates by providing advice, assisting in the implementation or development, reviewing and providing comments, or otherwise supporting the development or implementation effort.
A – Approval at the management level with responsibility for the project; establishes requirements for the project or serves as sponsor for the item.

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SECTION 4 – ADMINISTRATIVE PHASE

4.1 PROJECT SAFETY, HEALTH & ENVIRONMENT (SH&E) COMMITTEE

If a project has less than five (5) Parsons employees or a total of 25 Parsons and subcontractors, then the project staff will utilize information from the Parsons' office responsible for the project as a resource for SH&E committee information. The Project SH&E Representative will be responsible for obtaining and communicating information from the Parsons' Office SH&E Committee meeting minutes, with the project personnel on a monthly basis.

For this project, there will not be a Project SH&E Committee.

4.2 EMPLOYEE ORIENTATION

All new employees on a project, including new hires and transfers, must attend the site orientation program on their first day and sign an acknowledgment form indicating they attended and understood the orientation. Any employee who is unsure of any information presented in the orientation must request clarification. Employees who do not participate in the orientation or refuse to sign the acknowledgment cannot work on site. Site-specific safety procedures and training requirements are covered in Section 7.

4.3 AWARENESS CAMPAIGN

If a project is less than 3 months in duration or has less than five (5) Parsons employees, then the project will fall under the Parsons' office responsible for the project as a resource for SH&E awareness. The Project Manager may also provide training, presentations, or informational materials as part of the awareness campaign. For this project, the duration is more than 3 months in duration, and has less than five (5) Parsons employees.

SH&E bulletin boards maintained by the Project Manager are primary information points for the project awareness campaign. Bulletin boards are located at project field office/trailer and Parsons Chicago Office.

4.4 TRAINING

The project has a comprehensive SH&E training program tailored to the client requirements and scope of work. All office-based employees or field employees who spend a significant portion of their time in an office or trailer must receive specialized office training consisting of proper lifting techniques, ergonomics, housekeeping, common office hazards, waste management and office emergencies. All projects should be associated with a Parsons office, and the Office SHE Plan should be reviewed for additional information.

All personnel shall be listed in the PSHEP Training-Medical Records spreadsheet (see Appendix), which will identify the training requirements and expiration dates for applicable certifications. Safety training for project personnel will be based primarily on their work activities and corresponding exposure to hazardous substances and health hazards. The Parsons Corporate Safety and Health Manual (CSHM) and applicable sections will be used as a reference for determining the minimum training requirements based on the project scope of work.

Applicable	Corporate Safety and Health Manual Section/Topic
Yes No	CSHM-1 Medical Qualification and Surveillance
Yes No	CSHM-2 First Aid - list all site personnel in the PSHEP Training-Medical spreadsheet that will be a first responder due to the insufficient response time of EMS personnel. See Section 6.9 of the PSHEP for additional information on first responders.
Yes No	CSHM-3 Ergonomics
Yes No	CSHM-4 Concrete and Masonry Construction
Yes No	CSHM-5 Field and Office Facilities
Yes No	CSHM-6 Personal Protective Equipment
Yes No	CSHM-7 Hearing Conservation – list all site personnel in the PSHEP Training-Medical spreadsheet that will be exposed to noise at levels greater than 85 decibels over an 8 hour time period, which require annual training and audiograms. Include the work activities generating the noise in Section 4.11.6 of this PSHEP.
Yes No	CSHM-8 Respiratory Protection – list all site personnel in the PSHEP Training-Medical spreadsheet that will have a theoretical potential exposure to contaminants above a permissible exposure limit (PEL) based on known soil or water analysis results, or when there is known contamination with no exposure data. Personnel are required to have annual training, medical clearance and a fit test in order to wear a respirator.
Yes No	CSHM-9 Air Monitoring – complete Exhibit 6-1 that identifies chemicals of concern, air monitoring equipment, action levels (based on OSHA PELs) and corresponding PPE/Action Taken.
Yes No	CSHM-10 Hazard Communication
Yes No	CSHM-11 Emergency Procedures
Yes No	CSHM-12 Fire Protection
Yes No	CSHM-13 Hazardous Waste Operations – list all site personnel in the PSHEP Training-Medical spreadsheet that will be engaged in hazardous substance removal or other activities that expose or potentially expose them to hazardous substances or health hazards (such as entering an exclusion zone), which are required to receive appropriate training as required by 29 CFR 1910.120, including, but not limited to, initial 40-hour, 8-hour Supervisor and annual 8-hour refresher training.
Yes No	CSHM-14 Process Safety Management
Yes No	CSHM-15 Confined Space - list all site personnel in the PSHEP Training-Medical spreadsheet that will be involved with confined spaces, which will require proof of training.
Yes No	CSHM-16 Signs, Barricades and Traffic Control
Yes No	CSHM-17 Hazardous Materials Handling, Transportation, Storage and Disposal – list all site personnel in the PSHEP Training-Medical spreadsheet that will be involved with handling or preparing (i.e. package, label, sign shipping papers, etc.) or packaging (i.e. soil and water samples, compressed gases or chemicals) materials listed in the DOT Hazardous Materials Table (49 CFR 172.101), which are required to receive DOT training every three years in accordance with HM126F, or annual

RCRA training in accordance with 40 CFR 265.16 (small or large quantity generators of hazardous waste). **NOTE:** Samples being sent for analysis to determine whether they are hazardous are considered non-hazardous, but classified as "Other Regulated Material" in the Hazardous Materials Table.

Yes No CSHM-18 Walking/Working Surfaces

Yes No CSHM-19 Ladders

Yes No CSHM-20 Scaffolds - list all site personnel in the PSHEP Training-Medical spreadsheet that will be involved with erecting, moving, dismantling, or altering scaffolds, which are required to show a scaffold competent person certification.

Yes No CSHM-21 Aerial Lifts - list all site personnel in the PSHEP Training-Medical spreadsheet that will be involved with operating an aerial lift, which will require proof of training and competency.

Yes No CSHM-22 Fall Protection - list all site personnel in the PSHEP Training-Medical spreadsheet that will be involved with activities at heights greater than six feet, which will require proof of training.

Yes No CSHM-23 Lockout/Tagout (LOTO) - list all site personnel in the PSHEP Training-Medical spreadsheet that will be involved with operating or performing maintenance on equipment that has stored, pneumatic, hydraulic or electrical energy, which will require proof of training and competency.

Yes No CSHM-24 Electrical

Yes No CSHM-25 Motor Vehicles and Equipment – list all Parsons site personnel in the PSHEP Training-Medical spreadsheet that will operate a Parsons company vehicle, which are required to complete the online ParsonsU "Hazard Perception" module and review the Fleet Driver policy.

Yes No CSHM-26 Cranes, Hoists, and Lifts

Yes No CSHM-27 Pressure Vessels

Yes No CSHM-28 Welding, Cutting and Brazing

Yes No CSHM-29 Tools

Yes No CSHM-30 Underground Construction

Yes No CSHM-31 Blasting

Yes No CSHM-32 Demolition

Yes No CSHM-33 Excavations - list all site personnel in the PSHEP Training-Medical spreadsheet that will be involved daily inspections of excavations greater than 4 feet in depth, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.

Yes No CSHM-34 Steel Erection

Yes No CSHM-35 Asbestos and Lead - list all site personnel in the PSHEP Training-Medical spreadsheet that will be involved

Yes No CSHM-36 Temperature Extremes – see Section 9.2 for mandatory information on all projects in California that must be reviewed prior to starting work

Yes No CSHM-37 Ventilation

Yes No CSHM-38 Substance Abuse

Yes No CSHM-39 Bloodborne Pathogens - see Section 6.9 for additional information

Yes No CSHM-40 Recordkeeping

Field-based employees and office employees who spend a significant portion of their time in the field also receive field training as described in Section 7 of this PSHEP.

For this project, the client does not require specific training for site personnel.

4.5 AUDITS AND INSPECTIONS

The Project Manager must implement an audit and inspection program in conjunction with the GBU and Corporate SH&E and Quality Assurance Departments. The Project Manager conducts periodic site inspections. If the Project Manager is not onsite, the most senior person onsite person will conduct the inspection. An inspection report will be completed and saved in the project files. Office work areas (including field trailers) are audited according to the corporate office audit checklist posted on ParShare (Home > Office Safety).

For this project, there may or may not be a field trailer. After the work plan is finalized and approved, this will be decided.

Additional information on audits and inspections is provided in Section 6.5 of this PSHEP.

4.6 SH&E MEETINGS

All project meetings that occur onsite and include five or more people must begin with a SH&E moment. The meeting chairperson may present the SH&E topic or ask for a volunteer to open the discussion. In general, these "SH&E moments" are brief, perhaps a minute or two, and should be directly relevant to the work of the day or applicable to most employees (e.g., nonwork-related injuries, waste management procedures, effects of stormwater discharges, home exposure to hazardous materials).

During periodic progress meetings, all Parsons Field Team Leaders/Supervisors or subcontractors submit written summaries of upcoming work tasks and associated risks and control measures to the Project Manager, if needed, and especially if there are deviations from the work plan. Progress meetings discuss the risks of the upcoming work tasks and the planned mitigation measures. The summaries identify upcoming mobilization or demobilization tasks, audits and inspections, competent person changes, and training requirements. Subcontractors add activities to these summaries at least two weeks in advance of the work. .

4.7 REWARDS AND RECOGNITION

4.7.1 Rewards and Recognition Program

Each project with a duration of at least 6 months must follow the Rewards and Recognition Procedure for developing a "Rewards and Recognition" program to foster continuous improvement in SH&E performance. If a project is less than 6 months in duration, then the project can choose to fall under the "Rewards and Recognition" Program for the Parsons' office responsible for the project.

The "Rewards and Recognition" program for this project will be office based.

4.7.1.1 Rewards and Recognition Corporate Policy Procedure

Parsons Corporate Safety Rewards and Recognition Policy recognizes Parsons employees and project teams who make a performance contribution to Parsons SH&E. This policy recognizes achievements or accomplishments that contribute to the overall SH&E objectives of the company.

This policy outlines acceptable methods of rewards and recognition and provides sample plans that focus on leading indicators rather than lagging indicators. Projects and programs are encouraged to reward their teams and individual employees with items from the Parsons Online Safety Products Store and are encouraged to base incentives on leading SH&E indicators.

4.7.1.2 Examples of Leading Indicators

Examples of leading indicators or actions to reward and recognize are as follows:

- Participating in or leading a safety meeting.
- Providing suggestions for improving workplace SH&E.
- Serving on a SH&E committee.
- Creating or revising an activity hazard analysis (AHA) worksheet.

Celebrations of achievements at a project or office level are still important. Project luncheons at milestone achievements are encouraged and are the appropriate place to recognize the collective achievements of working without incident.

4.8 WORK-RELATED INJURIES, MEASUREMENT AND REPORTING

4.8.1 Work-related Injury Procedures

4.8.1.1 Emergencies

Call 911.

4.8.1.2 Non-Emergencies

For work-related injuries or illnesses that may require physician direction on appropriate treatment, Parsons employees should then promptly contact WorkCare, ideally before seeking medical care, as this will provide the greatest opportunity for appropriate intervention.

WorkCare's Incident Intervention is available 24 hours a day, 7 days a week (24/7), and 365 days per year. The contact number is 1-888-449-7787.

If an injured employee requires medical care for a work related injury/illness, the Order for Treatment of Work-Related Injury/Illness Form MUST be sent with the injured worker and/or faxed to the occupational medicine clinic at the time of the initial evaluation.

For U.S. facilities, here is the link to the document on ParShare: Order for Treatment of Work-Related Injury or Illness. NOTE: The Workers Compensation carrier and Policy number for each State may be different.

For Canadian facilities, here is the link to the document on ParShare: Order for Work-Related Injury/Illness Eval/Treatment (Canada). NOTE: The Workers Compensation carrier for each Province will be different.

When contacting WorkCare, be prepared to provide the following:

- Injured employee's name and Parsons ID number
- Injured employee's contact number
- Injured employee's location (at a minimum include the city and state)
- Employee's GBU and client/project name
- Functional manager's name

If the WorkCare physician or nurse determines that an employee should be evaluated by a local physician, then an occupational clinic will be used whenever possible (i.e. during normal business hours). A secondary facility must be able to provide treatment during all hours of operations (i.e. hospital). The facilities are listed below:

- Primary – Concentra Medical Center, 6423 Columbia Avenue, Hammond, IN 46320, (219) 937-3632.
- Secondary – Saint Catherine Hospital, 4321 Fir Street, East Chicago, IN, (219) 392-1700.

Driving directions are provided in Attachment 10.3.

NOTE: Transportation of an injured worker to a medical facility for non-emergency treatment must be done by at least two (2) individuals (i.e. driver and observer). If a driver is not available, then a cab service is acceptable as long as an observer is present.

4.8.2 Measurement and Compliance

To accurately measure performance and comply with corporate and regulatory requirements, Parsons and its subcontractors have an emergency communications system to contact the following onsite offices for the events listed below:

All incidents	Mark Raybuck, Dan Martoccia, Greg Ertel
Worker injury or exposure	Mark Raybuck, Dan Martoccia, Greg Ertel
Environmental release	Mark Raybuck
Fires/explosions	911
Medical emergencies	911
Site/industrial security	Mark Raybuck

4.8.3 Incident Reporting

Employees involved in or witnessing an injury, worker exposure, environmental incident, or near miss must immediately report it to the responsible supervisor or foreman, who in turn immediately relays the report to Parsons Project Manager, Mark Raybuck (716) 541-0760, or Project SH&E Representative, Florin Savin (312) 930-5104. No supervisor may decline to accept or relay a report of SH&E incident or significant near miss from a subordinate.

Each Project Manager must ensure that all SH&E incidents are reported to the GBU SH&E Director and other management personnel (as required) within four hours using the IndustrySafe Online SH&E Reporting System. The online SH&E reporting system includes an Incident Investigation Form, which can only be viewed by system administrators, designated managers, and the assigned investigator. The GBU SH&E Director serves as the default investigator and may assign that role on a case-by-case basis.

Incident investigation link folder on ParShare is as follows: Incident Investigation.

Procedures for investigating workplace accidents and hazardous exposures include the following:

- Emergency Response Team responds to the accident scene as soon as possible.
- Report all injuries to the Parsons Workers' Compensation Claims Analyst.
- Report on PWeb using the online IndustrySafe Reporting System.
- Report to appropriate client point of contact in accordance with contractual requirements.
- Interview injured workers and witnesses.
- Have employee complete the Employee Accident Report and the Individual Statement Report within 24 hours. If the employee is unable to complete the statement, the functional manager must complete the form. (Note: The Individual Statement Report is also known as the Narrative Statement form.)
- Report to the Division or Project SH&E Manager (or Parsons Project Manager) immediately.
- Examine the workplace for factors associated with the accident/exposure.
- Determine the cause of the accident/exposure.
- Take corrective action to prevent the accident/exposure from recurring.
- Record the findings and corrective actions taken.

The Division or Project SH&E Manager must notify the local OSHA office and/or regional, municipal and/or local regulations office in writing within 8 hours if an accident involves the death of an employee or hospitalization of three or more workers. In addition, spills/releases of reportable quantities and other reporting required by environmental regulation are the responsibility of the Project Manager.

Subcontractors must submit a monthly report of exposure hours (hours worked on the project, paid or unpaid) to the Parsons Project Manager within four (4) days after the end of each month, or as specified by the contract. The Project Manager compiles the figures and submits them via the online safety reporting system. If necessary, estimated figures are acceptable, but the reports must be filed.

4.9 INCIDENT INVESTIGATIONS

All accidents, worker over exposures, environmental incidents and significant near misses are investigated by an individual or team with training in incident investigation and root cause analysis. Subcontractors must investigate incidents involving their employees or activities and submit an investigation report to the Parsons Project Manager within 48 hours of an incident.

In Parsons, the GBU SH&E Director investigates or assigns an investigator to each significant incident. The investigator submits a final investigation report using the online safety reporting system within 72 hours of the incident. Each Project Manager maintains the investigation file.

4.10 Responsibility/Identification of Key Line Personnel

Project Key Personnel

Company Executive responsible for Project	Contact Information
Name: Bob Glenn Title: Vice President	Direct Line: (678) 969-2324 Non-Responsive Email: Robert.Glenn@Parsons.com
Project Manager	**Contact Information**
Name: Mark Raybuck	Direct Line: (716) 541-0752 Non-Responsive Email: Mark.Raybuck@Parsons.com
Field Team Leader	**Contact Information**
Name: Florin Savin	Direct Line: (312) 930-5104 Non-Responsive Email: Florin.Savin@Parsons.com
Project SH&E Representative	**Contact Information**
Name: Florin Savin	Direct Line: (312) 930-5104 Non-Responsive Email: Florin.Savin@Parsons.com

The personnel listed above have the authority and responsibility for implementing the provisions of this PSHEP.

4.11 Medical Requirements and Workers' Compensation

In accordance with corporate requirements the Project SH&E has established and implemented the following medical requirements for the project:

4.11.1 Functional Capacity Evaluations (FCEs)

FCEs are not applicable for Parsons personnel working on this project.

4.11.2 Substance Abuse Tests

The Talent Management Department administers required substance abuse tests. For this project, the client requires the following types of drug and/or alcohol testing:

- Pre-work
- Random
- Post-incident – applicable for incidents involving medical treatment or reasonable suspicion

Reasonable suspicion – NOTE: Supervisor must have training in Controlled Substance and/or Alcohol Awareness Training, and a Reasonable Suspicion form must be completed.

4.11.3 Workers Compensation Program

This project does NOT participate in an Owner's Controlled Insurance Program (OCIP) or

project-specific insurance program. The workers' compensation policy covering Parsons employees on this project is as follows:

Workers' compensation carrier – AIG policy number WC015656170, effective 1/1/14 through 1/1/15, PO Box 1832, Alpharetta, GA 30023.

4.11.4 Medical Monitoring

All personnel engaged in activities that results in the exposure to chemicals at or above the OSHA Permissible Exposure Limit (PEL) or wear a respirator for more than 30 days in a year, must comply with 29 CFR 1910.120(f) – Medical Surveillance. All personnel who wear a respirator must be medically qualified by a physician, trained and fit-tested on an annual basis, even if they are not required to participate in a medical surveillance program under 29 CFR 1910.120(f).

Based on the scope of work listed in Section 2.1, the following hazards or activities are associated with this project, which may result in an exposure that requires an employee to participate in a medical surveillance program. It is not expected that exceedances will be encountered requiring respirator use, and any respirator use is not expected to exceed 30 days in a year, therefore, at this time, medical monitoring is not required. If conditions change, the need for medical monitoring will be re-evaluated.

Work Activity	Hazard	Medical Surveillance/Training
N/A	Noise	If noise exposures exceed 85 decibels over an 8-hour time weighted average, an employee must participate in a Hearing Conservation Program.
Monitoring methane gas vents onsite	Chemical exposures – Methane	For respirator use, medical qualification, training and fit-testing must be received on an annual basis. If an individual is exposed at or above the PEL or wears a respirator more than 30 days per year, then participation in a Medical Surveillance Program is required.
Sediment Sampling	Other project specific chemicals (i.e. mercury, lead, asbestos, etc).	Identify the type and frequency of monitoring required.

- The Division or Program SH&E Manager administers the medical surveillance program.

SECTION 5 – PRE-FIELD WORK

5.1 RISK ANALYSIS AND SAFETY SPECIFICATION DEVELOPMENT

The Project Manager has led an analysis using the prebid risk analysis checklist to document existing exposures that may impact the work, surrounding facilities, equipment, workers, or the public at large. The checklist is included in the Appendix.

5.2 SUBCONTRACTOR PREQUALIFICATION REVIEW

For this project, there will be subcontractors directly hired by Parsons.

The subcontractors directly hired by Parsons that will be working on the project are included in Exhibit 5-1.

Exhibit 5-1 – Hired Subcontractors

SUBCONTRACTOR	WORK ACTIVITIES	DATE OF EVALUATION
TBD		

5.3 PRE-FIELD WORK MEETING

A copy of the Pre-Field Work SH&E Meeting and Site-Specific SH&E Review Checklist is part of the Appendix and will be reviewed by all project personnel before work begins. The meeting includes the Parsons Project Manager and subcontractor representatives, including safety.

5.4 COMPETENT PERSON SUBMISSION REVIEW

Copies of signed Competent Person forms for subcontractor personnel is part of the Appendix. Exhibit 9-1 represents regional, municipal, provincial, local, and/or OSHA regulations, owner, and Parsons corporate regulations and requirements applicable to the project.)

5.5 SUBCONTRACTOR SAFETY PLAN SUBMISSION REVIEW

The subcontractor SH&E plan (SSHEP) has been posted on ParShare (PE&I Safety > Project Safety Plans > Environmental Division > *insert Client Name* > *insert Project Name and hyperlink to the Project folder)*. The Parsons Project Manager has reviewed the SSHEP for adequacy in accordance with the Subcontractor SHE Plan Review form posted on ParShare.

5.6 MOBILIZATION/KICKOFF SH&E MEETING

Project Managers conduct the Mobilization/Kickoff SH&E Meeting on or before the first day of subcontractor mobilization in the field at each work site. The meeting includes a review of the prebid site/area risk analysis and a walk through of the work area to locate items on the prebid risk analysis checklist.

SECTION 6 – CONSTRUCTION PHASE

6.1 SITE RISK ANALYSIS

Below is a list of potential hazards on the project.

- Biological – viruses or toxins (poisonous snakes, ticks, rabid animals, poisonous plants, moaquitos, stinging insects)
- Chemical exposures – if soil and/or water analysis data, or historical air monitoring data indicates the need for Level C respiratory protection, then action levels (based on OSHA PELs) and corrective action(s) must be provided. Use the Action Level Table in the Appendix for entering Action Levels and PPE/Action Taken in Table 6-1. NOTE: A respirator cartridge changeout schedule must be developed and included - use the Wood Math Model Table based on the anticipated levels of chemical exposure.
- Environmental – cold/heat related illnesses, animals, insects, poisonous plants/vegetation. See Section 9.2 for information related to Environmental hazards.
- Fires – reference CSHM-12
- Hazardous material handling – reference CSHM-17
- Landscaping and brush hog operation – See Section 10.4 for information related to specific AHA and manufacturer's instructions
- Lightning - personnel shall follow the 30/30 rule - stop field activities and seek shelter when the time between seeing the lightning and hearing the thunder is less than 30 seconds. When the lightning has subsided for 30 minutes, work activities can resume.
- Marine safety/work around water
- Noise – reference CSHM-7
- Overhead utility lines
- Underground utilities or obstructions - if subsurface soil disturbance more than 6" below grade surface will occur, then the Parsons Subsurface Soil Disturbance Protocol must be followed (included in the Appendix).
- Traffic

Table 6-1 – Chemicals of Concern

Chemical of Concern	*Air (ft^3), Soil (mg/kg) or ground water (g/ml) concentrations*	*Monitoring Equipment*	*Action Levels*	*PPE/Action Taken*
Methane		GEM-200 Landfill Gas Monitor	1,000 ppm TWA over 8 hour period	Level D, Level C pending air monitoring results
VOCs		PID	1 ppm TWA over 8 hour period	Level D, Level C pending air monitoring results

6.2 CONTROL MEASURES

Site hazards and hazards resulting from investigation and remediation activities are controlled using one or more of the control measures listed below. The order of precedence is as follows:

Engineer/design to eliminate or minimize hazards.

Workers will use the buddy system to avoid working alone in remote areas of the site. Equipment inspections will be performed prior to starting work, and any inoperable or unsafe equipment will be removed from use and either repaired or replaced. During tick season, if ticks have been observed, Tyvek coveralls may be worn with the wrists and ankles taped, tick repellent may be used, frequent checks for ticks on skin and clothing should be performed, and personnel should do a thorough tick inspection at the end of the work day.

Guard the hazard.

When sampling groundwater wells, buckets or containers with tight-fitting lids will be used to prevent spillage of potentially contaminated groundwater. Plastic sheeting (Visqueen) will be used in soil sampling to contain any soil cuttings, along with buckets or containers with tight-fitting lids. Fixed, open-blade knives are not to be used onsite for any reason. Special cutting tools designed for opening sample cores will be used to prevent injury. During tick season, high grass/weeds in the immediate work area will be kept trimmed low to the ground to lower potential exposure.

Provide warnings.

Heavy equipment and vehicles onsite will have working backup alarms to warn personnel who may be in the line of fire. Any personnel using vehicle that does not have a working backup alarm will honk the horn twice prior to backing up the vehicle, along with performing a 360 check around the vehicle for any hazards.

Provide special procedures or training.

Personnel decontamination will consist of:

1. Remove boot covers (if worn);
2. Remove Tyvek overalls (if worn);
3. Remove outer gloves;
4. Remove inner gloves (if necessary);
5. Wash hands and face.

All single-use PPE will be properly contained and disposed of.

Sample equipment decontamination will consist of:

1. Rinse/wash in water to knock off loose mud/debris as needed;
2. Wash/scrub in a solution of laboratory-grade detergent and water;
3. Rinse in potable water;
4. Rinse in laboratory-supplied de-ionized water;
5. Containerize spent decontamination fluids.

All investigation-derived wastes will be managed in accordance with the Waste Management Plan.

Heavy equipment decontamination will consist of:

1. Rinse/wash in water to knock off loose mud/debris using a steam cleaner or pressure washer;
2. Wash using a pressure washer/steam cleaner and a solution of laboratory-grade detergent and water;
3. Rinse in potable water;
4. Containerize decontamination fluids.

Decontamination of heavy equipment will be completed at a designated decontamination pad. All equipment will undergo a visual inspection prior to departure from the site.

Provide personal protective equipment.

The minimum level of PPE will be Level D, with modified Level D being implemented as needed for tick control and splash hazards.

6.3 ACTIVITY HAZARDS ANALYSIS

Below is a list of Activity Hazards Analyses (AHAs) for the hazards identified in Section 6.1, and all aspects of the work.

- Air Monitoring
- Brush Clearing
- Drilling Oversight
- Fence Installation Oversight
- General Field Activities
- Groundwater Sampling
- Monitor Well Development
- Monitor Well Installation Oversight
- Motor Vehicle Operation
- Slug Testing
- Soil Sampling
- Soil, Sediment, and Surface Water Sampling and Boat Tasks
- Surface Water and Sediment Sampling
- Utility and Boring Location
- Test Pits

The Parsons TAG program will also be employed. The purpose of the TAG program is to improve and promote hazard recognition and encourage everyone to take personal responsibility for their safety and the safety of others. TAG does not require completing any forms, but it does require personnel to:

- **THINK** about the hazards associated with their task
- **ANALYZE** and find safe solutions
- **GO** ahead and complete their tasks safely

All significant changes to the scope of work or equipment that are not replacements in kind must be properly documented in accordance with the approved Management of Change program. This includes a deviation from an established process or technical standard, modification of existing technology, or demonstration of remediation in different equipment. The change approval will include documentation of any operating instructions required for the specific change and will ensure that the change has no adverse effects on safety, remedy quality, and the environment.

6.4 SAFETY SYSTEMS AUDIT PROTOCOL

GBU SH&E Directors use the Safety Systems Audit Protocol for field staff and subcontractors whose work on a project site will be more than six (6) months.

This project will be more than six (6) months in duration.

6.5 SITE INSPECTION

Each Inspection Category below will be assigned the following employees.

Inspection Category [a]	Parsons Corporate Safety & Health Manual	Title of Assigned Employee	Minimum Frequency
Comprehensive Audit			Annual
Compliance			Weekly
Focused			Weekly
Sanitary Facilities, Drinking Water, Food Service Areas, And Temporary Quarters	5		Daily
Respiratory Protection	8		Monthly
Fire Extinguishers	12		Monthly
Hazardous Material Storage	17		Weekly
Ladders	19		Monthly
Lockout/Tagout (LOTO)	23		Monthly
Motor Vehicles and Equipment	25		Each Shift
Excavations	33		Daily

[a] Additional inspections may be required by local, state, and federal regulatory agencies based upon the project scope of work.

6.6 WEEKLY SH&E SITE INSPECTIONS

The Project Manager or most senior onsite person conducts a periodic inspection to identify problem areas using the Weekly SH&E Inspection Checklist (see Appendix). Items found to be

out of compliance must be assigned corrective action and tracked to completion. Due to the intermittent nature of the work, inspections will be conducted periodically, but not necessarily weekly.

6.7 SH&E ENFORCEMENT

Parsons and its subcontractors enforce all applicable SH&E requirements of regional, federal, municipal, state, local, and all other regulations; and where applicable OSHA 1910 and 1926 and Engineering Manual (EM) 385.1, where applicable. Subcontractors must also comply with and enforce Parsons site requirements.

Parsons and its subcontractors must have written progressive disciplinary systems available for review in their Human Resources departments.

6.8 NOTICE OF VIOLATION OF SAFETY AND HEALTH REGULATIONS

A Notice of Subcontractor Violation of SH&E Regulations form will be used document immediately dangerous to life and health (IDLH) situation, respiratory airborne hazards (RDLH), and/or when the subcontractor repeatedly fails to comply with SH&E requirements.

The Notice of Subcontractors Noncompliance to SH&E Regulations form documents poor performance and requires a response from subcontractor senior management. The notice contains five distinct levels of discipline, from submission of a recovery plan to contract termination.

6.9 COMPETENT FIRST AID PERSON

The response time for Emergency Medical Services (EMS) when dialing 911 has been determined to be approximately 5 minutes. Based on the activities provided in the Scope of Work (Section 2.1) and the list of Activity Hazard Analysis (AHA) included in Section 6.3, the project does not expect to have an accident involving suffocation, severe bleeding, or other life threatening or permanently disabling injury or illness.

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SECTION 7 – SAFETY TRAINING

7.1 PROJECT SAFETY ORIENTATION

The Parsons Project Manager, Field Engineer, or Project SH&E Representative will conduct an orientation for all new Parsons staff and subcontractor management personnel using the completed HASP Orientation.

All visitors must receive a brief orientation on emergency procedures, and be escorted by the Project Manager, Project Engineer, Project SH&E Representative or a designee familiar with the potential hazards on the project, and who has received a full safety orientation.

7.2 PARSONSU MODULES AND START TRAINING – ZERO INCIDENT TECHNIQUES

The following project personnel are current in the completion of safety modules on ParsonsU.

- *Insert employee name and number of completed safety modules (add rows as needed)*

The following Project Manager and supervisors have completed START training.

- Mark Raybuck – 2006
- Florin Savin – August 6, 2009

7.3 DAILY TOOLBOX SH&E MEETINGS

The Field Team Leader documents toolbox SH&E meetings and attendance and retains all records. Subcontractors shall lead the portion of the meeting that involves their scope of work. Meetings shall be documented and signed by all individuals accessing the site using a Toolbox Safety Meeting form (Safety Meeting Sign-In Sheet).

7.4 ACTIVITY HAZARDS ANALYSIS TRAINING

When the Activity Hazards Analysis (AHA) is complete, the Parsons supervisor or subcontractor conducts a training session with all individuals involved with the task. Individuals should be given an opportunity to provide input regarding task steps, hazards identified, and appropriate control measures.

7.5 REGULATORY TRAINING PROGRAMS

Regional, municipal, provincial, local, and OSHA regulations require specific training in certain circumstances. Based on the scope of work and meetings with regulatory officials, the following training topics are provided on the project:

Yes No Hazard Communication – as per 29 CFR 1910.1200

Yes No HAZWOPER – all workers engaged in activities which are potentially exposed to hazardous substances and health hazards must be trained to meet 1910.120(e)(1).

Annual 8-hour refresher training as per 29 CFR 1910.120(e)(3) is required for workers and supervisors must be trained to meet 29 CFR 1910.120(e)(4).

Yes No AED/CPR/First aid/Bloodborne Pathogens – provided to personnel based on project activities identified in the Scope of Work (i.e. life threatening) and EMS response time (i.e. less than 15 minutes). See Section 6.9.

Yes No Emergency response – only applicable to workers engaged in emergency response as per 29 CFR 1910.120(q).

Yes No Respiratory protection – as per 29 CFR 1910.134. Medical qualification by a physician is required to wear a respirator. Annual fit testing and training is also required.

Yes No Signaling

Yes No Process safety management – as per 29 CFR 1910.119.

Yes No Powder-operated hand tools

Yes No Gas welding and cutting

Yes No Confined space entry – Supervisor must be trained to meet 29 CFR 1926.651(j).

Yes No Lockout/tagout – as per 29 CFR 1910.147.

Yes No Asbestos abatement – as per 29 CFR 1926.1101.

Yes No Scaffold use – as per 29 CFR 1926.451.

Yes No Excavation/Trenching – as per 29 CFR 1926.651.

SECTION 8 – RECORDKEEPING AND POSTING

Parsons and its subcontractors must comply with the recordkeeping requirements of the regional, municipal, local, and/or OSHA regulations, Owner, Parsons Corporation, and this PSHEP, including:

- OSHA 300 and/or applicable regional, municipal, and local regulation logs
- Medical treatment and follow-up
- Cranes
- Heavy equipment inspection logs
- Fall protection
- Training
- Inspections
- Audits
- Others, as required

Parsons Talent Management and the Division or Program SH&E Manager are the official recordkeepers for files relating to Parsons employees. Each subcontractor maintains its own files.

For this project, safety bulletin boards used for displaying regional, municipal, provincial, local and/or OSHA posters in conspicuous places will be located at the Parsons Chicago, Illinois office.

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SECTION 9 – SAFETY AND HEALTH REQUIREMENTS

9.1 COMPETENT PERSON AND ACTIVITY HAZARDS ANALYSIS

Parsons and its subcontractors are individually responsible for training their respective employees and for complying with all project requirements. Failure to comply could lead to disciplinary actions against Parsons employees and subcontractors or their employees. Further guidance is available in the Parsons Corporate Safety and Health Manual; ParShare link is as follows: Corporate Safety and Health Manual.

Competent Person forms will be submitted for subcontractor personnel for applicable Safety and Health Requirements in Exhibit 9-1.

Exhibit 9-1 – Competent Person and Activity Hazards Analysis Requirements

Safety and Health Requirement	Parsons Safety, Health, and Environmental Manual	OSHA Regulation	EM 385-1-1 Regulation	Competent/ Qualified Person	Training Required	Written Plan and AHA Required
General Safety and Health		1926.20	01.A	*Yes*	*Yes*	*Yes*
Safety Training		1926.21	01.B.01	*Yes*	*Yes*	*Yes*
Confined Spaces	15	1926.21, 1910.147	06.01	*N/A*	*N/A*	*N/A*
Confined Space Permit System	15	See above	06.01	*N/A*	*N/A*	*N/A*
First Aid and Medical	2	1926.23, 50	03.A	*Yes*	*Yes*	*Yes*
Fire Protection and Prevention	12	1926.24, 150-155, 352	09.A	*Yes*	*Yes*	*Yes*
Housekeeping	4	1926.25	14.C	*N/A*	*N/A*	*N/A*
Illumination	4	1926.26, 56	07.A	*Recommended*	*N/A*	*N/A*
Sanitation	4	1926.27, 51	02.A	*N/A*	*N/A*	*N/A*
Personal Protective Equipment	6	1926.28, 95-98, 100-107	05.A	*Yes*	*Yes*	*Yes*
Acceptable Certifications		1926.29		*Yes*	*Yes*	*Yes*
Incorporation by Reference		1926.31	Preamble	*N/A*	*N/A*	*N/A*
Emergency Employee Action Plans	11	1926.35	01.E	*Recommended*	*Yes*	*Yes*
Noise Exposure	7	1926.52	05.C	*Yes*	*Yes*	*Yes*
Radiation Protection	9	1926.53, 54	06. E&F; 28.A.02	*N/A*	*N/A*	*N/A*
Gases, Vapors, Dusts and Mists	9	1926.1926.55		*Yes*	*Yes*	*Yes*
Ventilation	37	1926.57, 353		*Recommended*	*Yes*	*Yes*
Hazard Communication	10	1926.59	1.B.06	*Yes*	*Yes*	*Yes*
Process Safety Management	14	1926.64 1910.119		*Yes*	*Yes*	*Yes*

Exhibit 9-1 – Competent Person and Activity Hazards Analysis Requirements (Cont'd)

Safety and Health Requirement	Parsons Safety, Health, and Environmental Manual	OSHA Regulation	EM 385-1-1 Regulation	Competent/ Qualified Person	Training Required	Written Plan and AHA Required
Hazardous Waste Operations and Emergency Response	13	1926.65 1910.120	28.A	*Yes*	*Yes*	*Yes*
Accident Prevention Signs and Tags	16	1926.200	08.A	*N/A*	*N/A*	*N/A*
Signaling	16	1926.201	08.B	*Recommended*	*N/A*	*Yes*
Barricades	16	1926.202		*N/A*	*N/A*	*N/A*
Material Storage	17	1926.250	14.B	*N/A*	*Yes*	*Yes*
Rigging	26	1926.251	15.A	*Yes*	*Yes*	*Yes*
Waste Disposal		1926.252	14.D	*Yes*	*Yes*	*Yes*
Tools	29	1926.300-307	13.A	*N/A*	*N/A*	*Yes*
Gas Welding and Cutting	28	1926.350	10.A	*N/A*	*N/A*	*N/A*
Arc Welding	28	1926.351	10.E	*N/A*	*N/A*	*N/A*
Electrical	24	1926.400-415	11.E	*Yes*	*Yes*	*Yes*
General Electrical	24	1926.416	11.A	*Yes*	*Yes*	*Yes*
Lockout Tagout	23	1926.417, 1910.147	12.A	*N/A*	*N/A*	*N/A*
Lockout Tagout Permit System	23	See above	12.A	*N/A*	*N/A*	*N/A*
Maintenance of Electrical Equipment		1926.431	11A	*Yes*	*Yes*	*Yes*
Environmental Deterioration of Electrical Equipment	24	1926.432		*Yes*	*Yes*	*Yes*
Batteries/Battery Charging Equipment	24	1926.441	11.E	*N/A*	*Yes*	*Yes*
Scaffolding	20	1926.450-454	22.A	*N/A*	*N/A*	*N/A*
Aerial Lifts	21	1926.453	22.J and K	*N/A*	*N/A*	*N/A*
Fall Protection	22	1926.500-503	21.A	*N/A*	*N/A*	*N/A*
Cranes, Derricks, Hoists, Elevators and Conveyors	26	1926.550	16.A	*N/A*	*N/A*	*N/A*
Motor Vehicles, Mechanized Equipment	25	1926.600-603	18.A	*Yes*	*Yes*	*Yes*
Powered Industrial Trucks (forklifts)	25	1910.178		*N/A*	*N/A*	*N/A*
Site Clearing	32	1926.604	31.A	*N/A*	*Yes*	*Yes*
Marine Operations and Equipment		1926.606	16.F	*Yes*	*Yes*	*Yes*
Excavations	33	1926.650-652	25.A	*Yes*	*Yes*	*Yes*
Excavation Permit	33	N/A	N/A	*Yes*	*Yes*	*Yes*
Concrete and Masonry Construction	4	1926.700-706	27.A	*N/A*	*N/A*	*N/A*

Exhibit 9-1 – Competent Person and Activity Hazards Analysis Requirements (Cont'd)

Safety and Health Requirement	Parsons Safety, Health, and Environmental Manual	OSHA Regulation	EM 385-1-1 Regulation	Competent/ Qualified Person	Training Required	Written Plan and AHA Required
Stairways and Ladders Scope	18	1926.1050	21.A	*N/A*	*Yes*	*Yes*
Stairway/Ladder General Requirements	18	1926.1051		*Yes*	*Yes*	*Yes*
Stairways	18	1926.1052	21.E	*Recommended*	*Yes*	*N/A*
Ladders	19	1926.1053	21.D	*Yes*	*Yes*	*Yes*
Ladder/Stair Training	19	1926.1060		*Yes*	*Yes*	*Yes*
Liveboating		1926.1087	30.A.05	*Yes*	*Yes*	*Yes*
Internal Traffic Control	16	N/A	8.D	*N/A*	*Yes*	*Yes*
Traffic Movement Restriction Times	16	N/A	8.C	*N/A*	*Yes*	*Yes*
Line Breaking	23	1910.119 and 1926.54		*Yes*	*Yes*	*Yes*
Major Material Movements	17	N/A	N/A	*N/A*	*Yes*	*Yes*
Right-of-way Restrictions	16	N/A	N/A	*N/A*	*Yes*	*Yes*
IIPP/SSPP		Cal 3203	Cal 3203	*N/A*	*N/A*	*N/A*

9.2 ENVIRONMENTAL HAZARDS

9.2.1 Heat Related Illness

Project activities may take place during time periods where exposure to temperature extremes could occur. In order to minimize exposure to temperature extremes, project personnel shall be familiar with the health effects of exposure to temperature extremes and the control measures that can minimize exposure. Personnel wearing impermeable protective clothing when ambient temperatures exceed 70F will be subject to a heat stress monitoring program (see Appendix).

For this project, personnel will not be required to wear impermeable protective clothing or respirators when ambient temperatures exceed 70F.

Training shall be provided to all employees to recognize heat illness hazards before starting to work outdoors.

Any employee experiencing or witnessing signs and/or symptoms of a heat related illness shall report the findings to their supervisor immediately.

Supervisors shall understand the procedures to follow when an employee exhibits symptoms consistent with heat illness, including emergency response.

Definitions

Acclimatization - a temporary adaption of the body to work in the heat that occurs gradually when a person is exposed to it. Acclimatization peaks in most people within 4-14 days of regular work for at least 2 hours per day in the heat.

Environmental Risk Factors - working conditions that create the possibility that heat illness could occur, including air temperature, relative humidity, radiant heat from the sun and other sources, conductive heat sources such as the ground, air movement, workload severity and duration, protective clothing and personal protective equipment worn by employees.

Heat Illness - a serious medical condition resulting from the body's inability to cope with a particular heat load, and includes heat cramps, heat exhaustion, heat syncope and heat stroke.

Heat Wave - a sudden and temporary rise of temperature above the seasonal average for a particular region, which lasts for a prolonged period of time. A heat wave can greatly increase the risk of heat related illnesses.

Personal Risk Factors - an individual's age, degree of acclimatization, health, water consumption, alcohol consumption, caffeine consumption, and use of prescription medications that affect the body's water retention or other physiological responses to heat.

Preventive Recovery Period - a period of time to recover from the heat in order to prevent heat illness.

Shade - blockage of direct sunlight. Canopies, umbrellas and other temporary structures or devices may be used to provide shade. One indicator that blockage is sufficient is when objects do not cast a shadow in the area of blocked sunlight. Shade is not adequate when heat in the area of shade defeats the purpose of shade, which is to allow the body to cool. For example, a car sitting in the sun does not provide acceptable shade to a person inside it, unless the car is running with air conditioning.

Signs and Symptoms of Heat Illnesses

Heat Rash – or prickly heat, occurs in hot and humid environments where sweat is not removed from the skin. Usually disappears when worker returns to cool environment.

Heat Cramps – muscle contractions from the loss of fluids /electrolytes due to sweating. Occurs when workers perform hard physical labor in a hot environment. Most common in the arms and legs. Cramping can occur after work has stopped.

Heat Exhaustion – inadequate blood circulation from stress due to constant heat. The whole body, especially the circulatory system, is extremely stressed. Possible symptoms include: pale, flushed face and neck; clammy skin; heavy sweating; fatigue; shortness of breath; headache; dizziness or fainting; nausea and vomiting; and rapid heartbeat and breathing.

Heat Stroke – body's failure to regulate its' temperature. The most serious stage of heat illness. Symptoms include: dizziness and confusion, red, hot, dry skin; nausea and vomiting; very little sweating; rapid pulse; high body temperature, 105° F or higher; convulsions, and fainting.

Heat Illness Prevention

Prevention of heat related illness in extreme temperature project personnel shall consider implement a Physiological monitoring program, include monitoring with a WBGT and implementing work rest regiments. The field team shall be encouraged to drink plenty of liquids to replenish electrolytes. The field team shall also, construct a shaded rest area for workers to take breaks.

