G.W. Lisk Company, Inc.

Final Remedial Investigation Work Plan

January 2020

G.W. Lisk Facility – 2 South Street
Village of Clifton Springs,
Ontario County, New York
NYSDEC BCP Site Number C835026

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Prepared for:

G.W. Lisk Company, Inc.

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FINAL REMEDIAL INVESTIGATION WORK PLAN
JANUARY 2020
G.W. LISK FACILITY – 2 SOUTH STREET
VILLAGE OF CLIFTON SPRINGS, ONTARIO COUNTY, NEW YORK
NYSDEC BCP SITE NUMBER C835026

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

Jon S. Fox, P.G.
ERM Consulting & Engineering, Inc.

Date: 21 January 2020

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ACRONYMS AND ABBREVIATIONS

AA	Alternatives Analysis
amsl	above mean sea level
ASP	Analytical Services Protocol
AOPC	Area of Potential Concern
APS	Advanced Profiling System
ASP	Analytical Services Protocol
AST	Aboveground Storage Tank
BCP	Brownfield Cleanup Program
bgs	below ground surface
°C	Degrees Celsius
CAMP	Community Air Monitoring Plan
CBS	Chemical Bulk Storage
CCR	Construction Completion Report
CFR	Code of Federal Regulations
COPC	Compound of Potential Concern
CPP	Citizen Participation Plan
CSHC	Clifton Springs Hospital and Clinic
CVOC	Chlorinated Volatile Organic Compound
DCA	Dichloroethane
DCE	Dichloroethene
DER	Division of Environmental Remediation
DO	Dissolved Oxygen
DQO	Data Quality Objective
DSNY	Dig Safely New York
DUSR	Data Usability Summary Report
EDD	Electronic Data Deliverable
EDS	Electronic Data Summary
ERM	ERM Consulting & Engineering, Inc.
eV	electron Volt
ft	feet
ft bgs	feet below ground surface
FWRIA	Fish and Wildlife Resource Impact Assessment
GPS	Global Positioning System
HASP	Health and Safety Plan
HDPE	High-Density Polyethylene
IDW	Investigation-Derived Waste
IRM	Interim Remedial Measure
ISMP	Interim Site Management Plan
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter
MGP	Manufactured Gas Plant
MW	Monitoring Well
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health

NYSGS	New York State Geological Survey
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Reproducibility, Completeness, and Comparability
PBS	Petroleum Bulk Storage
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
P.E.	Professional Engineer
P.G.	Professional Geologist
PID	Photoionization detector
PPE	Personal Protective Equipment
ppm	Parts per million
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SC	Site Characterization
SCGs	Standards, Criteria and Guidance
SCOs	Soil Cleanup Objectives
SMP	Site Management Plan
STARS-#1	Spill Technology and Remediation Series Memorandum Number One
SVI	Soil Vapor Intrusion
SVOCs	Semivolatile Organic Compounds
TAL	Target Analyte List
TCA	Trichloroethane
TCE	Trichloroethene
TCL	Target Compound List
TIC	Tentatively Identified Compound
TOGS	Technical Operations Guidance Series
µg/kg	Micrograms per Kilogram (parts per billion)
µg/L	Micrograms per Liter (parts per billion)
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

At the request of the New York State Department of Environmental Conservation (NYSDEC), G.W. Lisk Company, Inc. (G.W. Lisk) entered into an Order on Consent and Administrative Settlement with NYSDEC dated 27 May 2015 (Index Number R8-0852-15-04) to perform Site Characterization (SC) of environmental media at the G.W. Lisk Facility located at 2 South Street in the Village of Clifton Springs, Ontario County, New York (the Site). The location of the Site is shown in Figure 1. The Site was initially classified as a "P" (potential) site by NYSDEC and identified as Site Number 835026. G.W. Lisk submitted an application to NYSDEC for entry into the Brownfield Cleanup Program (BCP) as a Participant and the application was accepted by NYSDEC after public notice and review. Brownfield Site Cleanup Agreement Index Number C835026-12-18 was executed by NYSDEC on 23 January 2019. The Site is identified as NYSDEC BCP Site Number C835026.

1.1 PURPOSE AND OBJECTIVES

Based on the results of the SC presented in the NYSDEC-approved SC Report (ERM, 2018) and consistent with NYSDEC technical requirements contained in the Final Technical Guidance for Site Investigation and Remediation (DER-10; NYSDEC, 2010), a Remedial Investigation (RI) scope of work has been developed to meet the following goals:

- define the nature and extent of contamination;
- identify contaminant source areas;
- evaluate potential exposures; and
- produce data of sufficient quantity and quality to support the development of an acceptable Remedial Alternatives Analysis (AA) or Remedial Action Work Plan (RAWP).

If appropriate, the RI should also identify additional removal, treatment, containment, or other interim remedial measures (IRMs) to:

- remove, treat, or contain any source areas identified; and
- prevent, mitigate, or remedy potential exposure to Compounds of Potential Concern (COPCs) while remedial alternatives are being evaluated.

Results from previous environmental investigation and sampling activities conducted at the Site have been incorporated into this RI Work Plan. Additional sampling locations are proposed for the RI to address data gaps based on the results of previous investigations.

1.1.1 Project Organization

The Site is currently owned by Raer Corporation and operated by G.W. Lisk. Primary contacts for G.W. Lisk are provided below.

Operator		
G.W. Lisk	Arno Bebernitz	315-462-4255
Operator's Consultant		
ERM	Jon Fox, P.G.	315-256-5352
	Stephen Mirabello, P.E.	609-403-7564
Operator's Counsel		
Harter Secrest & Emery	Leslie Connolly, Esq.	585-231-1367

1.1.2 Citizen Participation

As required in the Brownfield Cleanup Agreement (BCA), G.W. Lisk prepared and submitted a Citizen Participation Plan (CPP) to NYSDEC for review (ERM, 2019a). The CPP was approved by NYSDEC on 17 May 2019. The CPP describes procedures that will be used to keep the public informed of the current status of environmental activities at the Site.

1.2 SITE LOCATION AND LAYOUT

The Site is located in the south-central portion of the Village of Clifton Springs in Ontario County, New York. Figure 1 shows the location of the Site and adjacent areas. Figure 2 show the layout and land use of the Site including the parcel boundary (red line), the official BCP Site boundary (yellow line), and surrounding areas. The parcel currently contains approximately 26.654 acres and the BCP Site boundary contains approximately 8.828 acres. The Site is located within a mixed industrial, commercial, and residential use area.

1.3 GENERAL DESCRIPTION AND HISTORY

The Site was originally developed in the mid-1800s for agricultural use. The G.W. Lisk facility is privately owned and has been operating since the early-1900s. The facility originally operated as a manufacturer of tin cake pans, pails, and spraying devices from 1910 until the late-1940s. The facility began solenoid manufacturing operations in 1948 and continues to operate as a manufacturer of solenoids and valves for industrial and commercial markets.

After originally consisting of a single chicken coop in 1910, the facility currently occupies approximately 225,000 square feet of building space. There are two main clusters of attached buildings where facility operations occur (Figure 2). Paved parking areas are located on the central, southern, and eastern portions of the Site. Paved driveways and shipping areas are also located throughout the Site. The western and southern portions of the Site are primarily wooded.

The Site and other properties in the area obtain potable water from the Village of Clifton Springs Water Department. There are three reported water wells within a 0.5 mile radius from the Site dating as far back as at least 1929; however, it is not known whether these wells still exist and/or if they supply water for potable purposes. Information on these wells was provided to NYSDEC in correspondence dated 31 October 2019. Two non-potable water supply wells are present at the Site (Figure 2). Water from these two wells is reportedly used to supply a water fountain located at the Clifton Springs Hospital and Clinic (CSHC) property immediately north of the Site.

1.4 PREVIOUS INVESTIGATIONS AND REMEDIAL ACTION

1.4.1 Clifton Springs Hospital and Clinic

Several volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and inorganic (metal) compounds were detected in one or more groundwater samples previously collected at the CSHC property located immediately north of the Site. The investigations were performed in 2014 and 2015 in association with a proposed acquisition of the CSHC property by others (H&A, 2015).

Chlorinated VOCs were detected in some groundwater samples at concentrations above the ambient water quality standards and guidance

values. At least one on-site source of VOCs, SVOCs, and metals detected in soil and/or groundwater at the CSHC property was identified during the 2014 and 2015 investigations (H&A, 2015) which resulted in the identification of a former manufactured gas plant (MGP) at the CSHC property. NYSDEC has assigned Spill Number Spill Number 1402630 to the CSHC property. Groundwater analytical data contained in H&A (2015) are summarized in this RI Work Plan.

1.4.2 G.W. Lisk Site Characterization

The Order required the performance of a SC at the Site. The SC Report (ERM, 2018) describes the field efforts and associated analytical results for environmental media samples. Figures 4 through 9 and Tables 1 through 4 of this RI Work Plan summarize the results of the SC.

Compounds of potential concern (COPCs) including several CVOCs, SVOCs, and metals were detected in soil and groundwater at the Site at concentrations above potentially-applicable SCGs. The polychlorinated biphenyl (PCB) compound Aroclor 1260 was detected in one surface water sample at the Site at a concentration above the Class D surface water standard. Trichloroethene (TCE) was previously detected at two indoor air sample locations in the Main Building at concentrations above its Indoor Air Guideline value. TCE in indoor air is being addressed through implementation of a Department-approved Soil Vapor Intrusion (SVI) Interim Remedial Measure (IRM; see Section 1.4.3). Additional investigation of the environmental media listed above is proposed in this RI Work Plan.

Results from the previous investigations described above will be combined with results from the additional work described in this RI Work Plan to fulfill the technical requirements for an RI.

1.4.3 G.W. Lisk Soil Vapor Intrusion Interim Remedial Measure

A Revised SVI IRM Work Plan (ERM, 2019b) was prepared by G.W. Lisk to address potential SVI in the Main Building. The Revised SVI Work Plan was approved by NYSDEC and NYSDOH in correspondence dated 14 February 2019 (NYSDEC, 2019). G.W. Lisk is currently implementing the SVI IRM under Department oversight and will be preparing a Construction Completion Report (CCR) to document work performed during the SVI IRM, provide the results of post-mitigation sampling, and present an Interim Site Management Plan (ISMP) for Department review.

1.5 SITE GEOLOGY

The Site is located within the Erie-Ontario Lowlands physiographic province (Bloom, 1978). The Site is positioned directly on the Onondaga Escarpment where it intersects the Sulphur Creek outwash valley. Topography generally slopes towards the northeast (towards Sulphur Creek) on the western part of the Site, and generally towards the northwest (towards Sulphur Creek) on the eastern part of the Site. Topographic relief across the site is approximately 90 feet with the highest elevations in the southwestern portion of the Site and the lowest elevations along Sulphur Creek in the north-central portion of the Site. Examination of topography shown in Figure 1 suggests that regional groundwater flow in the mapped area may be north to northwest towards the Canandaigua Outlet.

Native soil at the Site was previously mapped by United States Department of Agriculture (USDA) Soil Conservation Service as Palmyra gravelly loam (USDA, 2017). Native soil is predominantly derived from glacial outwash deposits or bedrock (Caldwell, 1988). The glacial outwash deposits consist predominantly of gravel with sand and are generally thin or not present in upland portions of the Site and increase in thickness towards the north and west. Diamictons encountered are interpreted as glacial till (Caldwell, 1988). Overburden deposits underlying the facility generally consists of clean fill, including fine sand and gravel. Based on available data, total overburden thickness in the area ranges from less than 3- to over 51-feet in thickness. Figure 3 summarizes typical geological units encountered near the Main Building during SC activities. Geologic materials encountered southwest of the facility (i.e., borings B-01 through B-03) consist of approximately 20 feet of fill-like material which is underlain by native sorted lithic sands. The underlying native sand unit is consistent with a glacial outwash sand.

Bedrock consists of medium gray limestone of the Middle Devonian Onondaga Limestone. Onondaga Limestone typically encountered at the Site is consistent with mudstone or wackestone based on the carbonate rock classification of Dunham (1962). The top of bedrock was encountered at depths ranging from 13.3 to greater than 51 feet below ground (or floor) surface in soil borings installed during the SC. The limestone also contains bedding partings with locally significant concentrations of dark gray to black chert. Areas of cherty limestone are significantly harder than non-cherty limestone and very difficult to drill through when encountered beneath buildings (i.e., in areas where smaller drilling equipment must be used). Generally, the bedrock surface slopes towards the west-northwest at the Site.

The primary groundwater-bearing zones in the Onondaga Limestone are typically horizontal bedding-plane separations that are often connected with solution-widened vertical joints. Other geological controls on groundwater and contaminant movement in the Onondaga Limestone can include synclinal or anticlinal folds, low-angle thrust faults, high-angle normal faults, or solution-enlarged cavities.

Groundwater was encountered in the overburden units on top of the bedrock at depths ranging from 10.91 to 21.22 feet below ground (or floor) surface. Mapped groundwater flow direction in the overburden across the Site is generally towards the west-northwest towards and along Sulphur Creek. This estimated flow direction is consistent with the interpolated bedrock surface topography. Groundwater was also encountered within the bedrock unit. Estimated groundwater flow direction in shallow bedrock across the Site is generally also towards the west-northwest.

Hydraulic head measurements from the bedrock wells indicate that the bedrock unit groundwater elevations occur within the overburden unit at depths ranging from 0.32 to 7.76 feet above the top of the bedrock surface. Comparison of overburden and bedrock groundwater levels from all four monitoring well couplets indicate that vertical hydraulic gradient is downwards (from overburden into bedrock) in all monitoring well clusters with the exception of MW-03 where it is upwards (from bedrock into overburden). These data suggest that vertical groundwater flow direction at the Site can be either downwards or upwards depending on the specific location and depth.

The natural geochemical constituents in groundwater are obtained primarily from the solution of rock materials and/or overburden. The major mineral constituent of limestone is calcite ($CaCO_3$), but other dissolved minerals are also picked up as groundwater passes through bedrock, including dolomite [$CaMg(CO_3)_2$], gypsum (CaSO4.2H2O), pyrite (FeS_2), and halite (NaCl). Due to the likelihood that groundwater will encounter these various minerals as it passes through the bedrock or overburden, significant concentrations of these minerals including calcium, sodium, magnesium, manganese, and iron are typically naturally present in groundwater in this area.

Sulphur Creek flows generally from the south towards the north and northwest through the Site and has been designated as Class D surface water body by NYSDEC. The stream channel has been influenced by development and construction activities over the years and the channel morphology is variable. Bedrock locally crops out in the stream channel. Stream depth was typically less than one foot when measured during the SC and calculated stream discharge was consistently approximately seven

cubic feet per second at all stream gauge stations. Stream discharge can vary significantly as a function of precipitation received in the area.

1.6 CONCEPTUAL SITE MODEL

The NYSDEC contacted G.W. Lisk in February 2015 (NYSDEC, 2015) and identified the following points of interest and outfall locations at the Site:

- degreasers;
- 1,1,1-trichloroethane (TCA) tanks;
- petroleum storage tank area;
- plating discharge and boiler blowdown;
- tumbler machine rinse; and
- former sanitary tanks and associated leachfields.

These points of interest and outfall locations were reviewed by G.W. Lisk and ERM during the Records Search effort and sampling was conducted in nine Areas of Potential Concern (AOPCs) during the SC (ERM, 2018). G.W. Lisk historically held permits from NYSDEC to discharge wastewater into Sulphur Creek. All industrial discharges into Sulphur Creek were terminated in 1988 when an updated plating and wastewater treatment system was installed at the Site and industrial wastewaters were connected to the Village of Clifton Springs Publicly-Owned Treatment Works (POTW).

The streambed of Sulphur Creek beneath the G.W. Lisk facility was lined with concrete in 1993 for erosion and sediment control purposes to protect the structural integrity of the G.W. Lisk Main Building. Concrete lining of the streambed also occurred on the adjacent CSHC property.

The SC confirmed that some COPCs were released at the Site and have affected soil or groundwater at the Site. Data collected during the SC suggests that the former sanitary leachfields beneath the Main Building are a source area for COPCs. Groundwater flow direction at the Site and the neighboring CSHC property in both overburden and bedrock generally appears to be to be towards the northwest to north. COPCs at the Site vary by AOPC and consist predominantly of several CVOCs, SVOCs, one PCBs, or several metals. Data resulting from the RI will be reviewed and evaluated to further refine and develop a conceptual site model with regards to potential contaminant sources, fate and transport, and potential exposure pathways.

1.7 AREAS OF POTENTIAL CONCERN

Nine AOPCs were evaluated and discussed in the Final SC Report (ERM, 2018). AOPCs at the Site have been re-organized and focused based on the observed distribution of COPCs in various environmental media and the current conceptual site model (Section 1.6). Several new AOPCs are designated to consolidate the results of the SC with proposed RI activities. Table 5 summarizes updated AOPCs for the Site. Additional investigation during the RI is proposed in AOPCs with the exception of AOPC-10, which as discussed above in Section 1.4.3 is being addressed through implementation of the State-approved SVI IRM.

1.7.1 AOPC-4: Arsenic in Soil at Former Outfall 001

Wastewater was previously discharged for a period of time to a former septic tank and its associated leachfield near this location. Arsenic was detected in soil at a concentration above the Industrial SCO at location MW-03D.

1.7.2 AOPC-6: Southwestern Parking Lot

The former septic tanks associated with former outfalls 011 and 012 were crushed and the concrete was reused as sub-base material in this parking area. Some soil excavated during removal of the former septic tanks and some unknown debris from the CSHC may have been reused in this location as well. Several SVOCs were detected in soil at concentrations above Industrial SCOs at location B-01. The metals arsenic and mercury were detected at concentrations above Industrial SCOs at location B-03. Several VOCs were detected in unsaturated zone soil at concentrations above the Protection of Groundwater SCOs.

1.7.3 AOPC-10: Potential SVI in the Main Building

CVOCs detected in sub-slab soil vapor and indoor air samples previously collected beneath and in the Main Building are being addressed through implementation of the State-approved SVI IRM (ERM, 2019a).

1.7.4 AOPC-11: Potential SVI in the Hundreds Building

CVOCs have been detected in groundwater at several locations that are hydraulically up-gradient of the Hundreds Building. Additional indoor air, outdoor ambient air, and sub-slab soil vapor samples will be collected to further evaluate potential SVI in the Hundreds Building.

1.7.5 AOPC-12: CVOCs in Groundwater

CVOCs have been detected at concentrations above SCGs in groundwater beneath the Main Building at the Site, between the Main Building and the Hundreds Building, and also at the CSHC property which is located hydraulically down-gradient from the Site. Previous sampling events at the two properties have been conducted at different times separated by years. CVOCs in groundwater will be evaluated simultaneously on a property scale to holistically evaluate potential sources, migration, and extent of CVOCs in groundwater.

1.7.6 AOPC-13: Phenol in Groundwater at MW-04D

Phenol was detected in shallow bedrock groundwater at a concentration slightly above SCGs at location MW-04D. This monitoring well and nearby monitoring wells will be sampled for phenols to further evaluate the detection at MW-04D.

1.7.7 AOPC-14: PCBs in Surface Water at SW-02

PCB Aroclor 1260 was detected in the surface water sample collected at location SW-02 at a concentration above the Class D surface water standard. Filtered and unfiltered surface water samples and co-located sediment samples will be collected at location SW-02 as well as up-stream and down-stream of location SW-02.

1.8 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative criteria required to support the decision making process. DQOs define the uncertainty in an analytical data set and are expressed in terms of precision, accuracy, representatives, completeness, and comparability (PARCC).

- Precision is a measure of mutual agreement among measurement of the same property usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation.
- Accuracy is the degree of agreement of a measurement (or an average of measurements) with an accepted reference of "true

value". Accuracy is an estimate of potential numerical bias (i.e., low or high) in analytical data.
- Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point a process condition, or an environmental condition.
- Completeness is a measure of the amount of valid data obtained compared to the amount that was expected to be obtained under correct normal conditions.
- Comparability expresses the confidence with which one data set can be compared with another. Comparability is a qualitative measurement. Comparability is assessed by reviewing results or procedures for analytical data that do not agree with expected results.

The Quality Assurance Project Plan (QAPP; see Section 3.3) describes sampling and analysis procedures to be used during implementation of the RI along with QA/QC criteria. The field team will collect representative and complete samples. The chemist at the laboratory will analyze samples using accepted protocols resulting in data that meet PARCC standards.

1.9 STANDARDS, CRITERIA, AND GUIDANCE

The following standards and criteria apply to this project.

- 6 NYCRR Part 375 - Environmental Remediation Programs
- 6 NYCRR Part 608 - Use and Protection of Waters
- 6 NYCRR Parts 700-706 - Water Quality Standards
- 29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response
- 29 CFR Part 1910.1000 – Air Contaminants

The following guidance applies to this project.

- DER-10 – Technical Guidance for Site Investigation and Remediation (May 2010)
- NYSDEC Screening and Assessment of Contaminated Sediment, 24 June 2014 (NYSDEC, 2014).
- NYSDEC Division of Spills Management - Sampling Guidelines and Protocols: Technologies Background and Quality Control/Quality Assurance for the NYSDEC Spill Response Program (NYSDEC, 1992)

- TOGS 1.1.1 - Ambient Water Quality Standards & Guidance Values and Groundwater Effluent Limitations (NYSDEC, 1998)
- NYSDOH Guidance for Evaluating Soil Vapor Intrusion in New York State (NYSDOH, 2006) and the May 2017 Updates to Soil Vapor/Indoor Air Decision Matrices

Sample results will be compared to applicable NYSDEC standards, criteria and guidance (SCGs) by environmental media as summarized below.

Groundwater

Groundwater results will be compared to NYSDEC's ambient water quality standards and guidance values (NYSDEC, 1998) for groundwater (Class GA).

Surface Water

Sulphur Creek has been designated as a Class D stream by NYSDEC. Therefore, surface water results will be compared to NYSDEC's ambient water quality standards and guidance values (NYSDEC, 1998) for Class D surface water using type W values (wildlife protection). Surface water results will also be compared to one or more samples collected upstream of the known impact at the Site.

Soil

Soil results will be compared to 6 NYCRR Part 375 Soil Cleanup Objectives (SCOs; NYSDEC, 2006) for the current and anticipated future land use (industrial) and for the protection of groundwater as applicable. As required in DER-10, soil results will also be compared to unrestricted SCOs to facilitate performance of a remedial alternatives analysis based on RI data.

Sediment

Sediment results will be compared to applicable sediment guidance values for freshwater listed in NYSDEC's guidance on Screening and Assessment of Contaminated Sediment (NYSDEC, 2014). Sediment results will also be compared to one or more samples collected upstream of the known impact to sediment at the Site, if any (sediment samples have not been collected to date).

Sub-Slab Soil Vapor, Indoor Air, and Outdoor (Ambient) Air

Sub-slab soil vapor, indoor air, and outdoor (ambient) air sample results are compared to the NYSDOH's Guidance for the Evaluation of Soil Vapor Intrusion in New York State (NYSDOH, 2006), including the May

2017 Updates to the Soil Vapor/Indoor Air Decision Matrices. Results from indoor air samples for VOCs that are in use within an industrial facility may also be compared to United States Occupational Safety and Health Administration (OSHA) permissible exposure levels (PELs) or other levels referenced in 29 CFR Part 1910.1000.

2.0 SCOPE OF THE REMEDIAL INVESTIGATION

G.W. Lisk has obtained an access agreement with CSHC to allow performance of RI activities on the CSHC property. Locations on the CSHC property that are proposed in this RI Work Plan assume that CSHC will provide access to G.W. Lisk for RI activities at the proposed locations. Proposed sampling locations may need to be modified based on the conditions of the access agreement, overhead and subsurface utilities, or other site-specific safety considerations.

2.1 SUBSURFACE CLEARANCE

Dig Safely New York (DSNY) will be notified prior to the initiation of intrusive activities at the Site and requested to identify, locate, and mark public utilities. G.W. Lisk and CSHC personnel will be requested to identify underground utilities associated with plant operations. Additionally, an independent underground utility locating service will be contracted to evaluate and clear proposed drilling locations prior to commencement of intrusive activities. The private utility location contractor will scan, identify, locate, and mark potential subsurface utilities at the proposed sample locations. To the extent practicable, samples will be located in areas that are at least 10 feet away from underground utilities and in areas not subject to drafts from over-head heating, ventilation, or air conditioning equipment.

Proposed sampling locations may be adjusted in the field if necessary to facilitate protection of health and safety based on the results of subsurface clearance efforts.

2.2 SOIL SAMPLING

Soil samples will be collected at soil boring and monitoring well locations listed in Table 6 and shown in Figure 9.

Surface and near-surface soil samples will not be collected at the soil boring locations installed on pavement or other engineered surfaces. Surface and near-surface soil samples will be collected at proposed sampling locations where soil is present at the ground surface within the BCP Site boundary. Surface soil samples will be collected using a stainless steel hand auger or equivalent at a depth of 0 to 2 inches below the surficial vegetative cover and root system. Near-surface soil samples will be collected using the same approach at a depth of 2 to 12 inches below

the surficial vegetative cover. Soil will be screened by an ERM geologist using a calibrated photoionization detected (PID) equipped with an 11.7 eV lamp. Soil samples will also be visually examined for physical properties including color, texture, composition, moisture content, odor, and visual evidence of staining, discoloration, or product/sheen. Soil descriptions and other field data/observations will be documented in soil boring logs.

Each borehole will be sampled continuously using dedicated sample liners. Retrieved soil samples will be visually examined by a geologist to assess subsurface conditions and physical properties. These properties include: color, texture, moisture content, odor, and visual evidence of discoloration or sheen. If necessary, companion boreholes explorations will be made adjacent to the original sample location to obtain sufficient sample volume from selected depth intervals. Field observations will be documented on boring logs. All soil cores will be field screened for visual and olfactory evidence of potential contamination and for VOCs using a calibrated photoionization detector equipped with an 11.7 eV lamp. One subsurface soil sample will be collected for laboratory analysis from each borehole advanced using direct push or hollow-stem auger drilling methods.

Soil samples collected for laboratory analysis will be biased towards the one-foot interval of highest suspected contamination based on the results of field screening, previous sampling results, and consultation with NYSDEC's field representative (if present). In the absence of apparent contamination, one soil sample will be collected from the one-foot depth interval above the groundwater table. Soil samples collected for VOC analysis will be collected using a Terracore sampler. Five grams of soil will be weighed in the field and added to 40-milliliter vials containing methanol or sodium bisulfate preservative. The remaining sample containers will be unpreserved and filled with soil from each sampling interval.

Soil samples will be collected into laboratory-provided sample containers, which will be labeled and stored in a clean pre-chilled cooler. All samples will be managed under chain-of-custody procedures and submitted to the project laboratory for analysis of parameters indicated in Table 6.

Reusable sampling equipment will be cleaned between each borehole location by washing in an Alconox® and potable water solution followed by rinsing with Poland Spring water or laboratory-supplied distilled water.

2.3 SOIL VAPOR AND AIR SAMPLING

Passive Soil Vapor Sampling

Passive soil vapor sampling will be performed prior to other sampling activities on an approximate 100-foot sampling grid will be used as a screening tool for soil and groundwater to identify the potential presence of VOCs beneath the Hundreds Building. Proposed passive soil vapor sampling locations are presented in Figures 9 and 10.

Soil vapor sampling points will be installed using an electric hammer drill or slam bar to a depth of approximately 2 to 3 feet bgs. Passive soil vapor samplers provided by Amplified Geochemical Imaging, LLC of Newark, Delaware (AGI; formerly W.L. Gore and Associates) will be installed in each borehole using insertion rods. Boreholes will be sealed near the surface using a laboratory-supplied cork.

The AGI passive sampler is a proprietary, passive, sorbent-based sampler which collects VOCs present in air, soil gas, and water. The sampler is constructed of a polytetrafluoroethylene (PTFE) membrane tube. The membrane is chemically-inert, vapor permeable and waterproof. The membrane has over 80% open area and pore sizes that are 1000 times larger than the largest SVOC molecule. The membrane does not adsorb compounds or off-gas chemicals. Engineered adsorbents are housed within the PTFE membrane tube. The adsorbents were selected due to their affinity for a broad range of organic compounds while having minimal water vapor uptake.

The adsorbents are located near the bottom of an approximately one-foot length of the membrane tube which is fashioned with a loop. The loop is used as a means of tying the sampler to a string to facilitate installation and retrieval. The unique membrane is hydrophobic and excludes liquid water, and does not retard vapor transfer, thus allowing VOC vapors to penetrate the sampler freely and collect on the adsorbent material.

The passive samplers will be left in the boreholes for 7 to 10 days and then collected. The samplers will be transported to AGI for VOC analysis by thermal desorption/gas chromatography/mass selective detection.

The results of the passive soil vapor sampling effort will be presented to NYSDEC for review. The results will be used to select four locations for the collection of co-located sub-slab soil vapor and indoor air samples, and may also be used if needed to focus the installation of soil borings or monitoring wells.

Sub-Slab Soil Vapor and Indoor Air Sampling

Four co-located sub-slab soil vapor and indoor air sampling locations will be placed within the Hundreds Building at locations biased towards the highest anticipated level of VOCs based on the passive soil vapor results. Co-located sub-slab soil vapor and indoor air samples will be collected during the 2019-2020 heating season. An outdoor ambient air sample will also be collected at an upwind location. The additional four locations inside the Hundreds Building will supplement the co-located sub-slab soil vapor and indoor air sample that was previously collected in the southeast quadrant of the Hundreds Building during the SC (ERM, 2018).

Prior to conducting this sampling, a pre-sampling building inspection will be performed to assess building construction and to inventory products or chemicals used and/or stored in the Building. During the inspection, ERM will complete a building questionnaire consistent with the NYSDOH SVI guidance (NYSDEC, 2006).

Sub-slab vapor points will be installed using an electric hammer drill to drill a 1.5-inch diameter hole approximately 1.75-inches into the concrete slab for installation of a drilling guide and secure cover. The borehole will be further advanced using a 5/8-inch drill bit to a depth approximately 1-inch beneath the slab to create an adequate space from which to collect a vapor sample. A stainless steel vapor pin will be installed into the borehole and sealed. A calibrated PID will be used to measure VOCs in sub-slab vapor through each of the vapor pins. A helium tracer test will be performed to test the integrity of the seal of the vapor pins.

Co-located sub-slab soil vapor and indoor air samples will be collected concurrently over a 24-hour sampling period. Air samples will be collected in laboratory-certified clean 2.7-liter or 6-liter SUMMA® canisters with a calibrated flow controller. Indoor air samples will be collected with the sample inlet of the canister positioned approximately 3- to 5-feet above the floor surface. An outdoor ambient air sample will be collected over the same 24-hour period at a location upwind of the building. This sample inlet will also be located approximately 3- to 5-feet above the ground surface. One blind duplicate sample will also be collected for quality control purposes. The vacuum on the SUMMA® canister flow controller will be recorded at the start and completion of the sampling period. Following the sampling event, the canister's valve will be closed and the Swagelok®-type nut will be placed over the inlet and secured. The vacuum will be recorded on the chain of custody.

Active Soil Vapor Sampling

Active soil vapor samples will be collected at four locations near the perimeter of the Site between the Site and nearby residences (Figures 9

and 10). Samples will be collected from a depth consistent with a typical building footer (approximately 3 to 4 feet below ground surface) or a minimum of 1 foot above groundwater. Stainless steel rods equipped with a detachable stainless steel sampling point will be driven to the sampling depth. Dedicated Nylaflow® tubing will be attached to each sampling point. Boreholes will be backfilled with glass beads to a minimum of 6 inches above the soil vapor sampling point. The remainder of the annular space will be filled with bentonite chips and immediately hydrated with approved potable water. Soil vapor sampling points will set for a minimum of 24-hours. The sampling point and tubing will be purged prior to sampling. An enclosed container will be placed over each soil vapor sampling point to create a seal. A helium tracer gas test will be performed to confirm a tight seal between the bentonite and soils at each location. Soil vapor samples will be collected over a 24-hour period using Summa canisters and will be analyzed for VOCs by USEPA Method TO-15. The soil vapor sampling points will be removed from the subsurface and boreholes will be backfilled with soil cuttings.

2.4 SURFACE WATER SAMPLING

Filtered and unfiltered surface water samples will be collected at the locations shown in Figures 9-11 to evaluate the SC result for the PCB detected at location SW-02. Field parameters including DO, pH, ORP, conductivity, turbidity, and temperature will be measured and recorded during sampling activities. Flow velocity, channel bathymetry, and water level will be measured at the new sample locations to facilitate evaluation of stream discharge and flux. Samples will be placed into a pre-chilled cooler for transport under proper chain-of-custody procedures to the project laboratory for analysis of parameters indicated in Table 6.

2.5 SEDIMENT SAMPLING

Sediment samples will be collected at the proposed locations shown in Figures 9-11 to further evaluate the SC result for the PCB detected in surface water at location SW-02. If necessary, the proposed sediment sampling locations in Figures 9-11 may be modified in the field based on the results of a field assessment of sediment occurrence and thickness that will be performed prior to sampling. Sediment samples will be collected from 0- to 6-inches (if possible based on the thickness of sediment present) using a ponar dredge or other sampling device appropriate for the sediment thickness encountered. Sediment samples will also be collected from 6- to 12-inches and 12- to 24-inches if these thicknesses are encountered. Sediment will be removed from the sampling device and placed into a clean, stainless steel bowl for evaluation. Sediment will be inspected to evaluate the level of benthic organism activity, if any, to the

extent practicable in the field. The physical characteristics of the sediment (i.e., grain size, sediment and detrital material composition, organic matter, mineral content, water content, percent solids, stratification, etc.) will be inspected and recorded on a sampling form. Sediment will be screened using a calibrated PID with an 11.7 eV lamp. The sediment will be formed into a slurry and large debris, sediment clasts, wood fragments, and leaves will be removed and discarded. Sediment will then be placed directly into sample containers provided by the project laboratory and transferred to the laboratory for analysis of the parameters listed in Table 6.

2.6 GROUNDWATER SAMPLING

Characterization of groundwater will include sampling and laboratory analysis and hydrogeological evaluation during the RI. Following fixed monitoring well installation and development, representative groundwater samples will be collected and submitted to the project laboratory for the analyses listed in Table 6. Upon completion of the groundwater sampling effort, comprehensive well-gauging and the hydrogeological evaluation will be performed to prevent the occurrence of pre-sample cross-contamination. Results will be used to develop a conceptual site model of groundwater interaction and transportation.

2.6.1 Monitoring Well Installation and Groundwater Sampling

Overburden and bedrock monitoring wells will be installed at the locations shown in Figures 9 through 11. Proposed monitoring well couplets will consist of either two overburden wells (in AOPC-6) or one overburden well and one shallow bedrock well (all other AOPCs). Proposed monitoring well triplets will consist of one overburden well, one shallow bedrock well, and one deeper bedrock well.

The following standard well designations will be used at each new location. Anticipated typical well screen (or open borehole) depth intervals in feet below ground surface (ft bgs) are provided in parentheses, although the actual screened or open-hole interval may vary and will be determined in the field based on the specific geologic units encountered.

- S – shallow overburden monitoring well (7-15 ft bgs);
- S2 – deeper overburden monitoring well (25-30 ft bgs);
- D – shallow bedrock monitoring well (open hole interval 2-20 feet into competent bedrock); or
- D2 – deeper bedrock monitoring well (open hole interval 25-45 feet into competent bedrock).

Overburden monitoring wells will be constructed using 2-inch diameter polyvinyl chloride (PVC) threaded well screen (0.010-inch slots) and flush-jointed threaded well riser pipe. Washed quartz sand (size to be determined based on geologic materials encountered) will be installed as a filter pack to a depth of approximately 1 foot above the top of the screen. The remaining well annulus will be sealed with bentonite chips and hydrated.

Shallow bedrock monitoring wells will be constructed by cementing steel casing approximately 2 feet into competent bedrock followed by an open-hole well completion using rock coring drilling techniques to a depth of approximately 20 feet into bedrock, or as adjusted based on observations by ERM's geologist in consultation with NYSDEC's field representative. Deeper bedrock monitoring wells will be constructed by cementing steel casing approximately 25 feet into competent bedrock followed by an open-hole well completion using air rotary or rock coring drilling techniques to a depth of approximately 20 feet below the bottom of the casing. Rock cores will be collected during bedrock drilling at selected locations to facilitate evaluation of Site geology and groundwater flow.

Borehole geophysical logging will be performed in selected bedrock boreholes for the following parameters: fluid temperature, fluid resistivity, caliper, acoustic televiewer, and flowmeter readings. Geophysical data will be reviewed to evaluate the depth and orientation of transmissive fractures in bedrock.

Monitoring wells will be developed to facilitate collection of representative groundwater samples. Groundwater levels will be measured in each well using an electronic water level indicator. Wells will be developed using an air lift technique. The volume of water removed during well development will be measured and recorded. Turbidity will also be measured using a calibrated electronic turbidity meter. After completion of well development, each well will be secured with a locking expansion cap.

At least two weeks after the completion of well development, depth to water will be measured in all monitoring wells. Groundwater samples will be collected from all monitoring wells using low-flow/minimal drawdown purging and sampling techniques. Field parameters including DO, pH, ORP, conductivity, turbidity, and temperature will be measured and recorded during sampling activities. Samples for laboratory analysis will be placed into a pre-chilled cooler for transport under proper chain-of-custody procedures to the project laboratory for analysis of the parameters indicated in Table 6.

2.6.2 Hydrogeologic Evaluation

Groundwater level monitoring and aquifer testing will be performed to evaluate hydrogeological conditions in overburden and bedrock groundwater. The goals of the hydrogeological evaluation include:

- measure water levels and calculate groundwater elevations for each well location;
- calculate horizontal and vertical hydraulic gradients;
- obtain a range of hydraulic conductivity values;
- estimate a range of transmissivity values;
- estimate a range of groundwater flow rates; and
- evaluate potential bedrock fracture interconnectivity between bedrock well locations.

Hydrogeological evaluation methods include both water level gauging events and single-well aquifer slug tests. A slug test is designed to measure the response of an aquifer to an instantaneous displacement of a known volume of water within a well. Recovery of the groundwater levels to at least 90 percent of the pre-test condition (static) will be measured using an electronic programmable data logger equipped with a pressure-sensitive water level transducer. The data set will be analyzed to calculate an estimated hydraulic conductivity value for each well screen interval. A range of hydraulic conductivity values will be obtained by performing slug tests in monitoring wells across the Site.

Wells screened across the groundwater table will be tested using a physical method of water displacement with a physical solid slug. Wells screened below the water table and bedrock wells will be tested using either a solid slug or pneumatic equipment assemblies. Groundwater level gauging and slug tests will be performed after new wells are installed.

- Prior to the start of groundwater level gauging and slug testing, rinse blanks will be collected from equipment used during aquifer testing.
- Two sets of groundwater level measurements will be collected using electronic water level meters: one set before and one set following completion of the slug-testing program.
- Either compressed air or nitrogen will be used for the pneumatic slug testing method.
- Selected bedrock monitoring wells will be outfitted with remote water level/transducer logging devices to continuously monitor water levels during slug testing.

Hydrogeologic data will be evaluated and analyzed using: 1) the aquifer test analysis software program Aqtesolv™; 2) analytical methods set forth by Bouwer and Rice (1976, 1989); and/or 3) other analytical methods deemed appropriate by a New York-licensed Professional Geologist or New York-licensed Professional Engineer.

2.7 SAMPLE ANALYSES

The laboratory analysis of samples collected during the RI will be performed by a NYSDOH-approved environmental laboratory using analytical methods consistent with the NYSDEC's Analytical Services Protocol (ASP; NYSDEC, 2010b). The project laboratory will be requested to achieve detection and reporting limits that are below applicable cleanup levels whenever feasible. Laboratory analytical reports will contain ASP Category B deliverables and electronic data deliverables (EDDs) to facilitate data usability review as required by NYSDEC. Samples collected during the RI will be analyzed for the parameters indicated in Table 6. The proposed analytical parameters listed in Table 6 include geochemical parameters that are useful for the evaluation of hydrochemical facies (Fetter, 2001) and natural attenuation processes in groundwater.

2.8 DATA USABILITY

A Data Usability Summary Report (DUSR) will be prepared for all samples collected during the RI. The DUSR will be prepared consistent with the NYSDEC guidance contained in DER-10 Appendix 2B. The results of the data usability evaluation will be presented in an Electronic Data Summary (EDS) consistent with the requirements of DER-10 Section 3.14(b).

2.9 INVESTIGATION-DERIVED WASTE

Management of investigation-derived waste (IDW) will comply with DER-10 Section 3.3(e). Investigation-derived wastes will be disposed within the borehole of origin in reverse order of removal to the extent practicable unless non-aqueous phase liquids, sheen, unusual odor, discoloration, or other evidence of gross contamination is observed. Any soil cuttings, decontamination water, and well development or purge

water exhibiting visual, olfactory, or field screening evidence of potential contamination will be containerized into steel 55-gallon drums or other appropriate containers for waste characterization and disposal. The containers will labeled and moved to a designated on-Site staging area until characterized and disposed. Waste characterization samples will be analyzed for the following parameters:

- Toxicity Characteristic Leaching Procedure (TCLP) VOCs;
- TCLP SVOCs;
- PCBs;
- Resource Conservation and Recovery Act (RCRA) Metals;
- Ignitability (solids) or flammability (liquids);
- Reactivity; and
- pH.

2.10 QUALITATIVE HUMAN HEALTH EXPOSURE ASSESSMENT

A qualitative human health exposure assessment will be completed consistent with NYSDOH guidance contained in Appendix 3B of DER-10. The assessment will consist of characterizing the anticipated human exposure settings for the contemplated use of the property, identifying potential exposure pathways, and evaluating contaminant fate and transport. Site contaminants will be selected for further evaluation based on consideration of the following factors:

- concentrations of contaminants in environmental media;
- potential exposure pathways;
- field data quality, laboratory data quality, and sampling design; and
- comparison of contaminant concentrations in environmental media at the Site with typical background levels.

2.11 ECOLOGICAL RESOURCES ASSESSMENT

Due to the presence of surface water (Sulphur Creek) flowing through the Site, a Fish and Wildlife Resources Impact Analysis (FWRIA) Part 1 Resource Characterization will be performed at the Site. The FWRIA Part 1 assessment will be performed in accordance with DER Section 3.10.1. Sediment and surface water samples collected during the RI will be incorporated into the Part 1 analysis.

A FWRIA Part 2 Ecological Impact Assessment may be needed based on the results of the FWRIA Part 1, and this will be determined by NYSDEC and NYSDOH. If a FWRIA Part 2 assessment is needed, a supplemental work plan for the assessment will be prepared and submitted to the Departments for review.

2.12 SITE SURVEY

After completion of RI site work, each borehole or other sampling location will be surveyed by a New York State-licensed professional surveyor to establish horizontal and vertical locations. The location and elevation of other selected features may also be surveyed.

2.13 RI REPORT

A Draft RI Report will be prepared in a manner consistent with NYSDEC requirements contained in DER-10 Section 3.14. The Draft RI Report will build upon the results presented in the SC Report and will:

- identify and characterize the sources of contamination;
- describe the amount, location, concentration, environmental fate and transport, and other significant characteristics of the substances present;
- evaluate geological and hydrogeological factors;
- identify potential routes of exposure to human populations;
- provide an evaluation of ecological resources; and
- identify surface water classification and existing use designation.

Conclusions and recommendations will be provided, and if appropriate based on the results of the RI, the report may include a remedial Alternatives Analysis (AA) consistent with DER-10 Section 4.4(c). A stand-alone electronic data submission consistent with DER-10 Section 1.15 will also be provided to NYSDEC.

The RI Report will finalized after receipt, discussion, and incorporation of NYSDEC comments as appropriate. The Final RI Report will be certified in accordance with DER-10 Section 1.5.

3.0 ASSOCIATED DOCUMENTS

3.1 HEALTH AND SAFETY PLAN

A Site-specific Health and Safety Plan (HASP) is presented in Appendix A. The procedures set forth in the HASP are designed to minimize the risk of exposure to chemical and physical hazards that may be present at the Site. These procedures generally conform to applicable federal, state and local regulations, including OSHA requirements governing activities at hazardous waste sites contained in 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response). Specific practices and procedures, including the level of personal protective equipment (PPE), are based on a review of currently-available information for the Site.

Every potential safety hazard associated with this IRM may not be predicted. The HASP does not attempt to establish rules to cover every contingency that may arise, but it does provide a basic framework for the safe completion of field activities and plans for reasonable contingencies.

3.2 COMMUNITY AIR MONITORING PLAN

The Community Air Monitoring Plan (CAMP) for the Site is presented in Appendix B. The CAMP is consistent with the requirements of DER-10 Appendix 1A (NYSDEC, 2010). The CAMP describes monitoring requirements and response action levels associated with monitoring of VOCs and particulates (i.e., dust) downwind of intrusive RI activities. The action levels specified in the CAMP require increased monitoring, corrective actions to abate emissions, and/or work stoppage if necessary. The CAMP provides a measure of protection for the down-wind community from potential airborne contaminant releases as a result of Site work activities.

3.3 QUALITY ASSURANCE PROJECT PLAN

The QAPP for the Site is presented in Appendix C. The QAPP is consistent with the requirements of DER-10 Section 2.4 (NYSDEC, 2010). The QAPP describes sampling and analysis procedures to be used during implementation of the RI along with QA/QC criteria. The QAPP will facilitate generation of data of acceptable precision, accuracy, reproducibility, completeness, and comparability (PARCC).

3.4 INVESTIGATION PERSONNEL AND QUALIFICATIONS

The experience and qualifications of key ERM project personnel that will be involved in implementing the RI are presented in Appendix D. Mr. Ernest Rossano will be the ERM Partner-in-Charge. Mr. Jon Fox, P.G. will be the Principal Consultant and New York-licensed Professional Geologist. Mr. Stephen Mirabello, P.E. will be the New York-licensed Professional Engineer. Mr. Andrew Coenen will be the Project QA/QC Officer.

4.0 PROJECT SCHEDULE

An estimated project schedule for implementation of the RI is presented in Table 7.

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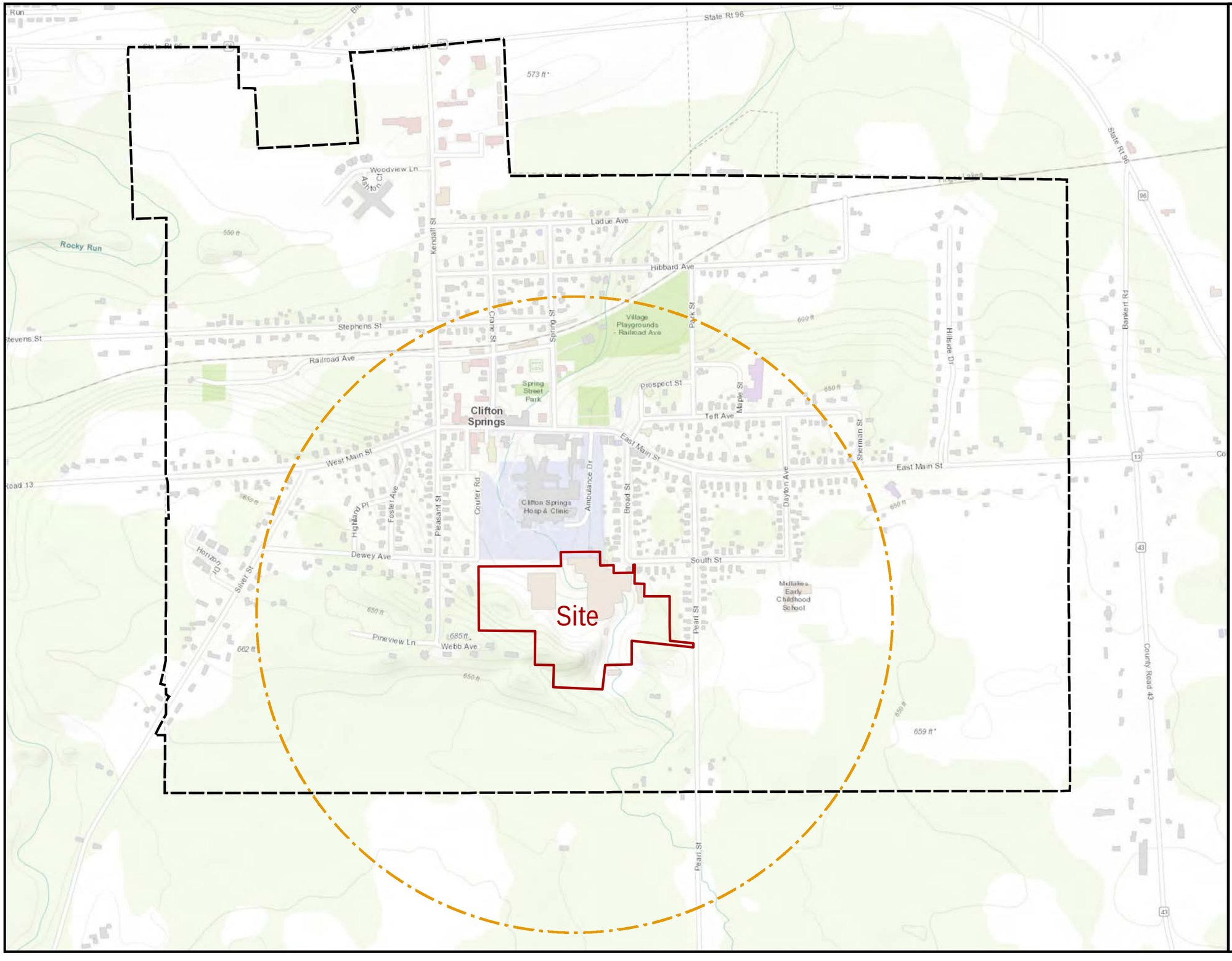
FIGURES



Legend

- Tax Parcel Boundary
- 1/2 Mile Radius Site Buffer
- Village of Clifton Springs

N

0 125250 500 750 1,000

Feet

Figure 1: Site Location
G.W. Lisk Company, Inc.
2 South Street, Clifton Springs, NY
03 January 2020

ERM

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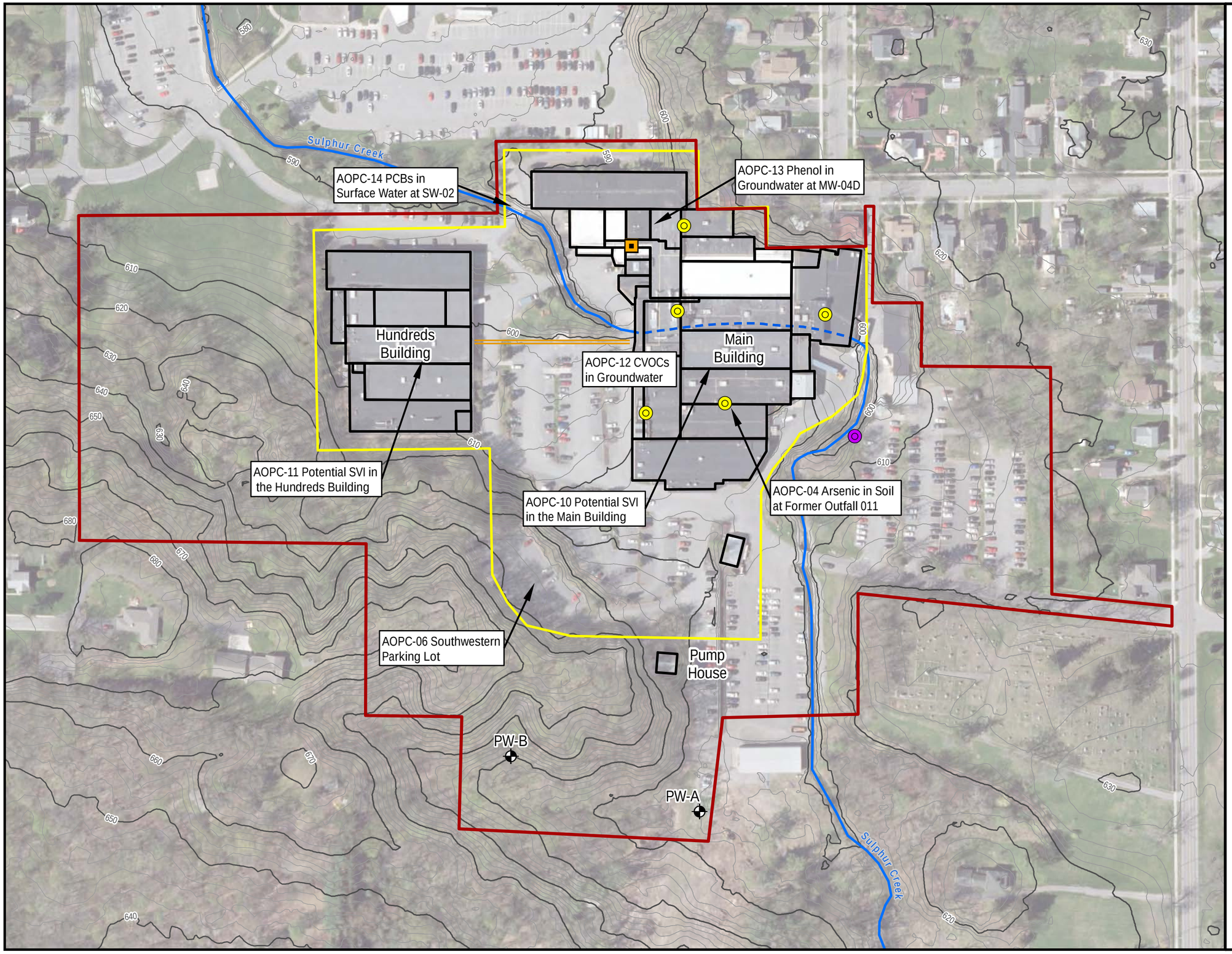


Legend

- Property Parcel Boundary
- BCP Boundary
- Water Supply Wells
- Stormwater Outfall Location
- Former Degreaser Sump
- Former Outfall Location
- Former Trench
- Surface Stream
- Inferred Stream Path
- 10 ft. Elevation Contour
- 2 ft. Elevation Contour

NOTES:

- Facility room outlines are approximate in location and converted from AutoCAD models.
- Surface elevation contours are modified from Ontario County, 2017.
- Elevation is reported as feet above Mean Sea Level (MSL).
- Aerial imagery provided by Esri World Imagery.

N

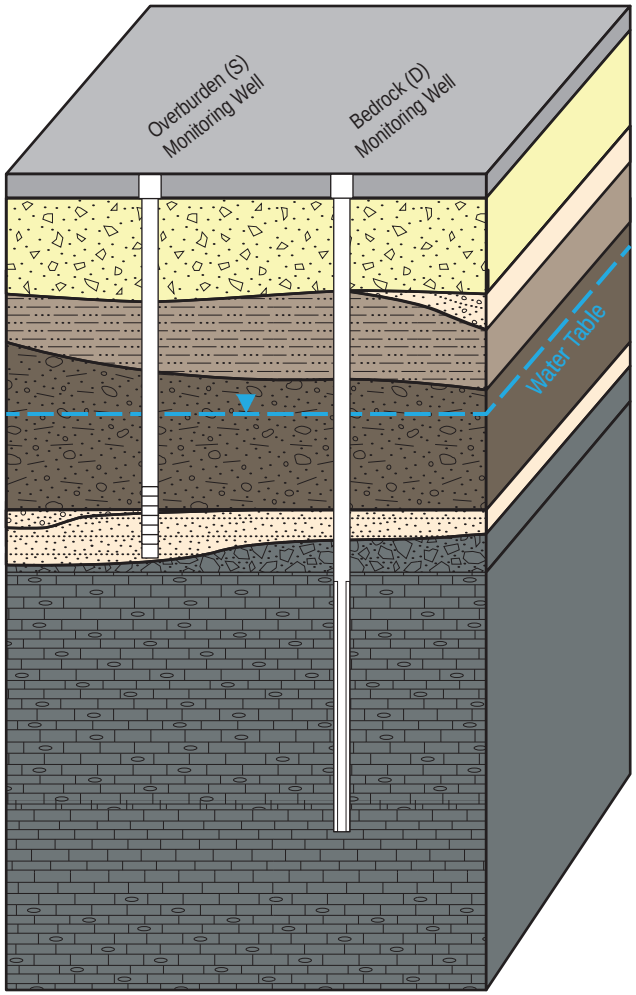
0 25 50 100 150 200
Feet

Figure 2: Site Layout

G.W. Lisk Company, Inc.
2 South Street, Clifton Springs, NY
03 January 2020

ERM

Hydrogeological Unit	*Geological Unit* [1]	*Lithology (Thickness)*
Overburden	Fill	Cement Floor (0 - 1') Fill: Mixed Sand & Gravel (4.25 - 8.0') Fine to coarse angular gravel in sand and silt matrix.
	Lacustrine Silt and Clay (lsc)	Interbedded Silt & Clay (1.5 - 5.0 ') Thinly bedded silt and clay, variable thickness. Local incisions of lithic sand and gravel.
	Till (t)	Diamicton (2.0 - 9.5') Fine subangular gravel and sand suspended in silt and clay matrix. Local inclusions of peat.
	Outwash Sand & Gravel (osg)	Fine Silty Sand (1.0 - 3.5') Fine lithic sand and silt with thin gravel interbeds.
Bedrock	Onondaga Limestone (Don)	Weathered Limestone (0 - 1.25') Cherty mudstone fragments in sandy clay matrix. Cherty Mudstone Medium gray mudstone with thin wackestone and packstone interbeds of crinoid columnals and rugose coral. Dark gray to black chert nodules along bedding.



Explanation

- Cement Floor
- Diamicton
- Cherty Limestone (Bedrock)
- Previously Disturbed Gravel & Debris
- Sorted Sand and Gravel
- Monitoring Well Riser
- Sandy Silt
- Weathered Limestone
- Monitoring Well Screen Interval
- Open Bore hole

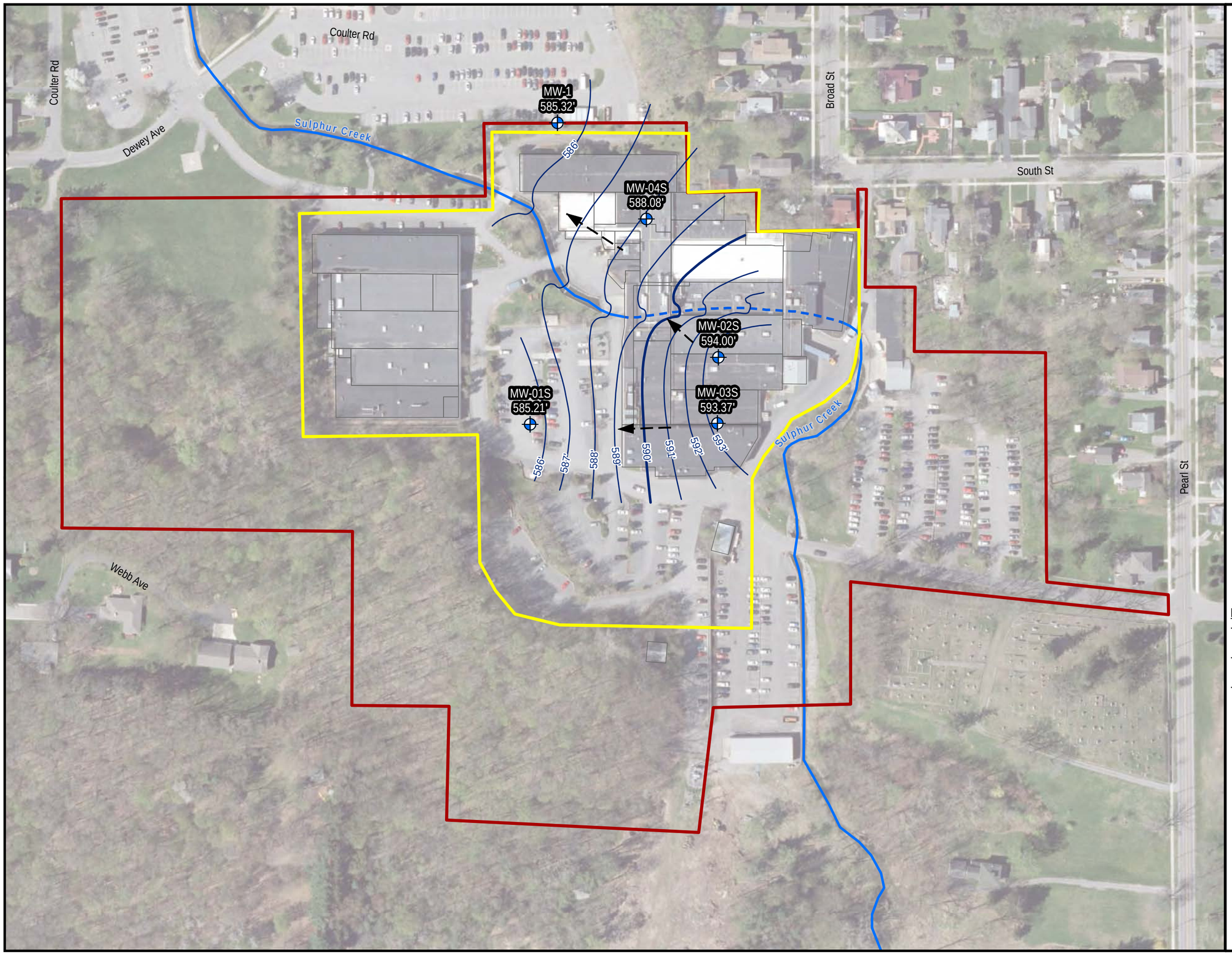
Notes:

1 - Except for fill, geological unit nomenclature is from the Surficial Geologic Map of New York, Finger Lakes Sheet (Caldwell and others, 1986).

2 - Lithological descriptions, thickness ranges, and approximate water table depth are from ERM's on-site boring logs.

Figure 3: Stratigraphic Type Section
G.W. Lisk Company, Inc.
Clifton Springs, NY
03 January 2020

ERM



Legend

- Overburden Monitoring Well
- Groundwater Elevation Contour - 5 ft.
- Groundwater Elevation Contour - 1 ft.
- Property Parcel Boundary
- BCP Boundary
- Surface Stream
- Inferred Stream Path
- Estimated Groundwater Flow

NOTES:

- Facility room outlines are approximate in location and converted from AutoCAD models.
- Groundwater elevations were measured on 11/21/2017 and are reported as feet above mean sea level.
- Aerial imagery provided by Esri World Imagery.

N

0 25 50 100 150 200
Feet

Figure 4: Overburden Groundwater Contours
G.W. Lisk Company, Inc.
2 South Street, Clifton Springs, NY
03 January 2020

ERM

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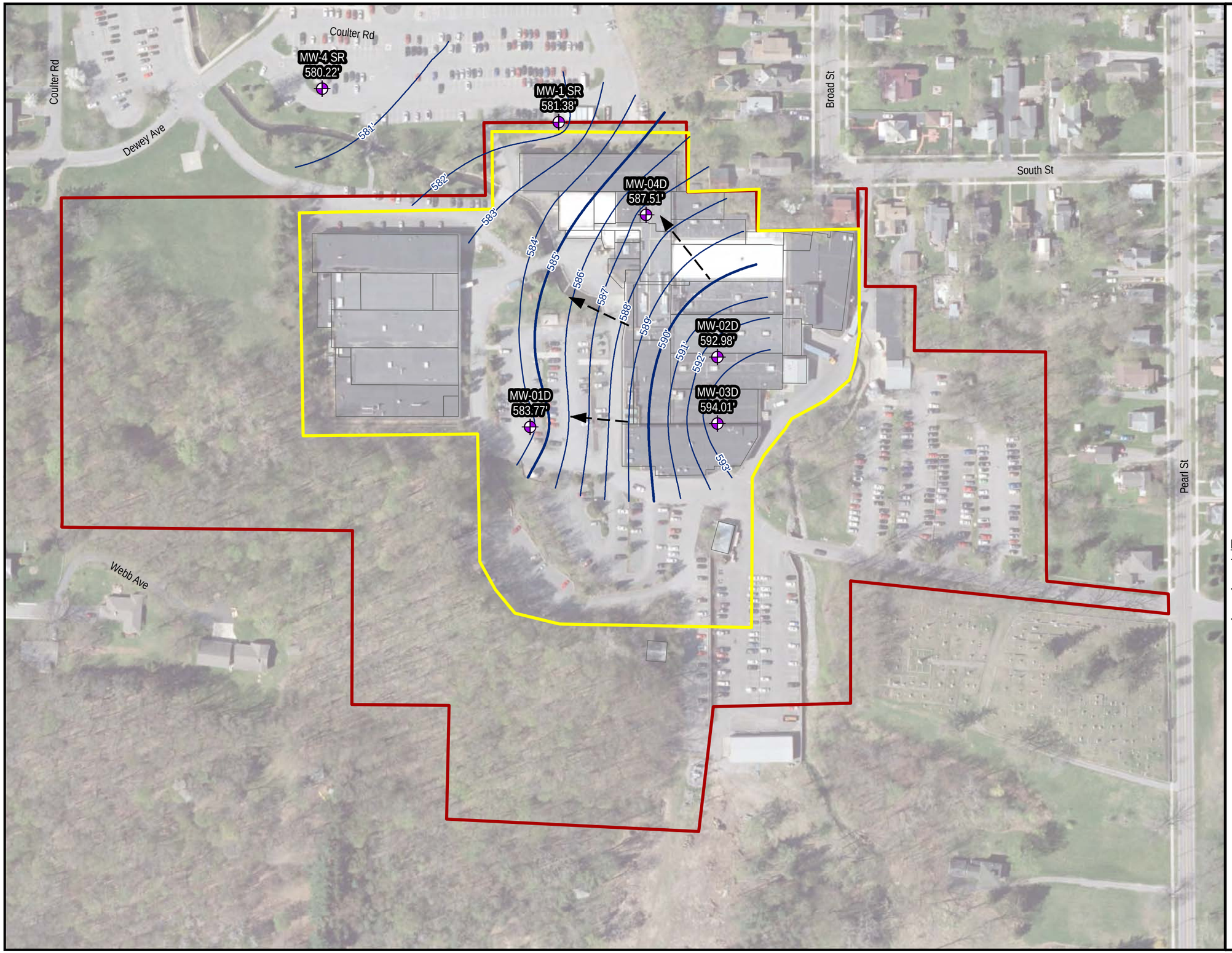

Legend

- Bedrock Monitoring Well
- Groundwater Elevation Contour - 5 ft.
- Groundwater Elevation Contour - 1 ft.
- Property Parcel Boundary
- BCP Boundary
- Estimated Groundwater Flow Direction

NOTES:
- Facility room outlines are approximate in location and converted from AutoCAD models.
- Groundwater elevations were measured on 11/21/2017 and are reported as feet above mean sea level.
- Aerial imagery provided by Esri World Imagery.

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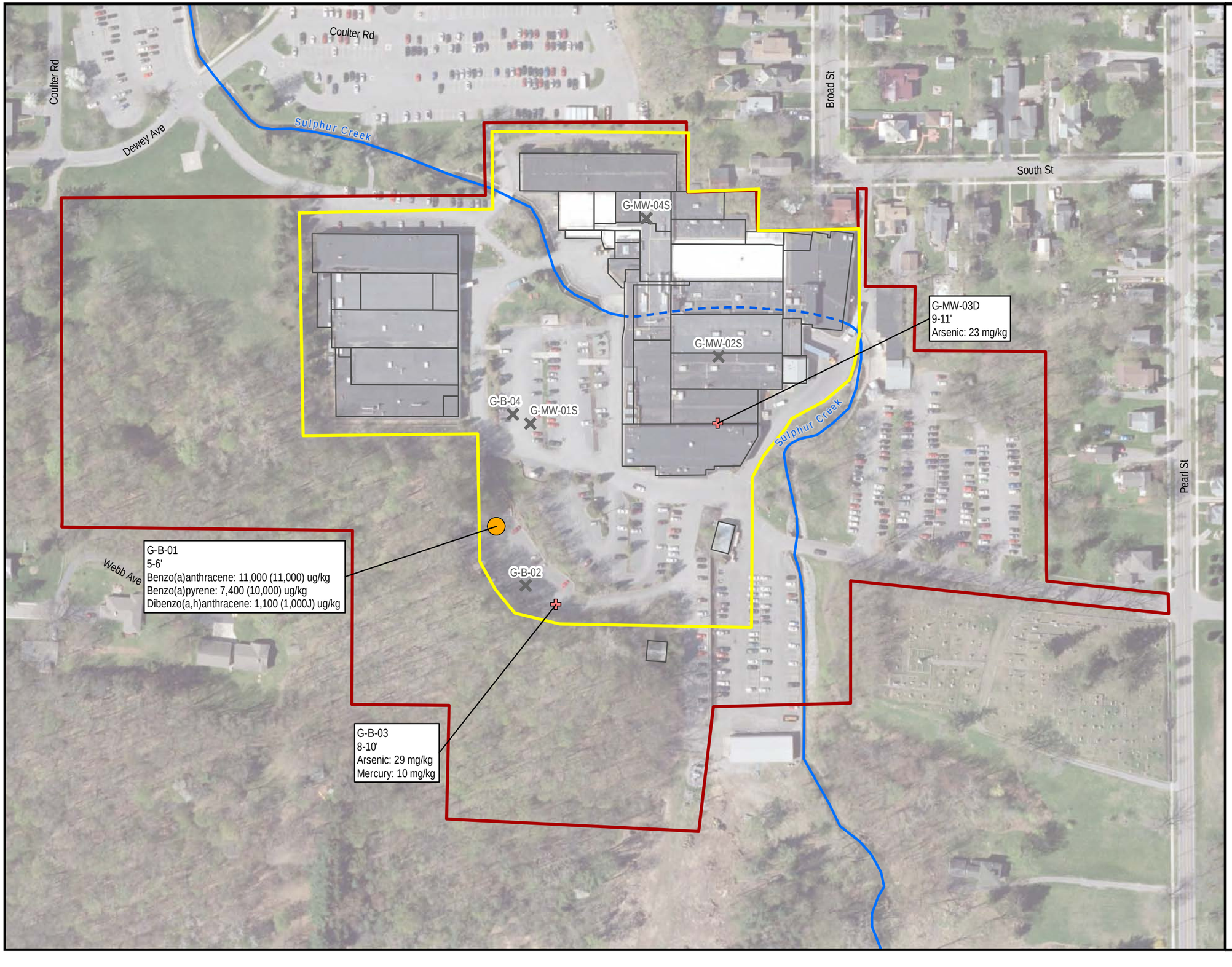
Feet

Figure 5: Bedrock Groundwater Contours

G.W. Lisk Company, Inc.
2 South Street, Clifton Springs, NY
03 January 2020

ERM



Legend

Restricted Industrial SCO Exceedance

Exceedance Compound

- SVOC
- Metals
- No Exceedance
- Property Parcel Boundary
- BCP Boundary
- Surface Stream
- Inferred Stream Path

NOTES:

- Values in parantheses represent field duplicate results.
- Facility room outlines are approximate in location and converted from AutoCAD models.
- Aerial imagery provided by Esri World Imagery.

N

0 25 50 100 150 200

Feet

Figure 6: Soil Sample Exceedances - Restricted Industrial SCOs

G.W. Lisk Company, Inc.

2 South Street, Clifton Springs, NY

03 January 2020

ERM

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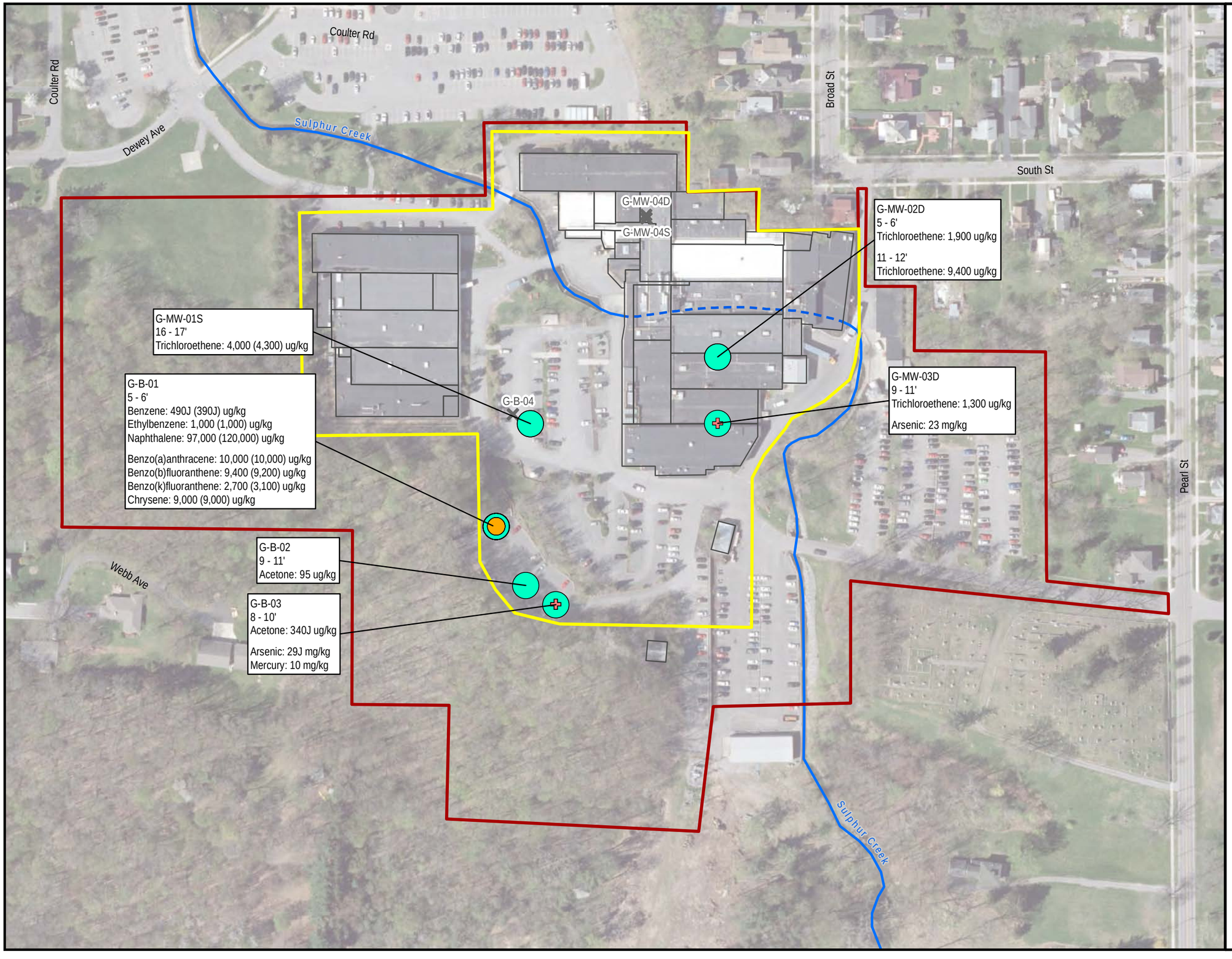

Legend

Protection of Groundwater SCO Exceedance

Exceedance Compound

- VOC
- SVOC
- Metals
- No Exceedance
- Property Parcel Boundary
- BCP Boundary
- Surface Stream
- Inferred Stream Path

NOTES:

- Values in parantheses represent field duplicate results.
- J = The analyte was positively identified; associated numerical value is the approximate concentration of the analyte in the sample.
- "G" designation indicates sampling location within G.W. Lisk property.
- Facility room outlines are approximate in location and converted from AutoCAD models.
- Aerial imagery provided by Esri World Imagery.