Prevention of heat related illness may call for establishing work teams to rotate to minimize heat related illnesses.

Heat Illness Treatment

Heat Cramps - take water every 15 to 20 minutes. Drinking an electrolyte replacement (like Gatorade) may help.

Heat exhaustion - Get medical help. Don't leave the person alone. While waiting, remove worker to cool place to rest; remove as much clothing as possible; give water and electrolytes; and don't allow person to get chilled.

Heat Stroke – Call 911 immediately. While awaiting medical help, get victim into cool area, fan vigorously, apply cool water to clothing or skin, and apply ice packs under arms and to the groin area.

Heat Waves

Heat illness prevention during heat waves means taking extra measures.

More vigilance - supervisors/employees watch others very closely and provide more frequent feedback during work activities. Site workers shall avoid working alone and utilize the "Buddy System", watch each other and closely monitor/report an employees' condition. Personnel shall be accounted for their whereabouts throughout the work shift and at the end of the day.

More water - employees should drink small quantities of water more frequently before, during and after work. There should be extra supplies of water for replenishment, encourage employees to consult with their doctor on salt/mineral replacement.

More cooling - use other cooling measures in addition to shade, spraying body with water/wiping with wet towels and taking additional/longer breaks in the shade.

Change schedule - work activities may be started earlier on later in the evening, split-up work shifts and avoid working during the hotter parts of the day. Work shifts can be cut short or stop work.

Change meals - encourage employees to eat smaller/or more frequent meals (less body heat during digestion than with big meals), choose foods with higher water content (for example, fruits, vegetables and salads).

Acclimatization warning - personnel should allow the body time to adjust to sudden, abnormally high temperatures or other extreme conditions. Even employees previously fully acclimatized are at risk for heat illness.

Environmental and Physiological Factors

- Average ambient air temperature 96ºF (75-116ºF)
- Average humidity 29% (12% - 55%)
- Average wind speed 7 mph
- Average core body temperature 104ºF (98 -108ºF)

Provision of Water

Sufficient amounts of cool water shall be available and replenished at all times w/at least one quart per employee per hour for the entire shift.

Easy access to clean and cool water shall be available to encourage frequent drinking.

Access to Shade

A Preventative Recovery Period (PRP) is necessary if an employee is suffering from heat illness or believes that a rest break is needed to recover from the heat.

Access to shade shall be permitted at all times. Employees shall have access to an area with shade that is either open to the air or provided with ventilation or cooling for a period of no less than 5 minutes.

Measurement

Portable heat stress meters or monitors are used to measure heat conditions. These instruments can calculate both the indoor and outdoor WBGT Index according to established ACGIH Threshold Limit Value equations. With this information and information on the type of work being performed, heat stress meters can determine how long a person can safely work or remain in a particular hot environment.

Additional Guidance

Cal/OSHA - http://www.dir.ca.gov/DOSH/HeatIllnessInfo.html

NIOSH - http://www.cdc.gov/niosh/topics/heatstress

SECTION 10 – APPENDIX

10.1 ATTACHMENTS/FORMS

10.1.1 PSP Training-Medical Record

10.1.2 Pre-Field Work Safety Meeting

10.1.3 Employee/Contractor Training Acknowledgement

10.1.4 Remediation Safety and Health Inspection Checklist

10.1.5 Mobilization/Kickoff Safety Meeting

10.1.6 Safety Meeting Sign-in Sheet

10.1.7 Heat Stress and Heat Stress Monitoring

SAFETY TRAINING, HAZWOPER TRAINING AND MEDICAL INFORMATION

INDIVIDUAL INFORMATION					SITE SPECIFIC	HAZWOPER TRAINING				MISCELLANEOUS SAFETY TRAINING										
NAME (Last, First)	COMPANY NAME	JOB TITLE	TYPE OF ACTIVITY	TYPE OF ACCESS	Annual PSP/HASP Orientation Date	40-hr. Training	24-hr. Training	8-hr. Supervisor Training	Annual 8-hr. Refresher Expires	AED Expires	CPR Expires	First Aid Expires	Bloodborne Pathogens Expires	DOT Training Expires	Excavation Competent Person	Scaffold Competent Person	Confined Space Entry Training	Forklift Operation Expires	LPS Training	Medical Examination Expires
Doe, John	Parsons	Inspector	Non-engaged	Escort Only	5/1/05	n/a	1/2/90	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Doe, Jane	XYZ Contractor	Laborer	Engaged	Unrestricted	2/1/04	1/2/91	n/a	n/a	1/1/05	2/1/06	2/1/06	2/1/06	2/1/07	6/1/05	5/1/97	5/1/97	8/1/99	n/a	n/a	5/1/06

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Pre-Field Work SH&E Meeting
Site-Specific SH&E Review Checklist
(Sheet 1 of 3)

Date:
Subcontractor Representative:
Phone:
Project Location:
Parsons Project Manager:
Phone:
Subcontractor SH&E Representative:
Phone:
Parsons SH&E Representative:
Phone:

This checklist supports the identification of work activities and programs in a pre-field work SH&E meeting. This list also includes items identified through the subcontractor review and high-risk activities identified through the project specification review.

High-risk activities must be followed up during the field work with training, written plans and/or a specific Activity Hazard Analysis (AHA).

This list should be reviewed with prospective bidders during the pre-bid meeting.

NOTE: Use check box and add specifics and details as applicable (next to the callouts)

	SAFETY & HEALTH
☐	Site-Specific Safety, Health and Environmental Plans
☐	Competent/Qualified Person Documentation
☐	SH&E Audits/Inspections
☐	Subcontractor Responsibilities
☐	Site Orientation Requirements
☐	Pre-Field Work SH&E Meeting/Date
☐	Crane Inspection Certification
☐	Personal Protective Equipment (PPE) (Work activities or work site requires hearing protection/using respirators/special protective clothing/other)
☐	Exposure to General Public (Work activities or location requires special precautions to protect the public)
	FIELD WORK SAFETY ISSUES
☐	Excavations/Trenching
☐	Powered Industrial Trucks, Fork Lifts
☐	Crane Work/Heavy Lifts, Rigging
☐	Work involving Hazardous Materials
☐	Electrical Tie-ins/Lockout – Tagout
☐	Aerial Lift Work – Scissor Lifts, Extendable Boom, etc.
☐	Underground, Caissons, Cofferdams
☐	Scaffold Erection/Work
☐	Demolition
☐	Marine Work/Live Boating

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Pre-Field Work SH&E Meeting Form
Site-Specific SH&E Review Checklist
(Sheet 2 of 3)

FIELD WORK SAFETY ISSUES (Contd.)	
☐	Heavy Hauling
☐	Concrete
☐	Diving
☐	Work Adjacent to Production Areas
☐	Site Security/Visitor Control/Public Areas
☐	Permits (Excavations, Scaffolding, Demolition, Traffic, Confined Space, Hot Work, Line Breaking, etc.)
☐	Confined Space (Confined space entry is required)
☐	Welding and cutting (Acetylene/gas cutting, arc welding, soldering and brazing)
☐	Ladders (Portable ladder use is required)
☐	Traffic Control (Work is on or near highways, roads, or mass transit)
MEDICAL	
☐	Substance Abuse Screening
☐	Emergency Procedures
☐	Site Security
☐	Smoking Policy
☐	Medical Services Requirements
☐	Treatment Locations, Addresses, and/or Phone List
ENVIRONMENTAL	
☐	Environmental Hazards
☐	Air Pollution/Emissions and required reporting
☐	Wastewater Discharges
☐	Drinking Water
☐	Management of Hazardous Materials and Hazardous and Solid Wastes
☐	Emergency Response to Spills and Releases Environmental Assessments
☐	Protected Ecological and Cultural Resources
☐	Specific Reports on Toxic or Hazardous Chemicals Usage and Storage (Required by Environmental Regulation)
☐	Materials to be Recycled
☐	Possibility of Buried Items Onsite (cultural artifacts, tanks, wastes, and ordinance) and what to do if encountered
☐	Environmental Regulatory Requirements
☐	Environmental Assets
☐	Resource Conservation/Sustainability

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Pre-Field Work SH&E Meeting Form
Site-Specific SH&E Review Checklist
(Sheet 3 of 3)

Additional Notes/Comments:

ATTENDEES

Name	Title	Company

SITE-SPECIFIC HEALTH AND SAFETY PLAN (HASP) TRAINING

(For All Parsons and subcontract employees on site)

I hereby confirm that site-specific health and safety training has been conducted by the site health and safety officer which included:

- Names of personnel responsible for site safety and health
- Safety, health, and other hazards at the site
- Proper use of personal protective equipment
- Work practices by which the employee can minimize risk from hazards
- Safe use of engineering controls and equipment on the site
- Acute effects of compounds at the site
- Decontamination procedures

For the following project:

Gary Development Landfill	448411.01000	Gary, Indiana
(Project Title)	(Project Number)	(City, State)

Name (print)	Signature	Company	Date

Maintain in Health & Safety Plan file.

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Weekly SH&E Inspection Checklist (Sheet 1 of 2)

	Week Ending Date:
Project Name: Gary Development Landfill	Project Number: 448411.01000
Name of Auditor:	Signature:
Check each box during your inspection or indicate N/A. Substandard conditions found must be identified on the back of this checklist	

	Electrical: temporary power, circuits marked, GFCI protection, damaged cords, cords protected, correct outlets, and signage.
	Environmental: Air emissions controlled, hazard com program, specific MSDS sheets, fuel signage, spillage dike, dust control, HAZMAT storage, and waste disposal.
	Excavations: Guarded, Soil Condition, Trenching Controls, Blue Stake/Equivalent, Daily Inspections Subcontractor, and Proper Access.
	Fire Safety: Extinguishers; Proper Size, Numbers, Proper Locations, Hose Stations, Hot Work Permit, Fuel Storage.
	Framing Activities: Proper Positions, Monitor, Fall Protection, Housekeeping, Forklift Activity, Training, and Tool Use.
	Guarding: Floors, Walls, Windows, Leading Edge, Roof, Elevator Shafts, Open Holes, Material, Quality, and Handrail
	Housekeeping: Office, Walkways, Waste Material, Lay Down Yard, Grounds, and Subcontractor Areas, Food Debris.
	Ladders: Height, Secured Top/ Bottom, Condition, Employee Position; Three Points of Contact.
	Material Handling: Rigging, Material Condition, Training, Tasks, Proper Lifting, Wheel Barrows, Stacking/Storage.
	Medical: First Aid Kits, Numbers Posted, Address Knowledge, Nearest Emergency Assistance, CPR/First Aid Training.
	Mobile Equipment: Inspections, Condition, Backup Alarms, Leaks, Fuel Storage, Proper Parking, and Training.
	PPE: Hearing, Head, Hand, Eye, Foot, Fall, Seatbelts, Respiratory,
	Sanitary: Drinking Water, Toilets Clean and Adequate, Soap and Water for Washing
	Scaffolds: Component Damage, Footing, Secured, Guardrail, Training, Inspections, Pins & Bracing, Planking, and Ladders.
	Tools: Damage, Cords, Blades, Guards, Hoses, Handles, Switches, Training, Proper Use, Storage, Adequate.
	Training: Forklift, Man Lift, Water Truck, Orientation, Task, Hazards, Power Tools, Scaffolds, and Trenching.
	Welding: Hot Work Permit, PPE, Gas Checks, Confined Space, Tank Storage, Equipment Inspections, and Fire Protection
	Miscellaneous: Any condition or behavior not identified on this checklist.

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Weekly SH&E Inspection Checklist (Sheet 2 of 2)

				Week Ending Date:	
Project Name: Gary Development Landfill				Project Number: 448411	
Name of Auditor:				Signature:	
Hazard Type	1.	Improper or Inadequate Guarding		8.	Substandard Housekeeping
	2.	Improper Wiring		9.	Hazardous Environmental Conditions
	3.	Defective Tools, Equipment, Substances		10.	Radiation Exposures
	4.	Hazardous Arrangements		11.	Congestion or Restricted Movement
	5.	Inadequate Illumination		12.	Inadequate Warning System
	6.	Inadequate Ventilation		13.	Fire & Explosive Hazard
	7.	Improper Personal Protective Equipment		14.	Other:
Basic Causes	1.	Inadequate Engineering		7.	Inadequate Leadership & Supervision
	2.	Normal Wear & Tear		8.	Physical Incapacity
	3.	Inadequate Purchasing		9.	Lack of Knowledge
	4.	Inadequate Maintenance		10.	Improper Motivation
	5.	Inadequate Work Standards		11.	Mental Incapacity
	6.	Abuse		12.	Other:
Hazard Classification	Class A: Likelihood of Death Class B: Likelihood of Serious Injury Class C: Likelihood of Minor Injury				

Items	Hazard Type	Basic Cause	Hazard Class	Location	Remedial Action(s)

Comments:

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Mobilization/Kickoff SH&E Meeting Form

Date:	Project/Location:
Parsons Representative:	Subcontractor Representative:

The following project site safety, health, security, and environmental requirements, procedures, and hazards have been identified and reviewed with the subcontractor:

Mark with "X"	Item	Mark with "X"	Item	Mark with "X"	Item
☐	Air Pollution and Emissions	☐	Fall Protection, Guardrails, and/or Scaffolding	☐	Personal Protective Equipment
☐	Asbestos			☐	Process Safety Management (PSM)
☐	Buried Items	☐	Fire Protection		
☐	Competent / Qualified Person	☐	Hazardous Materials and Wastes	☐	Protected Ecological and Cultural Resources
☐	Confined Spaces (Permit / Non-Permit)	☐	Hot Work, Welding, and/or Cutting	☐	Resource Conservation and Sustainability
☐	Cranes / Hoists / Annual Inspection Certificate(s)	☐	Ladders	☐	Site Security, Visitor Control, and Public Exposure
☐	Demolition	☐	Lead Paint	☐	Specific Reports (Required by Environmental Regulation) on Toxic or Hazardous Chemicals Usage and Storage
☐	Drinking Water	☐	Lockout / Tagout		
☐	Electrical	☐	Management of Hazardous Materials and Hazardous Solid Wastes		
☐	Emergency Response to Spills and Releases			☐	SSHEP, Emergency Planning and Response Plan
☐	Environmental Assessments	☐	Overhead Power Lines	☐	Wastewater Discharges
☐	Excavations and Trenches	☐	Permits (Excavations, Scaffolding, Demolition, Traffic, Confined Spaces, etc.)	☐	Vehicle and Heavy Equipment
				☐	Other:

Protection of the Public:

Additional Project Concerns:

Attendees:

Name	Title	Company

SAFETY MEETING SIGN-IN SHEET

Safety Meeting Presenter: _____ Date: _____

Current Weather Conditions:

Temperature (^{o}F) = _____ Wind Direction = _____ Wind Speed = _____

Clear - Sunny – Cloudy – Rain - Snow Forecast = _____

Current Site Conditions (circle as appropriate):

Dry - Wet - Muddy - Frozen - Snow Covered - Other (describe) _____

1. Incidents or Injuries to report from Previous Day Activities: No ☐ Yes ☐ - explain below:

_____

2. Safe and/or At-Risk Observations from Previous Day Activities: _____

_____

_____

3. Activities Taking Place Today: _____

_____

_____

3. Anticipated Hazards: _____

_____

_____

4. Engineering Controls-Work Practices-PPE to Protect Against Hazards: _____

_____

_____

5. Additional Safety Topic or Comments: _____

_____

_____

SAFETY MEETING SIGN-IN SHEET

PRINTED NAME	SIGNATURE	COMPANY	LAST 4 DIGITS OF SS #

GDL Temperature Monitoring Log

Date & Time	Name	Temp. Inside Compound	Temp. Outside	Corrective Actions Taken

1. DESCRIPTION

This element of the CSHM provides guidelines for monitoring, prevention, and training for cold stress and heat stress.

This element applies to all Parsons personnel working on Parsons projects at any location worldwide, regardless of country of operation and/or GBU.

2. DEFINITIONS

Term	Description
Acclimate	To accustom or become accustomed to e new climate, environment, or situation.
Activity Hazards Analysis (AHA)	A procedure, described in Parsons SHARP Manual, used to identify the hazards or potential hazards essociated with each step of a job or work plan to uncover hazards and then eliminete, control, or remove them before the work is started.
Anemometer	An instrument to measure wind speed.
Cold Stress	The disruption of the body's thermal balance as a result of exposure to cold.
Core Temperature	The temperature of the inner parts of the body, most accurately determined by measuring with a rectal thermometer.
Heat stress	The total heat burden to which the body is subjected by both external and internal factors.
Industrial Hygienist (IH)	Scientist or engineer committed to protecting the safety, heelth, end environment of people in the workplace end the community. A certified industrial hygienist is accredited by the American Board of Industrial Hygienists (ABIH).
WBGT	Wet bulb globe temperature: a heat stress indicator that considers the effects of temperature, humidity, and radiant energy. The required inputs for the iodex are measured by a wet-bulb globe temperature meter.
Wind Chill Index	Cooling effect of any combination of temperature and wind velocity or air movement. The wind chill index does not take into account the body pert exposed to cold, the level of activity effect on the body's heat production, end the amount of clothing worn.

3. RESPONSIBILITIES

Role	Responsibility
Corporate Health and Safety	• Reinforce the need to comply with requirements. • Provide structure and training for safety programs.
GBU Safety Director	• Responsible for providing support to ensure that the success of this element. • Provide expertise and guidance necessary to that ensure exposure assessments are performed properly.
Project Manager	• Responsible for providing resources for, and ensuring compliance with, this element. • Designate persons to conduct environmentel monitoring.

Role	Responsibility
Records Custodian	• Document employee training and maintain training documentation.
Superintendent	• Facilitate compliance with and enforce this element. • Identify jobs with temperature extremes.
Site Safety and Health Officer (SSHO)	• Assess thermal stress hazards and determine appropriate (e.g., work/rest regimens) controls. • Conduct wet bulb globe temperature (WBGT) Index monitoring. • Conduct orientations for subcontractors and new employees. • Arrange physiological and behavioral monitoring. • Coordinate training. • Monitor program effectiveness.
Designated Person(s)	• Conduct environmental monitoring.
Foreman/Supervisor	• Identify potential hazards. • Confirm that jobs are properly evaluated for exposure hazards and that hazards are properly eliminated or controlled. • Review exposure hazards and controls with employees during daily huddles. • Ensure that employees adhere to preventive measures.
Employees	• Be knowledgeable of exposure hazards and control requirements. • Dress appropriately for environments.
Subcontractors	• Train subcontractor employees.

4. Exposure Assessment

The SSHO ensures that AHAs identify the jobs or tasks with exposure to extreme temperatures. Before beginning work, supervisors review relevant AHAs with employees during daily huddles.

If an AHA has identified potential thermal stress hazard for a project, job or task, the SSHO assesses worker PPE, acclimatization, and workloads and establishes work/rest regimens in accordance with the current American Conference of Governmental Industrial Hygienists (ACGIH) guidelines for thermal stress.

The SSHO determines if an IH must conduct an exposure assessment to thoroughly assess the hazards and recommend controls, and contacts the GBU Safety Manager for further guidance.

HEAT STRESS

5. Heat Stress Factors

Individuals vary in their susceptibility to heat stress. The following factors may predispose a person to heat stress:

- Age
- Alcohol and drug use

- Dehydration
- Diarrhea
- Chronic disease
- Infection
- Lack of physical fitness
- Lack of acclimatization
- Obesity
- Sunburn

Increased risk of excessive heat stress is directly influenced by the amount and type of PPE worn. PPE adds weight and bulk, severely reduces the body's access to normal heat exchange mechanisms (evaporation, convection and radiation), and increases energy expenditure.

The safe duration of work/rest periods is based on the following criteria:

- Anticipated work rate
- Ambient temperature and other environmental factors
- Type of protective ensemble
- Individual worker characteristics and fitness

6. HEAT STRESS EVALUATION

The SSHO conducts wet bulb globe temperature (WBGT) index monitoring for workers wearing the ACGIH standard ensemble of permeable clothing (e.g., standard cotton or synthetic work clothes):

- WBGT index monitoring is based on air temperature, radiant heat, and humidity
- Work/rest schedules are adjusted for work demands, clothing, and acclimatization
- Exposure assessment by an IH and/or physiological monitoring is used for very heavy work conducted for more than half the work/rest period

The IH's exposure assessment for heat stress consists of a detailed task analysis and/or rational model of heat stress, in accordance to ACGIH guidelines.

The SSHO arranges physiological and behavioral monitoring for workers wearing clothing that differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability when the temperature in the work area is above 70°F (21°C).

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work, in accordance to the Physiological Monitoring Frequency Table (Attachment CSHM-36-01). The duration of the work cycle is governed by the frequency of the required physiological monitoring.

Monitor the employee's heart rate and count the radial pulse during a 30-second period as early as possible in the rest period.

- If the heart rate exceeds 110 beats per minute (bpm) at the beginning of the rest period, shorten the next work cycle by one-third and keep the same rest period.
- If the heart rate still exceeds 110 bpm at the next rest period, shorten the following work cycle by one-third.

Monitor the employee's oral temperature. Use a clinical thermometer (3 minutes under the tongue) to measure the oral temperature at the end of the work period (before drinking).

- If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
- If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
- Workers are not permitted to wear semipermeable or impermeable garments when oral temperatures exceed 100.6°F (38.1°C).

If possible, monitor body water loss by measuring weight on a scale accurate to ± 0.25 lb at the beginning and end of each work day to ensure that the employee is taking enough fluids to prevent dehydration.

- Weigh the employee weighed while he is wearing similar clothing or, ideally, nude.
- Ensure that body water loss does not exceed 1.5% total body weight loss in a workday.

7. PREVENTION

Preventing heat stress is particularly important because each instance causes a person to be more susceptible to additional heat injuries. An individual's exposure to heat stress must be discontinued when the following symptoms of excessive heat strain occur:

- Sustained (several minutes) heart rate greater than 180 bpm, minus age in years, for individuals with normal cardiac performance
- Body core temperature greater than 38.5°C (101.3°F) for acclimatized personnel or greater than 38°C (100.4°F) for unacclimatized workers
- Recovery heart rate at 1 minute after a peak work effort is greater than 110 bpm
- Symptoms of sudden and severe fatigue, nausea, dizziness, or lightheadedness
- Profuse sweating sustained over hours
- Weight loss over a shift greater than 1.5% of body weight
- 24-hour urinary sodium excretion less than 50 millimoles

To avoid heat stress, take the following steps to adjust work schedules:

- Modify work/rest schedules according to monitoring requirements.
- Mandate work slowdowns as needed.
- Rotate personnel. Alternate job functions to minimize overstress or overexertion.
- Add personnel to work teams.

- Perform work during cooler bours of the day or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.

Body fluids of workers must be maintained at normal levels to ensure that tbe cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat: 8 fluid ounces (0.23 liter) of water must be ingested for approximately every eight ounces (0.23 kg) of weight lost. The normal thirst mechanism is not sensitive enough to ensure that enough water must be ingested to replace lost sweat. When beavy sweating occurs, the worker must increase fluid intake. The following strategies may be useful:

- Maintain water temperature at 50° to 60°F (10° to 15.6°C).
- Provide small disposable cups that hold about 4 ounces (0.1 liter).
- Urge workers to drink 16 ounces (0.5 liter) of fluid (preferably water or dilute drinks) before beginning work.
- Urge workers to drink a cup or two of fluid at each monitoring break (approximately every 20 minutes). A total of 1 to 1.6 gallons (4 to 6 liters) of fluid a day are recommended, but more may be necessary depending on body weight.

Encourage workers to maintain an optimal level of physical fitness as follows:

- Acclimatize workers to site work conditions, i.e., temperature, protective clothing, and workload, as necessary.
- Urge workers to maintain normal weigbt levels.

Provide cooling devices to aid natural body heat exchange during prolonged work or severe heat exposure. Cooling devices include cooling jackets, vests, or suits.

Where there is the potential for sunburn, provide employees with sunscreen with a sun protection factor (SPF) appropriate for their skin type and exposure.

COLD STRESS

8. GENERAL

Cold weather conditions can be bazardous to the safety and health of employees, endanger the stability of the body system, and cause conditions such as hypothermia and frostbite. It is vitally important that adequate precautions be taken to alleviate the effect of cold environments and to ensure tbat personnel can work safely and efficiently.

Prevent the deep body temperature from dropping below 36°C (96.8°F) and the core temperature from dropping below 35°C (95°F). Prevent cold injury to body extremities.

9. COLD STRESS FACTORS

The following factors may contribute to a cold injury:

- Age
- Contact with wetness or metal
- Exposure to high winds
- Exposure to humidity
- General health
- Inadequate clothing

The following physical conditions worsen the effect of cold exposure:

- Allergies
- Excessive drinking
- Excessive smoking
- Specific drugs and medicines
- Vascular disease (e.g., Raynaud's phenomenon, acrocyanosis)

10. COLD STRESS MONITORING

The project manager designates persous responsible to conduct environmental monitoring at air temperatures below 45°F (7°C).

- At air temperatures helow 30°F (–1°C) measure and record the wind chill index at least every 4 hours. The equivalent wind chill temperature and frostbite precautions will he determined using the Wind Chill Index Table (Attachment CSHM-36-02).
- In indoor workplaces, measure and record tbe wind speed at least every 4 hours when the rate of air movement exceeds 5 mph (2.2 meters per second [m/s]); in outdoor work situations, measure and record the wind speed with the air temperature.
- The wind-chill index takes into account the wind velocity. If no anemometer is available (measures wind speed), use the following to estimate wind speed:
  - 5 mph: light flag moves
  - 10 mph: light flag fully extended
  - 15 mph: raises newspaper sbeet
  - 20 mph: causes blowing and drifting snow

11. ENGINEERING CONTROLS

- Use general or spot heating to increase temperature at the site.
- If work is being performed with bare hands for 10 or more minutes, to keep the worker's hands warm hy supplying warm air jets, radiant heaters, or contract warm heaters.
- If the air velocity at the site is increased by the wind, draft, or ventilation equipment, shield the work area.

- When fine work must be performed with bare hands for more than 10 to 20 minutes in an environment below 60.8°F (16°C), establish a means for keeping workers' hands warm.
- At temperatures below 40°F, cover metal handles of tools and control bars with thermal insulation.
- When necessary, substitute, isolate, relocate, or redesign equipment and processes to reduce the cold stress.
- Use power tools, hoists, cranes, and lifting aids to reduce the metabolic workload.
- If work is performed continuously in an equivalent chill temperature of 30°F or below, supply heated warming shelters such as tents, cabins, automobiles, or trucks and encourage workers to use them.

12. Administrative Controls

- Move work to warmer or less drafty areas whenever possible.
- Employees working in air temperatures of 19.4°F (–7°C) or less must use the Work/Warm-Up Schedule (Attachment CSHM-36-03). Schedule work/rest periods and enforce scheduled work breaks as follows:
  - Allow frequent rest periods in warm environments to prevent cold stress disorders.
  - Allow workers to pace themselves and take extra work breaks when needed.
  - Schedule the coldest work for the warmest part of the day.
  - Provide relief workers for break times.
  - Avoid double shifts and overtime in cold environments.
  - Assign extra workers to highly demanding jobs.
- In accordance with CSHM-38, Substance Abuse, neither sedative drugs nor alcoholic products, including cough medications containing alcohol, may be taken prior to work in cold environments. Alcohol dilates blood vessels near the skin surface, which increases heat loss and lowers body temperature. Sedatives interfere with the transmission of impulses to the brain.
- Urge frequent intake of warm, sweet, caffeine-free, nonalcoholic drinks or soup provided at regular intervals.
- Exclude workers from work in cold (30°F (–1°C) or below), if they are suffering from disease or taking medication that interferes with normal body temperature regulation or reduces tolerance to work in cold environments.
- Terminate exposure to cold when severe shivering or exhaustion becomes evident.
- At air temperatures of 36°F (2°C) or less, workers who become immersed in water (or sweat) or whose clothing becomes wet must immediately be provided a change of clothing and treated for hypothermia.
- Workers with blood vessel abnormalities (e.g., Raynaud's phenomenon, acrocyanosis) must take extra precautions to avoid chilling.
- Maintain protective supervision or a buddy system for those who work in temperatures below 20°F.

- Allow new employees time to adjust to conditions before they work full-time in cold environments.
- Arrange work to minimize sitting still or standing for long periods. Avoid unprotected metal chairs.
- Reorganize work procedures to ensure that as much of a job as possible is performed in a warm environment.

13. PERSONAL PROTECTIVE EQUIPMENT

Include the weight and bulkiness of clothing when estimating work performance criteria.

Remove the outer layer of clothing when entering the heated shelter. Loosen the other layers to allow sweat to evaporate.

Parsons provides the following cold weather PPE:

- Liners for hard hats.
- Face protection: a face mask or scarf is vital when working in cold wind. A ski mask gives better visibility than a snorkel hood. Remove face protectors periodically to check for frostbite.
- Special safety goggles to protect against ultraviolet light and glare are required in snow cover, which could cause eye exposure hazard.

When manual dexterity is not required, workers are provided thermally protective gloves when exposed to the following temperatures:

- For sedentary work, 60.8°F (16°C) and below
- For light work, 39.2°F (4°C) and below
- For moderate work, 19.4°F (–7°C) and below

Because evaporative cooling increases the risk of cold injury, workers handling evaporative liquid (e.g., gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F (4°C) must take precautions to avoid soaking clothing or contact with skin.

In cold weather, the employee is responsible for dressing in clothing appropriate to the expected work conditions, as recommended below:

- Clothing should fit loosely. Tight clothing of synthetic fabrics interferes with evaporation. It is important to preserve the air space between the body and the outer layer of clothing in order to retain body heat.
- It is most important to protect the feet, hands, head, and face. The hands and feet are farthest from the heart and are cooled most easily. Keeping the head covered is important because as much as 40% of body heat is lost when the head is exposed to the elements.
- Ensure that all clothing and equipment fits properly and does not interfere with circulation.

- Clothing should be made of thin cotton, whicb helps evaporate sweat by absorbing it and bringing it to the surface.
- The recommended first layer of clothing includes a cotton T-shirt and sborts or underpants under cotton and wool thermal underwear. Two-piece long underwear is preferred because the top can be douned and doffed as needed.
- Socks with high wool content are best. When two pairs are worn, the inside sock must be smaller and made of cotton. If necessary, wool socks can also double for mittens.
- Wool or thermal trousers are preferred; the best is either quilted or specially lined.
- Belts are not recommended because they cut off the circulation at the waist. Suspenders are encouraged.
- Trousers must fit over the top of tbe boot to prevent snow and ice from entering.
- Boots must be felt-lined, rubber-bottomed, and leather-topped with a removable felt insole. Boots must be waterproofed and socks must be cbanged when they are soaked with sweat.
- Wear a wool sweater over a cotton shirt. Wear tops worn in layers to ensure proper insulation.
- An anorak or snorkel coat or arctic parka sbould fit loosely and should bave a drawstring at the waist. The sleeves sbould fit snugly. A bood prevents the escape of warm air from the neck and also funnels the warm air past the face to provide sligbtly warmer breathing air. Wear a warm cap under the bood.
- Employees wbose clothing may become wet must wear an outer layer of clothing that is impermeable to water. If clothing is wet, the employee must change into dry clothes before entering a cold environment.

14. TRAINING

Parsons trains supervisors and employees in prevention, recognition, and response of thermal stress. Subcontractors must train their own employees.

The SSHO arranges employee training at the time of initial assignment and wben a new hazard is introduced to the jobsite. This training can be organized and presented to groups or on a work area by work area basis, depending on the operation.

Supervisors brief employees on relevant AHAs and special work practices during daily buddles before beginning work.

Further information on signs and symptoms of thermal stress and first aid treatment are included in Thermal Stress Disorders (Attachment CSHM-36-04). Training includes the following topics:

- Appropriate first aid treatment and emergency response
- Recommended clothing practice
- Safe work practices for preventing thermal stress
- Signs and symptoms of impending thermal stress
- Warming and/or cooling procedures
- Work/rest schedules

Using an acceptable training form, the records custodian maintains a record of all training or instruction given to employees.

15. DOCUMENTATION

The records custodian documents all instruction and training and maintains employee medical records and physiological monitoring records in employee files in accordance with CSHM-1, Medical Qualification and Surveillance.

The SSHO maintains project records at the site for the duration of the project and archives them at project close.

16. REFERENCES

ACGIH, Threshold Limit Values and Biological Exposure Indices, Latest Edition

EM 385-1-1, Safety – Safety and Health Requirements, Section 6.J, Hazardous Suhstances, Agents and Environments: Inclement Weather and Environmental Hazards; Section 6.K, Cumulative Trauma Prevention

Parsons SHARP Manual

17. ATTACHMENTS

CSHM-36-01	Physiological Monitoring Frequency Table
CSHM-36-02	Wind Chill Index Tahle
CSHM-36-03	Work/Warm Up Schedule
CSHM-36-04	Thermal Stress Disorders

Table 5.2

Heat Index - Apparent Temperature For Given Humidity And Ambient Temperature Readings In Shade

	ENVIRONMENTAL TEMPERATURE (Fahrenheit)										
	70	75	80	85	90	95	100	105	110	115	120
RELATIVE HUMIDITY	APPARENT TEMPERATURE*										
0%	64	69	73	78	83	87	91	95	99	103	107
10%	65	70	75	80	85	90	95	100	105	111	116
20%	66	72	77	82	87	93	99	105	112	120	**130**
30%	67	73	78	84	90	96	104	113	123	**135**	**148**
40%	68	74	79	86	93	101	110	123	**137**	**151**	
50%	69	75	81	88	96	107	120	**135**	**150**		
60%	70	76	82	90	100	114	**132**	**149**			
70%	70	77	85	93	106	124	**144**				
80%	71	78	86	97	113	**136**					
90%	71	79	88	102	122						
100%	72	80	91	108							

*Combined Index of Heat and Humidity...what it "feels like" to the body
Source: National Oceanic and Atmospheric Administration

How to use Heat Index:
1. Across top locate Environmental Temperature
2. Down left side locate Relative Humidity
3. Follow across and down to find Apparent Temperature
4. Determine Heat Stress Risk on chart at right

Note: Exposure to full sunshine can increase Heat Index values by up to 15 degrees F.

Apparent Temperature	Heat Stress Risk with Physical Activity and/or Prolonged Exposure
90-105	Heat Cramps or Heat Exhaustion Possible
105-130	Heat Cramps or Heat Exhaustion Likely, Heat Stroke Possible
>130	Heatstroke Highly Likely

Adjusted Temperature, °F (°C)[a]	Normal Work Ensemble[b]	Impermeable Ensemble
≥90° (≥32.2°)	After each 45 minutes of work	After each 15 minutes of work
87.5° to 90° (30.8° to 32.2°)	After each 60 minutes of work	After each 30 minutes of work
82.5° to 87.5° (28.1° to 30.8°)	After each 90 minutes of work	After each 60 minutes of work
77.5° to 82.5° (25.3° to 28.1°)	After each 120 minutes of work	After each 90 minutes of work
72.5° to 77.5° (22.5° to 25.3°)	After each 150 minutes of work	After each 120 minutes of work

For fit and acclimatized workers at work levels of 250 kilocalories/hour.

[a]Calculate the adjusted air temperature (ta adj) by using this equation:

ta adj F = ta F + (13 X % sunshine).

Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent of the time the sun is not covered by clouds that are thick enough to produce a shadow. (100% sunshine: no cloud cover and a sharp, distinct shadow; 0% sunshine: no shadows.)

[b]A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

What Is Heat Index?

Heat index (HI) is sometimes referred to as the "apparent Temperature". The HI, given in degrees F, is a measure of how hot it feels when relative humidity (RH) is added to the actual air temperature.

The following equation approximates the heat Index. There are many assumptions made to produce this, far too many to list here. The equation was obtained by multiple regression analysis and there is a ±1.3 degree °F error.

$$HI = -42.379 + 2.04901523T + 10.14333127R - 0.22475541TR - 6.83783\times10^{-3}\,T^2 - 5.481717\times10^{-2}\,R^2 + 1.22874\times10^{-3}\,T^2R + 8.5282\times10^{-4}\,TR^2 - 1.99\times10^{-5}\,T^2R^2$$

where
T = ambient dry bulb temperature degrees Fahrenheit
R = relative humidity

Thanks to Lans Rothfusz, MIC at NWS Tulsa, OK for the following table.

HEAT INDEX °F (°C)													
	RELATIVE HUMIDITY (%)												
Temp.	40	45	50	55	60	65	70	75	80	85	90	95	100
110 (47)	136 (58)												
108 (43)	130 (54)	137 (58)											
106 (41)	124 (51)	130 (54)	137 (58)										
104 (40)	119 (48)	124 (51)	131 (55)	137 (58)									
102 (39)	114 (46)	119 (48)	124 (51)	130 (54)	137 (58)								
100 (38)	109 (43)	114 (46)	118 (48)	124 (51)	129 (54)	136 (58)							
98 (37)	105 (41)	109 (43)	113 (45)	117 (47)	123 (51)	128 (53)	134 (57)						
88 (38)	101 (38)	104 (40)	108 (42)	112 (44)	116 (47)	121 (49)	126 (52)	132 (56)					
94 (34)	97 (36)	100 (38)	103 (39)	106 (41)	110 (43)	114 (46)	119 (48)	124 (51)	129 (54)	135 (57)			
92 (33)	94 (34)	96 (36)	99 (37)	101 (38)	105 (41)	108 (42)	112 (44)	118 (47)	121 (49)	126 (52)	131 (55)		
90 (32)	91 (33)	93 (34)	95 (35)	97 (36)	100 (38)	103 (39)	106 (41)	109 (43)	113 (45)	117 (47)	122 (50)	127 (53)	132 (58)
88 (31)	88 (31)	89 (32)	91 (33)	93 (34)	95 (35)	98 (37)	100 (38)	103 (39)	108 (41)	110 (43)	113 (45)	117 (47)	121 (49)
88 (30)	85 (29)	87 (31)	88 (31)	89 (32)	91 (33)	93 (34)	95 (35)	97 (36)	100 (38)	102 (39)	105 (41)	108 (42)	112 (44)
84 (29)	83 (28)	84 (29)	85 (29)	86 (30)	88 (31)	89 (32)	90 (32)	92 (33)	94 (34)	96 (36)	98 (37)	100 (38)	103 (39)
82 (28)	81 (27)	82 (28)	83 (28)	84 (29)	84 (29)	85 (29)	86 (30)	88 (31)	89 (32)	90 (32)	91 (33)	93 (34)	95 (35)
80 (27)	80 (27)	80 (27)	81 (27)	81 (27)	82 (28)	82 (28)	83 (28)	84 (29)	84 (29)	85 (29)	86 (30)	88 (30)	87 (31)

Category	Heet Index	Possible heat disorders for people in high risk groups
Extreme Denger	130°F or higher (54°C or higher)	Heat stroke or sunstroke likely.
Danger	105 - 129°F (41 - 54°C)	Sunstroke, muscle cramps, and/or heat exhaustion likely. Heatstroke possible with prolonged exposure and/or physical activity.
Extreme Caution	90 - 105°F (32 - 41°C)	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure end/or physical activity.
Ceution	80 - 90°F (27 - 32°C)	Fatigue possible with prolonged exposure and/or physical activity.

NOAA's National Weather Service
Jackson, KY Weather Forecast Office
1329 Airport Road
Jackson, KY 41339
606-666-8000
Page Author: JKL Webmaster
Web Master's E-mail: w-jkl.webmaster@noaa.gov
Page last modified: June 15th 2006 6:53 AM

10.2 SUBCONTRACTOR SAFETY PLANS (SSPS)

PARSONS

Subcontractor Safety, Health, and Environmental Plan Review

Date: Project/Location:

Subcontractor: Parsons SH&E Manager:

The information provided here is based on a review of the Subcontractor Safety, Health, and Environmental Plan (SSHEP). Areas identified as incomplete are reevaluated and modified based on the standards in the contract specifications and the Project Safety, Health, and Environmental Program manual. Subcontractors resubmit corrected sections of the SSHEP to the Parsons Construction Manager within 1 week of receiving review documentation.

Section	Complete	Incomplete	Section	Complete	Incomplete
Site Specific SH&E Plan	☐	☐	Specific Activity Hazard Analysis (AHA)	☐	☐
Responsibilities assigned	☐	☐	Project Site Employees Orientation Program	☐	☐
Compliance	☐	☐	Emergency Action Plan	☐	☐
Hazard Communication	☐	☐	Site-Specific Medical Emergency Plan	☐	☐
Hazard Assessment	☐	☐	Identification of Key Line Personnel	☐	☐
Accident Investigation	☐	☐	Identification of Competent & Qualified Personnel	☐	☐
Hazard Correction	☐	☐	Written Progressive Disciplinary Program	☐	☐
Training and Instruction	☐	☐	Written Trenching and Shoring Plan (if applicable)	☐	☐
Recordkeeping	☐	☐	Written 100% Fall Protection Plan (if applicable)	☐	☐
Scope of Work Evaluation	☐	☐	Other	☐	☐

Additional Comments:

_____

_____

_____

_____

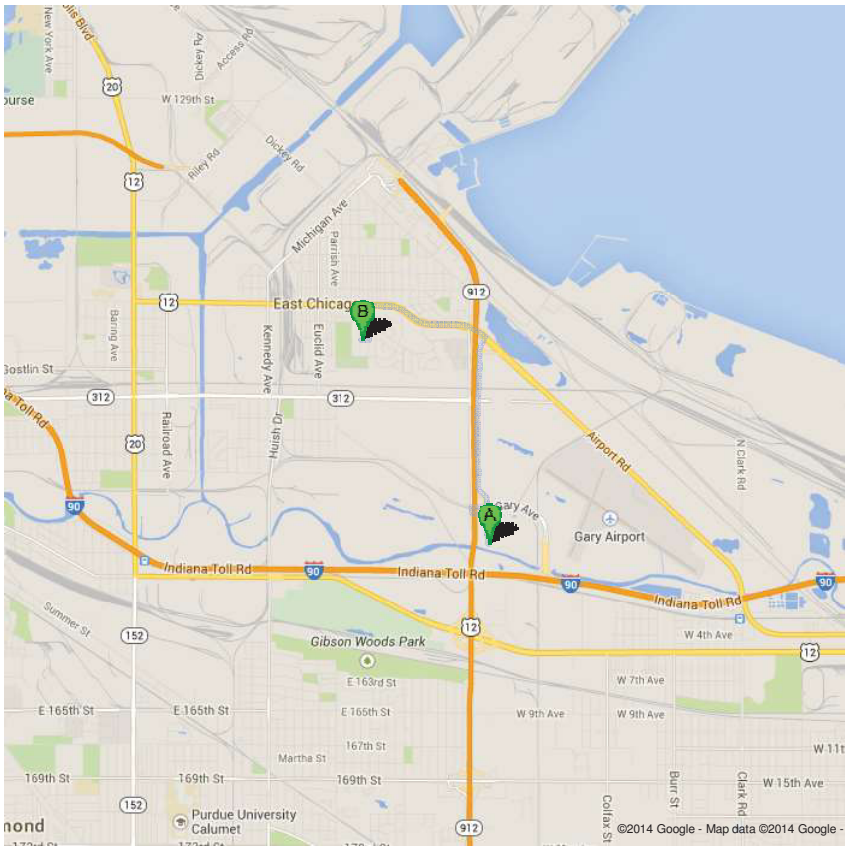
Reviewed by:

Name Title

_____ _____ _____

10.3 HOSPITAL AND OCCUPATIONAL HEALTH CLINIC ROUTE MAPS

Directions to Saint Catherine Hospital
4321 Fir St, East Chicago, IN 46312
3.0 mi – about **7 mins**



A 479 Cline Ave, Gary, IN 46406

	1. Head **north** on **Cline Ave** About 47 secs	go 0.3 mi total 0.3 mi
	2. Turn right toward **Cline Ave**	go 236 ft total 0.4 mi
	3. Merge onto **Cline Ave**	go 46 ft total 0.4 mi
	4. Turn right onto **Gary Ave**	go 0.1 mi total 0.5 mi
	5. Turn left onto **Cline Ave** About 3 mins	go 1.2 mi total 1.7 mi
	6. Continue onto **US-12 E**	go 463 ft total 1.8 mi
	7. Turn left onto **Airport Rd**	go 0.1 mi total 1.9 mi
	8. Continue onto **US-12 W/Cesar Chavez Memorial Dr/E Columbus Dr** About 1 min	go 0.8 mi total 2.7 mi
	9. Turn left onto **Elm St** About 55 secs	go 0.3 mi total 3.0 mi
	10. Turn right onto **E 143rd St**	go 331 ft total 3.0 mi

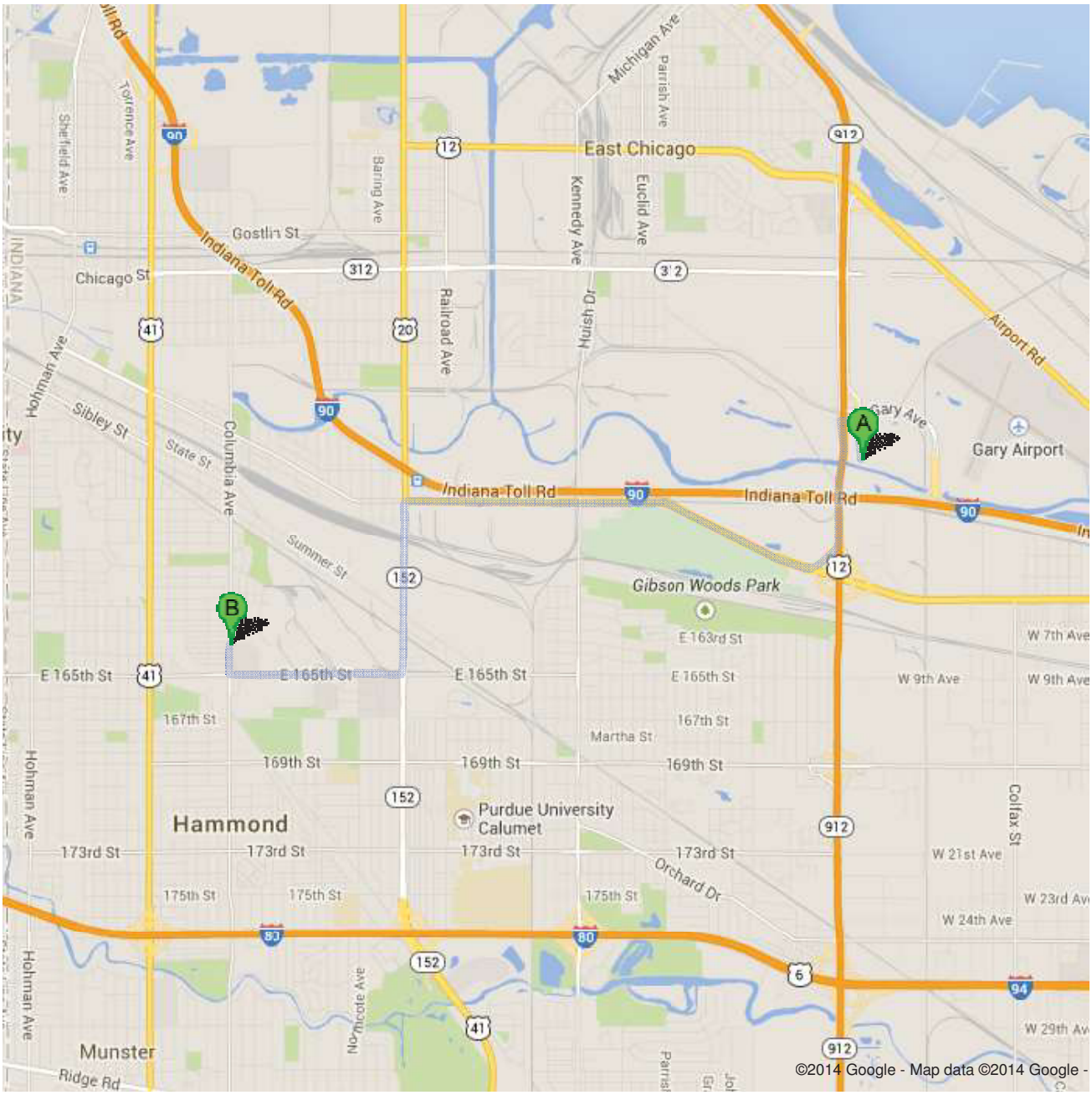
B **Saint Catherine Hospital**
4321 Fir St, East Chicago, IN 46312

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Map data ©2014 Google

Directions weren't right? Please find your route on maps.google.com and click "Report a problem" at the bottom left.

Directions to Concentra Immediate Care - Hammond
6423 Columbia Ave, Hammond, IN 46320
5.8 mi – about **10 mins**



A 479 Cline Ave, Gary, IN 46406

1.	Head **north** on **Cline Ave** About 47 secs	go 0.3 mi total 0.3 mi
2.	Turn left to merge onto **US-12 E** About 1 min	go 0.7 mi total 1.0 mi
3.	Take exit **8A** to merge onto **US-20 W/Michigan St** About 3 mins	go 2.6 mi total 3.7 mi
4.	Turn left onto **IN-152 S/Indianapolis Blvd** About 2 mins	go 1.0 mi total 4.6 mi
5.	Take the 2nd right onto **E 165th St** About 2 mins	go 1.0 mi total 5.6 mi
6.	Turn right onto **Columbia Ave** Destination will be on the left	go 0.2 mi total 5.8 mi

B **Concentra Immediate Care - Hammond**
6423 Columbia Ave, Hammond, IN 46320

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

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10.4 ACTIVITY HAZARD ANALYSIS (AHAS)

Activity Hazard Analysis (AHA)

Activity/Work Task:	Air Monitoring
Project Location:	Gary Development Landfill, Gary, IN
Contract Number:	19457-0001
Date Prepared: (mm/dd/yy)	10/01/14
Prepared by (Name/Title):	Caryn A. Moore/Geologist
Reviewed by (Name/Title):	Florin Savin/Principal Geologist
Employer/GBU:	Parsons/PE&I

Notes: (Field Notes, Review Comments, etc.)
References :

Overall Risk Assessment Code (RAC) (Use highest code): L

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Unloading equipment	Muscle Strain. Pinch Point. Lacerations. Slips, Trips, Falls. Biological.	Use proper lifting techniques and use a partner when moving >50 pounds of weight. Keep an eye out including on the ground for biological and trip hazards. Mark any trip and plant hazards seen. Wear the proper PPE. Wear bug spray.	U	Marginal	L
Setting up equipment.	Muscle Strain. Pinch Point. Lacerations Slips, Trips, Falls. Biological.	Inspect equipment for damage. Wear proper PPE, including gloves. Use proper lifting technique when moving equipment. Use a partner to move anything weighing >50 pounds. Keep an eye out including on the ground for biological and trip hazards. Mark any trip and plant hazards seen.	U	Marginal	L
Setting up generator.	Muscle Strain. Pinch Point. Slips, Trips, Falls. Biological.	Inspect generator. Ensure it has GFCI outlets. Inspect extension cords. Inspect data and electrical connections. Use proper lifting techniques and use a partner when moving the generator. Keep an eye out including on the ground for trip and biological hazards. Mark any trip and plant hazards seen. Wear the proper PPE, including gloves. Wear bug spray.	U	Marginal	L

AIR MONITORING

Job Steps	Hazards	Controls	P	S	RAC
Starting air monitoring.	Muscle Strain. Pinch Point. Slips, Trips, Falls. Biological. Electrocution	Double check all connections. Use proper body position while starting the generator. Wear proper PPE, including gloves. Keep an eye out including on the ground for trip and biological hazards. Mark any trip and plant hazards seen. Wear bug spray.	U	Marginal	L
Tearing down and loading equipment.	Muscle Strain. Pinch Point. Lacerations. Slips, Trips, Falls. Biological.	Inspect generator, extension cords and other equipment for damage. Use proper lifting techniques and use a partner when moving >50 pounds of weight. Keep an eye out including on the ground for biological and trip hazards. Mark any trip and plant hazards seen. Wear the proper PPE, including gloves. Wear bug spray.	U	Marginal	L

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Utility and Boring Location	**Overall Risk Assessment Code (RAC) (Use highest code)**	L
Project Location:	Gary Development Landfill, Gary, IN		
Contract Number:	19457-0001		
Date Prepared: (mm/dd/yy)	10/01/14		
Prepared by (Name/Title):	Caryn A. Moore/Geologist		
Reviewed by (Name/Title):	Florin Savin/Principal Geologist		
Employer/GBU:	Parsons/PE&I		
Notes: (Field Notes, Review Comments, etc.) **References :**			

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Walk over site, review utilities marked by state locators. Review proposed boring locations.	Slip, trip & fall	Constant awareness of surroundings and ground terrain. Examine site for debris or slip/trip hazards prior to walk over. Clear walking area of hazards by picking up debris if possible or walk around.	U	Negligible	L
	Traffic (pedestrian)	**Be seen!** Wear a brightly colored traffic vest, steel-toed boots and long-sleeve shirt Be extra observant in the highly traveled areas (parking lots, driveways, shoulders of roadways etc.) and constan be aware of local traffic.			
	Natural Hazards (stinging insects, ticks)	Insects are more visible on light colored clothing. Avoid repellants directly on skin. Awareness/recognition of surroundings.			
Use equipment to identify buried metal conduit.	Slip, trip & fall	Constant awareness of surroundings and ground terrain. Examine site for debris or slip/trip hazards prior	U	Moder	L

Job Steps	Hazards	Controls	P	S	RAC
		to walk over. Clear walking area of hazards by picking up debris if possible or walk around. Wear brightly colored vest. Hard hat, steel-toed boots and long-sleeve shirt are also required.		ate	
	Pinch points, muscle strain	Avoid twisting upper torso when removing equipment fro field vehicle. Keep fingers clear when assembling GPR unit.			
	Traffic	**Be seen!** Be extra observant in the highly traveled areas (parking l driveways, shoulders of roadways etc.) and constantly ch traffic conditions.			
Open utility manway covers (if present and necessary) to access utility & determine orientation of conduit(s).	Pinch point/sharp edges	Wear leather work gloves. Use the proper hand tools to remove bolts which typically secure the covers. Debris (dirt, gravel) may hav be removed from around the manhole cover. Add hearing protection if a sledge hammer is needed to tap (loosen) the manhole.	U	Mo der ate	L
	Losing control of cover while trying to remove cover, pinched hands & feet	Assess the approximate weight of the cover, plan the lift. May require a stronger staff member or team-up with a staff member to perform the lift.			
	Muscle/joint strain Improper lifting posture while removing heavy covers-back injuries	Avoid twisting upper torso when dragging cover. Use larger muscle groups (legs). Use proper body mechanics by keeping back straight, chin-up and relying on large muscle groups to drag/remove cover. Wear appropriate (leather) gloves for better grip & protection from burrs. Use the lifting tool (hook) and crow bar to pry open manh cover and drag it off of its manhole/manbox.			
	Slip, trip & fall Injury from fall into manhole/manbox	Store manhole cover next to manbox and mark it with a safety cone to remind you and other site personnel of its presence. Created a large tripping hazard. Avoid			

Job Steps	Hazards	Controls	P	S	RAC
	Encounter active utilities (gas, electric, Water, sewer, telephone etc.) *Exposure to COCs (methane, H2S, etc.)*	leaving an open manbox unattended. Conduct removal activity slowly – do not rush. Immediately **stop work if** initial lift plan cannot remove cover. Re-evaluate. Must wear *safety glasses*, nitrile (inner) and leather (outer) gloves. May be exposed to energy sources in an active recovery well.			
Mark utility and boring locations using spray paint and stakes.	Muscle strain Exposure to paint fumes Pinch point	Use wheeled marking rod to hold paint can (will keep can away from breathing zone and avoids bending over). Use gloves when hammering in stakes. Keep proper posture. Hold stake several inches from the top to keep hand away from hammer. Inspect stakes to insure none will break while hammering.	U	Negligible	**L**
Collect photographs of utility markings and boring locations.	Slip, trip, & fall	Constant awareness of surroundings and ground terrain. Examine site for debris or slip/trip hazards prior to walk over. Clear walking area of hazards by picking up debris if possible or walk around. Wear brightly colored vest. Hard hat, steel-toed boots and long-sleeve shirt are also required.	U	Negligible	**L**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Surface Water and Sediment Sampling	**Overall Risk Assessment Code (RAC) (Use highest code)**	**M**
Project Location:	Gary Development Landfill, Gary, IN		
Contract Number:	19457-0001		
Date Prepared: (mm/dd/yy)	10/01/14		
Prepared by (Name/Title):	Caryn A. Moore/Geologist		
Reviewed by (Name/Title):	Florin Savin/Principal Geologist		
Employer/GBU:	Parsons/PE&I		
Notes: (Field Notes, Review Comments, etc.) **References :**			

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Access sampling locations	Off highway driving	Driver must be familiar with site and vehicle, see driving policy, vehicle will only be driven off path when surface conditions (depressions/surface debris) are visible. If surface conditions are not visible to the driver a spotter will walk in front of the vehicle. The vehicle will not be parked over tall grass/brush that could ignite when in contact with hot surfaces such as the tailpipe/catalytic converter. Vehicle will not be driven on slopes greater than the vehicle manufacturer's recommend slope and the driver's comfort level. If a utility vehicle is more appropriate, discuss with the PM. (Review the Driving Hazards AHA for other vehicle operation precautions).	U	Critical	**M**
	Slips/Trips/Falls	Inspect work area before hauling sampling equipment into work area. Clear a foot path to the sampling point			

Job Steps	Hazards	Controls	P	S	RAC
		if necessary. Remove trip hazards (vines/stumps) or mark trip hazards with flagging or hi-vis paint. Carry the minimum amount of equipment into tall brush, perform decontamination/sample packing on clear level ground or at the site trailer. Soft/saturated soil can create a trip/ankle twist hazard. (Review brush clearing AHA if necessary)			
	Heat/Cold Stress	Adjust clothing and break times for the conditions, vehicle are warm up and cool down zones.			
	Cuts/Abrasions	Wear cut resistant gloves under nitrile gloves when handling groundwater sample containers. Use kneeling pad or knee pads as necessary. Use proper tools.			
	Stinging/Biting Insects	Wear insect repellent applied to clothing if necessary. Wear Tyvek coveralls if ticks have been found. Use insecticide (Hornet Spray) as necessary if hornets/wasps are nesting in brush or burrows. If hornets are seen, stop work to determine if they are nesting in the work zone. Burrowing ground hornets can be difficult to detect until they are swarming.			
	Poor Weather	Review forecast prior to starting work, keep track of approaching storms through the office or cellular phone forecast tools. Stop work as necessary – to not resume work for 30 minutes after the occurrence of thunder or lightning. Review site assembly points in HASP.			
Collect surface water and shallow sediment samples	Contact with contaminated surface water or sediments.	Wear nitrile gloves, historical monitoring data indicates elevated levels of metals (lead) may be present in sediment but are unlikely in standing water. Decontaminate waders after use.	U	Marginal	L
	Cuts/Abrasions	Inspect glass sample bottles prior to use, wear cut resistant synthetic fiber gloves under nitrile gloves. If possible wrap cracked glass containers with packing tape or place in a cardboard box for disposal – do not place broken glass in a plastic trash bag.			

Job Steps	Hazards	Controls	P	S	RAC
		Use kneeling pad or knee pads as necessary. Use proper tools.			
	Back Strain	If using a pole to position a surface water sampling container or sample tube do not extend the pole to a length which causes back strain. Holding a pole from the "middle" like a pendulum will remove most of the back strain caused by suspending all of the weight of the pole from the arms. Wade into the shallow water as necessary to reduce back strain. Never work alone especially wading into soft sediments. If water depth exceeds 3' at the required sample location, stop work and contact the PM as additional precautions must be discussed such as the use of PFDs. Use two persons to carry coolers greater than 50lbs.			
	Slips/trips/falls	Make multiple trips to carry field equipment back to truck from sampling locations and remove waders when not needed – do not wear clumsy waders when not necessary.			

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task: Soil, Sediment and Surface Water Sampling and Boat Tasks	**Overall Risk Assessment Code (RAC) (Use highest code)** M
Project Location: Gary Development Landfill, Gary, IN	**Risk Assessment Code (RAC) Matrix**
Contract Number: 19457-0001	
Date Prepared: (mm/dd/yy) 10/01/14	
Prepared by (Name/Title): Caryn A. Moore/Geologist	
Reviewed by (Name/Title): Florin Savin/Principal Geologist	
Employer/GBU:	
Notes: (Field Notes, Review Comments, etc.) **References :**	

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart
- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Minimum PPE: Safety Glassess ***x Safety Shoes x Hard Hat*** High Vis Vest or Clothes ***x Hearing Protection x Respiratory Protection Type: Level B (full face respiratory)***
x Gloves Type:latex undergloves/nitrile overgloves Other: ***Tyvek BR or Tychem coveralls*** ie Face-shields, Flame Resistant Clothing,Coveralls, etc
PPE should be the "last line of defense" after using substitution, engineering controls, warning labels, work procedures and training

Job Steps	Hazards	Controls	P	S	RAC
(1) Moving or setting up equipment	a. Injuries due to lifting equipment out of vehicle. b. Pinches, cuts and scrapes when unloading equipment. c. Slip, trips, and falls while setting up work area. d. Vehicle shifting or rolling e. Vehicle/Pedestrian Traffic	a. Bend knees while keeping back 90 degrees. Lift with legs. Do not exceed lifting 50lbs. without two people. Use 3-point stance when climbing/leaving truck bed. b. Wear chemical resistant gloves when handling contaminated equipment and protective heavy duty work gloves if not working with contaminated equipment. c. Keep work area free of excess material and debris. Keep work area and pathways neat and orderly. Survey work area for ruts or tripping hazards. e. Secure area w/barricades, traffic cones and caution tape, etc., when necessary.	U	N	L
			U	Cat	M

Minimum PPE: Safety Glassess ***x Safety Shoes x Hard Hat*** High Vis Vest or Clothes ***x Hearing Protection x Respiratory Protection Type: Level B (full face respiratory)***
x Gloves Type:latex undergloves/nitrile overgloves Other: ***Tyvek BR or Tychem coveralls*** ie Face-shields, Flame Resistant Clothing,Coveralls, etc
PPE should be the "last line of defense" after using substitution, engineering controls, warning labels, work procedures and training

Job Steps	Hazards	Controls	P	S	RAC
Working from boat.	a) Drowning b) Falling out of boat c) Slipping	a) Discuss boat and water safety, housekeeping and planned tasks before loading and launching boat. b) Minimize team time on or near the water. Wear PPE: USCG approved personal flotation devices and throw ring on rope. c) Conduct as many tasks before and after heading off-shore. d) Enter and exit the boat one at a time e) Maintain good housekeeping on the boat at all times. f) Limit movement and standing up in boat. g) Use shoes/boots with good traction and manage boat space.		ast rop hic	
Working outdoors and possible inclement weather (e.g. rain, wind, choppy water, thunder and lightning)	a) Postpone work if there is any risk to safety due to weather. b) Monitor weather regularly to determine if inclement weather is approaching.	a) Check weather report on the day of sampling. b) Check with boat captain on safety of boating in inclement weather. c) Use best professional judgment in assessing weather conditions.	S	Ma rgi nal	**L**
Lifting and moving boats	a) Back injuries b) Slip, trip, fall	a) Lift and move heavy or awkward gear as a team b) Follow proper lifting techniques (use legs not back, keep load close to body) c) Discuss tasks and plans before the lift d) Clear the pathway e) Pre walk the pathway f) Communicate as a team during lift/move	U	Ma rgi nal	**L**
Working outdoors and Sun, Wind, Mosquitos	a) Sunburn b) Heat Stress c) Bites d) wind blowing gear into personnel or into water	a) Cover skin from sunlight b) Wear sunscreen c) Drink plenty of water and fluids d) Take frequent routine breaks to cool down e) Take a break and discuss heat hazards if any team member begins to feel fatigue f) Wear bug spray if necessary g) Keep vehicle doors closed when possible to	U	Ma rgi nal	**L**

Minimum PPE: Safety Glassess ***x Safety Shoes x Hard Hat*** High Vis Vest or Clothes ***x Hearing Protection x Respiratory Protection Type: Level B (full face respiratory)***
x Gloves Type:latex undergloves/nitrile overgloves Other: ***Tyvek BR or Tychem coveralls*** ie Face-shields, Flame Resistant Clothing,Coveralls, etc
PPE should be the "last line of defense" after using substitution, engineering controls, warning labels, work procedures and training

Job Steps	Hazards	Controls	P	S	RAC
		prevent them slamming in the wind. h) Secure all loose or light gear.			
Collect soil/groundwater samples	Exposure to contaminate in soil/groundwater	Workers will collect samples in Level D (Level C if air monitoring results indicate higher risk.	U	Marginal	L

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Soil Sampling	**Overall Risk Assessment Code (RAC) (Use highest code)**	L
Project Location:	Gary Development Landfill, Gary, IN		
Contract Number:	19457-0001		
Date Prepared: (mm/dd/yy)	10/01/14		
Prepared by (Name/Title):	Caryn A. Moore/Geologist		
Reviewed by (Name/Title):	Florin Savin/Principal Geologist		
Employer/GBU:	Parsons/PE&I		
Notes: (Field Notes, Review Comments, etc.) **References :**			

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Collect soil sample from sample core.	Slip, trip & fall	Constant awareness of surroundings and ground terrain. Examine site for debris or slip/trip hazards prior to walk over. Clear walking area of hazards by picking up debris if possible or walk around.	U	Marginal	L
	Traffic (pedestrian)	**Be seen!** Wear a brightly colored traffic vest, steel-toed boots and long-sleeve shirt Be extra observant in the highly traveled areas (parking lots, driveways, shoulders of roadways etc.) and constan be aware of local traffic.			
	Natural Hazards (stinging insects, ticks)	Insects are more visible on light colored clothing. Avoid repellants directly on skin. Awareness/recognition of surroundings.			
	Contact with contaminated soils	Wear nitrile gloves when handling soils			

Job Steps	Hazards	Controls	P	S	RAC
	Cuts/lacerations - glass sample jars	Wear cut resistant gloves when handling glassware.			
Pack coolers and load them into vehicle for transport to FedEx or temporary storage for courier pick up	Lifting Pinch points Slip, trips, and falls while setting up work area.	Use proper lifting technique; use two-man lift methods when necessary; use mechanical lifting means for items over 100 lbs; do not reach/stretch from the side of a truck to reach an item in the middle; use a 3-point hold and climb into the truck to reach items. Wear leather gloves or other protective heavy duty work gloves. Be alert while walking, and survey work area for ruts, or tripping hazards.	U	Marginal	L

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Slug Testing
Project Location:	Gary Development Landfill, Gary, IN
Contract Number:	19457-0001
Date Prepared: (mm/dd/yy)	10/01/14
Prepared by (Name/Title):	Caryn A. Moore/Geologist
Reviewed by (Name/Title):	Florin Savin/Principal Geologist
Employer/GBU:	Parsons/PE&I

Notes: (Field Notes, Review Comments, etc.)
References :

Overall Risk Assessment Code (RAC) (Use highest code) L

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Equipment Setup	Site debris Slip, trip, fall Traffic Weather-Cold High Winds	Constant awareness of surroundings and ground terrain. Examine site for debris or slip/trip hazards prior to walk over. Wear brightly colored vest, hard hat, safety glasses at all times. Site traffic is very heavy all through the day. Use 42" traffic cones to surround survey equipment; however, set-up survey station out of harms way if possible. Wear proper winter clothing: insulated boots, coveralls, hat Clear work area of snow to reveal potential trip hazards. Watch out for ice when crossing Spring Grove Road. Keep paper documents pinned down.	L	Negligible	L
Rising and Falling Head Slug Tests	Lifting Splashes Trip Hazard Caused by rope	Use proper lifting technique Wear proper PPE-especially eye protection with side shields	S	Negligible	L

Job Steps	Hazards	Controls	P	S	RAC
	Bending-back strain Cuts to hands from rope	Constant awareness of surroundings, use good housekeeping Be aware of posture when moving slug, and reading water level measurements, wear knee pads if necessary. Wear cut resistant gloves leather or synthetic over standard nitrile gloves.			
Equipment Decon	Splashes Bending Numb hands from immersion in cold water	Wear proper PPE-especially eye protection with side shields Be aware of posture when moving slug, and reading water level measurements, wear knee pads if necessary. Fill water tank with warm/hot water to prevent freezing, keep in cab of truck. Take a break from decon for hands to warm up.	U	Ne glig ible	L

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Monitoring Well Installation Oversight
Project Location:	Gary Development Landfill, Gary, IN
Contract Number:	19457-0001
Date Prepared: (mm/dd/yy)	10/1/14
Prepared by (Name/Title):	Caryn A. Moore/Geologist
Reviewed by (Name/Title):	Florin Savin/Principal Geologist
Employer/GBU:	Parsons/PE&I

Notes: (Field Notes, Review Comments, etc.)
References :

Overall Risk Assessment Code (RAC) (Use highest code) **M**

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Ensure that subcontractor performs daily pre-operation safety inspection on drill rig, and of any associated heavy equipment. Place emphasis on integrity of hydraulics and safety features.	Slip, trip, fall on uneven or slippery ground Struck by moving equipment	Walk slowly and ensure good footing on uneven or slippe ground. Remain a safe distance from the drill rig when it is in operation.	U	Ne glig ible	L
Oversee installation of monitoring well.	Slip, trip, fall on uneven or slippery ground Struck by equipment Noise Dust	Walk slowly and ensure good footing on uneven or slippe ground. Remain a safe distance from the drill rig when it is in operation. Wear ear plugs as needed. Utilize eye protection and dust mask as needed.	U	Cat ast rop hic	M

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Monitoring Well Development
Project Location:	Gary Development Landfill, Gary, IN
Contract Number:	19457-0001
Date Prepared: (mm/dd/yy)	10/01/14
Prepared by (Name/Title):	Caryn A. Moore/Geologist
Reviewed by (Name/Title):	Florin Savin/Principal Geologist
Employer/GBU:	Parsons/PE&I
Notes: (Field Notes, Review Comments, etc.) **References :**	

Overall Risk Assessment Code (RAC) (Use highest code) L

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Access/open monitoring wells.	Slips/Trips/Falls	Proper housekeeping and footwear. Proper foot placement.	U	Negligible	L
	Heat Stress	Adjust clothing and break times for the conditions, vehicle and trailer are cool down zones.			
	Pinch Points	Wear cut resistant gloves, use proper tools, report damaged well lids/protective covers to PM. Do not use excessive force - use proper tool.			
	Cuts/Abrasions	Wear cut resistant gloves and long pants. Use kneeling pad or knee pads as necessary. Use proper tools.			
	Splash of standing water – compressed air trapped in well casing.	Remove standing water from manholes and crack expandable caps to allow air to vent prior to cap removal.			

Job Steps	Hazards	Controls	P	S	RAC
	Traffic Stinging/Biting Insects Poor Weather	Wear high visibility vest or jacket. Wear insect repellent applied to clothing if necessary. Use insecticide (Hornet Spray) as necessary if hornets/wasps are nesting in well covers. Review forecast prior to starting work, keep track of approaching storms through the office or cellular phone forecast tools. Stop work as necessary – to not resume work for 30 minutes after the occurrence of thunder. Review assembly points in HASP.			
Gauge monitoring wells	Contact with contaminated groundwater, chemicals of concern – dissolved metals.	Wear nitrile gloves.	U	Negligible	L
Using low flow purging equipment	Back strain-heavy lifting Splash spray of contaminated water. Slip/Trips/Falls	Use proper lifting technique; lift with legs, individual lifting limit is 50 lbs. Set up purging equipment in vehicle so that a minimum amount of equipment needs to be removed from the vehicle and relocated to the work zone. Pump development water directly into poly tanks or 5-gallon buckets with tight fitting lids. Only fill to 4-gal. Wear cut resistant and nitrile gloves when lowering submersible pump in well. Wear proper PPE – safety glasses. Inspect tubing connections for proper fit prior to pressurization of sampling system. Keep all waste in trash bags and out of work zone and vehicles. Keep walking area clear of tubing/power cables.	U	Marginal	L

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Motor Vehicle Operation
Project Location:	Gary Development Landfill, Gary, IN
Contract Number:	19457-0001
Date Prepared: (mm/dd/yy)	10/01/14
Prepared by (Name/Title):	Caryn A. Moore/Geologist
Reviewed by (Name/Title):	Florin Savin/Principal Geologist
Employer/GBU:	Parsons/PE&I

Notes: (Field Notes, Review Comments, etc.)
References :

Overall Risk Assessment Code (RAC) (Use highest code) **M**

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Driving to and from the job site	Vehicle Accident	▪ All employees shall complete the ParsonsU safety module on Defensive Driving. ▪ Familiarize oneself with the vehicle prior to mobilization if necessary. ▪ Plan your travel route and check maps for directions or discuss with colleagues. ▪ Complete a Vehicle Inspection Report before driving and check for proper equipment/supplies. ▪ Clean windows and mirrors as needed throughout the trip. ▪ Have sun glasses available to reduce sun glare and wear as needed. ▪ Follow vehicle maintenance schedule to reduce possibilities of breakdown while driving.	S	Critical	**M**
Driving to and from the job site (continued)	Distraction while driving	▪ Stop driving a vehicle, regardless of the speed (i.e. even 5 mph) or location (i.e. private road), when the potential of being distracted by conversation exists. ▪ Drivers are prohibited from using communication	S	Critical	**M**

Job Steps	Hazards	Controls	P	S	RAC
		devices (e.g., cell phones) while operating any motor vehicle.			
Driving to and from the job site (continued)	Fatigue/Falling asleep	▪ Get adequate rest prior to driving. ▪ Work and driving shall not exceed 12 hours. ▪ Pull over and rest/take a break, if experiencing signs/symptoms of fatigue or drowsiness. ▪ Share driving duties with another person.	U	Catastrophic	**M**
Driving to and from the job site (continued)	Weather /Road conditions	▪ Check road and weather conditions prior to driving. ▪ Be prepared to adjust driving habits/speed, if road conditions change for the worse (i.e. rain, snow, fog, etc). ▪ Travel during daylight hours, if possible. ▪ Give yourself plenty of time to allow for delays due to construction, accidents or other unforeseen circumstances. ▪ Use lights at night and lights/wipers during inclement weather. ▪ Cancel and reschedule field work if road conditions create excessive hazards.	S	Critical	**M**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Groundwater Sampling	**Overall Risk Assessment Code (RAC) (Use highest code)**	L
Project Location:	Gary Development Landfill, Gary, IN		
Contract Number:	19457-0001		
Date Prepared: (mm/dd/yy)	10/01/14		
Prepared by (Name/Title):	Caryn A. Moore/Geologist		
Reviewed by (Name/Title):	Florin Savin/Principal Geologist		
Employer/GBU:	Parsons/PE&I		
Notes: (Field Notes, Review Comments, etc.) **References :**			

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
(1) Mobilize personnel & equipment	a). Unauthorized vehicle and pedestrian traffic in work zone. b). Injury due to lifting equipment our of support truck. c). Pinched, cut and scrapes when unloading equipment. d). Slip, trips, and falls while setting up work area. e). Vehicle shifting or rolling.	a). Cordon off work area immediately, using w/ barricades, traffic cones and caution tape etc. b). Bend knees while keeping back 90 degrees. Lift with legs. Do not exceed lifting 50lbs. without two people. Use 3 points of contact when climbing/leaving truck bed. c). Wear leather gloves or other protective heavy duty work gloves. Keep vehicle neat and orderly. d). Be alert while walking, Survey work area for ruts, or tripping hazards. e). Place wheel chocks under truck wheels if on unlevel ground.	U	Marginal	L

Job Steps	Hazards	Controls	P	S	RAC
(2) Open and gauge well with interface probe	a). Bee sting due to nest in well head during spring, summer, and early autumn. b). Inhale vapor c). Pinch, cuts, scrapes while opening well d). Splash contaminated water in eyes, skin, or on clothes	a). Do not open cap if bees are swarming near well head. Open cap in early cold morning when bees are sluggish. Either wait for bees to leave, then remove nest and/or remove nest with spray/ discuss bee spray with project manager. b). Allow well to vent and keep face away from well opening and measure well head space with PID. c). Use leather gloves when opening well cap. d). Lower probe gently into well. Wear safety, chemical protective coveralls, and nitrile gloves.	U	Negligible	L
(3) Connect pump to tubing and compressor and advance pump into well	a). Cuts, laceration, splash b). Electrocution c). Lifting	a). Use non-blade cutting tool (e.g., snips, tube cutter). Advance pumps slowly into well to prevent splashing. b). Use Ground fault circuit Interrupters (GFCI). c). Use proper lifting technique; use two-man lift methods when necessary; use mechanical lifting means for items over 100 lbs; do not reach/stretch from the side of a truck to reach an item in the middle; use a 3-point hold and climb into the truck to reach items.	U	Marginal	L
(4) Connect compressor to generator or battery. Turn on generator. Run pump to start purging and take water quality measurement with water quality meter	a). Fire/explosion hazards b). Noise hazards c). Splash	a). Do not smoke on site. If necessary, designate a smoking area off of site. Have fire extinguisher available at all times on site. b). Wear hearing protection when operating equipment if noise levels are greater than 85 dBA. Be aware of possible noise sources from plant activities near sampling locations. Ear plugs or ear muffs will be provided for use in high noise areas. c). Wear safety glasses, chemical protective coveralls, and nitrile gloves.	U	Critical	L
(5) Obtain ground water sample through pump or bailer	a) Exposure to hazardous material contained in ground water.	a). Nitrile gloves must be donned while collecting a sample. When severe splash hazards exist, Tyvek coveralls must be worn.	U	Negligible	L
(6) Decontamination	a) Splash solvent (chemical cleaner) in eye or on contact.	a). See 5a	U	Negligible	L

Job Steps	Hazards	Controls	P	S	RAC
(7) Close well and clean probe with solvent and wipes	a). Splash solvent (chemical cleaner) in eyes/skin or on clothes b). Lifting c). Pinch points d). Splash	a). Wear eye protection and chemical protective clothing. Keep face away from probe in bucket. Spray into bucket to clean probe. b). Use proper lifting technique; use two-man lift methods when necessary; use mechanical lifting means for items over 100 lbs; do not reach/stretch from the side of a truck to reach an item in the middle; use a 3-point hold and climb into the truck to reach items. c). Wear leather gloves or other protective heavy duty work gloves. d). Wear safety glasses, chemical protective coveralls, and nitrile gloves.	U	Negligible	L
(8) Pack coolers and load them into vehicle for transport to FedEx or temporary storage for courier pick up	a). Lifting b). Pinch points c). Slip, trips, and falls while setting up work area.	a). Use proper lifting technique; use two-man lift methods when necessary; use mechanical lifting means for items over 100 lbs; do not reach/stretch from the side of a truck to reach an item in the middle; use a 3-point hold and climb into the truck to reach items. b). Wear leather gloves or other protective heavy duty work gloves. c). Be alert while walking, and survey work area for ruts, or tripping hazards.	U	Marginal	L

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	General Field Activities	**Overall Risk Assessment Code (RAC) (Use highest code)**	L
Project Location:	Gary Development Landfill, Gary, IN		
Contract Number:	19457-0001		
Date Prepared: (mm/dd/yy)	10/01/14		
Prepared by (Name/Title):	Caryn A. Moore/Geologist		
Reviewed by (Name/Title):	Florin Savin/Principal Geologist		
Employer/GBU:	Parsons/PE&I		
Notes: (Field Notes, Review Comments, etc.) **References :**			

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Mobilization/Preparation/Set-up	Change in weather conditions Rain Sunshine/hot temperatures Snow/cold temperatures Lightning High winds, dust storm Struck by/ Against Objects (vehicles) Struck against Vehicle Fire	Check weather forecast Have proper PPE (i.e. rain gear, footwear, etc) available. Be aware of slip hazards, puddles, etc. Have sunscreen (SPF > 15) available for ultraviolet protection. Have sufficient drinking water for hydration during warm weather. Have warm clothes available for cold temperatures. Do not use gel insoles in footwear. Do not begin or continue work until lightning subsides for 30 minutes. Wear spoggles if dust/debris is visible. Park vehicles a safe distance away from active roadways and intersections, fences, railroad tracks, etc. Inspect work area for objects that could cause harm before placing your body on the ground (i.e. nails). Do not park vehicles in fields where vegetation could catch on fire from the exhaust system.	U	Critical	L

Job Steps	Hazards	Controls	P	S	RAC
	Struck By Vehicle (workers)	Install physical barriers between workers and operating vehicles, or assign a flag person to monitor and control vehicle traffic, if necessary.			
	Environmental and biological hazards	Mow tall grass around the work area prior to mobilization. Use tick repellent as necessary.			
Accessing/Working in Field	Slips/trips/falls	Visually determine the approximate location of the desired point of destination and the corresponding path of egress. Keep eyes on path ahead and be sure of footing on uneven or slippery ground.	U	Marginal	L
	Pollen	Take medication (i.e. anti-histamine) if needed, to minimize allergic reaction to pollen. Wear dust mask, if necessary.			
	Hidden objects (i.e. barbwire fencing, irrigation ditch, abandoned utilities – conduit, pipes, etc)	Use a walking stick or other object to survey the walking area in front of you.			
	Streams	Observe depth of stream and speed of current before proceeding through the stream.			
	Walking on uneven or wet terrain (i.e. slopes, leaves, covered objects, holes, puddles, etc.)	Wear steel toe rubber boots versus over-the-shoe rubber boots when walking long distances. Use a walking stick or other object for additional support/balance and to check for animal burrows/holes in high vegetation.			
	Vegetation	Create a clear path or route with mechanical equipment, whenever possible. Wear appropriate PPE for the vegetation (i.e. Tyvek or Carhartt coveralls, leather gloves, face shield, etc) for vegetation that could cause cuts/punctures and/or is higher than waist level.			
	Insects (ticks, spiders, bees, etc), rodents, animals, etc. – bites, allergic reaction, Lyme disease, Rocky Mountain Spotted Fever.	Report known allergic reactions to insect bites to supervisor. Wear light colored long-sleeved shirts/pants or disposable coveralls with footed booties and overboots (e.g. Tyvek), and treat clothing with Permethrin as per manufacturer recommendation (e.g. every 6 washes) when working in wooded areas, tall grass and brush that are expected to contain ticks and other biting insects, especially during tick seasons (e.g. early spring through June, and September through October). Apply insect repellant containing at least 20% DEET to exposed skin every 2-3 hours, especially during tick and insect seasons. Use duct tape around wrists and ankles to protect against insect bites under			

Job Steps	Hazards	Controls	P	S	RAC
	Struck by/against	clothing, especially during tick and insect seasons Wear appropriate personal protective equipment (PPE) based on the surrounding work environment (i.e. hard hat, safety glasses, work boots, traffic safety vest, hearing protection, etc).			

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Fence Installation Oversight
Project Location:	Gary Development Landfill, Gary, IN
Contract Number:	19457-0001
Date Prepared: (mm/dd/yy)	10/01/14
Prepared by (Name/Title):	Caryn A. Moore/Geologist
Reviewed by (Name/Title):	Florin Savin/Principal Geologist
Employer/GBU:	Parsons/PE&I

Notes: (Field Notes, Review Comments, etc.)
References :

Overall Risk Assessment Code (RAC) (Use highest code) L

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Ensure equipment checklists and daily equipment inspections are completed.	Slip, trip, fall.	While observing, keep an eye on the surroundings, includ the ground.	U	Negligible	L
Observing fence post installation; driving fence posts using a bobcat equipped with an auto-hammer. (After brush hogging: See Brush Hogging AHA.)	Noise Pinch Points Slips, Trips, Falls Drowning Biological.	Wear appropriate hearing protection and bug spray. Keep a safe distance from the bobcat and the work area while work is taking place. Keep an eye out on the surroundings, including the ground and wildlife. Refrain from walking and standing on steep slopes. Some work may take place in swampy areas with shallow standing water. Use the buddy system and make sure someone can see you at all times. Ensure the subcontractors are wearing the correct PPE and following the SOP.	U	Critical	L
Observing fencing installation.	Slips, trips, falls Pinch points Lacerations Drowning	Keep an eye out on the surroundings, including the ground and wildlife. Refrain from walking and standing on steep slopes. Wear bug spray. Keep a safe distance from the work area while work is	U	Negligible	L

Job Steps	Hazards	Controls	P	S	RAC
	Biological	taking place. Some work may take place in swampy areas with shallow standing water. Use the buddy system and make sure someone can see you at all times. Ensure the subcontractors are wearing the correct PPE and following the SOP.			

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Drilling Oversight	**Overall Risk Assessment Code (RAC) (Use highest code)**	**M**
Project Location:	Gary Development Landfill, Gary, IN		
Contract Number:	19457-0001		
Date Prepared: (mm/dd/yy)	10/01/14		
Prepared by (Name/Title):	Caryn A. Moore/Geologist		
Reviewed by (Name/Title):	Florin Savin/Principal Geologist		
Employer/GBU:	Parsons/PE&I		
Notes: (Field Notes, Review Comments, etc.) **References :**			

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Ensure that subcontractor performs daily pre-operation safety inspection on drill rig, and of any associated heavy equipment. Place emphasis on integrity of hydraulics and safety features.	Slip, trip, fall on uneven or slippery ground Struck by moving equipment	Walk slowly and ensure good footing on uneven or slippe ground. Remain a safe distance from the drill rig when it is in operation.	U	Ne glig ible	L
Drilling Oversight	Slip, trip, fall on uneven or slippery ground Struck by equipment Noise Contaminated soil	Walk slowly and ensure good footing on uneven or slippe ground. Remain a safe distance from the drill rig when it is in operation. Wear ear protection as needed. Conduct air monitoring as needed.	U	Cat ast rop hic	M

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

Activity Hazard Analysis (AHA)

Activity/Work Task:	Brush Clearing	**Overall Risk Assessment Code (RAC) (Use highest code)**	**M**
Project Location:	Gary Development Landfill, Gary, IN		
Contract Number:	19457-0001		
Date Prepared: (mm/dd/yy)	10/01/14		
Prepared by (Name/Title):	Caryn A. Moore/Geologist		
Reviewed by (Name/Title):	Florin Savin/Principal Geologist		
Employer/GBU:	Parsons/PE&I		
Notes: (Field Notes, Review Comments, etc.) **References :**			

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each "Hazard" with identified safety "Controls" and determine RAC (See above).
The RAC is developed after correctly identifying all the hazards and fully implementing all controls.