0 25 50 100 150 200

Feet

N

Figure 7: Soil Sample Exceedances - Protection of Groundwater

G.W. Lisk Company, Inc.

2 South Street, Clifton Springs, NY

03 January 2020

ERM

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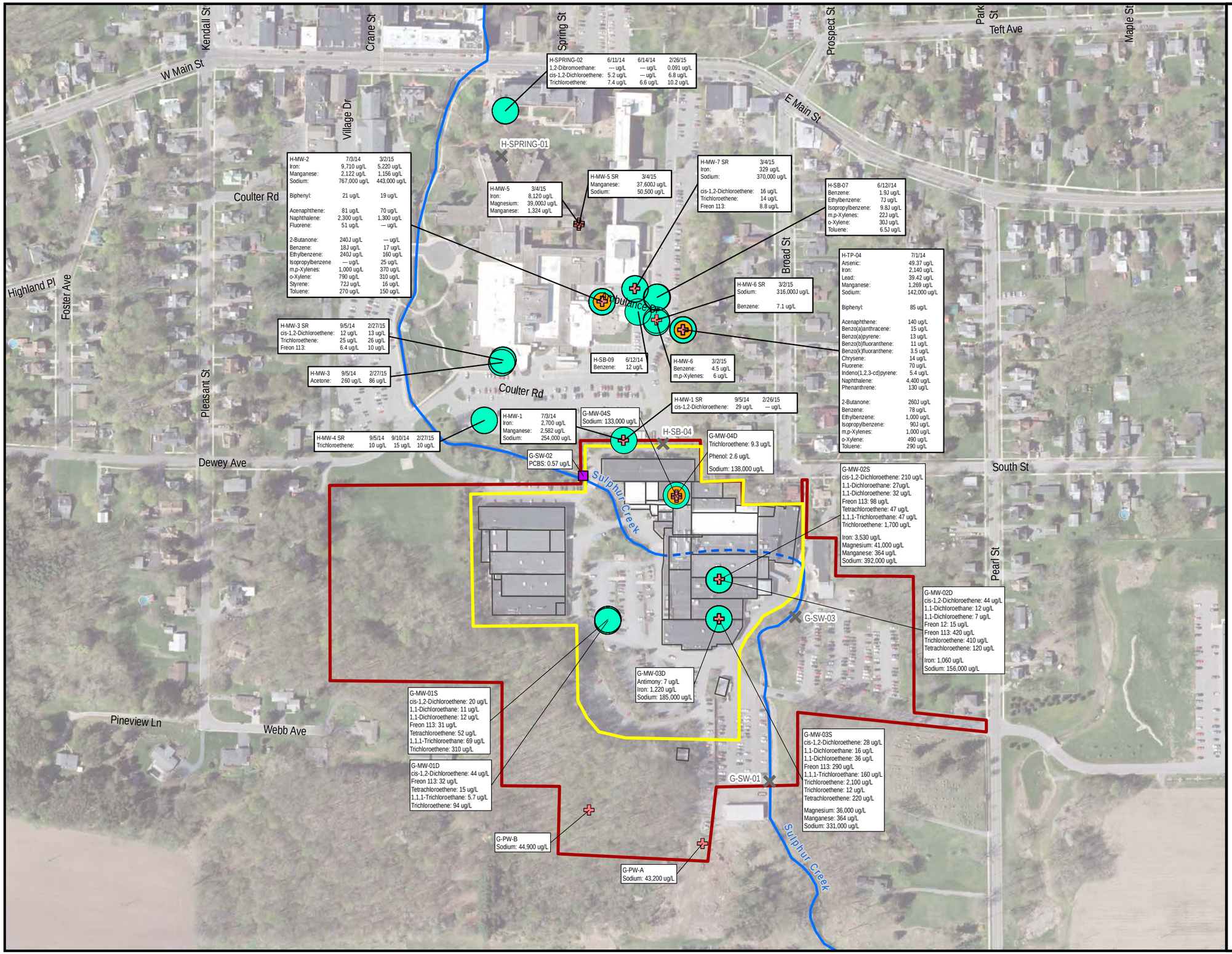

Legend

NYS GA or D Standard Exceedance

Exceedance Compound

- VOCs
- SVOCs
- PCBs
- Metals
- No Exceedance
- Property Parcel Boundary
- BCP Boundary
- Surface Stream
- Inferred Stream Path

NOTES:

- Groundwater results were compared to NYS Class GA standards.
- Groundwater analytical data for the Hospital property is from Haley Aldrich 2015.
- J = The analyte was positively identified; associated numerical value is the approximate concentration of the analyte in the sample.
- "G" designation indicates sampling location within G.W. Lisk property.
- "H" designation indicates sampling location within Hospital property.
- Facility room outlines are approximate in location and converted from AutoCAD models.
- Aerial imagery provided by Esri World Imagery.

0 50 100 200 300

Feet

N

Figure 8: Water Samples that Exceed Class GA or D Standards

G.W. Lisk Company, Inc.
2 South Street, Clifton Springs, NY
03 January 2020

ERM

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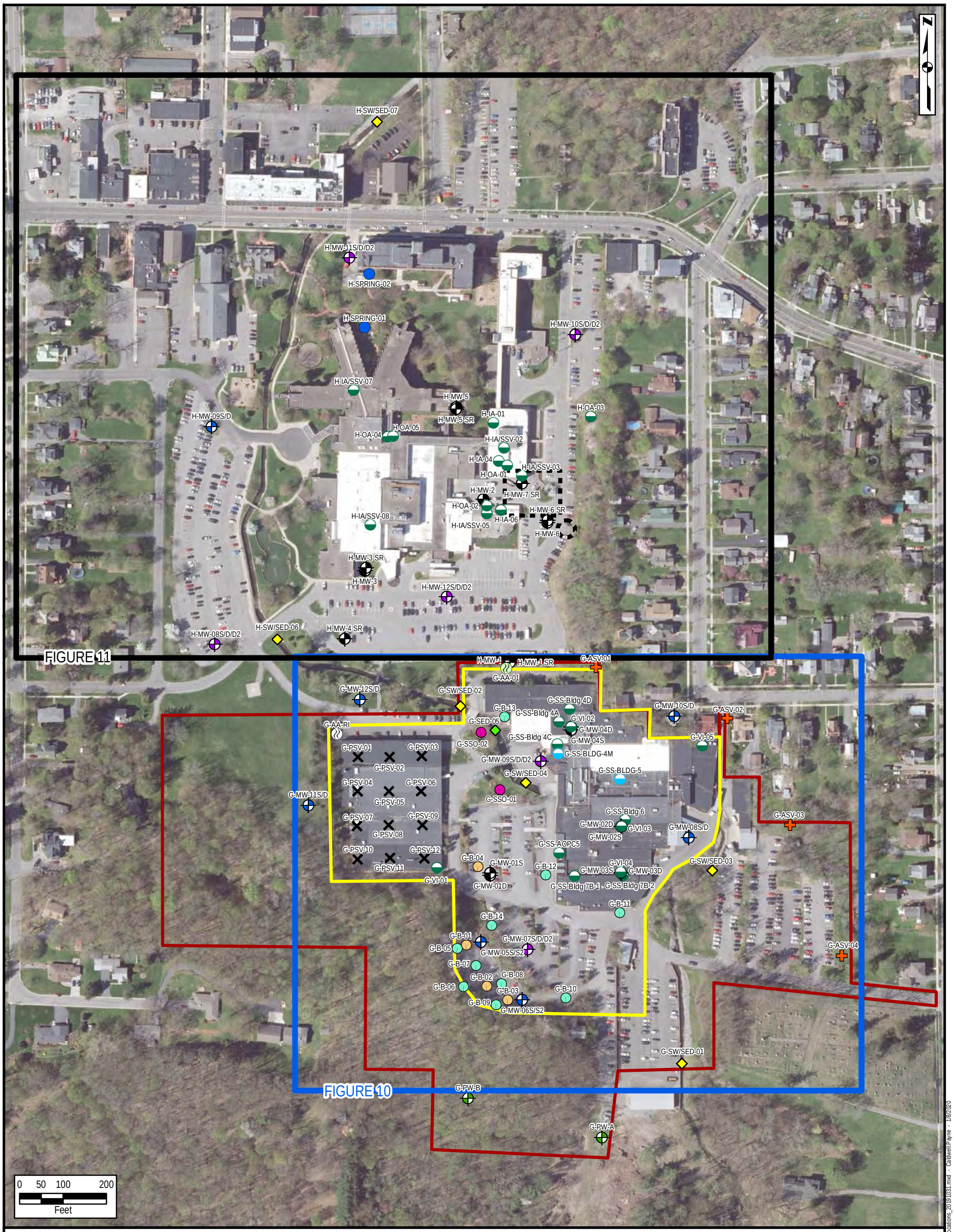

Legend

- Exisiting Monitoring Well
- Proposed Monitoring Well Couplet
- Proposed Monitoring Well Triplet
- Non-Potable Water Well
- Existing Indoor Air/Sub-Slab Soil Vapor
- Existing Sub-Slab Soil Vapor
- Proposed Passive Soil Vapor
- Proposed Active Soil Vapor
- Existing Ambient Air
- Proposed Ambient Air
- Exisiting Soil Boring
- Proposed Soil Boring
- Proposed Surface Soil
- Proposed Surface Water and Sediment
- Proposed Sediment
- Exisiting "Spring" Per CSHC
- Property Parcel Boundary
- Former MGP Structures
- BCP Boundary

Figure 9: Proposed RI Sample Locations

G.W. Lisk Company, Inc.
2 South Street, Clifton Springs, NY
03 January 2020

NOTES:
- Proposed sampling locations are approximate.
- "G" designation indates sampling location within G.W.Lisk property.
- "H" designation indicates sampling location within Hospital property.
- Former MGP Structures are inferred based off of CSHC 2015 Phase II report.
- Aerial imagery provided by Esri World Imagery.
- Blue outline is the extent of Figure 10.
- Black outline is the extent of Figure 11.

ERM

Legend

- Exisiting Monitoring Well
- Proposed Monitoring Well Couplet
- Proposed Monitoring Well Triplet
- Non-Potable Water Well
- Existing Indoor Air/Sub-Slab Soil Vapor
- Existing Sub-Slab Soil Vapor
- Proposed Passive Soil Vapor
- Proposed Active Soil
- Existing Ambient Air
- Proposed Ambient Air
- Exisiting Soil Boring
- Proposed Soil Boring
- Proposed Surface Soil
- Proposed Surface Water and Sediment
- Proposed Sediment
- Exisiting "Spring" Per CSHC
- Property Parcel Boundary
- BCP Boundary

NOTES:
- Proposed sampling locations are approximate.
- "G" designation indates sampling location within G.W. Lisk property.
- "H" designation indicates sampling location within Hospital property.
- Aerial imagery provided by Esri World Imagery.

0 25 50 100
Feet

N

Figure 10: Proposed RI Sample Locations - G.W. Lisk Property

G.W. Lisk Company, Inc.
2 South Street, Clifton Springs, NY
03 January 2020

ERM

Legend

- Exisiting Monitoring Well
- Proposed Monitoring Well Couplet
- Proposed Monitoring Well Triplet
- Existing Indoor Air/Sub-Slab Soil Vapor
- Proposed Surface Water and Sediment
- Exisiting "Spring" Per CSHC
- Former MGP Structures

NOTES:

- Proposed sampling locations are approximate.
- "G" designation indates sampling location within G.W. Lisk property.
- "H" designation indicates sampling location within Hospital property.
- Former MGP Structures are inferred based off of CSHC 2015 Phase II report.
- Aerial imagery provided by Esri World Imagery.

N

0 25 50 100
Feet

Figure 11: Proposed RI Sample Locations - CSHC Property
G.W. Lisk Company, Inc.
2 South Street, Clifton Springs, NY
03 January 2020

ERM

TABLES

Table 1
Summary of Soil Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	NY-375-CP51-UNRESTRICTED USE	NY-375-CP51-PROTECT GROUND WATER	NY-375-CP51-RESTRICTED INDUSTRIAL	Location ID: Sample Date: Sample Type: Sample Depth: B-01 11-May-17 N 5 - 6 ft	B-01 11-May-17 FD 5 - 6 ft	B-01 12-May-17 N 5 - 6 ft	B-01 12-May-17 FD 5 - 6 ft	B-02 12-May-17 N 9 - 11 ft	B-03 12-May-17 N 8 - 10 ft	B-04 17-Jul-17 N 19 - 20.5 ft	MW-01S 18-Jul-17 N 9 - 10 ft	MW-01S 19-Jul-17 N 16 - 17 ft	MW-01S 19-Jul-17 FD 16 - 17 ft	MW-02D 23-Sep-17 N 5 - 6 ft	MW-02D 23-Sep-17 N 11 - 12 ft	MW-03D 30-Sep-17 N 9 - 11 ft	MW-03D 30-Sep-17 N 17 - 19 ft	MW-04S 25-Jul-17 N 5 - 6 ft	MW-04S 25-Jul-17 N 13 - 13.7 ft
Volatile Organic Compounds (VOCs)																				
Acenaphthene	µg/kg	20,000	98,000	1,000,000	9,180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acetone	µg/kg	**50**	**50**	1,000,000	*5,600 U*	*9,400 U*	-	-	**95**	**340 J**	*16 U*	*8.2 U*	*580 U*	*660 U*	*560 U*	*980 U*	*510 U*	*490 U*	**3.4 J**	**3.9 J**
Benzene	µg/kg	**60**	**60**	89,000	**490 J**	**390 J**	-	-	5.5	0.54 J	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
Bromodichloromethane	µg/kg	NS	NS	NS	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
Bromoform	µg/kg	NS	NS	NS	*2,200 U*	*3,800 U*	-	-	*3.2 U*	*3.8 U*	*6.4 UJ*	*3.3 U*	*230 U*	*260 U*	*220 U*	*390 U*	*200 U*	*200 U*	*3.4 U*	*4.2 U*
Bromomethane	µg/kg	NS	NS	NS	*1,100 U*	*1,900 U*	-	-	*1.6 U*	*1.9 U*	*3.2 U*	*1.6 U*	*120 U*	*130 U*	*110 U*	*200 U*	*100 U*	*98 U*	*1.7 U*	*2.1 U*
2-Butanone	µg/kg	NS	300	1,000,000	*5,600 U*	*9,400 U*	-	-	18	**78 J**	*16 U*	*8.2 U*	*580 U*	*660 U*	*560 U*	*980 U*	*510 U*	*490 U*	*8.6 U*	*11 U*
Carbon disulfide	µg/kg	NS	2,700	NS	*5,600 U*	*9,400 U*	-	-	*8.0 U*	**3.6 J**	*16 UJ*	*8.2 UJ*	*580 U*	*660 U*	*560 U*	*980 U*	*510 U*	*490 U*	*8.6 U*	*11 U*
Carbon tetrachloride	µg/kg	760	760	44,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
Chlorobenzene	µg/kg	1,100	1,100	1,000,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 UJ*	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
Chlorobromomethane	µg/kg	NS	NS	NS	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 U*	*8.0 U*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
Chloroethane	µg/kg	NS	NS	NS	*1,100 U*	*1,900 U*	-	-	*1.6 U*	*1.9 U*	*3.2 U*	*1.6 U*	*120 U*	*130 U*	*110 U*	*200 U*	*100 U*	*98 U*	*1.7 U*	*2.1 U*
Chloromethane	µg/kg	NS	NS	NS	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 U*	*8.0 U*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
Chloroform	µg/kg	370	370	700,000	*840 U*	*1,400 U*	-	-	*1.2 U*	*1.4 U*	*2.4 U*	*1.2 U*	*87 U*	*98 U*	*85 U*	*150 U*	*76 U*	*73 U*	*1.3 U*	*1.6 U*
cis-1,2-Dichloroethene	µg/kg	250	250	1,000,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	*1.6 U*	*0.82 U*	**76**	**76**	*56 U*	**52 J**	*51 U*	*49 U*	**2.6**	*1.1 U*
cis-1,3-Dichloropropene	µg/kg	NS	300	NS	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 UJ*	*1.6 UJ*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
Cyclohexane	µg/kg	NS	NS	NS	*11,000 U*	*19,000 U*	-	-	*16 U*	**1.2 J**	*32 U*	*16 U*	*1,200 U*	*1,300 U*	*1,100 U*	*2,000 U*	*1,000 U*	**150 J**	*17 U*	*21 U*
Dibromochloromethane	µg/kg	NS	NS	NS	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
1,2-Dibromo-3-chloropropane	µg/kg	NS	NS	NS	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 U*	*8.0 UJ*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
1,2-Dichlorobenzene	µg/kg	1,100	1,100	1,000,000	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 UJ*	*8.0 UJ*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
1,3-Dichlorobenzene	µg/kg	2,400	2,400	560,000	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 UJ*	*8.0 UJ*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
1,4-Dichlorobenzene	µg/kg	1,800	1,800	250,000	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 UJ*	*8.0 UJ*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
1,2-Dichloroethane	µg/kg	20	20	60,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
1,1-Dichloroethene	µg/kg	270	270	480,000	*840 U*	*1,400 U*	-	-	*1.2 U*	*1.4 U*	*2.4 U*	*1.2 U*	**55 J**	**42 J**	*85 U*	**46 J**	*76 U*	*73 U*	*1.3 U*	*1.6 U*
1,1-Dichloroethene	µg/kg	330	330	1,000,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	*1.6 U*	*0.82 U*	**50 J**	**43 J**	*56 U*	**68 J**	*51 U*	*49 U*	*0.86 U*	*1.1 U*
1,2-Dichloropropane	µg/kg	NS	NS	NS	*1,900 U*	*3,300 U*	-	-	*2.8 U*	*3.3 U*	*5.6 U*	*2.8 U*	*200 U*	*230 U*	*200 U*	*340 U*	*180 U*	*170 U*	*3.0 U*	*3.7 U*
1,4-Dioxane	µg/kg	100	100	250,000	*22,000 U*	*38,000 U*	-	-	*32 U*	*38 U*	*64 U*	*33 U*	*2,300 U*	*2,600 U*	*2,200 U*	*3,900 U*	*2,000 U*	*2,000 U*	*34 U*	*42 U*
Ethylbenzene	µg/kg	**1,000**	**1,000**	780,000	**1,100**	**1,300**	-	-	0.97	0.18 J	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
Ethylene dibromide	µg/kg	NS	NS	NS	*2,200 U*	*3,800 U*	-	-	*3.2 U*	*3.8 U*	*6.4 U*	*3.3 U*	*230 U*	*260 U*	*220 U*	*390 U*	*200 U*	*200 U*	*3.4 U*	*4.2 U*
Freon 11	µg/kg	NS	NS	NS	*2,800 UJ*	*4,700 UJ*	-	-	*4.0 U*	*4.7 U*	*8.0 U*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
Freon 12	µg/kg	NS	NS	NS	*5,600 U*	*9,400 U*	-	-	*8.0 U*	*9.4 U*	*16 U*	*8.2 U*	*580 U*	*660 U*	*560 U*	*980 U*	*510 U*	*490 U*	*8.6 U*	*11 U*
Freon 113	µg/kg	NS	6,000	NS	*11,000 U*	*19,000 U*	-	-	*16 U*	*19 U*	**1.3 J**	**0.68 J**	**120 J**	*1,300 U*	*1,100 U*	**250 J**	*1,000 U*	*980 U*	*17 U*	*21 U*
2-Hexanone	µg/kg	NS	NS	NS	*5,600 U*	*9,400 U*	-	-	*8.0 U*	*9.4 U*	*16 UJ*	*8.2 U*	*580 U*	*660 U*	*560 U*	*980 U*	*510 U*	*490 U*	*8.6 U*	*11 U*
Isopropylbenzene (Cumene)	µg/kg	NS	2,300	NS	**200 J**	**260 J**	-	-	**0.20 J**	*0.94 UJ*	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
4-Isopropyltoluene	µg/kg	NS	10,000	NS	**160 J**	**210 J**	-	-	*0.80 U*	*0.94 UJ*	-	-	-	-	*56 U*	*98 U*	-	-	-	-
Methyl acetate	µg/kg	NS	NS	NS	*11,000 U*	*19,000 U*	-	-	*16 U*	*19 U*	*32 U*	*16 U*	*1,200 U*	*1,300 U*	*1,100 U*	*2,000 U*	*1,000 U*	*980 U*	*17 U*	*21 U*
4-Methyl-2-pentanone	µg/kg	NS	NS	NS	*5,600 U*	*9,400 U*	-	-	*8.0 U*	*9.4 U*	*16 U*	*8.2 U*	*580 U*	*660 U*	*560 U*	*980 U*	*510 U*	*490 U*	*8.6 U*	*11 U*
Methyl tert-butyl ether	µg/kg	930	1,000,000	NS	*1,100 U*	*1,900 U*	-	-	*1.6 U*	*1.9 U*	*3.2 U*	*1.6 U*	*120 U*	*130 U*	*110 U*	*200 U*	*100 U*	*98 U*	*1.7 U*	*2.1 U*
Methylcyclohexane	µg/kg	NS	NS	NS	**180 J**	*3,800 U*	-	-	**0.57 J**	**1.9 J**	**0.48 J**	*3.3 U*	**35 J**	*260 U*	*220 U*	*390 U*	*200 U*	**320**	*3.4 U*	**0.36 J**
Methylene chloride	µg/kg	50	50	1,000,000	*5,600 U*	*9,400 U*	-	-	*8.0 U*	*9.4 U*	*16 U*	*8.2 U*	*580 U*	*660 U*	*560 U*	*980 U*	*510 U*	*490 U*	*8.6 U*	*11 U*
Naphthalene	µg/kg	**12,000**	**12,000**	1,000,000	**97,000**	**120,000**	-	-	52	1.5 J	-	-	-	-	*280 U*	*490 U*	-	-	-	-
n-Butylbenzene	µg/kg	12,000	12,000	1,000,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 UJ*	-	-	-	-	*56 U*	*98 U*	-	-	-	-
n-Propylbenzene	µg/kg	3,900	3,900	1,000,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 UJ*	-	-	-	-	*56 U*	*98 U*	-	-	-	-
sec-Butylbenzene	µg/kg	11,000	11,000	1,000,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 UJ*	-	-	-	-	*56 U*	*98 U*	-	-	-	-
o-Xylene	µg/kg	**260**	**1,600**	1,000,000	**620 J**	**770 J**	-	-	3.0	0.36 J	*3.2 U*	*1.6 U*	*120 U*	*130 U*	*110 U*	*200 U*	*100 U*	*98 U*	*1.7 U*	*2.1 U*
Styrene	µg/kg	NS	NS	NS	*1,100 U*	*1,900 U*	-	-	*1.6 U*	*1.9 UJ*	*3.2 UJ*	*1.6 U*	*120 U*	*130 U*	*110 U*	*200 U*	*100 U*	*98 U*	*1.7 U*	*2.1 U*
tert-Butylbenzene	µg/kg	5,900	5,900	1,000,000	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 UJ*	-	-	-	-	*280 U*	*490 U*	-	-	-	-
Tetrachloroethene	µg/kg	1,300	1,300	300,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 UJ*	3.1	5.6	130	320	270	980	690	**20 J**	**0.77 J**	1.2
Toluene	µg/kg	700	700	1,000,000	**410 J**	**350 J**	-	-	**0.28 J**	1.4	*2.4 U*	*1.2 U*	*87 U*	*98 U*	*85 U*	*150 U*	*76 U*	*73 U*	*1.3 U*	**0.28 J**
trans-1,2-Dichloroethene	µg/kg	190	190	1,000,000	*840 U*	*1,400 U*	-	-	*1.2 U*	*1.4 U*	*2.4 U*	*1.2 U*	*87 U*	*98 U*	*85 U*	*150 U*	*76 U*	*73 U*	*1.3 U*	*1.6 U*
trans-1,3-Dichloropropene	µg/kg	NS	NS	NS	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 UJ*	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
1,1,1-Trichloroethane	µg/kg	680	680	1,000,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	5.1	2.2	20 J	82	**42 J**	220	65	*49 U*	*0.86 U*	*1.1 U*
1,1,2,2-Tetrachloroethane	µg/kg	NS	600	NS	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	*1.6 U*	*0.82 U*	*58 U*	*66 U*	*56 U*	*98 U*	*51 U*	*49 U*	*0.86 U*	*1.1 U*
1,1,2-Trichloroethane	µg/kg	NS	NS	NS	*840 U*	*1,400 U*	-	-	*1.2 U*	*1.4 U*	*2.4 U*	*1.2 U*	*87 U*	*98 U*	*85 U*	*150 U*	*76 U*	*73 U*	*1.3 U*	*1.6 U*
1,3,5-Trimethylbenzene	µg/kg	8,400	8,400	380,000	**690 J**	**920 J**	-	-	**0.99 J**	**0.32 J**	-	-	-	-	*280 U*	*490 U*	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	NS	NS	NS	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 UJ*	*8.0 UJ*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
1,2,4-Trichlorobenzene	µg/kg	NS	3,400	NS	*2,800 U*	*4,700 U*	-	-	*4.0 U*	*4.7 UJ*	*8.0 UJ*	*4.1 U*	*290 U*	*330 U*	*280 U*	*490 U*	*250 U*	*240 U*	*4.3 U*	*5.3 U*
1,2,4-Trimethylbenzene	µg/kg	3,600	3,600	380,000	**1,600 J**	**2,200 J**	-	-	**1.4 J**	0.48 J	-	-	-	-	*280 U*	*490 U*	-	-	-	-
Trichloroethene	µg/kg	**470**	**470**	400,000	*560 U*	*940 U*	-	-	*0.80 U*	*0.94 U*	11	7.4	**4,000**	**4,300**	**1,900**	**9,400**	**1,300**	32 J	0.61 J	0.52 J
Vinyl chloride	µg/kg	20	20	27,000	*1,100 U*	*1,900 U*	-	-	*1.6 U*	*1.9 U*	*3.2 U*	*1.6 U*	*120 U*	*130 U*	*110 U*	*200 U*	*100 U*	*98 U*	*1.7 U*	*2.1 U*
Xylenes, m/p	µg/kg	NS	NS	NS	**740 J**	**890 J**	-	-	2.4	**0.90 J**	*3.2 U*	*1.6 U*	*120 U*	*130 U*	*110 U*	*200 U*	*100 U*	*98 U*	*1.7 U*	*2.1 U*
Total TICs (Calculated)	µg/kg	NS	NS	NS	107,000	133,000	-	-	40.3	42.4	-	-	-	-	-	312	-	5,260	11.0	14.0

Notes and Abbreviations:
- - = Not analyzed
NS = No Standard
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ft = feet
Results shown in bold font indicate a compound was detectedabove the laboratory reporting detection limit.
N = Field sample
FD = Field Duplicate
J = The analyte was positively identified; associated numerical value is the approximate concentration of the analyte in the sample.
U = Compound not detected at concentrations above the laboratory reporting detection limit, the laboratory reporting detection limit is shown.
UJ = Analyte was analyzed for, but not detected. The detection limit is a quantitative estimate.
All analyses performed by Alpha Woods Hole Laboratories.
Exceedance of NY-375-CP51-UNRESTRICTED USE
Exceedance of NY-375-CP51-PROTECTION OF GROUNDWATER
Exceedance of NY-375-CP51-RESTRICTED INDUSTRIAL

Table 1
Summary of Soil Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	NY-375-CP51-UNRESTRICTED USE	NY-375-CP51-PROTECT GROUND WATER	NY-375-CP51-RESTRICTED INDUSTRIAL	Location ID: Sample Date: Sample Type: Sample Depth: B-01 11-May-17 N 5 - 6 ft	B-01 11-May-17 FD 5 - 6 ft	B-01 12-May-17 N 5 - 6 ft	B-01 12-May-17 FD 5 - 6 ft	B-02 12-May-17 N 9 - 11 ft	B-03 12-May-17 N 8 - 10 ft	B-04 17-Jul-17 N 19 - 20.5 ft	MW-01S 18-Jul-17 N 9 - 10 ft	MW-01S 19-Jul-17 N 16 - 17 ft	MW-01S 19-Jul-17 FD 16 - 17 ft	MW-02D 23-Sep-17 N 5 - 6 ft	MW-02D 23-Sep-17 N 11 - 12 ft	MW-03D 30-Sep-17 N 9 - 11 ft	MW-03D 30-Sep-17 N 17 - 19 ft	MW-04S 25-Jul-17 N 5 - 6 ft	MW-04S 25-Jul-17 N 13 - 13.7 ft
Semi-Volatile Organic Compounds (SVOCs)																				
Acenaphthene	µg/kg	20,000	98,000	1,000,000	-	-	18,000	19,000	190	-	-	-	-	-	-	-	-	-	*140 U*	*160 U*
Acenaphthylene	µg/kg	100,000	107,000	1,000,000	-	-	4,800	6,000	290	-	-	-	-	-	-	-	-	-	*140 U*	*160 U*
Acetophenone	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Anthracene	µg/kg	100,000	1,000,000	1,000,000	-	-	11,000	13,000	460	-	-	-	-	-	-	-	-	-	*100 U*	*120 U*
Atrazine	µg/kg	NS	NS	NS	-	-	*150 U*	*1,500 U*	*150 U*	-	-	-	-	-	-	-	-	-	*140 U*	*160 U*
Benzaldehyde	µg/kg	NS	NS	NS	-	-	*250 U*	*2,500 U*	*250 U*	-	-	-	-	-	-	-	-	-	*230 U*	*270 U*
Benzo(a)anthracene	µg/kg	**1,000**	**1,000**	**11,000**	-	-	**11,000**	**11,000**	980	-	-	-	-	-	-	-	-	-	130	34 J
Benzo(a)pyrene	µg/kg	**1,000**	22,000	**1,100**	-	-	**7,400**	**10,000**	930	-	-	-	-	-	-	-	-	-	130 J	*160 U*
Benzo(b)fluoranthene	µg/kg	**1,000**	**1,700**	**11,000**	-	-	**9,400**	**9,200**	**1,000**	-	-	-	-	-	-	-	-	-	180	*120 U*
Benzo(g,h,i)perylene	µg/kg	100,000	1,000,000	1,000,000	-	-	4,100	4,300	550	-	-	-	-	-	-	-	-	-	72 J	*160 U*
Benzo(k)fluoranthene	µg/kg	**800**	**1,700**	110,000	-	-	**2,700**	**3,100**	360	-	-	-	-	-	-	-	-	-	59 J	*120 U*
Benzyl butyl phthalate	µg/kg	NS	122,000	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Biphenyl	µg/kg	NS	NS	NS	-	-	2,000	2,000 J	44 J	-	-	-	-	-	-	-	-	-	*400 U*	*460 U*
Bis(2-chloroethoxy)methane	µg/kg	NS	NS	NS	-	-	*210 U*	*2,100 U*	*200 U*	-	-	-	-	-	-	-	-	-	*190 U*	*220 U*
Bis(2-ethylhexyl)phthalate	µg/kg	NS	435,000	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	150 J	*200 U*
4-Bromophenyl phenyl ether	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Caprolactam	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Carbazole	µg/kg	NS	NS	NS	-	-	690 J	650 J	150 J	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
4-Chloro-3-methylphenol	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2-Chloronaphthalene	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2-Chlorophenol	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
4-Chlorophenyl phenyl ether	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2,2-Oxybis(1-chloropropane)	µg/kg	NS	NS	NS	-	-	*230 U*	*2,300 U*	*230 U*	-	-	-	-	-	-	-	-	-	*210 U*	*240 U*
Chrysene	µg/kg	**1,000**	**1,000**	110,000	-	-	**9,000**	**8,800**	920	-	-	-	-	-	-	-	-	-	110	28 J
Dibenzo(a,h)anthracene	µg/kg	**330**	1,000,000	**1,100**	-	-	**1,100**	**1,000 J**	140	-	-	-	-	-	-	-	-	-	*100 U*	*120 U*
Dibenzofuran	µg/kg	NS	NS	1,000,000	-	-	3,900	4,500	150 J	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Dibutyl phthalate	µg/kg	NS	8,100	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2,4-Dichlorophenol	µg/kg	NS	400	NS	-	-	*170 U*	*1,700 U*	*170 U*	-	-	-	-	-	-	-	-	-	*160 U*	*180 U*
2,4-Dimethylphenol	µg/kg	NS	NS	NS	-	-	92 J	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
3,3-Dichlorobenzidine	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Dichloroethyl ether	µg/kg	NS	NS	NS	-	-	*170 U*	*1,700 U*	*170 U*	-	-	-	-	-	-	-	-	-	*160 U*	*180 U*
Diethyl phthalate	µg/kg	NS	7,100	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Dimethyl phthalate	µg/kg	NS	27,000	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Dinitro-o-cresol	µg/kg	NS	NS	NS	-	-	*500 U*	*5,000 U*	*490 U*	-	-	-	-	-	-	-	-	-	*460 U*	*530 U*
2,4-Dinitrophenol	µg/kg	NS	200	NS	-	-	*920 U*	*9,300 U*	*910 U*	-	-	-	-	-	-	-	-	-	*840 U*	*970 U*
2,4-Dinitrotoluene	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2,6-Dinitrotoluene	µg/kg	NS	1,000	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Di-n-octyl phthalate	µg/kg	NS	120,000	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Fluoranthene	µg/kg	100,000	1,000,000	1,000,000	-	-	22,000	22,000	2,000	-	-	-	-	-	-	-	-	-	190	76 J
Fluorene	µg/kg	30,000	386,000	1,000,000	-	-	13,000	14,000	410	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Hexachlorobenzene	µg/kg	NS	1,400	12,000	-	-	*120 U*	*1,200 U*	*110 U*	-	-	-	-	-	-	-	-	-	*100 U*	*120 U*
Hexachlorobutadiene	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Hexachlorocyclopentadiene	µg/kg	NS	NS	NS	-	-	*550 U*	*5,500 U*	*540 U*	-	-	-	-	-	-	-	-	-	*500 U*	*580 U*
Hexachloroethane	µg/kg	NS	NS	NS	-	-	*150 U*	*1,500 U*	*150 U*	-	-	-	-	-	-	-	-	-	*140 U*	*160 U*
Indeno(1,2,3-cd)pyrene	µg/kg	**500**	8,200	11,000	-	-	**4,700**	**4,100**	**550**	-	-	-	-	-	-	-	-	-	91 J	*160 U*
Isophorone	µg/kg	NS	4,400	NS	-	-	*170 U*	*1,700 U*	*170 U*	-	-	-	-	-	-	-	-	-	*160 U*	*180 U*
m-Cresol	µg/kg	NS	NS	1,000,000	-	-	220 J	310 J	66 J	-	-	-	-	-	-	-	-	-	*250 U*	*290 U*
2-Methylnaphthalene	µg/kg	NS	36,400	NS	-	-	14,000	13,000	270	-	-	-	-	-	-	-	-	-	*210 U*	*240 U*
Naphthalene	µg/kg	**12,000**	**12,000**	1,000,000	-	-	**36,000**	**37,000**	800	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2-Nitroaniline	µg/kg	NS	400	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
3-Nitroaniline	µg/kg	NS	500	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Nitrobenzene	µg/kg	NS	170	140,000	-	-	*170 U*	*1,700 U*	*170 U*	-	-	-	-	-	-	-	-	-	*160 U*	*180 U*
2-Nitrophenol	µg/kg	NS	300	NS	-	-	*420 U*	*4,200 U*	*410 U*	-	-	-	-	-	-	-	-	-	*380 U*	*440 U*
4-Nitrophenol	µg/kg	NS	100	NS	-	-	*270 U*	*2,700 U*	*260 U*	-	-	-	-	-	-	-	-	-	*240 U*	*280 U*
n-Nitrosodi-n-propylamine	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
n-Nitrosodiphenylamine	µg/kg	NS	NS	NS	-	-	*150 U*	*1,500 U*	*150 U*	-	-	-	-	-	-	-	-	-	*140 U*	*160 U*
o-Cresol	µg/kg	NS	NS	1,000,000	-	-	86 J	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
p-Chloroaniline	µg/kg	NS	220	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Pentachlorophenol	µg/kg	800	800	55,000	-	-	*150 U*	*1,500 U*	*150 U*	-	-	-	-	-	-	-	-	-	*140 U*	*160 U*
Phenanthrene	µg/kg	100,000	1,000,000	1,000,000	-	-	41,000	45,000	2,000	-	-	-	-	-	-	-	-	-	63 J	58 J
Phenol	µg/kg	330	330	1,000,000	-	-	160 J	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
p-Nitroaniline	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
Pyrene	µg/kg	100,000	1,000,000	1,000,000	-	-	22,000	24,000	2,000	-	-	-	-	-	-	-	-	-	170	61 J
1,2,4,5-Tetrachlorobenzene	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2,3,4,6-Tetrachlorophenol	µg/kg	NS	NS	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2,4,5-Trichlorophenol	µg/kg	NS	100	NS	-	-	*190 U*	*1,900 U*	*190 U*	-	-	-	-	-	-	-	-	-	*180 U*	*200 U*
2,4,6-Trichlorophenol	µg/kg	NS	NS	NS	-	-	*120 U*	*1,200 U*	*110 U*	-	-	-	-	-	-	-	-	-	*100 U*	*120 U*
Total TICs (Calculated)	µg/kg	NS	NS	NS	-	-	61,200	112,000	6,280	-	-	-	-	-	-	-	-	-	357	-

Notes and Abbreviations:
- - = Not analyzed
NS = No Standard
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ft = feet
Results shown in bold font indicate a compound was detectedabove the laboratory reporting detection limit.
N = Field sample
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J = The analyte was positively identified; associated numerical value is the approximate concentration of the analyte in the sample.
U = Compound not detected at concentrations above the laboratory reporting detection limit, the laboratory reporting detection limit is shown.
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All analyses performed by Alpha Woods Hole Laboratories.
Exceedance of NY-375-CP51-PROTECTION OF GROUNDWATER
Exceedance of NY-375-CP51-UNRESTRICTED USE
Exceedance of NY-375-CP51-RESTRICTED INDUSTRIAL

Table 1
Summary of Soil Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	NY-375-CP51-UNRESTRICTED USE	NY-375-CP51-PROTECT GROUND WATER	NY-375-CP51-RESTRICTED INDUSTRIAL	Location ID: B-01	B-01	B-01	B-01	B-02	B-03	B-04	MW-01S	MW-01S	MW-01S	MW-02D	MW-02D	MW-03D	MW-03D	MW-04S	MW-04S
					Sample Date: 11-May-17	11-May-17	12-May-17	12-May-17	12-May-17	12-May-17	17-Jul-17	18-Jul-17	19-Jul-17	19-Jul-17	23-Sep-17	23-Sep-17	30-Sep-17	30-Sep-17	25-Jul-17	25-Jul-17
					Sample Type: N	FD	N	FD	N	N	N	N	N	FD	N	N	N	N	N	N
					Sample Depth: 5 - 6 ft	5 - 6 ft	5 - 6 ft	5 - 6 ft	9 - 11 ft	8 - 10 ft	19 - 20.5 ft	9 - 10 ft	16 - 17 ft	16 - 17 ft	5 - 6 ft	11 - 12 ft	9 - 11 ft	17 - 19 ft	5 - 6 ft	13 - 13.7 ft
Polychlorinated Biphenyls (PCB)																				
Aroclor 1016	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Aroclor 1221	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Aroclor 1232	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Aroclor 1242	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Aroclor 1248	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Aroclor 1254	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Aroclor 1260	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Aroclor 1262	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Aroclor 1268	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Total PCBs	µg/kg	NS	NS	NS	*37.3 U*	*37.2 U*	-	-	*37.5 U*	*37.3 U*	-	-	-	-	*35.5 U*	*35.3 U*	*33.8 U*	*35.9 U*	*34.6 U*	*40.3 U*
Metals, Total																				
Aluminum	mg/kg	NS	NS	NS	2,800	3,300	-	-	4,700	3,200	-	-	-	-	4,350	1,600	2,600	2,130	4,000	2,520
Antimony	mg/kg	NS	NS	NS	*4.3 U*	*4.5 U*	-	-	0.64 J	1.2 J	-	-	-	-	*4.17 U*	*4.15 U*	*4.14 U*	*4.43 U*	*4.17 U*	*4.91 U*
Arsenic	mg/kg	**13**	**16**	**16**	6.0	6.0	-	-	5.0	**29 J**	-	-	-	-	2.06	1.20	**23.0**	2.08	5.90	4.11
Barium	mg/kg	NS	NS	10,000	30	35	-	-	41	29	-	-	-	-	39.7	8.36	32.1	7.96	28.0	11.0
Beryllium	mg/kg	7.2	47	2,700	0.19 J	0.21 J	-	-	0.23 J	0.15 J	-	-	-	-	0.133 J	*0.415 U*	0.108 J	0.071 J	0.183 J	0.137 J
Cadmium	mg/kg	2.5	7.5	60	1.5	1.8	-	-	0.73 J	1.1	-	-	-	-	0.450 J	0.316 J	0.489 J	0.505 J	0.450 J	0.285 J
Calcium	mg/kg	NS	NS	NS	34,000	40,000	-	-	27,000	24,000	-	-	-	-	50,100	148,000	108,000	179,000	36,000	30,300
Chromium	mg/kg	**30**	NS	6,800	6.2	7.3	-	-	7.0	**39 J**	-	-	-	-	7.28	2.88	4.52	3.70	9.44	4.85
Cobalt	mg/kg	NS	NS	NS	3.0	2.8	-	-	4.4	3.7	-	-	-	-	4.25	2.79	5.64	5.30	3.95	6.12
Copper	mg/kg	50	1,720	10,000	16	16	-	-	14	11	-	-	-	-	10.2	5.71	8.80	10.7	11.5	14.4
Cyanide CN-	mg/kg	NS	NS	10,000	1.2 J	0.92 J	-	-	*2.2 U*	*2.2 U*	-	-	-	-	*1.1 U*	*1.0 U*	*0.96 U*	*1.0 U*	0.41 J	*1.2 U*
Iron	mg/kg	NS	NS	NS	6,200	7,100	-	-	11,000	8,300 J	-	-	-	-	9,590	4,380	9,360	4,970	9,180	11,000
Lead	mg/kg	63	450	3,900	37	33	-	-	31	**200**	-	-	-	-	4.73	2.41 J	3.98 J	3.48 J	14.3	5.32
Magnesium	mg/kg	NS	NS	NS	9,900	8,400	-	-	7,700	9,600 J	-	-	-	-	14,600	11,200	13,900	12,600	7,470	8,670
Manganese	mg/kg	NS	NS	NS	200	230	-	-	620	330	-	-	-	-	264	214	421	310	343	338
Mercury	mg/kg	**0.18**	0.73	**5.7**	**0.45**	**0.48**	-	-	0.13	**10**	-	-	-	-	0.01 J	*0.07 U*	0.02 J	0.02 J	**0.28**	0.02 J
Nickel	mg/kg	30	130	10,000	8.4	9.0	-	-	10	8.4	-	-	-	-	10.2	5.96	10.0	11.7	9.61	17.9
Potassium	mg/kg	NS	NS	NS	320	360	-	-	460	330	-	-	-	-	589	275	530	464	349	354
Selenium	mg/kg	3.9	4	6,800	0.58 J	0.79 J	-	-	*1.8 U*	0.26 J	-	-	-	-	*1.67 U*	*1.66 U*	*1.66 U*	*1.77 U*	*1.67 U*	*1.96 U*
Silver	mg/kg	2	8.3	6,800	*0.86 U*	0.25 J	-	-	*0.88 U*	*0.89 U*	-	-	-	-	*0.834 U*	*0.831 U*	*0.829 U*	*0.887 U*	*0.834 U*	*0.982 U*
Sodium	mg/kg	NS	NS	NS	350	560	-	-	360	880	-	-	-	-	89.2 J	124 J	157 J	189	70.4 J	98.3 J
Thallium	mg/kg	NS	NS	NS	*1.7 U*	*1.8 U*	-	-	*1.8 U*	*1.8 U*	-	-	-	-	*1.67 U*	*1.66 U*	*1.66 U*	*1.77 U*	*1.67 U*	0.452 J
Vanadium	mg/kg	NS	NS	NS	8.5	9.5	-	-	10	8.9	-	-	-	-	10.3	5.26	7.98	5.85	9.46	7.63
Zinc	mg/kg	**109**	2,480	10,000	76	66	-	-	65	**130**	-	-	-	-	37.7	51.9	25.1	73.1	44.7	47.9

Notes and Abbreviations:
- - = Not analyzed
NS = No Standard
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
ft = feet
Results shown in bold font indicate a compound was detectedabove the laboratory reporting detection limit.
N = Field sample
FD = Field Duplicate
J = The analyte was positively identified; associated numerical value is the approximate concentration of the analyte in the sample.
U = Compound not detected at concentrations above the laboratory reporting detection limit, the laboratory reporting detection limit is shown.
UJ = Analyte was analyzed for, but not detected. The detection limit is a quantitative estimate.
All analyses performed by Alpha Woods Hole Laboratories.
Exceedance of NY-375-CP51-PROTECTION OF GROUNDWATER
Exceedance of NY-375-CP51-UNRESTRICTED USE
Exceedance of NY-375-CP51-RESTRICTED INDUSTRIAL

Table 2
Summary of Ambient Air, Indoor Air and Soil Vapor Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Location ID Sample Date Sample Type Lab Sample ID Unit	AA 10-May-17 N L1715353-01	AA 16-Oct-18 N L1842073-03	IA-BLDG-4A 16-Oct-18 N L1842073-04	IA-BLDG-4D 16-Oct-18 N L1842073-05	IA-BLDG-4D 16-Oct-18 FD L1842073-07	IA-BLDG-4M 16-Oct-18 N L1842073-01	IA-BLDG-5 16-Oct-18 N L1842073-08	SS-AOPC-5 07-Aug-18 N L1830687-04	SS-BLDG-4A 07-Aug-18 N L1830687-01
µg/m3										
1,1,1-Trichloroethane	µg/m3	0.109 U	0.109 U	0.109 U	0.109 U	0.109 U	0.109 U	**0.186**	**119**	**13.0**
1,1,2,2-Tetrachloroethane	µg/m3	1.37 U	1.37 U	1.37 U	1.37 U	1.37 U	1.37 U	1.37 U	6.87 U	1.37 U
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	µg/m3	1.53 U	1.53 U	1.53 U	1.53 U	1.53 U	1.53 U	1.53 U	**392**	**10.7**
1,1,2-Trichloroethane	µg/m3	1.09 U	1.09 U	1.09 U	1.09 U	1.09 U	1.09 U	1.09 U	5.46 U	1.09 U
1,1-Dichloroethane	µg/m3	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	**61.5**	0.809 U
1,1-Dichloroethene	µg/m3	0.079 U	0.079 U	0.079 U	0.079 U	0.079 U	0.079 U	0.079 U	3.96 U	0.793 U
1,2,4-Trichlorobenzene	µg/m3	1.48 U	1.48 UJ	1.48 UJ	1.48 UJ	1.48 UJ	1.48 UJ	1.48 UJ	7.42 U	1.48 U
1,2,4-Trimethylbenzene	µg/m3	0.983 U	0.983 U	**1.92**	**7.42**	**6.05**	**1.90**	**4.78**	4.92 U	**1.18**
1,2-dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	µg/m3	1.40 U	1.40 U	1.40 U	1.40 U	1.40 U	1.40 U	1.40 U	6.99 U	1.40 U
1,2-Dichlorobenzene	µg/m3	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	6.01 U	1.20 U
1,2-Dichloroethane	µg/m3	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	4.05 U	0.809 U
1,2-Dichloropropane	µg/m3	0.924 U	0.924 U	0.924 U	0.924 U	0.924 U	0.924 U	0.924 U	4.62 U	0.924 U
1,3,5-Trimethylbenzene	µg/m3	0.983 U	0.983 U	0.983 U	**3.49**	**2.85**	0.983 U	**2.06**	4.92 U	0.983 U
1,3-Butadiene	µg/m3	0.442 U	0.442 U	0.442 U	0.442 U	0.442 U	0.442 U	0.442 U	2.21 U	0.442 U
1,3-Dichlorobenzene	µg/m3	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	6.01 U	1.20 U
1,4-Dichlorobenzene	µg/m3	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	6.01 U	1.20 U
1,4-Dioxane	µg/m3	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	3.60 U	0.721 U
2,2,4-Trimethylpentane	µg/m3	0.934 U	0.934 U	0.934 U	**0.967**	0.934 U	0.934 U	**1.22**	4.67 U	0.934 U
2-Butanone	µg/m3	1.47 U	1.47 U	**1.53**	1.47 U	1.47 U	1.47 U	**1.75**	7.37 U	**7.49**
2-Hexanone	µg/m3	0.820 U	0.820 U	0.820 U	0.820 U	0.820 U	0.820 U	0.820 U	4.10 U	**0.922**
4-Ethyltoluene	µg/m3	0.983 U	0.983 U	0.983 U	0.983 U	0.983 U	0.983 U	0.983 U	4.92 U	0.983 U
4-Methyl-2-pentanone	µg/m3	2.05 U	2.05 U	2.05 U	2.05 U	2.05 U	2.05 U	2.05 U	10.2 U	2.05 U
Acetone	µg/m3	**6.03**	**3.66 J**	**22.0**	**189**	**189**	**16.2**	**45.4**	**22.2**	**35.4**
Allyl chloride	µg/m3	0.626 U	0.626 U	0.626 U	0.626 U	0.626 U	0.626 U	0.626 U	3.13 U	0.626 U
Benzene	µg/m3	0.639 U	0.639 U	0.639 U	0.639 U	0.639 U	0.639 U	0.639 U	3.19 U	0.639 U
Benzyl chloride	µg/m3	1.04 U	1.04 U	1.04 U	1.04 U	1.04 U	1.04 U	1.04 U	5.18 U	1.04 U
Bromodichloromethane	µg/m3	1.34 U	1.34 U	1.34 U	1.34 U	1.34 U	1.34 U	1.34 U	6.70 U	1.34 U
Bromoform	µg/m3	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	10.3 U	2.07 U
Carbon disulfide	µg/m3	0.623 U	0.623 U	**1.59**	0.623 U	0.623 U	**1.21**	**4.14**	**7.66**	**3.49**
Carbon tetrachloride	µg/m3	**0.346**	**0.390**	**0.421**	**0.415**	**0.579**	**0.409**	**0.421**	6.29 U	1.26 U
Chlorobenzene	µg/m3	0.921 U	0.921 U	0.921 U	0.921 U	0.921 U	0.921 U	0.921 U	4.61 U	0.921 U
Chloroethane	µg/m3	0.528 U	0.528 U	0.528 U	0.528 U	0.528 U	0.528 U	0.528 U	2.64 U	0.528 U
Chloroform	µg/m3	0.977 U	0.977 U	0.977 U	0.977 U	0.977 U	0.977 U	0.977 U	**64.9**	0.977 U
cis-1,2-Dichloroethene	µg/m3	0.079 U	0.079 U	0.079 U	0.079 U	0.079 U	0.079 U	0.079 U	**256**	0.793 U
cis-1,3-Dichloropropene	µg/m3	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	4.54 U	0.908 U
Cyclohexane	µg/m3	0.688 U	0.688 U	0.688 U	0.688 U	0.688 U	0.688 U	0.688 U	3.44 U	**0.823**
Dibromochloromethane	µg/m3	1.70 U	1.70 U	1.70 U	1.70 U	1.70 U	1.70 U	1.70 U	8.52 U	1.70 U
Dichlorodifluoromethane (Freon 12)	µg/m3	**2.13**	**2.61**	**3.00**	**2.82**	**2.94**	**2.52**	**3.17**	**22.4**	**1,010**
Ethanol	µg/m3	9.42 U	9.42 U	9.42 U	**76.9**	**71.2**	**16.1**	**76.9**	**279**	**87.6**
Ethyl acetate	µg/m3	1.80 U	1.80 U	1.80 U	1.80 U	1.80 U	1.80 U	1.80 U	9.01 U	1.80 U
Ethylbenzene	µg/m3	0.869 U	0.869 U	0.869 U	0.869 U	0.869 U	0.869 U	0.869 U	4.34 U	**2.33**
Ethylene dibromide	µg/m3	1.54 U	1.54 U	1.54 U	1.54 U	1.54 U	1.54 U	1.54 U	7.69 U	1.54 U
Heptane	µg/m3	0.820 U	0.820 U	**3.10**	**0.971**	**0.865**	0.820 U	**1.04**	4.10 U	**3.31**
Hexachlorobutadiene	µg/m3	2.13 U	2.13 U	2.13 U	2.13 U	2.13 U	2.13 U	2.13 U	10.7 U	2.13 U

Analyte	Location ID Sample Date Sample Type Lab Sample ID Unit	AA 10-May-17 N L1715353-01	AA 16-Oct-18 N L1842073-03	IA-BLDG-4A 16-Oct-18 N L1842073-04	IA-BLDG-4D 16-Oct-18 N L1842073-05	IA-BLDG-4D 16-Oct-18 FD L1842073-07	IA-BLDG-4M 16-Oct-18 N L1842073-01	IA-BLDG-5 16-Oct-18 N L1842073-08	SS-AOPC-5 07-Aug-18 N L1830687-04	SS-BLDG-4A 07-Aug-18 N L1830687-01
Isopropyl alcohol	µg/m3	1.23 U	**2.09**	**81.6**	**1,140**	**1,080**	**49.2**	**310**	**24.1**	**13.2**
m,p-Xylenes	µg/m3		1.74 U	1.74 U	**2.73**	**2.85**	1.74 U	**1.95**	8.69 U	**4.30**
Methyl bromide	µg/m3	0.777 U	0.777 U	0.777 U	0.777 U	0.777 U	0.777 U	0.777 U	3.88 U	0.777 U
Methyl chloride	µg/m3	**1.21**	**0.890**	**0.882**	**0.911**	**1.00**	**0.890**	**0.958**	2.07 U	0.413 U
Methyl tert-butyl ether	µg/m3	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	3.61 U	0.721 U
Methylene chloride	µg/m3	1.74 U	1.74 U	**26.8**	1.74 U	1.74 U	1.74 U	1.74 U	8.69 U	**8.79**
n-Hexane	µg/m3	0.705 U	0.705 U	0.705 U	0.705 U	0.705 U	0.705 U	0.705 U	**3.88**	**2.31**
o-Xylene	µg/m3	0.869 U	0.869 U	0.869 U	**1.36**	**1.35**	0.869 U	**0.877**	4.34 U	**1.38**
Styrene	µg/m3	0.852 U	0.852 U	0.852 U	0.852 U	0.852 U	0.852 U	0.852 U	4.26 U	0.852 U
tert-Butyl alcohol	µg/m3	1.52 U	1.52 U	1.52 U	1.52 U	1.52 U	1.52 U	1.52 U	7.58 U	**3.33**
Tetrachloroethene	µg/m3	0.136 U	0.136 U	0.136 U	0.136 U	0.136 U	**0.197**	**0.292**	**1,840**	**22.8**
Tetrahydrofuran	µg/m3	1.47 U	1.47 U	1.47 U	1.47 U	1.47 U	1.47 U	1.47 U	7.37 U	1.47 U
Toluene	µg/m3	0.754 U	0.754 U	**1.06**	**3.50**	**4.26**	0.754 U	**1.02**	**5.50**	**5.01**
trans-1,2-Dichloroethene	µg/m3	0.793 U	0.793 U	**1.83**	0.793 U	0.793 U	**2.37**	**1.43**	**44.4**	**1.02**
trans-1,3-Dichloropropene	µg/m3	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	4.54 U	0.908 U
Trichloroethene	µg/m3	0.107 U	0.107 U	**0.876**	0.107 U	0.107 U	**0.129**	**0.666**	**881**	**32.5**
Trichlorofluoromethane (Freon 11)	µg/m3	**1.35**	**1.37**	**1.23**	**1.46**	**1.36**	**1.44**	**1.82**	5.62 U	**2.58**
Vinyl bromide	µg/m3	0.874 U	0.874 U	0.874 U	0.874 U	0.874 U	0.874 U	0.874 U	4.37 U	0.874 U
Vinyl chloride	µg/m3	0.051 U	0.051 U	0.051 U	0.051 U	0.051 U	0.051 U	0.051 U	2.56 U	0.511 U
Xylenes, m/p	µg/m3	1.74 U								

Notes:
< = Compound not detected at concentrations
above the laboratory reporting detection limit.
The laboratory reporting detection limit is shown.
Empty cells = Not analyzed
Units are in µg/m3 = micrograms per cubic meter
Results shown in bold font indicate a compound was detected
above the laboratory reporting detection limit.

Qualifiers - Organic:
J = The analyte was positively identified; associated numerical value is the approximate concentration of the analyte in the sample
U
UJ = Analyte was analyzed for, but not detected. The detection limit is a quantitative estimate
All analyses performed by Alpha Analytical Westborough.

Table 2
Summary of Ambient Air, Indoor Air and Soil Vapor Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Location ID Sample Date Sample Type Lab Sample ID Unit	SS-BLDG-4A 07-Aug-18 FD L1830687-08	SS-BLDG-4C 07-Aug-18 N L1830687-02	SS-BLDG-4D 07-Aug-18 N L1830687-03	SS-BLDG-4M 16-Oct-18 N L1842073-02	SS-BLDG-5 16-Oct-18 N L1842073-06	SS-BLDG-6 07-Aug-18 N L1830687-06	SS-BLDG-7B-1 07-Aug-18 N L1830687-05	SS-BLDG-7B-2 07-Aug-18 N L1830687-07
µg/m3									
1,1,1-Trichloroethane	µg/m3	**12.4**	2.18 U	1.09 U	5.62 U	**45.9**	**13,400**	**33.0**	**4,670**
1,1,2,2-Tetrachloroethane	µg/m3	6.87 U	2.75 U	1.37 U	7.07 U	6.87 U	79.0 U	13.7 U	123 U
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	µg/m3	**10.4**	3.07 U	1.53 U	**27.2**	**58.1**	**34,500**	**400**	**9,120**
1,1,2-Trichloroethane	µg/m3	5.46 U	2.18 U	1.09 U	5.62 U	5.46 U	62.7 U	10.9 U	97.7 U
1,1-Dichloroethane	µg/m3	4.05 U	1.62 U	0.809 U	4.17 U	4.05 U	**1,050**	8.09 U	**181**
1,1-Dichloroethene	µg/m3	3.96 U	1.59 U	0.793 U	4.08 U	3.96 U	**3,860**	7.93 U	**346**
1,2,4-Trichlorobenzene	µg/m3	7.42 U	2.97 U	1.48 U	7.65 UJ	7.42 UJ	85.4 U	14.8 U	133 U
1,2,4-Trimethylbenzene	µg/m3	4.92 U	**10.0**	0.983 U	5.06 U	4.92 U	56.5 U	9.83 U	88.0 U
1,2-dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	µg/m3	6.99 U	2.80 U	1.40 U	7.20 U	6.99 U	80.4 U	14.0 U	125 U
1,2-Dichlorobenzene	µg/m3	6.01 U	2.40 U	1.20 U	6.19 U	6.01 U	69.1 U	12.0 U	108 U
1,2-Dichloroethane	µg/m3	4.05 U	1.62 U	0.809 U	4.17 U	4.05 U	46.5 U	8.09 U	72.4 U
1,2-Dichloropropane	µg/m3	4.62 U	1.85 U	0.924 U	4.76 U	4.62 U	53.1 U	9.24 U	82.7 U
1,3,5-Trimethylbenzene	µg/m3	4.92 U	**3.50**	0.983 U	5.06 U	4.92 U	56.5 U	9.83 U	88.0 U
1,3-Butadiene	µg/m3	2.21 U	0.885 U	0.442 U	2.28 U	2.21 U	25.4 U	4.42 U	39.6 U
1,3-Dichlorobenzene	µg/m3	6.01 U	2.40 U	1.20 U	6.19 U	6.01 U	69.1 U	12.0 U	108 U
1,4-Dichlorobenzene	µg/m3	6.01 U	2.40 U	1.20 U	6.19 U	6.01 U	69.1 U	12.0 U	108 U
1,4-Dioxane	µg/m3	3.60 U	1.44 U	0.721 U	3.71 U	3.60 U	41.4 U	7.21 U	64.5 U
2,2,4-Trimethylpentane	µg/m3	4.67 U	1.87 U	0.934 U	4.81 U	4.67 U	53.7 U	9.34 U	83.6 U
2-Butanone	µg/m3	7.37 U	**3.39**	**3.19**	7.61 U	7.37 U	84.9 U	14.7 U	132 U
2-Hexanone	µg/m3	4.10 U	1.64 U	0.820 U	4.22 U	4.10 U	47.1 U	8.20 U	73.4 U
4-Ethyltoluene	µg/m3	4.92 U	**2.83**	0.983 U	5.06 U	4.92 U	56.5 U	9.83 U	88.0 U
4-Methyl-2-pentanone	µg/m3	10.2 U	4.10 U	2.05 U	10.6 U	10.2 U	118 U	20.5 U	184 U
Acetone	µg/m3	**27.1**	**397**	**41.6**	**32.1 J**	**649**	**273**	23.8 U	213 U
Allyl chloride	µg/m3	3.13 U	1.25 U	0.626 U	3.22 U	3.13 U	36.0 U	6.26 U	56.0 U
Benzene	µg/m3	3.19 U	**2.04**	0.639 U	3.29 U	3.19 U	36.7 U	6.39 U	57.2 U
Benzyl chloride	µg/m3	5.18 U	2.07 U	1.04 U	5.33 U	5.18 U	59.5 U	10.4 U	92.7 U
Bromodichloromethane	µg/m3	6.70 U	2.68 U	1.34 U	6.90 U	6.70 U	77.0 U	13.4 U	120 U
Bromoform	µg/m3	10.3 U	4.14 U	2.07 U	10.6 U	10.3 U	119 U	20.7 U	185 U
Carbon disulfide	µg/m3	**3.21**	1.25 U	**0.772**	3.21 U	3.11 U	35.8 U	6.23 U	55.7 U
Carbon tetrachloride	µg/m3	6.29 U	2.52 U	1.26 U	6.48 U	6.29 U	72.3 U	12.6 U	113 U
Chlorobenzene	µg/m3	4.61 U	1.84 U	0.921 U	4.74 U	4.61 U	53.0 U	9.21 U	82.4 U
Chloroethane	µg/m3	2.64 U	1.06 U	0.528 U	2.72 U	2.64 U	30.3 U	5.28 U	47.2 U
Chloroform	µg/m3	4.88 U	1.95 U	0.977 U	5.03 U	4.88 U	**171**	9.77 U	**93.3**
cis-1,2-Dichloroethene	µg/m3	3.96 U	1.59 U	0.793 U	4.08 U	3.96 U	**1,560**	**78.1**	**967**
cis-1,3-Dichloropropene	µg/m3	4.54 U	1.82 U	0.908 U	4.68 U	4.54 U	52.2 U	9.08 U	81.3 U
Cyclohexane	µg/m3	3.44 U	**1.66**	0.688 U	**4.51**	3.44 U	39.6 U	6.88 U	61.6 U
Dibromochloromethane	µg/m3	8.52 U	3.41 U	1.70 U	8.78 U	8.52 U	98.0 U	17.0 U	152 U
Dichlorodifluoromethane (Freon 12)	µg/m3	**1,030**	1.98 U	**2.14**	**6.38**	4.94 U	**250**	**2,580**	**101**
Ethanol	µg/m3	**86.1**	**256**	**367**	**275**	**426**	543 U	**236**	844 U
Ethyl acetate	µg/m3	9.01 U	3.60 U	1.80 U	9.30 U	9.01 U	104 U	18.0 U	161 U
Ethylbenzene	µg/m3	4.34 U	1.74 U	**0.925**	4.47 U	4.34 U	50.0 U	8.69 U	77.7 U
Ethylene dibromide	µg/m3	7.69 U	3.07 U	1.54 U	7.92 U	7.69 U	88.4 U	15.4 U	138 U
Heptane	µg/m3	4.10 U	**6.64**	**3.89**	**5.49**	4.10 U	47.1 U	8.20 U	73.4 U
Hexachlorobutadiene	µg/m3	10.7 U	4.27 U	2.13 U	11.0 UJ	10.7 UJ	123 U	21.3 U	191 U

Analyte	Location ID Sample Date Sample Type Lab Sample ID Unit	SS-BLDG-4A 07-Aug-18 FD L1830687-08	SS-BLDG-4C 07-Aug-18 N L1830687-02	SS-BLDG-4D 07-Aug-18 N L1830687-03	SS-BLDG-4M 16-Oct-18 N L1842073-02	SS-BLDG-5 16-Oct-18 N L1842073-06	SS-BLDG-6 07-Aug-18 N L1830687-06	SS-BLDG-7B-1 07-Aug-18 N L1830687-05	SS-BLDG-7B-2 07-Aug-18 N L1830687-07
Isopropyl alcohol	µg/m3	**12.8**	**22.5**	**64.9**	**28.3**	**190**	70.8 U	**28.5**	110 U
m,p-Xylenes	µg/m3	8.69 U	**6.30**	**2.58**	8.95 U	8.69 U	99.9 U	17.4 U	155 U
Methyl bromide	µg/m3	3.88 U	1.55 U	0.777 U	4.00 U	3.88 U	44.7 U	7.77 U	69.5 U
Methyl chloride	µg/m3	2.07 U	0.826 U	0.413 U	2.13 U	2.07 U	23.7 U	4.13 U	37.0 U
Methyl tert-butyl ether	µg/m3	3.61 U	1.44 U	0.721 U	3.71 U	3.61 U	41.5 U	7.21 U	64.5 U
Methylene chloride	µg/m3	**8.86**	3.47 U	1.74 U	8.96 U	8.69 U	100 U	17.4 U	156 U
n-Hexane	µg/m3	3.52 U	**4.09**	**2.73**	**19.1**	**4.37**	40.5 U	7.05 U	63.1 U
o-Xylene	µg/m3	4.34 U	**3.34**	0.869 U	4.47 U	4.34 U	50.0 U	8.69 U	77.7 U
Styrene	µg/m3	4.26 U	1.70 U	0.852 U	4.39 U	4.26 U	49.0 U	8.52 U	76.2 U
tert-Butyl alcohol	µg/m3	7.58 U	**8.94**	**2.04**	7.82 U	7.58 U	87.3 U	15.2 U	136 U
Tetrachloroethene	µg/m3	**20.5**	**82.7**	**1.53**	6.98 U	6.78 U	**7,930**	**882**	**8,410**
Tetrahydrofuran	µg/m3	7.37 U	**7.93**	1.47 U	7.61 U	7.37 U	84.9 U	14.7 U	132 U
Toluene	µg/m3	**5.88**	**6.67**	**4.26**	3.88 U	3.77 U	43.3 U	7.54 U	67.5 U
trans-1,2-Dichloroethene	µg/m3	3.96 U	1.59 U	0.793 U	4.08 U	3.96 U	**97.1**	**809**	**121**
trans-1,3-Dichloropropene	µg/m3	4.54 U	1.82 U	0.908 U	4.68 U	4.54 U	52.2 U	9.08 U	81.3 U
Trichloroethene	µg/m3	**29.8**	**76.3**	**6.45**	5.54 U	**61.8**	**143,000**	**308**	**56,400**
Trichlorofluoromethane (Freon 11)	µg/m3	5.62 U	**2.71**	**1.33**	5.79 U	**47.8**	64.6 U	11.2 U	101 U
Vinyl bromide	µg/m3	4.37 U	1.75 U	0.874 U	4.50 U	4.37 U	50.3 U	8.74 U	78.3 U
Vinyl chloride	µg/m3	2.56 U	1.02 U	0.511 U	2.63 U	**2.91**	29.4 U	5.11 U	45.8 U
Xylenes, m/p	µg/m3								

Notes:
< = Compound not detected at concentrations
above the laboratory reporting detection limit.
The laboratory reporting detection limit is shown.
Empty cells = Not analyzed
Units are in µg/m3 = micrograms per cubic meter
Results shown in bold font indicate a compound was detected
above the laboratory reporting detection limit.

Qualifiers - Organic:
J = The analyte was positively identified; associated numerical value is the approximate concentr
U
UJ = Analyte was analyzed for, but not detected. The detection limit is a quantitative estimate
All analyses performed by Alpha Analytical Westborough.

Table 2
Summary of Ambient Air, Indoor Air and Soil Vapor Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Location ID Sample Date Sample Type Lab Sample ID Unit	VI-01-IA 10-May-17 N L1715353-02	VI-01-SS 10-May-17 N L1715353-03	VI-02-IA 10-May-17 N L1715353-04	VI-02-SS 10-May-17 N L1715353-05	VI-03-IA 10-May-17 N L1715353-06	VI-03-SS 10-May-17 N L1715353-07	VI-04-IA 10-May-17 N L1715353-08	VI-04-IA 10-May-17 FD L1715353-12	VI-04-SS 10-May-17 N L1715353-09
µg/m3										
1,1,1-Trichloroethane	µg/m3	**0.300**	5.46 U	0.109 U	**214**	**0.240**	**7,910**	**0.589**	**0.622**	**11,000**
1,1,2,2-Tetrachloroethane	µg/m3	1.37 U	6.87 U	1.37 U	13.7 U	1.37 U	321 U	1.37 U	1.37 U	279 U
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	µg/m3	**1.56**	**1,120**	1.53 U	**88.9**	**2.02**	**53,500**	**3.86**	**3.76**	**205,000**
1,1,2-Trichloroethane	µg/m3	1.09 U	5.46 U	1.09 U	10.9 U	1.09 U	255 U	1.09 U	1.09 U	222 U
1,1-Dichloroethane	µg/m3	0.809 U	4.05 U	0.809 U	8.09 U	0.809 U	**882**	0.809 U	0.809 U	**334**
1,1-Dichloroethene	µg/m3	0.079 U	3.96 U	0.079 U	7.93 U	0.079 U	**5,470**	**0.119**	**0.123**	**3,010**
1,2,4-Trichlorobenzene	µg/m3	1.48 U	7.42 U	1.48 U	14.8 U	1.48 U	347 U	1.48 U	1.48 U	301 U
1,2,4-Trimethylbenzene	µg/m3	0.983 U	4.92 U	**11.3**	9.83 U	**9.68**	230 U	**11.1**	**10.5**	200 U
1,2-dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	µg/m3	1.40 U	6.99 U	1.40 U	14.0 U	1.40 U	326 U	1.40 U	1.40 U	284 U
1,2-Dichlorobenzene	µg/m3	1.20 U	6.01 U	1.20 U	12.0 U	1.20 U	281 U	1.20 U	1.20 U	244 U
1,2-Dichloroethane	µg/m3	0.809 U	4.05 U	0.809 U	8.09 U	0.809 U	189 U	0.809 U	0.809 U	164 U
1,2-Dichloropropane	µg/m3	0.924 U	4.62 U	0.924 U	9.24 U	0.924 U	216 U	0.924 U	0.924 U	188 U
1,3,5-Trimethylbenzene	µg/m3	0.983 U	4.92 U	**5.01**	9.83 U	**3.99**	230 U	**4.62**	**4.27**	200 U
1,3-Butadiene	µg/m3	0.442 U	2.21 U	0.442 U	4.42 U	0.442 U	103 U	0.442 U	0.442 U	89.8 U
1,3-Dichlorobenzene	µg/m3	1.20 U	6.01 U	1.20 U	12.0 U	1.20 U	281 U	1.20 U	1.20 U	244 U
1,4-Dichlorobenzene	µg/m3	1.20 U	6.01 U	1.20 U	12.0 U	1.20 U	281 U	1.20 U	1.20 U	244 U
1,4-Dioxane	µg/m3	0.721 U	3.60 U	0.721 U	**7.96**	0.721 U	168 U	0.721 U	0.721 U	146 U
2,2,4-Trimethylpentane	µg/m3	0.934 U	4.67 U	**1.15**	9.34 U	**1.05**	218 U	**1.08**	**1.06**	190 U
2-Butanone	µg/m3	**1.75**	7.37 U	**2.28**	**74.0**	**2.13**	345 U	**9.88**	**9.47**	301 U
2-Hexanone	µg/m3	0.820 U	4.10 U	0.820 U	8.20 U	0.820 U	191 U	0.820 U	0.820 U	166 U
4-Ethyltoluene	µg/m3	0.983 U	4.92 U	**1.77**	9.83 U	**1.68**	230 U	**1.86**	**1.69**	200 U
4-Methyl-2-pentanone	µg/m3	2.05 U	10.2 U	2.05 U	20.5 U	2.05 U	479 U	**16.5**	**17.6**	418 U
Acetone	µg/m3	**158**	**618**	**96.4**	**4,920**	**23.5**	**725**	**85.0**	**90.7**	**5,580**
Allyl chloride	µg/m3	0.626 U	3.13 U	0.626 U	6.26 U	0.626 U	146 U	0.626 U	0.626 U	127 U
Benzene	µg/m3	0.639 U	**8.53**	**0.764**	**25.3**	0.639 U	149 U	**2.24**	**2.26**	130 U
Benzyl chloride	µg/m3	1.04 U	5.18 U	1.04 U	10.4 U	1.04 U	242 U	1.04 U	1.04 U	210 U
Bromodichloromethane	µg/m3	1.34 U	6.70 U	1.34 U	13.4 U	1.34 U	313 U	1.34 U	1.34 U	272 U
Bromoform	µg/m3	2.07 U	10.3 U	2.07 U	20.7 U	2.07 U	483 U	2.07 U	2.07 U	420 U
Carbon disulfide	µg/m3	0.623 U	3.11 U	**23.1**	**21.3**	**1.10**	145 U	**1.08**	**1.12**	126 U
Carbon tetrachloride	µg/m3	**0.403**	6.29 U	**0.390**	12.6 U	**0.409**	294 U	**0.447**	**0.484**	255 U
Chlorobenzene	µg/m3	0.921 U	4.61 U	0.921 U	9.21 U	0.921 U	215 U	0.921 U	0.921 U	187 U
Chloroethane	µg/m3	0.528 U	2.64 U	0.528 U	5.28 U	0.528 U	123 U	0.528 U	0.528 U	107 U
Chloroform	µg/m3	0.977 U	4.88 U	0.977 U	9.77 U	0.977 U	**242**	0.977 U	0.977 U	198 U
cis-1,2-Dichloroethene	µg/m3	**0.079**	3.96 U	0.079 U	7.93 U	**0.131**	**864**	**0.119**	**0.111**	**1,190**
cis-1,3-Dichloropropene	µg/m3	0.908 U	4.54 U	0.908 U	9.08 U	0.908 U	212 U	0.908 U	0.908 U	184 U
Cyclohexane	µg/m3	0.688 U	**15.4**	0.688 U	**185**	0.688 U	161 U	0.688 U	0.688 U	140 U
Dibromochloromethane	µg/m3	1.70 U	8.52 U	1.70 U	17.0 U	1.70 U	398 U	1.70 U	1.70 U	346 U
Dichlorodifluoromethane (Freon 12)	µg/m3	**1.93**	**12.7**	**1.86**	9.89 U	**2.13**	**354**	**2.46**	**2.36**	**870**
Ethanol	µg/m3	**34.1**	**245**	**28.6**	**748**	**42.0**	2,200 U	**168**	**194**	1,920 U
Ethyl acetate	µg/m3	1.80 U	9.01 U	1.80 U	18.0 U	1.80 U	422 U	1.80 U	1.80 U	368 U
Ethylbenzene	µg/m3	**20.5**	**14.2**	0.869 U	8.69 U	**1.53**	203 U	**5.95**	**5.43**	176 U
Ethylene dibromide	µg/m3	1.54 U	7.69 U	1.54 U	15.4 U	1.54 U	359 U	1.54 U	1.54 U	312 U
Heptane	µg/m3	0.820 U	**44.3**	0.820 U	**561**	0.820 U	191 U	0.820 U	0.820 U	166 U
Hexachlorobutadiene	µg/m3	2.13 U	10.7 U	2.13 U	21.3 U	2.13 U	498 U	2.13 U	2.13 U	433 U

Analyte	Location ID Sample Date Sample Type Lab Sample ID Unit	VI-01-IA 10-May-17 N L1715353-02	VI-01-SS 10-May-17 N L1715353-03	VI-02-IA 10-May-17 N L1715353-04	VI-02-SS 10-May-17 N L1715353-05	VI-03-IA 10-May-17 N L1715353-06	VI-03-SS 10-May-17 N L1715353-07	VI-04-IA 10-May-17 N L1715353-08	VI-04-IA 10-May-17 FD L1715353-12	VI-04-SS 10-May-17 N L1715353-09
Isopropyl alcohol	µg/m3	**349**	**62.7**	**102**	**398**	**300**	288 U	**376**	**410**	**403**
m,p-Xylenes	µg/m3									
Methyl bromide	µg/m3	0.777 U	3.88 U	0.777 U	7.77 U	0.777 U	181 U	0.777 U	0.777 U	158 U
Methyl chloride	µg/m3	**1.33**	2.07 U	**1.27**	4.13 U	**1.19**	96.4 U	**1.16**	**1.26**	83.8 U
Methyl tert-butyl ether	µg/m3	0.721 U	3.61 U	0.721 U	7.21 U	0.721 U	168 U	0.721 U	0.721 U	146 U
Methylene chloride	µg/m3	**20.0**	**11.9**	**2.39**	**30.4**	**11.9**	406 U	**19.0**	**20.2**	354 U
n-Hexane	µg/m3	0.705 U	**66.6**	0.705 U	**578**	**0.909**	165 U	0.705 U	0.705 U	**212**
o-Xylene	µg/m3	**11.8**	**8.12**	**1.61**	8.69 U	**2.10**	203 U	**9.69**	**8.90**	176 U
Styrene	µg/m3	**63.9**	**43.0**	0.852 U	8.52 U	0.852 U	199 U	0.852 U	0.852 U	173 U
tert-Butyl alcohol	µg/m3	1.52 U	7.58 U	1.52 U	**162**	1.52 U	355 U	1.52 U	1.52 U	309 U
Tetrachloroethene	µg/m3	**0.448**	6.78 U	0.136 U	**318**	**0.549**	**4,640**	**1.81**	**1.78**	**3,850**
Tetrahydrofuran	µg/m3	1.47 U	7.37 U	1.47 U	14.7 U	1.47 U	345 U	1.47 U	1.47 U	301 U
Toluene	µg/m3	0.754 U	**11.2**	**9.27**	**60.7**	**1.81**	176 U	**2.59**	**2.44**	153 U
trans-1,2-Dichloroethene	µg/m3	**110**	**60.3**	0.793 U	7.93 U	**43.6**	185 U	**51.5**	**50.4**	161 U
trans-1,3-Dichloropropene	µg/m3	0.908 U	4.54 U	0.908 U	9.08 U	0.908 U	212 U	0.908 U	0.908 U	184 U
Trichloroethene	µg/m3	**0.306**	5.37 U	**0.161**	**499**	**2.86**	**90,300**	**7.20**	**7.42**	**51,100**
Trichlorofluoromethane (Freon 11)	µg/m3	**11.4**	**6.97**	**1.30**	11.2 U	**5.10**	262 U	**9.78**	**10.0**	228 U
Vinyl bromide	µg/m3	0.874 U	4.37 U	0.874 U	8.74 U	0.874 U	204 U	0.874 U	0.874 U	178 U
Vinyl chloride	µg/m3	0.051 U	2.56 U	0.051 U	5.11 U	0.051 U	119 U	0.051 U	0.051 U	104 U
Xylenes, m/p	µg/m3	**74.7**	**50.4**	**3.08**	**21.7**	**6.60**	406 U	**26.5**	**24.7**	353 U

Notes:
< = Compound not detected at concentrations
above the laboratory reporting detection limit.
The laboratory reporting detection limit is shown.
Empty cells = Not analyzed
Units are in µg/m3 = micrograms per cubic meter
Results shown in bold font indicate a compound was detected
above the laboratory reporting detection limit.

Qualifiers - Organic:
J = The analyte was positively identified; associated numerical value is the approximate concentr
U
UJ = Analyte was analyzed for, but not detected. The detection limit is a quantitative estimate
All analyses performed by Alpha Analytical Westborough.

Table 2
Summary of Ambient Air, Indoor Air and Soil Vapor Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Location ID Sample Date Sample Type Lab Sample ID Unit	VI-05-IA 10-May-17 N L1715353-10	VI-05-SS 10-May-17 N L1715353-11
µg/m3			
1,1,1-Trichloroethane	µg/m3	0.109 U	5.46 U
1,1,2,2-Tetrachloroethane	µg/m3	1.37 U	6.87 U
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	µg/m3	1.53 U	7.66 U
1,1,2-Trichloroethane	µg/m3	1.09 U	5.46 U
1,1-Dichloroethane	µg/m3	0.809 U	4.05 U
1,1-Dichloroethene	µg/m3	0.079 U	3.96 U
1,2,4-Trichlorobenzene	µg/m3	1.48 U	7.42 U
1,2,4-Trimethylbenzene	µg/m3	**3.32**	**7.57**
1,2-dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	µg/m3	1.40 U	6.99 U
1,2-Dichlorobenzene	µg/m3	1.20 U	6.01 U
1,2-Dichloroethane	µg/m3	0.809 U	4.05 U
1,2-Dichloropropane	µg/m3	0.924 U	4.62 U
1,3,5-Trimethylbenzene	µg/m3	**1.32**	**5.31**
1,3-Butadiene	µg/m3	0.442 U	**6.95**
1,3-Dichlorobenzene	µg/m3	1.20 U	6.01 U
1,4-Dichlorobenzene	µg/m3	1.20 U	6.01 U
1,4-Dioxane	µg/m3	0.721 U	3.60 U
2,2,4-Trimethylpentane	µg/m3	0.934 U	4.67 U
2-Butanone	µg/m3	1.47 U	**28.4**
2-Hexanone	µg/m3	0.820 U	4.10 U
4-Ethyltoluene	µg/m3	0.983 U	4.92 U
4-Methyl-2-pentanone	µg/m3	2.05 U	10.2 U
Acetone	µg/m3	**11.4**	**556**
Allyl chloride	µg/m3	0.626 U	3.13 U
Benzene	µg/m3	0.639 U	**66.4**
Benzyl chloride	µg/m3	1.04 U	5.18 U
Bromodichloromethane	µg/m3	1.34 U	6.70 U
Bromoform	µg/m3	2.07 U	10.3 U
Carbon disulfide	µg/m3	0.623 U	**23.4**
Carbon tetrachloride	µg/m3	**0.384**	6.29 U
Chlorobenzene	µg/m3	0.921 U	4.61 U
Chloroethane	µg/m3	0.528 U	2.64 U
Chloroform	µg/m3	0.977 U	4.88 U
cis-1,2-Dichloroethene	µg/m3	0.079 U	3.96 U
cis-1,3-Dichloropropene	µg/m3	0.908 U	4.54 U
Cyclohexane	µg/m3	0.688 U	**100**
Dibromochloromethane	µg/m3	1.70 U	8.52 U
Dichlorodifluoromethane (Freon 12)	µg/m3	**2.52**	4.94 U
Ethanol	µg/m3	**54.1**	**754**
Ethyl acetate	µg/m3	1.80 U	9.01 U
Ethylbenzene	µg/m3	0.869 U	**6.52**
Ethylene dibromide	µg/m3	1.54 U	7.69 U
Heptane	µg/m3	0.820 U	**184**
Hexachlorobutadiene	µg/m3	2.13 U	10.7 U

Analyte	Location ID Sample Date Sample Type Lab Sample ID Unit	VI-05-IA 10-May-17 N L1715353-10	VI-05-SS 10-May-17 N L1715353-11
Isopropyl alcohol	µg/m3	**12.5**	**58.7**
m,p-Xylenes	µg/m3		
Methyl bromide	µg/m3	0.777 U	3.88 U
Methyl chloride	µg/m3	**1.14**	**2.75**
Methyl tert-butyl ether	µg/m3	0.721 U	3.61 U
Methylene chloride	µg/m3	**6.74**	8.69 U
n-Hexane	µg/m3	0.705 U	**259**
o-Xylene	µg/m3	0.869 U	**9.56**
Styrene	µg/m3	0.852 U	4.26 U
tert-Butyl alcohol	µg/m3	1.52 U	**24.1**
Tetrachloroethene	µg/m3	0.136 U	6.78 U
Tetrahydrofuran	µg/m3	1.47 U	7.37 U
Toluene	µg/m3	**1.82**	**113**
trans-1,2-Dichloroethene	µg/m3	0.793 U	3.96 U
trans-1,3-Dichloropropene	µg/m3	0.908 U	4.54 U
Trichloroethene	µg/m3	**0.118**	**39.8**
Trichlorofluoromethane (Freon 11)	µg/m3	**1.90**	5.62 U
Vinyl bromide	µg/m3	0.874 U	4.37 U
Vinyl chloride	µg/m3	0.051 U	2.56 U
Xylenes, m/p	µg/m3	1.74 U	**37.4**

Notes:
< = Compound not detected at concentrations
above the laboratory reporting detection limit.
The laboratory reporting detection limit is shown.
Empty cells = Not analyzed
Units are in µg/m3 = micrograms per cubic meter
Results shown in bold font indicate a compound was detected
above the laboratory reporting detection limit.

Qualifiers - Organic:
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U
UJ = Analyte was analyzed for, but not detected. The detection limit is a quantitative estimate
All analyses performed by Alpha Analytical Westborough.

Table 3
Summary of Surface Water Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	NY-TOGS 1.1.1-SW_WILDLIFE PROTECTION	SW-01 10-May-17 N	SW-01 18-Jul-17 N	SW-02 10-May-17 N	SW-02 10-May-17 FD	SW-02 18-Jul-17 N	SW-02 18-Jul-17 FD	SW-03 27-Jun-17 N
Volatile Organic Compounds (VOCs)									
Acetone	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Benzene	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
Bromodichloromethane	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
Bromoform	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
Bromomethane	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
2-Butanone	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Carbon disulfide	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Carbon tetrachloride	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
Chlorobenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Chlorobromomethane	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Chloroethane	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Chloromethane	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Chloroform	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
cis-1,2-Dichloroethene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
cis-1,3-Dichloropropene	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
Cyclohexane	µg/L	NS	*10 U*	--	*10 U*	*10 U*	--	--	--
Dibromochloromethane	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
1,2-Dibromo-3-chloropropane	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,2-Dichlorobenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,3-Dichlorobenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,4-Dichlorobenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,2-Dichloroethane	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
1,1-Dichloroethane	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,1-Dichloroethene	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
1,2-Dichloropropane	µg/L	NS	*1.0 U*	--	*1.0 U*	*1.0 U*	--	--	--
Ethylbenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Ethylene dibromide	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
Freon 11	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Freon 12	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Freon 113	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
2-Hexanone	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Isopropylbenzene (Cumene)	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
4-Isopropyltoluene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Methyl acetate	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
4-Methyl-2-pentanone	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Methyl tert-butyl ether	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Methylcyclohexane	µg/L	NS	*10 U*	--	*10 U*	*10 U*	--	--	--
Methylene chloride	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Naphthalene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
n-Butylbenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
n-Propylbenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
sec-Butylbenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
o-Xylene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Styrene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
tert-Butylbenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Tetrachloroethene	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
Toluene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
trans-1,2-Dichloroethene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
trans-1,3-Dichloropropene	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
1,1,1-Trichloroethane	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,1,2,2-Tetrachloroethane	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
1,1,2-Trichloroethane	µg/L	NS	*1.5 U*	--	*1.5 U*	*1.5 U*	--	--	--
1,3,5-Trimethylbenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,2,3-Trichlorobenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,2,4-Trichlorobenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,2,4-Trimethylbenzene	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
Trichloroethene	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
Vinyl chloride	µg/L	NS	*1.0 U*	--	*1.0 U*	*1.0 U*	--	--	--
Xylenes, m/p	µg/L	NS	*2.5 U*	--	*2.5 U*	*2.5 U*	--	--	--
1,4-Dioxane	ng/l	NS	*155 U*	--	*153 U*	*158 U*	--	--	--

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NY-TOGS 1.1.1-SW_WILDFIRE PROTECTION

Table 3
Summary of Surface Water Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	NY-TOGS 1.1.1-SW_WILDLIFE PROTECTION	SW-01 10-May-17 N	SW-01 18-Jul-17 N	SW-02 10-May-17 N	SW-02 10-May-17 FD	SW-02 18-Jul-17 N	SW-02 18-Jul-17 FD	SW-03 27-Jun-17 N
Semi-Volatile Organic Compounds (SVOCs)									
Acenaphthene	µg/L	NS	*0.10 U*	--	*0.10 U*	*0.10 U*	--	--	--
Acenaphthylene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Acetophenone	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Anthracene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Atrazine	µg/L	NS	*10 U*	--	*10 U*	*10 U*	--	--	--
Benzaldehyde	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Benzo(a)anthracene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Benzo(a)pyrene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Benzo(b)fluoranthene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Benzo(g,h,i)perylene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Benzo(k)fluoranthene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Benzyl butyl phthalate	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Biphenyl	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
Bis(2-chloroethoxy)methane	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Bis(2-ethylhexyl)phthalate	µg/L	NS	**3.5**	--	**5.4**	**5**	--	--	--
4-Bromophenyl phenyl ether	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
Caprolactam	µg/L	NS	*10 U*	--	*10 U*	*10 U*	--	--	--
Carbazole	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
p-Chloroaniline	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
4-Chloro-3-methylphenol	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
2-Chloronaphthalene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
2-Chlorophenol	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
o-Cresol	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
m-Cresol	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
4-Chlorophenyl phenyl ether	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
Chrysene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Dibenzo(a,h)anthracene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Dibenzofuran	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
Dibutyl phthalate	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
3,3'-Dichlorobenzidine	µg/L	NS	*5.0 UJ*	--	*5.0 U*	*5.0 U*	--	--	--
Dichloroethyl ether	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
2,4-Dichlorophenol	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
2,4-Dimethylphenol	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Diethyl phthalate	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Dimethyl phthalate	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Dinitro-o-cresol	µg/L	NS	*10 U*	--	*10 U*	*10 U*	--	--	--
2,4-Dinitrophenol	µg/L	NS	*20 U*	--	*20 U*	*20 U*	--	--	--
2,4-Dinitrotoluene	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
2,6-Dinitrotoluene	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Di-n-octyl phthalate	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Fluoranthene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Fluorene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Hexachlorobenzene	µg/L	NS	*0.80 U*	--	*0.80 U*	*0.80 U*	--	--	--
Hexachlorobutadiene	µg/L	NS	*0.50 U*	--	*0.50 U*	*0.50 U*	--	--	--
Hexachlorocyclopentadiene	µg/L	NS	*20 U*	--	*20 U*	*20 U*	--	--	--
Hexachloroethane	µg/L	NS	*0.80 U*	--	*0.80 U*	*0.80 U*	--	--	--
Indeno(1,2,3-cd)pyrene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Isophorone	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
2-Methylnaphthalene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
2-Nitroaniline	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
3-Nitroaniline	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
p-Nitroaniline	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Nitrobenzene	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
2-Nitrophenol	µg/L	NS	*10 U*	--	*10 U*	*10 U*	--	--	--
4-Nitrophenol	µg/L	NS	*10 U*	--	*10 U*	*10 U*	--	--	--
n-Nitrosodi-n-propylamine	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
n-Nitrosodiphenylamine	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
2,2-Oxybis(1-chloropropane)	µg/L	NS	*2.0 U*	--	*2.0 U*	*2.0 U*	--	--	--
Pentachlorophenol	µg/L	NS	*0.80 U*	--	*0.80 U*	*0.80 U*	--	--	--
Phenanthrene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
Phenol	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
Pyrene	µg/L	NS	*0.20 U*	--	*0.20 U*	*0.20 U*	--	--	--
1,2,4,5-Tetrachlorobenzene	µg/L	NS	*10 U*	--	*10 U*	*10 U*	--	--	--
2,3,4,6-Tetrachlorophenol	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
2,4,5-Trichlorophenol	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--
2,4,6-Trichlorophenol	µg/L	NS	*5.0 U*	--	*5.0 U*	*5.0 U*	--	--	--

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NY-TOGS 1.1.1-SW_WILDFIRE PROTECTION

Table 3
Summary of Surface Water Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	NY-TOGS 1.1.1-SW_WILDLIFE PROTECTION	SW-01 10-May-17 N	SW-01 18-Jul-17 N	SW-02 10-May-17 N	SW-02 10-May-17 FD	SW-02 18-Jul-17 N	SW-02 18-Jul-17 FD	SW-03 27-Jun-17 N
Polychlorinated Biphenyl (PCB)									
Aroclor 1016	µg/L	NS	*0.083 U*	--	*0.083 U*	*0.083 U*	--	--	*0.083 U*
Aroclor 1221	µg/L	NS	*0.083 U*	--	*0.083 U*	*0.083 U*	--	--	*0.083 U*
Aroclor 1232	µg/L	NS	*0.083 U*	--	*0.083 U*	*0.083 U*	--	--	*0.083 U*
Aroclor 1242	µg/L	NS	*0.083 U*	--	*0.083 U*	*0.083 U*	--	--	*0.083 U*
Aroclor 1248	µg/L	NS	*0.083 U*	--	*0.083 U*	*0.083 U*	--	--	*0.083 U*
Aroclor 1254	µg/L	NS	*0.083 U*	--	*0.083 U*	*0.083 U*	--	--	*0.083 U*
Aroclor 1260	µg/L	NS	*0.083 U*	--	**0.57**	**0.194**	--	--	*0.083 U*
Aroclor 1262	µg/L	NS	*0.083 U*	--	*0.083 U*	*0.083 U*	--	--	*0.083 U*
Aroclor 1268	µg/L	NS	*0.083 U*	--	*0.083 U*	*0.083 U*	--	--	*0.083 U*
Total PCBs	µg/L	**0.00012**	*0.083 U*	--	**0.57**	**0.194**	--	--	*0.083 U*
Metals, Total									
Aluminum	mg/L	NS	*0.0261 U*	--	*0.0193 U*	*0.0204 U*	--	--	--
Antimony	mg/L	NS	*0.00400 U*	--	*0.00400 U*	*0.00400 U*	--	--	--
Arsenic	mg/L	NS	**0.00049 J**	--	**0.00039 J**	**0.00054**	--	--	--
Barium	mg/L	NS	**0.06442**	--	**0.06078**	**0.0604**	--	--	--
Beryllium	mg/L	NS	*0.00050 U*	--	*0.00050 U*	*0.00050 U*	--	--	--
Cadmium	mg/L	NS	*0.00020 U*	--	*0.00020 U*	*0.00020 U*	--	--	--
Calcium	mg/L	NS	**92.8**	--	**91.4**	**93.5**	--	--	--
Chromium	mg/L	NS	*0.00100 U*	--	*0.00100 U*	*0.00100 U*	--	--	--
Cobalt	mg/L	NS	*0.00050 U*	--	*0.00050 U*	*0.00050 U*	--	--	--
Copper	mg/L	NS	**0.00159**	--	**0.00159**	**0.0014**	--	--	--
Cyanide	mg/L	NS	*0.250 U*	--	*0.005 U*	**0.003 J**	--	--	--
Hardness	mg/L	NS	--	**363.5**	--	--	**360.4**	**358**	--
Iron	mg/L	NS	**0.0558**	--	**0.0562**	**0.0542**	--	--	--
Lead	mg/L	NS	*0.00100 U*	--	*0.00100 U*	*0.00100 U*	--	--	--
Magnesium	mg/L	NS	**18.2**	--	**17.4**	**18**	--	--	--
Manganese	mg/L	NS	**0.01432**	--	**0.01383**	**0.0139**	--	--	--
Mercury	mg/L	0.0000026	*0.00020 U*	--	*0.00020 U*	*0.00020 U*	--	--	--
Nickel	mg/L	NS	**0.00098 J**	--	**0.00097 J**	**0.00104 J**	--	--	--
Potassium	mg/L	NS	**2.89**	--	**2.71**	**2.83**	--	--	--
Selenium	mg/L	NS	*0.00500 U*	--	*0.00500 U*	*0.00500 U*	--	--	--
Silver	mg/L	NS	*0.00040 U*	--	*0.00040 U*	*0.00040 U*	--	--	--
Sodium	mg/L	NS	**32**	--	**40.2**	**40.9**	--	--	--
Thallium	mg/L	NS	*0.00050 U*	--	*0.00050 U*	*0.00050 U*	--	--	--
Vanadium	mg/L	NS	*0.00500 U*	--	*0.00500 U*	*0.00500 U*	--	--	--
Zinc	mg/L	NS	**0.00342 J**	--	*0.01000 U*	*0.01000 U*	--	--	--
Per- and Polyfluoroalkyl Substances (PFAS)									
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOS	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeF	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorobutanesulfonic Acid (PFBS)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorodecanoic Acid (PFDA)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorododecanoic Acid (PFDoA)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluoroheptanoic Acid (PFHpA)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorohexane Sulfonic Acid (PFHxS)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorohexanoic Acid (PFHxA)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorononanoic Acid (PFNA)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorooctanesulfonic Acid (PFOS)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorooctanoic Acid (PFOA)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorotetradecanoic Acid (PFTA)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--
Perfluorotridecanoic Acid (PFTrDA)	ng/l	NS	*1.98 U*	--	*1.94 U*	*1.92 U*	--	--	--

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UJ = Analyte was analyzed for, but not detected. The detection limit is a quantitative estimate.
All analyses performed by Alpha Woods Hole Laboratories.
NY-TOGS 1.1.1-SW_WILDLIFE PROTECTION

Table 4
Summary of Groundwater Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	Location ID:	MW-01D	MW-01S	MW-02D	MW-02S	MW-03D	MW-03S	MW-04D	MW-04S	MW-1	MW-1 SR	MW-4 SR	PW-A	PW-B
		Sample Date:	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	09-May-17	08-May-17
		Sample Type:	N	N	N	N	N	N	N	N	N	N	N	N	N
		NY-TOGS 1.1.1-GW													
Volatile Organic Compounds (VOCs)															
Acetone	µg/L	50	*5.0 U*	*12 U*	**18 J**	*100 U*	**10**	*100 U*	**13**	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*
Benzene	µg/L	1	*0.50 U*	*1.2 U*	**0.65 J**	*10 U*	*0.50 U*	*10 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
Bromodichloromethane	µg/L	50	*0.50 U*	*1.2 U*	*2.0 U*	*10 U*	*0.50 U*	*10 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
Bromoform	µg/L	50	*2.0 U*	*5.0 U*	*8.0 U*	*40 U*	*2.0 U*	*40 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*
Bromomethane	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	**1.1 J**	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
2-Butanone	µg/L	5	*5.0 U*	*12 U*	*20 U*	*100 U*	*5.0 U*	*100 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*
Carbon disulfide	µg/L	5	*5.0 U*	*12 U*	*20 U*	*100 U*	*5.0 U*	*100 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*
Carbon tetrachloride	µg/L	5	*0.50 U*	*1.2 U*	*2.0 U*	*10 U*	*0.50 U*	*10 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
Chlorobenzene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Chlorobromomethane	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Chloroethane	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Chloromethane	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	**1.0 J**	*2.5 U*	*2.5 U*	*2.5 U*	**0.74 J**	*2.5 U*	*2.5 U*
Chloroform	µg/L	7	*2.5 U*	*6.2 U*	**5.2 J**	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
cis-1,2-Dichloroethene	µg/L	**5**	**44**	**20**	**44**	**210**	*2.5 U*	**28 J**	**3.6**	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	**4.1**	**4**
cis-1,3-Dichloropropene	µg/L	5	*0.50 U*	*1.2 U*	*2.0 U*	*10 U*	*0.50 U*	*10 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
Cyclohexane	µg/L	NS	*10 U*	*25 U*	*40 U*	*200 U*	*10 U*	*200 U*	*10 U*	*10 U*	*10 U*	*10 U*	*10 U*	*10 U*	*10 U*
Dibromochloromethane	µg/L	50	*0.50 U*	*1.2 U*	*2.0 U*	*10 U*	*0.50 U*	*10 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
1,2-Dibromo-3-chloropropane	µg/L	0.04	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
1,2-Dichlorobenzene	µg/L	3	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
1,3-Dichlorobenzene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
1,4-Dichlorobenzene	µg/L	3	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
1,2-Dichloroethane	µg/L	0.6	*0.50 U*	*1.2 U*	*2.0 U*	*10 U*	*0.50 U*	*10 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
1,1-Dichloroethane	µg/L	**5**	**3.5**	**11**	**12**	**27 J**	*2.5 U*	**16 J**	**2.7**	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
1,1-Dichloroethene	µg/L	**5**	**2.5**	**12**	**7**	**32**	**0.19 J**	**36**	**0.32 J**	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
1,2-Dichloropropane	µg/L	1	*1.0 U*	*2.5 U*	*4.0 U*	*20 U*	*1.0 U*	*20 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*
Ethylbenzene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Ethylene dibromide	µg/L	1	*2.0 U*	*5.0 U*	*8.0 U*	*40 U*	*2.0 U*	*40 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*
Freon 11	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Freon 12	µg/L	**5**	**1.7 J**	*12 U*	**15 J**	*100 U*	*5.0 U*	*100 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*
Freon 113	µg/L	**5**	**32**	**31**	**420**	**98**	**1.2 J**	**290**	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	**3.8**	**3.2**
2-Hexanone	µg/L	50	*5.0 U*	*12 U*	*20 U*	*100 U*	*5.0 U*	*100 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*
Isopropylbenzene (Cumene)	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
4-Isopropyltoluene	µg/L	5	--	--	--	--	--	--	--	--	--	--	--	*2.5 U*	*2.5 U*
Methyl acetate	µg/L	NS	*2.0 U*	*5.0 U*	*8.0 U*	*40 U*	*2.0 U*	*40 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*	*2.0 U*
4-Methyl-2-pentanone	µg/L	5	*5.0 U*	*12 U*	*20 U*	*100 U*	*5.0 U*	*100 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*	*5.0 U*
Methyl tert-butyl ether	µg/L	10	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Methylcyclohexane	µg/L	NS	**0.99 J**	**3.5 J**	**5.4 J**	**18 J**	**0.46 J**	**22 J**	*10 U*	*10 U*	*10 U*	*10 U*	*10 U*	*10 U*	*10 U*
Methylene chloride	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Naphthalene	µg/L	10	--	--	--	--	--	--	--	--	--	--	--	*2.5 U*	*2.5 U*
n-Butylbenzene	µg/L	5	--	--	--	--	--	--	--	--	--	--	--	*2.5 U*	*2.5 U*
n-Propylbenzene	µg/L	5	--	--	--	--	--	--	--	--	--	--	--	*2.5 U*	*2.5 U*
sec-Butylbenzene	µg/L	5	--	--	--	--	--	--	--	--	--	--	--	*2.5 U*	*2.5 U*
o-Xylene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Styrene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
tert-Butylbenzene	µg/L	5	--	--	--	--	--	--	--	--	--	--	--	*2.5 U*	*2.5 U*
Tetrachloroethene	µg/L	**5**	**15**	**52**	**120**	**47**	**0.95**	**220**	**3.6**	**1.3**	**0.56**	**1.1**	*0.50 U*	*0.50 U*	**0.40 J**
Toluene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
trans-1,2-Dichloroethene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
trans-1,3-Dichloropropene	µg/L	0.4	*0.50 U*	*1.2 U*	*2.0 U*	*10 U*	*0.50 U*	*10 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
1,1,1-Trichloroethane	µg/L	**5**	**5.7**	**69**	**4.0 J**	**47 J**	**0.90 J**	**160**	**3.3**	**0.96 J**	**0.98 J**	**1.5 J**	*2.5 U*	*2.5 U*	*2.5 U*
1,1,2,2-Tetrachloroethane	µg/L	5	*0.50 U*	*1.2 U*	*2.0 U*	*10 U*	*0.50 U*	*10 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*	*0.50 U*
1,1,2-Trichloroethane	µg/L	1	*1.5 U*	*3.8 U*	*6.0 U*	*30 U*	*1.5 U*	*30 U*	*1.5 U*	*1.5 U*	*1.5 U*	*1.5 U*	*1.5 U*	*1.5 U*	*1.5 U*
1,3,5-Trimethylbenzene	µg/L	5	--	--	--	--	--	--	--	--	--	--	--	*2.5 U*	*2.5 U*
1,2,3-Trichlorobenzene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
1,2,4-Trichlorobenzene	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
1,2,4-Trimethylbenzene	µg/L	5	--	--	--	--	--	--	--	--	--	--	--	*2.5 U*	*2.5 U*
Trichloroethene	µg/L	**5**	**94**	**310**	**410**	**1,700**	**12**	**2,100**	**9.3**	**3.7**	**1.5**	**2.6**	**0.19 J**	**3.4**	**3.2**
Vinyl chloride	µg/L	2	**0.12 J**	*2.5 U*	**0.32 J**	*20 U*	*1.0 U*	*20 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*	*1.0 U*
Xylenes, m/p	µg/L	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
TICs (Calculated), Total	µg/L	NS	--	--	7.56 J	--	3.48 J	--	--	--	--	--	--	--	--
1,4-Dioxane	µg/1	50	**1.36**	*620 U*	**2.59**	**3.64**	*0.155 U*	**0.429**	*0.170 U*	*0.161 U*	*0.156 U*	*0.160 U*	*0.158 U*	*0.153 U*	*0.153 U*

Table 4
Summary of Groundwater Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	Location ID:	MW-01D	MW-01S	MW-02D	MW-02S	MW-03D	MW-03S	MW-04D	MW-04S	MW-1	MW-1 SR	MW-4 SR	PW-A	PW-B
		Sample Date:	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	09-May-17	08-May-17
		Sample Type:	N	N	N	N	N	N	N	N	N	N	N	N	N
		NY-TOGS 1.1.1-GW													
Semi-Volatile Organic Compounds (SVOCs)															
Acenaphthene	µg/l	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Acenaphthylene	µg/l	5	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
Acetophenone	µg/l	NS	**1.36**	*620 U*	**2.59**	**3.64**	*0.155 U*	**0.429**	*0.170 U*	*0.161 U*	*0.156 U*	*0.160 U*	*0.158 U*	*0.153 U*	*0.153 U*
Anthracene	µg/l	50	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
Atrazine	µg/l	7.5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
Benzo(a)anthracene	µg/l	0.002	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Benzo(a)pyrene	µg/l	0.002	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Benzo(b)fluoranthene	µg/l	0.002	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Benzo(g,h,i)perylene	µg/l	NS	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Benzo(k)fluoranthene	µg/l	0.002	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Benzyl butyl phthalate	µg/l	NS	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
Bis(2-chloroethoxy)methane	µg/l	5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	µg/l	5	--	--	--	--	--	--	*3.0 U*	*3.0 U*	--	--	--	--	--
4-Bromophenyl phenyl ether	µg/l	NS	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Carbazole	µg/l	NS	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
4-Chloro-3-methylphenol	µg/l	NS	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
p-Chloroaniline	µg/l	5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
2-Chloronaphthalene	µg/l	5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
2-Chlorophenol	µg/l	5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
4-Chlorophenyl phenyl ether	µg/l	50	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
m-Cresol	µg/l	NS	--	--	--	--	--	--	**1.6 J**	*5.0 U*	--	--	--	--	--
Chrysene	µg/l	0.002	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Dibenzo(a,h)anthracene	µg/l	NS	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Dibenzofuran	µg/l	NS	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
Dibutyl phthalate	µg/l	50	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
1,2-Dichlorobenzene	µg/l	3	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
1,3-Dichlorobenzene	µg/l	5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
1,4-Dichlorobenzene	µg/l	3	*2.5 U*	*6.2 U*	*10 U*	*50 U*	*2.5 U*	*50 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*	*2.5 U*
3,3'-Dichlorobenzidine	µg/l	NS	--	--	--	--	--	--	*10 U*	*10 U*	--	--	--	--	--
Dichloroethyl ether	µg/l	1	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
2,4-Dichlorophenol	µg/l	10	--	--	--	--	--	--	*0.20 U*	*0.20 U*	--	--	--	--	--
Diethyl phthalate	µg/l	50	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
2,4-Dimethylphenol	µg/l	NS	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
Dimethyl phthalate	µg/l	50	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
Dinitro-o-cresol	µg/l	NS	--	--	--	--	--	--	*10 U*	*10 U*	--	--	--	--	--
2,4-Dinitrophenol	µg/l	4.7	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
2,4-Dinitrotoluene	µg/l	5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
2,6-Dinitrotoluene	µg/l	NS	--	--	--	--	--	--	*10 U*	*10 U*	--	--	--	--	--
Di-n-octyl phthalate	µg/l	50	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
Fluoranthene	µg/l	50	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Fluorene	µg/l	50	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Hexachlorobenzene	µg/l	5	--	--	--	--	--	--	*0.80 U*	*0.80 U*	--	--	--	--	--
Hexachlorobutadiene	µg/l	0.5	--	--	--	--	--	--	*0.50 U*	*0.50 U*	--	--	--	--	--
Hexachlorocyclopentadiene	µg/l	5	--	--	--	--	--	--	*20 U*	*20 U*	--	--	--	--	--
Hexachloroethane	µg/l	5	--	--	--	--	--	--	*0.80 U*	*0.80 U*	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	µg/l	0.002	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
Isophorone	µg/l	50	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
2-Methylnaphthalene	µg/l	NS	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
Naphthalene	µg/l	10	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	*2.5 U*	*2.5 U*
2-Nitroaniline	µg/l	NS	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
3-Nitroaniline	µg/l	20	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
p-Nitroaniline	µg/l	5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
Nitrobenzene	µg/l	0.4	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
2-Nitrophenol	µg/l	NS	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
4-Nitrophenol	µg/l	NS	--	--	--	--	--	--	*10 U*	*10 U*	--	--	--	--	--
n-Nitrosodiphenylamine	µg/l	50	--	--	--	--	--	--	*2.0 U*	*2.0 U*	--	--	--	--	--
n-Nitrosodi-n-propylamine	µg/l	NS	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
2,2-Oxybis(1-chloropropane)	µg/l	10	--	--	--	--	--	--	*20 U*	*20 U*	--	--	--	--	--
Pentachlorophenol	µg/l	1	--	--	--	--	--	--	*0.80 U*	*0.80 U*	--	--	--	--	--
Phenanthrene	µg/l	50	--	--	--	--	--	--	**0.02 J**	*0.10 U*	--	--	--	--	--
Phenol	µg/l	**1**	--	--	--	--	--	--	**2.6 J**	*5.0 U*	--	--	--	--	--
Pyrene	µg/l	50	--	--	--	--	--	--	*0.10 U*	*0.10 U*	--	--	--	--	--
1,2,4-Trichlorobenzene	µg/l	NS	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
2,4,5-Trichlorophenol	µg/l	5	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
2,4,6-Trichlorophenol	µg/l	0.07	--	--	--	--	--	--	*5.0 U*	*5.0 U*	--	--	--	--	--
TICs (Calculated), Total	µg/L	NS	--	--	--	--	--	--	--	4.03 J	--	--	--	--	--

Table 4
Summary of Groundwater Analytical Data
GW Lisk - 2 South Street Facility
NYSDEC BCP Site Number C835026

Analyte	Unit	Location ID:	MW-01D	MW-01S	MW-02D	MW-02S	MW-03D	MW-03S	MW-04D	MW-04S	MW-1	MW-1 SR	MW-4 SR	PW-A	PW-B
		Sample Date:	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	09-May-17	08-May-17
		Sample Type:	N	N	N	N	N	N	N	N	N	N	N	N	N
		NY-TOGS 1.1.1-GW													
Polychlorinated Biphenyl (PCB)															
Aroclor 1016	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Aroclor 1221	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Aroclor 1232	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Aroclor 1242	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Aroclor 1248	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Aroclor 1254	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Aroclor 1260	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Aroclor 1262	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Aroclor 1268	µg/L	NS	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Total PCBs	µg/L	0.09	--	--	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	*0.083 U*	--	--	--	--	--
Metals, Total															
Aluminum	mg/L	NS	--	--	0.456	0.035 J	0.213	*0.100 U*	0.122	0.101	--	--	--	*0.0100 U*	*0.0100 U*
Antimony	mg/L	**0.003**	--	--	*0.050 U*	*0.050 U*	**0.007 J**	*0.050 U*	*0.050 U*	*0.050 U*	--	--	--	*0.00400 U*	*0.00400 U*
Arsenic	mg/L	0.025	--	--	*0.005 U*	**0.002 J**	*0.005 U*	*0.005 U*	**0.003 J**	*0.005 U*	--	--	--	*0.00050 U*	*0.00050 U*
Barium	mg/L	1	--	--	**0.119**	**0.251**	**0.161**	**0.146**	**0.203**	**0.069**	--	--	--	**0.06101**	**0.0606**
Beryllium	mg/L	0.003	--	--	*0.005 U*	*0.005 U*	*0.005 U*	*0.005 U*	*0.005 U*	*0.005 U*	--	--	--	*0.00050 U*	*0.00050 U*
Cadmium	mg/L	0.005	--	--	*0.005 U*	*0.005 U*	*0.005 U*	*0.005 U*	*0.005 U*	*0.005 U*	--	--	--	*0.00020 U*	*0.00020 U*
Calcium	mg/L	NS	--	--	**159**	**158**	**92**	**146**	**55.3**	**112**	--	--	--	**106**	**108**
Chromium	mg/L	0.05	--	--	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	**0.002 J**	--	--	--	*0.00100 U*	*0.00100 U*
Cobalt	mg/L	0.005	--	--	*0.020 U*	**0.002 J**	*0.020 U*	*0.020 U*	*0.020 U*	*0.020 U*	--	--	--	*0.00050 U*	*0.00050 U*
Copper	mg/L	0.2	--	--	*0.010 U*	*0.010 U*	**0.003 J**	*0.010 U*	**0.002 J**	*0.010 U*	--	--	--	**0.00421**	**0.01515**
Cyanide	mg/L	0.4	--	--	*0.00050 U*	*0.00050 U*	*0.00050 U*	*0.00050 U*	*0.00050 U*	*0.00050 U*	--	--	--	*0.00050 U*	*0.00050 U*
Iron	mg/L	**0.3**	--	--	**1.06**	**3.53**	**1.22**	**0.013 J**	**0.117**	**0.176**	--	--	--	*0.0500 U*	*0.0500 U*
Lead	mg/L	0.025	--	--	*0.010 U*	**0.003 J**	**0.003 J**	**0.003 J**	*0.010 U*	**0.003 J**	--	--	--	*0.00050 U*	**0.00218**
Magnesium	mg/L	**35**	--	--	**0.378**	**41**	**1.05**	**36**	**2.02**	**24.2**	--	--	--	**20.8**	**21.5**
Manganese	mg/L	**0.3**	--	--	**0.012**	**0.364**	**0.012**	**0.029**	**0.006 J**	**0.02**	--	--	--	**0.00058 J**	*0.00100 U*
Mercury	mg/L	0.0007	--	--	*0.00020 U*	*0.00020 U*	*0.00020 U*	*0.00020 U*	*0.00020 U*	*0.00020 U*	--	--	--	**0.00006 J**	*0.00020 U*
Nickel	mg/L	0.1	--	--	*0.025 U*	**0.004 J**	**0.002 J**	**0.002 J**	**0.006 J**	*0.025 U*	--	--	--	**0.00150 J**	**0.00689**
Potassium	mg/L	NS	--	--	**15.1**	**6.63**	**13.4**	**5.99**	**21**	**5.98**	--	--	--	**2.63**	**2.69**
Selenium	mg/L	0.01	--	--	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	--	--	--	*0.00500 U*	*0.00500 U*
Silver	mg/L	0.05	--	--	*0.007 U*	*0.007 U*	*0.007 U*	*0.007 U*	*0.007 U*	*0.007 U*	--	--	--	*0.00040 U*	*0.00040 U*
Sodium	mg/L	**20**	--	--	**156**	**392**	**185**	**331**	**138**	**133**	--	--	--	**43.2**	**44.9**
Thallium	mg/L	0.0005	--	--	*0.020 U*	*0.020 U*	*0.020 U*	*0.020 U*	*0.020 U*	*0.020 U*	--	--	--	*0.00050 U*	*0.00050 U*
Vanadium	mg/L	0.014	--	--	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	*0.010 U*	--	--	--	*0.00500 U*	*0.00500 U*
Zinc	mg/L	2	--	--	*0.050 U*	*0.050 U*	*0.050 U*	**0.005 J**	*0.050 U*	**0.006 J**	--	--	--	**0.00935 J**	**0.00526 J**
Per- and Polyfluoroalkyl Substances (PFAS)															
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	ng/l	NS	*2.08 U*	*2.08 U*	*2.08 U*	*2.08 U*	*1.72 U*	*1.72 U*	*1.92 U*	*1.72 U*	*1.72 U*	*2.00 U*	*1.72 UJ*	*2.01 U*	*1.93 U*
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	ng/l	NS	*2.08 U*	*2.08 U*	*2.08 U*	*2.08 U*	*1.72 U*	*1.72 U*	*1.92 U*	*1.72 U*	*1.72 U*	*2.00 U*	*1.72 U*	*2.01 U*	*1.93 U*
Perfluorobutanesulfonic Acid (PFBS)	ng/l	NS	*2.08 U*	**1.21 J**	**0.808 J**	*2.08 U*	**2.49**	**0.683 J**	**4.89**	**5.88**	**2.09**	**2.2**	**0.703 J**	*2.01 U*	*1.93 U*
Perfluorodecanoic Acid (PFDA)	ng/l	NS	*2.08 U*	*2.08 U*	*2.08 U*	*2.08 U*	**0.248 J**	*1.72 U*	*1.92 U*	*1.72 U*	*1.72 U*	*2.00 U*	*1.72 U*	*2.01 U*	*1.93 U*
Perfluorododecanoic Acid (PFDoA)	ng/l	NS	*2.08 U*	*2.08 U*	**0.333 J**	*2.08 U*	*1.72 U*	*1.72 U*	*1.92 U*	*1.72 U*	*1.72 U*	*2.00 U*	*1.72 U*	*2.01 U*	*1.93 U*
Perfluoroheptanoic Acid (PFHpA)	ng/l	NS	*2.08 U*	**1.35 J**	**0.433 J**	*2.08 U*	**1.48 J**	**0.500 J**	**0.769 J**	**0.310 J**	**2.45**	**1.57 J**	**0.355 J**	*2.01 U*	*1.93 U*
Perfluorohexane Sulfonic Acid (PFHxS)	ng/l	NS	*2.08 U*	**0.767 J**	*2.08 U*	*2.08 U*	**0.762 J**	*1.72 U*	**1.47 J**	**1.23 J**	**0.603 J**	**0.340 J**	**0.452 J**	*2.01 U*	*1.93 U*
Perfluorohexanoic Acid (PFHxA)	ng/l	NS	*2.08 U*	**1.77 J**	**0.529 J**	*2.08 U*	**1.91**	**1.36 J**	**1.84 J**	**0.621 J**	**8.36**	**4.86**	**0.493 J**	*2.01 U*	*1.93 U*
Perfluorononanoic Acid (PFNA)	ng/l	NS	*2.08 U*	*2.08 U*	*2.08 U*	*2.08 U*	**0.634 J**	*1.72 U*	*1.92 U*	*1.72 U*	*1.72 U*	*2.00 U*	*1.72 U*	*2.01 U*	*1.93 U*
Perfluorooctanesulfonic Acid (PFOS)	ng/l	NS	**0.312 J**	*2.08 U*	**0.238 J**	*2.08 U*	**3.13 J**	*1.72 U*	**1.92 J**	**1.43 J**	**0.324 J**	**0.324 J**	**0.448 J**	*2.01 U*	*1.93 U*
Perfluorooctanoic Acid (PFOA)	ng/l	NS	*2.08 U*	*3.16 U*	*2.08 U*	*2.08 U*	**5.31 J**	*1.72 U*	*3.32 U*	*1.72 U*	*3.19 U*	*2.68 U*	*1.72 U*	*2.01 U*	*1.93 U*
Perfluorotetradecanoic Acid (PFTA)	ng/l	NS	*2.08 U*	*2.08 U*	*2.08 U*	*2.08 U*	*1.72 U*	*1.72 U*	*1.92 U*	*1.72 U*	*1.72 U*	*2.00 U*	*1.72 U*	*2.01 U*	*1.93 U*
Perfluorotridecanoic Acid (PFTrDA)	ng/l	NS	*2.08 U*	*2.08 U*	*2.08 U*	*2.08 U*	*1.72 U*	*1.72 U*	*1.92 U*	*1.72 U*	*1.72 U*	*2.00 U*	*1.72 U*	*2.01 U*	*1.93 U*
Perfluoroundecanoic Acid (PFUnA)	ng/l	NS	*2.08 U*	*2.08 U*	*2.08 U*	*2.08 U*	*1.72 U*	*1.72 U*	*1.92 U*	*1.72 U*	*1.72 U*	*2.00 U*	*1.72 U*	*2.01 U*	*1.93 U*

Notes and Abbreviations:
-- = Not analyzed
NS = No Standard
µg/L = micrograms per liter
µg/l = micrograms per liter
mg/L = milligrams per liter
ng/l = nanogram per liter
Results shown in bold font indicate a compound was detectedabove the laboratory reporting detection limit.
N = Field sample
FD = Field Duplicate
J = The analyte was positively identified; associated numerical value is the approximate concentration of the analyte in the sample.
U = Compound not detected at concentrations above the laboratory reporting detection limit, the laboratory reporting detection limit is shown.
UJ = Analyte was analyzed for, but not detected. The detection limit is a quantitative estimate.
All analyses performed by Alpha Woods Hole Laboratories.
Exceedance of NY-TOGS 1.1.1-GW

Table 5
Summary of Areas of Potential Concern
G.W. Lisk - 2 South Street Facility Remedial Investigation
NYSDEC BCP Site Number C835026

AOPC	Description	Rationale
4	Arsenic in Soil at Former Outfall 011	Wastewater was previously discharged for a period of time to a former septic tank and its associated leachfield near this location. Arsenic was detected in soil at a concentration above the Industrial SCO at location MW-03D.
6	Southwestern Parking Lot	The former septic tanks associated with former outfalls 011 and 012 were crushed and the concrete was reused as sub-base material in this parking area. Some soil excavated during removal of the former septic tanks and some unknown debris from the CSHC may have been reused in this location as well. Several SVOCs were detected in soil at concentrations above Industrial SCOs at location B-01. The metals arsenic and mercury were detected at concentrations above Industrial SCOs at location B-03. Several VOCs were detected in unsaturated zone soil at concentrations above the Protection of Groundwater SCOs.
10	Potential SVI in the Main Building	Additional investigation of potential SVI has been investigated and is being addressed through implementation of a State-approved IRM which includes additional monitoring and development of an Interim Site Management Plan; therefore, additional investigation of AOPC-10 during the RI is not required.
11	Potential SVI in the Hundreds Building	CVOCs have been detected in groundwater at several locations that are hydraulically up-gradient of the Hundreds Building. Additional indoor air, outdoor ambient air, and sub-slab soil vapor samples will be collected to further evaluate potential SVI in the Hundreds Building.
12	CVOCs in Groundwater	May include CVOCs from AOPCs-5, -7, and -8 described in the Final SC Report; CVOCs have been detected at concentrations above SCGs in groundwater beneath the Main Building at the Site, between the Main Building and the Hundreds Building, and also at the CSHC property which is located hydraulically down-gradient from the Site. Previous sampling events at the two properties have been conducted at different times separated by years. CVOCs in groundwater will be evaluated at the two properties simultaneously to holistically evaluate potential sources, migration, and extent of CVOCs in groundwater.
13	Phenol in Groundwater at MW-04D	Phenol was detected in groundwater at a concentration above SCGs at location MW-04D. This monitoring well and nearby monitoring wells will be sampled for phenolics to further evaluate the detection at MW-04D.
14	PCBs in Surface Water at SW-02	May include AOPCs-1 and -2 (outfalls into Sulphur Creek) described in the Final SC Report; PCB Aroclor 1260 was detected in the surface water sample collected at location SW-02 at a concentration above the Class D surface water standard. Surface water and co-located sediment samples will be collected at location SW-02 as well as up-stream and down-stream of location SW-02.

Notes and Abbreviations:

AOPC = Area of Potential Concern

CSHC = Clifton Springs Hospital and Clinic

CVOCs = chlorinated volatile organic compounds

IRM = Interim Remedial Measure

PCBs = polychlorinated biphenyls

SC = Site Characterization

SCGs = standards, criteria, and guidance

SCOs = Soil Cleanup Objectives from 6 NYCRR Part 375

SVI = soil vapor intrusion

SVOCs = semivolatile organic compounds

VOCs = volatile organic compounds

AOPC-3 and AOPC-9 were recommended for no further evaluation in the NYSDEC-approved Final Site Characterization Report

Table 6
Sampling and Analysis Plan
G.W. Lisk - 2 South Street Facility Remedial Investigation
NYSDEC BCP Site Number C835026
(See notes on the last page for selected abbreviations and additional information)

Areas of Potential Concern	Location	Media	Rationale	Laboratory Analyses							
				VOCs + TICs	1,4-Dioxane	SVOCs + TICs	PCBs	Phenols	TAL Metals + Hg	pH + TOC	Geochem Parameters
AOPC-4	G-B-11	subsurface soil	Delineation of soil south of the Main Building	X	X				X	X	
	G-B-12	subsurface soil	Delineation of soil west of the Main Building	X	X				X	X	
	G-MW-08S/D	subsurface soil	Delineation of soil east of the Main Building	X	X				X	X	
		groundwater	MW-8S: Delineation of overburden groundwater east of the Main Building	X	X				X	X	X
		groundwater	MW-8D: Delineation of shallow bedrock groundwater east of the Main Building	X	X				X	X	X
AOPC-6	G-B-05	subsurface soil	Delineation around SC soil boring G-B-01	X	X	X			X	X	
	G-B-06	subsurface soil	Delineate thickness/lateral extent of fill material & delineation around SC soil boring G-B-02	X	X	X			X	X	
	G-B-07	subsurface soil	Delineation around SC soil borings G-B-01 and G-B-02	X	X	X			X	X	
	G-B-08	subsurface soil	Delineation around SC soil borings G-B-02 and G-B-03	X	X	X			X	X	
	G-B-09	subsurface soil	Delineation around SC soil borings G-B-02 and G-B-03	X	X	X			X	X	
	G-B-10	subsurface soil	Delineate thickness/lateral extent of fill material	X	X	X			X	X	
	G-B-14	surface soil	Evaluate surface soil quality at Site	X	X	X	X		X	X	
		near-surface soil	Evaluate near-surface soil quality at Site	X	X	X	X		X	X	
		subsurface soil	Delineate thickness/lateral extent of fill material	X	X	X			X	X	
	G-MW-05S/05S2	subsurface soil	Delineation around SC soil boring G-B-01	X	X	X			X	X	
		groundwater	MW-05S: Evaluation of shallow overburden groundwater	X	X	X			X	X	X
		groundwater	MW-05S2: Evaluation of deeper overburden groundwater	X	X	X			X	X	X
	G-MW-06S/06S2	subsurface soil	Delineation around SC soil boring G-B-03	X	X	X			X	X	
		groundwater	MW-06S: Evaluation of shallow overburden groundwater	X	X	X			X	X	X
		groundwater	MW-06S2: Evaluation of deeper overburden groundwater	X	X	X			X	X	X
	G-MW-07S/D/D2	subsurface soil	Delineate extent of fill material	X	X	X			X	X	
		groundwater	MW-07S: Evaluation of shallow overburden groundwater	X	X	X			X	X	X
		groundwater	MW-07D: Evaluation of shallow bedrock groundwater	X	X	X			X	X	X
		groundwater	MW-07D2: Evaluation of deeper bedrock groundwater	X	X	X			X	X	X
AOPC-11	G-PSV-01	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-02	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-03	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-04	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-05	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-06	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-07	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-08	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-09	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-10	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-11	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	G-PSV-12	passive soil vapor	Screen for VOCs in soil or groundwater beneath the Hundreds Building	X							
	AA-RI	outdoor ambient air	Outdoor ambient air near the Hundreds Building	X							
	G-VI-06	sub-slab soil vapor & indoor air	Evaluation of potential soil vapor intrusion in the NW quadrant of the Hundreds Building (if necessary) based on passive soil vapor results	X							

Table 6
Sampling and Analysis Plan
G.W. Lisk - 2 South Street Facility Remedial Investigation
NYSDEC BCP Site Number C835026
(See notes on the last page for selected abbreviations and additional information)

Areas of Potential Concern	Location	Media	Rationale	Laboratory Analyses							
				VOCs + TICs	1,4-Dioxane	SVOCs + TICs	PCBs	Phenols	TAL Metals + Hg	pH + TOC	Geochem Parameters
AOPC-11	G-VI-07	sub-slab soil vapor & indoor air	Evaluation of potential soil vapor intrusion in the NE quadrant of the Hundreds Building (if necessary) based on passive soil vapor results	X							
	G-VI-08	sub-slab soil vapor & indoor air	Evaluation of potential soil vapor intrusion near the center of the Hundreds Building (if necessary) based on passive soil vapor results	X							
	G-VI-09	sub-slab soil vapor & indoor air	Evaluation of potential soil vapor intrusion in the SW quadrant of the Hundreds Building (if necessary) based on passive soil vapor results	X							
AOPC-12	MW-02S	groundwater	Evaluation of overburden groundwater near former septic leachfield	X	X					X	X
	MW-02D	groundwater	Evaluation of shallow bedrock groundwater near former septic leachfield	X	X					X	X
	MW-03S	groundwater	Evaluation of overburden groundwater near former septic leach field	X	X					X	X
	MW-03D	groundwater	Evaluation of shallow bedrock groundwater near former septic leach field	X	X					X	X
	G-MW-11S/D	surface soil	Evaluate surface soil quality at Site	X	X	X	X		X	X	
		near-surface soil	Evaluate near-surface soil quality at Site	X	X	X	X		X	X	
		subsurface soil	Evaluation of soil west of the Hundreds Building	X	X					X	
		groundwater	MW-11S: Evaluation of shallow overburden groundwater west of the Hundreds Building	X	X					X	X
		groundwater	MW-11D: Evaluation of shallow bedrock groundwater west of the Hundreds Building	X	X					X	X
	G-MW-12S/D	surface soil	Evaluate surface soil quality at Site	X	X	X	X		X	X	
		near-surface soil	Evaluate near-surface soil quality at Site	X	X	X	X		X	X	
		subsurface soil	Evaluation of soil north of the Hundreds Building	X	X					X	
		groundwater	MW-12S: Evaluation of shallow overburden groundwater north of the Hundreds Building	X	X					X	X
		groundwater	MW-12D: Evaluation of shallow bedrock groundwater north of the Hundreds Building	X	X					X	X
	H-MW-8S/D/D2	groundwater	MW-8S: Evaluation of shallow overburden groundwater NW of the G.W. Lisk facility and SW of the CSHC facility	X	X					X	X
		groundwater	MW-8D: Evaluation of shallow bedrock groundwater NW of the G.W. Lisk facility and SW of the CSHC facility	X	X					X	X
		groundwater	MW-8D2: Evaluation of deeper bedrock groundwater NW of the G.W. Lisk facility and southwest of the CSHC facility	X	X					X	X
	H-MW-9S/D	groundwater	MW-09S: Evaluation of shallow overburden groundwater west of the CSHC facility	X	X					X	X
		groundwater	MW-09D: Evaluation of shallow bedrock groundwater west of the CSHC facility	X	X					X	X
	H-MW-10S/D/D2	groundwater	MW-10S: Evaluation of shallow overburden groundwater east of the CSHC facility	X	X					X	X
		groundwater	MW-10D: Evaluation of shallow bedrock groundwater east of the CSHC facility	X	X					X	X
		groundwater	MW-10D2: Evaluation of deeper bedrock groundwater east of the CSHC facility	X	X					X	X
	H-MW-11S/D/D2	groundwater	MW-11S: Evaluation of shallow overburden groundwater north of the CSHC facility	X	X					X	X
		groundwater	MW-11D: Evaluation of shallow bedrock groundwater north of the CSHC facility	X	X					X	X

Table 6
Sampling and Analysis Plan
G.W. Lisk - 2 South Street Facility Remedial Investigation
NYSDEC BCP Site Number C835026
(See notes on the last page for selected abbreviations and additional information)

Areas of Potential Concern	Location	Media	Rationale	Laboratory Analyses							
				VOCs + TICs	1,4-Dioxane	SVOCs + TICs	PCBs	Phenols	TAL Metals + Hg	pH + TOC	Geochem Parameters
		groundwater	MW-11D2: Evaluation of deeper bedrock groundwater north of the CSHC facility	X	X					X	X
AOPC-12	H-MW-12S/D/D2	groundwater	MW-12S: Evaluation of shallow overburden groundwater between the G.W. Lisk and CSHC facilities	X	X					X	X
		groundwater	MW-12D: Evaluation of shallow bedrock groundwater between the G.W. Lisk and CSHC facilities	X	X					X	X
		groundwater	MW-12D2: Evaluation of deeper bedrock groundwater between the G.W. Lisk and CSHC facilities	X	X					X	X
	G-ASV-01	active soil vapor	Evaluation of soil vapor north of facility	X							
	G-ASV-02	active soil vapor	Evaluation of soil vapor NE of facility	X							
	G-ASV-03	active soil vapor	Evaluation of soil vapor east of facililty	X							
	G-ASV-04	active soil vapor	Evaluation of soil vapor east of facililty	X							
	G-SSO-01	surface soil	Evaluate surface soil quality at Site	X	X	X	X		X	X	
		near-surface soil	Evaluate near-surface soil quality at Site	X	X	X	X		X	X	
	G-SSO-02	surface soil	Evaluate surface soil quality at Site	X	X	X	X		X	X	
		near-surface soil	Evaluate near-surface soil quality at Site	X	X	X	X		X	X	
	H-MW-2	groundwater	Evaluate shallow overburdend groundwater quality	X	X					X	X
	H-MW-3	groundwater	Evaluate shallow overburdend groundwater quality	X	X					X	X
	H-MW-3SR	groundwater	Evaluate shallow bedrock groundwater quality	X	X					X	X
	H-MW-4SR	groundwater	Evaluate shallow bedrock groundwater quality	X	X					X	X
	H-MW-5	groundwater	Evaluate shallow overburdend groundwater quality	X	X					X	X
	H-MW-5SR	groundwater	Evaluate shallow bedrock groundwater quality	X	X					X	X
	H-MW-6	groundwater	Evaluate shallow overburdend groundwater quality	X	X					X	X
	H-MW-6SR	groundwater	Evaluate shallow bedrock groundwater quality	X	X					X	X
	H-MW-7	groundwater	Evaluate shallow overburdend groundwater quality	X	X					X	X
	H-MW-7SR	groundwater	Evaluate shallow bedrock groundwater quality	X	X					X	X
	H-SPRING-01	groundwater	Evaluate shallow overburdend groundwater quality	X	X					X	X
	H-SPRING-02	groundwater	Evaluate shallow overburdend groundwater quality	X	X					X	X
AOPCs-12 & -13	G-MW-04S	groundwater	Evaluation of shallow overburden groundwater for VOCs and Phenol	X	X			X		X	X
	G-MW-04D	groundwater	Evaluation of shallow bedrock groundwater for VOCs and Phenol	X	X			X		X	X
	G-MW-09S/D/D2	subsurface soil	Evaluation of soil west of the Main Building and location G-MW-04D	X	X			X		X	
		groundwater	MW-09S: Evaluation of shallow overburden groundwater west of the Main Building and location G-MW-04D	X	X			X		X	X
		groundwater	MW-09D: Evaluation of shallow bedrock groundwater west of the Main Building and location G-MW-04D	X	X			X		X	X
		groundwater	MW-09D2: Evaluation of deeper bedrock groundwater west of the Main Building and location G-MW-04D	X	X			X		X	X
	G-MW-10S/D	subsurface soil	Evaluation of soil east of the Main Building and east of location G-MW-04D	X	X			X		X	
		groundwater	MW-10S: Evaluation of shallow overburden groundwater east of the Main Building and location G-MW-04D	X	X			X		X	X
		groundwater	MW-10D: Evaluation of shallow bedrock groundwater east of the Main Building and location G-MW-04D	X	X			X		X	X
	H-MW-1	groundwater	Evaluation of shallow overburden groundwater north of Main Building and location G-MW-04D	X	X			X		X	X

Table 6
Sampling and Analysis Plan
G.W. Lisk - 2 South Street Facility Remedial Investigation
NYSDEC BCP Site Number C835026
(See notes on the last page for selected abbreviations and additional information)

Areas of Potential Concern	Location	Media	Rationale	Laboratory Analyses							
				VOCs + TICs	1,4-Dioxane	SVOCs + TICs	PCBs	Phenols	TAL Metals + Hg	pH + TOC	Geochem Parameters
	H-MW-1 SR	groundwater	Evaluation of shallow bedrock groundwater north of Main Building and location G-MW-04D	X	X			X		X	X
AOPC-14	G-SW-01	surface water	Evaluation of PCBs in surface water upstream from known impact at the facility				X			X	X
	G-SED-01	sediment	Evaluation of PCBs in sediment upstream from known impact at the facility	X	X	X	X		X	X	
	G-SW-02	surface water	Re-sample for evaluation of PCB detection in surface water during the SC				X			X	X
	G-SED-02	sediment	Co-located sediment sample at the location of surface water sample G-SW-02	X	X	X	X		X	X	
	G-SW-03	storm water	Evaluate storm water from off-site sources that discharges into Sulphur Creek	X	X	X	X	X	X	X	X
	G-SED-03	sediment	Evaluate sediment at the location of the off-site discharge of storm water into Sulphur Creek	X	X	X	X		X	X	
	G-SW-04	surface water	Evaluate surface water at a location upstream from G-SW-02				X			X	X
	G-SED-04	sediment	Co-located sediment sample at the location of surface water sample G-SW-04	X	X	X	X		X	X	
	G-SED-05	sediment	Evaluate sediment at a location between G-SED-02 and G-SED-04	X	X	X	X		X	X	
	H-SW-06	surface water	Evaluation of surface water at a location downstream from G-SW-02				X			X	X
	H-SED-06	sediment	Co-located sediment sample at the location of surface water sample H-SW-06	X	X	X	X		X	X	
	H-SW-07	surface water	Evaluation of surface water at a location downstream from H-SW-06				X			X	X
	H-SED-07	sediment	Co-located sediment sample at the location of surface water sample H-SW-07	X	X	X	X		X	X	

NOTES:

- All soil samples for laboratory analysis (generally two soil samples per boring) will be collected over a 1-foot interval from soil borings installed using direct-push or hollow-stem auger drilling techniques.
- One soil sample per boring will be collected at locations which lack visual, olfactory, or PID evidence of potential contamination.
- Soil sampling depth will be determined in the field based on visual, olfactory, and PID field screening evidence.
- Volatile Organic Compounds (VOCs) = Target Compound List and STARS-#1 VOCs plus 10 TICs.
- Semi-Volatile Organic Compounds (SVOCs) = Target Compound List and STARS-#1 SVOCs plus 20 TICs.
- Polychlorined Biphenyls (PCBs) by USEPA Method 8082
- Phenolics by USEPA Method 8270
- Metals by USEPA Method 6010B (Mercury by USEPA Method 7470)
- pH by SW-846 SM 4500-H+B-2000/9045D
- Total organic carbon (TOC) by SW-846 SM 5310 C-2000/ Lloyd Kahn Method
- Geochemical parameters = dissolved major cations (Ca, Mg, K, and Na) and major anions (HCO_3, CO_3, Cl, and SO_4), total and disssolved Fe and Mn, nitrate, alkalinity, ethene/ethane, and methane.
- Field parameters will be measured at all groundwater sampling locations and will include specific conductance, pH, dissolved oxygen, and oxidation-reduction potential.
- TICs = tentatively-identified compounds. TICs are not reported for soil vapor samples.

Table 7
Estimated Project Schedule for Remedial Investigation
G.W. Lisk Facility - Clifton Springs, New York
NYSDEC BCP Site Number C835026

Milestone	Estimated Completion Date *
Submit Revised RI Work Plan to DEC/DOH	31-Oct-2019
DEC Conditional Approval of RI Work Plan containing Additional RI Work Plan Comments	13-Dec-2019
G.W. Lisk written response to DEC on Additional RI Work Plan Comments	27-Dec-2019
Complete Discussions with DEC on finalization of RI Work Plan	3-Jan-2020
Submit Final RI Work Plan to DEC/DOH and place the Final RI Work Plan in the Document Repository	January 2020
Initiate RI Site Work (Passive Soil Vapor sampling in the Hundreds Building)	January 2020
Perform Sub-Slab Soil Vapor and Indoor Air Sampling in the Hundreds Building	February 2020
Initiate RI Soil Borings and Well Installations	April 2020
Complete RI Site Work and all Sampling	June 2020
Validation of All Laboratory Analytical Data Completed	October 2020
Submit Draft RI Report to DEC/DOH	December 2020

* The schedule is estimated and is subject to change based on review times, contractor availability, site conditions encountered, and other conditions.

Appendix A
Health and Safety Plan

This Level 2 health and safety plan (HASP) provides health and safety guidelines for project work meeting one or more of the following criteria:

- Some likelihood of physical and/or chemical hazard exposure (e.g., sampling, use of equipment and tools);
- Number of job tasks is five or greater;
- Use of contractors;
- Work meets the definition of being "high hazard", which includes, but is not limited to:
  - Activities that could have an adverse effect on the environment (e.g., use of bulk liquid storage tanks, generators, etc.);
  - Air or boat transport via charter or non-commercial carrier/vendor;
  - Confined space entry;
  - Construction;
  - Decommissioning, decontamination, and demolition (DDD) operations;
  - Diving;
  - Excavations, trenching, drilling, or other ground disturbance activities (i.e., activities requiring subsurface clearance [SSC] operations);
  - Hazardous energy control operations;
  - Hot work (e.g., welding, flame cutting, or other spark-producing activities);
  - Injection well operations;
  - Off-shore or over water work (including oil platform visits);
  - Rigging and lifting operations; and
  - Work at heights in excess of four feet.

The HASP should be developed with input from the project team and reviewed with all ERM project personnel, including contractors. A signed copy of the HASP must be maintained at the project site during work and must be archived in the project files.

H&S Team review is required for the Level 2 HASP. You can e-mail completed plans requiring review to the ERM North America HASP Review Team. This HASP must be reviewed by the Project Manager and reviewed/approved by the Partner in Charge (PIC) and updated as warranted to address changes in scope, hazards present, project personnel, etc. At a minimum, HASPs must be reviewed annually or if the scope of work changes. Updated HASPs should also be sent to the H&S Team for review and PIC for approval.

Administrative Information

This document has been developed for the sole use of ERM staff. Contractors and other project participants must develop their own HASP.

This document is valid for a maximum time period of one year after completion. The document must be reviewed if the scope of work or nature of site hazards changes and must be updated as warranted.

Project Name: GWL RIWP	Site Name & Location: G.W. Lisk Facility, 2 South Street, Clifton Springs, New York
Client Contact and Phone: Arno Biebernitz, 315-462-2611	Client: G.W. Lisk
Health & Safety Plan Date: 12/21/2017	GMS Project #: 0497315
Partner in Charge: Ernest Rossano	Revision Number and Date: 3, 3/13/2019
Project Manager: Jon Fox P.G	Field Work Start Date: TBD
Field Safety Officer: Tim Daniluk	Anticipated Field Work End Date: TBD
SSC Experienced Person (if applicable): Jason Reynolds/Tim Daniluk	Short Service Employees (SSE): Click here to enter text.
Additional ERM personnel on site: Caldwell Payne, Olivia Botting, Justin Vause	SSE Mentor: Click here to enter text.

Subject Matter Expert Review

SME review is required if the project includes contractors that will be performing work over or in water, using mobile construction equipment (excluding drilling equipment), or will be working without direct ERM supervision.

SME Review Required: ☐Yes ☒ No	If Yes, Provide name(s) of SME(s): Click here to enter text. Date of SME Review: Click here to enter a date.

H&S Team Review

Reviewer Name: Ernie Sweet Review Date: 12/27/2017	Signature File: Ernest F Sweet

Field Safety Officer Waiver

Note that use of an FSO can be waived with approval by the PIC and the Area Manager in accordance with Section 4.9 of NAM-1110-PR1. Note that if the PIC is the Area Manager, then the BUMP will be required to provide approval.

PIC Name: Click here to enter text. Approval Date: Click here to enter a date.	Signature File:
Rationale for waiver of FSO requirement: Click here to enter text.	
Area Manager: Click here to enter text. Approval Date: Click here to enter a date.	Signature File:

Site Description

Include relevant background information regarding the site, such as location, size, type of facility, topography, weather, infrastructure, security, previous site use, etc. Describe nature and extent of any soil/air/water/groundwater contamination. Describe any other aspects of the site that may potentially affect the health, safety, or security of on-site personnel.

Add Site Description here. The G.W. Lisk Company, Inc. (GWL) Facility is located at 2 South Street in the Village of Clifton Springs, New York. Previous site characterization work at the Site identified VOCs, including trichloroethene (TCE), 1,1-Dichloroethene (DCE), 1,1,1-Trichloroethane (TCA), and Tetrachloroethene (PCE) in soil vapor in one of more locations; TCE

was also detected in indoor air. This HASP has been prepared to assist in protecting on-site personnel from potential exposure to contaminated media.