P "Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

S "Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- E = Extremely High Risk
- H = High Risk
- M = Moderate Risk
- L = Low Risk

Job Steps	Hazards	Controls	P	S	RAC
Equipment Preparation – Fueling, Inspection, Cleaning	• Hand injury-pinch/cuts • Noise • Hot surfaces • Flash Fire – Fuel Vapors • Chemical splashes • Pressurized Water (Pressure Washer) • Working Alone	• Wear cut resistant synthetic or leather gloves, use the proper tool for maintenance activities "right tool for the job". • Use ear protection while running air compressor to blow off equipment before and after mowing. • Let equipment cool before cleaning or refueling. • Let spilled fuel evaporate before operating equipment-keep fire extinguisher in vicinity of equipment while performing service. • Use metal NFPA approved Type I fuel cans, fill on ground not in pickup bed, use the proper color code for fuel: Yellow-Diesel, Red-Gasoline. • Keep used oil in designated black and green, polyethylene, used oil recycling container-do	U	Marginal	L

Job Steps	Hazards	Controls	P	S	RAC
		not store oil in any other container-recycle oil as necessary to not store more than 3 gallons onsite. Use proper equipment when changing oil. • Wear STD PPE including eye protection to protect against chemical splashes while refueling equipment, use funnel as necessary. • Wear STD PPE including eye protection to protect against flying debris while blowing off equipment with compressed air. • Clean up spills of engine oil immediately. • Review pressure washer AHA if used, do not use pressure washer on engine, controls or electrical components of equipment-for cleaning deck/blades only. • Follow manufacturer's recommend maintenance schedule. • Follow Working Alone Procedures			
Mowing / Brush Hogging	• Personal injury, damage to equipment, or property damage. • Collision with obscured object. • Hand or foot injury from moving blades. • Attempting to mow very thick vegetation. • Potential rollover of mower. • Potential for getting the mower stuck. • Injury while trying to stop a rolling mower. • Injury to other persons. • Noise • Smoke/Vapors • Sunburn • Working Alone	• Review operator's manual and become familiar with equipment controls before beginning work. Receive training before operating mowers. • Visually mark all potential obstructions such as well surface casings. • Be familiar with the area to be mowed, including the locations of potential obstructions and overhead hazards. • Practice good housekeeping in the area where the mower deck will be operated. • Check tires, if present, for pressure and wear, oil level, fuel level, all electrical connections, and any other items listed in the owner's manual prior to starting the tractor. Do not use hand held cell phones, two-way radios, etc. while operating mower. Always wear hearing protection, gloves, high visibility vest, and safety glasses during operation of	U	Cat ast rop hic	**M**

Job Steps	Hazards	Controls	P	S	RAC
		the mower. Do not wear loose clothing that could be caught in rotating equipment. • Inspect grade. • Maintain safe distance from buildings and other potential obstructions. • Never operate mower deck near other persons. Never place hands or feet near operating mower deck. Keep all guards in place and confirm that they are in place when the deck is serviced. Wear steel-toed safety shoes. Other persons should keep a safe distance from mower. • Do not attempt to mow areas that are too thickly vegetated all at once. Raise deck, and lower gradually with each of one or more successive runs. • Do not use the mower deck on slopes that would present the danger of rolling the mower over. Travel straight up and down minor slopes. • Do not drive equipment in areas that have ground soft enough for the tires or treads to sink. The vehicle could become stuck or rollover under such conditions. • Equipment should not be operated in a fashion that could cause the wheels or tracks to come off the ground or slide. • Park only on level ground and set brake. If you see a driverless tractor rolling, make no attempt to stop it. • Do not exceed 15 mph, and slow down as conditions warrant. Always be on the lookout for holes, obstacles, branches, low wires, etc. Slow down or stop when pedestrians are in view, and allow them plenty of room. • Cover exposed skin with sunblock > 30 SPF and reapply as necessary. • Procure sunshade for tractor if necessary. • Maintain proper oil levels to prevent			

Job Steps	Hazards	Controls	P	S	RAC
		smoking/excessive fumes.			

Equipment to be Used	Training Requirements/Competent or Qualified Personnel	Inspection Requirements

10.5 SAFETY DATA SHEETS

Safety Data Sheets are required for the chemicals expected to be encountered during the field work. Some of them are based on:

- Site chemicals of concern (Metals, Methane, VOCs, SVOCs)
- Decontamination solutions (Alconox)
- Calibrations (Isobutylene)
- Preservatives from the laboratory (HCl, $NAHSO_4$, Methanol)

ALCONOX MSDS

Section 1 : MANUFACTURER INFORMATION

Product name: Alconox

Supplier: Same as manufacturer.

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Manufacturer emergency phone number: 800-255-3924.
813-248-0585 (outside of the United States).

Manufacturer: Alconox, Inc.
30 Glenn St.
Suite 309
White Plains, NY 10603.

Supplier MSDS date: 2009/04/20

D.O.T. Classification: Not regulated.

Section 2 : HAZARDOUS INGREDIENTS

C.A.S.	CONCENTRATION %	Ingredient Name	T.L.V.	LD/50	LC/50
25155-30-0	10-30	SODIUM DODECYLBENZENESULFONATE	NOT AVAILABLE	438 MG/KG RAT ORAL 1330 MG/KG MOUSE ORAL	NOT AVAILABLE
497-19-8	7-13	SODIUM CARBONATE	NOT AVAILABLE	4090 MG/KG RAT ORAL 6600 MG/KG MOUSE ORAL	2300 MG/M3/2H RAT INHALATION 1200 MG/M3/2H MOUSE INHALATION
7722-88-5	10-30	TETRASODIUM PYROPHOSPHATE	5 MG/M3	4000 MG/KG RAT ORAL 2980 MG/KG MOUSE ORAL	NOT AVAILABLE
7758-29-4	10-30	SODIUM PHOSPHATE	NOT AVAILABLE	3120 MG/KG RAT ORAL 3100 MG/KG MOUSE ORAL >4640 MG/KG RABBIT DERMAL	NOT AVAILABLE

Section 2A : ADDITIONAL INGREDIENT INFORMATION

Note: (supplier).
CAS# 497-19-8: LD50 4020 mg/kg - rat oral.
CAS# 7758-29-4: LD50 3100 mg/kg - rat oral.

Section 3 : PHYSICAL / CHEMICAL CHARACTERISTICS

Physical state: Solid

Appearance & odor: Almost odourless.
White granular powder.

Odor threshold (ppm): Not available.

Vapour pressure (mmHg): Not applicable.

Vapour density (air=1): Not applicable.

By weight: Not available.

Evaporation rate (butyl acetate = 1): Not applicable.

Boiling point (°C): Not applicable.

Freezing point (°C): Not applicable.

pH: (1% aqueous solution).
9.5

Specific gravity @ 20 °C: (water = 1).
0.85 - 1.10

Solubility in water (%): 100 - > 10% w/w

Coefficient of water\oil dist.: Not available.

VOC: None

Section 4 : FIRE AND EXPLOSION HAZARD DATA

Flammability: Not flammable.

Conditions of flammability: Surrounding fire.

Extinguishing media: Carbon dioxide, dry chemical, foam.
Water
Water fog.

Special procedures: Self-contained breathing apparatus required.
Firefighters should wear the usual protective gear.

Auto-ignition temperature: Not available.

Flash point (°C), method: None

Lower flammability limit (% vol): Not applicable.

Upper flammability limit (% vol): Not applicable.

Not available.

Sensitivity to mechanical impact: Not applicable.

Hazardous combustion products: Oxides of carbon (COx).
Hydrocarbons.

Rate of burning: Not available.

Explosive power: None

Section 5 : REACTIVITY DATA

Chemical stability: Stable under normal conditions.

Conditions of instability: None known.

Hazardous polymerization: Will not occur.

Incompatible substances: Strong acids.
Strong oxidizers.

Hazardous decomposition products: See hazardous combustion products.

Section 6 : HEALTH HAZARD DATA

Route of entry: Skin contact, eye contact, inhalation and ingestion.

Effects of Acute Exposure

Eye contact: May cause irritation.

Skin contact: Prolonged contact may cause irritation.

Inhalation: Airborne particles may cause irritation.

Ingestion: May cause vomiting and diarrhea.
May cause abdominal pain.
May cause gastric distress.

Effects of chronic exposure: Contains an ingredient which may be corrosive.

LD50 of product, species & route: > 5000 mg/kg rat oral.

LC50 of product, species & route: Not available for mixture, see the ingredients section.

Exposure limit of material: Not available for mixture, see the ingredients section.

Sensitization to product: Not available.

Carcinogenic effects: Not listed as a carcinogen.

Reproductive effects: Not available.

Teratogenicity: Not available.

Mutagenicity: Not available.

Synergistic materials: Not available.

Medical conditions aggravated by exposure: Not available.

First Aid

Skin contact: Remove contaminated clothing.
Wash thoroughly with soap and water.
Seek medical attention if irritation persists.

Eye contact: Check for and remove contact lenses.
Flush eyes with clear, running water for 15 minutes while holding eyelids open: if irritation persists, consult a physician.

Inhalation: Remove victim to fresh air.
Seek medical attention if symptoms persist.

Ingestion: Dilute with two glasses of water.
Never give anything by mouth to an unconscious person.
Do not induce vomiting, seek immediate medical attention.

Section 7 : PRECAUTIONS FOR SAFE HANDLING AND USE

Leak/Spill: Contain the spill.
Recover uncontaminated material for re-use.
Wear appropriate protective equipment.
Contaminated material should be swept or shoveled into appropriate waste container for disposal.

Waste disposal: In accordance with municipal, provincial and federal regulations.

Handling procedures and equipment: Protect against physical damage.
Avoid breathing dust.
Wash thoroughly after handling.
Keep out of reach of children.
Avoid contact with skin, eyes and clothing.
Launder contaminated clothing prior to reuse.

Storage requirements: Keep containers closed when not in use.
Store away from strong acids or oxidizers.
Store in a cool, dry and well ventilated area.

Section 8 : CONTROL MEASURES

Precautionary Measures

Gloves/Type:

Neoprene or rubber gloves.

Respiratory/Type:

If exposure limit is exceeded, wear a NIOSH approved respirator.

Eye/Type:

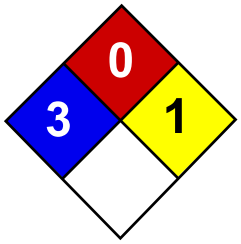
Safety glasses with side-shields.

Footwear/Type: Safety shoes per local regulations.

Clothing/Type: As required to prevent skin contact.

Other/Type: Eye wash capability should be in close proximity.

Ventilation requirements: Local exhaust at points of emission.



Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet
Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m3) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m3) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 05:45 PM

Last Updated: 11/01/2010 12:00 PM

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MATERIAL SAFETY DATA SHEET - CALIBRATION CHECK GAS

PRODUCT NAME: ISOBUTYLENE (1 PPM – 0.9%) IN AIR

MSDS NO: 248 **Version:3** **Date: August, 2010**

1. Chemical Product and Company Identification

Gasco Affiliates, LLC
320 Scarlett Blvd.
Oldsmar, FL 34677

TELEPHONE NUMBER: (800) 910-0051 **24-HOUR EMERGENCY NUMBER: 1-800-424-9300**
FAX NUMBER: (866) 755-8920
E-MAIL: info@gascogas.com

PRODUCT NAME: ISOBUTYLENE (1 PPM – 0.9%) IN AIR
CHEMICAL NAME: Isobutylene in air
COMMON NAMES/ SYNONYMS: None
TDG (Canada) CLASSIFICATION: 2.2
WHIMIS CLASSIFICATION: A

2. COMPOSITION/ INFORMATION ON INGREDIENTS

INGREDIENT	%VOLUME	PEL-OSHA	TLV-ACGIH	LD_{50} or LC_{50} Route/Species
Isobutylene FORMULA: C_4H_8	0.0001-0.9	N/A	N/A	N/A
Air FORMULA: Mixture	99.0 to 99.9999	N/A	N/A	N/A

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Release of this product may produce oxygen-deficient atmospheres (especially in confined spaces or other poorly ventilated environments); individuals in such atmospheres may be asphyxiated. Isobutylene may cause drowsiness and other central nervous system effects in high concentrations; however, due to the low concentration of this gas mixture, this is unlikely to occur.

ROUTE OF ENTRY:

Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
No	No	No	Yes	No

HEALTH EFFECTS:

Exposure Limits	Irritant	Sensitization	Reproductive Hazard	Mutagen
Yes	No	No	No	No

Carcinogenicity: --NTP: No IARC: No OSHA: No

EYE EFFECTS:
N/A.

SKIN EFFECTS:
N/A.

INGESTION EFFECTS:
Ingestion unlikely. Gas at room temperature.

INHALATION EFFECTS:
Due to the small size of this cylinder, no unusual health effects from over-exposure are anticipated under normal routine use.

NFPA HAZARD CODES		HMIS HAZARD CODES		RATING SYSTEM
Health:	1	Health:	1	0= No Hazard
Flammability:	0	Flammability:	0	1= Slight Hazard
Reactivity:	0	Reactivity:	0	2= Moderate Hazard
				3= Serious Hazard
				4= Severe Hazard

4. FIRST AID MEASURES

EYES:
N/A

SKIN:
N/A

INGESTION:
Not required

INHALATION:
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASED OF OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED THE SELF-CONTAINED BREATHING APPARATUS. Victims should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. If breathing has stopped administer artificial resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive.

5. FIRE-FIGHTING MEASURES

These containers hold gas under pressure, with no liquid phase. If involved in a major fire, they should be sprayed with water to avoid pressure increases, otherwise pressures will rise and ultimately they may distort or burst to release the contents. The gases will not add significantly to the fire, but containers or fragments may be projected considerable distances - thereby hampering fire fighting efforts.

6. ACCIDENTAL RELEASE MEASURES

In terms of weight, these containers hold very little contents, such that any accidental release by puncturing etc. will be of no practical concern.

7. HANDLING AND STORAGE

Suck back of water into the container must be prevented. Do not allow backfeed into the container. Use only properly specified equipment which is suitable for this product, its supply pressure and temperature. Use only in well-ventilated areas. Do not heat cylinder by any means to increase rate of product from the cylinder. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C).

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Use adequate ventilation for extended use of gas.

PRODUCT NAME: ISOBUTYLENE (1 PPM – 0.9%) IN AIR

9. PHYSICAL AND CHEMICAL PROPERTIES

PARAMETER:	VALUE:
Physical state	: Gas
Evaporation point	: N/A
pH	: N/A
Odor and appearance	: Colorless, odorless gas

10. STABILITY AND REACTIVITY

Stable under normal conditions. Expected shelf life 48 months.

11. TOXICOLOGICAL INFORMATION

No toxicological damage caused by this product.

12. ECOLOGICAL INFORMATION

No ecological damage caused by this product.

13. DISPOSAL INFORMATION

Do not discharge into any place where its accumulation could be dangerous. Used containers are acceptable for disposal in the normal waste stream as long as the cylinder is empty and valve removed or cylinder wall is punctured; but GASCO encourages the consumer to return cylinders.

14. TRANSPORT INFORMATION

	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Compressed Gas N.O.S. (Isobutylene in Air)	Compressed Gas N.O.S. (Isobutylene in Air)
HAZARD CLASS:	2.2	2.2
IDENTIFICATION NUMBER:	UN1956	UN1956
SHIPPING LABEL:	NONFLAMMABLE GAS	NONFLAMMABLE GAS

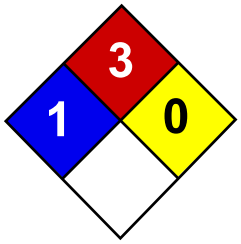
15. REGULATORY INFORMATION

Isobutylene is listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with a threshold quantity (TQ) of 10,000 pounds.

16. OTHER INFORMATION

This MSDS has been prepared in accordance with the Chemicals (Hazard Information and Packaging for Supply (Amendment) Regulation 1996. The information is based on the best knowledge of GASCO, and its advisors and is given in good faith, but we cannot guarantee its accuracy, reliability or completeness and therefore disclaim any liability for loss or damage arising out of use of this data. Since conditions of use are outside the control of the Company and its advisors we disclaim any liability for loss or damage when the product is used for other purposes than it is intended.

MSDS/S010/248/ August, 2010



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Methyl alcohol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Methyl alcohol

Catalog Codes: SLM3064, SLM3952

CAS#: 67-56-1

RTECS: PC1400000

TSCA: TSCA 8(b) inventory: Methyl alcohol

CI#: Not applicable.

Synonym: Wood alcohol, Methanol; Methylol; Wood Spirit; Carbinol

Chemical Name: Methanol

Chemical Formula: CH3OH

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Methyl alcohol	67-56-1	100

Toxicological Data on Ingredients: Methyl alcohol: ORAL (LD50): Acute: 5628 mg/kg [Rat]. DERMAL (LD50): Acute: 15800 mg/kg [Rabbit]. VAPOR (LC50): Acute: 64000 ppm 4 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator). Severe over-exposure can result in death.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Classified POSSIBLE for human. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to eyes. The substance may be toxic to blood, kidneys, liver, brain, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS), optic nerve. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 12°C (53.6°F). OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 6% UPPER: 36.5%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Explosive in the form of vapor when exposed to heat or flame. Vapor may travel considerable distance to source of ignition and flash back. When heated to decomposition, it emits acrid smoke and irritating fumes. CAUTION: MAY BURN WITH NEAR INVISIBLE FLAME

Special Remarks on Explosion Hazards:
Forms an explosive mixture with air due to its low flash point. Explosive when mixed with Choroform + sodium methoxide and diethyl zinc. It boils violently and explodes.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Flammable liquid. Poisonous liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, metals, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 from OSHA (PEL) [United States] TWA: 200 STEL: 250 (ppm) from ACGIH (TLV) [United States] [1999] STEL: 250 from NIOSH [United States] TWA: 200 STEL: 250 (ppm) from NIOSH SKIN TWA: 200 STEL: 250 (ppm) [Canada] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Alcohol like. Pungent when crude.

Taste: Not available.

Molecular Weight: 32.04 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 64.5°C (148.1°F)

Melting Point: -97.8°C (-144°F)

Critical Temperature: 240°C (464°F)

Specific Gravity: 0.7915 (Water = 1)

Vapor Pressure: 12.3 kPa (@ 20°C)

Vapor Density: 1.11 (Air = 1)

Volatility: Not available.

Odor Threshold: 100 ppm

Water/Oil Dist. Coeff.: The product is more soluble in water; log(oil/water) = -0.8

Ionicity (in Water): Non-ionic.

Dispersion Properties: See solubility in water.

Solubility: Easily soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources, incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizers. Violent reaction with alkyl aluminum salts, acetyl bromide, chloroform + sodium methoxide, chromic anhydride, cyanuirc chlorite, lead perchlorate, phosphorous trioxide, nitric acid. Exothermic reaction with sodium hydroxide + chloroform. Incompatible with beryllium dihydride, metals (potassium and magnesium), oxidants (barium perchlorate, bromine, sodium hypochlorite, chlorine, hydrogen peroxide), potassium tert-butoxide, carbon tetrachloride, alkali metals, metals (aluminum, potassium magnesium, zinc), and dichlormethane. Rapid autocatalytic dissolution of aluminum, magnesium or zinc in 9:1 methanol + carbon tetrachloride - sufficiently vigorous to be rated as potentially hazardous. May attack some plastics, rubber, and coatings.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 5628 mg/kg [Rat]. Acute dermal toxicity (LD50): 15800 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 64000 4 hours [Rat].

Chronic Effects on Humans:
MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Classified POSSIBLE for human. Causes damage to the following organs: eyes. May cause damage to the following organs: blood, kidneys, liver, brain, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS), optic nerve.

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:

Passes through the placental barrier. May affect genetic material. May cause birth defects and adverse reproductive effects(paternal and maternal effects and fetotoxicity) based on animal studies.

Special Remarks on other Toxic Effects on Humans:

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 29400 mg/l 96 hours [Fathead Minnow].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation:
Methanol in water is rapidly biodegraded and volatilized. Aquatic hydrolysis, oxidation, photolysis, adsorption to sediment, and bioconcentration are not significant fate processes. The half-life of methanol in surfact water ranges from 24 hrs. to 168 hrs. Based on its vapor pressure, methanol exists almost entirely in the vapor phase in the ambient atmosphere. It is degraded by reaction with photochemically produced hydroxyl radicals and has an estimated half-life of 17.8 days. Methanol is physically removed from air by rain due to its solubility. Methanol can react with NO2 in pollulted to form methyl nitrate. The half-life of methanol in air ranges from 71 hrs. (3 days) to 713 hrs. (29.7 days) based on photooxidation half-life in air.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Methyl alcohol UNNA: 1230 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Methyl alcohol Illinois toxic substances disclosure to employee act: Methyl alcohol Illinois chemical safety act: Methyl alcohol New York release reporting list: Methyl alcohol Rhode Island RTK hazardous substances: Methyl alcohol Pennsylvania RTK: Methyl alcohol Minnesota: Methyl alcohol Massachusetts RTK: Methyl alcohol Massachusetts spill list: Methyl alcohol New Jersey: Methyl alcohol New Jersey spill list: Methyl alcohol Louisiana spill reporting: Methyl alcohol California Directors List of Hazardous Substances (8CCR 339): Methyl alcohol Tennesse Hazardous Right to Know : Methyl alcohol TSCA 8(b) inventory: Methyl alcohol SARA 313 toxic chemical notification and release reporting: Methyl alcohol CERCLA: Hazardous substances.: Methyl alcohol: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). Class D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R23/24/25- Toxic by inhalation, in contact with skin and if swallowed. R39- Danger of very serious irreversible effects. R39/23/24/25- Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed. S7- Keep container tightly closed. S16- Keep away from sources of ignition - No smoking. S36/37- Wear suitable protective clothing and gloves. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -Material safety data sheet emitted by: la Commission de la SantÃ© et de la SÃ©curitÃ© du Travail du QuÃ©bec. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. LOLI, HSDB, RTECS, HAZARDTEXT, REPROTOX databases

Other Special Considerations: Not available.

Created: 10/10/2005 08:23 PM

Last Updated: 11/01/2010 12:00 PM

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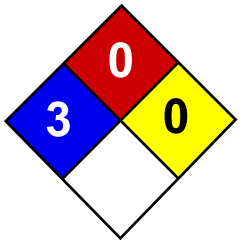

Health	3
Fire	0
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
Sodium bisulfate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium bisulfate

Catalog Codes: SLS2104, SLS4258

CAS#: 7681-38-1

RTECS: VZ1860000

TSCA: TSCA 8(b) inventory: Sodium bisulfate

CI#: Not available.

Synonym: GBS; Nitre cake; Sodium acid sulfate; Sodium pyrosulfate; Sodium hydrogen sulfate; Sulfuric acid, monosodium salt.

Chemical Name: Sodium Bisulfate

Chemical Formula: NaHSO4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium bisulfate	7681-38-1	100

Toxicological Data on Ingredients: Sodium bisulfate: ORAL (LD50): Acute: 2800 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator). The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Corrosive solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Granular solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 120.6 g/mole

Color: Off-white.

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: 157.22°C (315°F)

Critical Temperature: Not available.

Specific Gravity: 2.435 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:

Easily soluble in hot water. Soluble in cold water. Soluble in 2 parts cold water. Soluble in 1 part boiling water. Decomposed by alcohol into sodium sulfate and free H_2SO_4.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, moisture

Incompatibility with various substances: Reactive with oxidizing agents, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Do not mix with liquid chlorine bleach (hypochlorites), ammonia cleansers or similar products, or alcohols. Hygroscopic; keep container tightly closed.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 2800 mg/kg [Rat].

Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (corrosive, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Can cause severe skin irritation or burns. Eyes: Can cause severe irritation or burns of the eyes. Inhalation: It is destructive to the mucous membranes of the upper respiratory tract. Causes irritation and chemical burns to the respiratory tract with burning pain in the nose and throat, coughing , wheezing, shortness of breath, and pulmonary edema. Inhalation may be fatal as a result of spasm, inflammation, edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Ingestion: Causes gastrointestinal tract irritation and burns. Symptoms may include nausea and vomiting. May cause severe and permanent damage to the digestive tract. Chronic Potential Health Effects: Repeated exposure may cause erosion of teeth, lung irritation, bronchitis, persistant coughing,

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Corrosive Solid, n.o.s.(Sodium Bisulfate) UNNA: 1759 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Sodium bisulfate New Jersey: Sodium bisulfate TSCA 8(b) inventory: Sodium bisulfate

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive solid.

DSCL (EEC):
R34- Causes burns. R41- Risk of serious damage to eyes. S24/25- Avoid contact with skin and eyes. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S36/37/39- Wear suitable protective clothing, gloves and eye/face protection.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:27 PM

Last Updated: 11/01/2010 12:00 PM

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Safety Data Sheet

Material Name: Methane **SDS ID: 00244226**

* * *Section 1 - IDENTIFICATION* * *

Manufacturer Information

MATHESON TRI-GAS, INC.
150 Allen Road, Suite 302
Basking Ridge, NJ 07920

General Information: 1-800-416-2505
Emergency #: 1-800-424-9300 (CHEMTREC)
Outside the US: 703-527-3887 (Call collect)

Product Identifier: Methane

Trade Names/Synonyms

FIRE DAMP; MARSH GAS; METHYL HYDRIDE; NATURAL GAS; R50

Chemical Family

hydrocarbons, gas

Product Use

industrial

Restrictions on Use

None known.

* * *Section 2 - HAZARDS IDENTIFICATION* * *

GHS Classification

Flammable gas, Category 1
Gas under pressure, Compressed gas

GHS LABEL ELEMENTS

Symbol(s)

Signal Word

DANGER

Hazard Statement(s)

Extremely flammable gas
Contains gas under pressure; may explode if heated

Precautionary Statement(s)

Prevention

Keep away from heat, sparks, open flame, and hot surfaces - No smoking.

Response

Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage

Store in a well-ventilated place. Protect from sunlight.

Other Hazards which do not Result in Classification

May cause asphyxia. May cause frostbite upon sudden release of compressed gas.

* * *Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS* * *

CAS#	Component	Percent
74-82-8	METHANE	100

Component Related Regulatory Information

This product may be regulated, have exposure limits or other information identified as the following: Aliphatic hydrocarbon gases (Alkane [C1-C4]).

* * *Section 4 - FIRST AID MEASURES* * *

Inhalation

If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

Skin

If frostbite or freezing occur, immediately flush with plenty of lukewarm water (105-115 F; 41-46 C). DO NOT USE HOT WATER. If warm water is not available, gently wrap affected parts in blankets. Get immediate medical attention.

Eyes

Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

Ingestion

If a large amount is swallowed, get medical attention.

Note to Physicians

For inhalation, consider oxygen.

Symptoms: Immediate

frostbite, suffocation

Symptoms: Delayed

No information on significant adverse effects.

* * *Section 5 - FIRE FIGHTING MEASURES* * *

See Section 9 for Flammability Properties

Specific Hazards Arising from the Chemical

Severe fire hazard. Severe explosion hazard. Pressurized containers may rupture or explode if exposed to sufficient heat. Vapor/air mixtures are explosive above flash point. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

Extinguishing Media

carbon dioxide, regular dry chemical

Large fires: Use regular foam or flood with fine water spray.

Unsuitable Extinguishing Media

None known.

Protective Equipment and Precautions for Firefighters

Wear full protective fire fighting gear including self contained breathing apparatus (SCBA) for protection against possible exposure.

Fire Fighting Measures

Move container from fire area if it can be done without risk. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Evacuation radius: 800 meters (1/2 mile). Stop flow of gas.

* * *Section 6 - ACCIDENTAL RELEASE MEASURES* * *

Personal Precautions

Wear personal protective clothing and equipment, see Section 8.

Environmental Precautions

Avoid release to the environment.

Methods for Containment

Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering.

Cleanup Methods

Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray.

* * *Section 7 - HANDLING AND STORAGE* * *

Handling Procedures

Wash thoroughly after handling.

Storage Procedures

Store and handle in accordance with all current regulations and standards. Grounding and bonding required. Store in a well-ventilated place. Protect from sunlight. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. Keep separated from incompatible substances.

Incompatibilities combustible materials, halogens, oxidizing materials

* * *Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION* * *

Component Exposure Limits

METHANE (74-82-8)

ACGIH: 1000 ppm TWA

Component Biological Limit Values

There are no biological limit values for any of this product's components.

Engineering Controls

Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Eyes/Face

For the gas: Eye protection not required, but recommended. For the liquid: Wear splash resistant safety goggles. Contact lenses should not be worn. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

Protective Clothing

For the gas: Protective clothing is not required. For the liquid: Wear appropriate protective, cold insulating clothing.

Glove Recommendations

For the gas: Wear appropriate chemical resistant gloves. For the liquid: Wear insulated gloves.

Respiratory Protection

Under conditions of frequent use or heavy exposure, respiratory protection may be needed.
Respiratory protection is ranked in order from minimum to maximum.
Consider warning properties before use.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

* * *Section 9 - PHYSICAL AND CHEMICAL PROPERTIES* * *

Physical State:	Gas	**Appearance:**	Colorless gas
Color:	colorless	**Physical Form:**	gas
Odor:	odorless	**Odor Threshold:**	Not available
Taste:	tasteless	**pH:**	Not available
Melting/Freezing Point:	-183 °C	**Boiling Point:**	-162 °C
Flash Point:	-223 °C	**Decomposition:**	Not available
Evaporation Rate:	Not available	**LEL:**	5.0 %
UEL:	15 %	**Vapor Pressure:**	760 mmHg @ -161 °C
Henry's Law Constant:	0.00045830 atm-m3/mol	**Vapor Density (air = 1):**	0.555
Density:	0.717 g/L @ 0 °C	**Water Solubility:**	3.5 % @ 17 °C
KOW:	724.44 estimated from water solubility	**Log KOW:**	Not available
Coeff. Water/Oil Dist:	Not available	**KOC:**	2192.80 estimated from water solubility
Auto Ignition:	537 °C	**Viscosity:**	0.01118 cP @27 °C
Molecular Weight:	16.04	**Molecular Formula:**	C-H4

Solvent Solubility

Soluble: alcohol, ether, benzene, organic solvents

* * *Section 10 - STABILITY AND REACTIVITY* * *

Chemical Stability

Stable at normal temperatures and pressure.

Conditions to Avoid

Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.

Possibility of Hazardous Reactions

Will not polymerize.

Incompatible Materials

combustible materials, halogens, oxidizing materials

Decomposition Products

oxides of carbon

* * *Section 11 - TOXICOLOGICAL INFORMATION* * *

Acute and Chronic Toxicity

Component Analysis - LD50/LC50

The components of this material have been reviewed in various sources and no selected endpoints have been identified.

RTECS Acute Toxicity (selected)

The components of this material have been reviewed, and RTECS publishes the following endpoints:

METHANE (74-82-8)

Inhalation: 500000 ppm/2 hour Inhalation Mouse LC50; 326 gm/m3/2 hour Inhalation Mouse LC50

Acute Toxicity Level

METHANE (74-82-8)

Slightly Toxic: inhalation

Immediate Effects

frostbite, suffocation

Delayed Effects

No information on significant adverse effects.

Irritation/Corrosivity Data

No animal testing data available for skin or eyes.

RTECS Irritation

The components of this material have been reviewed and RTECS publishes no data as of the date on this document.

Respiratory Sensitizer

No data available.

Dermal Sensitizer

No data available.

Carcinogenicity

Component Carcinogenicity

None of this product's components are listed by ACGIH, IARC, NTP, OSHA or DFG.

Mutagenic Data

No data available.

RTECS Mutagenic

The components of this material have been reviewed, and RTECS publishes data for one or more components.

Reproductive Effects Data

No data available.

Tumorigenic Data

No data available.

RTECS Tumorigenic

The components of this material have been reviewed, and RTECS publishes data for one or more components.

Specific Target Organ Toxicity - Single Exposure

No data available.

Specific Target Organ Toxicity - Repeated Exposure

No data available.

Aspiration Hazard

Not applicable.

Medical Conditions Aggravated by Exposure

None known.

* * *Section 12 - ECOLOGICAL INFORMATION* * *

Component Analysis - Aquatic Toxicity

No LOLI ecotoxicity data are available for this product's components.

Persistence and Degradability

No data available.

Bioaccumulative Potential

No data available.

Mobility in Environmental Media

No data available.

* * *Section 13 - DISPOSAL CONSIDERATIONS* * *

Disposal Methods

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001.

Component Waste Numbers

The U.S. EPA has not published waste numbers for this product's components.

* * *Section 14 - TRANSPORT INFORMATION* * *

US DOT Information

Shipping Name: Methane, compressed
UN/NA #: UN1971 **Hazard Class:** 2.1
Required Label(s): 2.1

IMDG Information

Shipping Name: Methane, compressed
UN #: UN1971 **Hazard Class:** 2.1

* * *Section 15 - REGULATORY INFORMATION* * *

Component Analysis

U.S. Federal Regulations

None of this products components are listed under SARA Sections 302/304 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), or require an OSHA process safety plan.

SARA 311/312 Hazardous Categories

Acute Health: Yes **Chronic Health:** No **Fire:** Yes **Pressure:** Yes **Reactive:** No

U.S. State Regulations

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA
METHANE	74-82-8	No	Yes	Yes	Yes	Yes

Not regulated under California Proposition 65

Component Analysis - Inventory

Component	CAS	US	CA	EU	AU	PH	JP	KR	CN	NZ
METHANE	74-82-8	Yes	DSL	EIN	Yes	Yes	Yes	Yes	Yes	Yes

* * *Section 16 - OTHER INFORMATION* * *

NFPA Ratings: Health: 2 **Fire:** 4 **Reactivity:** 0

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

Key / Legend

ACGIH - American Conference of Governmental Industrial Hygienists; ADR - European Road Transport; AU - Australia; BOD - Biochemical Oxygen Demand; C - Celsius; CA - Canada; CAS - Chemical Abstracts Service; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CN - China; CPR - Controlled Products Regulations; DFG - Deutsche Forschungsgemeinschaft; DOT - Department of Transportation; DSL - Domestic Substances List; EEC - European Economic Community; EINECS - European Inventory of Existing Commercial Chemical Substances; EPA - Environmental Protection Agency; EU - European Union; F - Fahrenheit; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; ICAO - International Civil Aviation Organization; IDL - Ingredient Disclosure List; IDLH - Immediately Dangerous to Life and Health; IMDG - International Maritime Dangerous Goods; JP - Japan; Kow - Octanol/water partition coefficient; KR - Korea; LEL - Lower Explosive Limit; LOLI - List Of LIsts™ - ChemADVISOR's Regulatory Database; MAK - Maximum Concentration Value in the Workplace; MEL - Maximum Exposure Limits; NFPA - National Fire Protection Agency; NIOSH - National Institute for Occupational Safety and Health; NJTSR - New Jersey Trade Secret Registry; NTP - National Toxicology Program; NZ - New Zealand; OSHA - Occupational Safety and Health Administration; PH - Philippines; RCRA - Resource Conservation and Recovery Act; RID - European Rail Transport; RTECS - Registry of Toxic Effects of Chemical Substances®; SARA - Superfund Amendments and Reauthorization Act; STEL - Short-term Exposure Limit; TDG - Transportation of Dangerous Goods; TSCA - Toxic Substances Control Act; TWA - Time Weighted Average; UEL - Upper Explosive Limit; US - United States

Other Information

Matheson Tri-Gas, Inc. makes no express or implied warranties, guarantees or representations regarding the product or the information herein, including but not limited to any implied warranty or merchantability or fitness for use. Matheson Tri-Gas, Inc. shall not be liable for any personal injury, property or other damages of any nature, whether compensatory, consequential, exemplary, or otherwise, resulting from any publication, use or reliance upon the information herein.

End of Sheet 00244226

MATERIAL SAFETY DATA SHEET PACKET

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

SRM Number: 1866b
SRM Name: Common Commercial Asbestos

Date of Issue: 09 January 2007

MSDS Coordinator: Mario Cellarosi
Telephone: 301-975-6776
FAX: 301-926-4751
E-mail: SRMMSDS@nist.gov

Emergency Telephone Chem Trec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: Standard Reference Material (SRM) 1866b is comprised of three commercial-grade asbestos materials that were, or are, commonly used in commerce. These asbestos materials are typical of the asbestos found in bulk samples during routine asbestos inspections of building materials. The optical properties serve as a primary calibration standard in the identification of asbestos with polarized light microscopy (PLM). A unit of SRM 1866b consists of a set of three bottles: one bottle containing chrysotile, one bottle containing asbestiform grunerite (amosite), and one bottle containing asbestiform riebeckite (crocidolite). Each bottle contains between 1 gram and 3 grams of material.

Chrysotile

Asbestiform Grunerite (Amosite)

Asbestiform Riebeckite (Crocidolite)

An MSDS is provided for each of the three asbestos materials listed above, which contain hazardous components 1 % or greater and/or carcinogens 0.1 % or greater, in compliance with OSHA 29 CFR 1910.1200.

MATERIAL SAFETY DATA SHEET

1. Substance and Source Identification

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

SRM Number: 1866b
MSDS Number: 1866b
SRM Name: Common Commercial Asbestos

Date of Issue: 09 January 2007

MSDS Coordinator: Mario Cellarosi
Telephone: 301-975-6776
FAX: 301-926-4751
E-mail: SRMMSDS@nist.gov

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: Standard Reference Material (SRM) 1866b is a set of three individual commercial-grade asbestos materials: **chrysotile**, asbestiform grunerite (amosite), and asbestiform riebeckite (crocidolite). A unit of SRM 1866b consists of three bottles, each containing between 1 gram and 3 grams of individual material.

Substance: **Chrysotile**

2. Composition and Information on Hazardous Ingredients[a]

Component: **Chrysotile**
Other Designations: **Chrysotile** (metaxite; serpentine chrysotile; asbestos; chrysotile asbestos)
CAS Number: 12001-29-5
EC Number (EINECS): Not assigned.
SRM Nominal Concentration (% by weight or volume): > 90

Component: **Magnetite (as an impurity)**
Other Designation: **Magnetite** (magnetic iron oxide; black iron oxide; magnetic iron ore; lodestone; black ferric oxide)
CAS Number: 1309-38-2
EC Number (EINECS): 215-169-8
SRM NominalConcentration (% by weight): < 5

EC Classification: T
Carcinogen Category 1
EC Risk (R No.): 23, 45, 48
EC Safety (S No.): 45, 53

[a] Hazardous components 1 % or greater; carcinogens 0.1 % or greater are listed in compliance with OSHA 29 CFR 1910.1200.

3. Hazards Identification

NFPA Ratings (Scale 0–4): Health = 1 Fire = 0 Reactivity = 0

Major Health Hazards: Cancer hazard (in humans)

Potential Health Effects
Inhalation: Inhalation of chrysolite asbestos dust may be irritating. Symptoms include a cough and chest pain. Chronic exposure may cause asbestosis, interstitial fibrosis of the lung tissue, which may develop within 4 years to 9 years, but onset may be typically delayed 20 years to 40 years after first exposure. Death from asbestosis may be due to respiratory or cardiac failure. Secondary lung infections may also occur. Chronic exposure of asbestos to workers may also cause pleural effusion as early as 3 years to 4 years after initial exposure. Chronic exposure of asbestos to workers also increases the chance of pleural and peritoneal mesotheliomas, bronchogenic carcinoma, lung cancer, and cancers of the gastrointestinal tract and larynx. The latent period for mesothelioma is 3 years to 40 years; for lung cancer, 15 years to 30 years.

Skin Contact: Direct contact may cause irritation. Asbestos fibers may penetrate the skin and result in "asbestos corns", due to thickening of the skin around the implanted fiber. These corns usually occur on the hands and forearms, and they disappear on removal of the fibers.

Eye Contact: Direct contact may cause irritation with redness due to mechanical action.

Ingestion: Acute exposure by cause gastrointestinal irritation. Chronic exposure of asbestos fibers may be involved in cancers of the buccal cavity and pharynx, esophagus, stomach, colon, and rectum.

Listed as a Carcinogen/ Potential Carcinogen:

Yes	No	
X	____	In the National Toxicology Program (NTP) Report on Carcinogens.
X	____	In the International Agency for Research on Cancer (IARC) Monographs.
X	____	By the Occupational Safety and Health Administration (OSHA).

4. First Aid Measures

Inhalation: If adverse effects occur, remove to uncontaminated area. If not breathing, give artificial respiration by qualified personnel. Get immediate medical attention.

Skin Contact: Rinse affected area with copious amounts of water followed by washing with soap and water for at least 15 minutes while removing contaminated clothing. Get immediate medical attention.

Eye Contact: Flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Get immediate medical attention.

Ingestion: If a large amount is swallowed, get immediate medical attention.

5. Fire Fighting Measures

Fire and Explosion Hazards: Chrysotile is a negligible fire hazard.

Extinguishing Media: Regular dry chemical. Carbon dioxide. Water. Regular foam.

Fire Fighting: If material is involved in a fire, extinguish fire with a medium appropriate for the surrounding fire. Material itself does NOT burn or burns with difficulty. Keep run-off water out of sewers and water sources. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Component: **Chrysotile**
Flash Point: Not applicable.
Method Used: Not applicable.

Autoignition Temp.: Not applicable.

Flammability Limits in Air
UPPER (Volume %): Not applicable.
LOWER (Volume %): Not applicable.

6. Accidental Release Measures

Occupational Release: Do NOT touch or walk through spilled material. Avoid inhalation of asbestos dust (see Section 8, "Exposure Controls and Personal Protection"). Collect small dry spills with a shovel and place material into an appropriate container for disposal. Prevent entry into waterways and sewers. Clean up residue with a HEPA filter vacuum.

Disposal: Refer to Section 13, "Disposal Considerations".

7. Handling and Storage

Storage: Store and handle in accordance with all current regulations and standards.

Safe Handling Precautions: See Section 8, "Exposure Controls and Personal Protection".

8. Exposure Controls and Personal Protection

Exposure Limits: **Chrysotile**
OSHA (PEL): 0.1 fibers/cc TWA
ACGIH (TLV): 0.1 fibers/cc TWA
NIOSH: 0.1 fibers/cc recommended TWA (10 h)

Ventilation: Provide local exhaust ventilation system equipped with a HEPA-filter dust collection system.

Respirator: If workplace conditions warrant a respirator's use, a NIOSH/MSHA approved respirator should be used under an implemented respiratory protection program in accordance with OSHA Standard 29 CFR 1910.134 (General Industry, Use of Respirators) and 29 CFR 1910.1001 for occupational exposure to asbestos.

Eye Protection: Wear safety goggles. An eye wash station should be readily available near areas of use.

Personal Protection: Wear appropriate protective clothing and gloves to prevent skin exposure. Refer to OSHA Regulated Substances: OSHA 29 CFR 1910.1001.

9. Physical and Chemical Properties

Component: **Chrysotile**
Appearance: Fibrous solid to dust-like powder. White to grey-brown. Odorless.
Relative Molecular Mass: Not applicable.
Molecular Formula: $Mg_3(Si_2O_5)(OH)_4$
Water Solubility: Insoluble.
Solvent Solubility: Insoluble in organic solvents.

10. Stability and Reactivity

Stability: X Stable _____ Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Avoid generating dust. Keep out of water supplies and sewers.

Incompatible Materials: May be attacked by strong acids.

Fire/Explosion Information: See Section 5, "Fire Fighting Measures".

Hazardous Decomposition: Completely decomposes at temperatures of 1 000 °C.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. Toxicological Information

Route of Entry: X Inhalation X Skin X Ingestion

Toxicity Data: **Chrysotile**
Human, Inhalation TCL_O: 2.8 fibers/cc (5 years)
Rat, Inhalation-Intermittent TCL_O: 8 210 $\mu g/m^3$ (6 h to 20 d)
Rat, Oral-Continuous TDL_O: 10 867 mg/kg (78 weeks)

Tumorigenic, Reproductive, Mutagenic Data: Chrysotile has been investigated as a tumorigenic and mutagenic effector.

Health Effects (Acute and Chronic): See Section 3: "Hazards Identification" for potential health effects.

12. Ecological Information

Ecotoxicity Data: Not available.

13. Disposal Considerations

Waste Disposal: Dispose in accordance with all applicable federal, state, and local regulations.

14. Transportation Information

U.S. DOT and IATA: Asbestos; UN2212; Hazard Class 9
NOTE: This material, as packaged for SRM 1866b, is not subject to the regulations per DOT Special Provision 156 and IATA special Provision A61.

15. Regulatory Information

U.S. Regulations:

CERCLA Sections 102a/103 (40 CFR 302.4): Asbestos: 1 lbs RQ

SARA Title III Section 302 (40 CFR 355.30): Not regulated.

SARA Title III Section 304 (40 CFR 355.40): Not regulated.

SARA Title III Section 313 (40 CFR 372.65): Asbestos.

OSHA Process Safety (29 CFR 1910.119): Not regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	No.
CHRONIC:	Yes.
FIRE:	No.
REACTIVE:	No.
SUDDEN RELEASE:	No.

State Regulations: California Proposition 65: Asbestos is known to the state of California to cause cancer (Feb. 17, 1987).

CANADIAN Regulations
WHMIS Classification: Not determined for this material.

EUROPEAN Regulations

EC Classification (assigned):	T	Toxic. Carcinogen Category 1.
EC Risk Phrases:	R45	May cause cancer.
	R23/48	Toxic: danger of serious damage to health by prolonged exposure through inhalation.
EC Safety Phrases:	S45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
	S53	Avoid exposure.

National Inventory Status

U.S. Inventory (TSCA):	Asbestos:	Not listed on inventory.
TSCA 12(b) Export Notification:	Asbestos:	CAS No.: 1332-21-4 Section 6

16. Other Information

Sources: MDL Information Systems, Inc., MSDS *Chrysotile*, 15 June 2006.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.

MATERIAL SAFETY DATA SHEET

1. Substance and Source Identification

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

SRM Number: 1866b
MSDS Number: 1866b
SRM Name: Common Commercial Asbestos

Date of Issue: 09 January 2007

MSDS Coordinator: Mario Cellarosi
Telephone: 301-975-6776
FAX: 301-926-4751
E-mail: SRMMSDS@nist.gov

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: Standard Reference Material (SRM) 1866b is a set of three individual commercial-grade asbestos materials: chrysotile, **asbestiform grunerite (amosite)**, and asbestiform riebeckite (crocidolite). A unit of SRM 1866b consists of three bottles, each containing between 1 gram and 3 grams of individual material.

Substance: **Asbestiform Grunerite**

2. Composition and Information on Hazardous Ingredients[(a)]

Component: **Asbestiform Grunerite**
Other Designations: **Asbestiform Grunerite** (grunerite; amosite; brown asbestos; amosite asbestos)
CAS Number: 12172-73-5
EC Number (EINECS): Not assigned.
SRM Nominal Concentration (% by weight or volume): > 90

Component: **Magnetite (as an impurity)**
Other Designation: **Magnetite** (magnetic iron oxide; black iron oxide; magnetic iron ore; lodestone; black ferric oxide)
CAS Number: 1309-38-2
EC Number (EINECS): 215-169-8
SRM NominalConcentration (% by weight): < 5

Component: **Quartz**
Other Designation: Quartz (alpha quartz; silicon dioxide; silica; silicic anhydride; agate)
CAS Number: 14808-60-7
EC Number (EINESC): 238-878-4
SRM NominalConcentration (% by weight): < 5

EC Classification: T
Carcinogen Category 1
EC Risk (R No.): 23, 45, 48
EC Safety (S No.): 45, 53

[(a)] Hazardous components 1 % or greater; carcinogens 0.1 % or greater are listed in compliance with OSHA 29 CFR 1910.1200.

3. Hazards Identification

NFPA Ratings (Scale 0–4): Health = 1 Fire = 0 Reactivity = 0

Major Health Hazards: Cancer hazard (in humans)

Potential Health Effects

Inhalation: Inhalation of grunerite asbestos dust may be irritating. Symptoms include a cough and chest pain. Chronic exposure may cause asbestosis, interstitial fibrosis of the lung tissue, which may develop within 4 years to 9 years, but onset may be typically delayed 20 years to 40 years after first exposure. Death from asbestosis may be due to respiratory or cardiac failure. Secondary lung infections may also occur. Chronic exposure of asbestos to workers may also cause pleural effusion as early as 3 years to 4 years after initial exposure. Chronic exposure of asbestos to workers also increases the chance of pleural and peritoneal mesotheliomas, bronchogenic carcinoma, lung cancer, and cancers of the gastrointestinal tract and larynx. The latent period for mesothelioma is 3 years to 40 years; for lung cancer, 15 years to 30 years.

Skin Contact: Direct contact may cause irritation. Asbestos fibers may penetrate the skin and result in "asbestos corns", due to thickening of the skin around the implanted fiber. These corns usually occur on the hands and forearms, and they disappear on removal of the fibers.

Eye Contact: Direct contact may cause irritation with redness due to mechanical action.

Ingestion: Acute exposure by cause gastrointestinal irritation. Chronic exposure of asbestos fibers may be involved in cancers of the buccal cavity and pharynx, esophagus, stomach, colon, and rectum.

Listed as a Carcinogen/ Potential Carcinogen:

Yes	No	
X		In the National Toxicology Program (NTP) Report on Carcinogens.
X		In the International Agency for Research on Cancer (IARC) Monographs.
X		By the Occupational Safety and Health Administration (OSHA).

4. FIRST AID MEASURES

Inhalation: If adverse effects occur, remove to uncontaminated area. If not breathing, give artificial respiration by qualified personnel. Get immediate medical attention.

Skin Contact: Rinse affected area with copious amounts of water followed by washing with soap and water for at least 15 minutes while removing contaminated clothing. Get medical attention, if needed.

Eye Contact: Flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Get immediate medical attention.

Ingestion: If a large amount is swallowed, get immediate medical attention.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Asbestiform grunerite is a negligible fire hazard.

Extinguishing Media: Regular dry chemical. Carbon dioxide. Water. Regular foam.

Fire Fighting: If material is involved in a fire, extinguish fire with a medium appropriate for the surrounding fire. Material itself does NOT burn or burns with difficulty. Keep run-off water out of sewers and water sources. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Component: **Asbestiform Grunerite**
Flash Point: Not applicable.
Method Used: Not applicable.

Autoignition Temp.: Not applicable.

Flammability Limits in Air
UPPER (Volume %): Not applicable.
LOWER (Volume %): Not applicable.

6. Accidental Release Measures

Occupational Release: Do NOT touch or walk through spilled material. Avoid inhalation of asbestos dust (see Section 8, "Exposure Controls and Personal Protection"). Collect small dry spills with a shovel and place material into an appropriate container for disposal. Prevent entry into waterways and sewers. Clean up residue with a HEPA filter vacuum.

Disposal: Refer to Section 13, "Disposal Considerations".

7. Handling and Storage

Storage: Store and handle in accordance with all current regulations and standards.

Safe Handling Precautions: See Section 8, "Exposure Controls and Personal Protection".

8. Exposure Controls and Personal Protection

Exposure Limits:

Abestiform Grunerite
OSHA (PEL): 0.1 fibers/cc TWA
ACGIH (TLV): 0.1 fibers/cc TWA
NIOSH: 0.1 fibers/cc recommended TWA (10 h)

Quartz
OSHA (PEL): 0.3 mg/m^3 TWA (total dust) 30 mg/m^3/% SiO^2 + 2, based on size/aerodynamic characteristics)
OSHA (PEL): 0.1 mg/m^3 TWA (respirable dust) 10 mg/m^3/% SiO^2 + 2, based on size/aerodynamic characteristics)
ACGIH (TLV): 0.025 mg m^3 TWA (respirable dust)
NIOSH: 0.05 mg/m^3 recommended TWA (10 h) (respirable dust)

UK WEL: 0.3 mg/m^3 TWA (respirable particulate) (Chemical Hazard Alert Notice issued).

Ventilation: Provide local exhaust ventilation system equipped with a HEPA-filter dust collection system.

Respirator: If workplace conditions warrant a respirator's use, a NIOSH/MSHA approved respirator should be used under an implemented respiratory protection program in accordance with OSHA Standard 29 CFR 1910.134 (General Industry, Use of Respirators) and 29 CFR 1910.1001 for occupational exposure to asbestos.

Eye Protection: Wear safety goggles. An eye wash station should be readily available near areas of use.

Personal Protection: Wear appropriate protective clothing and gloves to prevent skin exposure. Refer to OSHA Regulated Substances: OSHA 29 CFR 1910.1001.

9. Physical and Chemical Properties

Component: **Asbestiform Grunerite**
Appearance: Fibrous solid to dust-like powder. Grey-brown to light brown. Odorless.
Relative Molecular Mass: Not applicable.
Molecular Formula: $Fe^{2+}{}_7(Si_8O_{22})(OH)_2$
Water Solubility: Insoluble

10. Stability and Reactivity

Stability: _X_ Stable _____ Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Avoid generating dust. Keep out of water supplies and sewers.

Incompatible Materials: May be attacked by strong acids.

Fire/Explosion Information: See Section 5, "Fire Fighting Measures".

Hazardous Decomposition: Completely decomposes at temperatures of 1 000 °C.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: X Inhalation X Skin X Ingestion

Toxicity Data: **Asbestiform Grunerite**
Rat, Intrapleural TD_{LO}: 150 mg/kg

Tumorigenic, Reproductive, Mutagenic Data: Asbestiform grunerite has been investigated as a tumorigenic and mutagenic effector.

Health Effects (Acute and Chronic): See Section 3: "Hazards Identification" for potential health effects.

12. ECOLOGICAL INFORMATION

Ecotoxicity Data: Not available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: Dispose in accordance with all applicable federal, state, and local regulations.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: **U.S. DOT and IATA:** Asbestos; UN2212; Hazard Class 9
NOTE: This material, as packaged for SRM 1866b, is not subject to the regulations per DOT Special Provision 156 and IATA special Provision A61.

15. REGULATORY INFORMATION

U.S. Regulations: CERCLA Sections 102a/103 (40 CFR 302.4): Asbestos: 1 lbs RQ.

SARA Title III Section 302 (40 CFR 355.30): Not regulated.

SARA Title III Section 304 (40 CFR 355.40): Not regulated.

SARA Title III Section 313 (40 CFR 372.65): Asbestos.

OSHA Process Safety (29 CFR 1910.119): Not regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	No.
CHRONIC:	Yes.
FIRE:	No.
REACTIVE:	No.
SUDDEN RELEASE:	No.

State Regulations: California Proposition 65: Asbestos is known to the state of California to cause cancer (Feb. 27, 1987).

CANADIAN Regulations WHMIS Classification: Not determined for this material.

EUROPEAN Regulations EC Classification (assigned): T Toxic.
Carcinogen Category 1

EC Risk Phrases: R45 May cause cancer.
R23/48 Toxic: danger of serious damage to health by prolonged exposure through inhalation.

EC Safety Phrases: S45 In case of accident of if you feel unwell, seek medical advice immediately (show the label where possible).
S53 Avoid exposure.

National Inventory Status

U.S. Inventory (TSCA):	Asbestos:	Not listed on inventory.
TSCA 12(b) Export Notification:	Asbestos:	CAS No.: 1332-21-4 Section 6

16. OTHER INFORMATION

Sources: MDL Information Systems, Inc., MSDS *Amosite*, 16 June 2005.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.

MATERIAL SAFETY DATA SHEET

1. Substance and Source Identification

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

SRM Number: 1866b
MSDS Number: 1866b
SRM Name: Common Commercial Asbestos

Date of Issue: 09 January 2007

MSDS Coordinator: Mario Cellarosi
Telephone: 301-975-6776
FAX: 301-926-4751
E-mail: SRMMSDS@nist.gov

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: Standard Reference Material (SRM) 1866b is a set of three individual commercial-grade asbestos materials: chrysotile, asbestiform grunerite (amosite), and **asbestiform riebeckite (crocidolite)**. A unit of SRM 1866b consists of three bottles, each containing between 1 gram and 3 grams of individual material.

Substance: **Asbestiform Riebeckite**

2. Composition and Information on Hazardous Ingredients[a]

Component: **Asbestiform Riebeckite**
Other Designations: **Asbestiform Riebeckite** (blue asbestos; crocidolite; asbestos; crocidolite asbestos)
CAS Number: 12001-28-4
EC Number (EINECS): Not assigned.
SRM Nominal Concentration (% by weight or volume): > 90

Component: **Magnetite (as an impurity)**
Other Designation: **Magnetite** (magnetic iron oxide; black iron oxide; magnetic iron ore; lodestone; black ferric oxide)
CAS Number: 1309-38-2
EC Number (EINECS): 215-169-8
SRM NominalConcentration (% by weight): < 5

EC Classification: T
Carcinogen Category 1
EC Risk (R No.): 23, 45, 48
EC Safety (S No.): 45, 53

[a] Hazardous components 1 % or greater; carcinogens 0.1 % or greater are listed in compliance with OSHA 29 CFR 1910.1200.

3. Hazards Identification

NFPA Ratings (Scale 0–4): Health = 1 Fire = 0 Reactivity = 0

Major Health Hazards: Cancer hazard (in humans)

Potential Health Effects
Inhalation: Inhalation of riebeckite asbestos dust may be irritating. Symptoms include a cough and chest pain. Chronic exposure may cause asbestosis, interstitial fibrosis of the lung tissue, which may develop within 4 years to 9 years, but onset may be typically delayed 20 years to 40 years after first exposure. Death from asbestosis may be due to respiratory or cardiac failure. Secondary lung infections may also occur. Chronic exposure of asbestos to workers may also cause pleural effusion as early as 3 years to 4 years after initial exposure. Chronic exposure of asbestos to workers also increases the chance of pleural and peritoneal mesotheliomas, bronchogenic carcinoma, lung cancer, and cancers of the gastrointestinal tract and larynx. The latent period for mesothelioma is 3 years to 40 years; for lung cancer, 15 years to 30 years.

Skin Contact: Direct contact may cause irritation. Asbestos fibers may penetrate the skin and result in "asbestos corns", due to thickening of the skin around the implanted fiber. These corns usually occur on the hands and forearms, and they disappear on removal of the fibers.

Eye Contact: Direct contact may cause irritation with redness due to mechanical action.

Ingestion: Acute exposure by cause gastrointestinal irritation. Chronic exposure of asbestos fibers may be involved in cancers of the buccal cavity and pharynx, esophagus, stomach, colon, and rectum.

Listed as a Carcinogen/ Potential Carcinogen:

Yes	No	
X		In the National Toxicology Program (NTP) Report on Carcinogens.
X		In the International Agency for Research on Cancer (IARC) Monographs.
X		By the Occupational Safety and Health Administration (OSHA).

4. First Aid Measures

Inhalation: If adverse effects occur, remove to uncontaminated area. If not breathing, give artificial respiration by qualified personnel. Get immediate medical attention.

Skin Contact: Rinse affected area with copious amounts of water followed by washing with soap and water for at least 15 minutes while removing contaminated clothing. Get medical attention, if needed.

Eye Contact: Flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Get immediate medical attention.

Ingestion: Get immediate medical attention. If vomiting occurs, keep head lower than hips to prevent aspiration. Give artificial respiration, if not breathing, by qualified personnel.

5. Fire Fighting Measures

Fire and Explosion Hazards: Asbestiform Riebeckite

Extinguishing Media: Regular dry chemical. Carbon dioxide. Water. Regular foam.

Fire Fighting: If material is involved in a fire, extinguish fire with a medium appropriate for the surrounding fire. Material itself does NOT burn or burns with difficulty. Keep run-off water out of sewers and water sources. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Component: **Asbestiform Riebeckite**
Flash Point: Not applicable.
Method Used: Not applicable.

Autoignition Temp.: Not applicable.

Flammability Limits in Air
UPPER (Volume %): Not applicable.
LOWER (Volume %): Not applicable.

6. Accidental Release Measures

Occupational Release: Do NOT touch or walk through spilled material. Avoid inhalation of asbestos dust (see Section 8, "Exposure Controls and Personal Protection"). Collect small dry spills with a shovel and place material into an appropriate container for disposal. Prevent entry into waterways and sewers. Clean up residue with a HEPA filter vacuum.

Disposal: Refer to Section 13, "Disposal Considerations".

7. HANDLING AND STORAGE

Storage: Store and handle in accordance with all current regulations and standards. Store in a cool, dry place.

Safe Handling Precautions: See Section 8, "Exposure Controls and Personal Protection".

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits: **Asbestiform Riebeckite**
OSHA (PEL): 0.1 fibers/cc TWA
ACGIH (TLV): 0.1 fibers/cc TWA
NIOSH: 0.1 fibers/cc recommended TWA (10 h)

Ventilation: Provide local exhaust ventilation system equipped with HEPA-filter dust collection system.

Respirator: If workplace conditions warrant a respirator's use, a NIOSH/MSHA approved respirator should be used under an implemented respiratory protection program in accordance with OSHA Standard 29 CFR 1910.134 (General Industry, Use of Respirators) and 29 CFR 1910.1001 for occupational exposure to asbestos.

Eye Protection: Wear safety goggles. An eye wash station should be readily available near areas of use.

Personal Protection: Wear appropriate protective clothing and gloves to prevent skin exposure. Refer to OSHA Regulated Substances: OSHA 29 CFR 1910.1001.

9. PHYSICAL AND CHEMICAL PROPERTIES

Component: **Asbestiform Riebeckite**
Appearance: Fibrous solid to dust-like powder. Blue to purple color. Odorless.
Molecular Formula: $Na_2(Fe^{2+}{}_3Fe^{3+}{}_2)(Si_8O_{22})(OH)_2$
Water Solubility: Insoluble.

10. STABILITY AND REACTIVITY

Stability: _X_ Stable ____ Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Avoid generating dust. Keep out of water supplies and sewers.

Incompatible Materials: May be attacked by strong acids.

Fire/Explosion Information: See Section 5, "Fire Fighting Measures".

Hazardous Decomposition: Completely decomposes at temperatures of 1 000 °C.

Hazardous Polymerization: ____ Will Occur _X_ Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: _X_ Inhalation _X_ Skin _X_ Ingestion

Toxicity Data: **Asbestiform Riebeckite**
Rat, Intraperitoneal LD_{LO}: 300 mg/kg
Rat, Inhalation-Intermittent TC_{LO}: 7 200 $\mu g/m^3$ (6 h – 20 days)
Rat, Inhalation-Intermittent TC_{LO}: 13 600 $\mu g/m^3$ (6 h – 5 days)

Tumorigenic, Reproductive, Mutagenic Data: Riebeckite asbestos has been investigated as a tumorigenic and mutagenic effector.

Health Effects (Acute and Chronic): See Section 3: "Hazards Identification" for potential health effects.

12. Ecological Information

Ecotoxicity Data: Not available.

13. Disposal Considerations

Waste Disposal: Dispose in accordance with all applicable federal, state, and local regulations.

14. Transportation Information

U.S. DOT and IATA: **U.S. DOT and IATA:** Asbestos; UN2212; Hazard Class 9
NOTE: This material, as packaged for SRM 1866b, is not subject to the regulations per DOT Special Provision 156 and IATA special Provision A61.

15. Regulatory Information

U.S. Regulations:

CERCLA Sections 102a/103 (40 CFR 302.4): Asbestos: 1 lbs RQ.

SARA Title III Section 302 (40 CFR 355.30): Not regulated.

SARA Title III Section 304 (40 CFR 355.40): Not regulated.

SARA Title III Section 313 (40 CFR 372.65): Asbestos.

OSHA Process Safety (29 CFR 1910.119): Not regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	No.
CHRONIC:	Yes.
FIRE:	No.
REACTIVE:	No.
SUDDEN RELEASE:	No.

State Regulations: California Proposition 65: Asbestos is known to the state of California to cause cancer (Feb. 27, 1987)

CANADIAN Regulations
WHMIS Classification: Not determined.

EUROPEAN Regulations

EC Classification (assigned):	T	Toxicity. Carcinogen Category 1.
EC Risk Phrases:	R45	May cause cancer.
	R23/48	Toxic: danger of serious damage to health by prolonged exposure through inhalation.
EC Safety Phrases:	S45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
	S53	Avoid exposure.

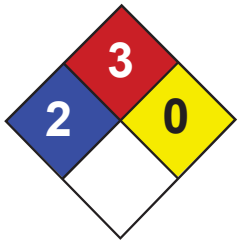
National Inventory Status

U.S. Inventory (TSCA):	Asbestos:	Not listed on inventory.
TSCA 12(b) Export Notification:	Asbestos:	CAS No. 1332-21-4 Section 6

16. Other Information

Sources: MDL Information Systems, Inc., MSDS *Crocidolite*, 14 September 2006.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C6-H6

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. The substance is toxic to blood, bone marrow, central nervous system (CNS). The substance may be toxic to liver, Urinary System. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 497.78°C (928°F)

Flash Points: CLOSED CUP: -11.1°C (12°F). (Setaflash)

Flammable Limits: LOWER: 1.2% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of oxidizing materials, of acids.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Extremely flammable liquid and vapor. Vapor may cause flash fire. Reacts on contact with iodine heptafluoride gas. Dioxygenyl tetrafluoroborate is as very powferful oxidant. The addition of a small particle to small samples of benzene, at ambient temperature, causes ignition. Contact with sodium peroxide with benzene causes ignition. Benzene ignites in contact with powdered chromic anhydride. Virgorous or incandescent reaction with hydrogen + Raney nickel (above 210 C) and bromine trifluoride.

Special Remarks on Explosion Hazards:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction

of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 STEL: 2.5 (ppm) from ACGIH (TLV) [United States] TWA: 1.6 STEL: 8 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.1 STEL: 1 from NIOSH TWA: 1 STEL: 5 (ppm) from OSHA (PEL) [United States] TWA: 10 (ppm) from OSHA (PEL) [United States] TWA: 3 (ppm) [United Kingdom (UK)] TWA: 1.6 (mg/m3) [United Kingdom (UK)] TWA: 1 (ppm) [Canada] TWA: 3.2 (mg/m3) [Canada] TWA: 0.5 (ppm) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Aromatic. Gasoline-like, rather pleasant. (Strong.)

Taste: Not available.

Molecular Weight: 78.11 g/mole

Color: Clear Colorless. Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 80.1 (176.2°F)

Melting Point: 5.5°C (41.9°F)

Critical Temperature: 288.9°C (552°F)

Specific Gravity: 0.8787 @ 15 C (Water = 1)

Vapor Pressure: 10 kPa (@ 20°C)

Vapor Density: 2.8 (Air = 1)

Volatility: Not available.

Odor Threshold: 4.68 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Miscible in alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 930 mg/kg [Rat]. Acute dermal toxicity (LD50): >9400 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 10000 7 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. Causes damage to the following organs: blood, bone marrow, central nervous system (CNS). May cause damage to the following organs: liver, Urinary System.

Other Toxic Effects on Humans:
Very hazardous in case of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (female fertility, Embryotoxic and/or foetotoxic in animal) and birth defects. May affect genetic material (mutagenic). May cause cancer (tumorigenic, leukemia)) Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through intact skin and affect the liver, blood, metabolism,and urinary system. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract and mucous membrane irritation. Can be absorbed through the lungs. May affect behavior/Central and Peripheral nervous systems (somnolence, muscle weakness, general anesthetic, and other symptoms similar to ingestion), gastrointestinal tract (nausea), blood metabolism, urinary system. Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation including vomiting. May affect behavior/Central and Peripheral nervous systems (convulsions, seizures, tremor, irritability, initial CNS stimulation followed by depression, loss of coordination, dizziness, headache, weakness, pallor, flushing), respiration (breathlessness and chest constriction), cardiovascular system, (shallow/rapid pulse), and blood.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Benzene UNNA: 1114 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Benzene California prop. 65 (no significant risk level): Benzene: 0.007 mg/day (value) California prop. 65: This product contains the following ingredients

for which the State of California has found to cause cancer which would require a warning under the statute: Benzene Connecticut carcinogen reporting list.: Benzene Connecticut hazardous material survey.: Benzene Illinois toxic substances disclosure to employee act: Benzene Illinois chemical safety act: Benzene New York release reporting list: Benzene Rhode Island RTK hazardous substances: Benzene Pennsylvania RTK: Benzene Minnesota: Benzene Michigan critical material: Benzene Massachusetts RTK: Benzene Massachusetts spill list: Benzene New Jersey: Benzene New Jersey spill list: Benzene Louisiana spill reporting: Benzene California Director's list of Hazardous Substances: Benzene TSCA 8(b) inventory: Benzene SARA 313 toxic chemical notification and release reporting: Benzene CERCLA: Hazardous substances.: Benzene: 10 lbs. (4.536 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R22- Harmful if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer. R62- Possible risk of impaired fertility. S2- Keep out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S39- Wear eye/face protection. S46- If swallowed, seek medical advice immediately and show this container or label. S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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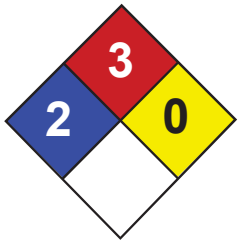

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Toluene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Toluene

Catalog Codes: SLT2857, SLT3277

CAS#: 108-88-3

RTECS: XS5250000

TSCA: TSCA 8(b) inventory: Toluene

CI#: Not available.

Synonym: Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol

Chemical Name: Toluene

Chemical Formula: C6-H5-CH3 or C7-H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Toluene	108-88-3	100

Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 1.1% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide; concentrated nitric acid, sulfuric acid + nitric acid; N2O4; AgClO4; BrF3; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetranitromethane.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 STEL: 500 CEIL: 300 (ppm) from OSHA (PEL) [United States] TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 100 STEL: 150 from NIOSH [United States] TWA: 375 STEL: 560 (mg/m3) from NIOSH [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweet, pungent, Benzene-like.

Taste: Not available.

Molecular Weight: 92.14 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 110.6°C (231.1°F)

Melting Point: -95°C (-139°F)

Critical Temperature: 318.6°C (605.5°F)

Specific Gravity: 0.8636 (Water = 1)

Vapor Pressure: 3.8 kPa (@ 25°C)

Vapor Density: 3.1 (Air = 1)

Volatility: Not available.

Odor Threshold: 1.6 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.7

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Soluble in diethyl ether, acetone. Practically insoluble in cold water. Soluble in ethanol, benzene, chloroform, glacial acetic acid, carbon disulfide. Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride. Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C. Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 636 mg/kg [Rat]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin. Eyes: Cauess mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abraisons. This usually resolves in 2 days. Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia,), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite. Ingestion: Aspiration hazard. Aspiration of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation. Chronic Potential Health Effects: Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophostatemia), severe, muscle weakness and Rhabdomyolysis. Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Toluene UNNA: 1294 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Toluene California prop. 65 (no significant risk level): Toluene: 7 mg/day (value) California prop. 65 (acceptable daily intake level): Toluene: 7 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Toluene Connecticut hazardous material survey.: Toluene Illinois

toxic substances disclosure to employee act: Toluene Illinois chemical safety act: Toluene New York release reporting list: Toluene Rhode Island RTK hazardous substances: Toluene Pennsylvania RTK: Toluene Florida: Toluene Minnesota: Toluene Michigan critical material: Toluene Massachusetts RTK: Toluene Massachusetts spill list: Toluene New Jersey: Toluene New Jersey spill list: Toluene Louisiana spill reporting: Toluene California Director's List of Hazardous Substances.: Toluene TSCA 8(b) inventory: Toluene TSCA 8(d) H and S data reporting: Toluene: Effective date: 10/04/82; Sunset Date: 10/0/92 SARA 313 toxic chemical notification and release reporting: Toluene CERCLA: Hazardous substances.: Toluene: 1000 lbs. (453.6 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S25- Avoid contact with eyes. S29- Do not empty into drains. S33- Take precautionary measures against static discharges.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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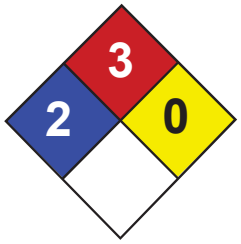

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Ethylbenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ethylbenzene

Catalog Codes: SLE2044

CAS#: 100-41-4

RTECS: DA0700000

TSCA: TSCA 8(b) inventory: Ethylbenzene

CI#: Not available.

Synonym: Ethyl Benzene; Ethylbenzol; Phenylethane

Chemical Name: Ethylbenzene

Chemical Formula: C8H10

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ethylbenzene	100-41-4	100

Toxicological Data on Ingredients: Ethylbenzene: ORAL (LD50): Acute: 3500 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (irritant, sensitizer). CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 432°C (809.6°F)

Flash Points:
CLOSED CUP: 15°C (59°F). (Tagliabue.) OPEN CUP: 26.667°C (80°F) (Cleveland) (CHRIS, 2001) CLOSED CUP: 12.8 C (55 F) (Bingham et al, 2001; NIOSH, 2001) CLOSED CUP: 21 C (70 F) (NFPA)

Flammable Limits: LOWER: 0.8% - 1.6%UPPER: 6.7% - 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Vapor may travel considerable distance to source of ignition and flash back. Vapors may form explosive mixtures with air. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Vapors may form explosive mixtures in air.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Sensitive to light. Store in light-resistant containers.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 125 (ppm) from OSHA (PEL) [United States] TWA: 435 STEL: 545 from OSHA (PEL) [United States] TWA: 435 STEL: 545 (mg/m3) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from ACGIH (TLV) [United States] TWA: 100 STEL: 125 (ppm) [United Kingdom (UK)] TWA: 100 STEL: 125 (ppm) [Belgium] TWA: 100 STEL: 125 (ppm) [Finland] TWA: 50 (ppm) [Norway] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish. Gasoline-like. Aromatic.

Taste: Not available.

Molecular Weight: 106.16 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 136°C (276.8°F)

Melting Point: -94.9 (-138.8°F)

Critical Temperature: 617.15°C (1142.9°F)

Specific Gravity: 0.867 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.66 (Air = 1)

Volatility: 100% (v/v).

Odor Threshold: 140 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in diethyl ether. Very slightly soluble in cold water or practically insoluble in water. Soluble in all proportions in Ethyl alcohol. Soluble in Carbon tetrachloride, Benzene. Insoluble in Ammonia. Slightly soluble in Chloroform. Solubility in Water: 169 mg/l @ 25 deg. C.; 0.014 g/100 ml @ 15 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources (flames, sparks, static), incompatible materials, light

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials. Sensitive to light.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation.

Toxicity to Animals: Acute oral toxicity (LD50): 3500 mg/kg [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals:
Lethal Dose/Conc 50% Kill: LD50 [Rabbit] - Route: Skin; Dose: 17800 ul/kg Lowest Published Lethal Dose/Conc: LDL[Rat] - Route: Inhalation (vapor); Dose: 4000 ppm/4 H

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data. May cause cancer based on animals data. IARC evidence for carcinogenicity in animals is sufficient. IARC evidence of carcinogenicity in humans inadequate. May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Can cause mild skin irritation. It can be absorbed through intact skin. Eyes: Contact with vapor or liquid can cause severe eye irritation depending on concentration. It may also cause conjunctivitis. At a vapor exposure level of 85 - 200 ppm , it is mildly and transiently irritating to the eyes; 1000 ppm causes further irritation and tearing; 2000 ppm results in immediate and severe irritation and tearing; 5,000 ppm is intolerable (ACGIH, 1991; Clayton and Clayton, 1994). Standard draize test for eye irritation using 500 mg resulted in severe irritation (RTECS) Inhalation: Exposure to high concentrations can cause nasal, mucous membrane and respiratory tract irritation and can also result in chest constriction and, trouble breathing, respiratory failure, and even death. It can also affect behavior/Central Nervous System. The effective dose for CNS depression in experimental animals was 10,000 ppm (ACGIH, 1991). Symptoms of CNS depression include

headache, nausea, weakness, dizziness, vertigo, irritability, fatigue, lightheadedness, sleepiness, tremor, loss of coordination, judgement and conciousness, coma, and death. It can also cause pulmonary edema. Inhalation of 85 ppm can produce fatigue, insomnia, headache, and mild irritation of the respiratory tract (Haley & Berndt, 1987). Ingestion: Do not drink, pipet or siphon by mouth. May cause gastroinestinal/digestive tract irritation with Abdominal pain, nausea, vomiting. Ethylbenzene is a pulmonary aspiration hazard. Pulmonary aspiration of even small amounts of the liquid may cause fatal pneumonitis. It may also affect behavior/central nervous system with

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 14 mg/l 96 hours [Fish (Trout)] (static). 12.1 mg/l 96 hours [Fish (Fathead Minnow)] (flow-through)]. 150 mg/l 96 hours [Fish (Blue Gill/Sunfish)] (static). 275 mg/l 96 hours [Fish (Sheepshead Minnow)]. 42.3 mg/l 96 hours [Fish (Fathead Minnow)](soft water). 87.6mg/l 96 hours [Shrimp].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Ethylbenzene UNNA: 1175 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Ethylbenzene Illinois toxic substances disclosure to employee act: Ethylbenzene Illinois chemical safety act: Ethylbenzene New York release reporting list: Ethylbenzene Rhode Island RTK hazardous substances: Ethylbenzene Pennsylvania RTK: Ethylbenzene Minnesota: Ethylbenzene Massachusetts RTK: Ethylbenzene Massachusetts spill list: Ethylbenzene New Jersey: Ethylbenzene New Jersey spill list: Ethylbenzene Louisiana spill reporting: Ethylbenzene California Director's List of Hazardous Substances: Ethylbenzene TSCA 8(b) inventory: Ethylbenzene TSCA 4(a) proposed test rules: Ethylbenzene TSCA 8(d) H and S data reporting: Ethylbenzene: Effective Date: 6/19/87; Sunset Date: 6/19/97 SARA 313 toxic chemical notification and release reporting: Ethylbenzene

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASSE D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S24/25- Avoid contact with skin and eyes. S29- Do not empty into drains.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Manufacturer's Material Safety Data Sheet. -Fire Protection Guide to Hazardous Materials, 13th ed., Nationial Fire Protection Association (NFPA) -Registry of Toxic Effects of Chemical Substances (RTECS) -Chemical Hazard Response Information System (CHRIS) -Hazardous Substance Data Bank (HSDB) -New Jersey Hazardous Substance Fact Sheet -Ariel Global View -Reprotext System

Other Special Considerations: Not available.

Created: 10/09/2005 05:28 PM

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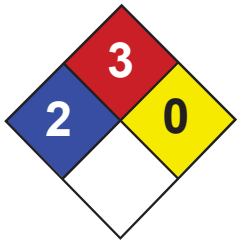

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Xylenes MSDS

Section 1: Chemical Product and Company Identification

Product Name: Xylenes

Catalog Codes: SLX1075, SLX1129, SLX1042, SLX1096

CAS#: 1330-20-7

RTECS: ZE2100000

TSCA: TSCA 8(b) inventory: Xylenes

CI#: Not available.

Synonym: Xylenes; Dimethylbenzene; xylol; methyltoluene

Chemical Name: Xylenes (o-, m-, p- isomers)

Chemical Formula: C6H4(CH3)2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Xylenes	1330-20-7	100

Toxicological Data on Ingredients: Xylenes: ORAL (LD50): Acute: 4300 mg/kg [Rat]. 2119 mg/kg [Mouse]. DERMAL (LD50): Acute: >1700 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 24°C (75.2°F). (Tagliabue.) OPEN CUP: 37.8°C (100°F).

Flammable Limits: LOWER: 1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Vapors may travel to source of ignition and flash back.

Special Remarks on Explosion Hazards:
Vapors may form explosive mixtures with air. Containers may explode when heated. May polymerize explosively when heated. An attempt to chlorinate xylene with 1,3-Dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin) caused a violent explosion

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined

areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 (ppm) [Canada] TWA: 435 (mg/m3) [Canada] TWA: 434 STEL: 651 (mg/m3) from ACGIH (TLV) [United States] TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless. Clear

pH (1% soln/water): Not available.

Boiling Point: 138.5°C (281.3°F)

Melting Point: -47.4°C (-53.3°F)

Critical Temperature: Not available.

Specific Gravity: 0.864 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 1 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water. Miscible with absolute alcohol, ether, and many other organic liquids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Store away from acetic acid, nitric acid, chlorine, bromine, and fluorine.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2119 mg/kg [Mouse]. Acute dermal toxicity (LD50): >1700 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5000 4 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals:
Lowest Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Man] - Route: Oral; Dose: 10000 ppm/6H

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in animal. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects (male and femael fertility (spontaneous abortion and fetotoxicity)) and birth defects based animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. Can be absorbed through skin. Eyes: Causes eye irritation. Inhalation: Vapor causes respiratory tract and mucous membrane irritation. May affect central nervous system and behavior (General anesthetic/CNS depressant with effects including headache, weakness, memory loss, irritability, dizziness, giddiness, loss of coordination and judgement, respiratory depression/arrest or difficulty breathing, loss of appetite, nausea, vomiting, shivering, and possible coma and death). May also affects blood, sense organs, liver, and peripheral nerves. Ingestion: May cause gastrointestinal irritation including abdominal pain, vomiting, and nausea. May also affect liver and urinary system/ kidneys. May cause effects similar to those of acute inhalation. Chronic Potential Health Effects: Chronic inhalation may affect the urinary system (kidneys) blood (anemia), bone marrow (hyperplasia of bone marrow) brain/behavior/Central Nervous system. Chronic inhalation may alsocause mucosal bleeding. Chronic ingestion may affect the liver and metabolism (loss of appetite) and may affect urinary system (kidney damage)

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Xylenes UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Xylenes Illinois chemical safety act: Xylenes New York acutely hazardous substances: Xylenes Rhode Island RTK hazardous substances: Xylenes Pennsylvania RTK: Xylenes Minnesota: Xylenes Michigan critical material: Xylenes Massachusetts RTK: Xylenes Massachusetts spill list: Xylenes New Jersey: Xylenes New Jersey spill list: Xylenes Louisiana spill reporting: Xylenes California Director's List of Hazardous Substances: Xylenes TSCA 8(b) inventory: Xylenes SARA 302/304/311/312 hazardous chemicals: Xylenes SARA 313 toxic chemical notification and release reporting: Xylenes CERCLA: Hazardous substances.: Xylenes: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R10- Flammable. R21- Harmful in contact with skin. R36/38- Irritating to eyes and skin. S2- Keep out of the reach of children. S36/37- Wear suitable protective clothing and gloves. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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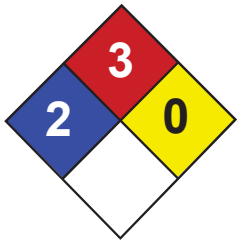

Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Methyl tert-butyl ether MSDS

Section 1: Chemical Product and Company Identification

Product Name: Methyl tert-butyl ether

Catalog Codes: SLM2152

CAS#: 1634-04-4

RTECS: KN5250000

TSCA: TSCA 8(b) inventory: Methyl tert-butyl ether

CI#: Not available.

Synonym:

Chemical Name: Methyl tert-Butyl Ether

Chemical Formula: C5-H12-O

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Methyl {tert-}butyl ether	1634-04-4	100

Toxicological Data on Ingredients: Methyl tert-butyl ether: ORAL (LD50): Acute: 4000 mg/kg [Rat]. 5960 mg/kg [Mouse]. VAPOR (LC50): Acute: 23576 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Extremely hazardous in case of eye contact (irritant), of ingestion. Very hazardous in case of skin contact (irritant), of inhalation. Hazardous in case of skin contact (permeator). Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Extremely hazardous in case of eye contact (irritant), of ingestion. Very hazardous in case of skin contact (irritant), of inhalation. Hazardous in case of skin contact (permeator). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to lungs, the nervous system, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged inhalation of vapors may lead to chronic respiratory irritation.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 224°C (435.2°F)

Flash Points: CLOSED CUP: -28°C (-18.4°F).

Flammable Limits: LOWER: 2.5% UPPER: 15.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Flammable in presence of open flames and sparks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Characteristic. (Strong.)

Taste: Not available.

Molecular Weight: 88.15 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 55.2°C (131.4°F)

Melting Point: -109°C (-164.2°F)

Critical Temperature: Not available.

Specific Gravity: 0.7405 (Water = 1)

Vapor Pressure: 245 mm of Hg (@ 20°C)

Vapor Density: 3.1 (Air = 1)

Volatility: 100% (v/v).

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether.

Solubility:

Soluble in methanol, diethyl ether. Partially soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 4000 mg/kg [Rat]. Acute toxicity of the vapor (LC50): 23576 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to lungs, the nervous system, mucous membranes.

Other Toxic Effects on Humans:
Extremely hazardous in case of ingestion. Very hazardous in case of skin contact (irritant), of inhalation. Hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Methyl tert-butyl ether : UN2398 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Methyl tert-butyl ether Massachusetts RTK: Methyl tert-butyl ether TSCA 8(b) inventory: Methyl tert-butyl ether SARA 313 toxic chemical notification and release reporting: Methyl tert-butyl ether CERCLA: Hazardous substances.: Methyl tert-butyl ether

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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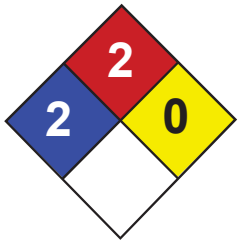

Health	2
Fire	2
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Naphthalene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Naphthalene

Catalog Codes: SLN1789, SLN2401

CAS#: 91-20-3

RTECS: QJ0525000

TSCA: TSCA 8(b) inventory: Naphthalene

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: C10H8

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Naphthalene	91-20-3	100

Toxicological Data on Ingredients: Naphthalene: ORAL (LD50): Acute: 490 mg/kg [Rat]. 533 mg/kg [Mouse]. 1200 mg/kg [Guinea pig]. DERMAL (LD50): Acute: 20001 mg/kg [Rabbit]. VAPOR (LC50): Acute: 170 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of ingestion. Hazardous in case of eye contact (irritant), of inhalation. Slightly hazardous in case of skin contact (irritant, permeator). Severe over-exposure can result in death.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE]. The substance is toxic to blood, kidneys, the nervous system, the reproductive system, liver, mucous membranes, gastrointestinal tract, upper respiratory tract, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact: Not available.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 567°C (1052.6°F)

Flash Points: CLOSED CUP: 88°C (190.4°F). OPEN CUP: 79°C (174.2°F).

Flammable Limits: LOWER: 0.9% UPPER: 5.9%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Not available.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Flammable solid. Stop leak if without risk. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe dust. Avoid contact with eyes Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. Keep container dry. Keep in a cool place.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
Israel: TWA: 10 (ppm) TWA: 10 STEL: 15 (ppm) from ACGIH (TLV) [1995] TWA: 52 STEL: 79 (mg/m3) from ACGIH [1995]
Australia: STEL: 15 (ppm) Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystalline solid.)

Odor: Aromatic.

Taste: Not available.

Molecular Weight: 128.19 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: 218°C (424.4°F)

Melting Point: 80.2°C (176.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.162 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 4.4 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.038 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties:
Partially dispersed in hot water, methanol, n-octanol. Very slightly dispersed in cold water. See solubility in methanol, n-octanol.

Solubility:
Partially soluble in methanol, n-octanol. Very slightly soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Highly reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: May attack some forms of rubber and plastic

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 490 mg/kg [Rat]. Acute dermal toxicity (LD50): 20001 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 170 ppm 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. DEVELOPMENTAL TOXICITY: Classified Development toxin [POSSIBLE]. The substance is toxic to blood, kidneys, the nervous system, the reproductive system, liver, mucous membranes, gastrointestinal tract, upper respiratory tract, central nervous system (CNS).

Other Toxic Effects on Humans:
Very hazardous in case of ingestion. Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Ecotoxicity in water (LC50): 305.2 ppm 96 hour(s) [Trout].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 4.1: Flammable solid.

Identification: : Naphthalene, refined : UN1334 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
Rhode Island RTK hazardous substances: Naphthalene Pennsylvania RTK: Naphthalene Florida: Naphthalene Minnesota: Naphthalene Massachusetts RTK: Naphthalene TSCA 8(b) inventory: Naphthalene TSCA 8(a) PAIR: Naphthalene TSCA 8(d) H and S data reporting: Naphthalene: 06/01/87 SARA 313 toxic chemical notification and release reporting: Naphthalene: 1% CERCLA: Hazardous substances.: Naphthalene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-4: Flammable solid. CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R36- Irritating to eyes. R40- Possible risks of irreversible effects. R48/22- Harmful: danger of serious damage to health by prolonged exposure if swallowed. R48/23- Toxic: danger of serious damage to health by prolonged exposure through inhalation. R63- Possible risk of harm to the unborn child.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 2

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 2

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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Health	1
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Lead MSDS

Section 1: Chemical Product and Company Identification

Product Name: Lead

Catalog Codes: SLL1291, SLL1669, SLL1081, SLL1459, SLL1834

CAS#: 7439-92-1

RTECS: OF7525000

TSCA: TSCA 8(b) inventory: Lead

CI#: Not available.

Synonym: Lead Metal, granular; Lead Metal, foil; Lead Metal, sheet; Lead Metal, shot

Chemical Name: Lead

Chemical Formula: Pb

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Lead	7439-92-1	100

Toxicological Data on Ingredients: Lead LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (permeator). CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances: Non-flammable in presence of open flames and sparks, of shocks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: When heated to decomposition it emits highly toxic fumes of lead.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable

protective clothing. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.05 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.05 (mg/m3) from OSHA (PEL) [United States] TWA: 0.03 (mg/m3) from NIOSH [United States] TWA: 0.05 (mg/m3) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Metal solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 207.21 g/mole

Color: Bluish-white. Silvery. Gray

pH (1% soln/water): Not applicable.