Project Background and Scope of Work

Include list of tasks to be completed by ERM personnel during this project, and a separate list of tasks to be completed by any contractors at the site. A site-specific Job Hazard Analysis (JHA; ERM-1115-FM1) must be completed for each task to be performed. Contractors must provide their own HASP and a JHA for each task they will perform for ERM review.

A JHA template and reference/example JHAs for more common tasks can be found at: North America H&S Page - JHAs.

Add ERM Scope of Work here. ERM will be directing a Remedial Investigation (RI) to define the nature and extent of contamination; identify contaminant source areas; evaluate potential exposures; and produce data of sufficient quantity and quality to support the development of an acceptable Remedial Alternatives Analysis (AA) or Remedial Action Work Plan (RAWP). The purpose of the RI Work Plan is to attempt to mitigate possible impacts to workers at the facility. ERM and its subcontractors will be performing the work indicated below. Level "C" PPE or above is not anticipated to be used for the duration of this project.

ERM Task 1: Hand Augering	☒ JHA Attached?
ERM Task 2: Soil Vapor Sampling	☒ JHA Attached?
ERM Task 3: Soil Sampling	☒ JHA Attached?
ERM Task 4: Water Sampling	☒ JHA Attached?
ERM Task 5:	☐ JHA Attached?
ERM Task 6: Click here to enter text.	☐ JHA Attached?
ERM Task 7: Click here to enter text.	☐ JHA Attached?

Add Contractor Scope of Work here. Private utility locating with GPR, soil borings and monitoring well installations. Lab to analyze samples.

Contractor Task 1: Private Utility Locate	☐ JHA Reviewed?
Contractor Task 2: Soil Vapor Sampling	☐ JHA Reviewed?
Contractor Task 3: GPRS	☐ JHA Reviewed?
Contractor Task 4: Soil Borings	☐ JHA Reviewed?
Contractor Task 5: Monitoring Well Installations	☐ JHA Reviewed?
Contractor Task 6: Sample Analyses	☐ JHA Reviewed?
Contractor Task 7: Click here to enter text.	☐ JHA Reviewed?

Contractor(s) to be used:	Approved under Contractor Management Program?
1. New York Leak Detection	☒ Yes ☐ No
2. Parratt-Wolff, Inc.	☒ Yes ☐ No
3. Alpha Analytical, Inc.	☒ Yes ☐ No
4. Click here to enter text.	☐ Yes ☐ No
5. Click here to enter text.	☐ Yes ☐ No
6. Click here to enter text.	☐ Yes ☐ No
7. Click here to enter text.	

Site/Project General Information

Site Type (check all applicable boxes)			
☒	Industrial	☒	Hazardous waste release (Hazwoper)
☐	Residential	☐	Remote site or inactive facility**
☐	Unsecured	☐	Other (specify): Click here to enter text.
☐	Coastal/offshore (on or near water)*	☐	Other (specify): Click here to enter text.

* ERM Form NAM-1534-FM1 (*Coastal and Offshore Risk Management*) must be completed and attached to this document.
** ERM Form NAM-1501-FM2 (*Undeveloped, Remote, or Inactive Sites*) must be completed and attached to this document.

Main Project Hazards (check all applicable boxes)

High Hazard Work Elements (Require H&S Team Coordination)

Use of an FSO cannot be waived for any work involving one or more of these issues. Additional control measures may be required beyond JHA.

- ☐ Aerial Lift Use (e.g., Scissor Lifts, Cherry Pickers)
- ☐ All-Terrain Vehicle/Snowmobile Use
- ☐ ASTs/USTs
- ☐ Chemical Mixing/Injection
- ☐ Confined Space Entry[1]
- ☐ Construction
- ☐ Control of Hazardous Energy (i.e., Lockout/Tagout)[1]
- ☐ DDD Operations[1]
- ☐ Diving
- ☒ Excavation/Trenching/Drilling
- ☐ Explosives Use[1]
- ☐ Falls from height (>4 feet)[1]
- ☐ Forklift/Industrial Truck Use
- ☒ Heavy Equipment Use
- ☐ Helicopter/Fixed Wing Aircraft Transportation[2]
- ☐ Hot Work (Welding, Cutting, Brazing)[1]
- ☐ Off-Shore Platform Work[5]
- ☐ Overhead Power Lines
- ☐ Rigging/Lifting[1]
- ☐ Scaffold Use[1]
- ☒ Subsurface Clearance (Buried Utilities)[1]
- ☐ Working on/over/near Water (including transport)
- ☐ Unexploded Ordnance/Munitions and Explosives of Concern (UXO/MEC)
- ☐ Other (specify): Click here to enter text.
- ☐ Other (specify): Click here to enter text.

Other Hazards

- ☐ Biological Hazards
- ☒ Chemical Exposure Potential (including asbestos)
- ☐ Compressed Gas
- ☒ Ergonomics/Material Handling
- ☐ Extended or Nonstandard Work Shifts (>14 hours)
- ☐ Extreme Weather
- ☒ Hand/Power Tool Use
- ☒ High Noise (>85 dBA)
- ☐ International Travel[3]
- ☐ Long Distance/Duration Driving[4]
- ☐ Mining (Surface/Underground)
- ☒ Natural Hazards (Plants, Animals, Insects)
- ☐ Portable/Fixed Ladders
- ☐ Radiation (Ionizing/Non-ionizing)
- ☒ Shift Work (e.g., night work)
- ☐ Short Service Employees
- ☒ Slips/Trips
- ☐ Other (specify): Click here to enter text.
- ☐ Other (specify): Click here to enter text.
- ☐ Other (specify): Click here to enter text.

1 An ERM or equivalent client-required permit must be completed.

2 If traveling using a helicopter or fixed wing aircraft, ERM employees are required to follow the provisions of ERM Standard ERM-1440-ST1 (*Fixed Wing Aircraft and Helicopter Safety*).

3 A Travel Risk Assessment (TRA) is required for all international travel (with the sole exception of travel to a Low Risk country where ERM has a permanent office). Consult ERM Standard ERM-1410-ST1.

4 If driving more than 500 km (310 miles) in a single day, driving in excess of 4.5 hours in a single day, or driving in a remote location, a Journey Management Plan (*ERM-1430-FM1*) is required and should be appended to this HASP.

5 If traveling to/from and working on an off shore platform, ERM employees are required to follow the provisions of ERM Standard ERM-1531-ST1 (*Offshore Platform Safety*).

Chemicals of Concern

Chemical Products Used or Stored On-Site

For each chemical product identified, a Safety Data Sheet (SDS) must be attached to this HASP.

☒ Alconox or Liquinox	☐ Household bleach (NaOCl)
☐ Hydrocholoric acid (HCl)	☒ Calibration gas
☐ Nitric acid (HNO_3)	☐ Other (specify): Click here to enter text.
☐ Sulfuric acid (H_2SO_4)	☐ Other (specify): Click here to enter text.
☐ Sodium hydroxide (NaOH)	☐ Other (specify): Click here to enter text.
☐ Isopropyl alcohol	☐ Other (specify): Click here to enter text.

Note: Emergency eyewash solution must be readily available on all project sites where materials are used or stored that pose a risk of getting into the eyes via splashing or through contact with airborne gases, vapors, dusts, or mists. This includes sample preservatives. The size and flushing capability of the eyewash must be proportional to the potential for contact with corrosive or injurious materials in the field and the resulting potential for injury. Contact your BU H&S Director for additional information or assistance.

Regulated Chemicals of Concern

Check any chemicals known or suspected to be present on the site to which the ERM team may be exposed to determine if they are regulated through any federal or provincial laws. These regulations may include OSHA-regulated potential carcinogens (29 CFR 1910.1003 through 1016), those chemicals for which OSHA has established specific respiratory protection requirements (29 CFR 1910.134), or any chemical identified under Canadian provincial regulations. A list of applicable regulations addressing regulated chemicals is provided in Section 5 of ERM Procedure NAM-1340-PR1 (*Chemical Hazards*). A list of OSHA regulated chemicals is provided in Appendix 1 of that procedure.

Is there any known or potential exposure to regulated chemicals as defined in NAM-1340-PR1 on the site?

☒ Yes ☐ No

If the answer to the question above is Yes, follow the requirements of NAM-1340-PR1. For additional assistance with interpretation /evaluation of the regulatory impacts, contact your Business Unit H&S Director.

Additional Known or Suspected Chemicals of Concern

Are there additional known or suspected chemicals of concern present on the site not identified in the ***Regulated Chemicals of Concern*** section above? ☒ Yes ☐ No

If the answer to the question above is Yes, NAM-1340-FM1 (Known or Suspected Chemicals of Concern) must be completed and attached to this HASP. Information on each chemical must be provided to all team members.

Monitoring Equipment

Will ERM staff be using equipment on the project site to monitor potential exposures to known or suspected chemicals of concern?

☒ Yes ☐ No

If the answer to the question above is Yes, attach ERM Form NAM-1302-FM3 (Monitoring Equipment) to define the equipment to be used and the action levels to be applied.

All monitoring equipment on site must be calibrated per manufacturer specifications (including daily bump tests) and results recorded. See ERM Procedure NAM-1302-PR1 (*Equipment Maintenance and Calibration*) for additional information. Under stable conditions, measurements must be made in the breathing zone at least once every 30 minutes.

Personal Protective Equipment

Req = Required PPE for one or more tasks to be performed; required on site at all times. NA = Not applicable to this project.

Equipment	Req	NA	Supplies	Req	NA
Steel-toed Boots	☒	☐	Inner Chemical Gloves	☐	☒
Outer Disposable Boots	☐	☒	Outer Chemical Gloves	☒	☐
Long Sleeve Shirt/Pants	☒	☐	Leather or Kevlar Gloves	☐	☒
Tyvek Suit	☐	☒	Safety Glasses/Goggles	☒	☐
Poly-Coated Tyvek Suit	☐	☒	Face Shield	☐	☒
Fully Encapsulated Chemical Suit	☐	☒	Hearing Protection	☒	☐
Flame Resistant Clothing/Coveralls	☐	☒	Half-face Respirator	☐	☒
High Visibility Traffic Vest	☒	☐	Full-face Respirator	☐	☒
Hard Hat/Approved Helmet	☒	☐	Personal Floatation Device	☐	☒
Wet Suit/Dry Suit	☐	☒	If either half or full-face respirator checked: • Define cartridge type: Click here to enter text. • Define cartridge change frequency: Click here to enter text.		
Other (specify): Click here to enter text.	☐	☐			

Respirator selection should be based on the Assigned Protection Factor (APF) and the Maximum Use Concentration (MUC). To determine the appropriate respirator selection, the lowest appropriate published exposure guideline should be known. The Business Unit H&S Director or project H&S consultant can provide assistance in defining the APF and MUC, as necessary. They can also assist in defining actions levels and cartridge change schedules when air-purifying respirators are used. Note that cartridge change schedules must be outlined above and in the JHA for any task requiring respiratory protection.

Use of respiratory protection requires three elements: training in respiratory protection techniques, completion of medical surveillance confirming that you are fit to wear a respirator, and fit testing with the make and model of respirator you will be using. Refer to NAM-1311-PR1 (*Respiratory Protection*) for additional information.

Training, Medical Surveillance, and Safety Supplies

Req = Required; requirements are based on the specific tasks performed in the field and the type of environments, chemicals, or hazards encountered. NA = Not applicable to this project.

Training	Req	NA	Medical Surveillance***	Req	NA
40-Hour Hazwoper	☒	☐	Medical Clearance	☒	☐
Current 8-hour Hazwoper Refresher	☒	☐	Respirator Clearance and Fit Test	☐	☒
8-Hour Hazwoper Supervisor*	☐	☒	Blood Lead and ZPP	☐	☒
Current First Aid/CPR	☒	☐	Other (specify): Click here to enter text.	☐	☐
40-Hour MSHA New Miner	☐	☒	Other (specify): Click here to enter text.	☐	☐
Current 8-hour MSHA Refresher	☐	☒	**Safety Supplies**	**Req**	**NA**
ERM Field Safety Officer (FSO)	☒	☐	First Aid Kit	☒	☐
DDD Practice FSO/DM	☐	☒	Emergency Eyewash Solution	☒	☐
Subsurface Clearance (SSC)	☒	☐	Air Horn	☐	☒
EPA Hazardous Waste	☐	☒	Decontamination Supplies	☒	☐
Hazmat/Dangerous Goods Shipping**	☐	☒	Fire Extinguisher	☒	☐
International Traveler	☐	☒	Potable Water	☐	☒
Respirator Wearer Certification	☐	☒	Toilets	☐	☒
Other (specify): Click here to enter text.	☐	☐	Other (specify): Click here to enter text.	☐	☐

* Provides specialized training to serve as an on-site manager supervising employees engaged in work covered by 29 CFR 1910.120.

** In Canada, Workplace Hazardous Materials Information System (WHMIS)/Globally Harmonized System (GHS) and Transportation of Dangerous Goods (TDG) regulations apply.

*** Physical examination requirements should be discussed with Workcare well in advance of project to allow adequate time to schedule exams.

Work Zones

Complete if exclusion zones are necessary because of chemical and/or equipment hazards. Describe the set-up of these zones. Include landmarks, dimensions (as necessary), and whether they are for equipment or personnel decontamination.

Define Exclusion Zone Requirements, if any, here.

Define Contamination Reduction Zone requirements, if any, here.

Define Support Zone requirements, if any, here.

Site Access/Control

Describe procedures for limiting unauthorized entry to the work zone(s). Describe any security requirements.

Define Site Access/Control procedures, if any, here. As Site is currently active, security will be managed by Site Security personnel and established practices

Decontamination Procedures

Describe procedures for the decontamination of personnel and equipment.

Define personnel decontamination procedures, if any, here.

Define equipment decontamination procedures, if any, here. ERM staff will use alconox or liquinox to decontaminate any sampling equipment used before, during, and after the sampling activities.

Spill Prevention and Response

Ensure all chemical containers on site are labeled and lids are secured when not in use. When transferring chemicals from one container to another, or when refueling vehicles or equipment, provide containment beneath the transfer point to capture potential spills. Immediately report all chemical spills to the PIC/PM and submit an ECS entry with 24 hours.

Will ERM staff or ERM-hired contractors possess containerized chemicals on the project site? ☒ Yes ☐ No

If the answer to this question is **Yes**, follow the requirements outlined in ERM Procedure NAM-1123-PR1 (*Spill Prevention and Response*).

Waste Management Planning

Will ERM's project activities generate waste materials? ☒ Yes ☐ No

Will ERM undertake some level of contractual responsibility for handling waste for the client? ☐ Yes ☒ No

If the answer to either of these questions is **Yes**, follow the requirements outlined in ERM Procedure NAM-1122-PR1 (*Waste Management Planning*).

Describe any waste reduction/minimization techniques to be used on the site here.

Client-Specific Emergency Response

In the event of an emergency, client-specific emergency response procedures may take precedence over ERM established procedures.

While engaging in field-related activities on an active client site, measures they have in place to signal either emergency response or evacuation need to be reviewed and documented.

Once completed, this summary should be discussed with all visitors, contractors, and others subject to HASP review upon site visit.

Describe any contributing factor potentially initiating emergency response (e.g., process, material, or weather) here. TBD

Describe any lights and/or sounds associated with evacuation here. TBD

Describe any emergency drill requirements for contractors on-site here. None.

Describe any primary and alternative muster points here. Parking lot areas. TBD based on location within building.

Describe any site-specific evacuation procedures here. Follow GW Lisk contact instructions, rally point outside building.

Describe the methodology to be used for accounting for site visitors here. Client contact will account for us. Record of being onsite is with secretary. All ERM subcontractors are to remain with ERM personnel for this reason.

Describe any PPE and spill kit requirements here. Steel toe boots, safety glasses, long pants, gloves as appropriate.

Is a map associated with evacuation attached? ☐Yes ☒ No

Emergency Contacts

All ERM employees are empowered to pause or stop work to address any unsafe acts/conditions, questions, concerns or changed conditions. All work-related safety events should be shared with the project team and promptly entered into the Event Communication System (ECS).

FOR ALL MEDICAL EMERGENCIES, CALL 911 OR THE LOCAL EMERGENCY NUMBER.

For ALL non-emergency incidents resulting in any injury or illness, you must:

- *Give appropriate first aid care to the injured or ill individual and secure the scene.*
- *Immediately notify the PM, PIC, and the H&S Team.*
- *At direction of PM, PIC, or H&S Team, call WorkCare Incident Intervention at (888) 449-7787 (available 24 hours/7 days per week in US only).*
- *Clients may have their own procedures which we need to follow.*

For all incidents (injuries, illnesses, spills, fires, property damage, etc.) and significant near misses, enter the event into ECS within 24 hours.

Contact	Name	Location	Phone
Hospital (attach map)	Clifton Springs Hospital	2 Coulter Road, Clifton Springs, NY	315-462-9561
Police	Clifton Springs Police Department	1 West Main Street, Clifton Springs, NY	315-462-2422
Fire	Clifton Springs Fire House	39 Kendall Street, Clifton Springs, NY	315-462-7501
Poison Control*	The Upstate New York Poison Center	750 East Adams Street Syracuse, New York 13210	800-222-1222
Incident Intervention	WorkCare	NA	888-449-7787
Partner-in-Charge	Ernest Rossano, C.P.G	Melville, NY	Work: 631-449-7787
			Cell: 516-250-1429
Project Manager	Jon S Fox P.G	Syracuse, NY	Work: 315-233-3035
			Cell: 315-256-5352
Field Manager (if not PM)	Jason Reynolds	Syracuse, NY	Work: : 315-233-3030
			Cell: 716-725-5369
Field Safety Officer (if not PM)	Tim Daniluk	Syracuse, NY	Work: 315-445-2554
			Cell: 315-317-2044
SSC Experienced Person	Jason Reynolds/Tim Daniluk	Syracuse, NY	Work: : 315-233-3030
			Cell: 716-725-5369
Business Unit H&S Director	John Torrence	Malvern, PA	Work: 484-913-0402
			Cell: 609-932-7090
Regional H&S Director	Millard Griffin	Atlanta, GA	678-294-8658
Contractor Contact	TBD	TBD	TBD
Client Contact	Arno Biebernitz	Clifton Springs, NY	Work: 315-462-2611
Additional Contact	Click here to enter text.	Click here to enter text.	Click here to enter text.

Additional Contact	Click here to enter text.	Click here to enter text.	Click here to enter text.

* Poison control centers in the US can be contacted at 800-222-1222. In Canada, poison control centers are specific to each province; contact information can be found here: https://safemedicationuse.ca/tools_resources/poison_centres.html.

Acknowledgement

I have read, understood, and agree with the information set forth in this health and safety plan (HASP), and will follow guidance in the plan and in ERM's Document Control System (DCS). I understand the training and medical monitoring requirements (if any) for conducting activities covered by this HASP and have met these requirements.

ERM has prepared this plan solely for the purpose of protecting the health and safety of ERM employees. Contractors, visitors, and others at the site are required to follow provisions in this document at a minimum, but must refer to the organization's health and safety program for their protection.

Printed Name	Signature	Organization	Date
Jon Fox		ERM	
Tim Daniluk		ERM	
Jason Reynolds		ERM	
Caldwell Payne		ERM	
Olivia Botting		ERM	
Justin Vause		ERM	

Approval Signatures

Signatures in this section indicate the signing employee will comply with and enforce this HASP, as well as procedures and guidelines established in ERM's DCS. Signatures also indicate that any contractors performing work under contract to ERM have met the minimum safety standards in NAM-1130-PR1 (Contractor Management).

Project Manager	Date
Typed Name: Jon S Fox Signature File: 	4/11/2019
Partner-in-Charge	**Date**
Typed Name: Ernie Rossano Signature File: 	4/11/2019

Attachments ***Check all appropriate documents to be attached to this HASP.***	
☒ Site-specific JHAs for all tasks (including contractors)	☒ Map of route to hospital with turn-by-turn instructions
☒ Subsurface Clearance (SSC) Project Plan	☒ SNAP Cards
☒ Site Safety Meeting Form (NAM-1501-FM1)	☒ Field Audit Form (ERM-1941-FM4)
☒ Vehicle Inspection Forms (ERM-1430-FM2)	☐ Industrial Hygiene Sample Data (NAM-1302-FM1)
☐ Journey Management Plans (ERM-1430-FM1)	☒ Ambient Air Monitoring Form (NAM-1302-FM2)
☒ Safety Data Sheets (SDS) for chemicals brought to site	☐ Client-specific requirements
☐ PLAN Risk Assessment	☐ Other: Click here to enter text.
☒ Facility site map(s)	☐ Other: Click here to enter text.
Applicable ERM Safety Standards/Procedures ***Check procedures/standards that are applicable to this project. Refer to the documents for guidance and, where applicable, use forms, work instructions, and guidelines associated with these standards/procedures in the completion of site work. Indicated documents must be procured from ERM's Document Control System. Note that this list is not comprehensive!***	
Global Standards/Procedures	
☐ Short Service Employees (ERM-1611-PR1)	☐ Travel Risk Assessment (ERM-1410-ST1)
☐ Offshore Platform Safety (ERM-1531-ST1)	☒ Subsurface Clearance Standard (ERM-1511-PR1)
☒ Driver and Vehicle Safety (ERM-1430-PR1)	☐ Fixed Wing Aircraft/Helicopter Standard (ERM-1440-ST1)
Regional Standards/Procedures	
☐ Fire Prevention (NAM-1213-PR1)	☐ Demolition (NAM-1544-PR1)
☐ Confined Space Entry (NAM-1572-PR1)	☒ Excavation and Trenching (NAM-1512-PR1)
☐ Fall Protection (NAM-1313-PR1)	☒ Hazard Communication (NAM-1301-PR1)
☐ Ladder Safety (NAM-1521-PR1)	☒ Cold Stress (NAM-1323-PR1)
☒ Hearing Conservation (NAM-1312-PR1)	☒ Heat Stress (NAM-1323-PR2)
☒ Incident Reporting and Investigation (NAM-1220-PR1)	☒ Medical Services (NAM-1840-PR1)
☐ Medical Surveillance (NAM-1810-PR1)	☒ Personal Protective Equipment (NAM-1310-PR1)
☐ Hot Work (NAM-1542-PR1)	☐ Respiratory Protection (NAM-1311-PR1)
☐ Blood-borne Pathogens (NAM-1325-PR1)	☒ Contractor Management (NAM-1130-PR1)
☒ Hand Tools/Portable Power Equipment (NAM-1329-PR1)	☒ Insect Bite Prevention Standard (NAM-1361-ST1)
☐ Electrical Safety (NAM-1561-PR1)	☒ Incident/Illness Management (NAM-1210-PR1)

☒ Waste Management Planning (NAM-1122-PR1)	☐ Energy Isolation (NAM-1562-PR1)
☐ Work Over Water (NAM-1460-PR1)	☐ Spill Prevention and Response (NAM-1123-PR1)
☐ Fatigue Management (NAM-1328-PR1)	☒ Safe Use of Cutting Tools (NAM-1324-PR1)
☐ Lone Worker (NAM-1326-PR1)	☒ Compressed Gas Cylinders (NAM-1341-PR1)

See It; Own It; Share It

It means that:

- **We know that we have a responsibility to look out for each other, to intervene when necessary, to be proactive and to help keep safety issues from becoming problems.**
- **We also look out for ourselves. If we recognize that a situation is unsafe, we are expected to stop what we are doing, reassess the situation and consult with others if necessary before proceeding safely.**
- **We assign no blame to anyone who raises safety issues.**
- **We strive to learn lessons from the large and small events that are part of our daily experience.**

Stop Work Authority

It is ERM policy that all ERM and ERM Contractor employees have the authority, without fear of reprimand or retaliation to:

- **Immediately stop any work activity that presents a danger to the site team or the public.**
- **Get involved, question and rectify any situation or work activity that is identified as not being in compliance with the HASP or with broader ERM health and safety policies.**
- **Report any unsafe acts or conditions to supervision or, preferably, intervene to safely correct such acts or conditions themselves.**

Hospital Map

NORTH

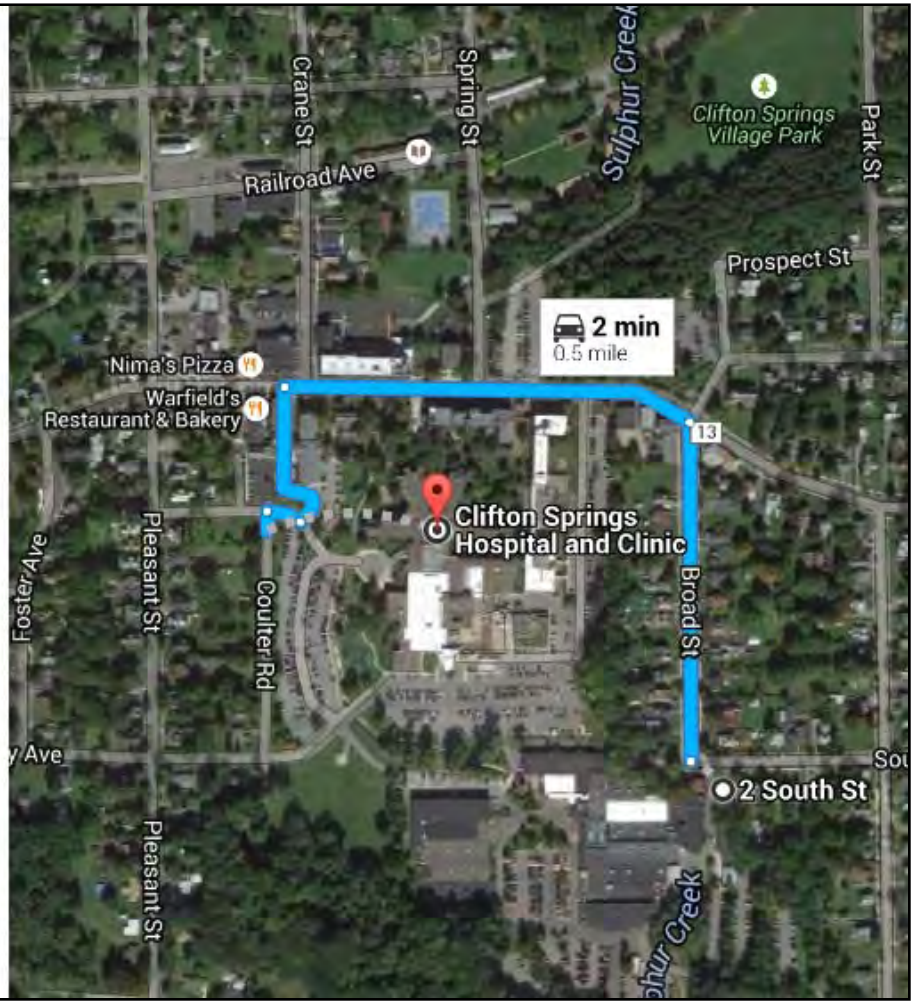
2 min (0.5 mile)

Via Broad St and E Main St

2 South St
Clifton Springs, NY 14432

- Head north on Broad St toward E Main St — 0.2 mi
- Turn left onto E Main St — 0.2 mi
- Turn left onto Village Drive — 472 ft
- Turn right toward Coulter Rd — 105 ft
- Turn left onto Coulter Rd — 56 ft

Clifton Springs Hospital and Clinic
2 Coulter Road, Clifton Springs, NY 14432



Map To Nearest Hospital

G.W. Lisk Health And Safety Plan

Clifton Springs, New York 14432

ENVIRONMENTAL RESOURCES MANAGEMENT

Figure **1**

Job Hazard Analysis

JHA
Job Hazard Analysis

Project Number:	0497315	Project / Client Name:	Remedial Investigation / G.W. Lisk
Project Manager:	Jon Fox	Location:	2 South Street, Clifton Springs, New York 14432
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	3/18/2019, Rev. 0

SPECIFIC TASK:	**Groundwater Well Sampling**

Minimum Required PPE for Entire Task:	☑ Hard Hat ☑ Safety-Toe Shoes ☐ Hearing Protection ☐ Goggles ☐ Face Shield ☐ Respirator NA ☐ Other (specify): ☑ Safety Glasses ☑ Reflective Vest ☑ Gloves chemical resistant ☑ PPE clothing long sleeeves, pants NA		
Additional Task-Step Specific PPE: (as indicated below under Controls)	ear plugs, heavy leather gloves, cut resistant gloves	Equipment / Tools Required:	pump, DI water with alconox/liquinox
Training Required for this Task:	HAZWOPER 40-hr; current 8-hr Refresher Training	Permits Required for this Task:	None
Forms Associated with This Task:	S3-NAM-010-FM2 - Estimating Vaper Exposure from Volatile Compounds in Water		

JHA Developed / Reviewed By:			JHA Review In Field
Name / Job Title:	Name / Job Title:	Name / Job Title:	Field supervisor to ensure all personnel performing this task have reviewed JHA and agree to follow it. Site-specific changes to this JHA have been made as warranted based on this review. **Signature/Date:**
Justin Vause, Staff Scientist			

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
1	Load / Attach / Disconnect Equipment	1a	Pinch Points	H&S	2	3	6	1a	Consider body positioning prior to start of task to identify potential pinch points and change position to ensure no contact during task. Do not position your hand or body so it can be caught in identified pinch points. Do not position your hand or body so it can be caught between a lifted load and adjacent objects. Wear heavy leather or cut-resistant gloves; have gloves on your person at all times.
		1b	Property Damage from vehicle / sample trailer movement	multiple	2	2	4	1b	Inspect surrounding area prior to backing. Use trained spotters when backing and when visibility is restricted. Ensure spotters and equipment operators maintain eye contact. Establish parking/staging/loading/unloading areas (consider equipment turning circles, swing zones, etc.). Ensure trailers/trucks are rated and balanced. Chock truck/trailer wheels when not moving. Ensure load is distributed during load/unload to avoid tip/roll-over.
		1c	Muscle strain from lifting / handling equipment	H&S	3	3	9	1c	Use cart, dolly, or get assistance. Do not lift anything manually by yourself that is awkwardly shaped or weighs more than 35 pounds. When lifting lighter objects, bend and lift with legs/arms, not back. Keep objects close to body and do not twist while lifting (turn with feet). Position work equipment to avoid over-reaching while working. Store heavy/bulky items with safe access in mind.
2	Set up / break down at well	2a	Fire / Explosion from generator	multiple	1	3	3	2a	Monitor VOCs and LEL by handheld PID and stop work if monitoring result TBD. Follow facility/client hot work permit rules. Position generator at least 2 feet away from combustible/flammable materials. Make sure support straps for generator are clear from exhaust stream and pipe. Have fire extinguisher(s) on site and immediately available for use by trained personnel.
		2b	Getting struck by vehicular traffic and unauthorized access to work area	H&S	1	4	4	2b	Set up barricades around work zone (specify type: snow fencing, cones [min height should be such that drivers can see], delineator posts). Use parked vehicle(s) as barricades to protect work zone from oncoming traffic. Use traffic control contractor for work in public streets or at center divider of public streets. Wear reflective vest for all off-site work in or adjacent to traffic areas.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
		2c	Tripping hazards in work area	H&S	3	3	9	2c	Identify and use only safe pathways when entering/exiting/working in area. Obtain additional lighting and use clear safety glasses in areas with low/unclear visibility. Inspect work area for potential slip/trip/fall hazards prior to start of work; remove if possible, or, if not possible, cordon off with cone or mark with highly visible tape/flags, etc. Keep work area organized and free of surface obstructions during task. Immediately dry wet areas or restrict access (e.g., warning tape, signs, cones). Remove snow/ice/debris/vegetation prior to start of work. Reassess surface conditions if weather changes and address any new hazards (e.g., slick surface developing as a result of wet/freezing conditions). Do not carry loads that restrict visibility. Keep work area surfaces clear of debris (e.g., mud, leaves) and store tools/equipment to eliminate trip hazards when not in use. Keep eyes on path and nearby surroundings when walking. Fill in/flatten uneven ground. Wear footwear with appropriate traction for conditions (i.e., rubber non-slip soles, tread, crampons, etc.).
		2d	Electrical shock from portable tools	H&S	2	4	8	2d	Use GFCIs. Make sure the equipment is properly grounded. Use flexible cords that are splice-free and not worn or frayed. Do not turn on generator breaker until pump is down well.
		2e	Muscle strain from lifting / handling equipment	H&S	3	3	9	2e	See above, 1c
3	Opening and closing well cover and cap	3a	Skin / eye contact with contaminated water or free product	H&S	2	5	10	3a	Wear chemical resistant gloves selected for the specific chemials of concern and safety glasses. State glove type on Line 9 above. Have portable eyewash available on site. Ensure SDS is available (in HASP) for all chemicals of concern
		3b	Inhalation of contaminant vapors	H&S	2	5	10	3b	An exposure assessment must be conducted to identify the potential for exposures above an established action level or permissible exposure limit; and a site-specific program to address all required regulatory concerns must be included in the HASP. Perform ambient air monitoring (designate method and frequency) and if action levels are reached or exceeded, follow plan established in HASP. Position work area upwind. Set-up work zone to restrict non-essential access and minimize off-site impacts.
		3c	Back strain from bending over wellhead	H&S	3	3	9	3c	Obtain and use a chair or stool; otherwise use kneeling position or bend at knees, not waist.
		3d	Struck by / pinch point - wellhead lid	H&S	1	3	3	3d	Inspect work area prior to start of task to identify pinch points. Remove/protect or adjust body position to ensure no contact during task. Identify pinch points on wellhead by warning label and/or paint color. Do not position your hand or body so it can be caught in identified pinch points. Use an appropriate tool to assist. Wear heavy leather or cut-resistant gloves; have gloves on your person at all times.
		3e	Hit by well cap or contact with contaminated water from pressure build-up	H&S	1	3	3	3e	Open well cap slowly to allow for pressure release. Use heavy leather or cut resistant gloves and maintain firm grip (use two hands). Keep body out of the line of fire if well cap slips.
		3f	Posionous / stinging insects	H&S	2	5	10	3f	Visually inspect area around wellhead before approaching. Listen for buzzing / other noises inside vault before opening. Inspect well vault before reaching in to open well cap. Wear heavy leather or cut resistant gloves.
4	Gauging / sampling	4a	Skin / eye contact with contaminated water or free product	H&S	2	5	10	4a	Lower and raise downwell equipment slowly to avoid splashes. Wipe excess liquids from equipment as it is being raised. Wear chemical resistant gloves (selected for the specific chemials of concern) and wear safety glasses; state glove type above on Line 9. Have portable eyewash available on site. Ensure SDS is available (in HASP) for all chemicals of concern
		4b	Inhalation of contaminant vapors	H&S	2	5	10	4b	See above, 3b
		4c	Back strain from bending over wellhead / repetitive motion stress	H&S	3	3	9	4c	See above, 3c. Use a tool to minimize repetitive stress risk. Change position frequently during job (e.g., vary grip, hand motion). Keep wrists in a neutral (straight) position as you work. When possible, rotate tasks to give body parts a rest. Share tasks among employees present. Take breaks every hour and do simple stretches/exercises. Ensure gloves fit hands properly to decrease stress on hand/joints.
		4d	Struck by / pinch point - wellhead lid	H&S	1	3	3	4d	See above, 3d
		4e	Electrical shock - submersible pump	H&S	3	3	9	4e	See above, 2d. Use GFCI on the power supply, and use of a multimeter (Volt-Ohm meter) to confirm that all external parts of the pump system (i.e., sample port, sample riser, well head, etc.) are not electrically charged. Use of insulated rubber gloves is also recommended.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
		4f	Cuts from broken glass from sample container	H&S	2	5	10	4f	Store bottles in shipping container prior to filling. Inspect containers for any damage, cracks. When capping sample containers, do not place fingers across gap between cap and bottle neck. Wear chemical resistant gloves that are also cut resistant, or wear thin cut-resistant inner gloves.
		4g	Hearing damage from generator noise above 85 dbA	H&S	3	3	9	4g	Wear hearing protection when working within 20 feet of generator. Signage indicating this requirement should be affixed to generator. Measure noise levels with a noise dosimeter if project will last over 30 days or, for shorter work, use the rule or thumb that you should be able to hear a person talking to you in a normal voice at distance of 3 ft.
		4h	Spills of contaminated purge water	E	3	4	12	4h	Store purge water in dedicated containers/areas; close containers when not in use. Chemical containers must be labeled in accordance with regulations. Secure end of sample tubing to container so it doesn't slip off. Have general absorbent mats on hand. Place container and/or absorbent/plastic sheeting around wellhead. Inspect lines, tubing, hoses and all fittings/couplings to ensure integrity/closure. Assess rating and compatibility of materials used vs purpose.

ONE JHA PER TASK. CONTRACTORS MUST PROVIDE THEIR OWN JHAS. JHAS SHOULD BE WRITTEN IN PLAIN LANGUAGE AND SHOULD BE NO MORE THAN 2-3 PAGES IN LENGTH.
INSERT ADDITIONAL ROWS AS NEEDED ABOVE (MUST MANUALLY COPY AND PASTE FORMULA IN COLUMN H). ROW HEIGHTS MAY NEED TO BE MANUALLY EXPANDED TO VIEW ALL TEXT.
LEAVE SEVERAL BLANK OVERSIZED ROWS TO ALLOW HANDWRITTEN FIELD ADDITIONS. CAN ALSO DELETE UNNEEDED ROWS TO FIT PAGE(S).

1. Each task consists of a set of steps. List and number all the steps in the sequence they are performed. Specify the equipment or other details.

2. List potential health & safety hazards and consequences - ONE PER ROW - and select "H&S" from the drop-down list. Then list any potential security, environmental, and/or property loss impacts - ONE PER ROW - and select the corresponding code(s) from the drop-down list. Use numbers and letters for each hazard/impact listed (1a, 1b, etc). Hazards should be described in terms of their specific origin and negative consequences (e.g., instead of “moving equipment”, write “injury from getting struck by forklift”).

3. Describe the specific actions or procedures that will be implemented to eliminate or reduce each hazard. Be clear, concise, and specific. Use objective, observable, and quantified terms (e.g., instead of “use good body positioning,” write “don’t bend at waist or reach above head”). Use numbers and letters corresponding to listed hazards.

4. Select the probability of occurrence and consequence of each hazard, AFTER implementation of the planned control measures (use the Risk Matrix as a guide). The corresponding risk rating will then be automatically calculated [RISK = Likelihood x Severity].

A risk rating shaded red indicates that work cannot continue without additional control measures and approval of Partner-in-Charge.

WAYS TO ELIMINATE OR REDUCE RISKS (IN ORDER OF PREFERENCE):

ELIMINATE / AVOID --> SUBSTITUTE / MODIFY --> ISOLATE --> ENGINEER / SAFEGUARD --> TRAINING AND PROCEDURES --> WARNING AND ALERT MECHANISMS --> PPE

JHA
Job Hazard Analysis

Project Number:	0497315	Project / Client Name:	Site Characterization Planning / G.W. Lisk
Project Manager:	Jon Fox	Location:	2 South Street, Clifton Springs, New York 14432
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	3/28/2019, Rev. 0

SPECIFIC TASK: **Hand Augering and Shallow Soil Sampling**

Minimum Required PPE for Entire Task:	☑ Hard Hat ☑ Safety-Toe Shoes ☐ Hearing Protection ☐ Goggles ☐ Face Shield ☐ Respirator NA ☐ Other (specify): ☑ Safety Glasses ☑ Reflective Vest ☑ Gloves cut resistant/ heavy leather ☑ PPE clothing long sleeves, pants NA		
Additional Task-Step Specific PPE: (as indicated below under Controls)	NA	Equipment / Tools Required:	Hand auger with non-conductive nad/or insulated handles and upper shaft
Training Required for this Task:	SSC Experienced Person (EP)	Permits Required for this Task:	S1-ERM-007-FM3 – SSC Location Disturbance Permit (inside critical zones)
Forms Associated with This Task:	S1-ERM-007-FM1 – SSC Field Process Checklist S1-ERM-007-FM2 – SSC Field Process Checklist for RG Sites S1-ERM-007-FM3 – SSC Location Disturbance Permit S1-ERM-007-FM4 – SSC Project Plan S1-ERM-007-FM7 - SSC Field Review Checklist for Contractors		

JHA Developed / Reviewed By:			JHA Review In Field
Name / Job Title:	Name / Job Title:	Name / Job Title:	Field supervisor to ensure all personnel performing this task have reviewed JHA and agree to follow it. Site-specific changes to this JHA have been made as warranted based on this review. **Signature/Date:**
Justin Vause, Staff Scientist			

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
1	Set up at location	1a	Tripping hazards in work area	H&S	3	3	9	1a	Identify and use only safe pathways when entering/exiting/working in area. Obtain additional lighting and use clear safety glasses in areas with low/unclear visibility. Inspect work area for potential slip/trip/fall hazards prior to start of work; remove if possible, or, if not possible, cordon off with cone or mark with highly visible tape/flags, etc. Keep work area organized and free of surface obstructions during task. Immediately dry wet areas or restrict access (e.g., warning tape, signs, cones). Remove snow/ice/debris/vegetation prior to start of work. Reassess surface conditions if weather changes and address any new hazards (e.g., slick surface developing as a result of wet/freezing conditions). Do not carry loads that restrict visibility. Keep work area surfaces clear of debris (e.g., mud, leaves) and store tools/equipment to eliminate trip hazards when not in use. Keep eyes on path and nearby surroundings when walking. Fill in/flatten uneven ground. Wear footwear with appropriate traction for conditions (i.e., rubber non-slip soles, tread, crampons, etc.).
		1b	Getting struck by vehicular traffic and unauthorized access to work area	H&S	1	4	4	1b	Set up barricades around work zone (specify type: snow fencing, cones [min height should be such that drivers can see], delineator posts). Use parked vehicle(s) as barricades to protect work zone from oncoming traffic. Use traffic control contractor for work in public streets or at center divider of public streets. Wear reflective vest for all off-site work in or adjacent to traffic areas.
		1c	Muscle strain from lifting / handling equipment	H&S	3	3	9	1c	Use cart, dolly, or get assistance. Do not lift anything manually by yourself that is awkwardly shaped or weighs more than 35 pounds. When lifting lighter objects, bend and lift with legs/arms, not back. Keep objects close to body and do not twist while lifting (turn with feet). Position work equipment to avoid over-reaching while working. Store heavy/bulky items with safe access in mind.
		1d	Biological Hazards - insects, snakes, plants, wildlife	H&S	2	5	10	1d	Inspect work area upon arrival - do not proceed if biological hazards are identified - leave work area and contact PM. Clear brush/high grass from work area. Use insect repellent. Identify employees with known sensitivities to hazardous plants or insects; reassign sensitive employees or provide appropriate addt'l PPE, such as a bee sting kit. Wear long sleeve shirt and pants.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
2	Hand augering	2a	Injury or damage if striking underground utility lines / structures	multiple	2	5	10	2a	Follow ERM SSC Process, perform all utility location activities. Ensure contractors performing hand augering have been briefed on ERM SSC process requirements (use checklist form noted above - S1-ERM-007-FM7 - SSC Field Review Checklist for Contractors), and are overseen at ALL times by an ERM SSC EP. Hand auger slowly and don't force the hand auger if there is an obstruction that could be an underground line. Use correct auger head for the material to be encountered. Do not use pointed pry bar to pound into the borehole. If pea gravel, brick, or other non-native materials encountered, stop work immediately and contact ERM PM. If resistance encountered, stop and contact PM.
		2b	Improper tool use or tool condition resulting in injury	H&S	3	3	9	2b	Ensure personnel have been properly trained on use of hand auger. Inspect all tools and equipment IMMEDIATELY prior to use; if faulty or inappropriate, do not proceed until repaired or replaced. Use blunt-end probe to free hard to remove or sticky soil. Clear bucket by pushing material/tool away from body.
		2c	Muscle strain or overexertion from hand auger operation	H&S	3	3	9	2c	Do not force hand auger - if you get refusal, contact PM to determine safe step-out distance. Use appropriate auger cutting head for soil type encountered. Do not reach, stretch, or twist when using hand auger. Use 3' and 5' flights to keep handle between shoulders and thighs (keep back straight). Stretch muscles before starting work. Take breaks regularly. Use 5 gallon bucket of water as lubricant for augers.
		2d	Exposure to soil containing hazardous materials	H&S	3	4	12	2d	Wear _____ [specify] gloves when collecting soil samples. Monitor breathing zone/work area with PID if soil contains VOCs. Follow HASP requirements for upgrading PPE and doning respirators.
		2e	Cuts/abrasions from sharp and rough materials	H&S	2	4	8	2e	Wear leather/heavy work gloves (with sufficient grip) while hand augering. Clear soil from auger bucket wih blunt-end tool, not hands.
3	Shoveling / collecting soil into containers	3a	Muscle strain or overexertion	H&S	3	3	9	3a	Do not lift more than ___ lbs without assistance. Do not move drums without drum dolly. For single-person tasks, transfer soil to smaller containers such as 5-gallon buckets filled 1/2-way.
		3b	Pinch Points - Drum Lids	H&S	1	3	3	3b	Wear leather/heavy work gloves when opening/closing drum lids. Use the proper tool - [specify]. Keep fingers clear of "line of fire".
		3c	Mismanagement of wastes	E	2	3	6	3c	Coordinate with ERM PM and client/site contacts prior to job start for proper waste management instructions. Containers must be labelled properly BEFORE adding any waste materials.
		3d	Cut from broken glass or sharp edge of metal sleeve	H&S	2	5	10	3d	Inspect hand auger to make sure there are no sharp edges or barbs that could cut a hand. File down if needed. Wear cut resistant gloves. Store sample containers in shipping container prior to filling. Inspect containers for any damage, cracks. When capping sample containers, do not place fingers across gap between cap and bottle neck. Wear chemical resistant gloves that are also cut resistant, or wear thin cut-resistant inner gloves.
		3e	Exposure to soil containing hazardous materials	H&S	2	5	10	3e	See above, 2d.
4	Decontamination of equipment (over containment)	4a	Cuts/abrasions from sharp and rough materials	H&S	2	4	8	4a	See above, 2e. Do not use hands to wash off auger blades - use wire brush or other tool.
		4b	Exposure to soil containing hazardous materials	H&S	2	5	10	4b	See above, 2d.
		4c	Mismanagement of wastes	E	2	3	6	4c	See above, 3c. Conduct all decon activities over containment.
5	Backfill hole	5a	Tripping hazard from open or improperly backfilled borehole	H&S	2	4	8	5a	Do not leave open holes unattended. If this is not feasible, consult PM for instructions. Completely backfill all holes with bentonite chips [or specify other material], compact, and hydrate thoroughly; Revisit auger locations within 24 hours to ensure no settling.
6	Secure site	6a	Hazards from Poor Site Housekeeping - Tripping Hazards, Mismanaged Wastes	multiple	3	3	9	6a	Remove all tools, equipment, cones, debris, trash from site before leaving. Secure all equipment from theft, vandalism, energizing equipment. Contact waste management contractor and arrange for waste container pickup. Leave containers in secure, agreed-upon location; if off-site, DO NOT leave containers unattended!

Task Steps[1]	Potential Hazards & Consequences[2] select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]

ONE JHA PER TASK. CONTRACTORS MUST PROVIDE THEIR OWN JHAS. JHAS SHOULD BE WRITTEN IN PLAIN LANGUAGE AND SHOULD BE NO MORE THAN 2-3 PAGES IN LENGTH.
INSERT ADDITIONAL ROWS AS NEEDED ABOVE (MUST MANUALLY COPY AND PASTE FORMULA IN COLUMN H). ROW HEIGHTS MAY NEED TO BE MANUALLY EXPANDED TO VIEW ALL TEXT.
LEAVE SEVERAL BLANK OVERSIZED ROWS TO ALLOW HANDWRITTEN FIELD ADDITIONS. CAN ALSO DELETE UNNEEDED ROWS TO FIT PAGE(S).

1. Each task consists of a set of steps. List and number all the steps in the sequence they are performed. Specify the equipment or other details.
2. List potential health & safety hazards and consequences - ONE PER ROW - and select "H&S" from the drop-down list. Then list any potential security, environmental, and/or property loss impacts - ONE PER ROW - and select the corresponding code(s) from the drop-down list. Use numbers and letters for each hazard/impact listed (1a, 1b, etc). Hazards should be described in terms of their specific origin and negative consequences (e.g., instead of “moving equipment”, write “injury from getting struck by forklift”).
3. Describe the specific actions or procedures that will be implemented to eliminate or reduce each hazard. Be clear, concise, and specific. Use objective, observable, and quantified terms (e.g., instead of “use good body positioning,” write “don’t bend at waist or reach above head”). Use numbers and letters corresponding to listed hazards.
4. Select the probability of occurrence and consequence of each hazard, AFTER implementation of the planned control measures (use the Risk Matrix as a guide). The corresponding risk rating will then be automatically calculated [RISK = Likelihood x Severity].

A risk rating shaded red indicates that work cannot continue without additional control measures and approval of Partner-in-Charge.

WAYS TO ELIMINATE OR REDUCE RISKS (IN ORDER OF PREFERENCE):

ELIMINATE / AVOID --> SUBSTITUTE / MODIFY --> ISOLATE --> ENGINEER / SAFEGUARD --> TRAINING AND PROCEDURES --> WARNING AND ALERT MECHANISMS --> PPE

JHA
Job Hazard Analysis

Project Number:	0497315	Project / Client Name:	Remedial Investigation / G.W. Lisk
Project Manager:	Jon Fox	Location:	2 South Street, Clifton Springs, New York 14432
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	3/18/2019, Rev. 0

SPECIFIC TASK:	**Lifting, Moving, and Transporting Equipment**

Minimum Required PPE for Entire Task:	☑ Hard Hat ☑ Safety-Toe Shoes ☐ Hearing Protection ☐ Goggles ☐ Face Shield ☐ Respirator NA ☐ Other (specify): ☑ Safety Glasses ☑ Reflective Vest ☑ Gloves heavy leather or cut resistant ☑ PPE clothing long sleeves, pants NA		
Additional Task-Step Specific PPE: (as indicated below under Controls)	NA	Equipment / Tools Required:	NA
Training Required for this Task:	NA	Permits Required for this Task:	NA
Forms Associated with This Task:	S1-ERM-008-FM2 - Vehicle Inspection Form		

JHA Developed / Reviewed By:			JHA Review In Field
Name / Job Title:	Name / Job Title:	Name / Job Title:	Field supervisor to ensure all personnel performing this task have reviewed JHA and agree to follow it. Site-specific changes to this JHA have been made as warranted based on this review. **Signature/Date:**
Justin Vause, Staff Scientist			

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
1	Mobilize to / from location	1a	Loose articles inside the vehicle and carried in truck beds or on trailers can shift and cause distractions or traffic accidents	multiple	3	4	12	1a	Use the ERM Vehicle Inspection Form to document daily inspections of the vehicle. During vehicle inspection make sure any loose articles either inside the vehicle or in truck beds/on trailers are well-secured.
		1b	Accidents caused by larger vehicles or heavy equipment, and when backing / maneuvering in tight spaces.	multiple	1	4	4	1b	Inspect surrounding area prior to backing. Use spotter when driving large trucks or heavy equipment onto project sites, and for all vehicles when maneuvering in/out of tight spaces and backing up. Ensure spotters and equipment operators maintain eye contact. Establish parking/staging/loading/unloading areas (consider equipment turning circles, swing zones, etc.). Ensure trailers/trucks are rated and balanced. Chock truck/trailer wheels when not moving. Ensure load is distributed during load/unload to avoid tip/roll-over. Follow designated travel routes. Employees pulling trailers must first receive training and authorization from BU Fleet Manager. Make sure vehicle is capable to pull the weight of the trailer and its contents. Inspect the trailer to ensure brake and turn signals work properly and in concert with the main vehicle's signals, and that tire pressure is acceptable. Make sure trailer is attached securely to the main vehicle and the safety chain or other backup attachment device is in-place. Evenly distribute weight on any trailers pulled. Turn off engine, set parking brake, and chock tires for larger vehicles and when parking on inclines.
		1c	Inadequate / malfunctioning / damaged equipment and tools	multiple	2	3	6	1c	Inspect all tools and equipment and test for proper working condition prior to mobilizing to site / work area. Select only the right tools / equipment for the task. Audit contractor process / forms for equipment inspection. If contractor equipment is deficient, stop work and have the deficiency addressed prior to starting work again.
2	Load / Attach / Disconnect Equipment	2a	Pinch Points	**H&S**	1	4	4	2a	Consider body positioning prior to start of task to identify potential pinch points and change position to ensure no contact during task. Do not position your hand or body so it can be caught in identified pinch points. Do not position your hand or body so it can be caught between a lifted load and adjacent objects. Wear heavy leather or cut-resistant gloves; have gloves on your person at all times.
		2b	Property Damage from vehicle / trailer movement	multiple	2	4	8	2b	See above, 1b.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
		2c	Muscle strain from lifting / handling equipment	H&S	3	3	9	2c	Use cart, dolly, or get assistance. Do not lift anything manually by yourself that is awkwardly shaped or weighs more than 35 pounds. When lifting lighter objects, bend and lift with legs/arms, not back. Keep objects close to body and do not twist while lifting (turn with feet). Position work equipment to avoid over-reaching while working. Store heavy/bulky items with safe access in mind.
3	Lifting and carrying equipment	3a	Slips/Trips/Falls Resulting in Injury	H&S	3	3	9	3a	Determine travel path and staging area before lifting materials. Scan travel path to avoid trip hazards - walk on established roadways as much as possible. Keep work area and walkways free of trip hazards. Avoid uneven surfaces, overhead obstructions, soft/ muddy/ wet ground, and high vegetation where you can't see the ground. Wear boots with sufficient tread. Do not run.
		3b	Muscle strain from lifting and carrying equipment	H&S	3	3	9	3b	Determine travel path and staging area before lifting materials. When possible, use powered equipment, lift truck, drum cart, or other mechanical means to move heavy items (machine instead of manpower). Use of powered equipment / forklifts requires trained drivers and documented daily inspections. Establish plan for all forklift movements and ensure adequate space/clearances. Do not lift anything manually by yourself that is awkwardly shaped or weighs more than 35 pounds. When lifting lighter objects, bend and lift with legs/arms, not back. Keep objects close to body and do not twist while lifting (turn with feet). Position work equipment to avoid over-reaching while working. Do not reach, stretch, or twist to lift. Take breaks in addition to scheduled rest periods as needed.
		3c	Sharp/rough edges and pinch points	H&S	1	4	4	3c	See above, 2a. Position hands away from pinch points or sharp/rough areas where fingers may be crushed or cut/punctured/abraded. Wear appropriate PPE including cut-resistant gloves or leather / other heavy work gloves, and steel-toed boots.
		3d	Equipment rollover	multiple	1	5	5	3d	Choose level paths/terrain for equipment. Assess all paths prior to moving equipment onto the site (look for muddy areas in which the vehicle may slip, hidden travel path hazards, etc). Distribute loads/equipment on vehicles evenly to avoid tipping. Where inadequate travel paths exist, terrain modifications should be designed and implemented by a qualified professional engineer prior to start of work.
4	Securing tools and equipment	4a	Damage to equipment, unauthorized use resulting in incident, or theft	multiple	2	5	10	4a	Turn off the engine and lock any vehicle being left for even a short period of time when not on a secure jobsite. If the vehicle will be left for long periods or overnight, remove any company documents, computers, and equipment, personal valuables, or any items that would attract thieves. Secure all equipment in locked storage areas after use and at end of day. All heavy equipment must be placed in a neutral position when not in operation. Dump truck beds must be lowered, buckets must be at ground level, forklift tines must be at ground level, etc. Keys must be removed from all heavy equipment when not in use.

ONE JHA PER TASK. CONTRACTORS MUST PROVIDE THEIR OWN JHAS. JHAS SHOULD BE WRITTEN IN PLAIN LANGUAGE AND SHOULD BE NO MORE THAN 2-3 PAGES IN LENGTH.
INSERT ADDITIONAL ROWS AS NEEDED ABOVE (MUST MANUALLY COPY AND PASTE FORMULA IN COLUMN H). ROW HEIGHTS MAY NEED TO BE MANUALLY EXPANDED TO VIEW ALL TEXT.
LEAVE SEVERAL BLANK OVERSIZED ROWS TO ALLOW HANDWRITTEN FIELD ADDITIONS. CAN ALSO DELETE UNNEEDED ROWS TO FIT PAGE(S).

1. Each task consists of a set of steps. List and number all the steps in the sequence they are performed. Specify the equipment or other details.

2. List potential health & safety hazards and consequences - ONE PER ROW - and select "H&S" from the drop-down list. Then list any potential security, environmental, and/or property loss impacts - ONE PER ROW - and select the corresponding code(s) from the drop-down list. Use numbers and letters for each hazard/impact listed (1a, 1b, etc). Hazards should be described in terms of their specific origin and negative consequences (e.g., instead of “moving equipment”, write “injury from getting struck by forklift”).

3. Describe the specific actions or procedures that will be implemented to eliminate or reduce each hazard. Be clear, concise, and specific. Use objective, observable, and quantified terms (e.g., instead of “use good body positioning,” write “don’t bend at waist or reach above head”). Use numbers and letters corresponding to listed hazards.

4. Select the probability of occurrence and consequence of each hazard, AFTER implementation of the planned control measures (use the Risk Matrix as a guide). The corresponding risk rating will then be automatically calculated [RISK = Likelihood x Severity].

A risk rating shaded red indicates that work cannot continue without additional control measures and approval of Partner-in-Charge.

WAYS TO ELIMINATE OR REDUCE RISKS (IN ORDER OF PREFERENCE):

ELIMINATE / AVOID --> SUBSTITUTE / MODIFY --> ISOLATE --> ENGINEER / SAFEGUARD --> TRAINING AND PROCEDURES --> WARNING AND ALERT MECHANISMS --> PPE

JHA
Job Hazard Analysis

Project Number:	0497315	Project / Client Name:	Remedial Investigation / G.W. Lisk
Project Manager:	Jon Fox	Location:	2 South Street, Clifton Springs, New York 14432
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	3/18/2019, Rev. 0

SPECIFIC TASK: **Motor Vehicle Operation (excluding commercial vehicles and heavy equipment)**

Minimum Required PPE for Entire Task:	☐ Hard Hat ☐ Safety-Toe Shoes ☐ Hearing Protection ☐ Goggles ☐ Face Shield ☐ Respirator NA ☐ Other (specify): NA ☐ Safety Glasses ☐ Reflective Vest ☑ Gloves Wear work gloves when performing basic maintenance. ☐ PPE clothing NA		
Additional Task-Step Specific PPE: (as indicated below under Controls)	Reflective safety vests (when on-Site)	Equipment / Tools Required:	Anti-lock braking system (ABS); Air bags fitted for driver and passenger side; Three point lap/diagonal seat belts for front and rear outboard seats and lap belts for all other seats.
Training Required for this Task:	Valid Drivers License, Alert Driving Training	Permits Required for this Task:	NA
Forms Associated with This Task:	S1-ERM-008-FM2 - Vehicle Inspection Checklist		

JHA Developed / Reviewed By:			JHA Review In Field
Name / Job Title:	Name / Job Title:	Name / Job Title:	Field supervisor to ensure all personnel performing this task have reviewed JHA and agree to follow it. Site-specific changes to this JHA have been made as warranted based on this review. **Signature/Date:**
Justin Vause, Staff Scientist			

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
1	Inspect vehicle (walk-around exterior and interior)	1a	Broken or malfunctioning equipment resulting in unsafe operation/accidents, break-downs, or spill of engine fluids to ground	multiple	2	5	10	1a	For ERM owned or leased vehicles, rental vehicles and personal vehicles used for field operations: document regular inspections of the vehicle (S1-ERM-008-FM2 - Vehicle Inspection Checklist). Do not operate any vehicle if its safety is in question and report any vehicle safety issues to ERM Fleet Manager or Project Manager/Supervisor.
		1b	Loose articles inside the vehicle and carried in truck beds or on trailers can shift and cause distractions, property damage, and accidents	multiple	2	5	10	1b	During vehicle inspection make sure any loose articles either inside the vehicle or in truck beds/on trailers are well-secured. For trailers, ensure trailers are properly and securely attached to hitch. Do not tow a trailer unless you have received training and the vehicle is rated for the load.
2	Loading / unloading vehicle	2a	Loose articles inside the vehicle and carried in truck beds or on trailers can shift and cause distractions, property damage, and accidents	multiple	2	5	10	2a	See above, 1b
		2b	Muscle strain from lifting and carrying heavy or awkwardly-shaped objects	**H&S**	2	3	6	2b	Use a dolly/cart to transport items, or get assistance from another person. Only carry what can safely be transported to/from the vehicle. Make as many trips as necessary. While lifting and carrying, keep materials close to your core - do not bend at waist, reach above your head, twist, or extend weight out away from your core. If materials slip, just let them drop rather than try to catch them and risk getting hurt.
		2c	Slip / trip / fall resulting in injury	**H&S**	2	3	6	2c	Inspect area for potential slip/trip/fall obstructions prior to loading / unloading, and remove or avoid these. Obtain additional lighting and use clear safety glasses in areas with low/unclear visibility. Keep work area organized and free of surface obstructions. Immediately dry wet areas or restrict access. Remove snow/ice prior to start of work. Reassess surface conditions if weather changes and address any new hazards (e.g. slick surface developing as a result of wet/freezing conditions). Do not carry loads that restrict visibility. Ensure steps, walkways and shoes are not slippery or loose prior to use. Keep eyes on path and nearby surroundings when walking. Take small steps and shuffle feet in potentially slippery areas. Walk slowly around corners and when entering/exiting doors. Wear footwear with nonslip soles and good tread.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
		2d	Property damage from dropping equipment or improper loading	PL	2	2	4	2d	Use a dolly/cart to transport items, or get assistance from another person. Only carry what can safely be transported to/from the vehicle. Make as many trips as necessary. Secure equipment in the vehicle using tie-down straps (avoid bungee cables as they can slip and cause injury!). Ensure equipment will not move or shift during transport. Don't stack equipment such that equipment on bottom could be crushed by the weight.
3	Entering and exiting the vehicle.	3a	Caught in doors, trunk covers, and other vehicle equipment, causing injury	**H&S**	2	3	6	3a	Keep hands, feet, head, and loose articles of clothing or equipment out of the line of fire. Check before opening or closing any door to ensure you and others are not in line of fire.
		3b	Slip / trip / fall resulting in injury	**H&S**	1	3	3	3b	Use three points of contact when entering and exiting, and keep hands and feet placement and body posture in balance.
		3c	Property damage / theft from unattended vehicles	PL	2	3	6	3c	Unattended vehicles (even for a short period of time) must be locked so that all equipment inside them is secured (verify the vehicle is locked before walking away). Critical documents and equipment should be removed from the vehicle if unattended, or locked in the trunk/boot of the vehicle.
4	Driving to and from work locations	4a	Distraction resulting in accident	multiple	2	5	10	4a	Do not talk or text on phone while driving. Ensure all loose items and equipment inside the vehicle or in truck beds/on trailers are secured. Program electronics like GPS and radio before driving, or have passenger do this. Know how AC / heater / windshield wiper controls work before driving. Any activity that takes your eyes away from the road is dangerous - if you must read a map, make detailed adjustments to mirrors or other controls, or other related tasks - pull over to a safe area. Avoid drinking hot beverages or eating while driving. Avoid conversations with passnegers that will distract your mental focus from driving.
		4b	Fatigue resulting in accident	multiple	2	5	10	4b	Take a 15 minute break after every two hours of driving. Don't drive more than 8 hours/day, or after doing more than 12 hours of work-related activities. Avoid driving between 10 p.m. and 5 a.m. Share driving with others, if possible. Avoid driving after consecutive work days of 14 hours. Avoid driving after a flight of six hours or more without appropriate rest. A documented and approved Journey Management Plan (JMP) is mandatory for the following conditions: • Single day journey in excess of 500 km (310 miles) • Single day estimated driving duration in excess of 4.5 hours • Driving in a remote location (including off-road driving) • Driving in any location/region identified as “High Risk” by Control Risk Group (CRG) and/or Regional H&S Lead The JMP shall be completed using S1-ERM-008-FM1.
		4c	Broken or malfunctioning equipment resulting in unsafe operation/accidents, break-downs	multiple	2	5	10	4c	See above, 1a. If vehicle malfunctions during driving, pull safely off the road before exiting. ERM vehicles and vehicles used for field operations should be equipped with spare tire and jack; warning triangles (reflective), road flares (flares may not be stored in the passenger compartment of the vehicle), or LED road flares/emergency lighting; and reflective safety vests.
		4d	Actions of driver (or other drivers / pedestrians / cyclists) resulting in accident	multiple	2	5	10	4d	Follow designated vehicle travel routes only. Passengers and drivers are required to wear available passenger restraints (i.e. seatbelts with shoulder harness) while operating or riding in a vehicle. The number of passengers carried shall not exceed the seating capacity specified for the vehicle. All drivers must hold a current driver’s license valid in the location where they will be driving. Follow all posted signs and speed limits, all applicable laws and regulations, ERM safe driving policies, and any client-specific or site specific vehicle safety policies. ERM drivers must complete regular safe driver training through Alert Driving. Practice defensive driving techniques as learned during these trainings. Do not drive under the influence of alcohol or drugs, or any other substance or medication that could impair their ability to drive (per ERM Global Policy – Drug and Alcohol Use).
		4e	Becoming lost or stranded, resulting in accident or exposure to elements / crime	multiple	2	3	6	4e	Prepare a JMP as required. Program GPS prior to driving. Inspect vehicle before driving - see above 1a. Check weather forecasts and adjust trip accordingly to avoid inclement weather.
5	Towing	5a	Accident resulting in injury or property damage	multiple	2	5	10	5a	No ERM employee shall tow a trailer or equipment without having first received documented training on safe towing methods. Refer to and comply with the vehicle owner’s manual for safe towing capacity. Conduct an equipment inspection prior to use to ensure that weight is distributed evenly and that warning/signal lights are working properly. Ensure trailer is attached securely to the main vehicle and the safety chain or other backup attachment device is in-place. Use a spotter when driving in reverse. The use of straps or chains for towing purposes is prohibited.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
6	Backing up	6a	Accident resulting in injury or property damage	multiple	2	4	8	6a	Use spotter when maneuvering in/out of tight spaces and backing up. Make all backing maneuvers slowly and cautiously. Check mirrors and over shoulders. When parking, look for pull-through parking or back into parking spot when safe to do so.
7	Parking	7a	Accident resulting in injury or property damage	multiple	2	3	6	7a	Always set parking brake. Park only in designated areas. Park away from other cars when possible. Back into parking spot when safe to do so. Do not exit cab of vehicle with ignition running except in emergency. Maintain cushion of safety from fixed objects. Park so that driver and all passengers have enough room to open doors fully and enter/exit vehicle without obstructions or slip/trip/fall hazards. Look for pull-through parking to avoid backing. When parking on an incline, turn the wheels away from the curb and allow the vehicle to roll back until the wheels touch the curb. On a decline, turn the wheels toward the curb and allow the vehicle to roll forward until the wheels touch the curb. If parking on a hill without a curb, park with the wheels turned away from the roadway.
8	Driving on dirt roads or off road, or in remote areas	8a	Accident resulting in injury or property damage	multiple	2	3	6	8a	Only drivers trained on specific hazards of off-road driving may do so. Vehicles must be suitable for off-road use, including the use of 10-ply tires. Scan travel path for obstructions, debris. Do not drive through areas overgrown with vegetation where a clear view of the ground surface is obscured.
		8b	Property damage from rough terrain, sharp objects, uneven terrain	PL	3	2	6	8b	See above 8a. ERM has negotiated a separate contract with Enterprise for rental trucks for use on non-maintained, unpaved roads.
		8c	Getting stuck / stranded in soft / muddy / standing water conditions	multiple	3	3	9	8c	Where possible, carry a second spare tire if travelling off paved roads, and an emergency tire patch kit (these are usually a foam that is injected into the flat tire and can be used to temporarily seal a leak). Use of the buddy system is mandatory for remote site work – if for some reason this is not feasible then project teams must engage the H&S Leads and the Business Unit Managing Partner to discuss options. A communications plan must be established in advance and documented, to include: - Equipment suitable for the part of the world you're in (satellite GPS messenger, sat phone, etc.) – assume a cell phone will not work - Regular check-ins with office and client - Process to follow if no check-in occurs at scheduled time Be prepared for overnight conditions, including suitable clothing, water and survival items (this applies to any remote work, not just off-road travel).
9	Renting a vehicle	9a	Accident resulting in injury or property damage	multiple	2	5	10	9a	See above, 1a. Try to reserve a vehicle that is about the same size as your personal vehicle, so you are familiar with how it maneuvers. When renting a vehicle, proof of inspection must be available to the driver.
		9b	Renting a vehicle from an agency for which no negotiated contract is in place, resulting in unnecessary liability and risk.	PL	1	2	2	9b	Only rent from companies with which ERM has negotiated rates and contract terms. If employees cannot rent from a preferred provider with negotiated contract terms, the employee should purchase the collision damage waiver and personal accident insurance.
10	Taxi Cabs and other hired vehicles	10a	Accident resulting in injury or property damage	multiple	2	5	10	10a	Only use taxi cabs and hired vehicles from reputable companies / clients. Avoid using taxi cabs without seat belts for all passengers. The employees should encourage the driver to wear their seat belt, not use their mobile devices, and follow all posted speed limits and traffic laws. The use of the Taxi Card (S1-ERM-008-FM3) is encouraged.
11	Reporting and documenting vehicular accidents and property damage.	11a	Inadequate response / documentation resulting in increased liability (personal or ERM)	PL	1	2	2	11a	No matter how minor a vehicle accident or property damage event is, report it as a safety event. If involved in a vehicular accident, always call the police, so a report will be available. In addition, reporting will protect your liability and ERM liability. Take as many pictures as you can of the accident scene if you can do so without placing yourself in further danger.
12	Driving the vehicle near and across railroad tracks.	12a	Passing trains cannot stop quickly, and there is a risk for collisions resulting in property damage, injury, and death.	multiple	1	5	5	12b	Use caution when crossing any railroad track in a vehicle and do so only on designated crossing roads. Never come to a stop on RR tracks.
13	Minor Vehicle Maintenance - topping off fluids, cleaning windows, changing wiper blades, fuses	13a	Tool hazards, sharp edges	**H&S**	2	2	4	13a	Inspect all tools and equipment prior to use; if faulty or inappropriate, do not proceed until repaired or replaced. Use only the proper tool for the job, and only tools that you are trained / qualified to use. Position hands/fingers away from contact/striking/pinch points. Do not position any part of body such that it is in "line of fire". Use stable/neutral body position and do not reach, stretch, or twist when using tools. Wear heavy duty work gloves. For sharp edges and punture hazards, wear cut-resistant gloves.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
		13b	Electrical hazards from jump-starting dead battery	multiple	1	2	2	13b	Line both cars up so the batteries are as close as can be. Make sure the cars are in park, parking brake is set, and the engine is turned off. Make sure all headlights, blinkers, radios, and ACs are off. If the battery is cracked and liquid is leaking out, DO NOT go further! Inspect jumper cables for worn insulation. Ensure the red clamp is on (+) terminal and the black clamp is on (-) terminal. If unsure, refer to owner's manual.
14	Driving in adverse environment conditions	14a	Reduced visibility or road conditions increasing potential for collision or departure from roadway.	H&S	2	5	10	14a	Check weather report and road conditions before departing. If caught in poor conditions, drive at slower speeds (two second following distance, or slow so visibility is twice the distance required to stop). Avoid driving in extreme weather conditions (e.g., heavy rain, heavy snow, heavy fog). Use lights and hazard flashers to increase visibility as needed or allowed/required by local law. If forced to stop, attempt to move vehicle clear of roadway and stay in vehicle with seatbelt fastened.
		14b	Crossing flowing or standing water (flood or stream) and getting stuck or caught in rising or flowing water.	H&S	1	5	5	14b	When travelling at speed and encountering water on roadway, to reduce risk of hydroplaning, ease off gas and avoid braking or oversteering. Avoid crossing flooded roads or streams, or any water deeper than 1/2 meter (20 inches). If must cross, walk route first to verify depth, water flow, stability of travel path, and egress path. When driving, accelerate to create a small bow wave in front of the vehicle. If a current is present, cross at an angle from downstream to upstream to maintain the bow wave. If caught in water and able to open door or window, do so and exit vehicle unless vehicle is stable and water level is not rising. If vehicle is underwater, stay calm, remove seat belt and stay in air bubble until water fills car (equalizing pressure), then open door or break window and swim clear.
		14c	Driving in snow or icy conditions with increased risk of losing control or departing roadway.	H&S	2	5	10	14c	Whenever possible, avoid travel during icing conditions. Beware of icing on bridge decks and in shaded areas of roadway, even if the rest of the roadway is clear. In accordance with local laws and regulations, use winter-rated tires if possible. Some jurisdictions also allow the use of studded tires, and where possible, these should be used. Carry extra weight over the drive tires of rear-wheel drive vehicles, typically sand bags or cat litter. Winter emergency equipment should also include tire chains, shovel, and winter gloves. During heavy snowing conditions at night, avoid using high-beam headlights and reduce speed to ensure travel path is visible.

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3. Describe the specific actions or procedures that will be implemented to eliminate or reduce each hazard. Be clear, concise, and specific. Use objective, observable, and quantified terms (e.g., instead of “use good body positioning,” write “don’t bend at waist or reach above head”). Use numbers and letters corresponding to listed hazards.