Boiling Point: 1740°C (3164°F)

Melting Point: 327.43°C (621.4°F)

Critical Temperature: Not available.

Specific Gravity: 11.3 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, excess heat

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials. Incompatible with sodium carbide, chlorine trifluoride, trioxane + hydrogen peroxide, ammonium nitrate, sodium azide, disodium acetylide, sodium acetylide, hot concentrated nitric acid, hot concentrated hydrochloric acid, hot concentrated sulfuric acid, zirconium.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH, 2B (Possible for human.) by IARC. May cause damage to the following organs: blood, kidneys, central nervous system (CNS).

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential: Skin: Lead metal granules or dust: May cause skin irritation by mechanical action. Lead metal foil, shot or sheets: Not likely to cause skin irritation Eyes: Lead metal granules or dust: Can irritate eyes by mechanical action. Lead metal foil, shot or sheets: No hazard. Will not cause eye irritation. Inhalation: In an industrial setting, exposure to lead mainly occurs from inhalation of dust or fumes. Lead dust or fumes: Can irritate the upper respiratory tract (nose, throat) as well as the bronchi and lungsby mechanical action. Lead dust can be absorbed through the respiratory system. However, inhaled lead does not accumulate in the lungs. All of an inhaled dose is eventually abssorbed or transferred to the gastrointestinal tract. Inhalation effects of exposure to fumes or dust of inorganic lead may not develop quickly. Symptoms may include metallic taste, chest pain, decreased physical fitness, fatigue, sleep disturbance, headache, irritability, reduces memory, mood and personality changes, aching bones and muscles, constipation, abdominal pains, decreasing appetite. Inhalation of large amounts may lead to ataxia, deliriuim, convulsions/seizures, coma, and death. Lead metal foil, shot, or sheets: Not an inhalation hazard unless metal is heated. If metal is heated, fumes will be released. Inhalation of these fumes may cause "fume metal fever", which is characterized by flu-like symptoms. Symptoms may include metallic taste, fever, nausea, vomiting, chills, cough, weakness, chest pain, generalized muscle pain/aches, and increased white blood cell count. Ingestion: Lead metal granules or dust: The symptoms of lead poisoning include abdominal pain or cramps (lead cholic), spasms, nausea, vomiting, headache, muscle weakness, hallucinations, distorted perceptions, "lead line" on the gums, metallic taste, loss of appetite, insomnia, dizziness and other symptoms similar to that of inhalation. Acute poisoning may result in high lead levels in the blood and urine, shock, coma and death in extreme cases. Lead metal foil, shot or sheets: Not an ingestion hazard for usual industrial handling.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (female) which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (male) which would require a warning under the statute: Lead California prop. 65 (no significant risk level): Lead: 0.0005 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Lead California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Lead Connecticut hazardous material survey.: Lead Illinois toxic substances disclosure to employee act: Lead Illinois chemical safety act: Lead New York release reporting list: Lead Rhode Island RTK hazardous substances: Lead Pennsylvania RTK: Lead

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R20/22- Harmful by inhalation and if swallowed. R33- Danger of cumulative effects. R61- May cause harm to the unborn child. R62- Possible risk of impaired fertility. S36/37- Wear suitable protective clothing and gloves. S44- If you feel unwell, seek medical advice (show the label when possible). S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 1

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

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10.6 CHEMICAL HAZARDS TABLE

Table 1
Chemical Hazards Table

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
VOLATILE ORGANIC COMPOUNDS				
Acetaldehyde (Ethyl aldehyde) (75-07-0)	PEL: 200 ppm TLV: N/E AEL: 25 ppm STEL: 150 ppm IDLH: 2000 ppm (CA) Skin: No	Colorless liquid or gas (above 69°F) with a pungent, fruity odor Air odor threshold: 0.5 ppm LEL: 4.0% UEL: 60% IP: 10.22 eV VP: 740 mm FI.P.: -36°F	INH ING CON	Irritating to eyes, nose, and throat. May cause eye and skin burns. Conjunctivitis, cough, CNS depression, delayed pulmonary edema, and dermatitis. Potential occupational carcinogen.
Acetone (2-Propanone) (67-64-1)	PEL: 1,000 ppm TLV: 500 ppm AEL: 500 ppm STEL: 750 ppm IDLH: 2,500 ppm Skin: No	Colorless liquid with a fragrant mint-like odor. Air odor threshold: 13 ppm LEL: 2.5% UEL: 12.8% IP: 9.69 eV VP: 180 mm FI.P.: 0°F	INH ABS CON	Narcotic in high concentrations. Irritates eyes, nose, and throat; headache, dizziness, dermatitis, and CNS depression may occur.
Acetonitrile (Methyl cyanide) (75-05-8)	PEL: 40 ppm NIOSH: 20 ppm TLV: 20 ppm AEL: 20 ppm STEL: 60 ppm IDLH: 500 ppm Skin: Yes	Colorless liquid with an aromatic odor. Air odor threshold: UN LEL: 3% UEL: 16% IP: 12.2 eV VP: 73 mm FI.P.: 42°F	INH ABS ING CON	Irritating to the nose and throat. Asphyxiation, nausea, vomiting, chest pain, weakness, stupor, convulsions, liver and kidney damage may also occur. Exposure to acetonitrile can metabolize to cyanide.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Acrolein (Acraldehyde) (107-02-8)	PEL: 0.1 ppm TLV: N/E AEL: 0.1 ppm STEL: 0.1 ppm (C) IDLH: 2 ppm Skin: Yes	Colorless or yellow liquid with a piercing disagreeable odor. Air odor threshold: 2 ppm LEL: 2.8% UEL: 31% IP: 10.13 eV VP: 210mm Hg FI.P.: -15°F	INH ING CON	Irritating to the eyes, skin, and mucous membranes. Causes decreased pulmonary function, delayed pulmonary edema, and chronic respiratory disease.
Acrylonitrile (Vinyl cyanide) (107-13-1)	PEL: 2 ppm 10 ppm (C) TLV: 2 ppm AEL: 0.5 ppm STEL: N/E IDLH: 85 ppm (CA) Skin: Yes	Colorless to pale yellow liquid with an unpleasant odor. Air odor threshold: 20 ppm LEL: 3% UEL: 17% IP: 10.91 eV VP: 83 mm FI.P.: 30°F	INH ABS ING CON	Irritating to the eyes and skin. Asphyxiation, headache, nausea, sneezing, vomiting, weakness, light-headedness, skin vesiculation, dermatitis may occur. Potential occupational carcinogen.
Ammonia (Anhydrous Ammonia) (76644-41-7)	PEL: 50 ppm TLV: 25 ppm AEL: 25 ppm STEL: 35 ppm IDLH: 300 ppm (CA) Skin: No	Colorless gas with a pungent, suffocating odor. Note: Often used as an aqueous solution. Air odor threshold: 20 ppm LEL: 15% UEL: 28% IP: 10.18 eV VP: 8.5 atm FI.P: NA	INH ABS ING CON	Strong irritant to the eyes, nose, throat. May cause bronchitis, chest pain, pulmonary edema, skin burns, and blistering upon contact.
Benzene (Benzol) (71-43-2)	PEL: 1 ppm TLV: 0.5 ppm AEL: 0.5 ppm STEL: 2.5 ppm IDLH: 500 ppm (CA) Skin: Yes	Colorless to light yellow liquid with an aromatic odor. Air odor threshold: 12.0 ppm LEL: 1.2% UEL: 7.8% IP: 9.24 eV VP: 75 mm FI.P.: 12°F	INH ABS ING CON	A strong eye, nose, throat and respiratory irritant. Headache, nausea, fatigue, anorexia, weakness, and exhaustion may occur. Effects include bone marrow abnormalities. Potential occupational carcinogen.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
n-Butyl benzene (1-phenylbutane) (104-51-8)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless liquid. Air odor threshold: UN LEL: 0.8% UEL: 5.8% IP: UN VP: 1.03 mm FI.P.: 139°F	INH ABS ING CON	May cause harmful effects by inhalation, ingestion, or skin absorption. May cause skin irritation.
sec-Butyl benzene (2-phenylbutane) (135-98-8)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless liquid. Air odor threshold: UN LEL: UN UEL: UN IP: UN VP: 15 mm FI.P.: 113°F	INH ABS ING CON	May cause harmful effects by inhalation, ingestion, or skin absorption. May cause skin irritation.
Bromodichloromethane (75-27-4)	PEL: N/E TLV: N/E AEL: N/E IDLH: N/E Skin: No STEL: N/E	Clear olorless liquid Air odor threshold: UN LEL: UN UEL: UN IP: UN VP: UN FI.P.: UN	INH ABS CON	May cause eye, skin, mucous membrane, and upper respiratory tract irritation. Narcosis.
Bromoform (Tribromomethane) (75-25-2)	PEL: 0.5 ppm TLV: 0.5 ppm AEL: N/E STEL: N/E IDLH: 850 ppm (CA) Skin: Yes	Colorless to yellow liquid with a chloroform-like odor. Air odor threshold: UN LEL: NA UEL: NA IP: 10.48 eV VP: 5 mm FI.P.: NA	INH ABS ING CON	Irritating to eyes, nose, throat, and respiratory system. May cause central nervous system depression and kidney and liver damage.
1,3 Butadiene (Butadiene) (106-99-0)	PEL: 1 ppm TLV: 2 ppm AEL: 2 ppm STEL: N/E IDLH: 2000 ppm (CA) Skin: No	Colorless gas with a mild aromatic or gasoline-like odor. Air odor threshold: UN LEL: 2.0% UEL: 12.0% IP: 9.07 eV VP: 2.4 atm FI.P.: -105°F (liquid) N/A (gas)	INH CON	Irritating to eyes, nose, and throat. May cause drowsiness and light-headedness. Contact with liquid may cause frostbite. Potential occupational carcinogen.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
2-Butanone (Methyl Ethyl Ketone) (MEK) (78-93-3)	PEL: 200 ppm TLV: 200 ppm AEL: 200 ppm STEL: 300 ppm IDLH: 3000 ppm Skin: No	Colorless liquid with a moderately sharp, fragrant mint or acetone-like odor. Air odor threshold: 5 ppm LEL: 1.4% UEL: 11.4% IP: 9.54 eV VP: 78 mm FI.P.: 16°F	INH ING CON	Irritating to they eyes, skin, and nose. May cause headaches, dizziness, vomiting, and dermatitis.
Butyl acrylate (n-Butyl acrylate (141-32-2)	PEL: N/E TLV: 2 ppm AEL: 2 ppm STEL: N/E IDLH: N/E Skin: No	Clear, colorless liquid with a strong fruity odor. Air odor threshold: UN LEL: 1.5% UEL: 9.9% IP: UN VP: 4 mm FI.P.: 103°F	INH ABS ING CON	Irritating to the eyes, skin, and upper respiratory system. Sensitization dermatitis and breathing difficulty may also occur.
n-Butyl alcohol (71-36-3) (n-Butanol)	PEL: 100 ppm TLV: 20 ppm AEL: 25 ppm STEL: N/E IDLH: 1400 ppm Skin: No	Colorless liquid with a strong characteristic alcohol odor. Air odor threshold: UN LEL: 1.4% UEL: 11.2% IP: 10.04 eV VP: 6 mm FI.P.: 84°F	INH ABS ING CON	Irritating to eyes, nose, throat, and head. Symtoms include vertigo, drowsiness, corneal inflamation, hearing loss, and CNS depression.
n-Butyl acetate (123-86-4)	PEL: 150 ppm TLV: 150 ppm AEL: N/E STEL: 200 ppm IDLH: 1700 ppm Skin: No	Colorless liquid with a fruity odor. Air odor threshold: UN LEL: 1.7% UEL: 7.6% IP: 10.00 eV VP: 10 mm FI.P.: 72°F	INH ING CON	Irritating to the eyes, skin, and upper respiratory system. Headache, drowsiness, and narcosis may occur.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Carbon disulfide (Carbon bisulfide) (75-15-0)	PEL: 20 ppm 30 ppm (C) TLV: 1 ppm AEL: 3 ppm STEL: N/E IDLH: 500 ppm Skin: Yes	Colorless liquid with sweet ether-like odor. Reagent grades are foul smelling. Air odor threshold: UN LEL: 1.3% UEL: 50% IP: 10.08 eV VP: 297 mm FI.P.: -22°F	INH ABS ING CON	Symptoms include dizziness, fatigue, nervousness, psychosis, ocular changes, and coronary heart disease. Parkinson-like syndrome may occur. May also cause kidney, liver, and eye damage.
Carbon tetrachloride (Tetrachloromethane) (56-23-5)	PEL: 10 ppm 25 ppm (C) TLV: 5 ppm AEL: 5 ppm STEL: 10 ppm (CA) IDLH 200 ppm Skin: Yes	Colorless liquid with a characteristic ether-like odor. Air odor threshold: 70 ppm LEL: N/A UEL: N/A IP: 11.47 eV VP: 91 mm FI.P.: UN	INH ABS ING CON	Irritation to the eyes and skin. May cause central nervous system depression, drowsiness, dizziness, and incoordination. Nausea, vomiting, liver and kidney damage may occur. Potential occupational carcinogen.
Chlorine (7782-50-5)	PEL: 1 ppm (C) TLV: 0.5 ppm AEL: 0.5 ppm STEL: 1 ppm IDLH: 10 ppm Skin: No	Greenish-yellow gas with a pungent irritating odor. Air odor threshold: UN LEL: N/A UEL: N/A VP: 6.8 atm IP: 11.48 eV FI.P.: UN	INH CON	Burning of the eyes, nose, and mouth. Tearing, runny nose, cough, choking, substernal pain, fainting, pulmonary edema, pneumonia, hypoxia, and dermatitis may also occur.
Chlorobenzene (Benzene chloride) (108-90-7)	PEL: 75 ppm TLV: 10 ppm AEL: 25 ppm STEL: N/E IDLH 1000 ppm Skin: No	Colorless liquid with an almond-like odor. Air odor threshold: N/D LEL: 1.3 % UEL: 9.6 % IP: 9.07 eV VP: 9 mm FI.P.: 82°F	INH ING CON	Irritation of the eyes, skin, and nose. May cause drowsiness, incoordination, and CNS depression.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Chloroform (Methane trichloride) (67-66-3)	PEL: 50 ppm (C) TLV: 10 ppm AEL: 2 ppm STEL: N/E IDLH: 500 ppm (CA) Skin: No	Colorless liquid with a pleasant odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: 11.42 eV VP: 160 mm FI.P.: UN	INH ABS ING CON	Irritation to eyes and skin. Causes dizziness, mental dullness, nausea, confusion, headache, fatigue, and enlarged liver. Potential occupational carcinogen.
b-Chloroprene (2-Cloro-1,3-butadiene) (126-99-8)	PEL: 25 ppm TLV: 10 ppm AEL: 2 ppm STEL: N/E IDLH: 300 ppm (CA) Skin: Yes	Colorless liquid with a pungent, ether-like odor. Air odor threshold: UN LEL: 4.0% UEL: 20.0% IP: 8.79 eV VP: 188 mm FI.P: -4°F	INH ABS ING CON	Irritating to the eyes, skin, and respiratory track. May cause nervousness, irritation, dermatitis, hair loss, and reproductive effects. Potential occupational carcinogen.
Cumene (Isopropylbenzene) (98-82-8)	PEL: 50 ppm TLV: 50 ppm AEL: N/E STEL: N/E IDLH: 900 ppm Skin: No	Colorless liquid with a sharp, penetrating, aromatic odor. Air odor threshold: UN LEL: 0.9 % UEL: 6.5 % IP: 8.75 eV VP: 8 mm FI.P.: 96 °F	INH ABS ING CON	Irritating to the eyes, skin, and mucous membranes. May cause dermatitis, headache, narcosis, and coma.
Cyclohexane (110-82-7)	PEL: 300 ppm TLV: 100 ppm AEL: 300 ppm STEL: N/E IDLH: 1300 ppm Skin: No	Colorless liquid with a sweet, chloroform-like odor. A solid below 44 °F Air odor threshold: UN LEL: 1.3 % UEL: 8 % IP: 9.88 eV VP: 78 mm FI.P.: 0 °F	INH ING CON	Irritating to the eyes, skin, CNS, and respiratory system. May cause drowsiness, dermatitis, narcosis, and coma.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Cymene (4-Isopropyl toluene) (99-87-6)	PEL: N/E TLV: N/E AEL: 10 ppm STEL: N/E IDLH: N/E Skin: No	Colorless, transparent liquid with aromatic odor. Air odor threshold: UN LEL: 0.7 % UEL: 5.6 % IP: UN eV VP: UN FI.P.: 117°F	INH ABS ING CON	Harmful by inhalation , ingestion or skin absorption. Vapor or mist is irritating to the eyes, mucous membranes, and upper respiratory tract. Causes skin irritation.
Dichloroacetyl chloride (79-36-7)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Clear, fuming liquid. LEL: N/A UEL: N/A IP: UN VP: UN FI.P.: UN	INH ING CON	Irritating to eyes and skin. May cause tearing. Corrosive to tissues.
1,2-Dichlorobenzene (o-Dichlorobenzene) (95-50-1)	PEL: 50 ppm (C) TLV: 25 ppm AEL: 25 ppm STEL: 50 ppm IDLH: 200 ppm Skin: No	Colorless to pale yellow liquid with a pleasant aromatic odor. Air odor threshold: UN LEL: 2.2% UEL: 9.2% IP: 9.06 eV VP: 1 mm FI.P.: 151°F	INH ABS ING CON	An eye, skin, and mucous membrane irritant. May cause skin blisters and liver and kidney damage.
1,4-Dichlorobenzene (p-Dichlorobenzene) (106-46-7)	PEL: 75 ppm (C) TLV: 10 ppm AEL: 10 ppm STEL: N/E IDLH: 150 ppm (CA) Skin: No	Colorless or white crystalline solid with a mothball-like odor (insecticide). Air odor threshold: UN LEL: 2.5% UEL: N/A IP: 8.98 eV VP: 1.3 mm FI.P.: 150°F	INH ABS ING CON	Eye irritation, swelling surrounding eye, profuse runny nose, headache, anorexia, nausea, vomiting, jaundance, and liver cirrosis. Causes liver and kidney cancer in animals.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
1,1-Dichloroethane (Ethylidene chloride) (75-34-3)	PEL: 100 ppm TLV: 100 ppm AEL: N/E STEL: N/E IDLH: 3,000 ppm Skin: No	Colorless, oily liquid with a chloroform-like odor. Air odor threshold: N/D LEL: 5.4% UEL: 11.% IP: 11.06 eV VP: 182 mm FI.P: 2°F	INH ING CON	Irritation of the skin, Central Nervous System depression, liver, kidney, and lung damage.
Dichlorodifluoromethane (Halon® 122) (*Freon*® 12) (75-71-8)	PEL: 1,000 ppm TLV: 1,000 ppm AEL: N/E IDLH: 15,000 ppm Skin: No STEL: N/E	Colorless gas with a faint ether-like odor at high concentrations Air odor threshold: UN LEL: N/A UEL: UN IP: 11.75 eV VP: 5.7 atm FI.P.: N/A	INH CON	May cause dizziness, tremor, asphyxiation, cardiac arrhythmia, cardiac arrest. Contact with liquid can cause frostbite.
Dichloroethyl ether (Bis (2-chloroethyl) ether) (111-44-4)	PEL: 15 ppm (C) TLV: 5 ppm AEL: N/E STEL: 10 ppm IDLH: 100 ppm (CA) Skin: Yes	Colorless oily liquid with a chlorinated solvent-like odor. Air odor threshold: 0.1 ppm LEL: 2.7 % UEL: N/A IP: UN VP: 0.7 mm FI.P.: 131 °F	INH ING CON ABS	Irritating to the nose, throat, and respiratory system. Can cause tearing, cough, nausea, vomiting, pulmonary edema, and liver damage. Potential occupational carcinogen.
1,2-Dichloroethylene (cis and trans isomers) (Acetylene dichloride) (540-59-0)	PEL: 200 ppm TLV: 200 ppm AEL: N/E STEL: N/E IDLH: 1,000 ppm Skin: No	Colorless liquid with a slightly acrid chloroform-like odor. Air odor threshold: N/D LEL: 5.6% UEL: 12.8% IP: 9.65 eV VP: 180 - 265 mm FI.P: 36 - 39°F	INH ING CON	Symptoms include eye and liver irritation, respiratory system and central nervous system depression.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Dichlorotetrafluoroethane (Halon® 242) (*Freon*® 114) (76-14-2)	PEL: 1,000 ppm TLV: 1,000 ppm AEL: 1,000 ppm IDLH: 15,000 ppm Skin: No STEL: N/E	Colorless gas with a faint ether-like odor at high concentrations Air odor threshold: UN LEL: N/A UEL: N/A IP: 11.75 eV VP: 5.7 atm Fl.P.: UN	INH CON	Irritating to respiratory system, asphyxia, cardiac arrhythmia, cardiac arrest. Contact with liquid can cause frostbite.
Diesel Fuel (68476-30-2)	PEL: N/E TLV: 100 mg/m³ AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	Clear or light yellow liquid (may be dyed red) with an aromatic odor. Air odor threshold: UN LEL: 0.4% UEL: 6% VP: 1 mm IP: N/A Fl.P.: 130°F	INH ING CON	Irritating to the eyes, nose, throat, lungs, and skin after prolonged or repeated exposure. Extreme exposure or aspiration can cause lung damage or death. May cause weakness, headache, nausea, blurred vision, drowsiness, and other nervous system effects.
Dimethyl formamide (N,N-Dimethyl formamide) (DMF) (68-12-2)	PEL: 10 ppm TLV: 10 ppm AEL: 10 ppm STEL: N/E IDLH: 500 ppm Skin: Yes	Colorless to pale-yellow liquid with a faint, amine-like odor. Air odor threshold: 20 ppm LEL: 2.2 % UEL: 15.2% IP: 9.12 eV VP: 3 mm Fl.P.: 136°F	INH ABS ING CON	Irritating to the eyes, skin, respiratory system. Nausea, vomiting, colic, liver damage, high blood pressure, flushed face, and dermatitis may occur.
Dioxane (1,4-Dioxane) (123-91-1)	PEL: 100 ppm TLV: 20 ppm AEL: 25 ppm STEL: N/E IDLH: 500 ppm (CA) Skin: Yes	Colorless liquid or solid (below 54°F) with a mild, ether-like odor. Air odor threshold: 150 ppm LEL: 2% UEL: 22% IP: 9.13 eV VP: 29 mm Fl.P.: 55°F	INH ABS ING CON	Irritating to the eyes, skin, nose, and throat. May cause drowsiness, headache, nausea, vomiting. Causes liver damage and kidney failure. Potential occupational carcinogen.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Ethanol (Ethyl alcohol) (64-17-5)	PEL: 1000 ppm TLV: 1000 ppm AEL 1000 ppm STEL: N/E IDLH: 3300 ppm Skin: No	Clear, colorless liquid with a weak, ethereal, vinous odor. Air odor threshold: 5 ppm LEL: 3.3% UEL: 19% IP: 10.47 eV VP: 44 mm Fl.P.: 55°F	INH ING CON	Irritating to the eyes, skin, nose. Headache, drowsiness, fatigue, narcosis, cough. Liver damage, anemia, reproductive effects. Teratogen.
Ethyl acetate (Acetic ester, Ethyl ethanoate) (141-78-6)	PEL: 400 ppm TLV: 400 ppm AEL: N/E STEL: N/E IDLH: 2000 ppm Skin: No	Colorless liquid with an ether-like, fruity odor Air odor threshold: UN LEL: 2.0% UEL: 11.5% IP: 10.27 eV VP: 73 3mm Fl.P.: 24°F	INH ING CON	May cause irritation to the eyes, skin, nose, throat, narcosis, and dermatitis.
Ethyl acrylate (140-88-5)	PEL: 25 ppm TLV: 5 ppm AEL: 2 ppm STEL: 15 ppm IDLH: 300 ppm (CA) Skin: No	Colorless liquid with an acrid odor. Air odor threshold: N/A LEL: 1.4% UEL: 14% IP: 10.30 eV VP: 29 mm Fl.P.: 48°F	INH ABS ING CON	Irritating to the eyes, skin, and respiratory system. Potential occupational carcinogen.
Ethylene (Ethene) (74-85-1)	PEL: N/E TLV: Simple asphyxiant (c) AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless gas with a sweet odor. Air odor threshold: UN LEL: 2.7% UEL: 36.7% IP: N/A VP: 30000 mm Fl.P.: -213°F	INH	Acute effects include dizziness, headache, nausea, confusion, incoordination, and loss of consciousness. Chronic effects include abnormal liver function with nausea, vomiting, reduced appetitie, abdominal pain. Peripheral sight limitation.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Ethylbenzene (100-41-4)	PEL: 100 ppm TLV: 100 ppm AEL: 25 ppm STEL: 125 ppm IDLH: 800 ppm Skin: No	Colorless liquid with an aromatic odor. Air odor threshold: 2.0 ppm LEL: 0.8% UEL: 6.7% IP: 8.76 eV VP: 7 mm Fl.P.: 55°F	INH ING CON	Irritating to skin, eyes, CNS, and mucous membranes. Headache, dermatitis, narcosis, and coma may occur.
Ethyl chloride (Chloroethane) (75-00-3)	PEL: 1000 ppm TLV: 100 ppm AEL: 150 ppm STEL: N/E IDLH: 3,800 ppm Skin: Yes	Colorless gas or liquid (below 54°F) with a pungent, ether-like odor. Air odor threshold: UN LEL: 3.8% UEL: 15.4% IP: 10.97 eV VP: 1000 mm Fl.P.: -58°F (liquid) UN (Gas)	INH ING CON ABS	Symptoms may include central nervous system depression. May cause incoordination, narcosis, inebriation, abdominal cramps, cardiac arrhythmia, cardiac arrest, liver and kidney damage.
Ethylene dibromide (1,2-dichloromethane) (EDB) (106-93-4)	PEL: 20 ppm 30 ppm (C) TLV: N/E AEL: 20 ppb STEL: N/E IDLH: 100 ppm (CA) Skin: Yes	Colorless liquid or solid (below 50°F) with a sweet odor (fumigant). Air odor threshold: UN LEL: N/A UEL: N/A IP: 9.45 eV VP: 12 mm Fl.P: UN	INH ING CON ABS	Irritating to the eyes, skin and respiratory system. May cause damage to liver, heart, spleen, and kidneys. May cause skin and lung tumors and reproductive effects. Potential occupational carcinogen.
Ethylene dichloride (1,2-Dichloroethane) (EDC) (107-06-2)	PEL: 50 ppm TLV: 10 ppm AEL: 1 ppm STEL: N/E IDLH: 50 ppm (CA) Skin: No	Clear liquid with a sweet odor like chloroform. Air odor threshold: 100 ppm LEL: 6.2% UEL: 16% IP: 11.05 eV VP: 64 mm Fl.P.: 56°F	INH ING CON ABS	Symptoms include eye irritation, central nervous system depression, nausea, and vomiting. May cause narcosis and liver damage. Potential occupational carcinogen.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Fluorine (7782-41-4)	PEL: 0.1 ppm TLV: 1 ppm AEL: N/E STEL: 2 ppm IDLH: 25 ppm Skin: No	Pale yellow to greenish gas with a pungent irritating odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: 15.7 eV VP: >1 atm Fl.P.: UN	INH CON	Irritates eyes, nose, respiratory system. May cause laryneal spasms, bronchospasms, pulmonary edema, and skin burns.
Fluorotrichloromethane (Trichlorofluoromethane) (*Freon*® 11) (75-69-4)	PEL: 1,000 ppm TLV: N/A AEL: N/E STEL: 1,000 ppm (C) IDLH: 2,000 ppm Skin: No	Colorless to water-white, nearly odorless liquid or gas. Air odor threshold: UN LEL: N/A UEL: N/A IP: 11.77 eV VP: 690 mm Fl.P.: UN	INH ING CON	Incoordination, tremors, dermatitis, cardiac arrhythmia, cardiac arrest, asphyxia. Contact with liquid may cause frostbite.
Formaldehyde (Methylene oxide) (50-00-0)	PEL: 0.75 ppm 2 ppm (C) TLV: N/E AEL: 0.5 ppm STEL: 0.3 ppm (C) IDLH: 20 ppm (CA) Skin: Yes	Nearly colorless gas with a pungent, suffocating odor. Air odor threshold: 1 ppm LEL: 7.0% UEL: 73% IP: 10.88 eV VP: >1 atm Fl.P.: UN (Gas)	INH CON	Severely irritating to the eyes, nose, throat and respiratory system. Can cause coughing and bronchial spasms. Potential occupational carcinogen.
Gasoline (8006-61-9)	PEL: N/E TLV: 300 ppm AEL: N/E STEL: 500 ppm IDLH: NE (CA) Skin: No	Clear liquid with a characteristic odor. Air odor threshold: UN LEL: 1.4% UEL: 7.6% VP: 38-300 mm IP: UN Fl.P.: -45°F	INH ING CON ABS	Irritating to eyes, skin, mucous membranes, dermatitis, fatigue, blurred vision, dizziness, slurred speech, confusion, convulsions, chemical pneumonia (from aspiration). Possible CNS, liver, and kidney damage. Potential occupational carcinogen.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Heptane (n-Heptane) (142-82-5)	PEL: 500 ppm TLV: 400 ppm AEL: N/E STEL: 500 ppm IDLH: 750 ppm Skin: No	Colorless liquid with a gasoline-like odor. Air odor threshold: 200 ppm LEL: 1.05% UEL: 6.7% IP: 9.90 eV VP: 40 mm FI.P.: 25°F	INH ING CON	May cause light-headedness, giddiness, stupor, vertigo, incoordination, loss of appetite, nausea and unconsciousness. Skin contact may cause dermatitis. Aspiration of liquid may cause chemical pneumonia.
Hexafluoropropylene Oxide (428-59-1)	PEL: N/E TLV: N/E AEL: 20 ppm STEL: N/E IDLH: N/E Skin: No	Odorless, colorless gas. Unstable with heat. Polymerization may occur. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 675Kpa FI.P.: UN	INH CON	May cause labored breathing, pallor, pulmonary congestion and edema. Chronic exposure may result in kidney and liver dysfunction.
Hexane (n-Hexane) (110-54-3)	PEL: 500 ppm TLV: 50 ppm AEL: 25 ppm STEL: N/E IDLH: 1,100 ppm Skin: Yes	Colorless liquid with a gasoline like odor. Air odor threshold: UN LEL: 1.1% UEL: 7.5% IP: 10.18 eV VP: 124 mm FI.P.: -7°F	INH ING CON	Irritates eyes, nose, skin, and head. Nausea, light-headedness, numb extremities, muscle weakness, and dermatitis may also occur. May cause central nervous system depression.
1,6-Hexanedlamine (Hexamethylenediamine) (124-09-4)	PEL: N/E TLV: 0.5 ppm AEL: 1 ppm STEL: N/E IDLH: N/E Skin: No	Water-white solid with a fishy ammonia-like odor. Air odor threshold: UN LEL: 0.9% UEL: 4.1% VP: 3 mm IP: UN FI.P.: 185°F	INH ING CON ABS	May cause skin and eye burns; eye damage may result in blindness. May be absorbed through the skin. Inhalation may cause nose and throat irritation and asthma-like reactions. Ingestion may cause burns to upper gastrointestinal tract and liver damage.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
2-Hexanone (Methyl n-butyl ketone) (MBK) (591-78-6)	PEL: 100 ppm TLV: 5 ppm AEL: N/E STEL: 10 ppm IDLH: 1,600 ppm Skin: Yes	Colorless liquid with an acetone-like odor. Air odor threshold: UN LEL: N/A UEL: 8% IP: 9.34 eV VP: 11mm FI.P.: 77°F	INH ABS ING CON	Irritating to the eyes and nose. May cause dermatitis, headache, drowsiness, weakness, and paralysis.
Hexone (Methyl isobutyl ketone) 4-Methyl 2-pentanone) (MIBK) (108-10-1)	PEL: 100 ppm TLV: 50 ppm AEL: N/E STEL: 75 ppm IDLH: 500 ppm Skin: Yes	Colorless liquid with a pleasant odor. Air odor threshold: 0.5 ppm LEL: 1.2% UEL: 8% IP: 9.30 eV VP: 16mm FI.P.: 64°F	INH ING CON	Irritating to the eyes, skin, and mucous membranes. May cause headache, narcosis, coma, dermatitis, kidney and liver damage.
Hydrogen Cyanide (HCN) (74-90-8)	PEL: 10 ppm TLV: N/E AEL 5mg/ m^3 STEL: 4.7 ppm (C) IDLH: 50 ppm Skin: Yes	Colorless or pale blue liquid or gas (above 78°F) with a bitter almond-like odor. Air odor threshold: 1 ppm LEL: 5.6% UEL: 40% IP: 13.6 eV VP: 630 mm FI.P.: 0°F	INH ABS ING CON	Asphyxiation, central nervous system depression, weakness, headache, confusion, nausea, vomiting, increase rate of respiration or gasping, blood and thyroid changes.
Hydroquinonee (123-31-90)	PEL: 2 mg/m^3 TLV:: 2 mg/m^3 (Ceiling) AEL: 2 mg/m^3 STEL: NE IDLH: 50 mg/m^3 Skin: No	Light tan, light gray, or colorless crystals Air odor threshold: NA LEL: NA UEL: NA IP: 7.95 eV VP: 0.00001 mm FI.P.: 329°F	INH ING CON	Irritating to the eyes, conjunctivitis, keratitis, central nervous system excitement, discolored urine, nausea, dizziness, suffocation, rapid breathing, muscle twitching, delirium, collapse, skin irritation, sensitization, dermatitis

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Isobutyl alcohol (Isobutanol) (78-83-1)	PEL: 100ppm TLV: 50 ppm AEL: N/E STEL: N/E IDLH: 1600ppm Skin: No	Colorless oily liquid with a sweet musty odor. Air odor threshold: UN LEL: 1.7% UEL: 10.6% IP: 10.12eV VP: 9 mm FI.P.: 82°F	INH ING CON	Irritates eyes and head. Drowsiness, skin dryness, and narcosis may also occur.
Isopropyl Alcohol (Rubbing alcohol) (Isopropanol) (67-63-0)	PEL: 400 ppm TLV: 200ppm AEL 400 ppm STEL: 400 ppm IDLH: 2000 ppm Skin: No	Colorless liquid with the odor of rubbing alcohol. Air odor threshold: 50 ppm LEL: 2% UEL: 12.7% IP: 10.10 eV VP: 33 mm FI.P.: 53°F	INH ING CON	Irritating to the eyes, nose, and throat. May cause drowsiness, dizziness, headache. Contact may cause dry cracking skin.
Methane (Marsh gas, Natural gas) (74-82-8) JF	PEL: N/E TLV: Simple asphyxiant AEL N/E STEL: N/E IDLH: N/E Skin: No	Colorless, odorless gas. LEL: 5% UEL: 15% IP: UN VP: gas FI.P.: -369°	INH	An asphyxiant. Inhalation may cause headache, drowsiness, dizziness, salivation, vomiting, unconsciousness, and death.
Methanol (Methyl alcohol) (67-56-1)	PEL: 200 ppm TLV: 200 ppm AEL 200 ppm STEL: 250 ppm IDLH: 6000 ppm Skin: Yes	Colorless liquid with a characteristic pungent odor. Air odor threshold: 10 ppm LEL: 6% UEL: 36% IP: 10.84 eV VP: 96 mm FI.P.: 52°F	INH ABS ING CON	Irritating to the eyes, skin, and upper respiratory track. May cause headache, drowsiness, dizziness, vertigo, light-headedness, nausea, vomiting, and visual disturbances. May damage optic nerve causing blindness.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Methyl acetate (Methyl ethanoate) (79-20-9)	PEL: 200 ppm TLV: 200 ppm AEL: NE STEL: 250 ppm IDLH: 3100 ppm Skin: No	Colorless gas with a sweet odor. Fuel is shipped as Liquefied compressed gas. Air odor threshold: UN LEL: 3.1% UEL: 16% IP: 10.27 eV VP: 7173mm FI.P.: 14°F	INH ING CON	Irritating to eyes, nose, and throat. May cause headache, drowsiness, optic nerve atrophy, chest tightness..
Methyl chloroform (1,1,1-Trichloroethane) (TCEA) (71-55-6)	PEL: 350 ppm TLV: 350 ppm AEL: N/A STEL: 450 ppm IDLH: 700 ppm Skin: No	Colorless liquid with a mild, chloroform-like odor. Air odor threshold: 20 ppm LEL: 7.5% UEL: 12.5% IP: 11.00 eV VP: 100 mm FI.P: UN	INH ING CON	Irritating to the eyes and skin. May cause headache, central nervous system depression, poor equilibrium, cardiac arrhythmia, weakness or exhaustion, and liver damage.
Methyl Chloride Dichloromethane) (74-87-3)	PEL: 100 ppm 200 ppm (C) TLV: 50 ppm AEL 50 ppm STEL: 100 ppm IDLH: 2000 ppm (CA) Skin: Yes	Colorless liquid with a faint, sweet odor which is not noticeable at dangerous concentrations. Air odor threshold: 10 ppm LEL: 8.1% UEL: 17.4% IP: 11.28 eV VP: 5.0 atm FI.P.: UN (gas)	INH CON	Inhalation can cause dizziness, nausea, vomiting, vision disturbances, stagger, slurred speech, convulsions, coma, and liver and kidney damage. May cause reproductive and teratogenic effects. Potential occupational carcinogen. Contact with compressed liquefied compressed gas may cause frostbite.
Idomethane (Methyl iodide) (74-88-4	PEL: 5 ppm TLV: 2 ppm AEL: N/E STEL: N/E IDLH: 100 ppm (CA) Skin: Yes	Colorless liquid with a pungent ether-like odor. Air odor threshold: UN LEL: NA UEL: NA IP: 9.54 eV VP: 400 mm FI.P.: NA	INH ABS ING CON	Irritating to the eyes, skin, respiratory system, nausea, vomiting, vertigo, ataxia, slurred speech, drowsiness, and dermatitis. Animal carcinogen (lung, kidney, stomach).

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Methyl Methacrylate (Methacrylate Monomer) (80-62-6)	PEL: 100 ppm TLV: 50 ppm AEL N/E STEL: 100 ppm IDLH: 1000 ppm Skin: No	Colorless liquid with an acrid fruity odor. Air odor threshold: 0.2 ppm LEL: 1.7% UEL: 8.2% IP: 9.7 eV VP: 29 mm FI.P.: 50°F	INH ING CON	Irritating to the eyes, skin, nose, and throat. May cause dermatitis and skin sensitization.
Methyl-tert-butyl ether (MTBE) (1634-04-4)	PEL: N/E TLV: 50 ppm AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless clear liquid with a terpene-like odor. Air odor threshold: UN LEL: 1.5% UEL: 8.5% IP: 9.35 eV VP: 201 mm FI.P.: -22°F	INH ING CON	May irritate skin, eyes, nose, and throat. May cause reproductive or kidney damage. Inhalation may cause dizziness, headache, confusion, incoordination, and loss of consciousness.
Methylene chloride (Dichloromethane) (75-09-02)	PEL: 25 ppm TLV: 50 ppm AEL 50 ppm STEL: N/E IDLH: 2,300 ppm (CA) Skin: No	Colorless liquid with a chloroform-like odor. Air odor threshold: 200 ppm LEL: 13% UEL: 23% IP: 11.32 eV VP: 350 mm FI.P.: UN	INH ABS ING CON	Central nervous system depressant, an eye, skin, and respiratory tract irritant. Symptoms also include numb tingling limbs, nausea, weakness, fatigue, and drowsiness. Potential occupational carcinogen.
Pentadecafluorooctanoic Acid* (Perfluorooctanoic Acid) (PFOA) (335-67-1) ***Potential effects are based on data from structurally similar materials (Ammonium Perfluoroctanoate)**	PEL: N/E TLV: 0.01 mg/m^3 AEL 0.01 mg/m^3 STEL: N/E IDLH: N/E Skin: Yes	Waxy solid. Clear to pale yellow with a slight ammonia odor. Air odor threshold: N/A. LEL: N/A UEL: N/A IP: N/E VP: 10 mm Hg FI.P.: >100°C (212°F)	INH ABS ING CON	Skin contact may cause skin irritation with discomfort or rash. Eye contact may cause eye irritation with discomfort, tearing, or blurring of vision. Inhalation may cause irritation of the upper respiratory passages, with coughing and discomfort. Ingestion may cause gastrointestinal tract irritation.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Polyvinyl alcohol (9002-89-5	PEL: N/E TLV: N/E AEL: 10 mg/m^3 (total dust) AEL: 5 mg/m^3 (respirable dust) STEL: N/E IDLH: N/E Skin: No	White odorless granulated powder Air odor threshold: NA LEL: NA UEL: NA IP: NA VP: NA FI.P.: NA	CON	May cause skin and eye irritation
n-Propylbenzene (103-65-1)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless liquid Air odor threshold: UN LEL: UN IP: UN VP: UN FI.P.: 86 °F	INH ING CON	Irritating to the eyes, skin, and mucous membranes.
Propylene Dichloride (1,2-Dichloropropane) (78-87-5)	PEL: 75 ppm TLV: 10 ppm AEL: N/E STEL: N/E IDLH: 400 ppm(CA) Skin: No	Colorless liquid with a chloroform-like odor. Air odor threshold: UN LEL: 3.4% UEL: 14.5% IP: 10.87 eV VP: 40 mm FI.P.: 60°F	INH ABS ING CON	Irritating to the eyes, skin, and respiratory system. May cause drowsiness, light-headedness, liver/kidney damage, and CNS depression. Potential occupational carcinogen.
Propylene glycol monomethyl ether (Dowtherm®209) (107-98-2)	PEL: N/E TLV: 100 ppm AEL: N/E STEL: 150 ppm IDLH: N/E Skin: No	Clear colorless liquid with a mild ethereal odor. Air odor threshold: UN LEL: 1.6% UEL: 13.8% IP: UN VP: 12mm (77°F) FI.P.: 97°F	INH ING CON	Irritates eyes, skin, nose, and throat. Headache, nausea, lightheadedness, drowsiness, incoordination, vomiting, and diarrhea.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Pyrethrum (8003-34-7)	PEL: 5mg/m^3 TLV: 5mg/m^3 AEL: N/E STEL: N/E IDLH: 5,000 mg/m^3 Skin: No	A Pyrethrum-based pesticide with a chrysanthemum and petroleum-like odor. Viscous, clear to yellow liquid. Air odor threshold: UN LEL: N/A UEL: N/A VP: 70 mm IP: UN FI.P: UN	ABS INH CON	May cause nervous system depression, headache, vomiting, and abdominal cramps. Prolonged or repeated exposure to high concentrations may cause kidney and neural dysfunction.
Silvex (a herbicide/ester mixture) (2,4,5-TP) (1928-38-7, 93-72-1, and 4841-20-7)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless liquid. Air odor threshold: UN LEL: 1.1% UEL: 7.7% IP: UN VP: 124 mm FI.P.: -9.4°F	INH ABS ING CON	Vapors and mists may be irritating to eyes, mucous membranes, and upper respiratory tract. Can cause skin irritation and adverse reproductive effects. Exposure can cause headache, gastrointestinal disturbances, coughing, difficulty in breathing, lung irritation, chest pain, and edema. Suspected neurotoxin.
Styrene (Vinyl benzene) (100-42-5)	PEL: 100 ppm 200 ppm (C) TLV: 20 ppm AEL: 20 ppm STEL: 40 ppm IDLH: 700 ppm Skin: No	Colorless oily liquid with a sweet, floral odor. Air odor threshold: 0.05 ppm LEL: 0.9% UEL: 6.8% VP: 5 mm IP: 8.40 eV FI.P.: 88°F	ING ABS INH CON	Irritates eyes, nose, respiratory system, and central nervous system. Headache, fatigue, dizziness, confusion, weakness, and unsteady gait, defatting dermatitis, and liver damage may occur.
1,1,2,2-Tetrachloroethane (Acetylene tetrachloride) (79-34-5)	PEL: 5 ppm TLV: 1 ppm AEL: N/E STEL: N/E IDLH: 100 ppm (CA) Skin: Yes	Colorless to pale-yellow liquid with a pungent chloroform-like odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: 11.10 eV VP: 5 mm FI.P.: UN	INH ABS ING CON	An irritant to the eyes, upper respiratory tract, and mucous membranes. Can cause dermatitis, abdominal pain, jaundice, hepatitis, liver and kidney damage. Potential occupational carcinogen.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Tetrachloroethylene (Perchloroethylene) (PCE) (127-18-4)	PEL: 100 ppm 200 ppm (C) TLV: 25 ppm AEL: 25 ppm STEL: 100 ppm IDLH: 150 ppm (CA) Skin: No	Colorless liquid with a mild chloroform-like odor. Air odor threshold: 500 ppm LEL: N/A UEL: N/A IP: 9.32 eV VP: 14 mm FI.P.: UN	INH ABS ING CON	Eye, nose, and throat irritant. May cause nausea and flushness to face and neck, dizziness, and uncoordination. Potential occupational carcinogen.
Tetrahydrofuran (Diethylene oxide) (THF) (109-99-9)	PEL: 200 ppm TLV: 50 ppm AEL: 50 ppm STEL: 100 ppm IDLH: 2,000 ppm Skin: Yes	Colorless liquid with an ether-like odor. Air odor threshold: UN LEL: 2.0% UEL: 11.8% IP: 9.45 eV VP: 132 mm FI.P.: 6°F	INH ING CON	Irritation to the eyes and respiratory system. May cause nausea, dizziness, headache, and central nervous system depression.
Toluene (Methyl benzene) (108-88-3)	PEL: 200 ppm 300 ppm (C) TLV: 20 ppm AEL: 50 ppm STEL: N/E IDLH: 500 ppm Skin: No	Colorless liquid with a sweet pungent benzene-like odor. Air odor threshold: 2 ppm LEL: 1.1% UEL: 7.1% IP: 8.82 eV VP: 21 mm FI.P.: 40°F	INH ABS ING CON	A skin and eye irritant. Symptoms include central nervous system effects. May cause impairment of coordination, fatigue, headache, dizziness, weakness, dilated pupils, liver and kidney damage.
1,1,2-Trichloro-1,2,2-trifluoroethane (*Freon*® 113) (76-13-1)	PEL: 1,000 ppm TLV: 1,000 ppm AEL: N/E STEL: 1,250 ppm IDLH: 2,000 ppm Skin: No	Colorless to water-white liquid with an odor like carbon tetrachloride at high concentrations. Air odor threshold: N/A LEL: N/A UEL: N/A IP: 11.99 eV VP: 285 mm FI.P.: UN	INH ING CON	Irritant to skin and throat. Drowsiness, dermatitis, CNS depression, cardiac arrhythmia, and narcosis may occur.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
2,3,4-Trichlorobutene –1 (TCB) (2431-50-70)	PEL: N/E TLV: N/E AEL: 0.025 ppm (CA) STEL: N/E IDLH: N/E Skin: No	Colorless flammable liquid. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 2 mm Fl.P.: UN	INH ING CON	May cause nausea, headache, and weakness upon inhalation. Lung irritation with cough, shortness of breath, and discomfort. Prolonged exposures may lead to chronic lung disorders. Causes skin, eye, and throat irritation. Prolonged skin contact may produce burns and ulceration. DuPont potential carcinogen.
1,1,2-Trichloroethane (Ethane trichloride) (79-00-5)	PEL: 10 ppm TLV: 10 ppm AEL: N/E STEL: N/E IDLH: 100 ppm (CA) Skin: Yes	Colorless liquid with a sweet, chloroform-like odor. Air odor threshold: UN LEL: 6% UEL: 15.5% IP: 11.00 eV VP: 19 mm Fl.P.: UN	INH ING CON ABS	Irritation to the syes and nose. Central nervous system depression. Can damage the liver and kidney and has caused liver cancer in animals.
Trichloroethene (Trichloroethylene) (TCE) (79-01-6)	PEL: 100 ppm 200 ppm (C) TLV: 10 ppm AEL: 10 ppm STEL: 25 ppm IDLH: 1,000 ppm (CA) Skin: No	Colorless liquid, unless dyed, with a sweet chloroform like odor. Air odor threshold: 20 ppm LEL: 8.0% UEL: 10.5% IP: 9.45 eV VP: 58 mm Fl.P.: UN	INH ABS ING CON	Irritant to eyes and skin. May cause headache, nausea, vomiting, fatigue, weakness, cardiac arrhythmia, and liver damage. Potential occupational carcinogen.
2,4,5-Trichlorophenocyacetic acid (2,4,5-T) (93-76-5)	PEL: 10 mg/m^3 TLV: 10 mg/m^3 AEL: N/E STEL: N/E IDLH: 250 mg/m^3 Skin: No	Colorless crystalline odorless solid. Air odor threshold: N/A LEL: N/A UEL: UN VP: N/A Fl.P.: N/A	INH ING CON	May cause skin and eye irritation. Irritating to mucous membranes. Can cause skin burns. Respiratory tract irritation. Can also cause gastrointestinal tract disturbances, live damage, allergic skin reaction and nervous system injury.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
1,2,3-Trichloropropane (Allyl trichloride) (96-18-4)	PEL: 50 ppm TLV: 10 ppm AEL: N/E STEL: N/E IDLH: 100 ppm (CA) Skin: Yes	Colorless liquid with a chloroform-like odor. Air odor threshold: N/A LEL: 3.2% UEL: 12.6% IP: UN VP: 3 mm Fl.P.: 160°F	INH ABS ING CON	Irritating to the eyes, skin, nose, and throat. May also cause CNS depression. Potential occupational carcinogen.
1,2,3-Trimethyl benzene (Hemelitol) (526-73-8)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No NTOSH: 25 ppm	Clear, colorless liquid with a distinctive aromatic odor. Air odor threshold: UN LEL: 0.8% UEL: 6.6% IP: 8.48 eV VP: 1 mm (62°F) Fl.P.: UN	INH ING CON	Irritating to eyes, skin, nose, throat, and respiratory system. Bronchitis, hypochronic anemia, headache, drowsiness, fatigue, dizziness, nausea, incoordination, vomiting, confusion, and chemical pneumonia may also occur.
1,2,4-Trimethyl benzene (psi-cumene, Pseudocumene) (95-63-6)	PEL: N/E TLV: N/E AEL: N/E NIOSH: 25 ppm IDLH: N/E Skin: No	Clear, colorless liquid with a distinctive aromatic odor. Air odor threshold: UN LEL: 0.9% UEL: 6.4% IP: 8.27 eV VP: 1 mm (56°F) Fl.P.: 112°F	INH ING CON	Irritating to eyes, skin, nose, and respiratory system. Bronchitis, hypochronic anemia, headache, drowsiness, fatigue, dizziness, nausea, incoordination, vomiting, confusion, and chemical pneumonia may also occur.
1,2,5-Trimethyl benzene (Mesitylene) (108-67-8)	PEL: N/E TLV: N/E AEL: N/E NIOSH: 25 ppm IDLH: N/E Skin: No	Clear, colorless liquid. Air odor threshold: UN LEL: 0.9% UEL: 6.4% IP: 8.27 eV VP: 2.49 mm (55°F) Fl.P.: 112°F	INH ING CON	Irritating to eyes, skin, nose, and respiratory system. Bronchitis, hypochronic anemia, headache, drowsiness, fatigue, dizziness, nausea, incoordination, vomiting, confusion, and chemical pneumonia may also occur.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Vinyl acetate (108-05-4)	PEL: N/A TLV: 10 ppm AEL: 10 ppm STEL: 15 ppm IDLH: (CA) Skin: No	Colorless liquid with an acrid, ester-like odor. Air odor threshold: 0.11 ppm LEL: 2.6% UEL: 13.4% IP: UN VP: UN Fl.P.: 16°F	INH ABS ING CON	Severe eye irritant. May cause irritation and defatting of skin. Upper respiratory tract irritant, nausea, headache, or weakness upon inhlation. Carcinogen in animals.
Vinyl chloride (Chloroethene) (75-01-4)	PEL: 1 ppm 5 ppm (C) TLV: 1 ppm AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless gas or liquid with a pleasant odor at high concentrations. Air odor threshold: UN LEL: 3.6% UEL: 33.0% IP: 9.99 eV VP: 3.3 atm Fl.P.: UN (Gas)	INH CON	Confirmed human carcinogen. May be a severe irritant to skin, eyes, and mucous membranes. Symptoms include weakness, gastrointestinal bleeding, cyanosis of extremities, and enlarged liver.
Vinylidene chloride (1,1-Dichloroethene) (75-35-4)	PEL: N/E TLV: 5 ppm AEL: 5 ppm STEL: N/A IDLH: (CA) Skin: No	Colorless gas or liquid with a mild, sweet, chloroform-like odor. Air odor threshold: UN LEL: 6.5% UEL: 15.5% IP: 10.00 eV VP: 500 mm Fl.P.: -2°F	INH ABS ING CON	Irritating to the eyes, skin, throat. May cause dizziness, headache, nausea, breathing difficulty, liver and kidney disfunction. Potential occupational carcinogen.
o- m- p-Xylene (1330-20-7)	PEL: 100 ppm TLV: 100 ppm AEL: 100 ppm STEL: 150 ppm IDLH: 900 ppm Skin: No	Colorless liquid with aromatic odor. Air odor threshold: 0.5 ppm LEL: 0.9-1.1% UEL: 6.7-7.0% IP: 8.44 - 8.56 eV VP: 7-9 mm Fl.P.: 81-90°F	INH ABS ING CON	Narcotic at high concentrations. May cause vomiting and abdominal pain. Irritating to eyes, skin, nose, and throat.
SEMI-VOLATILE ORGANIC COMPOUNDS				

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Acetophenone (98-86-2)	PEL: N/E TLV: 10 ppm AEL: 1 ppm STEL: N/E IDLH: 100 ppm Skin: No	Colorless liquid with a sweet pungent odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 0.33 mm Fl.P.: 180°F	INH ING CON	A CNS depressant with anesthetic effects. May cause headache, dizziness, confusion, and loss of consciousness. Skin contact may cause rash, skin burns, or ulceration. Eye irritant may cause ulceration.
Acrylamide (2-Propenamide) (79-06-1)	PEL: 0.3 mg/m^3 TLV: 0.03 mg/m^3 AEL: N/E STEL: N/E IDLH: 60 mg/m^3(CA) Skin: Yes	White crystalline odorless solid. Air odor threshold: N/A LEL: N/A UEL: UN IP: 9.50 eV VP: 0.007 mm Fl.P.: 280°F	INH ABS ING CON	Irritating to eyes, skin, ataxia, numbness of limbs, paresthesia, muscle weakness, absence of deep tendon reflex, hand sweating, fatigue, and reproductive effects may occur. Potential occupational carcinogen.
Adiponitrile (1,4-Dicyanobutane) (111-69-3)	PEL: N/E TLV: 2 ppm AEL: 2 ppm STEL: N/E IDLH: N/E Skin: Yes	Water-white practically odorless, oily liquid. Air odor threshold: UN LEL: 1.7% UEL: 5.0% IP: UN VP: 0.002 mm Fl.P.: 199°F	INH ABS ING CON	Irritating to the eyes, skin, and respiratory system. May cause headache, dizziness, weakness, giddiness, confusion, convulsions, blurred vision, shortness of breath, abdominal pain, nausea, and vomiting. Exposure to Adiponitrile can metabolize to cyanide.
4-Aminodiphenyl (4-Aminodiphenyl) (4-ADP) (92-67-1)	PEL: No contact TLV: A1 AEL: No contact STEL: N/E IDLH: N/E Skin: Yes	Colorless crystalline solid Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 0.000024 mm Fl.P.: UN	INH ABS ING CON	Overexposure may cause methemoglobinemia, headache, weakness, or cyanosis, dizziness, incoordination, shortness of breath, increased pulse, and bladder cancer. Symptoms may be delayed.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Aldrin (Octalene) (309-00-2)	PEL: 0.25 mg/m^3 TLV: 0.05 mg/m^3 AEL: N/E STEL: N/E IDLH: 25 mg/m^3(CA) Skin: Yes	Colorless to dark brown crystalline solid with a mild chemical odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 8.0 X10^{-5}mm or .00008nm Fl.P.: UN	INH ABS ING CON	Headache, dizziness, nausea, vomiting, malaise, jerking limbs, convulsions, coma. Tumors of lungs, liver, thyroid and adrenal glands. Potential occupational carcinogen.
Aniline (Aminobenzene) (62-53-3)	PEL: 5 ppm TLV: 2 ppm AEL: 2 ppm STEL: N/E IDLH: 100 ppm (CA) Skin: Yes	Colorless to brown oily liquid with an aromatic amine-like odor. Air odor threshold: 1.0 ppm LEL: 1.3% UEL: 11% IP: 7.70 eV VP: 0.6 mm Fl.P.: 158°F	INH ABS ING CON	Causes headache, weakness, and dizziness. An eye and skin irritant. Can cause cyanosis, breathing difficulty, tachycardia, and methemoglobinemia. Potential occupational carcinogen.
Benzyl alcohol (100-51-6)	PEL: N/E TLV: N/E AEL: 10 ppm STEL: N/E IDLH: N/A Skin: No	Clear, colorless liquid with a faint aromatic odor. Air odor threshold: N/A LEL: 1.5% UEL: 13% IP: UN VP: 0.15 mm Fl.P.: 194°F	INH ABS CON ING	An eye, skin, nose, and throat irritant. May cause allergic skin rashes. Ingestion or absorption may cause nausea, weakness, headache, dizziness, confusion, incoordination, and loss of consciousness. Eye contact may cause irritation, tearing, and blurring of vision.
Benzoic Acid (65-85-0)	PEL: 15 mg/m^3 TLV: N/E AEL: 10 mg/m^3 STEL: N/E IDLH: N/E Skin: No	White to tan crystal or powder with a stale perfume-like, faint pleasant odor. Air odor threshold: N/A LEL: N/A UEL: N/A IP: UN VP: 0.02 mm Fl.P: 480°F	INH CON ING	Skin, eye, nose, and throat irritant. May cause asthma-like reactions. Ingestion may cause nausea, headache, weakness, and gastrointestinal tract irritation. Eye contact may cause irritation, tearing, and blurring of vision.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Biphenyl (Diphenyl) (92-52-4)	PEL: 0.2 ppm TLV: 0.2 ppm AEL: 0.2 ppm STEL: N/E IDLH: 100 mg/m^3 Skin: No	Colorless to pale yellow solid with a pleasant characteristic odor (fungicide). LEL: 0.6% (232 °F) UEL: 5.8% (311 °F) IP: 7.95 eV VP: UN Fl.P.: 235°F	INH ABS ING CON	Irritating to eyes and throat. Can cause headache, nausea, fatigue, numbness of limbs and liver damage.
Bladex® Herbicide (Cyanazine) (21725-46-2)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	Off-white liquid suspension pesticide. Air odor threshold: UN LEL: N/A UEL: N/A VP: UN IP: UN Fl.P.: UN	ING ABS INH CON	Irritating to the eyes. Slightly irritating to the skin. Toxic by ingestion may produce gastrointestinal irritation. May cause irritation to the nose, throat, and respiratory track.
Butyl benzyl phthalate (85-68-7)	PEL: N/E TLV: N/E AEL: 5 mg/m^3 STEL: N/E IDLH: N/E Skin: No	Clear and oily liquid. LEL: N/A UEL: N/A VP: UN IP: UN Fl.P.: UN	INH ING	Moderately toxic by inhalation and intraperitoneal routes.
4-chloroaniline (p-chloroaniline) (106-47-8)	PEL: N/E TLV: N/E AEL: 0.5 mg/m^3 STEL: N/E IDLH N/E Skin: Yes* * As per DuPont	White or pale yellow crystalline solid that darkens with storage or exposure to air. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 0.15 mm Fl.P.: UN	INH ING CON ABS	May cause skin irritation or allergic skin rash; or eye irritation with discomfort, tearing, or blurring of vision. May reduce the blood's oxygen carrying capacity causing cyanosis, weakness, or shortness of breath, or abnormal blood forming system function with anemia. Skin permeation can occur in amounts capable of producing systemic toxicity. Potential human carcinogen as per DuPont.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Cresol (all isomers o-m-p) (1319-77-3)	PEL: 5 ppm TLV: 5 ppm AEL: 5 ppm STEL: N/E IDLH: 250 ppm Skin: Yes	White crystals, solid or colorless to yellowish liquid with a sweet tarry odor. Air odor threshold: UN LEL: 1.1 - 1.4% UEL: N/A IP: 8.93 - 8.98 eV VP: 0.11 - 0.29 mm Fl.P.: 178-187°F	INH ABS ING CON	Irritating to the eyes, skin, and mucous membranes. CNS effects include confusion, depression, respiratory failure, shortness of breath, irregular rapid respiration and weak pulse. Contact can cause eye and skin burns including dermatitis. May also cause lung, liver, kidney, and pancreatic damage.
o-Cresol (2,methyl phenol) (95-48-7)	PEL: 5 ppm TLV: 5 ppm AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	White crystals with a sweet, tarry odor. Air odor threshold: UN LEL: >230 F IP: 8.93 eV VP: 0.29 mmHg Fl.P.: 178°F	INH ABS ING CON	Irritation eyes, skin, mucous membrane; central nervous system effects: confusion, depression, respiratory failure; dyspnea (breathing difficulty), irregular rapid respiration, weak pulse; eye, skin burns; dermatitis; lung, liver, kidney, pancreas damage.
1,2-Dibromo-3-chloropropane (1-Chloro-2,3-dibromopropane) (DBCP) (96-12-8))	PEL: 0.001 ppm TLV: N/E (CA) AEL: N/E STEL: N/E IDLH: N/E Skin: No	Dense yellow or amber liquid with a pungent odor at high concentrations (pesticide) Air odor threshold: UN LEL: ? UEL: ? IP: ? VP: 0.08 mm Fl.P.: 170°F	INH ABS ING CON	Irritating to the eyes, skin, nose, throat, drowsiness, nausea, vomiting, pulmonary edema, liver and kidney injury, and male sterility. Potential human carcinogen.
2,4-Dichlorophenoxyacetic acid (2,4-D) (94-75-7)	PEL: 10 mg/m^3 TLV: 10 mg/m^3 AEL: N/E STEL: N/E IDLH: 100 mg/m^3 Skin: No	White to yellow crystalline solid LEL: N/A UEL: N/A IP: UN VP: 0.4 mm Fl.P.: UN	INH ING CON	Irritating to the skin or eyes, weakness, stupor, muscle twitching, convulsions, dermatitis, may cause liver and kidney cancer