4. Select the probability of occurrence and consequence of each hazard, AFTER implementation of the planned control measures (use the Risk Matrix as a guide). The corresponding risk rating will then be automatically calculated [RISK = Likelihood x Severity].

A risk rating shaded red indicates that work cannot continue without additional control measures and approval of Partner-in-Charge.

WAYS TO ELIMINATE OR REDUCE RISKS (IN ORDER OF PREFERENCE):

ELIMINATE / AVOID --> SUBSTITUTE / MODIFY --> ISOLATE --> ENGINEER / SAFEGUARD --> TRAINING AND PROCEDURES --> WARNING AND ALERT MECHANISMS --> PPE

JHA
Job Hazard Analysis

Project Number:	0497315	Project / Client Name:	Remedial Investigation / G.W. Lisk
Project Manager:	Jon Fox	Location:	2 South Street, Clifton Springs, New York 14432
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	3/18/2019, Rev. 0

SPECIFIC TASK:	**Sub-slab soil vapor installations and sampling.**

Minimum Required PPE for Entire Task:	☐ Hard Hat ☐ Safety-Toe Shoes ☑ Hearing Protection ☐ Goggles ☐ Face Shield ☐ Respirator NA ☑ Other (specify): ☑ Safety Glasses ☑ Reflective Vest ☑ Gloves Kevlar when cutting ☑ PPE clothing Level D - Long Pants and Long Sleeves Shock resistant gloves for use with power tools		
Additional Task-Step Specific PPE: (as indicated below under Controls)	Cut-resistant gloves: Limited protection is afforded by leather gloves from cuts. Kevlar gloves provide more protection when significant cut/puncture hazards exist.	Equipment / Tools Required:	Hammer drill, cutting-tools (no fixed open blade), hand auger, shop vac, hammer, screwdriver, spanner tool.
Training Required for this Task:	40-hr HAZWOPER, 8-hr HAZ Refresher, First Aid/CPR (FSO), Alert Driver Training, SSC EP	Permits Required for this Task:	
Forms Associated with This Task:	Soil Vapor Installation and Sampling Forms		

JHA Developed / Reviewed By:			JHA Review In Field
Name / Job Title:	Name / Job Title:	Name / Job Title:	Field supervisor to ensure all personnel performing this task have reviewed JHA and agree to follow it. Site-specific changes to this JHA have been made as warranted based on this review. **Signature/Date:**
Justin Vause, Staff Scientist			

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
3	Setting up and breaking down equipment at each vapor sampling location	3a	Muscle strain from lifting or moving awkwards loads	H&S	Unlikely	Medium	4	3a	Utilize additonal personnel (team lift) for extremely heavy or awkward loads. Bend at the knees and keep the weight close to your center. Do not bend over the load and lift with your back.
	Drilling through concrete slab	3b	Contact with utility encased in concrete which was not identified by utility location subcontractor. Back strain and entanglement using large drill. Risk of spark in flammables storage areas.	H&S	Possible	Medium	8	3b	Follow ERM SSC procedures. Wear combination of chemical-resistant Nitrile gloves (if contact with water is possible) and work gloves while drilling. Lift drill with the legs not the back. Take turns drilling to avoid fatigue. Ensure no loose clothing or hair near drill. Avoid tripping on drill cord. Scan area with PID. If any PID detections, ventilate the area. Do not conduct drilling unless PID scan results in no detections. When drilling, wet the drill bit during drilling of first nested portion of hole to mitigate spark risk.
	Installation of Cox Colvin vapor pins and soil vapor sampling points.	3c	Slips, trips and falls within basements.	H&S	Possible	Minor	4	3c	Be aware of surroundings, have one person watch for hazards while the other installs and suspends the Cox Colvin vapor pins and soil vapor sampling points. Always wear cut-resistant gloves when working with blades or cutting tools.
	VP installation and removal	3d	Pinch points, concrete chips from hammering, use of caustic to reseal floor	H&S	Likely	Minor	5	3d	Wear proper PPE (gloves, safety glasses) avoid direct caustic contact with skin

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4. Select the probability of occurrence and consequence of each hazard, AFTER implementation of the planned control measures (use the Risk Matrix as a guide). The corresponding risk rating will then be automatically calculated [RISK = Likelihood x Severity].

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WAYS TO ELIMINATE OR REDUCE RISKS (IN ORDER OF PREFERENCE):

Task Steps[1]	Potential Hazards & Consequences[2] select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]

ELIMINATE / AVOID --> SUBSTITUTE / MODIFY --> ISOLATE --> ENGINEER / SAFEGUARD --> TRAINING AND PROCEDURES --> WARNING AND ALERT MECHANISMS --> PPE

JHA
Job Hazard Analysis

Project Number:	0497315	Project / Client Name:	Remedial Investigation / G.W. Lisk
Project Manager:	Jon Fox	Location:	2 South Street, Clifton Springs, New York 14432
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	3/18/2019, Rev. 0

SPECIFIC TASK:	**Using hand tools**

Minimum Required PPE for Entire Task:	☑ Hard Hat ☑ Safety-Toe Shoes ☐ Hearing Protection ☐ Goggles ☐ Face Shield ☐ Respirator NA ☐ Other (specify): ☑ Safety Glasses ☑ Reflective Vest ☑ Gloves cut resistant ☑ PPE clothing logn sleeves, pants NA		
Additional Task-Step Specific PPE: (as indicated below under Controls)	cut-resistant gloves	Equipment / Tools Required:	Miscellaneous hand tools (screwdrivers, hammers, cutting tools, etc.)
Training Required for this Task:	Tool Specific	Permits Required for this Task:	NA
Forms Associated with This Task:	NA		

JHA Developed / Reviewed By:			JHA Review In Field
Name / Job Title:	Name / Job Title:	Name / Job Title:	Field supervisor to ensure all personnel performing this task have reviewed JHA and agree to follow it. Site-specific changes to this JHA have been made as warranted based on this review. **Signature/Date:**
Justin Vause, Staff Scientist			

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
1a	Gather tools to take to jobsite	1a	An improper tool available at jobsites encourages unsafe behaviors and could lead to injury or property damage	H&S	2	5	10	1a	Ensure tools taken to jobsites are kept in optimal condition (sharp, clean, oiled, etc.) to ensure efficient operation. Tools must only be used for their intended purposes – tools should not be used as pry-bars. Ensure power cords attached to powered-equipment are not damaged. Inspect all power cords for damage prior to use. Remove all damaged tools and cords from service. Any damaged tool or electrical cord must be tagged and taken out of service. If a tool is designed to be handles and used with two hands then two hands must be used. Only use tools for their intended purpose and according to instructions.
		1b	Muscle strain from lifting / handling equipment	H&S	3	3	9	1b	Use cart, dolly, or get assistance. Do not lift anything manually by yourself that is awkwardly shaped or weighs more than 35 pounds. When lifting lighter objects, bend and lift with legs/arms, not back. Keep objects close to body and do not twist while lifting (turn with feet). Position work equipment to avoid over-reaching while working. Store heavy/bulky items with safe access in mind.
		1c	pinch points	H&S	2	3	6	1c	Do not position your hand or body so it can be caught in identified pinch points. Do not position your hand or body so it can be caught between a lifted load and adjacent objects. Wear heavy leather or cut-resistant gloves; have gloves on your person at all times.
2a	Using cutting tools	2a	Major and/or minor laceration bodily injury	H&S	2	5	10	2a	Fixed open-blade knives (such as pocket knives) may not be used on ERM jobsites. Cut-resistant gloves must be worn while using cutting tools or sharp objects. Employees performing significant amounts of cutting tool use should wear high-visibility gloves to encourage awareness of where hands are being placed. Review *Cutting Tools - Operational Control Document* prior to performing cutting tasks.
3a	Using screwdrivers	3a	Puncture and laceration bodily injuries	H&S	2	5	10	3a	Do not hold objects in the palm of your hand and press a screwdriver into it – these objects should be placed on a flat surface. Do not use screwdrivers as hammers or as a cutting tool, or use screwdrivers with broken handles. Use insulated screwdrivers for work on electrical equipment.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Probability	Consequence	RISK	Controls to Eliminate or Reduce Risks[3]	
4a	Using hammers / sledgehammers	4a	Creation of sparks which can cause bodily harm or damage to property or fire	multiple	1	5	5	4a	Use brass hammers and tools in areas where creating sparks would pose ignition hazards.
		4b	Particles may lodge in employee's eyes	H&S	2	4	8	4b	Always use safety glasses when striking any object with a hammer. If hammer-head shows signs of mushrooming, replace it immediately.
		4c	Loose handles may create a projectile hazard - causing bodily injury or property damage	multiple	2	5	10	4c	Replace any hammer with a loose handle so the hammer-head does not detach and cause injuries.
		4d	Smashed fingers	H&S	2	5	10	4d	Do not position your hand or body so it is in line of fire. Use minimal force when first driving nails and fingers are being used to hold nailhead in place. Use a stake driver tool for driving stakes to keep your hands out of line of fire of sledgehammer. Wear heavy leather gloves; have gloves on your person at all times.

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Sub-Surface Clearance Forms

Subsurface Clearance Project Plan

Site/Project Name: _____

Client: _____

ERM Project No.: _____

This Subsurface Clearance (SSC) Project Plan must be completed for each phase of ground disturbance activities at a project location. A copy of this document must be maintained at the project location for the duration of ground disturbance activities. The ERM Partner-in-Charge (PIC) and SSC Experienced Person (EP) or field team lead must review and approve the completed SSC Project Plan **prior to any point disturbance clearance or ground disturbance activities** (all approvals appear on final page of this document).

Administrative Information	Date Plan Started: Date Plan Completed:	Field Work Start Date: Field Work End Date:
	Project Manager:	Partner In Charge:
	SSC EP [1] / Field Team Lead:	Local MP or designee (for any waivers):
	List any additional SSC General Employees (GEs) working on this project:	
	Describe the Scope of Ground Disturbance Activities:	*Check all that apply:* ☐ Point disturbances (manual / hand digging only) ☐ Point disturbances (using mechanized equipment) ☐ Excavation / trenching / grading ☐ Removal / coring / drilling of concrete, asphalt, etc. ☐ Other - Describe:

Project Information Summary	Yes	No	N/A	Comments
Knowledgeable Contact Person(s) identified, and presence requested during site walk. SSC Project Plan reviewed with knowledgeable contact person(s)	☐	☐	☐	Who:
As-built drawings, site plans, maps, aerial photographs, and other information sources available and reviewed	☐	☐	☐	List (including dates):
Other information obtained (e.g., easements, right-of-ways, historical plot plans, current/historical aerial photographs, fire insurance plans, tank (dip) charts, SSC information obtained as part of previous site investigations, soil surveys, boring logs	☐	☐	☐	List (including dates):
All contractors (including ground disturbance, private utility locating, concrete coring, etc.) prequalified and approved	☐	☐	☐	List Private Utility Locate Contractor(s):
Specific SSC scope of work items in all work orders for contractors involved in SSC and ground disturbance activities (i.e. point disturbance clearance methods and required tools, field documentation and utility markout methods for private utility locate contractors, etc.)	☐	☐	☐	List all Ground Disturbance Contractors:
Additional client and/or regulatory requirements apply to the project and have been incorporated into H&S plan documents	☐	☐	☐	If yes, specify:
ERM / client / regulatory SSC requirements have been communicated to all field personnel including contractors (refer to SSC Review Checklist for Contractors - *ERM-1511-FM5*)	☐	☐	☐	
Current and valid SSC training certifications confirmed for all ERM staff (including PIC and PM)	☐	☐	☐	
Current and valid additional training certifications (e.g., detection equipment operation) confirmed for all ERM staff and contractor personnel	☐	☐	☐	List additional trainings:
UXO/MEC risks assessed: UXO/MEC is present or potentially present	☐	☐	☐	If Yes, stop work and contact PIC
Project location meets criteria for Remote/Greenfield Site	☐	☐	☐	If Yes, project teams can elect to complete the SSC Project Plan for Remote/Greenfield Sites (ERM-1511-FM2) instead of this form

[1] SSC EP not required for Remote / Greenfield sites, as defined in the ERM Global SSC Procedure (ERM-1511-PR1).

Subsurface Clearance Project Plan

Site Walk						
Identified Visual Clue	**Yes**	**No**		**Identified Visual Clue**	**Yes**	**No**
Lights	☐	☐		Pipeline markers	☐	☐
Signage	☐	☐		Fire hydrants	☐	☐
Sewer drains / cleanouts	☐	☐		Sprinkler systems	☐	☐
Cable markers	☐	☐		Water meters	☐	☐
Utility poles with conduit leading to the ground	☐	☐		Natural gas meters	☐	☐
Utility boxes	☐	☐		UST fill ports and vent pipes	☐	☐
Manholes	☐	☐		Equipment locations	☐	☐
Pavement scarring	☐	☐		Steam lines	☐	☐
Distressed vegetation or vegetation in linear pattern	☐	☐		Remote buildings with no visible utilities	☐	☐
Comments / Others:						

	Yes	**No**	**N/A**	**Comments**
Visual clues / site features (below) integrated into Site Services Model	☐	☐	☐	

Utility Markouts	**Yes**	**No**	**N/A**	**Comments**
Public Utility Locates completed (where available)?	☐	☐	☐	
Responses received from ALL companies notified?	☐	☐	☐	
List utilities notified:				

	Yes	**No**	**N/A**	**Comments**
Private Utility Locates completed [2] (waiver required if "NO")	☐	☐	☐	
Utilities clearly marked with agreed method?	☐	☐	☐	
Private locate findings documented?	☐	☐	☐	
Private Utility Locate Performed by:	Date of most recent training on equipment operation:			
Type of equipment / methods used:				
Date of most recent calibration of detection equipment:				
Note any limitations (e.g., sources of interference, geology, etc.):				

[2] Not required for Remote / Greenfield sites, except where required by local regulations or client procedures.

Subsurface Clearance Project Plan

Site Services Model
Attach a site plan or drawing (to scale) showing planned ground disturbance location(s), the locations / routes of all identified or suspected subsurface and above-ground utilities and structures, and associated critical zones and excavation buffers.

Utility / Structure	Present? Yes	Present? No	Present? Un-known	Anticipated depth (note units)	Located? Yes	Located? No	Status (active, inactive, abandoned / decommissioned, etc.)	Comments (For each, describe how located and quality of information available)
Electricity	☐	☐	☐		☐	☐		
Gas	☐	☐	☐		☐	☐		
Petroleum Pipeline	☐	☐	☐		☐	☐		
Other Pressurized Lines	☐	☐	☐		☐	☐		
Process Sewer	☐	☐	☐		☐	☐		
Sanitary Sewer	☐	☐	☐		☐	☐		
Storm Sewer	☐	☐	☐		☐	☐		
Potable Water	☐	☐	☐		☐	☐		
Telephone / Communication	☐	☐	☐		☐	☐		
Fiber Optic	☐	☐	☐		☐	☐		
Plant air / steam	☐	☐	☐		☐	☐		
Fuel / oil	☐	☐	☐		☐	☐		
Reclaimed / waste water	☐	☐	☐		☐	☐		
Fire suppression	☐	☐	☐		☐	☐		
Underground tank(s)	☐	☐	☐		☐	☐		
Other (Describe):	☐	☐	☐		☐	☐		

Additional Notes on Site Services Model including identification of any data gaps:

Contact Person(s) Approval of Ground Disturbance at All Locations

Name (Print)	Company	Name (Sign)	Date / Time

Final Critical Zone Determination

Are there any ground disturbance locations <u>known</u> or <u>suspected</u> to be inside Critical Zones? ☐ **YES** ☐ **NO**

PIC and Local MP (or designee) must BOTH grant waiver for work within the Critical Zone. A sketch map must be developed for EACH ground disturbance location inside a Critical Zone (refer to template on last page)

Subsurface Clearance Project Plan

Overhead Clearance	Yes	No	N/A	Comments
Overhead utility lines in the general vicinity of ERM work onsite?	☐	☐	☐	If NO, check N/A for remaining items in this section
If overhead utilities are present, has nominal voltage been determined? If yes, list in comments section.	☐	☐	☐	Voltage:
Overhead clearances confirmed with equipment operators for safely deploying equipment to the location?	☐	☐	☐	Clearance distance(s):
Proximity alarms, spotters, and /or warning signage necessary to ensure safe clearances?	☐	☐	☐	
If the equipment is closer than the minimum clearance distance to the overhead utility, can utility be de-energized?	☐	☐	☐	
If utility cannot be de-energized, alternate plan developed with approval from the PIC and client/site owner?	☐	☐	☐	

Plan for point disturbance clearance at location(s): _____ *(Note that this plan must be reviewed and approved by the PIC before any clearance activities commence)*	*Attach additional sheets to completely describe clearance method, tools and depth if these will vary during the process from location to location.*			
	Yes	**No**	**N/A**	**Comments**
Clearance technique to be used (indicate which method): ☐ Compressed air excavation *(ERM preferred method)* ☐ Pressurized water excavation ☐ Hand digging ☐ Hand augering ☐ Soil probe rod *Pick axes, pointed spades, or any other tool that comes to a point are NOT to be used for point disturbance clearance.* *Note: a waiver is required if no clearance will be performed prior to use of mechanized equipment*	☐	☐	☐	Provide rationale if NOT using preferred method of compressed air excavation: ☐ Scope of work limited to hand digging only ☐ Equipment not available ☐ Cannot meet technical objectives (e.g., vapor pins) ☐ Other (describe):
For locations that will be advanced with mechanized equipment (e.g., drill rig or direct-push) after initial clearance: Diameter of clearance must be to LARGER OF: 4 inches (10 cm), or at least 125% of the diameter of largest downhole tool to be used	☐	☐	☐	Specify diameter (include units) of largest downhole tool: Specify diameter (include units) to be cleared:
For locations that will be advanced with mechanized equipment (e.g., drill rig or direct-push) after initial clearance: Depth of clearance: ☐ Outside Critical Zones, to 5 feet (1.5 meters). ☐ Inside Critical Zones, to 8 feet (2.4 meters) at a minimum, and deeper if necessary to clear to depths greater than 8 feet for deeper utilities and structures ☐ For locations with frozen soils, to 2 feet (0.6 meters) beyond the bottom of the frost line at the site.	☐	☐	☐	Specify depth(s) and units:
Concrete coring / cutting – personnel performing these activities have been verified as trained and competent?	☐	☐	☐	Describe risk mitigation techniques to be employed:

Excavation Plan *(Note that this plan must be reviewed and approved by the PIC before any disturbance activities commence)*	**Yes**	**No**	**N/A**	**Comments**
Communicate excavation plan and 2-foot (0.6-meter) Excavation Buffer location(s) to contractor(s). Delineate all Excavation Buffers.	☐	☐	☐	
If possible, work with contact person / site owner to de-energize subsurface services prior to beginning excavation	☐	☐	☐	
Risk mitigation measures reviewed and acceptable?	☐	☐	☐	Describe:

Subsurface Clearance Project Plan

Approvals

Review Meeting
The SSC Project Plan must be reviewed with the PIC BEFORE any point disturbance clearance or ground disturbance activities occur. This review must be completed through a verbal conversation, whether in person or by phone or video conference. Documentation of review can be indicated as "verbal" or be received via e-mail initially, but must be followed up with signatures in the final SSC Project Plan.

Reviewed by	Signature	Date of Review	Comments
SSC EP or Field Team Lead (required review):			
PIC (required review):			
Project Manager (optional review):			

Waiver Approvals				
SSC Component Being Waived:	**Waived By (PIC)**	**Waived by (Local MP)**	**Date**	**Rationale**
Requirement for SSC EP to oversee execution of the SSC Process (can include the entire project or specific SSC-related tasks)				Specify scope of waiver:
Performance of private utility markouts				
Clearance of point disturbance locations prior to advancing with mechanized equipment (including no clearance or partial clearance)				Indicate specific locations and scope of waiver:
Prohibition of ground disturbance inside a Critical Zone				Indicate specific locations:

SSC Project Plan Close-out (SSC EP or Field Team Lead)		
Name (Print)	Name (Sign)	Date / Time

Additional Notes or Learnings

Subsurface Clearance
Project Plan – Critical Zone Sketch Map

Site/Project Name: _____

Client: _____

ERM Project No.: _____

SSC EP / Field Team Lead: _____

A sketch map must be developed for each ground disturbance location inside a Critical Zone (one map per location – attach additional maps as needed). Disturbance within a Critical Zone can only proceed with both PIC and Local MP (or designee) approval.

GROUND DISTURBANCE LOCATION ID:

GROUND DISTURBANCE LOCATION DESCRIPTION:

Instructions:

1. Create a sketch of the disturbance (in the space to left or attach) that is drawn to scale and contains the following information:
   a. The disturbance location
   b. Surface landmarks and overhead obstructions (buildings, roads, overhead lines, etc.)
   c. Subsurface utilities and structures that are:
      i. Identified in the Site Service Model
      ii. Marked by public and private utility locators
      iii. Communicated by knowledgable contact person(s)
   d. Any surface visual clues as to potential underground services (junction boxes, drains, disturbed concrete, signage, etc.)
2. Use your sketch to mark Critical Zones (3m / 10 feet) around underground utilities and structures.
3. For excavations, use your sketch to mark Excavation Buffers (0.6m or 2 feet) from subsurface utilities and structures.

Subsurface Clearance Field Process Checklist

Site/Project Name: GWL Remedial Investigation (RI)
Client: G.W. Lisk
ERM Project No.: 0497315
SSC Exp. Person: Jason Reynolds/Tim Daniluk

Project Information Utilized for Field SSC Activities	Yes	No	N/A	Comments
Knowledgeable Contact Person(s) requested and identified	X			
Contractors prequalified and approved				
ERM / client SSC requirements have been communicated to all field personnel (including contractors)				
As-built drawings, site plans, aerial photographs, and/or other information sources available and reviewed				
Site plan(s) / drawing(s) developed showing subsurface lines/structures, Critical Zones, and planned ground disturbance locations				
SSC Experienced Person (EP) with current SSC certification assigned				
Project staff with current SSC certification assigned				
UXO / MEC risks assessed: UXO / MEC is present or potentially present				If Yes, stop work and contact PIC

General Field Activity & Site Walk	Yes	No	N/A	Comments
HASP available, reviewed, and signed by project team	**X**			
Site walk visual clues / site features (below) integrated into Site Services Model				

Identified Visual Clue	Yes	No		Identified Visual Clue	Yes	No
Lights				Heated floors (in-floor radiant heating)		
Signage				Fire hydrants		
Sewer drains / cleanouts				Sprinkler systems		
Cable / pipeline markers				Water meters		
Utility poles with conduit leading to the ground				Natural gas meters		
Utility boxes				UST fill ports and vent pipes		
Manholes				Equipment / manifold locations		
Pavement scarring				Steam lines		
Distressed vegetation or vegetation in linear pattern				Remote buildings with no visible utilities		

Comments / Others:

Contact Person Approval of Ground Disturbance at All Locations (indicate verbal approval by printing "Verbal" in the signature space)

Name (Print)	Company	Name (Sign)	Date / Time

Utility Markouts	Yes	No	N/A	Comments
Public Utility Markouts completed (where available; waiver required if "NO")				
List utilities notified:				
Responses received from ALL companies notified?				
Private Utility Markout completed (waiver required if "NO");				

NOTE: Private utility markouts must be performed by competent, trained personnel. Contractors must be overseen directly by SSC EP with "eyes on" supervision".

Performed by:

Type of equipment / methods used:

Note any issues or limitations (e.g., sources of interference, geology, etc.):

Subsurface Clearance Field Process Checklist

Site/Project Name: GWL Remedial Investigation (RI)
Client: G.W. Lisk
ERM Project No.: 0497315
SSC Exp. Person: Jason Reynolds/Tim Daniluk

Final Critical Zone determinations made by the SSC EP				

Critical Zones

Are there any ground disturbance locations known or suspected to be inside Critical Zones?

☐ **Yes.** PIC and BU MP (or designee) must BOTH grant waiver for work within the Critical Zone. The SSC Location Disturbance Permit or equivalent is required for those locations.

☐ **No.** Physical Clearance will proceed to the deeper of: 0.6 m / 2 feet below the frost line or 1.5 m / 5 feet below ground level, whichever is deeper.

Overhead Clearance	Yes	No	N/A	Comments
Overhead utility lines in the general vicinity of ERM work onsite?				
If overhead utilities are present, has nominal voltage been determined? If yes, list in comments section.				Voltage:
Overhead clearances confirmed with equipment operators for safely deploying equipment to the location? (The minimum horizontal distance from any point on the equipment to the nearest overhead electrical power line should adhere to the minimum clearance requirements stipulated by regulation, utility companies, client requirements, and/or industry best practice.)				Clearance distance(s):
Proximity alarms and /or spotters necessary to ensure safe clearances?				
If the equipment is to be closer than the minimum clearance distance to the overhead utility, can utility be de-energized via formal lockout/tagout (LOTO) program?				
If utility cannot be de-energized, alternate plan developed with approval from the PIC, H&S Team, and client/site owner?				

Clearance for Point Disturbances	Yes	No	N/A	Comments
Physical Clearance technique used: (waiver required if no Physical clearance performed)				Specify:
Diameter of physical clearance at least 125% of outside diameter of largest downhole tool (150% is best practice)				
Physical Clearance successfully completed at all locations				

Clearance for Excavations	Yes	No	N/A	Comments
Communicate excavation plan and Excavation Buffer location(s) to contractor. Delineate excavation buffers.				
There are disturbance locations known or suspected to be inside Critical Zones (waiver required if yes)				
De-energize subsurface services via formal LOTO program prior to beginning excavation				

Additional Notes:

SSC Process Completed By (SSC Experienced Person)

Name (Print)	Name (Sign)	Date / Time

Subsurface Clearance Location Disturbance Permit

Disturbance Location Designation:

ERM Project No.: 0497315

SSC Exp. Person: Jason Reynolds/Tim Daniluk

Contact Person Approval of Ground Disturbance Locations (indicate verbal approval by printing "Verbal" in the signature space)

Name (Print)	Company	Name (Sign)	Date / Time

Critical Zone Determination and Clearance Depth (It is not preferred to initiate ground disturbance activities within a Critical Zone)

If the Disturbance Location is known or suspected to fall within a Critical Zone, then a sketch (see reverse) or other map **must be** developed showing the location of all potential utilities within 10 feet (3 m) of the disturbance location. Sketch / map must be to scale.

This Location Is:

☐ Inside a Critical Zone. Partner-in-Charge (PIC) and Business Unit Managing Partner (BU MP) must BOTH grant waiver for disturbance at this location. Ensure documentation in the SSC Project Plan addendum to the HASP. Physical Clearance for point disturbances will proceed to the deeper of: **0.6 m / 2 feet below the frost line, 0.6 m / 2 feet deeper than the expected invert elevation of the service, OR 2.4 m / 8 feet below ground level.**

☐ Outside a Critical Zone.
Physical Clearance for point disturbances will proceed to the deeper of: **0.6 m / 2 feet below the frost line or 1.5 m / 5 feet below ground level.**

Utility Markouts

Has this location been cleared through both public and private utility locates?	Y ☐	N ☐	*"N" requires waiver*

Physical Clearance Technique at This Location

☐ Cleared using the following techniques / equipment:

Clearance depth and diameter (specify units):

☐ None – or not completed to required depth or diameter. For point disturbances, this must be waived by PIC and BU MP. (Ensure documentation in the SSC Project Plan addendum to HASP.)

Reason: Date / Time:

Physical Clearance Executed & Observed By:

Company	Representative(s)	Date / Time Complete	Notes

Was any Subsurface Structure discovered (damaged or undamaged) during Clearance?

☐ No (Proceed) ☐ Yes If Yes: Work stopped and discussed with PIC (Date / Time):

Agreed Action:

SSC Process Complete

Name of SSC Experienced Person (Print)	Name (Sign)	Date / Time

Critical Zone Determination Sketch (use this or other map to confirm proximal Critical Zones).

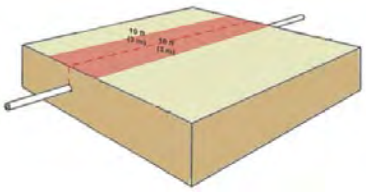
Instructions:

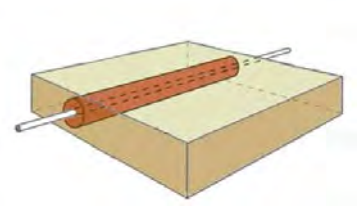
1. Create a sketch of the disturbance (in the space to left or attach) that is drawn to scale and contains the following information:
   a. The disturbance location
   b. Surface landmarks and overhead obstructions (buildings, roads, overhead lines, etc.)
   c. Critical landmarks and Subsurface Structures (tanks, transformers, wells, racks, etc.)
   d. Underground services:
      i. Identified in the Site Service Model
      ii. Marked by Public and Private utility markouts
      iii. As relayed by the Contact Person
      iv. Nearest shutoff / isolation mechanism for each
   e. Any surface clues as to potential underground services (junction boxes, drains, disturbed concrete, signage, etc.)
   f. The site property boundary
2. Use your sketch to mark Critical Zones (3m or 10 feet) around critical landmarks and underground structures / services.
3. For Excavations, use your sketch to mark Excavation Buffers (0.6m or 2 feet) from Subsurface Structures.
4. If the disturbance location falls inside the Critical Zone, the preferred course of action is step out to a safe location outside a Critical Zone.
5. Disturbance within a Critical Zone can only proceed with both PIC and BU MP (or designee) approval.

Subsurface Clearance (SSC)
Review Checklist for Contractors

Site Name:	
Client:	
ERM Project No.:	
Contractor activities to be performed on site:	

Use this form to conduct and document review with contractor personnel, to ensure they have been properly briefed on the applicable components of ERM's SSC Procedure (ERM-1511-PR1).

TOPIC	REVIEWED	N/A	COMMENTS
All personnel on ERM projects are empowered to stop work, without fear of reprimand, if it is unsafe to proceed or if there are concerns or questions.	☐	☐	
If at any time during project execution, the scope of work or site conditions change, work should be stopped and the potential impacts of the change discussed.	☐	☐	
Ground disturbance activities may NOT be performed at any location without authorization by the ERM SSC Experienced Person (EP) or field team lead. Clearance activities may NOT be performed at any location unless the ERM SSC EP or field team lead is physically present.	☐	☐	
Unless explicitly authorized by ERM's SSC EP, Partner-in-Charge and Local Managing Partner, ground disturbance may NOT be performed within 10 feet (3 meters) distance (referred to as the "Critical Zone") of any subsurface structure.	☐	☐	**"The Critical Zone"** 
Unless authorized by the ERM SSC EP, ground disturbance / clearance activities must NOT be performed in areas that are in direct conflict with any markings made by public or private utility locators.	☐	☐	
Unless explicitly authorized by ERM's Partner-in-Charge and Local Managing Partner, all borehole and small test pit locations must be cleared prior to use of mechanized equipment. Required clearance depths and diameters are as follows: • Physically clear to a diameter that is the LARGER OF: 4 inches (10 cm), or at least 125% of the largest downhole tool to be used. • Physically clear to a minimum depth as follows: o Outside Critical Zones, to 5 feet (1.5 meters). o Inside Critical Zones, to 8 feet (2.4 meters) at a minimum, and deeper if necessary to clear to depths greater than 8 feet for deeper utilities and structures. o For locations with frozen soils, to 2 feet (0.6 meters) beyond the bottom of the frost line at the site.	☐	☐	

TOPIC	REVIEWED	N/A	COMMENT:
Mechanical digging is prohibited inside a 2-foot (0.6-meter) distance (referred to as the "Excavation Buffer") in all directions from subsurface structures that will be intentionally exposed due to ground disturbance activities. Removal of material inside the Excavation Buffer may only proceed by hand or by compressed air excavation (if allowed by law and authorized in writing by the owner / operator the structure).	☐	☐	**"The Excavation Buffer"** 
For all equipment brought to the site, the minimum horizontal distance from any point on the equipment to the nearest overhead electrical power line must adhere to the minimum safe clearance requirements stipulated by regulation, utility companies, client requirements, and/or industry best practice. Other access constraints should be reviewed to plan vehicle moves accordingly.	☐	☐	
If subsurface structures are to be de-energized prior to ground disturbance activities, only trained personnel may do so via a formal, written energy isolation program.	☐	☐	
For compressed air excavation equipment, the operators should wear coveralls, ear, eye and hard hat protection. Safety precautions associated with compressed air must be employed. Grounding the hose and the tanker may also be required and should be assessed prior to start of operations. Filtering devices should be used to reduce release of materials and dust to the environment.	☐	☐	
Contractor personnel should be observant during ground disturbance activities for the presence of warning signs indicating non-native soil, fill materials, and/or the presence of unexpected subsurface structures. Any evidence of warning signs, unexpected encounters with subsurface structures, or any other near misses or incidents must result in immediate work stoppage and be reported to the ERM SSC EP or field team lead.	☐	☐	
In the event of contact or potential contact with a subsurface structure, contractor personnel must observe a no touch principle. The service is to be considered live and potentially damaged, therefore hazardous, until investigated by a specialist.	☐	☐	
Once clearance is completed, holes must be secured or covered in order to prevent slips, trips and falls until mechanical advancement commences.	☐	☐	
Contractor personnel must participate, as requested, in investigations of near misses and incidents.	☐	☐	
Contractors must comply with all other applicable regulatory or client requirements.	☐	☐	
Other topics discussed:	☐	☐	

N/A = Not applicable to this project.

REQUIREMENTS FOR TOOLS AND EQUIPMENT:

- A JHA must be developed for each contractor task. JHAs must be specific to the general location of the project as well as the equipment and methods to be used. Unless the project team can positively determine that no subsurface structures are present, all tools and equipment used in the clearance process must be selected based on the potential risks (i.e., energized electrical lines, fiber optic cables, natural gas pipeline, etc.) that cannot be ruled out. In addition to selecting tools and equipment, appropriate safety measures, including the need for specialized PPE, must be evaluated with input from subject matter experts. JHAs must be reviewed by the SSC EP and PIC.
- Blades on shovels and post-hole diggers must have rounded or blunt edges. Tools that come to a point, e.g., pick axes or pointed spades, are not to be used for clearance.
- Crow bars, pinch bars or pry bars must not be used to break hardened soil or backfill. The ERM SSC EP or field team lead may authorize use of bars only to loosen materials like bricks or larger stones so that removal of these materials is possible. Bars must not be used with excessive force.
- Electric-powered equipment must have ground fault protection.
- Equipment must be inspected prior to use, maintained according to manufacturer recommendations, and operated only by trained personnel. Training documentation must be provided upon request.
- Manual / hand tools must be used properly and not "over-muscled." In case of refusal or difficult advancement, the contractor must stop work and notify the ERM EP or field team lead.
- Rig- or stand-mounted concrete coring equipment must be anchored to the ground/floor using proper anchors.

Checklist Completed By: (SSC Experienced Person or Field Team Lead)		
Name (Print)	Name (Sign)	Date / Time

Reviewed By: (All Contractor Personnel)		
Name (Print)	Name (Sign)	Date / Time

1. Purpose and Scope

This document establishes the procedures for conducting subsurface clearance (SSC) of utilities and structures prior to any ERM project-related ground disturbance activities.

The SSC Procedure applies to all ERM employees and contractors for any ERM controlled operation, including supervision or oversight, or where ERM is legally or contractually responsible for SSC activities. Where a local regulatory, industry, or client requirement differs from ERM's SSC Process, the stricter requirement shall be adhered to.

When a differing client or regulatory requirement conflicts with or otherwise prevents compliance with the requirements of this procedure (beyond the waivers outlined in Section 5), a project-specific variance plan must be developed by the project team and approved by both the Regional Chief Executive Officer (RCEO) and Local Managing Partner (MP).

2. Roles and Responsibilities

Phase of SSC Activity	Local MP	PIC	PM	EP	GE	Local Safety
Program Management						
Review and approve individuals as SSC Experienced Persons (EPs)	A	C	C	C		C
Mentor SSC General Employees (GEs) and sign Mentorship Cards		I	I	A	R	I
Perform SSC audits - onsite	A	A	I	I	I	A
Project Planning Phase						
Overall project compliance with SSC process	I	A	R	R	I	C
Include appropriate scope of work items and technical requirements in Contractor agreements, including tool/equipment and training requirements		A	R	I	I	C
Determine if project meets Remote-Greenfield criteria		A	R	I		C
Assign Trained and Competent Site Personnel		A	R	I	I	I
Identify and comply with all relevant and appropriate client, legal, and regulatory requirements		A	R	I	I	I
Identify Knowledgeable Site Contact(s)		A	R	I	I	
Project-specific variance plans	A[1]	R	I	I	I	C

[1] Shared accountability with RCEO

Phase of SSC Activity	Local MP	PIC	PM	EP	GE	Local Safety
Field Execution Phase						
SSC Project Plan		A	R	R	C	
Exercise STOP WORK in the event of any change	A	A	A	A	A	A
Lead Implementation of SSC Process		A	I	R	I	C
Complete SSC Documentation			A	R	I	C
Eyes on Supervision of all SSC field tasks		A	I	R	I	
Communicate SSC Process to site team		A	I	R	I	
Verify Training and qualification of SSC-related Contractor field staff		A	I	R	I	C
Review and approve SSC waivers	A	A	I	I	I	C
Non-Conformance Management						
High Hazard Near Miss or Incident - Onsite Review	C	A	R	I	I	C
Approve re-start after High Hazard Event		A	R	I	C	C
Investigation, RCA and CAPA development	A	R	I	I	I	C
Participate in formal management review meetings associated with SSC near-miss or incident	I	I	I	I	I	I

PIC = Partner-in-Charge
PM = Project Manager
EP = SSC Experienced Person
GE = SSC general Employee
R = Responsible for completing activity – review of work product
A = Accountable for completing activity – approval of work product
C = Consulted when necessary
I = Involved in completing activity, when necessary

NOTE: The Local MP may designate another Partner to serve in these roles, provided the Partner has proper SSC-related experience and current SSC GE or EP Certification. A Technical Director that has proper SSC-related experience and current SSC GE or EP Certification may serve in this role with documented approval of the RCEO.

3. Definitions

Abandoned / Decommissioned – a subsurface structure that has been confirmed by the owner / operator as inactive and in a state of zero energy. For high value / high hazard subsurface strictures (as defined later in this section), confirmation must be made on-site by qualified personnel (representing the site and/or owner/operator of the line, unless these entities cannot be

identified), witnessed by ERM, and include positive verification of a zero-energy state. Otherwise, these lines must be considered potentially active.

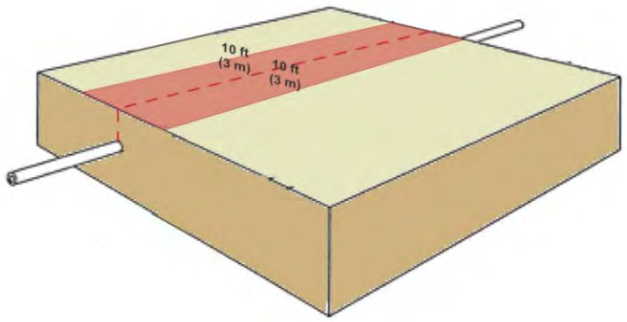
Compressed Air Excavation – The use of compressed air to make a cut, cavity, trench or depression in the earth's surface. Also known as "Vacuum Extraction," "Vac-Ex," "Air Knifing," and/or "Soft Digging."

Contact Person – a representative of the site where ground disturbance activities will be conducted who is knowledgeable of the subsurface and/or historical operations at the work location. The contact person may be a client employee or the employee of a third party.

Critical Zone – 10 feet (3 meters) distance in all directions from the surface projection of all known or suspected subsurface structures, taking into account the diameter and spatial extent of the structure (e.g., the outer diameter of a pipe or the outer edges of a tank).

Critical Zones do not apply to structures that have been confirmed as abandoned / decommissioned and do not need to be protected.

Example critical zone illustration, associated with an underground pipe:

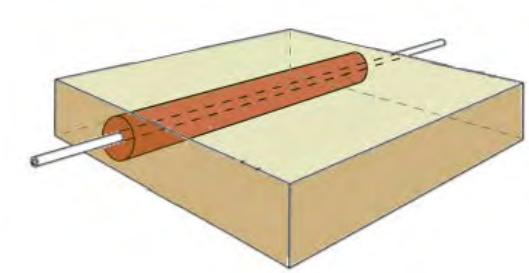


Detection Equipment – any equipment used for the detection of subsurface structures including, but not limited to, devices that utilize electromagnetic detection, magnetic detection, ground penetrating radar (GPR), acoustic detection, and video surveillance (e.g., sewer cameras). Guidance on the selection and applicability of detection equipment is provided in Appendix 3.

Excavation – any man-made cut, cavity, trench, or depression in the earth's surface, NOT including point disturbances as defined later in this section.

Excavation Buffer – a 2-foot (0.6-meter) distance in all directions from the outermost extents of subsurface structures that will be exposed or partially exposed during excavation activities, and within which mechanical digging is prohibited. Excavation Buffers do not apply to structures that have been confirmed as abandoned / decommissioned and do not need to be protected.

Example illustration of excavation buffer associated with underground line:



Ground Disturbance Activities – activities which require penetration of the ground surface to any depth, and/or the drilling, coring, or removal of engineered surfaces (pavement, concrete, etc.). Examples of ground disturbance activities include, but are not limited to: hand digging, hand augering, drilling, direct-push or Geoprobe® borings, well installation, well over-drilling, excavation, trenching, grading, concrete coring, drilling/installation of soil vapor points, and driving of posts, stakes, rods, poles, or sheet piles.

Hand Augering – Use of a manual auger to make a cavity or depression in the earth's surface.

Hand Digging – Use of manual digging tools and equipment (shovel, trowel, or post-hole-digger) to make a cut, cavity, trench or depression in the earth's surface.

High Value / High Hazard – Subsurface structures including electrical conductors / cable equal or greater than 110V, fiber optic cable, gas lines, petroleum pipelines, or structures containing hazardous substances.

Point Disturbance – ground disturbance activities associated with a distinct and definable location that, in general, will result in a ground disturbance that has a larger vertical extent (i.e. depth) than lateral extent (i.e. disturbed surface area). Examples include but are not limited to locations involving the following activities: soil sampling, soil borings (regardless of diameter) and involving any of the following types of tools/techniques: hand digging, hand auger, drilling, direct-push or Geoprobe®), well installation, and well over-drilling.

Point Disturbance Clearance – Methods used to identify the presence or absence of subsurface structures at a particular point disturbance location by removal of overburden and direct observation and/or contact. Approved point disturbance clearance methods include: compressed air excavation, pressurized water excavation, hand digging, hand auger and soil probe.

Pressurized Water Excavation – The use of pressurized water to make a cut, cavity, trench or depression in the earth's surface.

Remote/Greenfield Site –To be classified as Remote/Greenfield, a site must meet all of the criteria set forth in Appendix 2, as determined by the project PIC.

Site Services Model – a depiction of both the aboveground and underground utilities and services that are present or unaccounted for at a site. The site services model is developed from all available sources of information including, but not limited to: discussions with

knowledgeable contact persons, review of maps and as-built drawings, observation of visual clues, and information obtained from utility locate services.

Soil Probe Rod – a blunt-nosed probe with a T-handle that is pushed manually into the ground to check for obstructions that may indicate the presence of subsurface structures.

SSC Experienced Person (EP) – an ERM employee with requisite qualifications and experience in performing SSC activities, who will ensure execution of the SSC Process both in the planning stages and in the field.

SSC General Employee (GE) – an ERM employee that works on, manages, serves as PIC, or is responsible for issuing waivers or making other safety-critical decisions on projects where ground disturbance activities are performed, but does not serve in the role of SSC EP.

Subsurface Structures – man-made structures (excluding man-made debris) located beneath the surface of the ground or within or below engineered surfaces., These may include but are not limited to: pipes, cables, conduits, drains, galleries, tanks or other containers, wells, or any other useful property (as defined later in this section).

Useful Property – a subsurface structure that, if damaged, would need to be repaired or replaced, regardless of who makes the repairs or who is liable for the cost.

Unexploded Ordnance (UXO) / Munitions and Explosives of Concern (MEC) – ammunition that was fired but did not explode, or munitions (unfired ammunition, land mines, etc.) that could explode.

4. Procedure

The primary objective of the SSC Process is to develop a complete understanding of the subsurface structures that are present at a project site. This is done by developing a Site Services Model, as defined in Section 3. The activities outlined in this section are performed in order to construct a Site Services Model. These activities are presented in the general order they should be conducted, and are also summarized graphically in the SSC Process Flowcharts in Appendix 1.

4.1 Assignment of an SSC EP to the Project

All SSC planning and field execution activities must be performed or directly overseen by a currently certified SSC EP, unless the project location is a Remote/Greenfield site as defined in Section 3, or a waiver has been issued per the process outlined in Section 5.

The name of the SSC EP must be documented in the SSC Project Plan. The SSC EP role can be shared on a project, provided all employees serving in the role are currently certified as an SSC EP and listed in the SSC Project Plan.

4.2 Gathering and Review of Site Information

The following steps are required:

1) Identify any local regulatory, industry, or client requirements that are not otherwise covered by the ERM SSC Procedure. Document these additional SSC requirements in the SSC Project Plan.
2) Assess the potential for the presence of UXO/MEC. If UXO/MEC is present or potentially present, specialist technical assistance must be obtained to assist with project planning and site clearance. In the case of sites where UXO/MEC risks are present, adherence to the clearance plan developed by the specialist provider may supersede certain requirements of the SSC Process. If the UXO/MEC clearance plan deviates in any way from this SSC Procedure, a project-specific variance plan must be developed by the project team and approved by RCEO and Local MP.
3) Identify any contact persons knowledgeable of the subsurface and/or historical operations at the work location. Request any available information from them and review the preliminary SSC Project Plan with them. Request the participation of the contact person(s) during the site walk and visual clues survey.
4) Obtain all available (and in particular the most recent) as-built drawings and/or site plans showing subsurface structures. Requests should be made and followed up diligently until all available documents are received, or a positive confirmation is given that no such documents are available.
5) Where available and/or required by local legislative or regulatory requirements, obtain as-built drawings from third-party public agencies or private companies with subsurface structures in the area where ground disturbance will occur. Requests should be made and followed up diligently until all available documents are received, or a positive confirmation is given by the entities contacted that no such documents are available.
6) Obtain and review any additional site-related information such as easements, right-of-ways, historical plot plans, current and historical aerial photographs, fire insurance plans, tank (dip) charts, SSC information obtained as part of previous site investigations or Phase I environmental site assessments, soil surveys, boring logs, etc., as relevant to the planned ground disturbance activities.
7) Document the available preliminary information about the presence of known or suspected subsurface structures at the work location in the SSC Project Plan. This must include a site plan or map (drawn to scale) that identifies:
    a. The routes and locations of known services
    b. Gaps – those services suspected but not yet located based on currently available information
    c. Any Critical Zones and/or Excavation Buffers.

d. The preliminary disturbance location plan (boring location map, excavation plan, etc.) accounting for any Critical Zones, Excavation Buffers, gaps in subsurface information, and project objectives.

8) Remote/Greenfield Site Determination. If applicable, the PIC should use the available information obtained in previous steps to determine if the site meets the Remote/Greenfield criteria as defined in Appendix 2. Document this determination in the SSC Project Plan.

4.3 Public Utility Locates

The following steps are required:

1) Where they exist, the public utility locator(s) must be contacted to provide all available information and services. In jurisdictions where they provide this service, they should also be asked to physically mark utilities at and/or in the vicinity of the work location, in accordance with local regulatory requirements.
2) Ensure compliance with local regulations and guidelines governing public utility locates, including but not limited to:
   a. The process and required lead times for contacting public utility locators
   b. Marking planned ground disturbance areas at the work location
   c. Maintaining any required permits or dig tickets and ensuring public locator markings remain clear and visible for the duration of the project
   d. Any additional requirements for high hazard/high value subsurface structures
   e. Any restrictions for excavating within close proximity to underground structures (ie, “tolerance zones”)
   f. What to do if a subsurface structure or utility is encountered and how to report damage
3) Determine if there are utility owners/operators (including municipal water and sewer) that are not subscribers to the public utility service. If there are utility owners/operators that do not subscribe to the service or if a public one-call service is not available, identify and contact the owners/operators of known or suspected utilities in the vicinity of the work area and request they mark area lines.
4) Verify a response by each public utility locator prior to proceeding with any ground disturbance activities.
5) If, at any time during ground disturbance activities, the public utility locator markouts are not clear or visible, do not agree with other available sources of information, or are suspected to be inaccurate for any reason, the locators must be called back to the site to confirm their markouts.
6) Document the activities performed and results of the public utility locate in the SSC Project Plan.

4.4 Site Walk and Visual Clues Survey

The following steps are required:

1) A visual survey of all planned ground disturbance locations and surrounding areas must be conducted to identify signs of potential subsurface structures.

2) During the site walk, the routes and locations of services should be confirmed using visual clues, which include but are not limited to the following:

   - Utility poles with conduit leading to the ground
   - Lights
   - Signage
   - Sewer drains/cleanouts
   - Cable markers
   - Utility boxes
   - Manholes
   - Pavement scarring
   - Pipeline markers
   - Vegetative evidence (e.g., linear patterns or areas of distressed vegetation)
   - Remote buildings with no visible utilities
   - Equipment locations
   - Fire hydrants
   - Sprinkler systems
   - Water meters
   - Natural gas meters
   - Sewer manholes and drop inlets
   - Underground storage tanks fill ports and vent pipes
   - Steam lines

   Elevation changes across the site must also be noted and factored into clearance depth determinations.

3) Confirm overhead clearances with equipment operators for safely deploying equipment to the location. The minimum horizontal distance from any point on the equipment to the nearest overhead electrical power line must adhere to the minimum clearance requirements stipulated by regulation, utility companies, client requirements, and/or local industry best practice. If the equipment is closer than the minimum clearance distance to the overhead utility, the utility must be de-energized or an alternate plan developed with approval from the PIC and client/site owner. For more information, refer to ERM's Guidance on Avoiding Contact with Overhead Utility Lines (*ERM-1545-GU1*).

4) Where possible and practical (i.e. active industrial sites), work with the site contact(s) to identify the location and individual(s) responsible for key energy isolation devices and shutoff valves for site services. This information is to be included in the SSC Project Plan as part of emergency/contingency planning.

5) Whenever available, site contact person(s) are to participate in the site walk and approve planned ground disturbance locations. Approval (or lack thereof) must be documented on the SSC Project Plan.

6) Any proposed changes to ground disturbance locations made by a site contact person must be assessed by the SSC EP using the other available lines of evidence and only accepted

after a determination is made that the change is safe. The SSC Project Plan must be updated and the changes approved by the PIC.

7) Similarly, follow-up communication must be made to the site contact person when any changes are made to approved ground disturbance locations without their direct knowledge.

8) For Remote/Greenfield sites, if no utilities are identified or suspected during the site walk, and as a result the Remote/Greenfield site status is confirmed, the steps outlined in Sections 4.5 and 4.6 do not apply (except where required by local regulations or client procedures). However, if there is any evidence of the presence or possible presence of subsurface structures or useful property identified at the project location during the site walk, ground disturbing activities must be stopped immediately and the PIC contacted. If the presence of subsurface structures or useful property is confirmed, then the site is no longer considered a Remote/Greenfield site and must be fully risk-assessed using all the required steps in the SSC Process.

9) Document the activities performed and results of the visual clues survey in the SSC Project Plan.

4.5 Private Utility Markouts

NOTE: The SSC steps outlined in this section do not need to be completed for Remote/Greenfield sites, except where required by local regulations or client procedures.

The following steps are required:

1) Engage a qualified private utility locate contractor or a trained and competent ERM employee to locate and mark subsurface structures on the project site.

2) If using a private utility locate contractor, they must be prequalified and approved to conduct private locates through the ERM contractor prequalification process. The PIC and PM must ensure the contractor work order details the type of equipment to be used, mode of operation, reporting requirements (field summary and final) and method of markouts. Further guidance on this, including example work order language, is provided in Appendix 3. Confirm documentation of relevant and currently valid training and experience of all contractor personnel to be used. The SSC EP must be present on site to directly oversee the private utility locate contractors.

3) If using an ERM employee to locate and mark subsurface structures, they must have current training documented on ERM Academy to operate the detection equipment to be used, and must be approved by the PIC in the SSC Project Plan.

4) All available and site-appropriate detection equipment and methods must be used, and documented in the SSC Project Plan, including noting any limitations in the methods and equipment used. Guidance on the selection and use of detection equipment for private utility locates is provided in Appendix 3.

5) Ensure all detection equipment (whether ERM-owned, rented, or brought to the site by contractors) is:
   a. Maintained according to manufacturer specifications with maintenance records available.
   b. Calibrated according to manufacturer specifications. Calibrations must be documented.
   c. Calibrated or tested at the start of each work day and confirmed to be in proper working condition.
6) Detection equipment owned by ERM must be managed in accordance with ERM's Monitoring and Measurement Procedure (*ERM-1934-PR1*).
7) A Job Hazard Analysis (JHA) must be developed that covers all utility locating tasks. The JHA must be specific to the equipment and methods to be used, and be reviewed by the SSC EP and PIC.
8) Clear any vegetation, vehicles, equipment, or other obstructions to facilitate private utility markouts.
9) Using detection equipment, confirm the locations and routes of all identified or suspected subsurface structures, based on the data gathered during the other steps in the SSC process.
10) Using detection equipment, scan the area within a minimum 10-foot (3-m) distance around each planned ground disturbance location (a larger, more inclusive distance may be specified in the SSC Project Plan based on input from SSC EP and PIC), to assess the potential presence of any as-yet unknown subsurface structures.
11) For electromagnetic tools and equipment, employ active tracing methods whenever possible, using the conductive (direct connection) or inductive method.
12) Mark all subsurface structures identified within the defined boundaries of the work area with paint or other semi-permanent markings whose meaning is understood by the project team. Markings must remain clear and visible for the duration of the ground disturbance activities, and re-marked if necessary. Note that markings should be assessed by the SSC EP by evaluating the method(s) used to mark the utility locations, any limitations, and whether or not other lines of evidence corroborate or conflict with the markings.
13) The results and findings of the private utility locate must be documented in the field by either the contractor or the SSC EP. If using a contractor, ask that they provide a signed and dated report including a summary of equipment used, mode(s) of operation, names of operators and general map/sketch of findings.
14) Document the activities performed and results of the private utility locate in the SSC Project Plan.

4.6 Final Critical Zone Determination

NOTE: The SSC steps outlined in this section do not need to be completed for Remote/Greenfield sites, except where required by local regulations or client procedures.

The following steps are required:

1) In conjunction with site contact person(s), public and private utility locators, and any other knowledgeable persons identified during the site walk, confirm the status of all identified services (e.g., energized/de-energized, active/inactive, idled, abandoned/decommissioned, etc.).
2) Use the information gathered from all previous steps in the SSC process to determine the final Critical Zones around each planned ground disturbance location. Update the SSC Project Plan.
3) If any disturbance locations (or boundaries of disturbance areas) fall within a Critical Zone, they must be re-located or a waiver must be approved to proceed with work inside the Critical Zone. Any waivers must be documented in the SSC Project Plan.
4) For any work inside a Critical Zone, energized pipes or cables must be de-energized. If this is not possible, a specific JHA must be developed that covers the specific task steps, equipment, and methods associated with work around these energized structures. Appropriate safety measures, including the need for specialized PPE, must be evaluated with input from subject matter experts. JHAs must be reviewed by the SSC EP and PIC.

4.7 Review Meeting and Approval of Completed SSC Project Plan

The SSC Project Plan must be reviewed and approved by the PIC after completion of the SSC process steps in Sections 4.1 through 4.6, and BEFORE any further SSC or ground disturbance activities occur. This review must be completed through a verbal conversation, whether in person or by phone or video conference. Documentation of review can be via e-mail initially, but must be followed up with signatures in the final SSC Project Plan. A copy of the SSC Project Plan must be maintained at the work location for the duration of ground disturbance activities, and filed in the project folder upon completion of the field activity.

4.8 Concrete Coring / Cutting

In the case where concrete coring or cutting must be performed prior to ground disturbance, the following steps are required:

1. The preferred course of action is to use a prequalified and approved contractor. Where concrete coring / cutting services are not available for hire, the PIC must determine if there is a sufficiently trained and experienced ERM employee to accomplish the task using rented or ERM-owned equipment. Training documentation must be current on ERM Academy and attached to the HASP, with written approval from the PIC.

2. A JHA must be developed that covers all concrete coring / cutting tasks. The JHA must be specific to the equipment and methods to be used, and be reviewed by the SSC EP and PIC.
3. Concrete coring / cutting equipment must:
    a. Be inspected prior to use and maintained according to manufacturer specifications with maintenance records available.
    b. For rig- or stand-mounted coring equipment, be anchored to the floor using proper anchors.
    c. Be operated with ground fault circuit protection.
    d. Be operated by trained and qualified personnel.

    Any additional safety requirements for this equipment must be outlined in the task specific JHA.
4. Concrete core diameters must be large enough to allow for visual inspection during subsequent point disturbance clearance. For point disturbance locations that will be advanced with mechanical equipment (e.g., drill rig or direct-push) after initial clearance, core diameters must meet or exceed the larger of: 4 inches or 125% of the outside diameter (OD) of the largest downhole tool to be used.

4.9 Point Disturbance Clearance

Approved equipment and methods to be utilized for point disturbance clearance include the following, listed in order of preference:

- Compressed air excavation
- Pressurized water excavation
- Hand digging tools
- Hand augering tools
- Soil Probe Rod

Blades on shovels and post-hole diggers must have rounded or blunt noses. Pick axes, pointed spades, or any other tool that comes to a point are not to be used for point disturbance clearance. Crow bars, pinch bars or pry bars must not be used to break hardened soil or backfill. The ERM EP or field team lead may authorize the use of bars only to loosen materials like bricks or larger stones so that removal of these materials is possible. Bars must not be used with excessive force.

The following steps are required when clearing point disturbance locations:

1. A JHA must be developed that covers all clearance tasks. The JHA must be specific to the general location of the project as well as the equipment and methods to be used. Unless the project team can positively determine that no subsurface structures are present, all tools and equipment used in the clearance process must be selected based on the potential risks (i.e.,

energized electrical lines, fiber optic cables, natural gas pipeline, etc.) that cannot be ruled out. In addition to selecting tools and equipment, appropriate safety measures, including the need for specialized PPE, must be evaluated with input from subject matter experts. JHAs must be reviewed by the SSC EP and PIC.

2. Re-verify that appropriate overhead clearance requirements can be maintained at ground disturbance locations prior to mobilizing any equipment.
3. In the case of sites where UXO/MEC risks are present, review and adhere to the clearance plan developed by the specialist provider, which will supersede the instructions in this section.
4. The SSC EP must consider site-specific conditions and soil types when determining the equipment to be used.
5. If a hand auger will be used, an SSC EP must select the appropriate cutting head(s) based on the soil type, and if resistance is encountered that would require an inordinate/atypical amount of force to be applied for advancement, then augering must not continue.
6. For point disturbance locations that will be advanced with mechanical equipment (e.g., drill rig or direct-push) after initial clearance, clearance must be performed as follows:
    a. Clear the location using one of the approved methods outlined in this section. The selected clearance method must be documented in the SSC Project Plan. ERM's preferred clearance method is compressed air excavation. If this method is not used, the rationale and approval for using one of the other approved methods must also be documented in the SSC Project Plan.
    b. Clear to a minimum depth as follows:
        1. Outside Critical Zones, to 5 feet (1.5 meters).
        2. Inside Critical Zones, to 8 feet (2.4 meters) at a minimum. However, clearance MUST extend at least 2 feet (0.6 meters) beyond the known or suspected bottom depth of all subsurface structure(s) in the critical zone; therefore it may be necessary to clear to depths greater than 8 feet for deeper structures.
        3. For locations with frozen soils, to 2 feet (0.6 meters) beyond the bottom of the frost line at the site.
    c. Clear to a minimum diameter that is the LARGER OF:
        1. 4 inches (10 cm); or
        2. At least 125% of the outside diameter (OD) of the largest downhole mechanized tool (e.g. drilling auger, direct-push sampler) to be advanced.

    In all cases, clearance diameters must be large enough to allow visual inspection of the cleared hole. If hand augers are used to clear, multiple holes may need to be advanced to achieve clearance diameters.

d. For angled (non-vertical) drilling, clear to a minimum diameter of 125% of the OD of the largest downhole mechanized tool, taking into account the angle of the boring.

e. For locations where difficult soil or geologic conditions prevent the full clearance of a point disturbance location, a waiver must be obtained prior to proceeding with mechanized equipment. The waiver can be applied to multiple point disturbance locations across the site, provided each location is specified in the SSC Project Plan.

8. During clearance (and subsequent ground disturbance activities), watch for any warning signs indicating non-native soil, fill materials, and/or the presence of unexpected subsurface structures. If warning signs are observed, work must be stopped, the PM and PIC contacted, and this change managed per the requirements outlined in Section 8. Warning signs may include, but are not limited to:
   a. Any at-grade or above-grade visual clues
   b. Refusal
   c. Warning tape
   d. Pea gravel / sand / non-native materials
   e. Red concrete
   f. Colored plastic covers
   g. Voids/ cavities, or abrupt absence of soil
   h. Any unexpected change from native soil
   i. Any signs of damaged utilities in cuttings (broken materials, odors, etc.)
   j. Any other unexpected condition

4.10 Excavations

Blades on shovels and post-hole diggers must have rounded or blunt noses. Pick axes, pointed spades, or any other tool that comes to a point are not to be used for excavation. Crow bars, pinch bars or pry bars must not be used to break hardened soil or backfill. The ERM EP or field team lead may authorize the use of bars only to loosen materials like bricks or larger stones so that removal of these materials is possible. Bars must not be used with excessive force.

The following steps are required:

1. JHAs must be developed that cover all excavation / trenching tasks. The JHA must be specific to the general location of the project as well as the equipment and methods to be used. Unless the project team can positively determine that no subsurface structures are present, all tools and equipment used must be selected based on the potential risks (i.e., energized electrical lines, fiber optic cables, natural gas pipeline, etc.) that cannot be ruled out. In addition to selecting tools and equipment, appropriate safety measures, including the need for specialized PPE, must be evaluated with input from subject matter experts. JHAs must be reviewed by the SSC EP and PIC.

2. For excavation involving removal or working in close (2 feet / 0.6 m) proximity to subsurface structures (including those that are abandoned / decommissioned), the JHA must include appropriate emergency response measures, any additional personal protective

equipment, and safe excavation and removal methods to prevent spills, damage to other structures, etc.

3. Inform all ERM field personnel and excavation contractor(s) of information regarding the location of subsurface structures, Critical Zones, and Excavation Buffers. Ensure that the following are clearly marked and communicated to all site personnel, for all subsurface structures crossing through the excavation/trench perimeter or located within the Critical Zone around the excavation/trench perimeter:
   a. Locations/routes, including Excavation Buffers
   b. Expected excavation depths to the Excavation Buffer
4. During ground disturbance activities, watch for any warning signs indicating non-native soil, fill materials, and/or the presence of unexpected subsurface structures. Warning signs may include, but are not limited to:
   a. Any at-grade or above-grade visual clues
   b. Refusal
   c. Warning tape
   d. Pea gravel / sand / non-native materials
   e. Red concrete
   f. Colored plastic covers
   g. Voids/ cavities, or abrupt absence of soil
   h. Any unexpected change from native soil
   i. Any signs of damaged utilities in cuttings (broken materials, odors, etc.)
   j. Any other unexpected condition
5. Material inside an Excavation Buffer can ONLY be removed by the following methods (this is not subject to waiver):
   a. Compressed air excavation or pressurized water excavation (only with documented approval from the owner/operator of the utility or structure, and where allowed by law)
   b. Hand digging tools

5. Waivers

There are four waivers to the SSC Procedure that can be granted:

1. Waive the requirement for an SSC EP to oversee execution of the SSC Process (this could include the entire project or specific tasks);[2]

[2] An SSC EP is not required to oversee SSC activities at Remote/Greenfield sites, as defined in Section 3 and Appendix 2. A waiver is not needed for these sites.

2. Waive the requirement for private utility locates (performed by ERM contractors or ERM employees);
3. Waive the requirement for clearance of point disturbance locations prior to advancing with mechanized equipment (including no clearance or partial clearance); and
4. Waive the requirement prohibiting ground disturbance activities within a Critical Zone.

Both the Project PIC AND Local MP (or designee) must approve any waivers, with documentation in the ERM SSC Project Plan (can be documented in the field via notation of verbal approval or e-mail, with signature after project completion). If the Local MP is also the PIC on the project, then they must delegate the second review to another SSC Certified Partner and BOTH must approve the waiver.

PICs and Local MPs (or designees) must work with the SSC EP and broader project team to ensure the SSC Procedure is executed and to use available information to make safe decisions regarding waivers. A member of the H&S Team and/or a locally identified subject matter expert (SME) may also be consulted regarding waiver decisions, in particular when the project involves some degree of complexity or uncertainty. Additional guidance on conducting this evaluation is presented in Appendix 4, along with illustrative examples of waiver decisions.

Waivers should only be issued when exceptional circumstances limit the execution of parts of the SSC Procedure. PICs and Local MPs (or designees) cannot waive compliance with any legislative or regulatory requirement; nor can they waive any client-mandated requirements without prior discussion with, and documented approval by, the authorized client representative.

6. Training and Competency Requirements

There are two levels of certification for ERM staff engaged in SSC activities:

SSC GE Certification. SSC GEs (as defined in Section 3) must be certified by completing all of the requirements of the SSC GE Certification on ERM Academy and maintaining a status of "Certified / Renewal in Progress." Current requirements for SSC GE Certification are summarized in Appendix 5.

SSC EP Certification. Employees who will serve in the role of SSC EP must be certified as SSC EPs by completing all of the requirements of the SSC EP Certification on ERM Academy and maintaining a status of "Certified / Renewal in Progress." Current requirements for SSC EP Certification are summarized in Appendix 5.

The Local MP must assess the skills and experience level of all prospective SSC EPs and provide documented approval to the ERM Academy Team in order for an employee to become fully certified as an SSC EP. The Local MP may also revoke SSC EP certification, at their discretion, based on feedback from others, inability of the EP to demonstrate competency, or other identified performance issues.

SSC GEs that lack the qualifications and experience to be SSC EPs must participate in mentoring to develop the skills and experience to become SSC EPs. SSC GEs can utilize the "SSC

Mentorship Card" template (*ERM-1511-FM3*) to document field mentoring received by different SSC EPs.

ERM employees and contractors operating detection equipment must have experience and current training specific to the equipment they will be operating. Documentation of currently valid training must be obtained and included with the project HASP and in the project files. Training records for ERM employees must also be documented in ERM Academy.

If subsurface or overhead utilities will be de-energized by ERM employees or contractors, they must have formal and documented training for their role as required by local legislation and/or regulation.

Each region must develop a list of approved instructors for ERM SSC training, to be approved by the Regional H&S Leader in consultation with the regional management team.

Any changes to SSC training requirements are communicated to all affected employees via the ERM Academy Certification process.

7. Documentation

Thorough and complete documentation of the execution of the SSC Procedure must be maintained at the project site for the duration of ground disturbance activities, with copies maintained in the project files.

Documentation and forms associated with the SSC Procedure include the following:

- **SSC Project Plan (ERM-1511-FM1)** – this plan is required for each phase of ground disturbance activities at a project site. The SSC Project Plan includes the scope of authorized ground disturbance and SSC activities to be performed, available sources of information, summary of subsurface structures, documentation of SSC field activities, and approval of any waivers. The completed SSC Project Plan must be reviewed and approved by the PIC before any point disturbance clearance or ground disturbance activities may begin. If waivers will be granted, the SSC Project Plan must also be approved and signed by the Local MP or designee. Approvals can be initially documented in the field via notation of verbal approval or e-mail, with signature after SSC completion.
- **SSC Project Plan for Remote/Greenfield Sites (ERM-1511-FM2) –** version of the SSC Project Plan that can be used as an alternative for Remote/Greenfield sites, as defined in Section 3 and Appendix 2.
- **SSC Audit Form (ERM-1511-FM3)** – used to conduct and document field audits of SSC projects.
- **SSC Mentorship Card (ERM-1511-FM4)** – can be used by SSC GEs to document field mentoring received by different SSC EPs.

- **SSC Review Checklist for Contractors (ERM-1511-FM5)** – used to conduct and document safety meetings with contractor field personnel, to ensure they have been properly briefed on the applicable components of ERM's SSC Process.
- **SSC EP Review Questionnaire (ERM-1511-FM6)** – used to conduct and document Local MP review of a prospective SSC EP candidate's experience and competency.

Client required forms and/or equivalent field notes and sketches may be used in place of the SSC documentation outlined in this section, provided that the level and quality of documentation meets or exceeds that of ERM's forms, as determined and documented by the SSC EP and approved by the PIC.

8. Management of Change

Any change that occurs during the execution of the SSC Procedure or subsequent ground disturbance activities must be managed safely and effectively. Examples of change may include, but are not limited to:

- Changes to the location, scope, extent, or depth of ground disturbance activities
- Changes to the equipment or methods used
- Changes in personnel
- Changes in schedule
- Changes in encountered field conditions, including subsurface conditions (e.g., change in soil type or refusal)
- Safety events

To manage change:

1. Work must be stopped or paused and the PIC and PM contacted. As warranted based on the nature of the change (see below for additional guidance), a member of the Safety Team should also be contacted.
2. A re-assessment of the risks must be conducted with the input of the PIC, PM, and SSC EP (or field team lead for sites with no EP assigned). Additional input must be sought from the Local Managing Partner or designee for waivers, and a member of the Safety Team should also be consulted as warranted based on the nature of the risks involved.
3. SSC project documentation must be updated as necessary to reflect the change(s). The HASP, JHA(s), and other Safety planning documents must also be updated as necessary.
4. Any site or client contacts must also be notified of the change(s).
5. Work cannot be re-started without the concurrence of the PIC, PM, and SSC EP (or field team lead for sites with no EP assigned).

9. Safety Events

SSC-related safety events must be reported, managed, and investigated in accordance with ERM's Event and Non-conformity Management Procedure (*ERM-1200-PR1*) and Event Investigation Procedure (*ERM-1220-PR1*).

ERM classifies SSC-related safety events as follows:

1. Incident: Any injury, illness, damage to useful property, fire, explosion, spill, or other consequence that results from intercepting a subsurface utility or structure, either during the SSC process or subsequent ground disturbance activities.
2. Near Miss: Any unexpected encounter with a subsurface utility or structure that is verified as not damaged, or is determined to be NOT useful property (e.g., abandoned) and therefore does not require any repair or replacement.

   If a subsurface structure is intentionally exposed through use of a proper clearance technique to verify its location (or to comply with Excavation Buffer requirements), this is NOT considered a near miss. If a subsurface structure is intentionally exposed in order to excavate and remove it, this would also not be considered a near miss.

   Also, refusal caused by rocks, difficult geology, debris, or other natural matter is not considered a near miss.

   Due to the inherent uncertainty associated with SSC, it is possible that unexpected encounters with previously unidentified subsurface structures may occur during clearance, even after having successfully completed all other required steps in the SSC Process. If, however, it is determined that there were deviations or a lack of diligence in the execution of the SSC Process that may have contributed to the near miss, and/or if there are potential significant learnings to be shared within the organization, then the event can be classified as a "high-learning value" near miss. This classification can be made by the SSC EP, PIC, Regional Safety Leader or Global Health and Safety Director (GHSD).
3. Observation: Any actions or conditions that contradict or reduce the protections to health and safety outlined in the SSC Process; OR, any behaviors or best practices that significantly enhance the protections to health and safety beyond those outlined in the SSC Procedure.

In addition to the requirements outlined in ERM's Event and Non-conformity Management Procedure and Event Investigation Procedure, the following requirements apply in the event of an SSC-related incident or near miss:

1. In the event of ANY unexpected encounter with a subsurface structure, immediately contact the owner/operator so they can de-energize or shut off the service(s), as warranted, and assess any potential or actual damage and discuss the need for any repairs. The owner/operator must be contacted EVEN IF we believe no damage has occurred. ERM employees and contractors will not attempt to assess the status of any potential damage, or attempt to make any repairs without the involvement of the owner/operator (unless ERM is the owner/operator and a trained ERM employee is available to de-energize or shut off the

service). In the event of contact or potential contact with a subsurface structure, ERM and contractor personnel must observe a no touch principle. The service is to be considered live and potentially damaged, therefore hazardous, until investigated by a specialist.

2. In the event of an incident or near miss involving high hazard/high value subsurface structures, the PIC must go to the site as soon as practical to lead follow-up activities and initiate the investigation. For all other incidents or near misses, the PIC must consult with the Local MP and Local H&S Lead to determine if a PIC visit to the site is necessary.
3. A Root-Cause Analysis (RCA) is required for all SSC-related incidents and "high-learning-value" near misses. The investigation, RCA, corrective and preventive actions, and Safety Alert must be completed in accordance with the Event Investigation Procedure (*ERM-1220-PR1*) (or in accordance with client or regulatory requirements as applicable).

10. Auditing

To help assure safe operations on ERM SSC projects, audits will be conducted at a minimum as outlined below, using ERM's SSC Audit Form (or client-required equivalent form).

- Each Local MP (or designee) responsible for granting SSC Process waivers must perform a minimum of one SSC audit per year. This audit must be conducted in the field to observe the implementation of the SSC process.
- SSC PICs must audit at least one SSC project per year (unless they do not serve as PIC on any SSC projects during that year). This audit must include both an office review of documentation and field review of implementation.
- Regional and/or Local H&S Leaders must perform at least two SSC audits per year. These audits must include both an office review of documentation and field review of implementation.