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
DDT (Dichlorodiphenyltrichloroethane) (50-29-3)	PEL: 1.0 mg/m^3 TLV: 1.0 mg/m^3 AEL: N/E STEL: N/E IDLH: 500 mg/m^3(CA) Skin: No	Colorless crystals or off-white powder with a slight aromatic odor (pesticide). Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 2.0 x 10^{-7} mm Fl.P.: 162-171°F	INH ABS ING CON	Irritating to eyes and skin. Paresthesic to tongue, lips, and face. Tremor, apprehension, confusion, dizziness, malaise, headache, fatigue, convulsions, paresthesia of hands. Lung, liver, and lymphatic tumors may occur. Potential occupational carcinogen.
Dibutyl phthalate (Di-n-butyl phthalate) (84-74-2)	PEL: 5 mg/m^3 TLV: 5 mg/m^3 AEL: 5 mg/m^3 STEL: N/E IDLH 4,000 mg/m^3 SKIN: No	Colorless to faint yellow oily liquid with a slight aromatic odor. Air odor threshold: UN LEL: 0.5% UEL: N/A IP: UN VP: 7 x 10^{-5} mm Fl.P.: 315°F	INH ING CON	Irritates eyes, upper respiratory system, and stomach.
1,2 Dichlorobenzene (o-Dichlorobenzene) (95-50-1)	PEL: 50 ppm (CA) TLV: 25 ppm AEL: 25 ppm STEL: 50 ppm IDLH: 200 ppm Skin: No	Colorless to pale yellow liquid with a pleasant aromatic odor. LEL: 2.2% UEL: 9.2% IP: 9.06 eV VP: 1 mm Fl.P.: 151°F	INH ABS ING CON	An eye, skin and mucous membrane irritant. May cause skin blisters and liver and kidney damage.
1,3-Dichlorobenzene (541-73-1)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: N/E	Colorless liquid. Air odor threshold: UN LEL: N/A UEL: N/A Fl.P.: UN I.P.: UN V.P.: UN	INH ABS ING CON	Symptoms of exposure may include skin irritation and sensitization. Nausea, headache, weakness, confusion, dizziness, incoordination. Abnormal liver and kidney function may occur.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
1,4 Dichlorobenzene (p-Dichlorobenzene) (106-46-7)	PEL: 75 ppm (C) TLV: 10 ppm AEL: N/E STEL: N/E IDLH: 150 ppm (CA) Skin: No	Colorless or white crystalline solid with a mothball-like odor. LEL:2.5% UEL: N/A IP: 8.98 eV VP: 1.3 mm FI.P.: 150°F	INH ABS ING CON	Eye irritation, swelling surrounding eye, profuse runny nose, headache, anorexia, nausea, vomiting, low-weight, jaundice, liver cirrosis; causes liver and kidney cancer in animals.
Dieldrin (HEOD) (60-57-1)	PEL: 0.25 mg/m^3 TLV: 0.25 mg/m^3 AEL: N/E STEL: N/E IDLH: 50 mg/m^3(CA) Skin: Yes	Colorless to light tan crystals with a mild chemical odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 8 x 10^{-7}mm (77°F) FI.P.: UN	INH ABS ING CON	Headache, dizziness, nausea, vomiting, sweating, limb jerks, convulsions, and coma. May cause tumors of the liver, kidneys, thyroid, and adrenal glands. Potential occupational carcinogen.
Diphenylamine DPA (122-39-4)	PEL: N/E TLV: 10mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: No	Appearance and Odor: Pale, tan flake or chips which darkens with storage; amine odor Solubility: insoluble in water Soluble in hydrocarbon solvents Melting Pont: 125°F (52°C) Boiling Point: 575°F (302° C) Specific Gravity (H2O=1): 1.16 soild; 1.05 liquid Vapor Pressure@ 20°C ND: @ 108°C: 1mmHg Vapor Density (Air=1): NA Volatility @ 70°F: Lov LEL: N/Æ FI.P.: 81-90°	INH CON	Contact with mucous membranes can cause irritation. Overexposure can cause methemoglobinemia and red blood cell damage. Human experience has shown this material to cause respiratory irritation. DPA has been shown to cause liver and kidney damage in animals.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Dimethyl Terephthalate (DMT) (120-61-6)	PEL: N/E TLV: N/E AEL: 10 mg/m^3 (total dust) AEL: 5 mg/m^3 (respirable dust) STEL: N/E IDLH N/E Skin: No	White, colorless solid at ambient temperature with a faint ester-like odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 9 mm (288°F) FI.P.: 307°F	INH CON	Inhalation may cause irritation of nose and throat with sneezing, sore throat, or runny nose. Skin contact may cause irritation. Eye contact may cause eye irritation.
Dinitro-o-cresol (2-methyl-4,6-dinitrophenol) (534-52-1)	PEL: 0.2 mg/m^3 TLV: 0.2 mg/m^3 AEL: N/E STEL: N/E IDLH: 5 mg/m^3 Skin: Yes	Yellow, olorless solid. Insecticide. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 0.00005 mm FI.P: UN	INH ABS CON ING	Acute exposure can cause nausea, vomiting, stomach upset, sensation of heat, flushed skin, sweating, rapid breathing. May cause cyanosis and shortness of breath. Skin damage upon contact. Mutagen.
Dinitrotoluene (DNT) (25321-14-6) *AEL listed for 2,4-Dinitrotoluene	PEL: 1.5 mg/m^3 TLV: 0.2 mg/m^3 AEL: *0.15 mg/m^3 STEL: N/E IDLH: 50 mg/m^3(CA) Skin: Yes	Yellowish tan, crystalline solid with distinct aromatic odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 1 mm FI.P.: 404°F	INH ABS CON ING	Eye or skin contact may cause irritation. May cause allergic rash. Inhalation may cause nausea, headache, weakness, dizziness, confusion, joint pain, methemoglobinemia, abnormal liver function. Potential occupational carcinogen.
Diphenyl oxide (Phenyl ether) vapor (Biphenyl ether) (73% component of Dowtherm A®) (101-84-8)	PEL: 1 ppm TLV: 1 ppm AEL: 1 ppm STEL: 2 ppm IDLH: 100 ppm Skin: No	Colorless, crystalline solid or liquid (above 82°F) with a geranium-like odor. Air odor threshold: UN LEL: 0.7% UEL: 6.0 % IP: 8.09 eV VP: 0.02 mm FI.P.: 239°F	INH CON	Irritating to the eyes, nose, and skin. May cause nausea.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Dimethyl phthalate (DMP) (131-11-3)	PEL: 5 mg/m^3 TLV: 5 mg/m^3 AEL: N/E STEL: N/E IDLH 2,000 mg/m^3 Skin: No	Colorless, oily liquid with a slight, aromatic odor. Air odor threshold: UN LEL: 0.9% (358°F) UEL: N/A IP: 9.64 eV VP: 0.01 mm FI.P.: 295°F	INH ING CON	Symptoms include skin, eye, upper respiratory irritation, and stomach pain.
Di-sec-octyl phthalate (Di(2-ethylhexyl)phthalate) (DEHP) bis -(2 ethyl hexyl)phthalate (117-81-7)	PEL: 5 mg/m^3 TLV: 5 mg/m^3 AEL: 1 mg/m^3 STEL: N/E IDLH: 5,000 mg/m^3(CA) Skin: No	Colorless, oily liquid with a slight odor. Air odor threshold: UN LEL: 0.3% (474˚F) UEL: N/A IP: UN VP: <0.01 mm FI.P: 420˚F	INH CON ING	A skin, eye, and mucus membrane irritant. Affects the human gastrointestinal tract. Potential occupational carcinogen.
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate (Naled) (300-76-5) Note: Dibrom® is comprised of 85% naled and 15% inert ingredients	PEL: 3 mg/m^3 TLV: 0.1 mg/m^3 (I,V) AEL: N/E STEL: N/E IDLH: 200 mg/m^3 Skin: Yes	Colorless to white solid or straw-colored liquid with a slightly pungent odor (insecticide). Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 0.0002 mm FI.P.: UN	INH ABS ING CON	Irritating to the eyes, and skin. Causes tearing, headache, chest tightness, wheezing, laryngeal spasms, salivation, cyanosis, anorexia, nausea, vomiting, abdominal cramping, diarrhea, weakness, twitching, giddiness, convulsions, low blood pressure, cardiac irregularity, and increased sensitivity.
2,4-Dinitrophenol (51-28-5)	PEL: 15 mg/m^3 TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	Yellowish crystalline paste with a sweet odor. Material is unstable with heat and shock causing explosion. Air odor threshold: UN LEL: N/A UEL: N/A VP: UN IP: UN FI.P.: UN	INH ABS ING CON	May cause skin and eye irritation including dermatitis and cataracts. Irritating to mucous membranes and upper respiratory tract. Disrupts metabolism causing nausea, vomiting, anorexia, weakness, dizziness, vertigo, headache, and sweating.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Endosulfan (Thiodan®) (115-29-7)	PEL: N/E TLV: 0.1 mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	Brown crystals with a slight sulfur dioxide odor (insecticide). Air odor threshold: UN LEL: N/A UEL: N/A VP: 1 x 10^{-5}mm IP: UN FI.P.: UN	INH ABS ING CON	Irritating to skin. Nausea, confusion, headache, dry mouth, tremor, convulsions, headache.
Endrin (Hexadrin®) (72-20-8)	PEL: 0.1 mg/m^3 TLV: 0.1 mg/m^3 AEL: N/E STEL: N/E IDLH: 2 mg/m^3 Skin: Yes	Colorless to tan crystalline solid with a mild chemical odor (insecticide). Air odor threshold: UN LEL: N/A UEL: N/A VP: Low IP: UN FI.P.: UN	INH ABS INH CON	Epilepsy, confusion, stupor, headache, dizziness, abdominal discomfort, nausea, vomiting, insomnia, aggressiveness, lethargy, weakness, and anorexia.
Ethylene glycol (Antifreeze) (107-21-1)	PEL: N/E TLV: N/E AEL: 50 ppm STEL: 100 mg/m^3(C) IDLH: N/E Skin: No	Clear colorless syrupy odorless liquid. LEL: 3.2% UEL: 15.3% VP: 0.06 mm IP: UN FI.P.: 232°F	INH ING CON	Irritating to the eyes, skin, nose, and throat. Ingestion may cause nausea, vomiting, abdominal pain, weakness, dizziness, stupor, convulsions, and CNS depression.
Heptachlor (76-44-8)	PEL: 0.5 mg/m^3 TLV: 0.05 mg/m^3 AEL: N/E STEL: N/E IDLH: 35 mg/m^3(CA) Skin: Yes	White to light tan crystals with a camphor-like odor (insecticide). Air odor threshold: UN LEL: N/A UEL: N/A VP: 3.0 X 10^{-4} mm (77°F) IP: UN FI.P.: UN	INH ABS INH CON	CNS effects include tremors and convulsions. Potential occupational carcinogen.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Hexachlorobenzene (118-74-1)	PEL: 15 mg/m^3 TLV: 0.002 mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	White, needle-like solid. Combustible. LEL: N/A UEL: N/A VP: 0.0000123 mm IP: UN Fl.P.: 468°F	INH ING CON	Irritating to the nasal passages and decreased sense of smell. Skin irritation. Restlessness, loss of appetite, increased liver and kidney weights, twitching of skin, chemical porphria. Light sensitivity, excessive color and hair growth, red or dark brown urine. Arthritis in fingers and toes.
Isophorone (78-59-1)	PEL: 25 ppm TLV: N/E AEL: N/E STEL: 5 ppm (C) IDLH: 200 ppm Skin: No	Colorless to white liquid with a peppermint-like odor. Air odor threshold: UN LEL: 0.8% UEL: 3.8% IP: 9.07 eV VP: 0.3 mm Fl.P.: 184°F	INH ING CON	Symptoms include eye, skin, and throat irritation, nausea, dizziness, fatigue, headache and narcosis.
Lindane (BHC) (58-89-9)	PEL: 0.5 mg/m^3 TLV: 0.5 mg/m^3 AEL: N/E STEL: N/E IDLH: 50 mg/m^3 Skin: Yes	White to yellow crystalline powder with a slight musty odor. (pesticide) Air odor threshold: UN LEL: N/A UEL: N/A VP: 1 x 10^{-5}mm IP: UN Fl.P.: UN	INH ABS INH CON	Irritating to eyes, skin, nose, and throat. Headache, nausea, chronic convulsions, respiratory difficulty, cyanosis, aplastic anemia, and muscle spasms.
Methomyl (Lannate®) (16752-77-5)	PEL: N/E NIOSH: 2.5 mg/m^3 TLV: 2.5 mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	White, crystalline solid with a slight, sulfur like odor.. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 0000.5 mm Fl.P.: NAF	INH ABS ING CON	Irritating to the eyes, blurred vision, miosis, salivation, abdominal cramps, nausea, vomiting, weakness, muscle twitching, liver and kidney damage.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Methyl Parathion (Axophos®, parathion methyl) (298-00-0)	PEL: N/E NIOSH: 0.2 mg/m^3 TLV: 0.2 mg/m^3 AEL: N/E STEL: N/E IDLH: 10 mg/m^3 Skin: Yes	White to tan, crystalline solid or powder with a pungent, garlic-like odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 1.0 X 10^{-5} mm Fl.P.: 392°F	INH ABS ING CON	Irritating to eyes, skin, nausea, vomiting, cramps, diarrhea, salivation, headache, giddiness, vertigo, weakness, chest tightness, blurred vision.
Malathion (121-75-5)	PEL: 15 mg/m^3 NIOSH: 10 mg/m^3 TLV: 1 mg/m^3 (I,V) AEL: N/E STEL: N/E IDLH: 250 mg/m^3 Skin: Yes	Deep brown to yellow liquid with a garlic-like odor (insecticide). Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 4.0 X 10^{-5} mm Fl.P: > 325°F	INH ABS ING CON	Irritating to the eyes, skin, miosis, aching eyes, blurred vision, tearing, salivation, anorexia, nausea, vomiting, abdominal cramps, diarrhea, dizziness, confusion, chest tightness, and wheezing.
Methoxychlor (Methoxy-DDT) (DMDT) (72-43-5)	PEL: 15 mg/m^3 TLV: 10mg/m^3 AEL: N/E STEL: N/E IDLH: 5000 mg/m^3(CA) Skin: No	Colorless to light yellow crystals with a slight fruity odor (insecticide). Air odor threshold: UN LEL: N/A UEL: N/A VP: very low IP: UN Fl.P.: UN	INH INH	In animal testing: fasciculation, trembling, convulsions, kidney and liver damage. Potential occupational carcinogen.
Naphtha (Coal tar) (8030-30-6)	PEL: 100 ppm TLV: N/E AEL: N/E STEL: N/E IDLH: 1000 ppm Skin: No	Reddish-brown mobile liquid with an aromatic odor. Air odor threshold: UN LEL: 1% UEL: N/A IP: UN VP: < 5 mm Fl.P.: 100–109°F	INH ING CON	Irritating to the eyes, skin, and nose. Light headedness, drowsiness, and dermatitis may occur.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Naphthalene (White-tar) (91-20-3)	PEL: 10 ppm TLV: 10 ppm AEL: 0.1 ppm STEL: 15 ppm IDLH: 250 ppm Skin: Yes	Colorless to a brown solid with an odor of mothballs. Air odor threshold: 0.3 ppm LEL: 0.9% UEL: 5.9% IP: 8.12 eV VP: 0.08 mm Fl.P.: 174°F	INH ABS ING CON	An eye and skin irritant. Can cause nausea, headache, fever, anemia, liver damage, vomiting, convulsions, and coma.
1-Naphthylamine (134-32-7)	PEL: N/E (CA) TLV: N/E AEL: N/E STEL: N/E IDLH: CA Skin: N/E	Colorless crystals with an ammonia-like odor. LEL: UN UEL: UN IP: 7.30 eV VP: 1 mm Fl.P.: 315°F	INH ABS ING CON	Dermatitis, hemorrhagic cystitis, breathing difficulty, failure of muscle coordination, methemoglobinemia, blood in urine, painful or difficult urination, carcinogen.
2-Naphthylamine (91-59-8)	PEL: N/E (CA) TLV: N/E AEL: 4 µg/m^3 STEL: N/E IDLH: CA Skin: No	Odorless, white to red crystals with a faint aromatic odor. LEL: UN UEL: UN IP: 9.71 eV VP: 1 mm Fl.P.: 315°F	INH ABS ING CON	Dermatitis, hemorrhagic cystitis, breathing difficulty, failure of muscle coordination, methemoglobinemia, blood in urine, painful or difficult urination, carcinogen.
4-Nitroaniline (para-nitroaniline) (100-01-6)	PEL: 1 ppm TLV: 3 mg/m^3 AEL: 3 mg/m^3 STEL: N/E IDLH: 300 mg/m^3 Skin: Yes	A yellow solid, crystals, or powder. May be odorless or have a slight ammonia-like odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: 8.85 eV VP: 2 x 10^{-5} mm Fl.P.: 390°F	INH ING CON ABS	May be fatal if swallowed, inhaled, or absorbed through skin. Causes methemoglobinemia (changes in red blood cells), cyanosis, headache, weakness, irritability, drowsiness, shortness of breath, and unconsciousness.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Nitrobenzene (98-95-3)	PEL: 1 ppm (5mg/m^3) TLV: 1 ppm AEL: 0.1 ppm STEL: N/E IDLH: 200 ppm Skin: Yes	Yellow, oily liquid with a pungent odor like paste shoe polish. Air odor threshold: 0.005 ppm LEL: 1.8% (200°F) UEL: N/A IP: 9.92 eV VP: 0.3 mm Fl.P.: 190°F	INH ABS ING CON	Causes irritation to the eyes and skin. Anoxia, dermatitis, and anemia may also occur.
m-Nitrophenol (3-Nitrophenol) (554-84-7)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: N/E	Light yellow crystalline solid. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: UN Fl.P.: UN	INH ING CON	Causes skin irritation, severe eye irritation, and irritation to the mucous membranes and upper respiratory tract. Effects may vary form mild irritation to severe destruction of tissues. Inhalation may result in spasm, pulmonary edema, and chemical pneumonitis. Absorption into the body leads to the formation of methemoglobin, leading to cyanosis. Onset may be delayed.
p-Nitrophenol (4-Nitrophenol) (100-02-7)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: N/E	A buff-colored solid or flake with a phenolic odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 0.6 mm Fl.P.: UN	INH ING CON	Overexposure may cause symptoms of skin irritation with discomfort or rash; nausea; headache, weakness, cyanosis; and shortness of breath. Blood abnormalities including blood formation disfunction, anemia, and red blood cell destruction. Symptoms may be delayed.
N-Nitrosodimethylamine (Dimethylnitrosamine) (67-75-9)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: N/E	Yellow oily, liquid, soluble in water UN LEL: N/A UEL: N/A IP: UN VP: UN Fl.P.: UN	INH ING CON	Irritating to the skin or eyes.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Parathion (56-38-2)	PEL: 0.1 mg/m^3 NIOSH: 0.05 mg/m^3 TLV: 0.05 mg/m^3 (I,V) AEL: N/E STEL: N/E IDLH: 10 mg/m^3 Skin: Yes	Pale yellow to dark brown liquid with a garlic-like odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 4.0 X 10^{-5} mm FI.P.: 392°F	INH ABS ING CON	Irritating to eyes, skin, and respiratory system. Runny nose, headache, chest tightness, wheezing, salivation, anorexia, nausea, vomiting, cyanosis, diarrhea, sweating, weakness, convulsions, coma, low blood pressure, and cardiac irregularity.
Pentachlorobenzene (608-93-5)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: N/E	Colorless to white crystals. Air odor threshold: LEL: N/A UEL: N/A IP: N/A VP: 2 mm FI.P.: N/A	INH ING	Short-term exposure may cause CNS effects. Chronic exposure may cause liver and kidney lesions. Suspected teratogen.
Pentachlorophenol (PCP) (87-86-5)	PEL: 0.5 mg/m^3 TLV: 0.5 mg/m^3 AEL: N/E STEL: N/E IDLH: 2.5 mg/m^3 Skin: Yes	Colorless to white, crystalline solid with a benzene-like odor. Air odor threshold: 0.3 ppm LEL: N/A UEL: N/A IP: UN VP: 1.0 X 10^{-4} mm FI.P.: UN	INH ING CON ABS	Irritating to the eyes, nose, and throat. May cause sneezing, couching, weakness, anorexia, weight loss, sweating, headache, dizziness, nausea, vomiting, chest pain, difficulty breathing, high fever, and dermatitis.
Phenol (Carbotic acid) (108-95-2)	PEL: 5 ppm TLV: 5 ppm AEL: N/E STEL: N/E IDLH: 250 ppm Skin: Yes	Colorless to light-pink crystalline solid with a sweet, acrid odor. Air odor threshold: 0.3 ppm LEL: 1.8% UEL: 8.6% IP: 8.50 eV VP: 0.4 mm FI.P.: 175°F	INH ING CON ABS	Severe skin, eye, nose, and throat irritant. Symptoms include weakness, muscle ache, dark urine, narcosis, defatting dermatitis, cyanasis, tremors, liver and kidney damage.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Polychlorinated biphenyl (54% chlorine) (PCB) (11097-69-1)	PEL: 0.5 mg/m^3 TLV: N/E NIOSH: 0.001 mg/m^3 AEL: N/E STEL: N/E IDLH: 5.0 mg/m^3 (CA) Skin: Yes	Colorless to pale yellow, viscous liquid or solid (below 50°F) with a mild hydrocarbon odor. Air odor threshold: UN LEL: N/A VEL: N/A IP: UN V.P.: 6.0 x 10^{-5} mm F.I.P.: UN	INH ING CON ABS	Irritating to eyes. Excessive exposure may cause chloroacne, liver damage, and reproductive effects. Potential occupational carcinogen.
Polynuclear aromatic hydrocarbons (coal tar pitch volatiles) (PAH's) (65996-93-2)	PEL: 0.2 mg/m^3 NIOSH: 0.1 mg/m^3 AEL: N/E STEL: N/E IDLH: 80 mg/m$_3$ (CA) Skin: Yes	The pitch of coal tar is black or dark brown amorphous residue that remains after the redistillation process. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: UN F.I.P: UN	INH CON	Direct contact or exposure to vapors may be irritating to the eyes. Direct contact can be highly irritating to the skin and produce dermatitis. Exposure to vapors may ause nausea and vomiting. A potential human carcinogen.
TDE (Dichlorodiphenyldichloroethylene) (72-54-8)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	Colorless crystals or dust (insecticide). Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: N/A FI.P: N/A	INH ABS ING CON	Toxic by ingesting, inhalaiton, and skin absorption.
Tetraethyl lead (TEL) (78-00-2)	PEL: 0.075 mg/m^3 TLV: 0.1 mg/m^3 AEL: 0.075 mg/m^3 STEL: N/E IDLH: 40 mg/m^3 Skin: Yes	Colorless liquid with a pleasant sweet odor. Air odor threshold: UN LEL: 1.8% UEL: N/A IP: 11.10 eV VP: 0.2 mm FI.P.: 200°F	INH ABS ING CON	Poison by ingestion, inhalation, and skin contact. Symptoms include anxiety, tremor, hyper-reflexia, spasticity, hallucination, nausea, disorientation, and psychosis.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Toluene-2,4-diisocyanate (TDI) (584-84-9) (A mixture of 80% 2, 4 – Isomer and 20% 2, 6 – Isomer.)	PEL: 0.02 ppm (C) TLV: 0.005 ppm AEL: 5 ppb STEL: 0.02 ppm IDLH: 2.5ppm (CA) Skin: No	Colorless to pale yellow solid or liquid (above 71°F) with a sharp pungent odor. Air odor threshold: UN LEL: 0.9% UEL: 9.5% IP: UN VP: 0.5 mm (77°F) FI.P.: 260°F	INH ABS ING CON	Irritates eyes, skin, nose and throat. Symptoms include coughing, chest pain, abdominal pain, nausea, pulminary edema, and skin sentitization. Potential occupational carcinogen. Acute sensitizer.
o-Toluidine (2-Aminotoluene) (95-53-4)	PEL: 5 ppm TLV: 2 ppm AEL: 2 ppm STEL: N/E IDLH: 50 ppm (CA) Skin: Yes	Colorless to pale yellow liquid with a weak aromatic, aniline like odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: 7.44 eV VP: 0.3 mm FI.P.: 185°F	INH ABS ING CON	A skin and eye irritant. Causes cyanosis, weakness, blood in urine, dizziness, and drowsiness. Potential occupational carcinogen.
1,2,4-Trichlorobenzene (120-82-1)	PEL: N/E TLV: N/E AEL: 5 ppm STEL: 5 ppm (C) IDLH: N/E (CA) Skin: No	Colorless liquid or crystalline solid (below 53°F) with an aromatic odor. Air odor threshold: 3 ppm LEL: N/A UEL: 6.6% IP: UN VP: 1 mm FI.P.: 222°F	INH ABS ING CON	Irritating to eyes, nose, throat, and skin. May cause drowsiness. Potential occupational carcinogen.
2,4-Xylenol (2,4-Dimethyl phenol) (105-67-9)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless liquid. Air odor threshold: UN LEL: >230 F IP: UN VP: UN FI.P.: UN	INH ABS ING CON	Causes burns to skin. Irritation up to destruction of the mucous membranes of the respiratory tract, eyes, and skin. Inflammation, spasm, and edema of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms of exposure may cause burning, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
METALS				
Aluminum (metal dust) (7429-90-5)	PEL: 5 mg/m^3 (resp. dust) TLV: 10 mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: No	Silver-white malleable, ductile, odorless metal.	INH CON ING	Symptoms include irritation to the eyes, nose, throat, mouth, and respiratory system.
Antimony (7440-36-0)	PEL: 0.5 mg/m^3 TLV: 0.5 mg/m^3 AEL: 0.2 mg/m^3 STEL: N/E IDLH: 50 mg/m^3 Skin: No	Silver-white lustrous hard metal. Brittle solid scale-like crystals or dark gray powder.	INH CON ING	Symptoms include irritation to the eyes, nose, throat, and mouth. Nausea, dizziness, stomach cramps, olfactory fatigue, diarrhea, and headache may occur.
Arsenic (inorganic) (7440-38-2)	PEL: 0.010 mg/m^3 TLV: 0.01 mg/m^3 AEL: N/E STEL: N/E IDLH: 5 mg/m^3(CA) Skin: No	Silvery-gray or tin-white brittle, odorless solid.	INH ABS CON ING	Symptoms include ulceration of nasal septum, gastrointestinal disturbances, respiratory irritation, and peripheral neuropathy. Potential occupational carcinogen.
Barium (7440-39-3)	PEL: 0.5 mg/m^3 TLV: 0.5 mg/m^3 AEL: N/E STEL: N/E IDLH: 50 mg/m^3 Skin: No	Varies depending on specific compound.	INH ING CON	Upper respiratory tract irritant by inhalation; gastrointestinal disorders may also occur. Skin burns may result from dermal contact.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Beryllium (7440-41-7)	PEL: 0.002 mg/m^3 0.005 mg/m^3 (C) TLV: 0.002 mg/m^3 AEL: N/E STEL: 0.01 mg/m^3 IDLH: 4 mg/m^3(CA) Skin: No	Hard brittle gray-white solid.	INH CON	Inhalation causes weakness, fatigue, and weight loss. Symptoms also include chest pain, clubbing of fingers, berylliosis, cyanosis, and pulminary insufficiency. Potential occupational carcinogen.
Boron oxide (Boric oxide) (1303-86-2)	PEL: 15 mg/m^3 TLV: 10 mg/m^3 AEL: N/E STEL: N/E IDLH: 2,000 mg/m^3 Skin: No	Colorless semi-transparent lumps or hard, white, odorless crystals.	INH ING CON	Irritates eyes, skin, and respiratory system. Coughing, conjunctivitis, and skin redness may occur.
Cadmium (elemental) (7440-43-9)	PEL: 0.005 mg/m^3 TLV: 0.01 mg/m^3 AEL: 0.005 mg/m^3 STEL: N/A IDLH: 9 mg/m^3(CA) Skin: No	Silver-white, blue-tinged lustrous, odorless solid. Air odor threshold: N/D	INH ING	Symptoms include pulmonary edema, cough, tight chest, head pain, chills, muscle aches, vomiting, and diarrhea. Potential occupational carcinogen.
Chromium (Metal and CR III compounds) (Water soluble CrVI compounds) (7440-47-3)	PEL: 1.0 mg/m^3 TLV: 0.5 mg/m^3 AEL: 0.01 mg/m^3 STEL: N/E IDLH: 250 mg/m^3 Skin: No	Blue-white to steel-gray lustrous, brittle, hard odorless solid.	INH ING CON	Symptoms may include skin ulcerations, irritative dermatitis, and allergic skin reactions. Respiratory symptoms include coughing, wheezing, and shortness of breath.
Chromium (Water Insoluble CrVI compounds) (7440-47-3)	PEL: 0.001 mg/m^3 TLV: 0.01 mg/m^3 AEL: 0.01 mg/m^3 STEL: N/E IDLH: 15 mg/m^3(CA) Skin: No	Dark red, odorless, flakes or powder.	INH ING CON	Symptoms include blood and respiratory damage, liver, and kidney damage, irritation to the eyes and skin. Lung cancer.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Cobalt (Cobalt metal dust/fume) (7440-48-4)	PEL: 0.1 mg/m^3 TLV: 0.02 mg/m^3 AEL: 0.02mg/m^3 STEL: N/E IDLH: 20 mg/m^3 Skin: No	Odorless metal, silver-gray to black solid.	INH ING CON	Cobalt metal dust and fume can cause eye and skin irritation. Affects the respiratory system, causing cough, wheezing, and respiratory hypersensitivity-and asthma.
Copper (dusts and mists) (7440-50-8)	PEL: 1.0 mg/m^3 TLV: 1.0 mg/m^3 AEL: N/E STEL: N/E IDLH: 100 mg/m^3 Skin: No	Reddish, lustrous, malleable, odorless solid. Air odor threshold: N/D	INH ING CON	Symptoms include eye and nose irritation, metallic taste in mouth, cough, chills, and dermatitis.
Copper hydroxide (Copper hydrate) (20427-59-2) *Exposure limits listed as Cu	PEL: 1.0 mg/m^3 TLV: 1.0 mg/m^3 AEL: N/E STEL: N/E IDLH: 100 mg/m^3 Skin: No	Blue to green powder. Soluble in acids and ammonium hydroxide. Air odor threshold: N/D UEL: N/A LEL: N/A FI.P.: UN I.P.: UN V.P.: 0 mm	INH CON ING	May cause skin, eye, nose, and throat irritation. May cause allergic skin rashes. Ingestion may cause nausea and vomiting.
Copper sulfate (Blue vitriol) (7758-98-7) *Exposure limits listed as Cu	PEL: 1.0 mg/m^3 TLV: 1.0 mg/m^3 AEL: N/E STEL: N/E IDLH: 100 mg/m^3 Skin: No	Blue crystals or blue crystalline powder. White when dehydrated.	INH CON ING	May irritate skin, eyes, nose, and throat. May cause eye ulceration. May cause perforation of the nasal septum. Ingestion may cause salivation, nausea, vomiting with a metallic taste in the mouth. Skin contact may include irritation or rash.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Iron (7439-89-6)	PEL: 15 mg/m^3 TLV: 15 mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: No	Soft, malleable metal, silver-white or gray powder.	INH ING CON	Eye irritation with tearing, or blurring of vision. Upper respiratory tract irritation with coughing. Ingestion may cause irritation and damage to the gastrointestinal tract; nausea or vomiting; reduced appetite; abdominal pain; lethargy; tarry stools; diarrhea; acidosis and coma. Delayed symptoms may include pulmonary edema, shock, convulsions, liver dysfunction, acidosis, fever, and death. Other effects may include temporary nervous system depression.
Iron Salts (Soluble as Fe) (Ferrous Chloride)	PEL: 1 mg/m^3 TLV: 1 mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: None	Appearance and odor vary depending upon the specific solible iron salt.	INH ING CON	Irritation to eyes, skin, and mucuous membranes. Abdominal pain, diarrhea, and vomiting. Possible liver damage.
Iron oxide (Dust and fume as Fe) (1309-37-1)	PEL: 10 mg/m^3 TLV: 5 mg/m^3 AEL: N/E STEL: N/E IDLH: 2,500 mg/m^3 Skin: No	Reddish brown solid.	INH	Exposure may produce benign pneumoconiosis.
Lead (Elemental & inorganic as Pb) (7439-92-1)	PEL: 0.05 mg/m^3 TLV: 0.05 mg/m^3 AEL: 0.05 mg/m^3 STEL: N/E IDLH: 100 mg/m^3 Skin: No	A heavy, gray ductile soft solid.	INH ING CON	Accumulative poison may cause weakness, insomnia, facial pallor, anorexia, malnutrition, constipation, abdominal pain, anemia, gingival lead line, paralysis of wrists and ankles, hypertension, and kidney disease.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Magnesium oxide (fume) (1309-48-4)	PEL: 15 mg/m^3 TLV: 10 mg/m^3 AEL: N/E STEL: N/E IDLH: 750 mg/m^3 Skin: No	Silvery white finely-divided particulate. Flammable solid and dangerous when wet.	INH CON	Inhalation of dust or fumes can cause metal fume fever. Symptoms include eye and nose irritation, chest pain, and flu-like fever.
Manganese compounds (as Mn) (7439-96-5)	PEL: 5 mg/m^3 Ceiling TLV: 0.2 mg/m^3 AEL: N/E STEL: N/E IDLH: 500 mg/m^3 Skin: No	Metal: a lustrous, brittle, silvery solid. May be found as powder or flakes.	INH ING	Parkinson's; asthenia; insomnia; mental confusion; metal fume fever; dry throat; cough; chest tightnes; breathing difficulty; rales; flu-like fever, low back pain, vomiting, malaise; fatigue; kidney damage.
Mercury (Inorganic and metallic) (7439-97-6)	PEL: 0.1 mg/m^3(C) TLV: 0.025 mg/m^3 AEL: N/E STEL: N/E IDLH: 10 mg/m^3 Skin: Yes	Silvery-white, heavy, odorless liquid. Appearance and odor vary depending on specific compound. VP: 0.0012 mm	INH ABS CON ING	Highly toxic by skin absorption and inhalation of fume or vapor. Symptoms include irritated eyes and skin, cough, chest pain, headache, gastrointestinal distress, insomnia, bronchitis, stomatitis, and pneumonitis.
Nickel (Elemental metal) (7440-02-0)	PEL: 1 mg/m^3 TLV: 1.5 mg/m^3 AEL: 0.02 mg/m^3 STEL: N/E IDLH: 10 mg/m^3(CA) Skin: No	Lustrous silvery, odorless solid. Air odor threshold: N/A	INH ING CON	Symptoms include sensitization dermatitis and allergic asthma. Ingestion causes nausea, vomiting, and diarrhea. Potential occupational carcinogen.
Selenium (7782-49-2)	PEL: 0.2 mg/m^3 TLV: 0. 2 mg/m^3 AEL: N/E STEL: N/E IDLH: 1 mg/m^3 Skin: No	Amphorous or crystalline red to gray solid.	INH ING CON	Irritates eyes, skin, nose, and throat. May cause visual disturbances, headache, chills, fever, bronchitis, metallic taste in mouth, garlic breath, gastrointestinal disturbance, dermatitis, and skin burns.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Silver (Metal dust and soluble compounds) (7440-22-4)	PEL: 0.01 mg/m^3 TLV: 0.1 mg/m^3 METAL: 0.1 mg/m^3 SOLUABLE: 0.01 mg/m^3 AEL: N/E STEL: N/E IDLH: 10 mg/m^3 Skin: No	White lustrous solid.	INH ING CON	Silver dust and its soluble compounds causes local impregnation of the mucous membranes, skin, and eyes: a condition termed argyria (grayish pigmentation). Skin ulceration and gastrointestinal disturbance may also occur.
Sodium (7440-23-5)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Soft, silver, white solid oxidizing rapidly in air. Severe fire risk when in contact with water in any form. Ignites, if heated, spontaneously in dry air.	CON	Forms sodium hydroxide and hydrogen when in contact with water. Extremely caustic to tissue.
Thallium (Elemental and soluble compounds) (7440-28-0)	PEL: 0.1 mg/m^3 TLV: 0.1 mg/m^3 AEL: .05mg/m^3 STEL: N/E IDLH: 15 mg/m^3 Skin: Yes	Appearance and odor vary depending on the specific soluble compound.	INH ABS ING CON	Irritant to eyes, lungs, and skin. Can affect the central nervous system, liver, kidneys, and gastrointestinal tract. Can cause nausea, diarrhea, abdominal pain, vomiting, and chest pain.
Tin (metal) (7440-31-5)	PEL: 2 mg/m^3 TLV: 2 mg/m^3 AEL: N/E STEL: N/E IDLH: 100 mg/m^3 Skin: No	Gray to almost silver-white, ductile, malleable, lustrous solid.	INH CON	Irritant to eyes, skin, and respiratory system.
Vanadium Pentoxide (Respirable dust or fume) (1314-62-1)	PEL: 1.0 mg/m^3(C) TLV: 0.05 mg/m^3 AEL: 0.05 mg/m^3 STEL: N/E IDLH: 35 mg/m^3 Skin: No	Yellow-orange powder or dark gray, odorless flakes.	INH ING CON	Symptoms include eye, skin, and throat irritation, green tongue, metallic taste in mouth, coughing, wheezing, breathing difficulty, and bronchitis.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Zinc Oxide (Zinc dust) (1314-13-2)	PEL: 5 mg/m^3 TLV: 2 mg/m^3 AEL: N/E STEL: 10 mg/m^3 IDLH: 500 mg/m^3 Skin: No	Fine white odorless particulate. Air odor threshold: N/A	INH	Irritant to eyes, nose, throat, and skin. Symptoms include metal fume fever, blurred visions, chills, nausea, muscle ache, fever, and tight chest.
OTHER				
Acetic Acid (64-19-7)	PEL: 10 ppm TLV: 10 ppm AEL: 10 ppm STEL: 15 ppm IDLH: 50 ppm Skin: No	Colorless liquid or crystals with a sour, vinegar-like odor. Air odor threshold: UN LEL: 4% UEL: 19.9% (200°F) VP: 11 mm IP: 10.66 eV FI.P.: 103°F	INH CON	Irritant to the eyes, skin, nose, throat, and eyes. Can cause skin burns and skin sensitivity, black skin, dental erosion, hyperkeratosis, tearing, chronic bronchitis, and edema of the pharynx.
Adipic Acid (Hexanedioic acid) (124-04-9)	PEL: N/E TLV: 5 mg/m^3 AEL: 5 mg/m^3 STEL: N/E IDLH: N/E Skin: No	White, crystalline solid found in powder or crystalline form. Relatively stable. (Combustible) Air odor threshold: UN LEL: N/A UEL: N/A VP: UN IP: UN FI.P.: 385°F	INH CON	Skin contact may cause irritation or rash. Eye contact may cause tearing or blurring of vision, irritation. May cause irritation of the upper respiratory tract.
Aluminum Chloride (7446-70-0)	PEL: 2 mg/m^3 TLV: 2 mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: No	Gray to yellowish green granular solid or powder. Acidic in solution. Air odor threshold: UN LEL: N/A UEL: N/A VP: 1 mm @ 212°F IP: UN FI.P.: UN	INH ING CON	Reactive with water. Do not use water to remove material from skin. Irritating of eyes, nose, and throat with cough. Difficulty breathing. Shortness of breath. Skin contact may cause severe irritation with burning redness, swelling, pain, or rash. Prolonged contact to skin may cause burns or ulcers. Severe irritation with tearing, pain, or blurred vision. Ingestion may cause burns of throat, mouth, esophagus, and stomach.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Ammonium Nitrate (Nitric Acid, Ammonium Salt Ammonium Nitrate Prills) (6484-52-2)	PEL: N/E TLV: N/E AEL 10 mg/m^3 STEL: N/E IDLH: N/E Skin: No	White or beige odorless prill, powder, crystal or granules. Used as a base for commercial explosives. Air odor threshold: UN LEL: N/A UEL: N/A FI.P.: UN IP.: UN V.P.: UN	INH ING CON	Eye and upper respiratory tract irritant. Minor pulmonary changes upon inhalation. Ingestion may lead to methemoglobinemia and gastric irritation, weakness shortness of breath, bluish discoloration of skin and mucous membranes, nausea, and headache.
Asbestos (Chrysotile)(Tremolite)(Amosite) (1332-21-4)	PEL: 0.1 fibers/cc 1.0 f/cc (excursion limit) TLV: 0.1 fibers/cc (f) AEL: 0.1 fibers/cc STEL: NA IDLH: N/E (CA) Skin: No	White or greenish (chrysotile), blue (crocidolite) or gray-green (amosite) fibrous, odorless solid. UEL: N/A LEL: N/A VP: 0 mm IP.: UN Fi. P.: UN	INH ING CON	Asbestosis (with chronic exposure), difficulty breathing, interstitial fibrosis, restricted pulmonary function, eye irritation, lung carcinogen. Confirmed human carcinogen.
Bis(hexamethylene)triamine (143-23-7) *No established limits. DuPont recommends a full-face respirator from 1 to 50 ppm. Supplied air above 50 ppm.	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Slightly yellow corrosive liquid with a weak amine odor. Air odor threshold: UN LEL: N/A UEL: N/A VP: 2.5 mm IP: UN FI.P.: 250°F	INH ING CON ABS	May cause skin and eye burns and ulcerations. Eye damage may result in blindness.
Calcium oxide (lime) (1305-78-8)	PEL: 5 mg/m^3 TLV: 2 mg/m^3 AEL: N/E STEL: N/E IDLH: 25 mg/m^3 Skin: No	White or gray odorless lumps or granular powder. Air odor threshold: UN LEL: N/A UEL: N/A VP: 0 mm IP: UN FI.P.: UN	INH ING CON	Irritating to the eyes, skin upper respiratory tract. May cause ulcers and perforation of the nasal septum, pneumonia, and dermatitis.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Carbon Black (>80% carbon) (<0.1 % PAH's) (1333-86-4)	PEL: 3.5 mg/m^3 TLV: 3.5 mg/m^3 AEL: 0.5 mg/m^3 STEL: N/E IDLH: 1750 mg/m^3 Skin: No	Black odorless solid. Air odor threshold: N/A LEL: N/A UEL: N/A VP: 0 mm IP: UN FI.P.: UN	INH CON	May cause coughing and irritation to the eyes.
Carbon Monoxide (Carbon Oxide, Flue gas, monoxide) (630-08-0)	PEL: 50 ppm TLV: 25 ppm AEL: 50 ppm STEL: N/E IDLH: 12000 ppm Skin: No	Colorless odorless gas. Air odor threshold: UN LEL: 12.5% UEL: 74% VP: < 35 atm IP: 14.01ev FI.P.: N/A	INH CON (liq)	Headache, tachypnea, nausea, weak, dizziness, confusion, hallucinations; cyanosis; depressed S-T segment of electrocardiogram, angina, syncope
Chromic Acid (1333-82-0) *IDLH listed as Cr VI	PEL: 0.1 mg/m^3(C) TLV: 0.05 ppm AEL: 0.01 mg/m^3 STEL: N/E IDLH: *15 mg/m^3 Skin: No	Dark red odorless flakes or powder often used in solution. Air odor threshold: UN LEL: N/A UEL: N/A VP: Very low IP: UN FI.P.: UN	INH ING CON	Irritating to the respiratory system, nasal septum perforation, eye irritation, conjunctivitis, and dermatitis. May also cause liver and kidney damage.
Coal Ash (Fly Ash) Exposure limits listed as Silica, fused (Amorphous) *mppcf = million particles per cubic foot	PEL: *20 mppcf TLV: 10.0 (E,I) mg/m^3 AEL: 0.1 mg/m^3 STEL: N/E IDLH: N/E Skin: No	Gray on white, odorless solid (ash residue from coal). Air odor threshold: UN LEL: N/A UEL: N/A VP: UN IP: UN FI.P.: UN	INH CON	May cause eye, skin, nose, and respiratory tract irritation. Coughing, wheezing, decreased pulmonary function, and silicosis may also occur.
Coke (65996-77-2) *Exposure limits listed for carbon black	PEL: 3.5 mg/m^3 TLV: 3.5 mg/m^3 AEL: 0.5 mg/m^3 STEL: N/E IDLH: N/E Skin: No	Black, granular solid composed of 99% carbon. Air odor threshold: UN LEL: N/A UEL: N/A VP: 0 mm IP: UN FI.P: UN	INH	May cause eye, skin, nose, and respiratory tract irritation.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Copper Bromide (Cupric bromide) (7789-45-9)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Gray to black crystalline powder with a bromine-like odor. Air odor threshold: UN LEL: N/A UEL: N/A VP: UN IP: UN FI.P.: UN	INH ING CON	Eye, skin, and mucous membrane irritant. Tightness in chest, coughing, breathing difficulty may also occur. Chronic exposure may cause nasal septum perforation.
Cyanide (Potassium cyanide {KCn} or Sodium Cyanide {NaCn} Total as Cn)	PEL: 5 mg/m^3 TLV: N/E AEL: N/E STEL: N/E IDLH: 25 mg/m^3 Skin: No	KCn & NaCn are white granular or crystalline solid with a faint almond-like odor. Air odor threshold: UN UEL: N/A LEL: N/A V.P: UN I.P.: UN F.I.P.: UN	INH ING CON ABS	Asphyxia and death may occur. Weakness, headache, confusion, nausea, vomiting, increased respiratory rate, gasping respirations, and skin or eye irritation may also occur.
Detraprime Boosters (78-11-5, 77-90-7, 9004-70-0)	PEL: N/E TLV: N/E AEL N/E STEL: N/E IDLH: N/E Skin: No	Red or rubber-like tube with no odor. Will detonate if primed. Air odor threshold: UN LEL: N/A UEL: N/A FI.P.: UN I.P.: UN V.P.: UN	INH ING CON	Detonation may cause severe physical injury including death. Excessive inhalation, skin or eye contact or swallowing may cause drop of blood pressure, decreased weight and diarrhea.
Dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin) (chlorinated dioxins) (1746-01-6)	PEL: N/E TLV: N/E AEL N/E STEL: N/E IDLH: N/E (CA) Skin: Yes	Dioxin is a white, crystalline solid in pure form. Air odor threshold: UN UEL: N/A LEL: N/A VP: 2.0x10^{-6} mm IP: N/E FI.P.: N/E	INH ING CON ABS	Dioxin is a known carcinogen, teratogen, and a motagen. Irritates eyes, allergic dermatitis, chloroacne, porphyria, and GI disturbances may also occur.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Dynamite Liquid (111-76-2/10213-79-3)	PEL: 50 ppm TLV: 25 ppm AEL N/E STEL: N/E IDLH: 700 ppm Skin: Yes	Clear blue liquid with characteristic odor. Air odor threshold: N/A LEL: 1.1% UEL: 12.7% V.P. 0.8mm I.P.: 10.00eV FI.P.: 143˚F	INH ING CON ABS	Irritating to eyes. Can defat skin. Inhalation can cause dizziness, nausea, and headache. Chronic effects include kidney, liver, and hematopoietic tissues.
Formic Acid (Hydrogen carboxylic acid) (64-18-6)	PEL: 5 ppm TLV: 5 ppm AEL: 5 ppm STEL: 10 ppm IDLH: 30 ppm Skin: No	Colorless liquid with a pungent penetrating odor. Air odor threshold: UN LEL: 18% UEL: 57% VP: 35 mm IP: 11.05ev FI.P.: 122°F	INH ING CON	Irritating to eyes, skin, and throat. May cause skin burns, dermatitis, tearing, coughing, and nausea.
Fluboric Acid (Tetrafluorobic acid) (Hydrogen tetraflouroborate) (Borate(1-), tetrafluoro-, hydrogen) (16872-11-0)	PEL: N/E TLV: 2.5 mg/m^3 ppm AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless, odorless, poisonous liquid. Air odor threshold: UN LEL: UN UEL: UN VP: 5 mmHg IP: UN FI.P.: UN	ING INH CON	Nausea, vomiting, and diarrhea are common. Dyspnea, bronchospasm chemical pneumonitis, pulmonary edema tracheobronchitis, chemical burns to trachea, larynx, and bronchi. Lips and throat may become red. Erythemoatous rash/
Kerosene (Fuel Oil No. 1) (8008-20-6)	PEL: N/E NIOSH: 100 mg/m^3 TLV: 200 mg/m^3 AEL: N/E STEL: N/E IDLH: N/E Skin: Yes	Colorless to yellowish liquid with a strong, characteristic odor Air odor threshold: UN LEL: 0.7% UEL: 5% VP: 5 mm @ 100°F IP: UN FI.P.: 100-162°F	INH CON ING	Irritates eyes, skin, and respiratory system. May cause CNS effects in high concentrations.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Hydrochloric Acid (Hydrogen chloride) (7647-01-0)	PEL: 5 ppm (C) TLV: N/E AEL: 5 ppm STEL: 2 ppm(C) IDLH: 50 ppm Skin: No	Colorless to slightly yellow with a pungent irritating odor. Air odor threshold: UN LEL: N/A UEL: N/A VP: 40.5 atm IP: 12.74eV FI.P.: UN	INH ING CON	Irritating to the nose, throat, and larynx. May cause cough, choking, dermatitis, eye and skin burns.
Hydrogen fluoride (Hydrofluoric acid) (HF) (7664-39-3)	PEL: 3 ppm TLV: 0.5 ppm AEL 3 ppm IDLH: 30 ppm Skin: No STEL: 2 ppm (C)	Colorless gas or funing liquid (below 67°F) with a strong irritating odor. Air odor threshold: 0.3 ppm LEL: N/A UEL: N/A VP: 783 mm IP: 15.98 eV FI.P.: U/N	INH ABS ING CON	Irritating to the eyes, skin, nose, and throat. May cause pulmonary edema, bronchitis, eye and skin burns. Latent skin burns with necrosis can occur even at concentrations of at least 2%. Healing of skin burns caused by concentrated HF may be prolonged. The fluoride ion readily penetrates the skin and deep tissue causing destruction of soft tissue and decalcification of bone. Tissue destruction and neutralization of HF may proceed for days. HF can be absorbed through the skin in toxic amounts.
Hydrogen Peroxide (Hydrogen Dioxide, Hydrogen Peroxide (aqueous)) (7722-84-1)	PEL: 1 ppm (1.4 mg/m^3) TLV: 1 ppm AEL: N/E STEL: N/E IDLH: 75 ppm Skin: No	Colorless liquid with a slightly sharp odor. LEL:N/A UEL: N/A VP: (86°F): 5mmHg IP: 10.54 eV FI.P.: N/A	INH ING CON	Irritation eye, nose, throat; corneal ulcer; erythema (skin redness), skin vesiculation; bleaching hair.
Hydrogen sulfide (7783-06-4) (Sewer gas)	PEL: 20 ppm C TLV: 10 ppm STEL: 15 ppm IDLH: 100 ppm Skin: No	Colorless gas with a strong odor of rotten eggs. Note: Sense of smell becomes rapidly fatigued and CAN NOT be relied upon as a warning property Air odor threshold: 0.0002 ppm LEL: 4% UEL: 44% VP: 17.6 ATM IP: 10.46 eV FI.P.: NA	INH CON	Irritation to the eyes, respiratory system, May cause apnea, coma, convulsions, conjunctivitis, eye pain, tearing, photo sensitivity, dizziness, headache, fatigue, irritability, insomnia, and gastrointestinal disturbances

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Krytox Oil (Perfluoropolyether carboxylic acid) (51798-33-5)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Light amber viscous liquid with no odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: UN FI.P.: UN	CON ING	Slight skin irritant and mild eye irritant. Decomposition products may cause lung irritation and pulmonary edema.
Oil mist (mineral) (8012-95-1)	PEL: 5 mg/m^3 TLV: 5 mg/m^3 (H) AEL: 5 mg/m^3 STEL: 10 mg/m^3 IDLH: 2,500 mg/m^3 Skin: No	Colorless, oily liquid aerosol in air. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: <0.5 mm FI.P.: 380°F	CON ING	Irritates eyes, skin, and respiratory system.
MBAS (140-60-3, 50854-94-9, 27176-87-0. 25496-01-9, 7664-93-9, and 7732-18-5)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Clear liquid with a slight organic odor. Air odor threshold: UN LEL: UN UEL: UN IP: UN VP: UN FI.P.: UN	INH ING CON	Primary irritant. Irritates and defats the skin. Burns and irritates the eyes. May cause cough, upper airway irritation.
Mineral Spirits (Stoddard solvent) (8052-41-3)	PEL: 500 ppm TLV: 100 ppm AEL: N/E STEL: N/E IDLH: 20,000 mg/m^3 Skin: No	White to clear liquid with kerosene-like odor. Air odor threshold: UN LEL: N/A UEL: N/A VP: UN IP: UN FI.P.: 102-110°F	INH CON ING	Irritates eyes nose and throat. Inhalation may cause headache, dizziness, nausea, respiratory tract irritation.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Niachlor filter sludge Contains: (Calcium sulfate, calcium carbonate, sodium chloride, water)	PEL: N/E TLV: N/E AEL N/E STEL: N/E IDLH: N/E Skin: No	Odorless, grayish white slurry with a pH between 8-11. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: UN FI.P.: UN	CON ING	Eye contact may include irritation with discomfort, tearing, or blurring. Ingestion may include discomfort such as nausea, headache, or weakness.
Nitric Acid (7697-37-2)	PEL: 2 ppm TLV: 2 ppm AEL 5 mg/m^3 STEL: 4 ppm IDLH: 25 ppm Skin: No	Colorless, yellow, or red fuming liquid with an acrid suffocating odor. Air odor threshold: <5.0 ppm LEL: N/A UEL: N/A VP: 48 mm IP: 11.95 FI.P.: UN	INH ING CON	Irritating to the eyes, skin, and mucous membranes; may cause delayed pulmonary edema, bronchitis, dental erosion, and pneumonitis.
Nitroglycerin (1,2,3-Propanetriol trinitrate, Nitrin, Nitrol) (55-63-0)	PEL: 0.2 mg/m^3 2 mg/m^3 (Ceiling) TLV: 0.05 ppm AEL N/E STEL: N/E IDLH: 75 mg/m^3 Skin: Yes	Colorless to pale yellow, viscous liquid or solid. An explosive ingredient in dynamite. Air odor threshold: UN LEL: N/A UEL: N/A VP: 0.0003 mm I.P.: UN FI.P.: explodes	INH ING CON ABS	Throbbing headache, dizziness, nausea, vomiting, abdominal pain, hypotension, flush, heart palpitations, methemoglobinemia, delirium, CNS depression, angina. Skin irritant.
Pentaeythritol tetranitrate (PETN) (Primary component of blasting caps) (78-11-5)	PEL: N/E TLV: N/E AEL N/E STEL: N/E IDLH: N/E Skin: No	Warning! Explosive! White crystalline solid, odorless. Shipped wet and methanol may be added as antifreeze. Air odor threshold: UN Explosion temp: 272°C Impact sensitivity: 2 kg. Wt. At 17 cm 100% detonations	INH ING	PETN is a Class A explosive and detonation. May cause severe physical injury, including death. Inhalation and ingestion in amimals caused a drop in blood pressure.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Persistent Bioaccumulative and Toxic (PBT) Chemicals Includes: ☐ chlordane ☐ DDT, DDP, DDE ☐ Hexachlorobenzene ☐ alkyl-lead ☐ aldrin/dieldrin ☐ benzo(a)pyrene ☐ octachlorostyrene ☐ PCBs ☐ dioxins and furans ☐ toxaphene ☐ mercury and its compounds ☐ mirex				PBTs include a variety of highly-toxic, long-lasting substances that can build up in the food chain to levels that are harmful to humans and the ecosystem. Human health effects may include nervous system, reproductive and developmental problems, cancer and genetic impacts.
Phosphoric Acid (7664-38-2)	PEL: 1 mg/m^3 TLV: 1 mg/m^3 AEL 1 mg/m^3 STEL: 3 mg/m^3 IDLH: 1000 mg/m^3 Skin: No	Thick colorless odorless crystalline solid often used in an aqueous solution. Air odor threshold: UN LEL: N/A UEL: N/A VP: 0.03 mm IP: UN FI.P.: UN	INH ING CON	Irritating to the eyes, skin, and upper respiratory system. May cause eye and skin burns and dermatitis.
Polyethylene Glycol 400 (9081-95-2)	PEL: N/E TLV: N/E AEL: 5 mg/m^3 (resp.dust) STEL: N/E IDLH: N/E Skin: No	Clear, viscous liquids or white solids which dissolves in water. Air odor threshold: UN LEL: 1.1% UEL: 6.9% IP: UN VP: UN FI.P.: 300-450°F	CON INH ING	Low potential for toxicity Overexposure to vapors may result in eye and respiratory tract irritation, dizziness, and nausea.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Potassium acetate (127-08-2)	PEL: N/E TLV: N/E AEL: N/E (total dust) AEL: N/E (respirable dust) STEL: N/E IDLH: N/E Skin: No	White, deliquescent, crystalline powder. Odorless Air odor threshold: NA LEL: NA UEL: NA IP: NA VP: NA FI.P.: NA	INH ING CON	May cause mild irritation to the respiratory tract, eye contact may cause mild irritation and redness. Consumption of large oral doses may produce gastrointestinal disturbances..
Potassium Carbonate (584-08-7)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless to white, granular powder, or crystalline solid. Air odor threshold: UN UEL: N/A LEL: N/A I.P.: UN V.P.: UN FI.P.: UN	INH CON ING	Skin irritation, rash, eye irritation with tearing or blurring. Prolonged eye contact may cause corneal destruction. Inhalation may cause mucous membrane effects including cough, painful throat and nasal irritation.
Potassium Hydroxide (Lye) (Pot Ash) (1310-58-3)	PEL: N/E TLV: N/E AEL: N/E STEL: 2 mg/m^3(C) IDLH: N/E Skin: No	Odorless, white, or slightly yellow lumps, rods, flakes, sticks, or pellets. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 1 mm FI.P.: UN	CON INH ING	Irritating to the eyes, skins, respiratory system. May cause coughing, sneezing, eye and skin burns, vomiting, and diarrhea.
2,4-Lutidine (Pyridine) (108-47-4)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Oily, colorless liquid with a peppermint odor. Flammable. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: UN FI.P.: 99°F	INH ABS ING CON	Harmful if swallowed, inhaled, or absorbed through he skin. Eye irritation. Irritating to the mucous membranes and respiratory tract. May cause coughing, chest pain, difficulty in breathing, and gastrointestinal disturbances.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Pyridine (Azabenzene) (Azine) (110-86-1)	PEL: 5 ppm TLV: N/E AEL: 0.2 ppm STEL: N/E IDLH: 1,000 ppm Skin: No	Colorless to yellow liquid with a nauseating, fish-like odor. Flammable. Air odor threshold: UN LEL: 1.8 % UEL: 12.4 % IP: 9.27 eV VP: 16 mmHg FI.P.: 68°F	INH ABS ING CON	Harmful if swallowed, inhaled, or absorbed through he skin. Eye irritation. Chronic exposure may cause kidney, liver damage and gastrointestinal disturbances.
Rabon® Insecticide (22248-79-9)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: N/E	Off white to tan crystalline solid. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 2.6 x 10^{-7} mm Hg FI.P.: UN	CON INH ING	An irritant to eyes and skin. May cause cholinesterase depression. Chronic exposure may cause weakness, headache, tightness in chest, blurred vision, pinpoint pupils, salivation, sweating, nausea, vomiting, diarrhea, and abdominal cramps.
Sodium acetate (127-09-03)	PEL: N/E TLV: N/E AEL 10 mg/m^3 (total dust) AEL: 5 mg/m^3 (respirable dust) STEL: N/E IDLH: N/E Skin: No	Colorless crystals with a slight acetic acid odor Air odor threshold: NA LEL: NA UEL: NA IP: NA VP: NA FI.P.: NA	INH ING CON	May cause irritation to the respiratory tract including coughing, sore throat, labored breathing and chest pain. May cause eye and skin irritation. Ingestion of large doses may cause abdominal pain, nausea, and vomiting.
Sodium Carbonate (Soda Ash) (497-19-8)	PEL: N/E TLV: N/E AEL: 5 mg/m^3 STEL: N/E IDLH: N/E Skin: No	Colorless to white hygroscopic power or granules. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: UN FI.P.: UN	INH ING	Skin irritant. Concentrated solutions may produce local necrosis on mucous membranes.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Sodium Fluoride (Floridine) (7681-49-4)	PEL: 2.5 mg/m^3 TLV: N/E AEL: N/E STEL: N/E IDLH: 250 mg/m^3 Skin: No	Colorless, white, or blue crystals or powder. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: 0mm FI.P.: UN	CON INH ING	Irritates eyes and respiratory system. May cause nausea, abdominal pain, diarrhea, salivation, thirst, sweating, and dermatitis. Stiff spine and calcification of the ribs and pelvis ligaments may also occur.
Sodium Hydroxide (Caustic soda) (1310-73-2)	PEL: 2 mg/m^3 TLV: N/E AEL: 2 mg/m^3 STEL: 2 mg/m^3(C) IDLH: 10 mg/m^3 Skin: No	Colorless to white, odorless solid. (flakes, beads or granular form). Air odor threshold: UN LEL: N/A UEL: N/A VP: 0 mm IP: UN FI.P.: UN	INH ING CON	Irritating to the eyes, skin, mucous membranes. May cause pneumonitis, eye and skin burns, and temporary loss of hair.
Sulfuric Acid (Battery Acid) (7664-93-9)	PEL: 1 mg/m^3 TLV: 0.2 mg/m^3 AEL 0.5 mg/m^3 STEL: N/E IDLH: 15 mg/m^3 Skin: No	Colorless to dark brown, oily, odorless liquid. Air odor threshold: UN LEL: N/A UEL: N/A VP: 0.001 mm IP: UN FI.P.: UN	INH ING CON	Irritating to the eyes, skin, nose, throat, and mucuos membranes. May cause pulmonary edema, bronchitis, emphysema, stomatitis, dental erosion, skin burns, and dermatitis.
TAF Solvent (TAF 1250) (Dimethyl Silicone Emulsion)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	White fluid, soluble in water with no or a slight odor. Air odor threshold: UN LEL: N/A UEL: N/A IP: UN VP: UN FI.P.: >199°F	CON ING	Not expected to cause a health hazard via inhalation. Skin and eye contact may cause mild to moderate irritation. May cause gastrointestinal disturbances if swallowed.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Terephthalic Acid (TPA) (100-21-0)	PEL: N/E TLV: 10 mg/m^3 AEL: 5 mg/m^3 (resp. dust) STEL: N/E IDLH: N/E Skin: No	Off-white powder, may have a vinegar-like odor above 570°F. Dusts may form explosive mixture in air. Air odor threshold: UN LEL: N/A UEL: N/A VP: <0.01 mm (68 °F) IP: UN FI.P.: 500°F	INH ING	Eye contact may cause slight irritation with discomfort, tearing, or blurring of vision. Inhalation may cause irritation of mouth, nose, and throat.
Tetraglyme (Tetraethylene glycol dimethyl ether) (143-24-8)	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: No	Colorless liquid. Organic peroxides will develop when exposed to air. Air odor threshold: N/A LEL: N/A UEL: N/A IP: UN VP: <0.01 mg F.I.P.: 285°F	CON INH ING ABS	May cause eye irritation. Repeated contact may result in allergic skin reaction. Inhalation may cause nausea, headache, and vomiting.
Titanium dioxide (13463-67-7)	PEL: 15 mg/m^3 TLV: 10 mg/m^3 AEL: 5 mg/m^3 (resp. dust) STEL: N/E IDLH: 5000 mg/m^3(CA) Skin: No	White, odorless powder. Air odor threshold: N/A LEL: N/A UEL: N/A VP: 0 mm IP: UN FI.P: UN	INH	Exposures may produce lung fibrosis. Potential occupational carcinogen.
Triethylene glycol (TEG) (112-27-6)	PEL: N/E TLV: N/E AEL: 2 ppm STEL: N/E IDLH: N/E Skin: No	Clear colorless syrupy odorless liquid. Air odor threshold: N/A LEL: 0.9 % UEL: 9.2% VP: <0.01 mm IP: UN FI.P.: 351°F	ING CON	Eye contact may result in eye irritation with tearing or blurring of vision. Prolonged skin contact may cause irritation with itching, burning, redness, or rash. Ingestion may cause nausea, vomiting, CNS depression, confusion, and death.

Chemical Name Synonyms (trade name) (CAS No.)	OSHA PEL ACGIH TLV DuPont AEL ACGIH STEL NIOSH IDLH Skin Designation	Characteristics	Route of Exposure	Symptoms of Exposure
Trimethyl Phosphate (512-56-1)	PEL: N/E TLV: N/E AEL: 0.1 ppm STEL: N/E IDLH: N/E Skin: No	Colorless liquid. LEL: N/A UEL: N/A VP: UN IP: UN FI.P.: UN	INH ING CON	Skin irritation with itching, burning, redness, or rash. Eye irritation with tearing, pain, or blurred vision. Overexposure may cause peripheral nervous system effects with tingling, pain, or loss of sensation. May cause weakness or loss of muscle control. Possible carcinogen and germ-cell mutagen.
2,4,6-Trinitrotoluene (TNT) (118-96-7)	PEL: 1.5 mg/m^3 TLV: 0.1 mg/m^3 AEL: N/E STEL: N/E IDLH: 500 mg/m^3 Skin: Yes	Colorless to pale yellow, ordorless solid or crushed flakes. LEL: N/A UEL: N/A IP: 10.59 eV VP: 0.0002 mm FI.P.: Explodes	INH ABS ING CON	Symptons include skin irritation, sore throat, muscle pain, dermatitis, amemia, and liver and kidney damage.
Ultramid B (Polycaprolactam) (Nylon 6) (25038-54-4)	PEL: N/E TLV: N/E AEL N/E STEL: N/E IDLH: N/E Skin: No	Odorless, opaque pellets. LEL: N/A UEL: N/A VP: UN IP: UN FI.P.: 752°F	INH ING CON	Molten material can cause burns. During processing caprolactam monomer may irritate nose and throat. Powder may cause skin and eye irritation.
Vapona®	PEL: N/E TLV: N/E AEL: N/E STEL: N/E IDLH: N/E Skin: N/E	Yellow plastic with mild chemical odor. Insecticide. Air odor threshold: UN LEL: N/A UEL: N/A VP: 0.01 mm IP: UN FI.P.: 175°F	INH ABS	Sweating, salivation, tearing, nausea, headache, ataxia, tightness in chest, vomiting, diarrhea, pinpoint pupils. A cholinesterase inhibitor.

OSHA PEL	Occupational Safety and Health Administration Final Rule Limits, Permissible Exposure Limit for an eight-hour, time-weighted average.
ACGIH TLV	American Conference of Governmental Industrial Hygienists, Threshold Limit Value for an eight-hour, time-weighted average.
DuPont AEL	DuPont, Acceptable Exposure Limit.
ACGIH STEL	American Conference of Governmental Industrial Hygienists, Short-term Exposure Limit for a 15-minute, time-weighted average.
NIOSH IDLH	National Institute for Occupational Safety and Health, Immediately Dangerous to Life or Health concentration.

ppm	Part of vapor or gas per million parts of air by volume at 25° Celsius and 760 mm Hg.
mg/m^3	Milligram of substance per cubic meter of air.
µg/m^3	Microgram of substance per cubic meter of air.
CAS	The Chemical Abstracts Service registry number is a numeric designation assigned by the American Chemical Society's Chemical Abstracts Service and uniquely identifies a specific chemical compound. This entry allows one to conclusively identify a substance regardless of the name or naming system used.
CA	NIOSH has identified numerous chemicals that it recommends be treated as potential or confirmed human carcinogens.
(C)	The (ceiling) concentration that should not be exceeded during any part of the working exposure.
Skin	The potential contribution to the overall exposure by the cutaneous route, including mucous membranes and eye, either by airborne or, more particularly, by direct contact with the substance.
UEL	Upper Explosive Limit—the highest concentration of a material in air that produces an explosion in fire or ignites when it contacts an ignition source. A higher concentration of the material in a smaller percentage or concentration of air may be too rich to be ignited.
LEL	Lower Explosive Limit—the lowest concentration of the material in air that can be detonated by spark, shock, fire, etc.
INH	Inhalation
ABS	Skin absorption
ING	Ingestion
CON	Skin and/or eye contact
N/E	Not Established
N/A	Not Applicable
UN	Unavailable
Polynuclear Aromatic Hydrocarbons	Includes acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, carbazole, chrysene, o-cresol, m-cresol, p-cresol, fluoranthene, fluorene, high-boiling tar acids, indene, medium-soft pitch, a-methylnaphthalene, b-methylnaphthalene, naphtha, naphthalene, phenanthrene, pyrene, tar bases, and xylenols.