SSC audit findings must be entered into ERM's online Active Leadership Audit Program (ALAP) system to allow for data trending, awareness and communication of lessons learned. Any identified corrective and preventative actions (CAPAs) must be entered into ERM's online CAPA database, which is used to assign, track and close CAPAs. It is the responsibility of the PIC to ensure that all CAPAs are completed by the assigned due date(s).

11. References

- ERM-1511-FM1 - SSC Project Plan
- ERM-1511-FM2 - SSC Project Plan for Remote/Greenfield Sites
- ERM-1511-FM3 - SSC Audit Form
- ERM-1511-FM4 - SSC Mentorship Card
- ERM-1511-FM5 - SSC Review Checklist for Contractors
- ERM-1511-FM6 - SSC Experienced Person (EP) Review Questionnaire

- ERM-1545-GU1 - Guidance on Avoiding Contact with Overhead Utility Lines
- ERM-1200-PR1- Event and Non-conformity Management Procedure
- ERM-1220-PR1 - Event Investigation Procedure
- ERM-1934-PR1 - Monitoring and Measurement Procedure

Document Control Information

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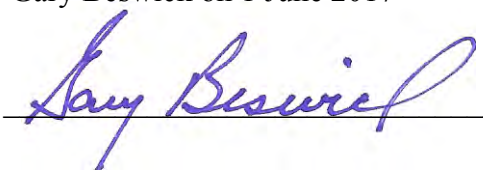
Policy Approval by: Gary Beswick on 1 June 2017

Approval Signature: 

Revision History

Section	Version No: Reason for Revision	Date
All	2.0: Major Revision	Sept 2009
All	3.0: Major Revision.	April 2013
All	3.0: Clarified near miss reporting	October 2013
All	3.1: Formatted for upload to Document Control System (DCS); added approval signature block for GHSD; Modified language in Appendix A flowchart for physical clearance requirements to match procedure text; removed field forms for upload to DCS as separate controlled documents	February 2015
All	3.2: Clarified applicability of SSC Process as it applies to contractors and third parties, inundated areas, areas covered by snow/ice, and UXO/MEC; removed 1 foot (0.3 meter) depth exemption from definition of ground disturbance; clarified definition of intercept / near miss related to abandoned structures designated for removal; added reference to SSC Field Review Checklist for Contractors; added waiver for SSC EP presence when hand digging in uppermost 1 foot; made other minor revisions for clarity but without changing content.	March 2015
All	4.0: Re-formatted. Removed public locate waiver. Modified SSC EP waiver. Merged SSC Project Plan with SSC Field Checklist forms. Removed SSC Location Disturbance Permit. Made explicit requirement for PIC/PM approval of SSC project Plan after completion of certain steps in SSC process. Removed references to "non-conductive" tools. Revised SSC flow chart in Appendix 1. Numerous other changes to respond to incident trends.	May 2017
4.8	4.1: Clarified core diameters must meet or exceed 'the larger of 4 inches or' 125% OD.	June 2017
11	4.2: Updated all links to post official version to DCS.	Sept 2017

Appendix 1: SSC Process Flow Charts

Subsurface Clearance (SSC) Process – Overview Flow Chart
ERM-1511-PR1 – Appendix 1

Main Process Steps

- Ensure all project personnel meet SSC EP and/or GE training requirements. Assign an EP to the project.*
- Identify knowledgeable contact person(s). Request any available information from them and review preliminary Site Services Model with them.
- Obtain all available and relevant site-related information
- Conduct public utility locates (where available)
- Conduct a site walk with knowledgeable contact person(s) and visual clues survey of planned ground disturbance locations and surrounding areas
- Conduct private utility locates to locate and mark utilities on the project site*
- Determine Critical Zones*
- **Review completed SSC Project Plan with PIC, before any ground disturbance activity occurs**
- Clear each point disturbance location prior to using any mechanized equipment. Adhere to Excavation Buffers for excavations and trenches.

Documentation

- SSC Project Plan (ERM-1511-FM1)
- SSC Project Plan for Remote/Greenfield Sites (ERM-1511-FM2)
- SSC Audit Form (ERM-1511-FM3)
- SSC Mentorship Card (ERM-1511-FM4)
- SSC Review Checklist for Contractors (ERM-1511-FM5)
- SSC EP Review Questionnaire (ERM-1511-FM6)

Managing Change

- Following any change, work must be stopped or paused to review the potential change in risks.
  Work cannot be re-started without the concurrence of the SSC EP, PIC, and PM.

  Examples include: Changes in the locations, dimensions, or extent of planned ground disturbance locations; Changes in equipment or methods to be used; Changes in personnel; Any safety event or identified hazard

* - Step not required for Remote / Greenfield projects

Subsurface Clearance (SSC) Process – Detailed Flow Chart
ERM-1511-PR1 – Appendix 1

MAIN PROCESS STEPS [SSC Procedure Section 4]

DOES THE PROJECT MEET SSC CRITERIA?

SSC is required before any activities that involve penetration of the ground surface to any depth, and / or the drilling, coring, or removal of engineered surfaces such as pavement or concrete.

Examples include:
- Hand digging or hand auger
- Drilling, direct-push or Geoprobe® borings
- Well installation or well over-drilling
- Excavation, trenching, or grading
- Concrete coring
- Installation of soil vapor points
- Driving of posts, stakes, rods, poles, or sheet piles.

YES

NO

Project does not require SSC Process

TRAINING & STAFFING

All employees working on, managing, or serving as PIC on SSC projects must have current SSC Certification.

An SSC Experienced Person (EP) must be assigned to the project, unless:

1. The project is a Remote / Greenfield site, as defined in the SSC Procedure; or
2. A waiver has been issued

KNOWLEDGABLE CONTACT(S)

Identify all contact person(s) knowledgeable of the subsurface and/or historical operations at the work location. Request any available information from them and review preliminary site services model with them. Request participation of the contact person(s) during the site walk and visual clues survey.

GATHER SITE INFORMATION

Obtain all available and relevant site-related information, such as:
- as-built drawings and site plans
- aerial photographs
- information obtained as part of previous site investigations
- soil surveys and/or boring logs

PUBLIC UTILITY LOCATE

Where they exist, public utility locator(s) must be contacted to provide all available information and services. Where available, they should also be asked to mark utilities at the site in accordance with local regulatory requirements.

SITE WALK

Conduct a visual survey of planned ground disturbance locations and surrounding areas to identify signs of potential subsurface utilities and structures. If available, contact person(s) should participate and approve planned ground disturbance locations.

If ANY evidence of subsurface utilities or structures are identified at a Remote/Greenfield site, the team must STOP WORK and review the findings with the PIC.

PRIVATE UTILITY LOCATE*

Use a private utility locator to locate and mark utilities on the project site. All available and site-appropriate detection equipment and methods should be used, and the findings of the private utility locate must be documented.

* This step is not required for Remote/Greenfield sites, except where required by local regulations or client procedures.

CRITICAL ZONE DETERMINATION*

If any planned ground disturbance locations will be inside Critical Zones (within 10 feet or 3 meters) of any identified subsurface structure:
- The locations must be moved outside the Critical Zone, or
- The locations must be approved by waiver

* This step is not required for Remote/Greenfield sites, provided that the site walk confirms there are NO subsurface utilities or structures present.

PIC must approve completed SSC Project Plan before any ground disturbance occurs!

STOP

CLEARANCE

For **Point Disturbance Locations:**
- Use an approved clearance method (refer to SSC Procedure) to clear each location to the required depths and diameters

For **Excavations and Trenches:**
- Clear areas as necessary to confirm the presence / absence of services
- Communicate Excavation Buffers to contractors
- No mechanical digging inside Excavation Buffers! (2 feet or 0.6 meters)

During clearance, the SSC EP should be observant for the presence of warning signs indicating non-native soil, fill materials, or the presence of unexpected subsurface structures.

FIELD DOCUMENTS [SSC Procedure Section 7]

SSC PROJECT PLAN
- ***ERM-1511-FM1***
- Completed for each phase of ground disturbance activities
- Documents sources of information and field activities, and includes Site Services Model
- Includes waiver approvals
- Must be reviewed and approved by the PIC before ground disturbance may begin

SSC PROJECT PLAN FOR REMOTE / GREENFIELD SITES
- ***ERM-1511-FM2***
- This version of the SSC Project Plan can be used as an alternative for Remote / Greenfield sites

SSC MENTORSHIP CARD
- ***ERM-1511-FM4***
- Can be used by SSC GEs to document field mentoring received by different SSC EPs.

SSC REVIEW CHCKLIST FOR CONTRACTORS
- ***ERM-1511-FM5***
- Used to conduct and document safety meetings with contractor personnel, to ensure they have been briefed on the applicable components of ERM's SSC Process.

AUDITING [SSC Procedure Section 10]

SSC AUDIT FORM
- ***ERM-1511-FM3***
- SSC PICs and BU MPs must complete at least 1 SSC audit per year
- Online form available on Active Leadership Audit Program (ALAP) page
- Final audits must be uploaded via the online form
- Any deficiencies should be closed out immediately if possible, or entered in the online audit form as Corrective and Preventive Actions (CAPAs)

MANAGING CHANGE [SSC Procedure Section 8]

Following any change, work must be stopped or paused to review the potential change in risks. Work cannot be re-started without the concurrence of the SSC EP, PIC, and PM. Examples of change include (but are not limited to):
- Changes in the locations, dimensions, or extent of planned ground disturbance locations
- Changes in equipment or methods to be used
- Changes in project personnel (including contractors)
- Changes in site conditions (e.g., newly identified or suspected utilities, weather, other nearby activities)
- The presence of any warning signs while digging
- Any safety event or identified hazard

SAFETY EVENT REPORTING [SSC Procedure Section 9]

If there is an unexpected encounter with a subsurface utility or structure (or any other safety event):

1. Stop work and secure / stabilize the situation (this could include getting medical attention for any injured or ill persons, evacuating the area, notifying owner / operator of damage, etc.). ERM and contractor personnel must observe a no touch principle.
2. Immediately notify the PIC, PM, and H&S Team
3. Do not re-start work without the concurrence of the SSC EP, PIC, PM, and H&S
4. Enter the event into the Event Communication System (ECS) within 24 hours
5. Follow-up investigation and management review will be conducted per ERM's Event Management and Investigation procedures.

Appendix 2: Remote/Greenfield Site Criteria

Remote/Greenfield sites are those situated in remote/rural or wilderness areas, where ONLY hand digging or hand augering is to be conducted. To be classified as a Remote/Greenfield site (or to classify portions of a larger site as Remote/Greenfield), the Partner-in-Charge (PIC) of the project must possess sufficient knowledge and experience to evaluate the site based on the following criteria and be able to determine the possible presence or absence of subsurface structures.

For a site to be classified as "Remote/Greenfield", the answer to ALL of the following questions must be "NO."

1. Will the scope of ERM or contractor activities include any form of mechanical digging/excavation, or the drilling, coring, or removal of engineered surfaces such as pavement or concrete?
2. Did a review of the most recent available maps and aerial photos or historical maps or aerial photos indicate the presence of anthropogenic activity that might have resulted in the presence of subsurface structures or useful property?
3. Is the site used for commercial purposes (excluding field agriculture or tree planting/harvesting) or was it so used based on the review of available maps and aerial photos?
4. Is the proposed site within 1.0 kilometer of a developed area (town, city or other large human settlement) that exceeds more than 50 inhabitants?
5. Is the proposed site within 100 meters of an isolated habitation dwelling (defined as the only habitation dwelling within 500 meters)?
6. Unexploded Ordinance/Munitions of Explosive Concern (UXO/MEC) risks have been assessed and UXO/MEC is present or potentially present?

Remote/Greenfield site status must be confirmed in the field by completing the site walk and visual clues survey as outlined in Section 4.4 of the SSC Procedure. If any evidence of subsurface structures is identified, the site must no longer be considered a Remote/Greenfield site.

Appendix 3: Guidance on Selection and Use of Detection Equipment

3.1 Work Order Instructions for Private Utility Locate Contractors

- Below is example language that can be incorporated into work orders, work authorizations, or subcontract agreements for private utility locate contractors. Utility locates must be performed by qualified, trained, and competent personnel. Documentation of training and experience for all on-site personnel must be provided to ERM in advance.
- No work of any kind is to be performed at the project location without authorization and direct oversight of ERM personnel.
- A JHA or similar document must be developed for all tasks and provided to ERM in advance for review.
- All equipment must be:
  - Maintained according to manufacturer specifications with maintenance records available.
  - Calibrated according to manufacturer specifications. Calibrations must be documented.
  - Calibrated or tested at the start of site activities.
- At a minimum, the following types of equipment are to be brought to the site and used to locate utilities *(note: it is best to develop this list in consultation with the private locator)*:

  _____
- For electromagnetic tools and equipment, active tracing methods are to be used whenever possible, using the conductive (direct connection) or inductive method.
- For ground penetrating radar (GPR), the following depths need to be achieved / antennae frequencies used *(note: it is best to develop this list in consultation with the private locator)*:

  _____
- Based on the site information provided, the locations and routes of all identified or suspected subsurface structures must be confirmed.
- The area within a minimum 10-foot (3-m) distance around all planned ground disturbance locations shall be assessed for the potential presence of any structures (NOTE: a larger, more inclusive distance may be specified as warranted).
- All identified or suspected subsurface structures within the defined boundaries of the work area shall be marked with paint or other semi-permanent markings in accordance with local regulatory, client, or industry standards.
- A signed and dated report must be provided upon completion of activities, including a summary of equipment used, mode(s) of operation, names of operators and general map/sketch of findings.

3.2 Applicability Matrix

The following guidance should be used as a starting point to assess potentially applicable detection equipment for a project. Each project may have unique conditions, therefore do not use this table as the sole decision criteria for technology selection.

Technology →	Electro-Magnetic Detection[1]							
	Cable Avoidance Tool (CAT)			Ground Conductivity Meter (e.g., EM-31 or EM-61)	Probe, Beacon, Sonde, or Trace Wire	Ground Penetrating Radar (GPR)[3]	Acoustic Plastic Pipe Locator	Cesium Magneto meter[4]
Subsurface Utility / Structure ↓	Passive – "Power" Mode[2]	Passive – "Radio" Mode[2]	Active Mode Using Signal Generator[2]					
Electric / Instrument Line (Energized/Signaled[5])	**G**	**G**	**G**	**R**	**R**	**Y**	**R**	**Y**
Electric Line (Non-energized)	**Y**	**Y**	**G**	**R**	**R**	**Y**	**R**	**Y**
Sewer/Water Line (Metallic)	**Y**	Y	G	**Y**	**G**	>12" diameter **G** <12" diameter **Y**	**Y**	**Y**
Sewer/Water Line (Non-metallic)	**R**	**R**	**R**	**R**	**G**	>12" diameter **G** <12" diameter **Y**	**G**	**Y**
Instrument/Telecomm (Non-energized)	**R**	**R**	**Y**	**R**	**R**	**Y**	**R**	**R**
Fiber Optic Cable	**R**	**R**	**R**	**R**	**Y**[6]	**R**	**R**	**R**
Fiber Optic w/tracer or in with a group of cables	**G**	**Y**	**Y**	**Y**	**N/A**	**Y**	**R**	
Natural Gas (Metallic)	**G**	**G**	**G**	**G**	**R**	>12" diameter **G** <12" diameter **Y**	**R**	**G**
Natural Gas Line (Non-metallic/PVC)[7]	**R**	**R**	**R**	**R**	**R**	>12" diameter G <12" diameter Y	**R**	**R**
Metallic/Non-Metallic Line (w/Tracer Wire)	**G**	**G**	**G**	**Y**	**Y**	>12" diameter **G** <12" diameter **Y**	**Y**	**Y**
Metallic/Non-Metallic Line (w/o Tracer Wire)	**R**	**R**	**Y**	**Y**	**Y**	>12" diameter **G** <12" diameter **Y**	**Y**	**R**
Metal UST	**Y**	Y	G	**G**	**R**	**G**	**R**	**G**
Fiberglass UST	**R**	R	R	**R**	**R**	**G**	**R**	**Y**

Additional Considerations

Technology → / Variable ↓	Electro-Magnetic Detection[1]					Ground Penetrating Radar (GPR)[3]	Acoustic Plastic Pipe Locator	Cesium Magneto meter[4]
	Cable Avoidance Tool (CAT)			Ground Conductivity Meter (e.g., EM-31 or EM-61)	Probe, Beacon, Sonde, or Trace Wire			
	Passive – "Power" Mode[2]	Passive – "Radio" Mode[2]	Active Mode Using Signal Generator[2]					
Moist Soil	G	G	G	Y	G	Y	G	Y
Dry Soil	Y	Y	G	Y	G	G	Y	G
Clay	Y	Y	Y	Y	G	R	G	Y
Concrete w/Rebar	R	R	Y	R	G	Y	G	R
Man-made fill such as construction/demolition debris, coal ash, slag, etc	Y	Y	Y	Y	G	Y	Y	Y
Long Horizontal Profile	G	G	G	G	G	G	G	G
Short Horizontal but Deep Vertical Profile	Y	Y	Y	Y	R	G	R	G
Access to Line[8]	G	G	G	N/A	G	N/A	G	N/A
No Access to Line[8]	Y	Y	R	G	R	G	Y	G
Ferrous Metal	G	G	G	G	G	G	G	G
Non-ferrous Metal	Y	Y	G	Y	G	G	G	Y

Green (G): Generally an applicable technology
Yellow (Y): May or may not be applicable
Red (R): Not generally applicable

1 = Site structures, rebar in concrete, etc. can significantly affect performance and reliability of any electromagnetic method.
2 = The CAT can be used in 3 modes:
- In the Power mode, the CAT can detect signals radiated by loaded cables. This is used to detect, locate and avoid buried electrical cables.
- In the Radio mode, the CAT detects VLF radio signals re-radiated by buried metallic pipes and cables. This is used to detect, locate and avoid other buried metallic pipes and cables such as natural gas, phone & communication lines, ducts & water services.
- In the Active mode, the CAT detects a tone radiated by a signal generator ("Genny") to a buried conductor. This is done by directly connecting the signal generator to the source via plug sockets, valves, etc.

3 = Most sensitive to interpretation and soil conditions; the skill, training, and experience of operator are critical. Also note that the size and power of GPR antenna arrays can provide variable results and pick up signals at different depth ranges.
4 = Sensitive to noise and operator error. Generally more applicable for large targets.
5 = Metallic lines that have power running through them or can be connected to a tracer signal generator. Caution should be exercised when attaching a transmitter to high-voltage lines for active trace with CAT.
6 = If the fiber optic cable is in a conduit, it may be possible to trace the line using a probe
7 = Assumes no tracer wire installed through which a signal can be induced.
8 = Access: induce unique electronic signature, apply acoustical impulse, or insert probe/beacon/sonde.

3.3 Additional Considerations

- Communicate the detailed scope of work and review all available SSC information with private locators in advance, prior to mobilizing to the site. This way they can bring the right equipment and schedule sufficient time to achieve the clearance objectives.
- Provide all available information to locators to help them confirm the routes of all known or suspected services. This includes but may not be limited to: as-builts, public locator responses/markings, knowledgeable site contact(s) information, and results of visual cues survey.
- Ensure that utility locators are thorough and use multiple tools and methods. Ground penetrating radar (GPR) surveys should be used wherever possible.
- Consider the need to perform at least two different depth scans with GPR: (1) a higher frequency near-surface scan and (2) a lower-frequency scan within the target depth range for site services. This is especially critical for sites with shallow buried utilities and/or concrete slabs or other engineered surfaces, where utilities may be direct buried within or directly below the surface.
- For electromagnetic (EM) location, insist on active tracing methods using conduction or induction of a signal wherever possible.
- Ask the private locators about any issues or limitations with their surveys, especially if other lines of evidence conflict with their markings, or if they cannot identify known or suspected subsurface structures.

Appendix 4: Waiver Guidance Examples

Introduction

"Reasonably assured" denotes the standard that must be satisfied for Partners-in-Charge (PICs) and Local Managing Partners (MPs) or their designees to grant waivers to the execution of (or, more precisely, make an explicit decision to allow non-performance of) portions of the Subsurface Clearance (SSC) Procedure. There are four waivers to the SSC Procedure that can potentially be granted:

1. Waive the requirement for an SSC EP to oversee execution of the SSC Process (this could include the entire project or specific tasks;[3]
2. Waive the requirement for private utility locates (performed by ERM contractors or ERM employees);
3. Waive the requirement for clearance of point disturbance locations prior to advancing with mechanized equipment (including no clearance or partial clearance); and
4. Waive the requirement prohibiting ground disturbance activities within a Critical Zone.

This guidance is intended to present a risk-based framework through which being "reasonably assured" may be assessed.

Definition and Factors to Consider

Being "reasonably assured" means that one would make the same decision as another PIC concerning a waiver, based on the same set of factors. PICs and Local MPs (or designees) should integrate the following two factors into their decisions to issue a waiver:

1. Available pieces of information/data about the services present in the subsurface, and quality of that information/data.
2. Relative hazard of striking the services known or suspected to be present (i.e., not confirmed as absent from the site).

The relative hazard of striking a service can be prioritized in terms of the potential severity of such a strike in terms of health, safety, or environmental consequences. For relatively low-hazard services, the potential cost implications of repair can also be considered. All other things being equal, an example prioritized list of common underground services – from high hazard to low hazard – might include:

   a. High / medium voltage electrical cables
   b. Low voltage electrical cables

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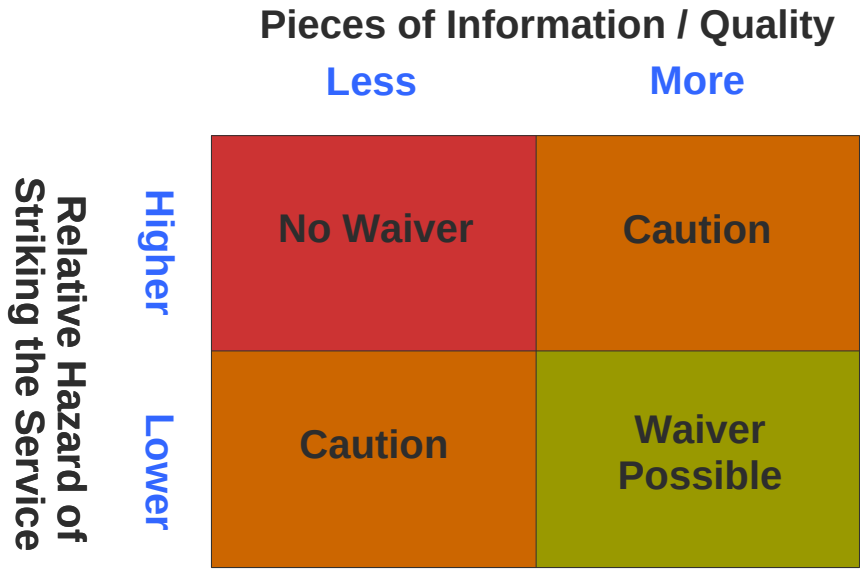
[3] An SSC EP is not required to oversee SSC activities at Remote/Greenfield sites, as defined in Section 3 and Appendix 2. A waiver is not needed for these sites.

c. Pressurized gas lines
d. Other pressurized pipelines
e. Fiber optic cables
f. Gravity drain process sewers
g. Gravity drain sanitary sewers
h. Gravity drain storm sewers

The particular circumstances of the site (e.g., active or inactive facility), whether or not the lines are energized, and whether or not the routes of the services are known or would meet the definition of "Useful Property" may change the relative hazard ranking.

Multiple, high-quality pieces of information/data and low relative hazard support granting waivers. Limited and/or low-quality lines of evidence and high relative hazard do not support granting waivers. This can be illustrated using the following diagram:

The Waiver Matrix



The way in which these factors are considered can be illustrated by the example below.

Example Project

An ERM team has been awarded a project to assess suspected impact at an inactive manufacturing site. The client previously demolished all surface structures, but did not fully address the process sewer. Some surface clues are present. The project team is planning to complete 25 soil borings along the run of the former process sewer (due to regulatory requirements, samples must be taken within 1 m of the sewer lines) looking for potential impact.

The site is known to be constructed over man-made ground, and debris – both from historical operations and the recent demolition – is widespread over the site in the 0-1 meter depth interval.

The SSC Procedure first asks the project team to evaluate the available information sources about subsurface risks. This is memorialized in the Project Information Summary section of the SSC Project Plan. The more information sources that are checked "Yes" indicates more lines of evidence potentially established. Comments regarding the quality or reliability of those lines of evidence should also be noted and weighed in subsequent decisions.

Project teams are also asked to assess the potential underground services at a site. The goal is to ultimately confirm either the presence or absence of such services from the work area. The presence / absence and knowledge of the routes of subsurface services on the Example Project site are noted in the Site Services Model, as shown in the following example:

Example Project Site Services Model (Pre-Mobilization for Drilling)

Site Services Model								
	Present?			Anticipated depth (note units)	Located?		Status (active, inactive, abandoned, etc)	Comments (For each, describe how located and quality of information available)
Utility / Structure	Yes	No	Un-known		Yes	No		
Electricity	x			2m	x		De-energized from substation	On Site Plan; public util. markouts confirm
Gas	x			2m	x			Present on site, but blinded at street
Petroleum Pipeline		x						Not present
Other Pressurized Lines	x			1m		x		H2 pipeline crosses former process area
Process Sewer	x			1m	x		Deactivated, but not abandoned	On Site Plan
Sanitary Sewer	x			??		x	Deactivated, cut and blinded at street	On Site Plan
Storm Sewer		x					Previously abandoned by client	On Site Plan
Potable Water		x						Not present
Telephone / Communication		x						Per phone company, none on-site
Fiber Optic		x						Not present
Plant air / steam		x						Not present
Fuel / oil		x						Not present
Reclaimed / waste water		x						Not present
Fire suppression		x						Not present
Underground tank(s)		x						On Site Plan; public util. markouts confirm
Other (Describe):		x						

Decisions on granting waivers should be based on considerations of what is known (or will be known, based on planned work activity) and what risks are present from the identified services at the site.

In this case, there are three potential waiver decisions for the PIC and Local MP (or designee) to make:

- Waiving the private utility mark-out,
- Waiving the need for point disturbance clearance, and
- Advancing within Critical Zones (within a 3-meter envelope of a sewer line).

The thought process includes weighing the lines of evidence against the relative hazard of the services known or suspected. In the end, the PIC and Local MP (or designee) must ask themselves if they are reasonably assured that the decision to grant a waiver is a safe one. Consultation with the SSC Experienced Person (EP) and others on the project team, as well as a member of the H&S Team, may assist the PIC and Local MP (or designee) in making the decision. In the end, the PIC and Local MP (or designee) are the only ones who may grant a waiver.

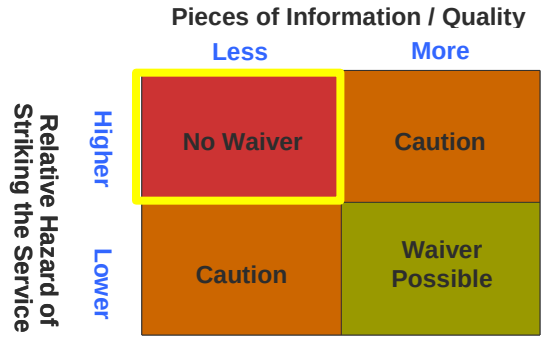
What follows is an illustration of the decision-making process, based on the situation presented in the Example Project.

Waiver Decision: Private Markouts

The Project Information Summary suggests that the team has two of four possible lines of evidence in hand (a site plan and public utility markouts). The Site Services Model suggests that while those lines of evidence have provided us with a good idea about the locations and status of some high-hazard services and the former process sewer, they have not provided any sufficient detail about the hydrogen pipeline, which is known to be active and suspected to be running through the work area. That is, we have zero lines of evidence concerning the route of the hydrogen pipeline.

The private utility markout is the only available option for obtaining a line of evidence on the hydrogen pipeline. While that provider is on site, they may also be utilized to verify the route of the process sewer (as a second line of evidence) and the status of the de-energized conductors (i.e., that they are indeed de-energized). Additional lines of evidence never hurt!

The Private Utility Markout Waiver Decision



To continue the example, the PIC and Local MP were not reasonably assured that it would be safe to waive the Private Utility markout and thus decided not to grant the waiver.

For purposes of the example, assume that the private utility markout was used to:

- Verify the route of the process sewer (which was found to align well with available surface clues and the site plan),
- Confirm that the electrical conductors are indeed de-energized, and
- Identify the route of the hydrogen pipeline (which was found to be distant from the process sewer).

Waiver Decision: Allowing Ground Disturbance within a Critical Zone

In addition to being "reasonably assured" about the safety of advancing within a Critical Zone, the PIC and Local MP are also required to factor the following into their decisions:

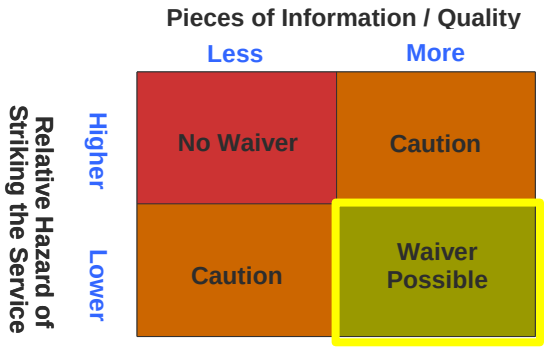
- If possible, energized pipes or cables within the Critical Zone should be de-energized.
- Ground disturbance activities within the Critical Zone do not present an unacceptable safety, environmental, or operational risk, either on-site or off-site.

In this case, with the process sewer, there is no need to de-energize it (it is inactive). If the sewer were to be struck, however, there is certainly an environmental risk – but there is some question as to it being an "unacceptable" risk. For the time being, assume that the PIC, Local MP, and project team believe the risk to be "acceptable".

Even though the first position, of course, is to not advance within the Critical Zone unless absolutely necessary, the technical objectives of the Example Project require that the team advance borings within the Critical Zone (i.e., close to the lines). Taking that into consideration, the PIC and Local MP review the Project Information Summary and the Site Services Model – both of which have evolved with the execution of the private locator service. The PIC, Local MP, SSC EP and project team ask, "Given what we know, are we reasonably assured that we will not strike the sewer line?"

By virtue of the private utility markout, the team now has an additional line of evidence about the route of the former process sewer and a high degree of confidence in it. The process sewer is not energized and is on the lower end of the relative hazard scale.

The Critical Zone Waiver Decision



All things being equal, the PIC and Local MP are reasonably assured that advancing within the Critical Zone would be a safe decision, and will grant the waiver to allow the work inside the Critical Zone to proceed.

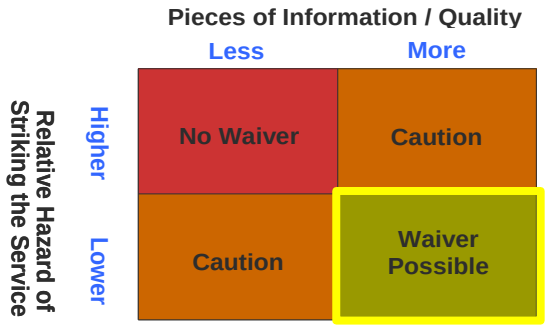
Waiver Decision: Point Disturbance Clearance

Recall that there is widespread subsurface debris at the site, mostly present in the 0-1 meter depth interval. Ground disturbance will occur inside a Critical Zone, which requires point disturbance clearance to the deeper of:

- 2 feet / 0.6 meters beyond the expected bottom depth of the service (in this case, up to 2.4 meters given the depth of the process sewer);
- 8 feet / 2.4 meters; or
- 2 feet / 0.6 meters below the frost line.

In this example, the required depth of clearance is 2 feet beyond the expected bottom depth of the sewer line. However, given the logistical and technical challenges of clearing the locations given the presence of debris, should the PIC and Local MP waive the requirement for point disturbance clearance?

The Point Disturbance Clearance Waiver Decision



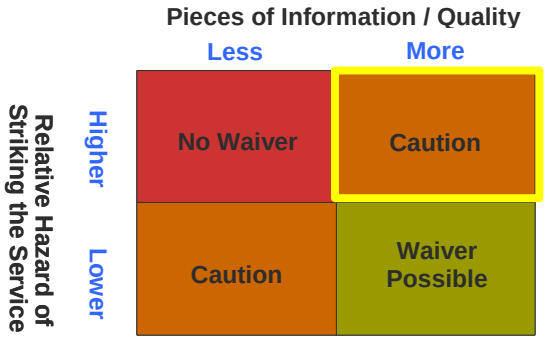
There are multiple, good quality lines of evidence that confirm the routes of nearby services (as well as the absence of others), and the former process sewer ranks low in terms of relative hazard. In this case, the PIC is reasonably assured that waiving the point disturbance clearance requirement is a safe decision.

Another Case to Consider

In the example above, circumstances led to fairly clear-cut decisions for granting waivers to the SSC Process. Considerations of the lines of evidence and relative hazard tended to the regions of "Waiver Possible" in the Wavier Matrix. Real world circumstances may lead to less clear-cut decisions and more ambiguity in being reasonably assured.

As an illustration, replace the former process sewer in the example above with an energized high voltage electrical cable. For the project, it is required to sample within 1 meter of the cable. Assume that the private utility markout was performed, and that the route of the cable determined from that work matches well with what is shown on the site plan. Should the PIC and Local MP allow advancing within the Critical Zone?

The High Voltage Cable Critical Zone Waiver Decision



There are several quality lines of evidence that provide the route and location of the high voltage cable. Striking the cable would indeed be very hazardous. The Waiver Matrix indicates approaching the waiver decision cautiously. Indeed, that is exactly what the PIC and Local MP should do.

If the cable can be de-energized to reduce the hazard, then a Waiver to advance inside the Critical Zone would certainly be a safer decision. But what if the local utility says that the cable cannot be de-energized? The project requires advancing borings inside a Critical Zone. Even though the team believes that they have a very good understanding of the location of the service, the potential magnitude of the hazard is high, and presents a level of risk that would likely be unacceptable. In this case, not allowing the disturbance within the Critical Zone (i.e., not granting the waiver) may be the best decision.

Additional considerations may be taken into account here. For example:

- Would it be possible (after discussion with the client and discussing the risks) to advance farther away from the service (i.e., is it really necessary to get within 1 meter of the service)?
- Have we confirmed that the selected point disturbance clearance method uses non-conductive equipment?
- Might another discussion with the utility be useful in terms of de-energizing the high voltage cable?
- Are there any additional safety precautions (e.g., grounding the drilling equipment) that might reduce the relative hazard?

Final Notes

Some waiver decisions may affect other waiver decisions. For example, waiving the private utility markout eliminates a potential high-quality line of evidence. Not having this line of evidence will affect the ability to be reasonably assured that permitting work within a Critical Zone or waiving the point disturbance clearance is a safe decision. Additionally, not being able to conduct point disturbance clearance will affect the ability to be reasonably assured that working inside the Critical Zone is a safe decision. Each waiver that is granted reduces or removes a safeguard, and extreme caution must be exercised when granting multiple waivers on a single project site.

In the end, the PIC and Local MP should err on the side of caution when it comes to making any waiver decision. PICs and Local MPs must ultimately be "reasonably assured" that a waiver decision is a safe one for their project team, contractors and client.

Appendix 5 – SSC Training Certification Requirements

SSC GE Certification Process		
Initial Training	**Required Element:**	**How Completed:**
	Initial SSC Training	2.5 Hour Event (Instructor-Led Session)
	Post-Work Quiz	Online Test
	Acknowledgement of Procedure Review	Online Material
Refresher Training	**Required Element:**	**How Completed:**
	Annual Refresher Class	1 Hour Event (Instructor-Led Session)
	Post-Work Quiz	Online Test
SSC EP Certification Process		
Initial Training	**Required Element:**	**How Completed:**
	Initial Training	2.5 Hour Event (Instructor-Led Session)
	Post-Work Quiz	Online Test
	Acknowledgement of Procedure Review	Online Material
	EP Competency Assessment	Online Test
	Documentation of Experience	Online Form – enter 5 to 10 projects
	SSC EP Approval Certificate	Standardized questionnaire completed by Local MP based on input from Line Manager of candidate, PICs the candidate has worked for, and EPs that have mentored the candidate. Upon receipt of completed and signed questionnaire, Academy Team will mark EP status as Certified.
Refresher Training	**Required Element:**	**How Completed:**
	Annual Refresher Class	1 Hour Event (Instructor-Led Session)
	Post-Work Quiz	Online Test
	Documentation of EP Assignment during previous 12 month period	Online Form – EP will need to document at least 1 field assignments over the previous 12 months where they served as EP and completed SSC Project Plan. This requirement can only be "exempted" under direction of Local MP via formal request to Academy.
	Documentation of Partner SSC Audit during previous 12 month period	Online Form – EP will need to verify that at least 1 SSC Audit was completed by a SSC certified Partner, TD, or H&S Team Member over previous 12 months on a project where they served as EP. This requirement can only be "exempted" under direction of Local MP.

This form is presented in English

Subsurface Clearance (SSC) Audit

ERM-1511-FM5

Remember: this form must be completed and submitted online in order to be counted in your Active Leadership Audit Dashboard

Auditor Information:		Audit Location:	
Enter GMS Number:		Audit Date:	

1.0	Office / Pre-mobilization	Yes / No / NA	Comments
1.1	Have subcontractor(s) working at the project site been pre-qualified and approved by ERM?	Yes / No / NA	
1.2	Has a certified SSC "Experienced Person" been assigned to manage SSC activities, been identified in the SSC Project Plan, and provided 'eyes-on' supervision (been present onsite) during all on-site field pre-clearance activities?	Yes / No / NA	
	Please identify the EP being audited:		
1.3	Have all ERM project employees (including project manager and Partner in Charge) have current SSC Certification on ERM Academy? *Record names and & dates in the comments.*	Yes / No / NA	
1.4	Question Deleted		
1.5	Have the Level 2 HASP and SSC Project Plan been completed?	Yes / No / NA	
1.6	Have knowledgeable site contact person(s) been identified? *Describe whether they were present to participate in site walk and approve disturbance locations in the comments.*	Yes / No / NA	
1.7	Have available as-builts, maps, aerial photos, etc. been obtained and reviewed?	Yes / No / NA	

2.0	Field Activities: Pre-clearance	Yes / No / NA	Comments
2.1	Are ground disturbance locations/points clearly marked with white paint or other suitable means?	Yes / No / NA	
2.2	Have public and private utility locates/markouts been conducted? *Describe by who and when in the comments.*	Yes / No / NA	
2.3	If utility locate/mark-out was conducted by ERM staff or an ERM Contractor, was the individual qualified to execute the locate service? *Provide details of training/qualifications in the comments.*	Yes / No / NA	
2.4	If utility locate/mark-out was conducted by ERM staff or an ERM Contractor, has the location equipment been adequately maintained and calibrated? *Provide date of last calibration in the comments.*	Yes / No / NA	
2.5	Question Deleted		
2.6			

	Have Critical Zones been identified on the Site Services Model and marked? *Review the Site Services Model accuracy as part of this evaluation (considering information obtained and data gaps).*	Yes / No / NA	
2.7	Has the site been assessed by a UXO/MEC specialist, where required? *If no UXO/MEC suspected, answer N/A. If UXO/MEC suspected but not assessed, answer No.*	Yes / No / NA	
2.8	Are all required SSC process waivers approved and documented in the SSC Project Plan?	Yes / No / NA	
2.9	Has the fully completed SSC Project Plan been reviewed and approved by the PIC and PM prior to ANY point disturbance clearance or ground disturbance activities?	Yes / No / NA	
3.0	**Field Activities: Physical Clearance**	**Yes / No / NA**	**Comments**
3.1	Has Critical Zone (CZ) distance been correctly managed during project? *"Correctly managed" means: no ground disturbance has occurred within the CZ, or if ground disturbance has occurred in the CZ all required waivers have been issued and control measures have been implemented. Describe in comments.* *Critical Zone - 10 feet (3 meters) distance from all known or suspected underground lines, edge of tanks, pump islands, pump gallery, manifold, electrical transformer, compressor, production well, loading rack, or other process equipment with associated underground lines.*	Yes / No / NA	
3.2	Have point disturbance locations been correctly managed during project? *"Correctly managed" means: the use of physical clearance to clear to the minimum depths /diameters prior to use of any mechanical digging, or all required waivers have been issued and control measures have been implemented. Describe in comments.* *Clearance must meet or exceed the large of: 4 inches (10 cm) or 125% of the outside diameter of the largest downhole tool. In Critical Zones, physical clearance to the DEEPER of 2 feet (0.6 meters) below frost line; OR 2 feet (0.6 meters) deeper than expected invert depth of service or 8 feet (2.4 meters). In Non-Critical Zones, physical clearance to 2 feet (0.6 meters) below frost line; OR 5 feet (1.5 meters)*	Yes / No / NA	
3.3	Have trenching or excavation activities been correctly managed during the project? *"Correctly managed" means only non-mechanical equipment was used within the 2-foot (0.6 meters) buffer zones for known/suspected utilities, or all required waivers have been issued and control measures have been implemented. Describe in comments.*	Yes / No / NA	
3.4	Question deleted		
3.5	Are the appropriate hand tools being used (i.e., non-conductive hand digging tools, blunt edges only, no pick axes or pointed spades, etc.) and are they specifically called out in the task JHA?	Yes / No / NA	
3.6	If SSC-related events have occurred, have they been reported per ERM Subsurface Clearance Procedure? *Answer Yes if SSC event(s) occurred and were reported. Answer No if SSC event(s) occurred but were not reported. Use N/A if there were no SSC events and therefore none were reported.*	Yes / No / NA	
3.7	If change(s) occurred during project execution, were Management of Change procedures implemented per ERM Subsurface Clearance Procedure for any HASP/SSC Plan changes? *Answer Yes if change(s) occurred and were managed. Answer No if change(s) occurred but were not managed adequately. Use N/A if there were no change(s) and therefore no change to be managed.*	Yes / No / NA	

Include any additional information / comments about this audit below:

ERM Field Audit Checklist

Project Introduction and Background	
GMS No:	PIC:
PM:	Staff:
Date of audit:	Auditor(s):
Project information (Client / Site / Type of services/ Name and Number of contractors/Current project activities):	
Brief summary of audit results (list best practices observed, repeat findings, etc.):	

Instructions:
The audit should include observations, spot-checks of pertinent documentation (such as training or inspection records) and interviews with site staff. Auditors should ensure that interviewees understand that the goal of the audit is to improve on site safety and should encourage interviewees to speak openly. It is an opportunity for leaders to communicate their expectations.

This checklist has been developed for all types of field projects and therefore includes open questions. For field work including (i) travelling abroad or (ii) secondments, please use the relevant section in addition to the project audit checklist.

Please use the Audit Finding Action Plan at the end of this document to describe the finding for each item that has not been marked “Yes” or “N/A”.

In exceptional cases, use the auditor’s notes section to explain why an element that is marked “No” does not require an Action Item.

Corrective action measures should be developed by the PIC for the project with support by the PM and local H&S advisers. This completed form and associated action plan should be sent to the BU H&S Lead. Where a corrective action has been implemented immediately on site, this should also be noted.

Scoring the Audit – Score the audit by following the instructions provided on the scoring page of this document. The resulting score is a relative guide for the project leadership on how well their project performed during the audit.

☆ This symbol indicates situations or actions that are of high risk or relate to 5 For Life (driver and vehicle safety, travel safety and security, subsurface clearance, short-service employees, and marine/offshore activities), and are weighted more heavily during scoring the project.

ERM Field Audit Checklist

	Field Visit Review Questions		Insert "X" or similar, below		
			Yes	No	N/A
	1	**Planning and Risk Assessment**			
☆	1.1	Is the appropriate level ERM HASP available / complete / up-to-date / signed by field staff?			
	1.2	Is the information included in the HASP (e.g., safety measures, job hazard analyses, emergency procedures, etc.) appropriate to the project risks?			
	1.3	Is the PPE identified in the HASP appropriate to risks?			
	1.4	Does the HASP include a requirement to report accidents and near misses?			
	1.5	If work permits are required (client, regulatory, or procedural), have they been full completed (including date and signature, if required)?			
	1.6	If work permits are required, are all personnel on the site aware of and following the requirements?			
☆	1.7	Do ERM personnel have the appropriate H&S training? Verify training in the Academy for onsite employees upon your return to the office.			
	2	**Site Access, Registration and Induction**			
	2.1	Are all site workers accessing the work site familiar with scope of work and associated risks?			
☆	2.2	Did all site workers attend a site orientation/client specific training and sign off on the HASP?			
	2.3	Have all persons temporarily accessing the work site received a safety induction and are unauthorized persons prevented from entering the work site?			
	2.4	Are daily tailgate meetings conducted at the beginning of each day?			
	3	**Layout and Condition of Work Area**			
	3.1	Is the work site appropriately delineated (cones / fencing / tape)?			
	3.2	Is the size and location of delineated work site adequate?			
☆	3.3	If working on or near roadways, is the work area appropriately marked and secured against traffic impact? (i.e. adequate safety zone, appropriate barriers, traffic controls signage)			
	3.4	Have obstacles or other hazards (such as holes or excavations) within the work area been removed or secured and are warning signs in place and appropriate for hazards which cannot be mitigated?			
	3.5	Are materials stored /stacked safely and orderly to prevent hazards from falling, rolling or collapsing materials and trip hazards? Are storage areas appropriate for the items being stored?			
	3.6	Is the storage of hazardous materials on work site acceptable and labelled?			
	3.7	Have areas with specific fire risks within or close to the work site been identified (flammables or fuel storage areas etc.) and are minimum distances kept?			
☆	3.8	Are emergency precautions in the work area (including emergency escape routes, hydrants, fire extinguishers) accessible / unblocked?			
	3.9	Is the appropriate fire extinguishing equipment in place?			
	3.10	Are worker hygiene facilities, toilets, hand-wash stations, and/or lunch areas present and in good/clean condition?			
	3.11	Are first aid kits / facilities available?			
	3.12	Are emergency phone numbers displayed / available?			
	3.13	Is a map to the local hospital/clinic prominently posted/available?			
	3.14	Is ERM staff and contractors familiar with site-specific emergency procedures, escape routes, and assembly points?			
	3.15	Are specific site procedures being adhered to (such as speed limits, smoking, eating, cell phone use)?			
	3.16	Is the work site appropriately lighted?			
	3.17	Is the general housekeeping at the work site appropriate?			
	3.18	Are wastes appropriately collected and disposed of?			

		Field Visit Review Questions	Insert "X" or similar, below		
			Yes	No	N/A
	4	**Subsurface Clearance (SSC)**			
	4.1	Has an Experienced Person (EP) responsible for the supervision of SSC activities been appointed?			
☆	4.2	Has a Subsurface Clearance Project Plan (SCPP) been completed as part of the project HASP?			
	4.2.1	Have all parts of the SCPP been sufficiently completed (information sources, site service model, and any clearance waivers)?			
☆	4.3	Has a Location Disturbance Permit been completed for each drilling location?			
	4.4	Have all planned areas of disturbance been cleared (unless waived) by a public and private utility marking contractor using a Cable Avoidance Tool, Ground Penetrating Radar (GPR), or other suitable means?			
	4.5	Are utilities present within a 10 foot or 3 meter radius of drilling or excavation location? (if "no" or "N/A" move to Question 4.6)			
	4.5.1	Have the appropriate waivers been completed for performing intrusive work within a critical zone?			
	4.6	Have the appropriate tools been brought by the contractor to perform physical clearance, and equipped with the appropriate electrical insulation?			
☆	4.7	Has physical clearance been performed down to the following for each borehole? (If soft clearing was waived, moved to 4.9)			
		· 2 ft/60 cm beyond bottom of local frost line, or			
		· 5 ft/150 cm below ground surface (outside of critical zone), or			
		· 2 ft/60 cm deeper than the expected invert elevation or 8 ft/240 cm below ground surface (inside of critical zone).			
	4.8	Has the point disturbance been physically cleared to a diameter of at least 125% larger than the largest downhole tool?			
	4.9	If excavating, has the 2 ft/60 cm "no mechanical digging" buffer around subsurface structure or utility been adhered to?			
	4.9.1	Has hand digging been waived? If "yes", has a similar safety level been achieved (describe below)?			
	5	**Contractors**			
☆	5.1	Are all contractors being used approved per the local Contractor Pre-qualification process?			
	5.2	Does the contractor have the work specifications and understand the scope, and all HASP requirements/risks?			
	5.3	Is the contractor performance (housekeeping, adherence to rules, PPE) in accordance with the project HASP?			
	6	**Personal Protective Equipment**			
☆	6.1	Do onsite staff correctly wear the appropriate task specific PPE in accordance with the site HASP?			
	6.1.1	Is the PPE in use still effective/in good condition and within their designed lifespan? (i.e. clean high visible vest, worn respirators, old hard hats, etc.)			
	6.1.2	Is there a source/procedure for staff to replace/resupply worn or used PPE?			
	6.2	Through discussions with field personnel, are staff aware of the proper/storage/disposal of PPE?			
	7	**Chemical Exposure**			
☆	7.1	Has the potential for exposure to hazardous substances been identified, including exposure limits for chemicals and explosive atmosphere? (should be included in HASP)			
	7.2	Is monitoring equipment (such as PID, gas detectors, explosion meters) present, well-maintained, calibrated, and used as required by HASP?			
	7.3	Are emergency showers or eyewash facilities available if identified in the HASP?			
	7.4	Do field staff know the chemical exposure limits, as well as PPE requirements, and potential emergency procedures after accidental contact with chemicals?			
	7.5	Are worker and equipment decontamination procedures followed as required?			

7.6	Is appropriate safety information (Safety Data Sheets) available for chemicals used on site or hazardous substances likely to be present in the soil/groundwater?			

	Field Visit Review Questions		Insert "X" or similar, below		
			Yes	No	N/A
	8	**Machinery, Equipment and Vehicles**			
☆	8.1	Do ERM staff and contractors have the required training and authorizations to operate equipment and vehicles (such as driving or operating licenses)?			
	8.2	Are ERM and contractor machinery, equipment, and vehicles in good condition?			
	8.2.1	Have vehicle inspection checklists been completed for ERM-owned vehicles onsite?			
	8.3	Are vehicles/rigs regularly maintained and inspected as required (last inspection report available)?			
☆	8.4	Have risks from moving equipment and/or parts been addressed (e.g. being struck or hit by vehicles, caught by augers, etc.)?			
	8.4.1	Is machinery appropriately guarded, a work area/safety zone established, and are only the appropriate personnel allowed around the equipment in operation?			
	8.4.2	Are the emergency switch off devices present, in working order, and accessible from the work area?			
	8.5	Are electrical tools and connections in good condition and appropriate for the site conditions and their intended use?			
	8.6	Is portable electrical equipment electrically isolated (e.g., equipped with Ground Fault Circuit Interrupters - GFCI-, or double insulated) and are all electrical cords/plugs in good condition?			
	9	**Specific High Risk Hazards and Safety Procedures**			
☆	9.1	Is the “buddy system” being followed while onsite? (if “yes” move to Question 9.2)			
	9.1.1	Has a lone working procedure been established and being followed?			
☆	9.2	Are procedures for work at or near water required / established / followed?			
☆	9.3	Are lockout / tagout / de-energize procedures required / established / followed?			
☆	9.4	Is entering of confined spaces by contractors required? Have all permits and procedures established and followed?			
☆	9.5	If hot work is being performed, have all permits been obtained from site contact?			
☆	9.6	If work in explosion-protected areas required, have are all procedures established and being followed?			
☆	9.7	If work at heights are performed, is fall prevention measures in place? Are collective measures (scaffolding) preferred to individual measures (harnesses)?			
☆	9.8	If lifting / hoisting is required, is a Hoisting plan in place, including a pre-hoist equipment check?			
☆	9.9	Have all overhead risks been addressed (i.e. trees and power lines)?			

		Field Visit Review Questions	Insert "X" or similar, below		
			Yes	No	N/A
	1	**Travel Planning and Travel Risk Assessment**			
	1.1	Travellers, PMs and PIC with TRA training? Verify training in the Academy for onsite employees upon your return to the office.			
	1.2	Travellers, PMs and PIC with malaria awareness training? Verify training in the Academy for onsite employees upon your return to the office.			
☆	1.3	Has a Travel Risk Assessment (TRA) been prepared, and is the approved version onsite?			
	1.4	Has the TRA been reviewed and approved by required parties?			
	1.5	Has any Control Risk Group (CRG) advice been taken into account and appropriate prevention measures included in TRA, including standing travel advice?			
☆	1.6	Has experience and information from other ERM staff, client, and local embassies obtained and taken into account?			
	1.7	Are travellers comfortable with all planned travel arrangements?			
	1.8	Have the travel arrangements been discussed within project team prior to departure?			
	2	**Travel to and In Country Travel – Accommodation & Safety**			
	2.1	Has whole itinerary been considered, including intermediate locations in different destinations (customs/visas issues)?			
	2.2	Have arrangements been made to be met at airport by contact for High Risk Countries?			
☆	2.3	Have in-country travel risks been assessed and information obtained with regard to reliability of transportation plans?			
	2.4	If vehicle or driver services are to be used, are vehicles in good condition and are the drivers deemed reliable?			
	2.5	Are the accommodations and living premises during travel appropriate?			
☆	2.6	Have natural / environment hazards been assessed for travel and destination and have prevention measures been implemented (insects, animals, plants, climate, etc.)?			
	3	**Health / Medical**			
	3.1	Have hygiene and health risks been assessed and suitable arrangements implemented?			
☆	3.2	Have vaccination, medical prophylaxis and expert medical advice obtained and implemented?			
	3.3	Are food and drink provided of appropriate standards?			
	3.4	Are project specific medical exams required and being performed as scheduled?			
	4	**Emergency Preparedness, Security and Terrorism**			
	4.1	Has insurance limitations and/or needs for additional insurance coverage been verified (e.g. additional insurance premium for disturbed or remote locations)?			
☆	4.2	Has means and schedule of communication been established, verified and described in TRA?			
	4.3	Has registration for country-specific CRG or International SOS alerts – CRG consulted prior to departure for high risk locations?			
	4.4	Has registration to local embassy been completed?			
☆	4.5	Have security and terrorism risks assessed and prevention measures implemented?			
	4.6	Has an evacuation plan established?			

Secondment Additional Questions		Insert "X" or similar, below		
		Yes	No	N/A
1	**Project Planning**			
1.1	Is the HASP prepared, including health, safety and security risks appropriate to ERM tasks, client facilities, project environment and travel/accommodation?			
1.2	Has workload and work/rest distribution been considered (including travel time to and from the site)? (travel and work hours should be below 12 total)			
1.3	Are the contact people defined, responsibilities defined and communication schedule established with the ERM team (definition of relationships/responsibilities and communication/reports)?			
1.4	Are consultants in secondment with appropriate qualification and training?			
1.5	Are specific project-related medical exams implemented?			
1.6	Has any client-specific training received by consultants?			
1.7	Has any client-specific standards communicated and understood?			
2	**Project Implementation**			
2.1	Is confirmation of both parties understanding the expectations/deliverables of the project available?			
2.2	Are the appropriate arrangements in place as planned?			
2.2.1	- systems & utilities			
2.2.2	- equipment			
2.2.3	- PPE			
2.2.4	- accommodations			
2.2.5	- travel means			
2.2.6	- emergency instructions, facilities and equipment			
2.3	Conflicting or redundant ERM / Client policies identified and managed?			

Project Field Audit Scoring
(To be completed upon return to office, within excel file)

The audit score should be provided to the project leadership on the basis that the score indicates the relative condition of their project's health and safety compliance. Additionally, it should be communicated that no matter how well or poorly the project performed, the goal for all projects are 100% compliance and any corrective actions should be performed as quickly as able, and to the fullest extent.

Each audit item was given a weighted score based on its importance/level of risk associated with the hazard/impact to the project or staff/relation to the 5 For Life (driver and vehicle safety, travel safety and security, subsurface clearance, short-service employees, and marine/offshore activities).

		Project Score Percent
Project Score	254	100%
Total Score Possible	254	

Audit Findings Action Plan (attach a separate sheet if needed)			
Finding *(Please provide checklist ref.)*	**Corrective Action** *(be specific)*	**Person/Party Responsible**	**Target Date**

Other observations / Auditor's Notes / Photos / Additional comments from interviewees, including positive observations: (use separate sheets as needed)

Supporting Documents

	Applicability:	Guideline	Document Number:	Version:
ERM	North America		NAM-1110-GU1	3
	Title: **Project Manager Health and Safety Checklist**		**Last Revision Date:**	6/27/17

Project Name:	G.W. Lisk Remedial Investigation
Project Manager (PM):	Jon S. Fox
Start/End Date:	TBD
Project Partner in Charge (PIC):	Ernest Rossano
Project Field Safety Officer (FSO):	Tim Daniluk

This document can be used by the PM to identify project health and safety requirements for project planning, project site work, and project closeout. It can also serve as guideline to give to project team members to inform the team of health and safety planning undertaken and team efforts required.

Project Planning		
Applicable?	**Description**	**Details**
☒ Y ☐N	Level of health and safety plan (HASP) has been determined (Email, Level 1, Level 2, or Level 3 HASP)	Click here to enter text.
☒ Y ☐N	Risks of travel have been identified (Travel Risk Assessment or Journey Management Plan)?	Click here to enter text.
☐ Y ☐N	Health and Safety (H&S) team has reviewed Level 2 or Level 3 HASPs	Click here to enter text.
☐ Y ☐N	For all levels of HASP, the project PIC has given written approval	Click here to enter text.
☐ Y ☐N	For projects that must undergo Project Liability Analysis (PLAN) analysis, risk review is provided to H&S team during HASP review	Click here to enter text.
☐ Y ☐N	Job Hazard Analyses (JHAs) obtained from contractors and provided to H&S team during HASP review	Click here to enter text.
☐ Y ☐N	Personal protective equipment (PPE) requirements have been determined for each task	Click here to enter text.
☐ Y ☐N	Real-time/industrial hygiene/noise monitoring requirements have been determined based on chemical exposure potential at the site	Click here to enter text.
☐ Y ☐N	Contractors utilized for the project are green-flagged in PICS	Click here to enter text.
☒ Y ☐N	Medical surveillance requirements for ERM and contractor employees have been determined	Click here to enter text.
☒ Y ☐N	Training requirement, including client-specific HS requirements, for ERM and subcontractor employees have been determined	Click here to enter text.
☒ Y ☐N	Applicable permits, notifications, and registrations have been identified	Click here to enter text.
☒ Y ☐N	ERM personnel identified and assigned to the project meet training/medical requirements	Click here to enter text.
☒ Y ☐N	Trained and qualified ERM FSO has been identified and assigned to the project (as applicable)	Click here to enter text.
☒ Y ☐N	SNAP Cards (*ERM-1140-FM1*) will be used on the project and procedures for using have been explained to ERM and contractors employees	Click here to enter text.

☐ Y ☐N	ERM HASP provided to each contractor firm involved in the project along with minimum health and safety requirements each firm must meet	Click here to enter text.
Project Work		
Applicable?	**Description**	**Details**
☐ Y ☐N	ERM personnel and FSO have not changed since project planning phase, or new personnel meet training and medical surveillance requirements?	Click here to enter text.
☒ Y ☐N	Health and safety included in initial project kickoff meeting or separate health and safety kickoff meeting has been planned	Click here to enter text.
☒ Y ☐N	Site Safety Meeting Form (*NAM-1501-FM1*) is at the project site and used to discuss safety each day with ERM and contractor employees onsite	Click here to enter text.
☒ Y ☐N	Everyone on site informed that any change to work scope (weather conditions, personnel, timing, etc.) require short meeting to determine if the change compromises personnel safety	Click here to enter text.
☒ Y ☐N	All PPE and emergency equipment identified in the HASP and JHAs is present at the project site	Click here to enter text.
☒ Y ☐N	Emergency contact information, emergency evacuation/assembly point, and route to nearest medical facility are included in HASP and posted at the site	Click here to enter text.
☒ Y ☐N	Guidance on how to handle a regulatory inspection (*NAM-1944-PR1*) is at the project site	Click here to enter text.
☐ Y ☐N	Training/medical surveillance documents are collected by PM for each contractor employee	Click here to enter text.
☒ Y ☐N	Safety Data Sheets (SDS) are located at the project site for each chemical ERM or contractor brings to the site	Click here to enter text.
☐ Y ☐N	Method to keep site visitors out of ERM work areas has been determined and managed by FSO	Click here to enter text.
☒ Y ☐N	For project work lasting longer than one week, a Field Safety Audit will be conducted, kept with project files, and recorded in the Active Leadership Audit Program (ALAP) database	Click here to enter text.
Project Closeout		
Applicable?	**Description**	**Details**
☐ Y ☐N	Project HASP, JHAs, PM H&S Checklist, subcontractor training/medical documentation, daily Site Safety Meeting Forms, work permits, air and/or noise monitoring and calibration results are placed in project file	Click here to enter text.
☐ Y ☐N	Project team has performed a post-project brainstorming session to close any ECS events and determine any lessons learned	Click here to enter text.

Project Name:	G.W. Lisk Remedial Investigation
Project Manager (PM):	Jon S. Fox
Partner-in-Charge (PIC):	Ernest Rossano
Start/End Date:	TBD

Part I: Project Scope and Team

1. What is the general scope of work for this project?

The purpose of the RI Work Plan is to define the nature and extent of contamination; identify contaminant source areas; evaluate potential exposures; and produce data of sufficient quantity and quality to support the development of an acceptable Remedial Alternatives Analysis (AA) or Remedial Action Work Plan (RAWP). ERM and its subcontractors will be performing the work indicated below.

2. Who are the key ERM members of the envisioned project team?

Role	Assigned
Partner-in-Charge (PIC)	Ernest Rossano
Project Manager (PM)	Jon S. Fox
Field Safety Officer (FSO)	Tim Daniluk
Construction Manager	Click here to enter text.
Subject Matter Expert (SME)	Click here to enter text.
Other: SSC Experienced Person	Jason Reynolds
Other: Click here to enter text.	Click here to enter text.

3. Who are ERM's direct contractors for this project? Ensure that all contractors are green-flagged in PICS prior to work start.

Contractor	Task
NYLD	Subsurface utility location
Parratt-Wolff, Inc.	Soil Boring, Monitoring Well Installation
Alpha Analytical	Sample Analyses
Click here to enter text.	Click here to enter text.
Click here to enter text.	Click here to enter text.
Click here to enter text.	Click here to enter text.

Part I Completed: *PM Initials:* Click here to enter text. *Date:* Click here to enter a date.

Part II: Project Security Issues

4. Is full-time security needed/required?

Not Required

5. Who controls site access?

The Client.

6. How is site access controlled?

Click here to enter text.

7. What site constituents pose special security risks (e.g., highly toxic chemicals or very valuable materials)?

Potential chemical exposure during soil/water sampling and ground intrusive activities.

8. Are there hazardous materials (e.g., drill cuttings or other wastes) that will be shipped from the site?

Samples will be sent to lab for analysis.

9. Are there community issues that may impact safety?

None.

10. If work will affect local traffic patterns, are plans in place to contact authorities for specific local requirements?

N/A

Part II Completed: *PM Initials:* Click here to enter text. *Date:* Click here to enter a date.

Part III: Project Environmental Issues

11. Where is the site located (provide address)?

G.W. Lisk Facility, 2 South Street, Clifton Springs, New York

12. What regulations will apply to the work (e.g., EPA, State or local regulations, building codes, etc.)?

Preparation of a SC Work Plan will be consistent with applicable requirements contained in the DER-10

13. What aspects of the work will require specific professional training, certification, or licenses (e.g., State contractor's license, Professional Engineer seal, etc.)?

Oversight of ground intrusive work requires at least one employee to possess SSC Experienced Person training and certification. Preparation of a RI Work Plan will be consistent with applicable requirements contained in DER-10.

HAZWOPER training is required for all employees.

Part III Completed: *PM Initials:* Click here to enter text. *Date:* Click here to enter a date.

Part IV: Client-Specific Requirements

14. What client-specific health and safety (H&S) above and beyond what would normally be specified in the ERM health and safety plan (HASP) will impact the work? Examples may include site-specific training, use of client-specific incident reporting procedures, loss prevention training, and permit-to-work policies.

Click here to enter text.

Part IV Completed: *PM Initials:* Click here to enter text. *Date:* Click here to enter a date.

PART V: Project Health and Safety Planning/Execution Checklist		
Item	**PM Initials**	**Date Complete**
Draft HASP Preparation		
Applicable HASP documents completed.	Click here to enter text.	Click here to enter a date.
Approximate scope of work and tasks developed.	Click here to enter text.	Click here to enter a date.
Applicable procedures from the Global Safety Management System (SMS) identified.	Click here to enter text.	Click here to enter a date.
Site constituents identified; appropriate informational sheets on each collected.	Click here to enter text.	Click here to enter a date.
Safety Data Sheets (SDS) acquired for chemicals/materials that will be used to help complete the work.	Click here to enter text.	Click here to enter a date.
Personal protective equipment (PPE) and respiratory protection assessment has been performed.	Click here to enter text.	Click here to enter a date.
Medical surveillance requirements have been determined.	Click here to enter text.	Click here to enter a date.
Draft Job Hazard Analyses (JHAs) have been prepared for envisioned work tasks.	Click here to enter text.	Click here to enter a date.
Client approval prior to issuing draft HASP for bid.	Click here to enter text.	Click here to enter a date.
HASP Finalization and Pre-mobilization		
Contractors' means and methods understood.	Click here to enter text.	Click here to enter a date.
Final JHAs prepared with input of contractors.	Click here to enter text.	Click here to enter a date.
HASP reviewed by member of ERM North America HASP review team.	Click here to enter text.	Click here to enter a date.
HASP signed by ERM Project Team.	Click here to enter text.	Click here to enter a date.
Project FSO appointed and made familiar with the HASP.	Click here to enter text.	Click here to enter a date.
Subcontractor personnel training documentation received and verified.	Click here to enter text.	Click here to enter a date.
First Day on Site		
All site personnel read and sign the HASP. Note that subsequently arriving site personnel must also read and sign the HASP prior to initiating site work.	Click here to enter text.	Click here to enter a date.
All site personnel training requirements verified. Note that subsequently arriving site personnel must also provide ERM with appropriate training documentation.	Click here to enter text.	Click here to enter a date.
All "first day" HASP review and training completed at the site.	Click here to enter text.	Click here to enter a date.
Project Close Out		
Ensure that all medical monitoring requirements have been met.	Click here to enter text.	Click here to enter a date.
Ensure that all ECS entries have been finalized.	Click here to enter text.	Click here to enter a date.
Ensure that all action items, if any, from any incident, near miss, unsafe act, or unsafe condition ECS reports have been completed.	Click here to enter text.	Click here to enter a date.
Ensure that all subcontractor safety performance information has been obtained and the performance evaluation has been conducted.	Click here to enter text.	Click here to enter a date.
Transfer site health and safety files to the office.	Click here to enter text.	Click here to enter a date.
Consolidate project health and safety files.	Click here to enter text.	Click here to enter a date.

No.	Issue	Considered?	Additional Actions Necessary Before Beginning Work?
Personnel Management			
1	Does the team have directions on where to park?	☐ Y ☐ N ☐ NA	
2	Does the team have instructions on facility access in accordance with client/facility security?	☐ Y ☐ N ☐ NA	
3	Has the team reviewed site-specific hazards and acquired personal protective equipment (PPE) necessary for work at the facility?	☐ Y ☐ N ☐ NA	
4	Has the team discussed the need for and/or requirements regarding unaccompanied movement within the facility?	☐ Y ☐ N ☐ NA	
5	Has the team been briefed on emergency response requirements within the facility?	☐ Y ☐ N ☐ NA	
6	Has the team been informed of any chemical, physical, biological, or radiological hazards that may be encountered during the site visit?	☐ Y ☐ N ☐ NA	
7	Do any team members have health conditions that could make it unsafe to work in specific areas of the plant (e.g., asthma, skin conditions, allergies, pregnancy, etc.)?	☐ Y ☐ N ☐ NA	

Additional Advisory Information		
Hazards	**Control Measures**	**Comments & Follow Up**
Moving vehicles	Visitor parking areas, walkways, designated vehicular gates	Park in designated areas; be alert to truck and other traffic while entering/leaving the facility.
Chemical contact and exposure	Facility engineering controls, facility-designated boundaries and signs, use of required PPE	Know facility requirements on unaccompanied movement; follow posted signs and rules; wear the required PPE.
Walking and working surface hazards	Well-maintained walkways, aisles, stairs, railings, attention to work area	Do not go into potentially unsafe areas; avoid badly cluttered, contaminated, or poorly lit areas.
Plant emergencies from fire, explosion, or other	Facility engineering and operational controls, alarms, response plans and drills	Ensure emergency response to alarms is explained to all team members; follow facility rules on working alone.
High noise levels	Engineering controls, use of hearing protection, limit time in high noise areas	Wear hearing protection in areas designated by facility or if there is the potential for discomfort or distraction from the noise.
Moving facility equipment (e.g., forklifts, aerial lifts)	Alarms, demarcated travel paths	Be observant of all moving facility equipment and back-up alarms; stay on marked travel paths where available.
Work at elevated heights	Railings	Limit work at elevated heights. If required, stay within areas protected by guardrails.
Confined spaces (e.g., pits, vessels, bag houses, sewers)	Signage, secured against inadvertent entry	Do not enter confined spaces on any facility unless you have been formally trained on general confined space entry (CSE), as well as the facility's CSE program; contact your Business Unit Health and Safety Director for consultation.
Temperature extremes (hot or cold); inclement weather	Pre-planning for anticipated weather conditions, planned breaks from extreme exposures	Conduct facility tours and outside work during the most comfortable part of the day; provide appropriate outerwear based on weather conditions; take breaks from weather extremes as needed or in accordance with developed work/rest schedules.
Working alone/ injured and unattended	Initial decisions on ERM moving alone in the facility and property, determining sign-in and sign-out rules, and letting people know where you are going and anticipated length of time.	If working alone, then heightened awareness of potentially risky situations is essential.
Contact with moving production equipment and live electrical equipment	Machine guards, closed electrical cabinets, warning signs and barriers	Do not touch any plant equipment unless it is properly shut down/locked out and you have asked permission.

1. Purpose and Scope

This document establishes the procedure to provide a consistent approach for the internal investigation of health, safety and environmental events. This procedure is used when ERM is required to investigate and report findings related to an event as per the *Event and Non-Conformity Management* Procedure. Investigations that are required by clients shall conform to either this procedure or a similar procedure defined by the client.

2. Roles and Responsibilities

Partner in Charge (PIC) or Local Managing Partner. Coordinate event investigation for Actual Severity 1 events or lower.

Business Unit Managing Partner (BUMP). Coordinate event investigation for Actual Severity 3 and 5 events.

Regional CEO. Coordinate event investigation for Actual or Potential Severity 7 events.

Group CEO. Coordinate event investigation for Actual Severity 10 events.

Regional Legal. Direct the investigation of an Actual Severity 7 or 10 event.

Account Director. Shall, in conjunction with the PIC, define client-specific requirements for event investigations required for projects being performed under their remit. Account Directors shall also review and approve any investigation report prior to submission to the client.

3. Definitions

Event Severity. A means of quantifying the actual and potential seriousness of an incident or near miss based on criteria defined in the *Event and Non-Conformity Management* Procedure.

4. Procedure

4.1 Establishing Event Severity

Based on the criteria presented in the *Event and Non-Conformity Management* Procedure, all incidents and near miss events will be classified with an Actual and Potential Severity rating. The designation of severity governs the approach and rigor of the event investigation.

4.2 Investigation Team Selection

Based on the Actual Severity of an event, the investigations shall be coordinated by the individual designated in Section 2 of this procedure. At the discretion of the responsible investigation coordinator, additional investigation team members may include:

- Involved Staff Members;
- Project Manager;
- Line Manager of involved staff members;
- BU MP/Regional Service Leader;
- GKC Managing Partner/Account Manager/Account Director
- Local/BU/Regional Safety Lead;
- Global H&S Director (GHSD);
- Other legally required local function(s) (e.g. workplace safety committee members); and
- Subject matter experts.

4.3 Investigation Process

4.3.1 All Investigations

The team will follow an appropriate investigation technique to determine the following:

- Sequence of events leading up to the event and steps followed immediately following the event that may have had an impact on the final outcome.
- Identification of the People, Environmental, Equipment, Procedural, Organizational and other factors involved in the event, as presented in *Event Investigation Considerations*.
- Determination of root cause(s) using techniques agreed to by the lead investigator and Safety Lead. (Note: Example root cause investigation tools include "5 Why's", Cause-Effect Diagram,TapRoot, Fishbone Diagram, etc.).

4.3.2 Actual Severity 5 or Lower Investigations

When an investigation is required by the *Event and Non-Conformity Management* Procedure, the Investigation Team will complete its review of the event within 14 calendar days of the initial notification of the event (i.e. Date Reported within ECS). The investigation report shall be attached to the ECS event record and used to complete the appropriate fields within ECS. All findings and recommended Corrective and Preventive Actions (CAPAs) associated with the event investigation will also be entered into the ECS. When an investigation is not specifically required by the *Event and Non-Conformity Management* Procedure, all required and appropriate fields within ECS, including identified CAPAs, shall be completed within 14 calendar days of the initial notification of the event.

4.3.3 Actual Severity 7 or 10 Investigations

The Investigation Team, as directed by Legal, will prepare a Preliminary Investigation Report within 14 calendar days of the initial notification of the event. This preliminary report will document as many of the facts surrounding the event as possible including, but not limited to, the following:

- Update of the current status of (individuals, equipment, property, etc.) impacted by the event,
- description of the site conditions at the time of the event,
- listing of statements/interviews completed by the investigation team,
- listing of personnel involved in the event including staff and management of ERM, ERM contractors, client, and/or third parties,
- listing of tools and equipment utilized by the team/individuals,
- listing of processes and procedures governing the activities involved, and
- identification of information and/or data gaps needed to conclude the investigation.

The preliminary investigation report shall be issued by the Investigation Coordinator to the designated ERM Legal counsel directing the investigation. Distribution of the report shall be at the discretion of counsel.

4.4 Report Format and Senior Management Review for Actual Severity 7 or 10 Events

The final investigation report format for all events classified as Actual Severity 7 or 10 shall follow the sample template provided in *Event Investigation Report* or another format meeting similar expectations as stipulated by ERM legal counsel.

All Actual Severity 7 or 10 investigations will involve a formal conference call to review the draft final investigation report. The conference call will be arranged by the Investigation Coordinator and shall occur within 7 calendar days following submission of the preliminary investigation report. (unless otherwise directed by the Group CEO, Chief Legal Counsel or GHSD).

Required participants for the conference call will include:

- Regional CEO,
- Responsible BU MP and Local MP,
- Regional Legal,
- Responsible Line Manager (office-based) or PIC and Project Manager (project-based) of the injured/involved employee,
- Regional Safety Lead, and
- GHSD.

Other participants may include, at the discretion of the Regional CEO and/or GHSD:

- Global/Regional HR;
- Global Key Client Account Director, Regional Account Manager and/or Safety Advisor
- Relevant subject matter experts; or
- Members of ERM Executive Committee (ExComm) or Senior Leadership Team (SLT).
- Direct participation by the employee(s) involved in the event is not necessary and requires prior approval from the Senior Manager assigned to the event review committee. Other members of the event review committee will be at the discretion of the most Senior Manager involved in the committee and Legal.

Following the investigation review conference call the Investigation Coordinator, under the direction of Legal, shall issue a final Investigation Report to the ExComm. CAPAs identified by the investigation process must be entered into ECS and tracked to closure . Learnings will be incorporated into a Safety Alert. The Safety Alert shall be published within 5 calendar days following publication of the final Investigation Report.

4.5 High Learning Value Events

In addition to any event with an Actual Severity rated as 7 or 10, the GHSD and/or responsible Regional Safety Lead, Local Managing Partner, BU Managing Partner or RCEO may require any event, regardless of Actual Severity, to be escalated for investigation and review through a more senior, Global Review team. The investigation deliverables and timeframes for these events are at the discretion of the Regional Management Team and Regional Safety Lead.

4.6 Communication of Investigation Results

Where appropriate based on the learning value of any event, a Safety Alert shall be prepared by the lead investigator regardless of severity rating. The Safety Alert will be communicated to the most appropriate audience (i.e., regional, national, service line only, etc.).

CAPAs identified by the investigation teams will be entered into ECS and tracked to completion. Additionally, the results will be utilized to develop appropriate regional, national, key client and service area reports and to improve existing procedures.

Where required by local legislation and/or regulation or contract requirements, final event investigation reports shall be provided to the appropriate workplace safety committees.

4.6.1 Internal Communication Protocol for an Actual Severity 7 or 10 Event

It is important that communication within ERM be carefully managed following an Actual Severity 7 or 10 event.

It is preferable for any initial communications (i.e., communication which occurs within the first hour of an event occurring) from ERM employees be conducted by telephone, with Legal representatives on the line until such time as an ERM staff member is appointed as central point of contact to avoid confusion and unnecessary documentation.

In some cases, it will be appropriate for an Actual Severity 7 or 10 event response and investigation to be carried out under the direction of ERM Legal. This will occur where ERM contemplates actual or anticipated legal proceedings arising from an event and is seeking legal advice on its position. Where an investigation is conducted under Legal direction, it is important to ensure that all communication (including electronic mail) is also copied to ERM internal and/or external legal and is marked "**Attorney-Client Privilege; Attorney Work Product**."

Before creating any written documentation relating to an Actual Severity 7 or 10 event, the PIC and Local Managing Partner will contact the Regional Safety Lead and Regional Counsel to ascertain how communication should be handled in relation to that particular event.

ERM employees should be aware that all written communication (including emails) and documents created as a result of the event can likely be obtained by government agencies, as well as the client and injured third parties, and used to form part of an investigation into the event. For this reason, ERM employees should always record only factual information and avoid speculation as to the cause of an event in any documentation. Verbal communication related to the event should also be restricted to those persons who have a role related to the investigation and limited to the identification of facts, not speculation as to fault

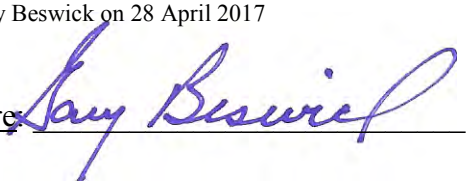
5. References

- ERM-1200-PR1 – Event and Non-Conformity Management Procedure
- ERM-1220-FM1 – Event Investigation Considerations
- ERM-1220-FM2 – Event Investigation Report

Document Control Information

Original Effective Date: 1 April 2015

Approved by: Gary Beswick on 28 April 2017

Approval Signature: 

Revision History

Section	Version: Reason for Revision	Date
All	1.0: New document.	29 Dec 2014
4.3.3	2:0 Added a sentence to allow the GHSD and/or Global Programs Director to require a Severity 7 / 10 level review for any event, regardless of Actual Severity.	20 Feb 2015
4.3.3	3.0:Modified Section title to remove "Potential".	23 Sept 2015
All	3.1: Updated links, tagline, and document number	28 Dec 2016
All	4.0: Clarified investigation requirements based on Actual Severity; updated organizational terminology (local Managing Partner, Safety lead, etc.) (All)	28 April 2017

1. Purpose and Scope

This document establishes the requirements for vehicular travel while on ERM company business (excluding public transportation). This procedure defines the minimum requirements; more stringent local requirements may be applicable.

2. Roles and Responsibilities

Business Unit (BU) Fleet Manager. Implement written procedures to manage the BU fleet in accordance with this procedure.

BU Managing Partner (MP). Establish driver training programs (as applicable); authorize employees that are permitted to operate a motor vehicle on company business; designate a BU Fleet Manager if the BU has leased or owned vehicles.

Employees. Notify their line manager within one day of suspension or revocation of their driver's license, if an Authorized Driver.

Journey Leader. Complete the JMP, pre-departure checks, and required check-in calls. The Journey Leader shall be identified in the JMP, and is typically the primary driver.

Journey Point of Contact. Receive the JMP identified check-in calls, initiate response plan in JMP if check-in call not received.

Partner in Charge (PIC). Ensure client-related driver training requirements have been communicated to the project team and implemented; approve Project-related Journey Management Plans (JMPs).

3. Definitions

Authorized Driver. ERM employee permitted by the BU MP to operate a motor vehicle while on company business.

Company business: All driving associated with ERM work, with the exception of an employee's standard commute from home to the office.

Defensive Driving: A driving technique that aims to reduce the likelihood of a serious accident by anticipating dangerous situations, despite adverse driving conditions or the mistakes of other drivers. In some locations, this is also known as Alert Driving.

Gross Vehicle Weight Rating (GVWR): Maximum operating weight of a vehicle as specified by the manufacturer.

Hired vehicle: Vehicle provided by a vehicle rental company that includes a driver.

Leased vehicle: A vehicle under a long-term rental agreement between the vehicle rental company and ERM.

Off-road driving: Any driving that does not occur on a permanently maintained road, with the exception of driving that occurs completely within the project site.

Remote driving: Driving in a location where emergency assistance may not be readily available or present (e.g., unpopulated areas on non-major highways), areas with known security concerns, or any other area deemed "remote" by the driver (i.e. driver is uneasy or uninformed about the destination).

Rented vehicle: Vehicle provided by a vehicle rental company that an ERM employee will be driving.

Vehicle used for Field Work: For the purposes of this Procedure, a vehicle is used for field work if the vehicle is driven for intrusive field activities, gauging, sampling, operations and maintenance (O&M), construction, demolition, or any work at remote sites; including motorcycles, motor bikes and all-terrain vehicles (ATVs).

4. Procedure

4.1 Risk Assessment and Planning

All vehicular travel shall be considered as a distinct task in the health and safety planning process, and shall have a Job Hazard Analysis (JHA) completed in accordance with the *Project Health and Safety Planning* Procedure. In addition to the JHA, a documented and approved Journey Management Plan (JMP) is mandatory for the following conditions:

- Single day journey in excess of 500 km (310 miles)
- Single day estimated driving duration in excess of 4.5 hours
- Driving in a remote location (including off-road driving)
- Driving in any location/region identified as "High Risk" by Control Risk Group (CRG) and/or Regional H&S Lead

The JMP shall be completed using *ERM-1430-FM1*, shall designate a Journey Leader and a Journey Point of Contact, and shall be approved by the PIC (or the Journey Leader's supervisor if the Journey Leader is the PIC or there is no PIC associated with the travel). A copy of the JMP shall be maintained with the traveller and in the Project File.

4.2 Driver Requirements

4.2.1 Minimum Expectations

All Authorized Drivers shall meet the following requirements:

- Hold a valid and current driver license for the class of vehicle to be operated. It is the responsibility of the employee to inform his/her supervisor within the next working day of a driver license suspension or revocation.
- Not use a mobile phone while operating a vehicle (per *ERM Global Policy – Mobile/Cellular Telephone and Personal Digital Assistant (PDA) Use While in a Vehicle*).
- Not be under the influence of alcohol or drugs, or any other substance or medication that could impair their ability to drive (per *ERM Global Policy – Drug and Alcohol Use*).
- Inspect vehicle prior to each use and confirm that there are no obstacles in the vehicles travel path or under the vehicle by completing a 360° walk around the entire vehicle.
- Follow all posted signs and speed limits, all applicable laws and regulations, and any client-specific or site specific vehicle safety policies.
- Not drive a vehicle (including a combination vehicle) with a combined gross vehicle weight rating (GVWR) in excess of 10,001 lbs (4,500 kg) without written authorization from the RCEO and appropriate regulatory licensing.

All Authorized Drivers should consider the following best practices:

- Utilize a "Back-In" or "First Move Forward" practice when parking a vehicle.
- Review weather conditions prior to travel and avoid driving in adverse conditions. Consider the anticipated road conditions and terrain and ensure the vehicle is fit for purpose.
- Obtain written directions prior to travel in an unfamiliar location.
- Be familiar with and comfortable operating the vehicle to be driven.

To avoid fatigued driving, all Drivers must:

- Plan a 15 minute break after every two hours of driving.
- Not drive more than 8 hours/day.

To avoid fatigued driving, all Drivers should:

- Avoid driving between 10 p.m. and 5 a.m.
- Share driving with others, if possible.
- Avoid driving if doing so will result in more than 12 hours of work-related activities (for example, limit driving to 4 hours after an 8 hour field day; limit driving to 6 hours after 6 hours in the office).
- Avoid driving after a flight of six hours or more without appropriate rest.

Project budgeting and trip planning must consider the above. Local regulations may be more stringent.

4.2.2 Authorized Driver Training

It is the responsibility of the PIC to ensure client-related driver training requirements have been communicated to the project team and implemented. All personnel training required by this procedure shall be documented in ERM Academy.

All Authorized Drivers must certify, on an annual basis, that:

- They have read and understand the requirements of this Procedure; and
- They hold a current driver's license valid in the location where they will be driving.

All Authorized Drivers that operate a vehicle in excess of 5000 km/annum (3100 miles/annum) on company business must receive Defensive Driver training. Refresher training shall be provided once every three years.

It is the responsibility of the BU MP to:

- Develop and maintain a means of tracking an Authorized Driver's annual work related driving (note, this is not required if all Authorized Drivers receive defensive driving training regardless of miles driven)
- Establish a defensive driving training process, in consultation with the Regional H&S Lead.

Drivers that perform the following high risk activities must have specific training on safe methods for completing these activities:

- Towing of equipment or a trailer
- Off-road driving
- Driving a vehicle with GVWR greater than 10,001 lbs

4.3 Vehicle Operation

4.3.1 Minimum Requirements

The following minimum requirement shall apply:

- Passengers and drivers are required to wear available passenger restraints (i.e. seatbelts with shoulder harness) while operating or riding in a vehicle.
- The number of passengers carried shall not exceed the seating capacity specified for the vehicle.
- Transporting people in the bed of a pickup truck is prohibited.
- Smoking within a vehicle is prohibited.
- Loose equipment in passenger compartments, in the back of pickup trucks, and on trailers shall be secured before driving.
- Unattended vehicles (even for a short period of time) shall be locked so that all equipment inside them is secured (verify the vehicle is locked before walking away).

Critical documents and equipment should be removed from the vehicle if unattended or locked in the trunk/boot of the vehicle.

A vehicle used for field work shall:

- Be inspected before the first use onsite and then on a weekly basis afterwards. These inspections shall be documented using the *Vehicle Inspection Checklist*.
- Maintain the minimum safety equipment listed in Section 4.5.

4.3.2 Towing of Trailers or Equipment

No ERM employee shall tow a trailer or equipment without having first received documented training on safe towing methods. The BU MP shall establish a safe towing training process (if required), in consultation with the Regional H&S Lead.

At a minimum, an ERM employee towing a trailer or vehicle shall:

- Refer to and comply with the vehicle owner's manual for safe towing capacity.
- Conduct an equipment inspection prior to use to ensure that weight is distributed evenly and that warning/signal lights are working properly.
- Use a spotter when driving in reverse.

The use of straps or chains for towing purposes is prohibited.

4.3.3 Motorcycles, Motor Bikes and All-terrain Vehicles (ATVs)

At a minimum, the driver of a motorcycle or motor bike on company business shall comply with the following:

- No passengers shall be permitted.
- Driver shall wear a suitable helmet.
- The driver's helmet shall have a face-shield, unless the motorcycle / motor bike is equipped with a windshield.
- Nothing may be carried that is not fully enclosed within a worn backpack or within a permanently installed "saddlebag" or trunk.
- A specific JHA has been completed and approved by the BU MP for the motorcycle / motor bike travel, and no other means of travel is feasible.

ATVs may only be used if a specific JHA has been completed and approved by the BU MP. Three-wheeled ATVs are not permitted for use at any time.

Note that the use of motorcycles, motor bikes, and/or ATVs may be prohibited by certain clients.

4.4 Vehicles

4.4.1 Minimum Expectations for All Vehicles

All vehicles used for company business (including vehicles provided by and/or driven by external vendors, clients, etc.) shall be in safe working order and suitable for the task. In addition, the vehicle used shall have a valid vehicle registration, valid insurance coverage and be current on all road taxes (where applicable) in accordance with the local regulatory requirements. Vehicles shall meet the following minimum expectations:

- Anti-lock braking system (ABS)
- Air bags fitted for driver and passenger side
- Three point lap/diagonal seat belts for front and rear outboard seats and lap belts for all other seats;

The PIC is required to specifically document and justify a variance from the above requirements in the travel JHA.

4.4.2 Rented or Hired Vehicles

When possible, the rental company should be a company with which ERM has negotiated rates and contract terms. When renting a vehicle:

- Proof of inspection must be available to the driver.
- If employees cannot rent from a preferred provider with negotiated contract terms, the employee should purchase the collision damage waiver and personal accident insurance.

When hiring a vehicle and driver, ensure that a means for identifying the car and driver has been established prior to pick-up.

4.4.3 Taxi Cabs and other Point-of-Hire Vehicles

Employees should avoid using taxi cabs without seat belts for all passengers. The employees should encourage the driver to wear their seat belt, not use their mobile devices, and follow all posted speed limits and traffic laws. The use of the *Taxi Card* is encouraged.

4.4.4 Personal Vehicle

The use of personal vehicles for driving on ERM business should be avoided. If personal vehicles are used, it is the employees responsibly to ensure that the vehicle has all required licensing and insurance coverage for business use, that all maintenance requirements are met and all safety equipment is available.

4.4.5 Company Owned or Leased Vehicles

For any ERM BU with owned or long-term leased vehicles, it is the BU MP's responsibility to formally designate a BU Fleet Manager. The BU Fleet Manager is responsible for the maintenance, inspection and repair of fleet vehicles, including:

- Vehicles shall receive regular, documented maintenance in accordance with the manufacturer's recommended schedule
- Vehicles shall have appropriate and current insurance coverage and road taxes (where applicable)
- Vehicles shall have the following safety equipment, unless a written waiver is received from the RCEO:
  - Anti-lock braking system (ABS).
  - Air bags fitted for driver and passenger side.
  - Head rests for front seats.
  - High-level third brake light.
  - Functional hazard lights.
  - Laminated glass windscreens/windshields and tempered glass side & rear windows.
  - Mirrors, outboard driver and passenger side and internal rear view mirror.
  - Tires must be fit for purpose, terrain and season (i.e., snow, off-road, all terrain), and in good condition (e.g., with suitable tread depth).
  - Spare tire in new or in relatively good condition, and an operational jack.
  - Three point lap/diagonal seat belts for front and rear outboard seats and lap belts for all other seats.
- Vehicle shall be less than five years old and have fewer than 100,000 miles (160,000 km), unless a written waiver from the RCEO has been obtained.

Each BU that maintains a fleet shall maintain a written BU-specific Fleet Management Procedure that documents routine maintenance/inspection procedures to ensure vehicles are in safe operating conditions and is sufficiently detailed to ensure that these minimum requirements are achieved.

4.5 Minimum Safety Equipment

Vehicles used for field work shall maintain the following safety equipment (note: local regulations may require additional equipment):

- First aid kit.
- Spare tire and jack.
- Warning triangles (reflective) or road flares (flares may not be stored in the passenger compartment of the vehicle).
- Reflecting safety vests for all occupants of the vehicle (these should be stored in the passenger compartment and not in the boot/trunk of the vehicle).

Recommended equipment includes:

- Jumper cables with instructions.
- Torch / flashlight.
- Fire extinguisher
- Camera capabilities (either cell phone, digital, or disposable camera) for incident investigation and documentation.

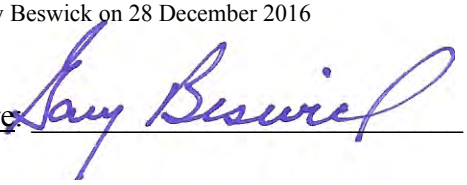
5. References

- ERM Global Policy – Mobile/Cellular Telephone and Personal Digital Assistant (PDA) Use While in a Vehicle
- ERM Global Policy – Drug and Alcohol Use
- ERM-1110-PR1 – Project Health and Safety Planning Procedure
- ERM-1430-FM1 - Journey Management Plan Template
- ERM-1430-FM2 – Vehicle Inspection Form
- ERM-1432-FM1 – Taxi Card

Document Control Information

Original Effective Date: 1 April 2015

Approved by: Gary Beswick on 28 December 2016

Approval Signature: 

Revision History

Section	Version: Reason for Revision	Date
All	1.0: New document.	29 Dec 2014
4.2.1; 4.4.1; 4.4.5	2.0: Included driver 'best practice' considerations and clarified the requirements around driver fatigue management in Section 4.2.1; clarified that the minimum vehicle expectations apply to all vehicles that an ERM employee is riding in Section 4.4.1; modified the requirements on tire tread depth in Section 4.4.5.	20 July 2015
Header	2.1: Modified date to show correct year.	22 July 2015
All	2.2: Updated links, tagline, and document number	28 Dec 2016

1. Purpose and Scope

To ensure that Short Service Employees (SSEs) are identified, adequately supervised, trained and managed in order to prevent injury to themselves, injury to others, property damage, or environmental harm.

2. Roles and Responsibilities

Line Manager: Identify SSEs that they manage; assign an experienced mentor to SSEs.

Office Head: Ensure that this procedure is implemented and communicated to staff members.

Partner in Charge (PIC): Ensure this procedure is communicated to project team members; ensure this procedure is adhered to in the field.

Project Manager (PM): Ensure SSE are identified and appropriately supervised; act as the SSE mentor while assigned to the field (or assign an appropriate mentor); ensure that clients are notified when SSE are assigned to projects and Contractors are aware of the requirements of this procedure.

Short Service Employee (SSE): Ensure they have received the appropriate safety awareness and induction training and have been assigned a mentor; follow the requirements of this procedure.

3. Definitions

SSE: Any employee with less than 6 months experience with ERM. In addition, employees who are new to a position and/or location may also be considered for inclusion in the SSE program if there are significant differences in:

- Job responsibilities / duties from previous assignments;
- Work processes / practices from previous assignments;
- Equipment / tools from previous assignments; and
- Skill level, relationships with co-workers.

4. Procedure

4.1 SSE Identification

Line Managers are responsible for identifying direct reports that are SSE and for ensuring that all SSEs are assigned a competent and experienced mentor to assist the employee during the short service period. In addition, the identity of all SSEs in the field shall be known to the ERM person

supervising the field activities. The PIC and / or PM shall determine if SSEs must be visually identifiable. This determination should consider:

- Whether multiple contractors are working in close proximity.
- Whether the SSE's activities are being directed and/or guided by others.
- The risk associated with the activities performed by the SSE.
- Client requirements.

When required, the SSE shall be identified:

- By the SSE wearing a high-visibility orange hardhat; or
- By displaying a visible sticker on their hard hat that includes the letters 'SSE'.

4.2 Use of SSEs for Field Work

Project teams should staff field work such that SSEs have adequate supervision and oversight. Situations in which an SSE is the only ERM employee on site to conduct field work should be avoided if possible. If an SSE will conduct field work without direct supervision from an ERM Mentor, then a communication plan should be established. The communication plan must ensure the availability of phone communication with an ERM Mentor and minimum check-ins at the beginning and end of the work shift.

The PM shall ensure that the make-up of field personnel within a Project team shall:

- Have no more than one SSE for field teams of 2 to 4 persons.
- Not exceed 20% of project teams for field crews greater than 5.

SSEs may not perform the following roles on ERM field projects:

- Field Safety Officer (FSO) on field projects conducted under a Level 2 Health and Safety Plan.
- Subsurface clearance (SSC) Experienced Person on projects involving ground disturbance.

The composition of the proposed project team shall be communicated to the client, where required.

4.3 Mentoring SSEs

Mentors shall be experienced team members with appropriate knowledge, skills, and training related to the tasks being performed and who display appropriate safety leadership and work ethic. Note that more than one mentor may be assigned to an SSE depending upon the type of work and work location, thus allowing maximum oversight and demonstration of appropriate skills and knowledge, and compliance with client expectations, where applicable.

Mentors will provide regular review, coaching and feedback to the SSE to enhance their understanding of ERM health and safety policies and procedures, as well as determining their continued suitability for field operations. Mentors should assess the SSE's knowledge in the following areas:

- ERM's health and safety policies and procedures;
- Client-specific health and safety policies and procedures (as applicable);
- Applicable health and safety resources;
- Proper use of personal protective equipment (PPE);
- Reporting of incidents, near misses, and safe behaviors;
- Use of the Event Communication System (ECS);
- Required training for assigned job operations;
- Principles of the OFP process;
- Use of Stop Work authority; and
- Basic hazard identification.

Documentation of the mentor's assessment of the SSE's performance can be provided through use of the *SSE Mentor Assessment Form*.

4.4 Removal of Employees from SSE Status

To be removed from SSE status, an employee must have a completed Mentor Assessment Form and exhibit safe behavior for 6 months (e.g. incident free performance, proactive participation in health and safety programs, participation in safety meetings and general awareness of ERM's health and safety requirements).

If an SSE has significant field experience from a previous job, can demonstrate adequate knowledge of ERM H&S policies and appropriate skills in their field operations, and has completed all required training, the SSE's Line Manager may request that the Office Head grant the SSE an early removal from the process via variance; such variance shall be documented.

4.5 Contractors

Project Managers shall ensure that Contractors are aware of the requirements of this Procedure during the procurement process and field activities. ERM Contractors are expected to manage SSE using their own process that meets the requirements of this procedure.

5. References

- ERM-1611-FM1 - SSE Mentor Assessment Form

Document Control Information

Original Effective Date: 1 April 2015

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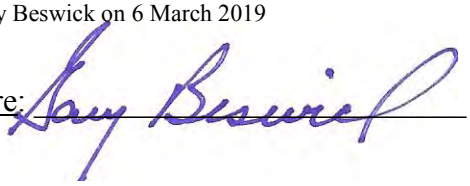
Approval Signature: 

Revision History

Section	Version: Reason for Revision	Date
All	1.0: New document.	29 Dec 2014
All	1.1: Updated links, tagline, and document number	28 Dec 2016
4.2	1.2: Clarified the inclusion of SSE in field teams	6 March 2019

SSE Mentor Evaluation Form

Employee: _____

Assessment Criteria

Yes ❑	No ❑	Understands ERM health and safety policies and procedures
Yes ❑	No ❑	Understands Client health and safety policies and procedures
Yes ❑	No ❑	Can identify ERM health and safety resources
Yes ❑	No ❑	Demonstrates proper use of PPE
Yes ❑	No ❑	Understands reporting of safety events (e.g., incidents, near misses, etc.)
Yes ❑	No ❑	Demonstrates principles of the OFP process
Yes ❑	No ❑	Can perform basic hazard identification
Yes ❑	No ❑	Understands when to apply Stop Work authority and is willing to do so

Comments

_____

_____

_____

_____

Mentor: _____ **Date:** _____

Based on the review and assessment of his/her performance, the above named employee is:

- ❑ Released from the SSE program
- ❑ Released from the SSE program early via the variance process
- ❑ Requested to remain in the program for an additional _____ months

Line Manager: _____ **Date:** _____

Office Head
(in case of Variance) _____ **Date:** _____

Perform

Conditions 1-4 require that you **STOP WORK** and consult with a second person. Conditions 5-9, proceed with caution.

1 Refer to the appropriate partner to decide.
2 Ask a specialist with more knowledge to advise.
3 Consult with your supervisor before starting.
4 Discuss with a colleague to assist.

5 How can risk be reduced?
6 Look for another way to do the job if possible.
7 Re-check your safety controls (JSA, SWMS, PPE, Procedures).
8 Re-check the area before proceeding.
9 Proceed with the usual level of safety awareness.

M1-ERM-004-FM1, Version 6

Scan

Take two minutes to: scan **LOW** scan **MEDIUM** scan **HIGH**

Safety AT ERM
Risk Management

SNAP Assessment
Scan
Notice
Analyze
Perform

ERM

Activity Level Risk Review

Notice

Notice the hazards and the quality of the control measures in place.
Ask yourself the following questions…

1	Have I looked and identified all the hazards?	☐ Yes	☐ No
2	Will the job be done as already discussed?	☐ Yes	☐ No
3	Are the resources I need available? (PPE, tools, people)	☐ Yes	☐ No
4	Can the job be done without causing an incident?	☐ Yes	☐ No
5	Is everything the same since I last did this task?	☐ Yes	☐ No
6	Are others protected from my activities in the area?	☐ Yes	☐ No
7	Have I identified emergency devices and locations and do I know what to do?	☐ Yes	☐ No
8	Do I have safe access to and from my work area?	☐ Yes	☐ No
9	Is my work area clean and tidy?	☐ Yes	☐ No

If you answered NO to any of the above then consider this when you ANALYZE

Analyze

What is the most likely adverse consequence from an incident?
What is the probability of this type of incident occurring?

Probability of an incident

- Almost certain
- Has happened
- Possible
- Heard of
- Unlikely
- Almost impossible

Exposure to the risk

- Weekly
- Daily
- Current Task

Consequence/Outcome

Injury	Impact
Multiple fatalities	Catastrophic
Fatality	Major
Disability	Significant
Serious (LTI)	Serious
Medical Treatment	Moderate
First Aid	Minor

Global Written Operational Control Register

Procedure Number	Procedure Title
Management System Documents	
M1-ERM-001-PR	Development of the Health, Safety and Environment Policy Statement
M1-ERM-001-GU1	SMS Summary Document
M1-ERM-001-GU2	SMS Overview (Two Page)
M1-ERM-001-FM1	Health, Safety and Environment Policy Statement
M1-ERM-001-WI	Definitions Applicable to SMS Documents
M1-ERM-002-PR	Hazard Identification and Risk Assessment
M1- ERM-002-GU	Global Safety Risk Register Overview
M1-ERM-003-PR	Environmental Aspects and Impacts
M1-ERM-003-FM1	EA&I Register
M1-ERM-004-PR	Management of Change
M1-ERM-004-FM1	SNAP Card
M1-ERM-004-GU	Using the SNAP Card
M1-ERM-005-PR	Legal and Other Requirements - Identification and Verification
M1-ERM-005-FM1	Regulatory Self-Assessment Verification Form
M1-ERM-006-PR	Objectives and Targets
M1-ERM-007-PR	Resources, roles, responsibility, accountability and authority
M1-ERM-007-GU1	SMS Roles and Responsibility Summary
M1-ERM-008-PR	Competence, Training, and Awareness
M1-ERM-009-PR	Contractor Management
M1-ERM-010-PR	Communication, Participation, and Consultation
M1-ERM-010-FM1	Safety Alert Template
M1-ERM-011-PR	Document Control and Record Keeping
M1-ERM-011-WI	Developing and Updating Global Documents
M1-ERM-011-GU1	Document Template for a Standard
M1-ERM-011-GU2	Document Template for a Procedure
M1-ERM-011-GU3	Document Template for a Work Instruction
M1-ERM-012-PR	Operational Control
M1-ERM-012-FM1	Global Written Operational Controls Register
M1-ERM-013-PR	Emergency Preparedness and Response

Procedure Number	Procedure Title
M1-ERM-013-PR2	Global Crisis Management Plan (Confidential)
M1-ERM-013-GU1	Emergency Action Plan Development Guidance Document
M1-ERM-013-GU2	Crisis Management Plan Overview
M1-ERM-014-PR	Monitoring and Measurement
M1-ERM-015-PR	Event and Non-conformity Management
M1-ERM-016-PR	Safety Management System Auditing
M1-ERM-016-FM1	BU Audit Priority Assessment
M1-ERM-016-FM2	BU Self-Assessment Form
M1-ERM-016-FM3	Project/Field Audit Checklist
M1-ERM-016-FM4	Office Inspection Checklist
M1-ERM-016-GU1	Corporate Internal Safety Management System Auditing Guidance Document
M1-ERM-017-PR	Management Review
M1-ERM-017-FM1	Management Review Documentation Form
Safety Documents	
S1-ERM-001-PR	Practice-specific Risk Assessment Procedure
S1-ERM-002-PR	Health and Safety Planning Procedure
S1-ERM-002-FM1	L1 HASP Template
S1-ERM-002-FM2	L2 HASP Template
S1-ERM-002-FM3	Email HASP Template
S1-ERM-002-FM4	JHA Template
S1-ERM-003-PR	Short Service Employees Procedure
S1-ERM-003-FM1	SSE Mentor Assessment Form
S1-ERM-004-PR	Malaria Prevention Program
S1-ERM-005-ST	Travel Risk Assessment Standard
S1-ERM-005-FM1	Travel Risk Assessment Form
S1-ERM-006-ST	Offshore Platform Safety
S1-ERM-007-ST	Subsurface Clearance Standard

Procedure Number	Procedure Title
S1-ERM-007-WI	Subsurface Clearance Work Instruction
S1-ERM-007-FM1	SSC Field Process Checklist
S1-ERM-007-FM2	SSC Field Process Checklist for RG Sites
S1-ERM-007-FM3	SSC Location Disturbance Permit
S1-ERM-007-FM4	SSC Project Plan
S1-ERM-007-FM5	SSC Field Audit Form
S1-ERM-007-FM6	SSC Mentorship Card
S1-ERM-008-PR	Driver and Vehicle Safety Procedure
S1-ERM-008-FM1	Journey Management Plan Template
S1-ERM-008-FM2	Vehicle Inspection Form
S1-ERM-008-FM3	Taxi Card
S1-ERM-009-ST	Fixed Wing Aircraft and Helicopter Safety
S1-ERM-010-PR	Drug Free Workplace
S1-ERM-010-FM1	Acknowledgement and Consent
S1-ERM-010-FM2	Project Manager Drug and Alcohol Testing Checklist
S1-ERM-010-FM3	Reasonable Suspicion Checklist
S1-ERM-010-WI1	Client Drug and Alcohol Testing Set-up
S1-ERM-010-WI2	Client Drug and Alcohol Testing Process
S1-ERM-010-WI3	For-Cause Testing Process
S1-ERM-010-WI4	Data Privacy in Drug and Alcohol Testing Program Enrollment
S1-ERM-011-PR	Health and Safety Recognition
S1-ERM-011-FM1	Safety Recognition Form
S1-ERM-015-PR1	Event Investigation
S1-ERM-015-PR2	Injury and Illness Reporting and Recording Procedure
S1-ERM-015-FM1	Event Investigation Considerations
S1-ERM-015-FM2	Severity 3 Event Investigation Report Template

Documents in blue are not yet complete.

Safety Management System – Global Procedure

Operational Controls

Procedure Number: **M1-ERM-012-PR** Version: **1.0**

1 PURPOSE AND SCOPE

This document describes how ERM establishes and implements operational controls. Operational controls have been established to mitigate the identified risks associated with our activities.

2 ROLES AND RESPONSIBILITIES

Regional CEO (RCEO), Divisional Managing Director (DMD), and Business Unit Managing Partner (BU MP). Own applicable operational controls, in consultation with the H&S group.

Regional Practice Leads. Develop and own applicable Practice-specific operational controls, in consultation with the H&S group.

Partner in Charge (PIC) and/or Key Client Director (KCD). Develop and own applicable project- and/or client-specific operational controls, in consultation with the H&S group.

Regional and BU H&S Leads. Develop and communicate operational controls associated with their area of responsibility.

Global Health and Safety Director (GHSD). Own the Safety Management System (SMS) Operational Control process, and ensure that Global operational controls are developed and implemented.

3 DEFINITIONS

Operational Control. A procedure, process, or tool (e.g., personal protective equipment, signs) that is developed to control the risks associated with the activities of employees, contractors, members of the public and / or visitors.

Document Control System. The identified location(s) within Minerva where written SMS procedures are maintained.

4 PROCEDURE

4.1 Establishing Operational Controls

Operational controls mitigate the risk posed to people or the environment due to the activities performed. The level of rigor associated with an operational control is commensurate to the risk; therefore, a high risk activity may be controlled by a written operating procedure while a low risk activity may be controlled though on-the-job training.

Depending on the severity or the scope of the identified risk, operational controls may be developed for the ERM global population, or for a BU-, Division-, Regional-, Practice-, and/or client-specific audience.

- **Global controls** are developed based on the identified risks applicable to the global organization. Risks are documented in the Global Safety Risk Register, as described in the ***Hazard Identification and Risk Assessment*** Procedure. The development of global procedures is prioritized based on risk.

  Global controls may also be developed based on identified trends in incidents or near misses, as described in the ***Monitoring and Measurement*** Procedure. Finally, global controls have been developed to describe and support the overall SMS. A list of current global procedures is provided on ***M1-ERM-012-FM1***.

  Global safety controls are developed and owned by the GHSD.

- **Regional/Divisional/BU controls** are developed to address risks specific to a particular location or Region, or to address local regulatory requirements. Local controls may impose more (but not less) stringent requirements than global controls, if driven by local:

  - Regulatory requirements,

- Risk profile,
- Management system certification expectations,
- Objectives or targets, etc.

Regional, Divisional and BU controls are developed and owned by the Regional CEO, the DMD or the BU MP, respectively, in consultation with members of the H&S group.

- **Practice-specific controls** are developed to address risks associated with a particular practice or sub-practice, but which may not apply to all of ERM. These controls may address elements beyond H&S, depending on their scope.

  Practice-specific controls are developed and owned by Regional Practice leads. H&S elements within these controls are developed in consultation with members of the H&S group, and shall be managed at the Global or Regional level.

- **Client-specific controls** are developed to meet particular client objectives. These controls typically address client requirements that are more stringent than global or regional/BU requirements.

  Client-specific controls are developed and owned by the PIC associated with the client. For global key clients (GKCs), the process is developed and owned by the designated KCD.

4.2 Implementation of Operational Controls

These controls are implemented in a number of ways:

- Written policies, procedure, or guidance documents;
- Formal or informal training, including mentoring or on-the-job training;
- Signs, communication, or postings; and/or
- Pre-job safety briefings.

In all cases, the operational controls required to mitigate risk associated with project activities are documented in the project Health and Safety Plan (HASP). Project HASP development and use is described in the ***Health and Safety Planning*** Procedure.

Written procedures are a particular subset of operational controls that are required to cover situations where their absence could lead to deviations from the Health, Safety, and Environment Policy Statement (***M1-ERM-001-FM1***). Written procedures will be approved and maintained in accordance with the ***Document Control and Record Keeping*** Procedure. Written SMS procedures are only acceptable for use if they are stored in the DCS.

4.3 Communication

Communication on the availability and applicability of operational controls is ongoing. Written procedures are available on Minerva and training is managed through the ERM Academy Learning Management System (LMS). PICs and PMs are responsible for ensuring that all employees comply with the operational controls applicable to their projects.

Additional information is available in the ***Communication, Participation and Consultation*** Procedure.

5 REFERENCES

- M1-ERM-012-FM1 – Global Written Operational Controls Register
- M1-ERM-001-FM1 – Health, Safety, and Environment Policy Statement
- M1-ERM-002-PR – Hazard Identification and Risk Assessment Procedure
- M1-ERM-008-PR – Competence, Training and Awareness Procedure
- M1-ERM-011-PR – Document Control and Record Keeping Procedure
- M1-ERM-014-PR – Monitoring and Measurement Procedure
- S1-ERM-002-PR – Health and Safety Planning Procedure

Document Control Information

Original Effective Date: 1 April 2015

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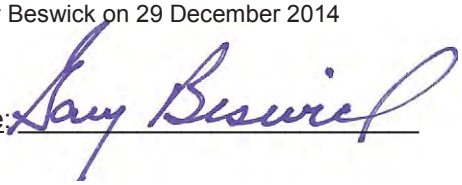
Approved by: Gary Beswick on 29 December 2014

Approval Signature: 

Revision History

Section	Version: Reason for Revision	Date
All	1.0: New document.	29 Dec 2014

Safety Management System – Global Procedure

Emergency Preparedness and Response

Procedure Number: **M1-ERM-013-PR** Version: **2.0**

1 PURPOSE AND SCOPE

This document establishes the guidelines for emergency preparedness and response (EPR), and documents methods in place to help protect employees and visitors in the event of an emergency situation.

2 ROLES AND RESPONSIBILITIES

Office Head. Ensure the development and maintenance of an office-specific Emergency Action Plan (EAP); ensure annual training and evacuation drills are completed.

Office Health and Safety (H&S) Coordinator. Support the implementation of the EAP and ensure employee's awareness of and compliance to the plan; ensure a process is in place to inform office visitors of the relevant elements of the Office EPR plans.

Partner in Charge (PIC). Ensure an emergency plan is in place for project sites, including field or temporary offices.

Regional H&S Lead. Develop Regional EPR plans as required; ensure Divisional/BU developed EPR plans are appropriate; ensure all permanent offices have and maintain a compliant EAP.

Executive Committee. Own, manage and periodically test the Global Crisis Management Plan.

Global Health and Safety Director (GHSD). Own the Safety Management System Emergency Preparedness and Response process.

3 DEFINITIONS

Emergency Preparedness and Response (EPR) Plan. Any process or document that describes ERM's approach to mitigating an emergency situation.

Emergency Action Plan (EAP). A particular type of EPR Plan that is mandatory in all permanent and field offices.

Permanent Office. A permanent office is any ERM office, regardless of number of employees, which is not distinctly related to a particular project or client site. In cases of doubt, the Regional CEO shall determine whether an office is permanent or temporary.

4 PROCEDURE

ERM has established distinct EPR processes and procedures at the Global, Regional, office and project levels.

4.1 Global Level EPR

The Executive Committee is responsible for maintaining the ERM ***Global Crisis Management Plan*** (CMP) which documents the response protocol to be used by the Executive Crisis Management Team in the event of a crisis event. The CMP is designed to help ERM identify, communicate and manage crisis events that will impact ERM's global operations. Among other topics, the CMP addresses the following:

- ERM's Crisis Management Policy, including the principles and approaches which the company will follow in all crisis situations;
- The procedure for Reporting a Crisis to the relevant parties at ERM;
- The criteria used to Assess the Situation and declare a crisis; and
- ERM's Crisis Management Protocol, including the specific steps to be taken during the crisis and when the crisis is over.

Given the sensitive nature of the information maintained in the CMP, the plan is not openly available to all employees. The document is controlled in accordance with the ***Document Control and Record Keeping*** Procedure, and has been assigned document number M1-ERM-013-PR2. To ensure that the document is readily accessible in the event of a crisis, it is posted on a limited-access internal website on

Minerva. For awareness and communication, a ***Crisis Management Plan Overview*** guidance document has been prepared (M1-ERM-013-GU2).

The CMP is tested periodically through documented table top exercises and drills, and revised as needed.

4.2 Regional Level EPR

When required, or as directed by the RCEO, the Regional H&S Lead may develop regional (or sub-regional) EPR documents, procedures or communications. Situations requiring a regional response may include:

- Pandemic planning
- Security / social unrest
- Significant weather events

In addition, the Regional H&S Lead will coordinate with Division/BU H&S Coordinators to ensure Division/BU EPR plans that may have been developed are consistent with global policy, adequate for the risk, and appropriately maintained in place in each of the region's Divisions.

4.3 Office Level EPR

The Office Head in each permanent office is responsible to develop, maintain and annually review an Office Emergency Action Plan (EAP). In coordination with the Office H&S Coordinator, the location, content, and critical elements of the EAP shall be communicated to all employees at least annually. EAPs shall include, but are not limited to, the following information:

- Building evacuation routes and external assembly points
- Fire response procedures
- Employees (or visitor) injury/first aid measures
- Emergency telephone numbers
- Natural disaster preparedness plans (including contagious diseases, if applicable)
- Bomb threat procedures
- Visitor management and security
- Emergency event communication plan
- Spill response

The ***Emergency Action Plan Development*** Guidance Document is available to assist an office in the development of this plan. It is the responsibility of the Office Head to develop the EAP with sufficient level of detail to address their local risk.

In addition to the development of an EAP, all offices will comply with the following minimum expectations, without exception:

- Evacuation and assembly point maps will be prominently posted.
- Emergency response numbers, including the number of the internal medical / case management provider, will be prominently posted.
- Illuminated (or fluorescing) Exit signs shall be posted at all emergency exit doors and along exit routes such that line-of-sign visibility is maintained from all locations within the occupied space.
- The EAP shall be reviewed and updated at least once per calendar year. The review shall be documented, even if no updates have been made.
- Evacuation drills shall be completed and documented at least once per calendar year.
- Failures of EAP implementation (i.e., as identified during actual emergencies or drills), shall be documented and addressed in accordance with the ***Event and Non-conformity Management*** Procedure.

The Office Head and the Office H&S Coordinator shall sign the document.

The Office H&S Coordinator shall develop a method of communicating relevant EPR information to all visitors.

The Regional H&S Lead is responsible for ensuring that each ERM office in their Region has an effective and thorough EAP in place.

4.4 Project Level EPR

At the project level, the Partner in Charge (PIC) is responsible for ensuring that a current and approved Health & Safety Plan (HASP) that contains a description of the responses to incidents and emergency situations is in place for all personnel. For

more information on project level EPR, refer to the ***Health and Safety Planning*** Procedure.

All ERM operated field offices and/or temporary locations shall have a documented EAP, often included as part of the project H&S planning documents. A physical copy of the EAP shall be maintained at the site (in a prominent location), and shall include similar information as required in a permanent office, as deemed applicable. In addition, an emergency contact list and a hospital route/map shall be posted in any field or temporary office.

5 REFERENCES

- M1-ERM-011-PR – Document Control and Record Keeping Procedure
- M1-ERM-013-PR2 – Global Crisis Management Plan (Confidential)
- M1-ERM-013-GU1 – Emergency Action Plan Development Guidance Document
- M1-ERM-013-GU2 – Crisis Management Plan Overview
- M1-ERM-015-PR – Event and Non-conformity Management Procedure
- S1-ERM-002-PR – Health and Safety Planning Procedure

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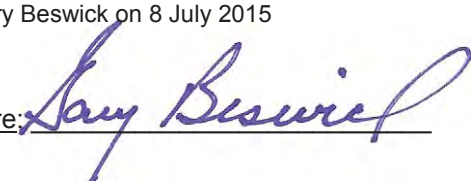
Approval Signature: 

Revision History

Section	Version: Reason for Revision	Date
All	1.0: New document.	29 Dec 2014
2.0; 4.3	Clarified the responsibility of the Office Coordinator to establish a visitor communication process; modified the requirement to 'train' employees on the Office Level EPR to 'communicate to employees'.	8 July 2015

1. Purpose and Scope

This procedure outlines general planning steps that should be followed on projects where ERM's activities (or those of ERM's contractors) are likely to create wastes or where ERM has taken some contractual responsibility for handling waste for the client. ERM generally does not generate significant hazardous or non-hazardous waste as part of its operations, since ERM's role is typically limited to supporting waste management activities of the client (owner or responsible party). In those situations, ERM does not direct or control waste management activities, but will use the waste management plan developed by the client.

This procedure is not intended to address all possible waste management situations. Project-specific adjustments may need to be made as appropriate depending on specific circumstances.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correct any deficiencies in the implementation of this procedure.

Project Manager: Responsible for the following elements:

- Perform observations of ERM work processes to assess employee compliance with this procedure;
- Stop work where deviations from this procedure are observed; and
- Correct, in conjunction with the PIC, any observed deficiencies in the implementation of this procedure.

3. Definitions

None.

4. Procedure

For projects described in Section 1, a waste management plan specific to the project activities should be developed. The plan should address the following basic elements:

- Assessment of the nature and type of waste;
- Estimate of the amount of each waste that may be created;

- Evaluation of the proper handling, storage, transportation and disposal methods appropriate to manage the various wastes;
- Evaluation of specific personal protective equipment to be worn, including requirement to use appropriate gloves;
- Sampling, analysis, and proper characterization of any wastes and interface with the client to confirm storage, transportation, and disposal requirements; and
- Arrangement for proper manifesting and transportation of the materials.

The waste management plan will be reviewed and approved by the PIC and, where necessary, the client prior to execution.

4.1 Pre-Mobilization

Prior to mobilizing to the field, a project health and safety plan (HASP) must be developed, in accordance with NAM-1110-PR1 (*Project Health and Safety*) to assess the potential hazards associated with the operations that will be undertaken during the project. As part of the review of project hazards, the ERM Project Manager and PIC will evaluate the project scope to assess whether the project will likely involve waste generation by ERM or if ERM will be directly responsible for managing wastes.

If the evaluation indicates that ERM or its contractors will be generating wastes or will be responsible for waste management, the applicable portions of NAM-1122-FM1 (*Pre-Mobilization Activities*) will be factored into the project-specific waste management plan. The form provides guidance on the subtasks that generally should be followed during the pre-mobilization phase of the project to address waste management requirements.

Depending on the complexity of the project and client requirements, NAM-1122-FM1 may be replaced with a more detailed document that addresses each element in NAM-1122-FM1, as needed. The documentation will then be combined with the project execution phase (Section 4.2) to complete the project-specific waste management plan.

4.2 Project Execution

The waste management plan must anticipate activities to be conducted in project execution and set the stage for carrying them out within the framework of the overall plan. A general proposed format for including the necessary components in the plan to address such activities is presented in NAM-1122-FM2 (*Project Execution Activities*).

Following the project execution phase and depending on the nature of the project, it may be appropriate to prepare a waste management report. Such a report would provide a discussion on the types, amounts, and disposition of wastes that were handled during the work. The specific format and content of such a report should be discussed with and approved by the client.

5. References

- ERM Form NAM-1122-FM1 (*Pre-Mobilization Activities*)
- ERM Form NAM-1122-FM2 (*Project Execution Activities*)
- ERM Procedure NAM-1110-PR1 (*Project Health and Safety*)

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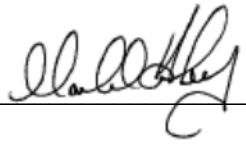
Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document.	6/9/11
All	Reformatted document. Revision of document language in several areas.	6/25/15
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/14/17
4	Added information on PPE selection	7/31/18

Safety Management System – Global Procedure

Contractor Management

Procedure Number: **ERM-1130-PR1** Version: 6.0

1 PURPOSE AND SCOPE

This document establishes the requirements for selection, approval and monitoring of Contractors engaged by ERM.

2 ROLES AND RESPONSIBILITIES

Partner in Charge (PIC). Accountable for the use of all contractors engaged by ERM on their projects; responsible for assuring the overall quality of the contractor selected.

Project Manager (PM). Select pre-qualified contractors for use on ERM projects; ensure contractors are managed during performance of work; provide feedback regarding the contractor performance.

Local Managing Partner (MP). Ensure that PICs and PMs comply with this Contractor Management Procedure; accountable for the overall risk to ERM from the engagement of contractors within their area of responsibility; approve pre-qualification variances.

Office Head. Select pre-qualified contractors for use within an ERM office; ensure contractors are managed during performance of work; provide feedback regarding the contractor performance.

Regional Safety Lead. Advise on the adequacy of risk mitigation plans for contractor's identified with an "Extreme" risk rating. Consult, upon request, on written Safety programs for contractors identified with a "High" risk rating.

Regional CEO (RCEO). Approve variances for a contractor meeting an "Unacceptable" pre-qualification condition.

3 DEFINITIONS

Contractor. A person or company engaged by ERM for work or services billed to a project, or work or services for ERM in an ERM office. Companies that provide a professional service to ERM such as accounting, legal or professional services, travel planning, taxis, etc., or who provide a supply service to ERM offices, such as non-operated equipment rental, coffee vending, food vending, water cooler vending etc. are not considered Contractors under this procedure.

Prequalification. The process of gathering information about a contractor, evaluating the information against a standard set of requirements, approving the contractor for consideration to work for ERM or not, and updating and re-evaluating the information on a regular basis. Prequalification means a contractor can be considered for work; it does NOT mean they are necessarily suitable, capable and competent to perform any given task.

Contractor risk. Risks to ERM from the procurement of a contractor can include financial, safety, reputational, and others. Overall risk is not wholly dependent on the size of the contractor, where they do their work (field or office), or the length of their relationship with ERM.

Industry Average. A description of the relative level of risk associated with a company's health and safety record compared to the records of other companies in the same or similar industries and location (i.e., the US uses OSHA reporting; the UK uses RIDDOR data; Canada uses information from the WCB).

4 PROCEDURE

4.1 Contractor Prequalification

All contractors used on ERM projects or in ERM offices must participate in a prequalification process prior to use. Each ERM organizational entity (Region, Business Unit, Country and/or Entity) must have a formal (e.g., written) contractor prequalification process.

4.1.1 Minimum Prequalification Requirements

All contractors shall meet and maintain the following minimum requirements:

- Safety statistics at or below industry average as defined by the Local MP.
- Insurance coverage that meets the organizational entities standard terms and conditions.
- Agreement to comply with ERM's ABC policy, ERM's Slavery, Child-labor, Human-trafficking Policy, and ERM's Code of Business Conduct and Ethics.
- Regulatory record free of open or unresolved citations or violations, when available.
- Submission of a Contractor Pre-Qualification Questionnaire as defined by the organizational entity.

Compliance with these requirements shall be documented.

The Safety Statistics used for evaluating a contractor against the Industry Average shall be updated by the Contractor an annual basis. When these statistics are driven by a local regulatory requirement, the update is due within 90 days of the regulatory submission deadline; otherwise, the update is due by 31 March of each year.

Insurance data should be updated regularly based on the contractor's policy expiration information at the time of submission.

Confirmation that the contractor has no open or unresolved regulatory citations shall be completed at least once per year. More frequent reviews shall be completed if practicable (e.g., if using the Global Contractor Management pre-qualification process).

All other information and information requests shall be reviewed at least once every three years.

4.1.2 Contractor Safety Risk Rating

Each organizational entity shall develop a Contractor Pre-Qualification Questionnaire; **Appendix 1** provides a list questions to be considered. The organizational entity shall have a defined process to establish a Contractor Safety Risk Rating based on the results of the pre-qualification questionnaire and the activities that the contractor performs. The risk rating shall be based on all the activities the contractor performs, not just those performed for ERM.

At a minimum, Contractors must be rated as either; Low Risk, High Risk, or Extreme Risk.

Contractors that are rated High Risk must provide copies of applicable Safety programs to ERM for review and approval. The review shall be completed by either the PIC (in consultation with the Local or Regional Safety Lead), or by an ERM third-party designee. The contractor's Safety programs must be adequate to address the identified risks (e.g., the risks that resulted in the contractor rating of High Risk) before the contractor can be prequalified.

Any of the following conditions will result in the contractor being assigned an Extreme Risk Rating, and if already prequalified, the immediate removal from the pre-qualified list:

- One or more work-related fatalities in the last 5 years
- Trade sanctions or banking blocks
- Unwillingness to comply with ABC and Code of Business Conduct and Ethics requirements
- Open or unresolved regulatory citations or actions

4.1.3 Prequalification Variance Process

There may be instances when we wish to consider contractors as prequalified who fail to meet all of the criteria normally required for pre-qualification. This is formalized through the issuance of a variance.

Contractors failing to meet the minimum prequalification requirements (identified in Section 4.1.1) can receive a variance from the BU MP (or designee) with input from the Regional Safety Leads, the Global Insurance Director, and the Regional Legal Lead, as appropriate.

Contractors that have been rated as an Extreme Risk can only receive a variance from the RCEO. In order for the RCEO to issue a variance a risk mitigation plan, written by the PIC and directly addressing the unacceptable contractor condition, must be submitted

to and approved by both the RCEO and Regional Safety Lead.

All variances must be issued in writing, and documented in a way that clearly associates the variance with the contractor. In other words, if another PIC / PM were to select the contractor from the prequalification list, it should be clear that the contractor has been issued a variance.

Variances may be granted for up to one (1) year, at the discretion of the Local MP. Individual variances shall be granted for each criterion that fails to meet the minimum standard, and not for the contractor as a whole. In this way, when new or updated information is obtained, contractors can be re-evaluated and their pre-qualified status reviewed.

4.2 Oversight of Contractors

For ERM client projects, the PIC shall consider contractor activities when developing the ERM project-specific Health and Safety Plan (HASP), as described in the ***Health and Safety Planning*** Procedure. The PM, in coordination with the PIC, will manage contractors to ensure that they are aware of and comply with the ERM HASP requirements as well as any HSE plans and controls included in the applicable client contract documents or client requirements specific to the facility/location where work is to be performed. This includes any HSE programs identified in the Contractor Pre-qualification process.

In the event that any contractor activities will be performed **without direct ERM oversight**, the PIC shall ensure that the contractor develops an appropriate HASP and that the contractor HASP is reviewed by a Safety team member designated by the Regional Safety Lead and that the contractor provides suitable evidence of a process to document that the plan will be implemented and followed (including appropriate and timely incident reporting).

For contractor activities in an ERM office that are not related to an ERM client project, the ERM Office Head has responsibility for managing the contractors.

All incidents and accidents involving contractors will be entered into the ECS system according to the ***Event and Non-conformity Management*** Procedure. When appropriate, the project team will complete an incident investigation and/or participate in the Contractor's investigation.

4.3 Contract Completion and Feedback

Following the completion of each contract on an ERM project, feedback shall be obtained by the PM regarding the performance of the contractor. In the event that the contract performance period exceeds one year, the PM shall consider providing interim feedback on the contractor's performance.

Any Office Head or PM who feels that a contractor should be removed from the pre-qualified list should submit a request directly to the BU MP. All requests should include relevant information about the contractor and the projects on which they were deficient.

5 REFERENCES

- ERM-1200-PR1 – Event and Non-conformity Management
- ERM-1110-PR1 – Health and Safety Planning Procedure
- ERM Global Policy – Anti-Bribery / Corruption ("ABC")
- ERM's Code of Business Conduct and Ethics
- ERM Global Policy – Slavery, Child Labor and Human Trafficking

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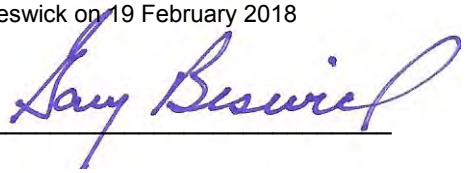
Approved by: Gary Beswick on 19 February 2018

Approval Signature: 

Revision History

Section	Version: Reason for Revision	Date
All	1.0: New document.	29 Dec 2014
App 1	2.0: Corrected screening criteria following question 3 with regard to 'yes' and 'no' answers	19 Mar 2015
App 2	3.0: Created new Appendix 2, and referenced it in the document body.	29 May 2015
4.2	4:0. Included reference to incident investigation following an event.	8 July 2015
All	4.1: Updated links, tagline, and document number	28 Dec 2016
4.2, All	5.0: Clarified the requirements for Contractor HASP preparation and review (Section 4.2); updated organizational terminology (local Managing Partner, Safety lead, etc.) (All)	28 April 2017
4.1.1	6.0: Included reference to ERM Global Policy Slavery, Child Labor and Human Trafficking	19 Feb 2018

Appendix 1: Potential Prequalification Questions and Ranking Strategy

	Potential Prequalification Questions	Yes	No
1.	Do your employees need to leave your company's offices, at any time to perform or the services you provide?	☐	☐
2.	Do any of your employees ever use hand, power, pneumatic or hydraulic tools? i.e. drill, circular saw, jackhammer, grinders, etc.	☐	☐
3.	Are your employees required to wear any personal protective equipment (PPE) (i.e., safety shoes, safety glasses, fire retardant clothing, hard hat, gloves, hearing protection, etc.)?	☐	☐
If all answers to Questions 1 to 3 are "No", then the Contractor may be considered a "Low" risk Contractor. If any answer is "Yes", then additional questions should be considered:			
4.	Is your company required to complete or obtain a “permit to work” in order to conduct ANY of the required operations (i.e., confined space permit, hot work permit, etc.)?	☐	☐
5.	Does the company have an internal "permit to work" process to govern higher risk activities?	☐	☐
6.	Does the company use any mobile equipment to carry out your operations (i.e., cranes, forklifts, aerial lifts, bulldozers, bobcats, front end loaders, etc?)	☐	☐
7.	Does the company at ANYTIME perform any of the following: abatement/remediation (asbestos/lead), confined space, demolition, lockout/tag-out, work at heights, mobile crane operation, electrical work, hazardous waste operations, hot work, work on, over or under water, rigging or trenching and excavations?	☐	☐
8.	Does the company require a pre-work hazard and risk assessment for your activities, on a documented and standardized form?	☐	☐
The answers to Questions 4 to 8 can be used to determine whether a Contractor is a "High" risk, if the BU's processes have established a distinction.			
9.	Has the company had one or more fatalities in the last 5 years?	☐	☐
10.	Does the company currently have any trade sanction violations or banking blocks filed against it?	☐	☐
11.	Are the company, and all employees, **unwilling** to comply with ERM's Anti-Bribery and Corruption Policy and Business Conduct and Ethics requirements?	☐	☐
12.	Does the company currently have any open or unresolved regulatory citations or actions filed against it?	☐	☐
If any of the answers to Questions 9 to 12 are "Yes", then the Contractor must be considered an "Extreme" risk Contractor.			

These questions are provided for guidance only. Each organizational entity shall determine Prequalification questions appropriate to the local regulatory requirements, customs and norms. Similarly, the organizational entity shall determine the strategy for assigning a Contractor Risk Rating based on the answers to the Prequalification questionnaire.

Appendix 1 (continued): Additional Insurance Coverage Requirement Questions

	Additional Insurance Coverage Questions	Yes	No
	Pollution Liability Insurance Coverage Questions		
1.	Does your company ever handle or dispose of regulated or non-regulated waste of any kind?	☐	☐
2.	Do you provide drilling services?	☐	☐
	Professional Liability/Indemnity Insurance Coverage Questions		
3.		☐	☐
4.	Does your company provide any of the following or similar services: consulting, design, engineering, testing, programming, underground line locating, or surveying?	☐	☐

If a contractor answers yes to either of the Pollution Liability questions, it may be necessary for them to provide evidence of Pollution Liability coverage to meet the BU's minimum insurance requirements based on the services they are providing.

If a contractor answers yes to either of the Professional Liability questions, it may be necessary for them to provide evidence of Professional Liability coverage to meet the BU's minimum insurance requirements based on the services they are providing.

For questions regarding specific coverage requirements, please contact the Global Insurance Director.

1. Purpose and Scope

This document supports the requirements to ensure that safety events are being properly reported and investigated within ERM operations. This document applies to all ERM North America field and office locations.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensuring this procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correcting any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director.

Project Manager (PM)/Supervisor/Area Manager: Responsible for the following elements:

- Performing observations of ERM work processes to assess whether or not employees are operating in accordance with this procedure; and
- Correcting, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluating implementation of this procedure by personnel during Event Communication System (ECS) reviews; and
- Communicating identified deficiencies to the PIC and Business Unit management teams.

Regional Health and Safety Director: Responsible for the following elements:

- Notifying the Occupational Safety and Health Administration (OSHA) of an employee fatality, hospitalization, amputation, or loss of an eye: and
- Determining, in conjunction with the Global Health and Safety Director, the recordability of incidents.

Employee: Responsible for the following elements:

- Completing ECS entries within 24 hours of a safety event; and
- Participating in the investigation of the event as directed by the ERM management and health and safety (H&S) teams.

3. Definitions

Event Communication System (ECS): The primary tool utilized at ERM for communicating the occurrence of safety events.

Event Principals: People who may be involved in safety events, including ERM employees, subcontractors, and third parties (including clients).

5 Why: A question-asking technique used to explore the cause and effect relationship underlying a problem or event.

Incident: One of the following:

- An employee becomes injured or is made ill;
- Useful property is damaged in some fashion;
- A hazardous material is spilled or released to air, water, or ground;
- Operational security is breached;
- A regulatory citation is issued; or
- A loss of reputation to clients or the general public is sustained.

Near Miss: An unplanned event that did not result in an incident, but had the potential to do so.

Reporting Person: The ERM employee entering the Safety Event into the ECS.

Root Cause Analysis: A method of problem solving that tries to identify the root causes of an issue. A root cause is one that, once removed, would have prevented the final undesirable event from occurring.

Safe Behavior: A positive action or attitude toward safety or that promoted safety within the workplace.

Safety Event: An incident, near miss, unsafe act/condition, or safe behavior occurring within or due to the working environment experienced by ERM personnel.

Unsafe Act: A task or activity conducted in a manner that may threaten the health and safety of co-workers.

Unsafe Condition: A condition in the work environment likely to lead an incident if not corrected.

Workcare: The occupational health consulting firm which assists ERM in management of its medical surveillance programs.

Working Environment: Anywhere ERM, its employees, and its subcontractors are engaged in work activity, including ERM offices, client sites (visits, meetings, field work, etc.), or during travel.

4. Procedure

4.1 Safety Event Initial Response

4.1.1 Injuries or Illnesses

The general steps for responding to an injury or illness incident include the following:

- For emergency situations, employees shall call 911. This would include chest pains, stroke, severe shortness of breath, sudden and severe pain, major injury (including potential fractures and trauma), uncontrolled bleeding, electrocution, second or third degree burns, or unconsciousness. If transport to an urgent care center or hospital is required, a second ERM employee must accompany or follow the injured or ill employee to the medical treatment center. Refer to ERM Procedure NAM-1210-PR1 (*Injury/Illness Management*) for additional information.
- For non-emergency situations, employees shall give necessary first aid care for the employee (if qualified to do so) and secure the scene.
- After stabilizing the scene and ensuring appropriate initial treatment is provided to the employee, contact the PM/Supervisor, who will then contact the PIC and/or the Area Manager, as well as the local and/or Business Unit H&S team, to report the event. Verbal communication requirements are provided in ERM Work Instruction NAM-1220-WI3 (*Verbal Communication Matrix*). ERM will also contact the client as soon as possible, but no later than 24 hours after the event.
- Immediately after contacting the ERM management and H&S personnel, an ERM representative shall call ERM's medical service provider (Workcare) to initiate the Incident Intervention process if follow-up medical treatment is deemed necessary by the management or health and safety team. The phone number is 888-449-7787.
- Within 24 hour, ERM employees shall enter the basic details of the event into the ECS.

Note that the above direction may change based on site-specific circumstances or client-specific requirements. Emergency response elements, including contact information and directions to urgent care facilities, will be included in the project health and safety plan (HASP) as well as the Emergency Action Plan (EAP) within each office.

In the event of a fatality or if an ERM employee suffers a work-related hospitalization, amputation, or loss of an eye, ERM's management team with the assistance of the Regional Health and Safety Director is responsible for notifying the Occupational Safety and Health Administration (OSHA). Notification must be made within eight hours of a fatality and within 24 hours of all other reportable events. *Note that these notification requirements only pertain to incidents occurring within the United States.*

4.1.2 Non-injury Incidents and Near Misses

After the occurrence of a work related non-injury incident (property damage, environmental release, etc.), work will be halted, the scene will be secured, and initial facts gathered regarding the event. Work should not continue until the causes of the incident or near miss are understood and corrected. Within 24 hours, ERM employees must enter the basic details of the event into the ECS. ERM will contact the client as soon as possible, but no later than 24 hours after the event.

4.1.3 Unsafe Acts and Conditions/Safe Behaviors

When a work related unsafe act or condition is identified, work will be halted until the act or condition is addressed and corrected. Similarly, when safe behaviors are identified, the employee(s) involved should be commended for their safe performance. Within 24 hours of the observation, ERM employees must enter the basic details of these events into the ECS.

4.2 Safety Event Follow-up

4.2.1 ECS Information/Routing

All safety events, including injuries/illnesses (including first aid cases), near misses, unsafe acts, and unsafe conditions, will be documented in ECS. An investigation into the safety event will be conducted, which will include at a minimum:

- The time, date, and location of the event;
- The type of event;
- The nature and the exact location of the injuries to the injured party;
- The persons involved in the event, including injured personnel and witnesses;
- A brief description of the event;
- Immediate actions taken in response to the event including the nature of first aid treatment given (if applicable);
- Information to the support the investigation and response, including additional details, photographs, documents, timelines, etc.;
- An evaluation of causal factors affecting the event;
- Corrective actions to prevent similar occurrences; and
- The names of the investigators and reviewers.

After the basic details of a safety event are entered into the ECS by the employee or designated reporting person, the system will automatically notify appropriate parties. All individuals receiving automatic notification are included on the communication chain for the safety event's

ECS record. Automatic notifications per Event Type are summarized in ERM Work Instruction NAM-1220-WI1 (*ECS Email Notification Matrix*). Note that any ERM employee may be added to the communication chain for an ECS record as an additional affected party.

4.2.2 Initiating and Conducting Follow-up

ERM assigns and tracks corrective actions for all safety events. The required detail of the follow-up and the personnel involved is based on the Event Type and its actual or potential severity, as judged by the project and/or safety team. The ECS record created by entering the Safety Event is meant to both guide follow-up and document the findings of the investigation.

At the option of ERM's H&S and/or management team, or as required by actual or potential severity of the event, a more robust follow-up may be required, including root cause analysis.

Within 24 hours of the initial communication of the Safety Event into ECS, a member of the BU safety team will contact the Reporting Person to gather initial facts and begin the investigation. The safety team will be responsible for:

- Stewarding the completion of the investigation with the persons involved in the Safety Event; and
- Verifying that all assigned corrective actions have been completed.

4.2.3 Determining Recordability

If the Safety Event is an occupational illness or injury, then the Regional Health and Safety Director will confer with ERM's Global Health and Safety Director to determine recordability of the Safety Event. This will include a calculation of lost work days and/or restricted duty/job transfer time. These determinations will be made based on the established facts of the Safety Event and according to US recordkeeping criteria established by the OSHA.

Collected data on events meeting OSHA's recordability definition will be summarized on OSHA Forms 300 (*Log of Work-Related Injuries and Illnesses*) within seven days of the event and will be maintained as required by OSHA recordkeeping and reporting requirements. At the end of the calendar year, the OSHA Form 300A (*Summary of Work-Related Injuries and Illnesses*) will be reviewed and signed by a company official (e.g., Regional H&S Director). The completed and signed 300A form will be forwarded to all offices for posting in a conspicuous location visible to all employees between the dates of February 1 and April 30. Completed OSHA forms will be maintained in a central location for a minimum of five years.

4.2.4 Root Cause Analysis

A root cause analysis (RCA) will be performed for all recordable incidents and high value learning events as determined by the client, ERM management and/or the Regional Health and Safety Director. See NAM-1221-FM1 (*Root Cause Analysis Worksheet*) for guidance.

The RCA process should begin as soon as possible after the incident has been reported, all immediate response measures have been taken, and the situation is under control. If possible (given geographical location, site conditions, logistical planning, weather, travel restrictions, etc.), the draft RCA shall be completed within 48 hours of the event, but no later than 10 working days after the event. A final RCA report will be issued within 15 working days.

The default ERM RCA methodology in the "5 Why" technique, but ERM reserves the right to substitute other valid methods as deemed appropriate by management or the Regional Health and Safety Director. All team members associated with the investigation will be trained in the application of their responsibilities and the chosen incident investigation technique.

The first step in the process is to assemble the RCA team. The team shall be led by the PIC and facilitated by a member of the ERM H&S team or another ERM employee trained in RCA methods. Other team members may include:

- The PM of the project;
- The Area Manager (if the Safety Event was based in the office);
- The person directly involved in the event;
- Other employees familiar with the activities during which the event occurred;
- Subcontractor representatives (if a subcontractor was involved); and
- A senior ERM Partner not involved in the event (e.g., Practice Leader or BU Managing Partner).

The RCA team leader will ensure that any equipment necessary to complete the investigation is assembled. This may include, but not be limited to, writing equipment, measurement equipment, cameras or other recording devices, marking devices, equipment manuals, and personal protective equipment (PPE).

The RCA team leader will facilitate the implementation of the process, which may include:

- Interviews and fact gathering;
- Casual factor determination;
- Root cause identification using the "5 Why" method; and
- Corrective action recommendation.

The final RCA report will be uploaded to the ECS record after the event. Adopted corrective actions will be tracked to completion in the ECS. All corrective actions must be completed within 30 days of the issuance of the RCA report. If additional time is needed to complete a corrective action, the Regional Health and Safety Director must be notified.

4.2.5 Approval and Record Finalization

When the corrective actions are verified as complete, the following individuals will indicate their approval of the event:

- For incidents, the applicable Business Unit Health and Safety Director, the Business Unit Managing Partner (MP), and the Regional Health and Safety Director.
- For all other safety events, the Business Unit Health and Safety Director.

After all approvals are made, the Business Unit Health and Safety Director will initiate the finalization check within ECS to save and close the record. Future changes are locked out after event finalization.

4.3 Additional Procedures for Mine-Related Safety Events

For ERM projects covered by the regulatory statues of the Mine Safety and Health Administration (MSHA), additional recordkeeping is required when specific safety events occur. Safety events meeting one or more of the following criteria must be reported to both the mine operator and MSHA immediately (i.e., no later than 15 minutes after occurrence):

- Death of an ERM employee;
- Injury to an ERM employee at the mine that had the reasonable potential to cause death;
- Entrapment of an ERM employee for more than 30 minutes or which had the reasonable potential to cause death;
- An unplanned inundation of a mine by liquid or gas;
- An unplanned ignition or explosion of gas or dust;
- In underground mines, an unplanned fire not extinguished within 10 minutes of discovery;
- In surface mines, an unplanned fire not extinguished within 30 minutes of discovery;
- An unplanned ignition or explosion of a blasting agent or explosive;
- An unplanned roof fall at or above the anchorage zone in active workings that impair ventilation or impede passage;
- A coal or rock outburst that causes withdrawal of miners or which disrupts regular mining activity for more than one hour;
- An unstable condition at an impoundment, refusal pile, or culm bank which requires emergency action to prevent failure, or which cause individuals to evacuate an area, or failure of an impoundment, refuse pile, or culm bank;
- Damage to hoisting equipment in a shaft or slope which endangers an individual or which interferes with use of the equipment for more than 30 minutes, and

- An event at a mine which causes death or bodily injury to an ERM employee not at the mine when the event occurs.

Within 10 days of occurrence, ERM must submit a report of any work-related incidents to MSHA using MSHA Form 7000-1. Additionally, each calendar quarter, ERM must submit employment information to MSHA utilizing MSHA Form 7000-2. The form must be completed and submitted to MSHA no later than 15 days after the end of each calendar quarter.

5. References

- Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1904 (*Recording and Reporting Occupational Injuries and Illnesses*)
- Mine Safety and Health Administration (MSHA) 30 CFR 50 (*Notification, Investigation, Reports, and Records of Accidents, Injuries, Illnesses, Employment, and Coal Production in Mines*)
- ERM Form NAM-1221-FM1 (*Root Cause Analysis Worksheet*)
- ERM Work Instruction NAM-1220-WI1 (*ECS E-mail Notification Matrix*)
- ERM Work Instruction NAM-1220-WI2 (*Event Severity Matrix*)
- ERM Work Instruction NAM-1220-WI3 (*Verbal Communication Matrix*)
- ERM Procedure NAM-1220-PR1 (*Injury/Illness Management*)

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Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	Revised and edited to meet new Global SMS requirements and update procedures	10/17/14
Intro; 5	Updated Applicability; added references to Section 5	1/11/16
4.2.1	Added information on data collected in ECS reports	7/14/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/101/17
4.1.1; 4.1.2	Added information on client notification	2/7/17
4.2.3	Added information on OSHA log requirements	2/12/17
4.2.4	Revised language around timing of RCA development and closure	4/19/18
4.2.1	Minor revision in information collected during investigation	6/26/18

1. Purpose and Scope

This procedure is designed to ensure that information necessary for the safe use, handling, and storage of hazardous products is provided and made available to all ERM employees. This document applies to all ERM employees who work with or near hazardous products, and covers all ERM work activities. The procedure is designed to meet the regulatory requirements of the US's Hazard Communication standard as well as Canada's Workplace Hazardous Materials Information System 2015 (WHMIS), each of which incorporates the Globally Harmonized System for Classification and Labelling of Chemicals (GHS).

2. Roles and Responsibilities

Regional Health and Safety Director: Responsible for ensuring that a written hazard communication program is prepared, implemented, and regularly evaluated for applicability.

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this program is implemented, understood, and followed by employees under their charge and working on their projects;
- Ensure, in conjunction with the Area Manager/Project Manager, that employees are properly trained in accordance with this procedure;
- Ensure that any site-specific health and safety plans (HASP) address hazard communication elements as described herein; and
- Correct any deficiencies in the implementation of this program as identified by the Business Unit Health and Safety Director.

Area Manager/Project Manager: Responsible for the following elements:

- Maintain a master inventory of all chemicals brought to and/or used in the workplace;
- Ensure that current Safety Data Sheets (SDS) for each chemical on the inventory are readily available to all employees;
- Ensure that all chemical containers are properly labeled upon receipt at the workplace and that labels are not defaced ore moved from the container until it is empty;
- Ensure that each ERM employee and affected ERM contractors are familiar with the chemicals present in the work area and their associated hazards; and
- Ensure that, when working on client sites, the client informs the project team of the location of applicable SDS or provides a copy of applicable SDS.

Business Unit Health and Safety Director: Responsible for the following elements:

- Monitor new employees for completion of appropriate training;

- Assist PICs, Area Managers, and Project Managers in the implementation of this program, as needed, and
- Evaluate compliance with this program during office and project audits.

Employee: Responsible for the following elements:

- Complete all ERM-required initial and update training;
- Follow all hazard control information provided on SDS and chemical labels; and
- Notify their Area Manager/Project Manager if unlabeled chemicals are observed in the workplace.

3. Definitions

- Globally Harmonized System (GHS) – A system for standardizing and harmonizing the classification and labelling of chemicals
- Hazardous Materials Identification System (HMIS) – A numerical hazard rating that incorporates colors to convey broad health warning information for chemical users.
- National Fire Protection Association (NFPA) Diamond – A labeling system used by emergency response personnel to quickly and easily define the risks associated with hazardous materials.
- Safety Data Sheet (SDS) – A document that contains information on the potential hazards of, and how to work safely with, a chemical product.

4. Procedure

4.1 Labeling

Supplier labels must be affixed to all containers of chemicals, whether used, handled, or stored in the field or on ERM property, and will minimally provide the following information:

- A product or chemical identifier;
- Appropriate hazard warnings (i.e., words, statements, pictures, and/or symbols) which provide general information regarding chemical hazards; and
- The identification of the manufacturer, distributor, or supplier of the chemical.

No person shall remove, deface or alter the supplier label as long as any amount of hazardous product remains in the container, unless the container is immediately marked with equivalent information via an alternate labeling format. If a supplier label is missing or illegible, it must be replaced with a workplace label providing equivalent information.

A container is defined as a bag, barrel, bottle, box, can, cylinder, drum, pail, vessel, or storage tank containing a hazardous chemical. Pipes or piping systems, as well as engines, fuel tanks, and other operating systems in a vehicle, are not considered to be containers.

Portable containers into which chemicals are transferred from labeled containers must themselves have an equivalent label except in the following circumstances:

- The portable container is filled directly from a container with a supplier or workplace label affixed to it;
- The person who transferred the chemical into the portable container is the only person who will use the chemical;
- The content of the container is clearly identified; and
- All of the chemical in the portable container will be used completely by the end of the work shift.

Labels will be legible, in English, and prominently displayed at all times. In addition to English, labels may be presented in other languages. However, if a label is in only one language, that language shall be English. If non-English speaking employees are present in the work area, all labels will be available and presented in their language as well as English.

Sites which utilize chemicals governed by this procedure will periodically audit chemical containers to ensure that labels are present, intact, and legible. Examples of labeling formats, such as the GHS, HMIS, and NFPA systems, are provided in NAM-1301-WI1 (*Examples of Common Labeling Systems*).

4.2 Chemical Inventory

A chemical inventory must be maintained at any office or project site where chemicals are in use. The inventory must be updated and revised as chemicals are received or depleted. The name/identifier of the chemical as it appears on the chemical inventory must allow employees to be able to match the chemical with the SDS.

The chemical inventory for field projects will be incorporated into the project-specific HASP. The chemical inventory for office locations will be incorporated into the office-specific Emergency Action Plan (EAP).

4.3 Safety Data Sheets

The SDS provides written information on the chemicals of concern to the employees. The minimum data which must appear on an SDS is provided in NAM-1301-WI2 (*Safety Data Sheet Composition*). An SDS must be obtained for any hazardous product used, handled or stored in an ERM workplace.

For field projects, Project Managers will determine during HASP development if ERM employees will use chemicals during execution of the project. During this development and review period, the Project Manager will evaluate any new products which are proposed to be used at the site to determine if they contain extremely hazardous or carcinogenic chemicals. If so, the Project Manager will work with the Business Unit Health and Safety Director to identify potential alternatives. Any new chemical products which will be introduced throughout the course of the job will be similarly evaluated. The SDS for any chemical used on a project site will be attached to the HASP and will be readily available at the site.

For offices, Area Managers will evaluate any new products which are proposed to be used at the office to determine if they contain extremely hazardous or carcinogenic chemicals. If so, the Area Manager will work with the Business Unit Health and Safety Director to identify potential alternatives. The SDS for any chemical used in the office will be attached to the EAP and will be readily available at the site.

SDS shall be readily available to any ERM employee, employee representative, health and safety team member, contractor, or client. Upon receipt of an SDS, the Project Manager/Area Manager shall review the SDS to ensure it is written in English, is legible, appears to be complete (in accordance with the requirements outlined in NAM-1301-WI2), and is current, with an effective date of less than five years. If non-English speaking employees are present in the work area, all labels will be available and presented in their language as well as English. Older SDS will be replaced with updated sheets when they are received.

4.4 Contractors

The Project Manager will provide the following information to contractors prior to the start of any work at a client's site:

- Chemicals to which they may be exposed, including any soil or groundwater contaminants;
- Hazards associated with specific chemicals;
- Measures taken to reduce the hazard, including use of personal protective equipment (PPE);
- Location of the SDS;
- Locations of any applicable safety equipment, including first aid supplies, safety showers, and/or eye wash stations; and
- Emergency response procedures.

Prior to starting work, the contractor will provide the Project Manager with information about any chemicals brought onto the client's site. This information should include, at a minimum, the name of the chemical, the associated hazards, and any PPE required. Contractors will have a legible SDS for each chemical brought onto the project site.

4.5 Employee Training and Information

Training of all employees potentially exposed to hazardous materials on the job will be conducted as follows:

- Before new employees begin their jobs; and
- Whenever new chemicals are introduced into the workplace.

This training will include:

- Applicable regulatory requirements (including state or province-specific requirements, where applicable);
- Elements of this program;
- Location of the program, chemical inventory, and SDS in the workplace;
- Chemicals used in their work areas and the associated hazards (chemical, physical, and health);
- How to detect the presence or release of chemicals, including monitoring techniques, visual indicators, or odors;
- Protective measures to be used, including safe use, storage, handling, and disposal practices (including those for products contained in piping systems, tanks, vessels, or conveyance systems, as applicable), use of PPE, and emergency response procedures;
- How to read and use SDS, including the purpose and significance of information contained therein;
- How to read and use supplier and workplace labels, including the purpose and significance of the information on the label;
- Procedures to be followed if fugitive emissions are present in the work area;
- Procedures to be followed in the event of an emergency involving workplace chemicals; and
- How to obtain additional hazard information.

Where non-English speaking workers are employed, provisions for training in the appropriate language will be arranged.

All initial training will be documented electronically via ERM's Academy Learning Management System (LMS). Documentation will include a brief description of the training and the trainer's name, and will be retained throughout the duration of the employee's tenure with the organization. Information on project-specific chemical hazards, labeling requirements, site-specific issues, and emergency response conditions will be documented as part of daily safety meetings at the project site using NAM-1501-FM5 (*Site Safety Meeting Form*).

4.6 Non-Routine Tasks

Occasionally, ERM employees may be required to perform non-routine field tasks which include exposure to hazardous chemicals. Prior to any non-routine work involving hazardous chemicals, the Project Manager will ensure that each affected employee is given information about the hazards presented by the chemicals, as well as the protective measures which will be utilized during the work.

4.7 Procedure Availability

The most recent version of the procedure will be available electronically at all times to employees and their designated representatives through ERM's Document Control System (DCS).

5. References

- ERM Form NAM-1301-FM1 (*Chemical Inventory Sheet*)
- ERM Work Instruction NAM-1301-WI1 (*Examples of Common Labeling Systems*)
- ERM Procedure NAM-1110-PR1 (*Project Health and Safety*)
- ERM Procedure NAM-1212-PR1 (*Emergency Action Plans*)
- US Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.1200 (*Hazard Communication*)
- Health Canada Workplace Hazardous Materials Information System (WHMIS) 2015
- Ontario Occupational Health and Safety Act (OHSA) Regulation 860 (*WHMIS*)

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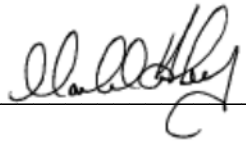
Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	Changed format; updated to meet state and federal regulations	6/2/15
4.1	Require all portable containers to have equivalent labels except where noted	8/18/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References	1/16/17
All	Updated titles and procedures to address WHMIS requirements	1/23/18
1, 4, 5	Revised Purpose statement (Section 1); minor changes to labeling and training requirements (Section 4); added reference to US and Canada regulations	6/26/18
4.1	Added additional information regarding replacement of label information	2/15/19

	Applicability:	Procedure	Document Number:	Version:
	North America		NAM-1310-PR1	5
	Title: **Personal Protective Equipment**		**Last Revision Date:**	2/15/19

1. Purpose and Scope

This document establishes safe work procedures to be used by ERM to minimize injury resulting from various occupational hazards through the use of personal protective equipment (PPE). Other types of hazard mitigation – including elimination, substitution, engineering controls, and administrative controls – are the best methods of hazard mitigation; however, in many cases the nature of consulting requires the use of PPE to supplement or replace those methods.

This procedure is applicable to all ERM operations. Note that respiratory protection (*NAM-1311-PR1*) and hearing protection (*NAM-1312-PR1*) are covered in other procedures.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this program is implemented, understood, and followed by employees under their charge; and
- Correct any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director.

Project Manager/Supervisor: Responsible for the following elements:

- Implement program during any project activities where the use of PPE is determined to be necessary;
- Perform observations of ERM work processes to assess whether or not employees are operating in accordance with this procedure; and
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of PPE during health and safety plan reviews and project audits; and
- Communicate identified deficiencies to the PIC.

Employee: Responsible for complying with the requirements stated within the procedure.

3. Definitions

None.

4. Procedure

4.1 Hazard Assessments

The project management team shall complete a workplace hazard assessment identifying the PPE requirements for the project. The PPE requirements for any work task will be addressed in the appropriate planning document, including health and safety plans (HASP) and job hazard analyses (JHA). Hazard assessments are performed by considering multiple basic types of hazards which may be able to the work scope. These include, but may not be limited to, impacts, heat or cold, penetration, dusts, compression, radiation, chemical hazards, and electrical hazards.

Site-specific HASPs will include information outlining the actual PPE requirements for the project, including those required by client-specific mandate. All project team members will be briefed on the elements of the site-specific HASP prior to participating in field activities. This briefing will include information on what PPE is required for the various project tasks.

A completed JHA addresses both the hazards specific to a job task and the appropriate controls, which may include PPE. All project team members are required to review the JHA prior to commencement of task-specific activities and use the indicated PPE. The JHA will identify the person(s) performing and certifying the workplace hazard assessment and the dates the hazard assessment was completed.

4.2 PPE Selection

Once hazards have been identified and evaluated though the hazard assessment process, the process of selecting PPE includes:

- Becoming familiar with the potential hazards and the types of PPE available to mitigate those hazards;
- Comparing available PPE to hazards associated with the project site;
- Selecting PPE meeting any applicable regulatory and client requirements that ensures a level of protection greater than the minimum required to protect employees; and
- Fitting the employees with proper, comfortable, and well-fitting PPE and instructing them on its use and care.

If conditions change on a project site or PPE fails for any reason, the PPE originally selected for employee protection must be re-evaluated. Re-evaluation should include the following elements:

- Levels of exposure, established through appropriate site monitoring;
- Adequacy of PPE originally selected;
- Number of hours PPE must be worn;
- Adequacy of training and fitting of PPE;

- Adequacy of PPE program records;
- Recommendations for H&S program improvement and modification; and
- Coordination with the overall H&S program.

4.2.1 Eye and Face Protection

When hazards present as a result of flying particulates, molten metal, liquid chemicals that are highly acidic or basic, chemical gases or vapors, or ionizing or nonionizing radiation, a combination of safety glasses, safety goggles, and/or face shields should be worn. For employees who wear prescription glasses, NAM-1310-WI1 (*Prescription Safety Eyewear*) provides additional details regarding purchase and care of prescription safety glasses.

4.2.2 Foot Protection

In most field situations, protective footwear should be worn by employees performing work in the field. Employees performing ancillary work activities, such as client meetings or work in the office environment at a client site, are not required to wear protective footwear unless client requirements dictate their use. NAM-1310-WI2 (*Protective Footwear*) provides additional details regarding selection and purchase.

4.2.3 Hand Protection

Gloves provide protection against a wide variety of hazards, including chemical exposure, burns, cuts, and other hand injuries. NAM-1324-PR1 (*Safe Use of Cutting Tools*) provides additional information on gloves types providing protection from cuts.

4.2.4 Head Protection

Hard hats approved by the American National Standards Institute (ANSI)/International Safety Equipment Association (ISEA) must be worn whenever a hazard exists from falling objects or other impact/bump hazards. The inner suspension of the hard hat must be inspected regularly and must ensure that at least 1 to 1-1/4" of gap exists between the suspension and the hard hat shell. ERM employees required to wear hard hats shall generally utilize Type 1 Class G (General) hard hats, although other types and classes may be appropriate based on site conditions.

4.3 Training

Employees shall receive initial training on risk assessment and hazard identification as part of EMR's Observation and Feedback Program (OFP) training. This mandatory training is required to be completed by all ERM employees within the first 90 days of employment. Additionally ERM consultants are required to complete training on health and safety planning, including evaluation of various levels of risk evaluation and control (including the use of PPE as a last resort).

Employees shall receive training on various types of PPE applicable to their project tasks. Training topics include, but are not limited to:

- Routes of exposure;
- Categories of exposure;
- Selection of chemical protective clothing;
- Eye and face protection;
- Hand protection;
- Foot protection;
- Head protection;
- Limitations of PPE;
- Storage, cleaning, and maintenance of PPE;
- Proper donning and doffing procedures;
- Adjusting PPE and determining proper fit; and
- Disposal of PPE.

Retraining will be conducted if any of the following occur:

- Employee observed not using appropriate PPE for task;
- Employee observed using PPE in a manner that is inconsistent with previous training;
- Changes in types of PPE used; and
- New hazards identified at the site which required the use of a different level or type of PPE.

All training is tracked in ERM's Academy learning Management System (LMS).

4.4 Usage, Storage, and Maintenance

All PPE must be kept clean and properly maintained by the employee to whom it is assigned. PPE will be inspected, cleaned, and maintained by employees at regular intervals as part of their normal job duties. Project Managers are responsible for ensuring compliance with cleaning of PPE by employee working on their projects.

In ERM's typical role on projects, PPE does not become grossly contaminated. During projects where chemical contamination of PPE occurs, PPE will be decontaminated (if it is to be reused) or discarded in accordance with waste management practices for the project site. If gross contamination with liquid chemicals occurs, employees will immediately stop work and proceed

to the decontamination area. Details of PPE and equipment decontamination are specified for each project in the site-specific HASP and/or JHA.

Change rooms and shower rooms are not typically required for ERM projects due to several factors, including the short duration and non-permanency of the projects. In the event change rooms and shower rooms are required for a project, details will be included in the site-specific HASP.

All PPE will be inspected prior to use and any damaged or defective PPE will not be used. All damaged or defective PPE will be immediately discarded.

4.5 ERM-Provided PPE

ERM provides PPE to our employees in accordance with applicable regulatory standards. Prescription safety glasses and protective footwear are subsidized (see *NAM-1310-WI1* and *S3-NAM-1310-WI2*, respectively). Employees are discouraged from providing their own PPE. Employees are responsible for ensuring that ERM-provided PPE is maintained and replaced as needed. During routine inspections of field-based activities, the Field Safety Officer (FSO), Project Manager, or Business Unit Health and Safety Director will observe the condition of employee PPE.

5. References

- ERM Work Instruction NAM-1320-WI1 (*Prescription Protective Eyewear*)
- ERM Work Instruction NAM-1320-WI2 (*Protective Footwear*)
- ERM Work Instruction NAM-1320-WI3 (*Selection, Care, and Use of Flame-Resistant Clothing*)
- ERM Procedure NAM-1311-PR1 (*Respiratory Protection*)
- ERM Procedure NAM-1312-PR1 (*Hearing Conversation*)
- ERM Procedure NAM-1324-PR1 (*Safe Use of Cutting Tools*)

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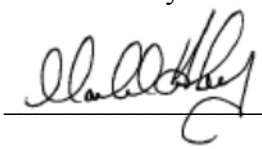
Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document.	2/10/15
All	Reformatted to meet ERM Global standards; language changes for clarity	1/14/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/10/17
4.3	Included discussion of risk assessment training	1/16/18
4.1	Revised criteria for workplace hazard assessments	2/15/19

1. Purpose and Scope

This procedure describes the requirements for prevention of occupational noise-induced hearing loss in those employees working in potentially noisy areas. Implementation of this hearing conservation procedure is required whenever noise exposures equal or exceed an 8-hour time-weighted average (TWA) of 85 decibels (dB). It is ERM policy that its employees will not be exposed to noise that exceeds 85 dB averaged over an 8-hour work day. Protective measures to mitigate exposure to hazardous sound levels will include the use of engineering controls, work practices and hearing protection devices.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correct any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director or other staff member.

Project Manager: Responsible for the following elements:

- Perform observations of ERM work processes to assess employee compliance with this procedure;
- Stop work where deviations from this procedure are observed; and
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Regional Health and Safety Director: Responsible for the development and implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of this procedure during health and safety plan reviews and project audits; and
- Communicate identified deficiencies to the PIC.

Employee: Responsible for the use of provided hearing protection in all designated areas.

3. Definitions

- **Decibel (dB):** A unit used to measure the intensity of a sound by comparing it with a given level on a logarithmic scale.
- **Hertz (Hz):** A unit of frequency equal to one cycle per second.

- **High noise area:** A work area in which employee noise exposures equal or exceed 85 dB (decibels) averaged over an eight hour workday.
- **Standard threshold shift (STS):** A change in hearing threshold relative to a baseline audiogram of an average 10 dB or more at 2000, 3000, and 4000 Hz in one or both ears.

4. Procedure

4.1 Noise Monitoring

Noise monitoring to characterize potential noise exposure will be conducted wither by a subject matter expert familiar with noise monitoring or a Field Safety Officer (FSO) that has received training in conducting noise monitoring. Both personal monitoring using noise dosimeters and area monitoring using a sound level meter may be conducted. Noise monitoring will be repeated whoever a change in production, process equipment, or controls occurs which could affect the number of employees exposed or render the attenuation of hearing protector no longer effective.

4.2 Employee Notification

All employees participating in personal noise monitoring will be notified of their results. Any employee whose exposure is determined to have met or exceeded 85 dB as an 8-hour TWA will be notified in writing within 15 calendar days. The results of area noise surveys will be communicated to project team members during daily site safety meetings.

4.3 Observation of Monitoring

Employees or their designated representatives will be offered the opportunity to observe any noise monitoring conducted which impacts their job or position.

4.4 Audiometric Testing

ERM employees who are exposed to noise at or above 85 dB as an 8-hour TWA within the working environment will receive a baseline audiogram within six months of the first exposure. Annually after obtaining the baseline audiogram, the employee shall receive a new audiogram for comparison to the baseline.

In preparation for both baseline and annual examinations, employees will be instructed to avoid noisy environments at both work and home for at least 14 hours before audiometric testing. Hearing protectors may be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

Each employee's annual audiogram will be compared to the baseline audiogram. If the results of the annual audiogram indicate a standard threshold shift (STS), an average change

in hearing threshold of 10 dB or more at the 2000, 3000, and 4000 Hz frequency in either ear relative to the baseline audiogram, the following actions will be taken (unless the shift is determined to be non-occupational in nature):

- The employee will be notified in writing with 21 days of the determination;
- The employee shall be referred for additional medical follow-up, as appropriate;
- Employees using hearing protectors will be refitted and retrained in their use;
- Where necessary, hearing protectors with greater noise attenuation properties will be offered; and
- Employees not using hearing protectors will be fitted with such, trained in their care and use, and required to use them.

Employees or their designated representatives will be offered the opportunity to observe any noise monitoring conducted. These tests are conducted at no cost to the employee. Results of audiograms and employee physicals will be forwarded directly to each employee within 10 working days of receipt of results.

4.5 Hearing Protectors and Hearing Protector Attenuation

A variety of hearing protectors will be provided to the employees at no cost. Hearing protectors will be maintained in good condition. Employees will wear hearing protectors in all designated high noise areas while performing tasks that generate loud noises (e.g., use of portable power tools) and while working within 25 feet of noisy operations (e.g., drilling).

The adequacy of the hearing protector will be evaluated to ensure that the hearing protector attenuates the employee exposure to an 8-hour TWA of 85 dB or less. The FSO is responsible for making this determination.

For work performed at client's location, the employees must observe posted noise signage and implement controls as needed.

4.6 Training

Hazard recognition and general awareness training on hearing conservation is provided to all ERM employees during the new hire orientation process which occurs during the first week of employment. Recognition of completion of this training is provided in ERM's Academy Learning Management System (LMS). A certificate of training is available to all employees.

Where employees are required to work regularly in areas where their exposure to noise is determined to be, or has the potential to be, in excess of 85 dBA as an 8–hour TWA, additional annual training will provide. The training will contain at least the following elements:

- Effects of noise on hearing;

- Purpose of hearing protectors and manufacturer's instructions on use and fitting;
- Advantages/disadvantages and attenuation of various types of hearing protectors;
- Instructions on selection, fitting, use, and care of hearing protectors (in accordance with manufacturer instructions);
- Purpose of audiometric testing program including an explanation of the test procedure; and
- Changes in ERM work processes and/or personal protective equipment (PPE) used.

4.7 Recordkeeping

Audiometric testing records will be maintained for each affected employee and contain the following information:

- Name and job classification;
- Date of audiogram;
- Name of person conducting audiogram;
- Date of last acoustic or exhaustive calibration of audiometer; and
- Employee's most recent noise exposure assessment.

Records of audiometric testing will be maintained by ERM's medical consultant WorkCare. All audiometric testing records shall be maintained for the duration of employment plus thirty years. All noise monitoring records shall be maintained for the duration of employment.

5. References

- US Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.95 (*Occupational Noise Exposure*)
- Ontario Occupational Health and Safety Act (OHSA) Regulation 381/15 (*Noise*)

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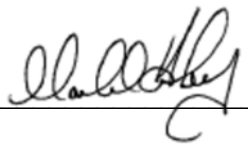
Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document.	3/17/14
All	Reformatted document. Minor language changes for clarity.	6/24/15
1.0	Added line clarifying that ERM employees will not be exposed to noise levels in excess of 85 dB averaged over an 8-hour day.	12/15/15
4.6	Updated training requirements	8/3/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/6/17
1, 4.5, 5	Revised Purpose statement (Section 1); added information on compliance with client requirements (Section 4.5); added reference to Ontario regulations	6/26/18

1. Purpose and Scope

This procedure establishes minimum requirements for work in environments where exposures to cold stress are encountered and provides guidance to evaluate and control these stressors. This procedure is applicable to all North American operations, and will be made available to employees at the work site upon request.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correct any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety director or other staff member.

Project Manager: Responsible for the following elements:

- Perform observations of ERM work processes to assess employee compliance with this procedure;
- Stop work where deviations from this procedure are observed; and
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of this procedure during health and safety plan reviews and project audits; and
- Communicate identified deficiencies to the PIC.

3. Definitions

- **Temperature:** The dry bulb temperature in degrees Fahrenheit (°F) or Celsius (°C).
- **Frostbite:** Injury caused by freezing of the skin and underlying tissues.
- **Hypothermia:** A medical emergency that occurs when the body loses heat faster than it can produce it, creating a dangerously low internal body temperature, typically less than 95 °F (35 °C).

4. Procedure

Cold stress can present a significant hazard to workers and can result in hypothermia or frostbite. Several factors incorporate the harmful effects of cold, including wet clothing, smoking, drinking alcoholic beverages, fatigue, emotional stress and certain diseases and medications.

4.1 Classification and Prevention

4.1.1 Hypothermia

Hypothermia is a potentially life threatening condition which results in a drop in the body's core temperature. At lower body temperatures, the body can react by a reduction in mental awareness, reduced rational decision making, loss of consciousness, and death.

The signs and symptoms of hypothermia include shivering, dizziness, numbness, confusion, weakness, impaired judgment, impaired vision and drowsiness. The stages of hypothermia are shivering, apathy, loss of consciousness, decreasing pulse and breathing rates, and death

First aid measures for hypothermia include calling emergency medical services and moving the victim to a warm area and into dry clothing.

4.1.2 Frostbite

Frostbite is the most common injury caused by cold. It happens when ice crystals form in body tissues, usually the nose, ears, chin, cheeks, fingers, or foes. This restricts blood flow to the injured parts. The effect is worse if the frostbitten parts are thawed and then refrozen.

Signs and symptoms of frostbite include an initial slight flushing of the skin. The skin color then changes to white and then grayish blue. Pain is sometimes felt early but later goes away. The frostbitten parts feel very cold and numb, and the victim may not be aware of the injury. In severe cases, frostbite may result in blisters or gangrene.

First aid measures for frostbite include moving the victim to a warm area and placing the frozen parts in warm water (100 to 105 °F/37.8 to 40.5 °C). Handle them gently and do not rub or massage them. Loosely bandage the injured parts. Seek prompt medical attention.

4.2 Recognition, Prevention, and Control

The first signs of cold stress are pain in the extremities. Severe shivering may result as body temperature drops.

Protection from cold stress must be considered in addition to provisions for personal protective equipment. Provisions for insulating dry clothing must be provided, regularly inspected, and replaced as required.

Wind chill can substantially reduce the cooling rate experienced by personnel. Prevention of excessive cooling exacerbated by wind chill condition requires increased insulation value of the protective work clothing. The effects of wind chill and temperature can be referenced in NAM-1323-WI1 (***Equivalent Chill Temperatures***).

The following work practices should be followed to minimize the effects of cold stress conditions:

- Wear adequate layers of insulating dry clothing. Keep a change of dry clothes available in case clothing becomes wet. Ensure adequate supplies of cold weather gear are available and stocked.
- Use the buddy system to look for signs of cold stress.
- If appropriate, use windshields to reduce the effects of wind.
- Heated warming shelters should be available when the equivalent chill temperature (ECT) is less than 20°F (-29°C). See NAM-1323-WI1 for additional information.
- To prevent dehydration, which can increase the susceptibility of workers to cold injuries, warm sweet drinks and soups should be provided. Coffee and soft drink intake should be limited due to the diuretic effects.
- Consult NAM-1323-WI2 (***Work/Warm-up Schedule***) for guidance on applications of work/warming regimens in extreme cold situations (-15 °F/-26 °C).
- Ensure regularly-used travel pathways are kept as clear of snow and ice as practicable.
- Be aware of the hazards of unstable snow and ice buildup, and avoid working close to areas of accumulated snow and ice whenever possible

4.3 Training Requirements

Worker training should be provided to discuss the hazards of cold stress environments and to review preventative work practices. Training is conducted during daily tailgate safety meetings when working in cold environments. This ensures more effective and timely training than a once-annual session. The training should include:

- Proper clothing and PPE requirements;
- Recognition, prevention, and first aid treatment of frostbite and hypothermia, including a discussion of re-warming procedures;
- Suggested work/rest regimens and eating/drinking habits; and
- Safe work practices in cold stress environments.

5. References

- ERM Work Instruction NAM-1323-WI1 (***Equivalent Chill Temperatures***)
- ERM Work Instruction NAM-1323-WI2 (***Work/Warm-up Schedule***)

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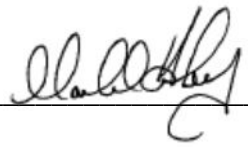
Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document.	6/8/15
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/6/17

1. Purpose and Scope

This procedure establishes minimum requirements for work in environments where exposures to heat stress are encountered and provides guidance to evaluate and control these stressors. This procedure is applicable to all North American operations, and will be made available to employees at the work site upon request.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correct any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director or other staff member.

Project Manager: Responsible for the following elements:

- Perform observations of ERM work processes to assess employee compliance with this procedure;
- Stop work where deviations from this procedure are observed; and
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of this procedure during health and safety plan reviews and project audits; and
- Communicate identified deficiencies to the PIC.

3. Definitions

- **Acclimatization** – The temporary adaptation of the body to work in the heat. Acclimatization peaks in most people within 4 to 14 days of regular work for at least two hours per day in the heat.
- **Heat Illness** – A serious medical condition resulting from the body's inability to cope with a particular heat load; includes heat cramps, heat rash, heat exhaustion, and heat stroke.
- **Environmental risk factors for heat illness** – 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 (e.g., impervious clothing vs. standard work attire).

- **Personal risk factors for heat illness** – Factors such as 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.
- **Shade** – Blockage of direct sunlight. 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. Shade may be provided by any natural or artificial means that does not expose employees to unsafe or unhealthy conditions and that does not deter or discourage access or use.
- **Temperature** – The dry bulb temperature in degrees Fahrenheit (°F) or Celsius (°C).

4. Procedure

4.1 Classification and Prevention

4.1.1 Heat Stroke

- Condition: (a) Hot dry red skin, (b) high and rising core temperature 105°F (40 °C) and over; and (c) brain disorders, including mental confusion, loss of consciousness, convulsions, or coma, as core temperature continues to rise. Heat stroke can be fatal if treatment is delayed.
- Predisposing Factors: (a) Sustained exertion in heat by non-acclimatized workers; (b) obesity and lack of physical fitness; (c) recent alcohol intake; (d) dehydration; (e) individual susceptibility; and (f) chronic cardiovascular disease in the elderly.
- Corrective Actions: Immediate and rapid cooling by immersion in chilled water with massage or by wrapping in wet sheet with vigorous fanning with cool dry air. Avoid overcooling. Treat shock if present. Seek medical attention.
- Prevention: Medical screening of workers. Selection based on health and physical fitness. Acclimatization for 8 to 14 days by graded work and heat exposure. Monitoring workers during sustained work in severe heat environments.

4.1.2 Heat Exhaustion

- Clinical Features: (a) Fatigue, nausea, headache, giddiness; (b) skin clammy and moist, complexion pale, muddy, or with hectic flush; and (c) may faint on standing, with rapid pulse and low blood pressure.
- Predisposing Factors: (1) Sustained exertion in heat, (2) lack of acclimatization, and (3) failure to replace water and/or salt lost in sweat.
- Treatment: Remove to cooler environment. Provide fluids with electrolytes such as Gatorade™ or equivalent. Seek medical attention.
- Prevention: Acclimatize workers using a breaking-in schedule for 1 to 2 weeks. Supplement dietary salt only during acclimatization. Ensure ample drinking water, Gatorade™ or equivalent is available at all times and taken frequently during the day.

4.1.3 Heat Cramps

- Clinical Features: Painful spasms of muscles used during work (arms, legs, or abdominal). Onset can occur during or after work hours.
- Predisposing Factors: (1) Heavy sweating during hot work and (2) drinking large volumes of water without replacing salt loss.
- Treatment: Drinking liquids with salt supplement such as Gatorade™ or equivalent. Seek medical attention.
- Prevention: Adequate salt intake with meals. In un-acclimatized persons, provide salted (0.1 percent) drinking water.

4.1.4 Heat Rash

- Clinical Features: Profuse tiny raised red blisters on affected areas. Pricking sensations during heat exposure.
- Predisposing Factors: Unrelieved exposure to humid heat with skin continuously wet with un-evaporated sweat.
- Treatment: Seek medical attention.
- Prevention: Cooled resting and sleeping quarters to allow skin to dry between heat exposures.

4.2 Prevention Procedures

Working in a hot environment requires that employers take precautions and provide adequate protection to prevent heat stress. The following procedures should be utilized on ERM project sites to recognize and prevent heat stress conditions.

4.2.1 Monitoring and Risk Evaluation

- Track the weather forecast for the job site and use forecasted information to plan daily activities. Forecasts may be obtained from National Weather Service, Weather Channel, local news, or other available reliable source.
- Review this procedure at daily tailgate safety meetings, including:
  - Encouraging employees to drink plenty of water and not wait until they are thirsty,
  - Reminding employees of their right to take a cool-down rest in the shade when necessary,
  - Establishing the number and schedule of water and rest breaks, and
  - Reviewing the signs and symptoms of heat illness and emergency response procedures in the project-specific health and safety plan (HASP) with all workers onsite.
- Use a thermometer to measure the outdoor temperature in an area where there is no shade. While the temperature measurement must be taken in an area with full sunlight, the bulb or sensor of the thermometer should be shielded while taking the measurement (e.g., with the hand or some other object) from direct contact by sunlight.
- The U.S. Occupational Safety and Health Administration (OSHA) has made available a Heat Safety Tool for use on smartphones (https://www.osha.gov/SLTC/heatillness/heat_index/heat_app.html). The tool allows workers and supervisors to calculate the heat index for their worksite and, based on the heat index, display a risk level to outdoor workers. The tool also provides reminders about the measures that should be taken at that risk level to protect workers from heat-related illness.

4.2.2 Establishing Work Assignments and Work/Rest Regimens

- Make assignments for work involving physical labor and heat stress based on physical fitness level of available labor pool. Employees newly exposed to heat should begin their work level at 50% of suggested work schedule and increase level by 10% per day to allow for acclimatization.
- An employee who has been newly assigned to a high heat area should be closely observed by the supervisor or Field Safety Officer (FSO) for the first 14 days of the employee's employment.
- Supervision and the “buddy system” should be used to carefully observe workers in heat stress environments to evaluate each individual’s susceptibility to heat stress. Any employee exhibiting signs of heat stress should be promptly investigated.
- All employees shall be closely observed by the supervisor or FSO during a heat wave. For purposes of this section, “heat wave” means any day in which the predicted high temperature

for the day will be at least 80 °F (27 °C) and at least 10 °F (5 °C) higher than the average high daily temperature in the preceding five days.

- Initiate a modified work/rest regimen when ambient temperatures and protective clothing create a potential heat stress hazard. If ambient temperatures are greater than or equal to 75°F, the following work/rest regimen is recommended (guidelines assume light to moderate work):

Temperature	Work Period	Rest Period
75 – 80 °F/24 – 27 °C	90 Minutes	15 Minutes
80 – 85 °F/27 – 29 °C	60 Minutes	15 Minutes
85 – 90 °F/29 – 32 °C	45 Minutes	15 Minutes
90 – 95 °F/32 – 35 °C	30 Minutes	15 Minutes

- Rest periods should be taken in a shaded area as described in Section 4.2.3 with open air movement, if available, as this will considerably reduce the effects of heat stress.
- Employees shall be allowed and encouraged to take a preventative cool-down rest in the shade for a period of no less than five minutes at a time when they feel the need to do so to protect themselves from overheating. Such access to shade shall be permitted at all times. An individual employee who takes a preventative cool-down rest:
  - Shall be monitored and asked if he or she is experiencing symptoms of heat illness;
  - Shall be encouraged to remain in the shade; and
  - Shall not be ordered back to work until any signs or symptoms of heat illness have abated, but in no event less than five minutes in addition to the time needed to access the shade.
- If an employee exhibits signs or reports symptoms of heat illness while taking a preventative cool-down rest or during a preventative cool-down rest period, the supervisor or FSO shall provide appropriate first aid or emergency response, as outlined in Section 4.2.5.
- Schedule physically demanding and strenuous tasks, or tasks requiring full-body chemical protection, for early in the day, if possible.
- Protective clothing inhibits the transfer of heat between the body and the surrounding environment. This can increase the onset of heat stress symptoms. The following consideration should be evaluated when protective clothing is worn in heat stress environments.
  - More frequent rest breaks in the shade;
  - Worker rotation to provide frequent breaks in cool areas;
  - Wear ice vests or vortex tubes, if practical; and

- Schedule changes to accommodate work at night or early morning hours.

4.2.3 Provision of Water and Shade

- Employees shall have access to potable drinking water that is fresh, pure, suitably cool, and provided to employees free of charge. The water shall be located as close as practicable to the areas where employees are working. Where drinking water is not plumbed or otherwise continuously supplied, it shall be provided in sufficient quantity at the beginning of the work shift to provide one quart per employee per hour for drinking for the entire shift. Supervisors or FSOs may begin the shift with smaller quantities of water if they have effective procedures for replenishment during the shift as needed to allow employees to drink one quart or more per hour. The frequent drinking of water shall be encouraged.
- When the outdoor temperature in the work area exceeds 80 °F (27 °C), the supervisor or FSO must establish and maintain one or more areas with shade at all times while employees are present that are either open to the air or provided with ventilation or cooling. The amount of shade present shall be at least enough to accommodate 25% of the number of employees on recovery or rest periods, so that they can sit in a normal posture fully in the shade without having to be in physical contact with each other. The shade must be located as close as practicable to the areas where employees are working.
- When the outdoor temperature in the work area does not exceed 80 °F (27 °C), the supervisor or FSO must either provide shade or provide timely access to shade upon an employee's request.
- Where it is infeasible or unsafe to have a shade structure, or otherwise to have shade present on a continuous basis, the project team may utilize alternative procedures for providing access to shade if the alternative procedures provide equivalent protection. Cooling measures other than shade (e.g., use of misting machines) may be provided in lieu of shade if these measures are at least as effective as shade in allowing employees to cool.

4.2.4 High Heat Procedures

When the temperature equals or exceeds 95 °F (35 °C), the following procedures will be implemented to the extent practicable:

- Ensuring that effective communication by voice, observation, or electronic means is maintained so that employees at the work site can contact a supervisor or the FSO when necessary. An electronic device, such as a cell phone or text messaging device, may be used for this purpose only if reception in the area is reliable.
- Observing employees for alertness and signs or symptoms of heat illness. The ERM project team must ensure effective employee observation/monitoring by implementing one or more of the following:
  - Supervisor or FSO observation of 20 or fewer employees,

- Mandatory buddy system,
- Regular communication with sole employee such as by radio or cellular phone, or
- Other effective means of observation.

- Designating one or more employees on each worksite as authorized to call for emergency medical services, and allowing other employees to call for emergency services when no designated employee is available.
- Reminding employees throughout the work shift to drink plenty of water.
- Reviewing the heat stress procedures at daily tailgate safety meetings, encouraging employees to drink plenty of water, and reminding employees of their right to take a cool-down rest when necessary.

4.2.5 Emergency Response Procedures

- If a supervisor or FSO observes, or any employee reports, any signs or symptoms of heat illness, the supervisor or FSO must take immediate action commensurate with the severity of the illness.
- When an employee displays possible signs or symptoms of heat illness, the supervisor or FSO will check the employee and determine whether resting in the shade and drinking cool water will suffice or if emergency service providers will need to be called. WorkCare Incident Intervention (888-449-7787) should also be contacted to provide guidance on appropriate care.
- An employee exhibiting signs or symptoms of heat illness must be monitored and not left alone or sent home without being offered onsite first aid and/or being provided with emergency medical services in accordance with the site HASP.
- If the signs or symptoms are indicators of severe heat illness (such as, but not limited to, decreased level of consciousness, staggering, vomiting, disorientation, irrational behavior or convulsions, incoherent speech, red and hot face), the supervisor or FSO must implement emergency response procedures outlined in the HASP. Emergency service providers must be contacted immediately, and while the ambulance is in route, initiate first aid (follow guidance in Section 4.1.1).
- In the event a heat stress related incident or near miss occurs, the supervisor or FSO will notify the PIC and PM and report the event following guidelines in the HASP.

4.3 Training Requirements

All field employees, including supervisors, shall be provided training on heat stress and working in hot environments in the language that they understand. Training shall be provided prior to working in hot environments and will be documented in ERM's Academy Learning

Management System (LMS). Employee training to recognize heat stress conditions and the methods necessary to prevent and treat heat stress include:

- The environmental and personal risk factors for heat illness, as well as the added burden of heat load on the body caused by exertion, clothing, and personal protective equipment.
- How to monitor weather reports and how to respond to hot weather advisories.
- The procedures for providing water, shade, cool-down rests, and access to first aid as well as the employees' right to stop work without retaliation.
- The importance of frequent consumption of small quantities of water, up to four cups per hour, when the work environment is hot and employees are likely to be sweating more than usual in the performance of their duties.
- The concept, importance, and methods of acclimatization.
- The different types of heat illness, the common signs and symptoms of heat illness, and appropriate first aid and/or emergency responses to the different types of heat illness.
- The importance to employees of immediately reporting any symptoms or signs of heat illness in themselves or in co-workers.
- ERM procedures contained in the HASP for responding to signs or symptoms of possible heat illness, including how emergency medical services will be provided should they become necessary.

5. References

- California Division of Occupational Safety and Health (Cal/OSH) Heat Illness Prevention Standard – California Labor Code Section 226.7

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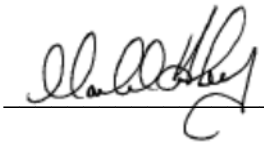
Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document.	4/26/10
All	Reformatted document. Edits for clarity; addition of new regulatory information,	6/5/15
4.2.1; 4.2.2; 5	Deleted references to ACGIH TLVs; language added confusion to implementation of procedure	6/8/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); changes shade requirements (Section 4); updated References (Section 5)	1/16/17

1. Purpose and Scope

This procedure is designed to ensure that ERM employees have formally considered the potential risks associated with the use of cutting tools, including but not limited to knives, shears, snips, scissors, core sleeves, tubing cutters, pruning tools, paper cutters, and hand-held electric saws. The procedure applies to all ERM work activities which involve the use of these tools within offices, equipment storage areas, or field trailers as used by ERM employees, contractors, and consultants.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this procedure is implemented, understood, and followed by employees under their charge and working on their projects;
- See to the performance of periodic inspections in the office and at projects to identify appropriate tools and procedures; and
- Correct any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director or other staff member.

Project Manager/Area Manager: Responsible for the following elements:

- Perform observations of ERM work processes to assess employee compliance with this procedure;
- Stop work where deviations from this procedure are observed; and
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Drector, any observed deficiencies in the implementation of this procedure.

Employees: Responsible for the following elements:

- Perform all work in accordance with this procedure; and
- Formally assess risks from use of cutting tools and take actions to effectively manage identified hazards prior to starting work.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of this procedure during health and safety plan reviews and project audits; and
- Communicate identified deficiencies to the PIC.

3. Definitions

Fixed open bladed knife: Any knife where the normal use and position of the tool creates an unguarded knife or razor edge.

4. Procedure

4.1 Hazard Assessment

ERM requires that hazard assessments be performed for all activities, including those that involve the use of cutting tools. A Job Hazard Analysis form (***ERM-1115-FM1***) should be used to identify and document the hazards and associated control measures, including selection of the most appropriate cutting tool(s) to be used. When considering how to manage cut/puncture hazards associated with cutting tool use, a recommended best practice is to apply the following control measures listed in order of priority:

- Eliminate or avoid the hazard.
- Reduce the hazard by using safer cutting tool(s)/equipment or other engineering controls.
- Limit who is permitted to use cutting tools and/or locations they are sued, and train those employees only.
- Train all employees on the proper use of cutting tools.
- Utilize personal protective equipment (PPE) such as cut-resistant gloves. This should be considered the last line of defense and used in conjunction with other control measures.

4.2 Cutting Tool Selection

- Use the cutting tools designed for the job.
- Do not use inadequate, inappropriate, or unsafe tools simply because they are available. Take the time to acquire the correct tool for the job.
- Use scissors/snips, safety cutters with guarded, concealed, or self-retracting blades; or other safety cutting devices without open or exposed blades whenever possible. Examples include the following:

Safety cutter for opening packages

Snips

Guarded utility knife

Concealed blade cutters

Sheet cutter/letter opener

Core sleeve cutters

Tubing cutter

- Fixed open-bladed knives (FOBKs) are dangerous tools, but they are used so routinely that their hazards are often underestimated or ignored. Examples include pocket knives (including Leatherman and similar multi-tools), utility knives, box cutters (including cutters with spring loaded blades), and X-acto knives.

The uncontrolled and unsafe use of FOBKs is a common factor in hand injuries (lacerations) reported within our industry. **For this reason, FOBKs are prohibited from being used unless they are determined to be the safest tool for the task**. This determination should be made in consultation with the PIC, Project Manager/Area Manager, and Business Unit Health and Safety Director. Note that some clients prohibit the use of FOBKs altogether; therefore, client expectations must be clearly known and understood.

- If FOBKs are to be used, their safe use must be documented in written job procedures (e.g. JHA), the blade must be locked when in use and protected when not in use, personnel must have received training on how to correctly and safely use the tool, and cut-resistant gloves must be worn during use. FOBKs that cannot be locked in the open position shall not be used.
- Kitchen knives used in designated kitchen areas for food preparation may be used without the requirement to document in a written job procedure or provide formal training; however their use should be consistent with other guidance outlined in Section 4.3.
- Paper shears pose a significant hazard and should only be used if no practicable alternative exists; a JHA has been prepared and reviewed by the H&S team; and only trained employees are permitted to use it. The procedure must include locking the shear in the closed position when not in active use, and preferably includes the use of cut-resistant gloves unless safety interlocks are incorporated into the design. Options to purchase shears with safety interlocks must be considered at the first available opportunity

4.3 Safe Cutting Tool Use

- Train personnel in the correct way to use cutting tools prior to use.
- Use the designated safest cutting tool for the task and ensure it is sharp.
- Inspect cutting tools prior to use to confirm they are in good condition and safe to sue.
- **Always cut away from your hands and body**, keeping all body parts behind the blade and out of the "line of fire".
- Ensure you and other people in the area are out of the “line of fire” of the cutting tool’s path/potential path (in event of tool slippage, etc.).
- Put the object to be cut in a vise or on a flat surface, or use another tool to hold the object instead of holding in your hand or against your body (e.g., do not hold the object to be cut against your thigh).

- If the cutting tool is designed to be used with two hands, then it must be held with two hands. Saws-alls and drills are designed to be held with two hands, but are commonly incorrectly held with one hand during use.
- Use the buddy system. Utilizing a co-worker to assist in cutting activities can often reduce hazards associated with cutting lumber, tubing, and piping.
- Always return cutting tools to an appropriate storage location. **Do not place cutting tools on the ground!**

4.4 Personal Protective Equipment

Gloves that are appropriate for specific task hazards and, in good condition, can prevent some injuries; however, gloves (and all PPE) are considered as a final barrier against potential injury. Gloves must be used in conjunction with other control mechanisms (see Section 4.1) as well as the appropriate cutting tool for the job.

Specific glove requirements for tasks to be performed on site must be stated in the JHA or equivalent written job procedure. Common glove types and levels of protection are as follows:

Glove Type	Protects From	Common Uses
Cotton, canvas cloth	Minor abrasions, chafing	Light duty (e.g., sweeping)
Leather, Aramid fiber, HexArmor™	Abrasions, punctures, minor lacerations	Handling rough, rigid or abrasive materials; working with hand and power tools (unless they may get caught)
Leather reinforced with metal or metal stitching	Abrasions, lacerations	Handling sharp-edged tools/equipment
Metal mesh, Stainless Core (stainless steel woven into material), Kevlar, HexArmor™	Lacerations and abrasions associated with glancing/slicing cuts	Using cutting tools; handling sharp/jagged tools and materials.
Nitrile-coated knit gloves	Chemicals, punctures	Clearing demolition and other uncontrolled debris

More information may be obtained from our internal PPE provider Northern Safety and Industrial (www.northernsafety.com). Cut-resistant gloves must be worn when using FOBKs, at a minimum.

When several hazards are encountered that one glove will not provide adequate protection against, gloves should be layered accordingly. For example, when handling contaminated materials with sharp edges, inner nitrile gloves may be worn to protect against chemical hazards with outer cut-resistant gloves to protect against cuts and abrasions.

Protective gloves must be inspected before each use to ensure that they are not torn, punctured, or made ineffective in any way (e.g., wet/water soaked or dirty gloves can become slippery).

5. References

- ERM Form ERM-1115-FM1 (***Job Hazard Analysis***)

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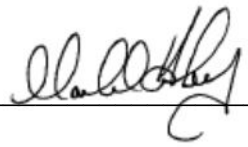
Original Effective Date: 10/23/13

Policy Approval by: Mark Hickey

Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document	10/23/13
All	Reformatted document; minor edits for clarity	6/1/15
4.4	Updated section to refer to Northern Safety	9/1/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/11/17

1. Purpose and Scope

This procedure establishes minimum requirements for work with hand tools and portable powered equipment. The purpose of this procedure is to ensure that hand tools and portable power equipment meet minimum safety requirements, are used in a the manner for which they are intended, and are maintained in a safe condition. This procedure is applicable to all North American operations.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correct any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director or other staff member.

Project Manager: Responsible for the following elements:

- Perform observations of ERM work processes to assess employee compliance with this
- procedure;
- Stop work where deviations from this procedure are observed; and
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of this procedure during project audits; and
- Communicate identified deficiencies to the PIC.

3. Definitions

Portable Power Equipment: Electric, pneumatic, gasoline or explosive-actuated hand tools.

Ground Fault Circuit interrupters (GFCI): A device that shuts off an electric power circuit when it detects that current is flowing along an unintended path, such as through water or a person.

Underwriters Laboratories (UL): A global product safety testing and certification organization.

4. Procedure

4.1 General Equipment Requirements

- All hand and portable power tools shall be maintained in safe working order and used only for the task for which they were designed.
- Hand and portable power tools, power supplies, and flexible cord sets (extension cords) shall be inspected prior to each use to identify any defects. Damaged or defective tools shall be immediately removed from service and identified through tagging or lockout of controls.
- Tool surfaces and handles shall be kept clean and free of dirt, grime, and excess oil to prevent slipping.
- Tools shall be cleaned and properly stored when not in use to prevent possible injuries and tool damage.
- Non-sparking tools shall be used in atmospheres with fire or explosive characteristics.
- Eye protection shall be used at all times during tool operation. Additional personal protective equipment (PPE) appropriate to the tool operation or work task shall be required and used, including face shields, hearing protection, respiratory protection and protective gloves.

4.2 Hand Tool Use

- Do not force tools beyond their capacity or use cheater bars or other instruments to increase their capacity.
- Do not use hand tools as pry bars.
- Do not throw tools from place to place or person to person.
- Do not drop tools from heights.
- Ensure that hands, fingers, and other body parts are out of the line of fire during tool usage.
- Brace yourself when using the tool in case the tool slips.

4.3 Portable Power Tool Use

- Loose clothing, long hair, loose jewelry, rings and chains are not allowed while working with power tools.
- Hands shall be kept clear of all cutting, rotating, or moving parts of powered tools.
- Portable power tools shall be safety tested and certified by Underwriters Laboratories (UL) or an equivalent authority.

- Electric power tools must be either double-insulated or equipped with a 3-wire grounded wiring and plug.
- Adapters which interrupt the continuity of the equipment grounding connection shall not be used.
- Tools shall only be used with a GFCI or a GFCI adapter. Do not handle wet cords and power tools unless they have been deenergized.
- Guards and safety devices provided by tool manufacturers shall not be removed or modified in any way which may interfere with their intended function.
- Portable equipment shall be handled in a manner which will not cause damage. Flexible electric cords shall not be used for raising or lowering the equipment and cords should not be fastened in any way that potentially damages the outer jacket or insulation.

5. References

- Occupational Health and Safety Adminsitration (OSHA) 29 Code of Federal Regulations (CFR) 1910 Subpart P (***Hand and Portable Powered Tools and Other Hand-Held Equipment***)
- OSHA Regulation 29 CFR 1926 Subpart I (***Tools – Hand and Po***wer)

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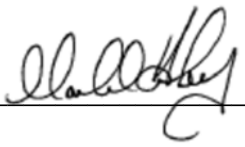
Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document	6/29/15
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/10/17

Known or Suspected Chemicals of Concern

The following form must be filled out for all confirmed or suspected chemicals present on the site to which the ERM team may reasonably be exposed. Information on each chemical must be provided to all team members. Add additional sheets as necessary to address all chemical concerns.

Chemical Name:	**Cadmium**			**CAS Number:**	7440-43-9		
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
Respiratory system, kidneys, prostate, blood		Inhalation, ingestion		Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia, emphysema, proteinuria, mild anemia			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:	0.005 mg/m3	**REL**	NA	**TLV**	0.01 mg/m3	**IDLH Level:**	9 mg/m3
STEL:	NA	**STEL**	NA	**STEL**	NA	**Ionization Potential:**	NA
Ceiling:	NA	**Ceiling:**	NA	**Ceiling:**	NA	**Known/Pot. Carcinogen**	Yes
Peak:	NA	**Sampling Methods:**	NIOSH 7048, 7300, 7301, 7303, 9102; OSHA ID121, ID125G, ID189, ID206				

Chemical Name:	**Lead**			**CAS Number:**	7439-92-1		
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
Eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue		Inhalation, ingestion, skin and/or eye contact		Lassitude, insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:	0.05 mg/m3	**REL**	0.050 mg/m3	**TLV**	0.05 mg/m3	**IDLH Level:**	100 mg/m3
STEL:	NA	**STEL**	NA	**STEL**	NA	**Ionization Potential:**	NA
Ceiling:	NA	**Ceiling:**	NA	**Ceiling:**	NA	**Known/Pot. Carcinogen**	No
Peak:	NA	**Sampling Methods:**	NIOSH 7082, 7105, 7300, 7301, 7303, 7700, 7701, 7702, 9100, 9102, 9105: OSHA ID121, ID125G, ID206				

Chemical Name:				**CAS Number:**	#N/A		
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
#N/A		#N/A		#N/A			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:	#N/A	**REL**	#N/A	**TLV**	#N/A	**IDLH Level:**	#N/A
STEL:	#N/A	**STEL**	#N/A	**STEL**	#N/A	**Ionization Potential:**	#N/A
Ceiling:	#N/A	**Ceiling:**	#N/A	**Ceiling:**	#N/A	**Known/Pot. Carcinogen**	#N/A
Peak:	#N/A	**Sampling Methods:**	#N/A				

Chemical Name:				**CAS Number:**	#N/A		
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
#N/A		#N/A		#N/A			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:	#N/A	**REL**	#N/A	**TLV**	#N/A	**IDLH Level:**	#N/A
STEL:	#N/A	**STEL**	#N/A	**STEL**	#N/A	**Ionization Potential:**	#N/A
Ceiling:	#N/A	**Ceiling:**	#N/A	**Ceiling:**	#N/A	**Known/Pot. Carcinogen**	#N/A
Peak:	#N/A	**Sampling Methods:**	#N/A				

Chemical Name:				**CAS Number:**	#N/A		
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
#N/A		#N/A		#N/A			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:	#N/A	**REL**	#N/A	**TLV**	#N/A	**IDLH Level:**	#N/A
STEL:	#N/A	**STEL**	#N/A	**STEL**	#N/A	**Ionization Potential:**	#N/A
Ceiling:	#N/A	**Ceiling:**	#N/A	**Ceiling:**	#N/A	**Known/Pot. Carcinogen**	#N/A
Peak:	#N/A	**Sampling Methods:**	#N/A				

Known or Suspected Chemicals of Concern

The following form must be filled out for all confirmed or suspected chemicals present on the site to which the ERM team may reasonably be exposed. Information on each chemical must be provided to all team members. Add additional sheets as necessary to address all chemical concerns.

Chemical Name:	**Hexavalent Chromium**			**CAS Number:**	18540-29-9		
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
		Inhalation, injestion, absorption		Harmful if swallowed, toxic by inhalation, causes severe burns, toxic in contact with skin and if swallowed.			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:	5 æg/m3 TWA	**REL**	0.001 mg/m3	**TLV**	0.05 mg/m3	**IDLH Level:**	
STEL:		**STEL**		**STEL**		**Ionization Potential:**	
Ceiling:		**Ceiling:**		**Ceiling:**		**Known/Pot. Carcinogen**	Yes
Peak:		**Sampling Methods:**					

Chemical Name:	**Zinc**			**CAS Number:**	7440-66-6		
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
		Inhalation, injestion, absorption		Eye/skin/respiratory irritation. May be harmful if swallowed.			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:	NA	**REL**	NA	**TLV**	NA	**IDLH Level:**	
STEL:		**STEL**		**STEL**		**Ionization Potential:**	
Ceiling:		**Ceiling:**		**Ceiling:**		**Known/Pot. Carcinogen?**	
Peak:		**Sampling Methods:**					

Chemical Name:				**CAS Number:**			
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:		**REL**		**TLV**		**IDLH Level:**	
STEL:		**STEL**		**STEL**		**Ionization Potential:**	
Ceiling:		**Ceiling:**		**Ceiling:**		**Known/Pot. Carcinogen?**	
Peak:		**Sampling Methods:**					

Chemical Name:				**CAS Number:**			
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:		**REL**		**TLV**		**IDLH Level:**	
STEL:		**STEL**		**STEL**		**Ionization Potential:**	
Ceiling:		**Ceiling:**		**Ceiling:**		**Known/Pot. Carcinogen?**	
Peak:		**Sampling Methods:**					

Chemical Name:				**CAS Number:**			
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**			
OSHA		**NIOSH**		**ACGIH**		**Additional**	
PEL:		**REL**		**TLV**		**IDLH Level:**	
STEL:		**STEL**		**STEL**		**Ionization Potential:**	
Ceiling:		**Ceiling:**		**Ceiling:**		**Known/Pot. Carcinogen?**	
Peak:		**Sampling Methods:**					

1. Purpose and Scope

This document supports the Management System and establishes procedures for the proper storage, handling, and use of compressed gas cylinders. This procedure is applicable to ERM field and office operations.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure this program is implemented, understood, and followed by employees under their charge; and
- Correct any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director.

Project Manager/Supervisor: Responsible for the following elements:

- Implement program during project or office activities involving the use of compressed gas cylinders;
- Perform observations of ERM work processes to assess whether or not employees are operating in accordance with this procedure; and
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of SSE policies during health and safety plan reviews and project audits; and
- Communicate identified deficiencies to the PIC.

Employee: Responsible for complying with the requirements stated within the procedure.

3. Definitions

Not applicable.

4. Procedure

4.1 Identification

The contents of a compressed gas cylinder should be readily identified by stencil, stamp or label affixed to the cylinder. No compressed gas cylinder should be used or accepted for use that does not legibly identify the contents of the cylinder.

A copy of the Safety Data Sheet (SDS) for the compressed gas contained in the cylinder must be acquired, maintained on-site, and available for immediate review.

Cylinders which are empty must be labeled as such ("Empty" or "MT"). Empty cylinders must be segregated from full cylinders as indicated in Section 4.3.

4.2 Handling

Use the following procedures when handling a compressed gas cylinder:

- Move cylinders in a vertical position using a suitable hand truck or cart. If cylinders need to be raised, use a cylinder cage or cradle. Secure the cylinder to the handling equipment using straps or other appropriate securing methods. Never lift a cylinder by the valve cap.
- Never roll, drag, or slide cylinders. Do not drop them or allow them to strike each other.
- Ensure the valve cap and any valve seals are in place and remain in place until cylinders have been secured in position and are ready to use.
- Wear the appropriate personal protective equipment when handling cylinders. This should include, at a minimum, safety glasses, leather gloves, and steel-toed boots.

4.3 Storage

Use the following procedures when storing compressed gas cylinders:

- Store cylinders in a dry, cool, well-ventilated, fire-resistant, and secured area designated specifically for that purpose. Avoid storage in very low or very high temperatures. Do not place cylinders adjacent heat sources.
- Storage location shall be protected from weather and wet or damp grounds, and placed away from combustible or corrosive materials, heavily traveled areas, and emergency exits. Ensure storage areas provide sufficient access for cylinder handling.
- Store cylinders upright with valve caps and any valve seals in place. Use brackets, chains, or straps around the upper third of the cylinder to secure cylinders in storage.
- Group stored cylinders based their hazard class. Post conspicuous signage that identifies the gas or hazard class.

- Provide adequate space between groups of cylinders or segregate by partition. A minimum of 20 feet must be maintained between oxidizers and flammable gases. A firewall five feet high with a 30 minute fire rating can be substituted.
- Segregate full and empty cylinders. Designated areas for separate storage should be labeled. Note that empty cylinders may have residual pressure and should be handled as though they were full.
- Hoses, connectors, gauges, cylinder valves, regulators, and other appliances used with compressed gas cylinders shall be stored when not in use. Storage should be in a cool, dry area which can protect the appliances from damage.

4.4 Inspection

Cylinder suppliers have the responsibility for complete inspection of compressed gas cylinders prior to delivery. ERM employees shall perform daily visual inspections of cylinders in use.

The following visual criteria will be used assessed during inspection:

- Dents
- Cuts or gouges
- Corrosion
- Pitting
- Bulges
- Burned spots
- Damage to valve threads and/or cylinder neck

If damage to the cylinder is identified or the cylinder is thought to be deficient in any manner, the cylinder shall be removed from service. The supplier will be notified and requested to inspect and, if necessary, repair or replace the cylinder.

Prior to use, hoses, connectors, gauges, cylinders valves, regulators and other appliances will be inspected for the presence of damage, grease, oil, dirt, solvents, or any other suspected concerns or substances. If appliances are left connected to the cylinder for more than 24 hours, they will also be inspected as part of the daily visual inspections of cylinder itself.

4.5 Usage

The following procedures apply to the usage of cylinders:

- Leave valve protection caps in place and hand tighten until cylinders are secure and either in use or connected for use. Replace caps when removing a cylinder from use, placing in

storage, and/or returning to the supplier. Valve caps shall remain in place when cylinders are in storage.

- If a cylinder cap cannot be removed by hand, tag the cylinder "Do Not Use". Return the cylinder to storage and alert the supplier to replace the cylinder.
- Only tools supplied and/or approved by the cylinder supplier shall be used to open and close cylinder valves. Do not tighten connections or attempt repairs while the system is under pressure.
- Cylinders must be equipped with the appropriate regulator. Consult the cylinder supplier for information on the correct regulator type, as needed.
- Keep cylinder valves closed except when the cylinder is being used.
- When opening a cylinder valve, stand to the side of the regulator and open slowly.
- Transfer of compressed gases from one container to another shall only be performed by properly trained and qualified personnel provided by the supplier. ERM personnel are not allowed to attempt transfer operations.

4.6 Leaking Cylinders

Cylinder leaks are most likely to be found in one of four locations:

- Valve threads
- Pressure relief devices
- Valve stems
- Valve outlets

When assembling cylinders and appliances, and before using, perform a leak check at the points indicated above. Leak checks can be performed using soapy water.

If a cylinder is found to be leaking, identify the type of gas contained within the cylinder and determine if the leaking cylinder can be safely moved to a well-ventilated location. Additional safe handling procedures are dependent upon the cylinder contents.

- For inert gases, contact the supplier for assistance.
- For flammable or oxidizers, post signs in the area warning of potential fire hazards. Eliminate any ignition sources in the area. If ignition should take place, do not attempt to extinguish the flame unless the gas supply can also be stopped, as this may lead to an accumulation of gas and a possible explosion. Contact the local fire department and cylinder supplier immediately. If safe to do so, take action to cool and protect nearby cylinders from the fire.

- For corrosives and toxics, secure the area and evacuate all personnel. Contact the local fire department or hazmat team, as well as the cylinder supplier immediately. Personnel attempting to contain the leak should only do if they have the appropriate training and personal protective equipment to do so.

4.7 Training

ERM employees required to work with compressed gas cylinders will complete training in their use, handling and storage. Training will be documented through ERM's Academy Learning Management System.

5. References

- Compressed Gas Association – Pamphlet P1 (***Safe Handling of Compressed Gases in Containers***)
- ISO Standard 11625 (***Gas Cylinders – Safe Handling***)

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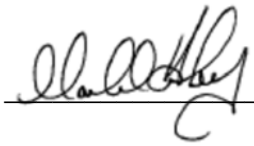
Original Effective Date: 2/3/15

Policy Approval by: Mark Hickey

Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document	2/3/15
1	Revised Applicability	1/12/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/11/17

1. Purpose and Scope

This document establishes procedures for the protection of personnel working on field projects with the potential for exposure to insect and arachnid bites, including mosquitoes and ticks. The standard applies to all North America operations where these hazards have been identified.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensuring this procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correcting any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director.

Project Manager (PM)/Supervisor: Responsible for the following elements:

- Performing observations of ERM work processes to assess whether or not employees are operating in accordance with this procedure;
- Pausing or stopping work where deviations from this procedure are observed; and
- Correcting, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluating implementation of this procedure during health and safety plan reviews and project audits; and
- Communicating identified deficiencies to the PIC.

3. Definitions

Babesiosis: A rare, severe and sometimes fatal tick-borne disease caused by various types of ***Babesia***, a microscopic parasite that infects red blood cells. It is transmitted by the bite of an infected ***Ixodes*** tick (e.g., deer ticks).

DEET: A synonym of N,N-dimethyl-meta-toluamide. It is the most common active ingredient in insect repellents, providing protection against mosquitoes, ticks, fleas, chiggers, and many other biting insects.

Lyme disease: An infectious disease caused by the ***Borrelia*** bacteria, it is transmitted to humans by the bite of infected ***Ixodes*** ticks (e.g., deer ticks). Signs of infection may include a red rash (sometimes seen as a bulls-eye), fever, headache, weariness, joint pains, heart palpitations, and memory loss.

Permethrin: A chemical belonging to the pyrethroid family which is widely used as an insecticide and insect repellent.

Picardin: A synthetic compound resembling the natural compound piperine, found in the plants which are used to produce black pepper. It is used an insect repellent for insects, ticks, and chiggers.

Rocky Mountain spotted fever: An infectious disease caused by the ***Rickettsia*** bacteria; it is transmitted to humans by the bite of infected ***Dermacentor*** ticks, a type of hard shelled tick (e.g., dog ticks). Initial signs and symptoms include sudden onset of fever, headache, and muscle pain, followed by development of a substantial rash. The disease is fatal in 3 to 5% of those who contract it.

West Nile virus: A member of the virus family ***Flaviviridae*** spread by various species of mosquitoes. Most infections (~80%) cause no symptoms. In less than 1% of cases, severe infection occurs which may result in neurological disease affecting the central nervous system, including encephalitis (inflammation of the brain) and meningitis (inflammation of the membranes covering the brain and spinal cord).

Zika virus: A member of the virus family ***Flaviviridae*** spread by the daytime-active ***Aedes*** mosquitoes. Zika virus is related to dengue, yellow fever, Japanese encephalitis, and West Nile viruses. It typically causes no or only mild symptoms, although it may spread from a pregnant woman to the baby, potentially resulting in microencephaly and other severe brain problems. Zika infections in adults can result in Guillain-Barre syndrome.

4. Standard

4.1 Hazard Assessment and Project Planning

Prior to the initiation of field work, the project team is required to perform a hazard assessment of the planned scope of work. This is done to identify any hazards that may impact project operations and the safety of ERM staff, as well as to identify the appropriate methods for mitigation. Mosquitos have the potential to transmit the West Nile or Zika Virus and ticks can transmit various tick-borne diseases such as Lyme disease, Rocky Mountain spotted fever, and ***Babesiosis***. Therefore, if it is determined that any member of the project field team is likely to be exposed to mosquito or tick prone environments, the following measures must be incorporated in the development of the project health and safety plan (HASP).

4.2 Mitigation Measures

4.2.1 Avoidance Measures

Avoidance of the exposure must be considered as first priority before entering the field. An effort should be made to schedule work to avoid hours of peak mosquito activity, which are

during the early morning and evening hours. Additionally, the identification of biting insect habitats such as grasslands, prairies, woodlands, and wetlands should also be identified, communicated to the field staff, and avoided to the extent practical.

The following measures must be implemented while out in the field:

- Avoid sitting on the ground.
- Wear long-sleeved, light colored garments.
- Tuck in shirts and tuck pants into socks or boots.
- Scan clothes, exposed skin, and equipment for ticks frequently. Ticks will climb upward in search of exposed skin, so check frequently.
- Shake off clothing and examine equipment before entering vehicles.
- Check vehicle for ticks. Placing a white or light colored cover over vehicle seats will aid with visual identification of ticks on the seats after the completion of field work.
- Conduct tick checks frequently, on self and on each other. At a minimum this should be done during breaks and before entering vehicles.

The following measures must be implemented when returning home or to the hotel at the end of the day:

- Shower as soon as you return to your room from the field. Showering should take place before doing any other activity.
- Wash and dry clothes in dryer for 20 minutes if possible; and
- Conduct a full body tick check using a mirror. Attached ticks generally climb upward until they reach a protected or creased area, often the back of the knee, groin, navel, armpit, ears, or nape of the neck.

4.2.2 Application of Topical Insect Repellent

While in the field, project team members are required to carry and periodically apply repellent containing DEET or an effective DEET alternative (e.g., Picaridin). Follow the product label application instructions printed on the bottle by the manufacturer.

Application tips and suggestions:

- Apply repellents only to exposed skin or clothing, as directed on the product label. Do not apply repellents under clothing.
- Repellents should be applied to field gear (e.g., backpacks) for additional protection.
- If wearing flame resistant clothing (FRC), make sure the repellent is safe to use with FRC. Some repellents can damage FRC.

- Never use repellents over cuts, wounds, or irritated skin.
- When using sprays, do not spray directly on face—spray on hands first and then apply to face. Do not apply repellents directly to eyes or mouth, and apply sparingly around ears.
- Wash hands after application to avoid accidental exposure to eyes or ingestion.
- Use enough repellent to cover exposed skin and clothing. If biting insects do not respond to applied repellents, apply a second application.
- After returning indoors, wash repellent-treated skin.

Repellant product specific Safety Data Sheets (SDS) should be obtained and kept with the project HASP.

4.2.3 Field Clothing and Pretreatment

In addition to the application of topical repellent, team members working in project environments that present a high risk of staff exposure to biting insects (as determined by the project team) are required to use treated clothing.

The cost of clothing treatment is considered a personal protective equipment expense and should be budgeted by the project team. There are two options for clothing treatment:

- **Factory-Applied Clothing Treatment:** Factory applied insect repellent to apparel has been proven to be the most effective option available to prevent exposure to mosquitos and ticks. There are several clothing brands (including, but not limited to, InsectShield®, ExOfficio®, and Columbia®) that sell garments treated with permethrin that can minimize exposure to biting insects. Costs of these garments vary and can range from $50 to $100 USD for a shirt or pants.

  For untreated garments owned by staff that are more adapted to heavy field use (i.e., jeans, high-vis shirts, or Carhartts®), Insect Shield® offers a service to treat garments with a formulation of permethrin. The garments to be treated are mailed to InsectShield® and returned within a week. The product is United States Environmental Protection Agency (USEPA) registered, which is designed to evaluate a proposed product to ensure it will not have adverse effects on people or the environment. InsectShield® states that the treatment can last up to 70 washes. A "how-to" video, shipping details, and pricing guide can be found on their website (www.insectshield.com). The standard cost to treat clothing is $10 USD per garment. Cost options should be factored into project budgets.

- **Self-Applied Clothing Treatment:** Insect repellent that is applied to field clothing by the employee is also an effective method of bite prevention. Several types of repellents are available on the market that can be applied to clothing in either a spray or a liquid soak method. These products are available from retailers, including but not limited to, Walmart, Bass Pro Shop, and Cabelas.

- Permethrin Spray – Non-aerosol and aerosol spray treatments can be effective against ticks, chiggers, and mosquitoes. Typically, one bottle contains enough spray to treat up to two outfits. One treatment will last up to six washings or six weeks. Permethrin should never be applied to skin but only to clothing, gear, or other fabrics as directed on the product label.
- Sawyer Permethrin Soak Treatment - This kit provides the same protection for clothing as the Permethrin spray, but in a soak treatment that is effective for six washings or six weeks. Soak your items in the solution for two hours and hang to dry.

It is important to note that due to the shorter effective duration for self-applied clothing treatments, an employee-maintained schedule for reapplication of the product should be implemented through the duration of the field season

4.2.4 Employee Reaction to Repellents/Treatments

ERM recommends that the employee "test" repellents and treated clothing prior to field use. If an employee experiences a rash or other reaction, such as itching or swelling, from an insect repellent, the repellent should be washed off with mild soap and water and its use discontinued. If a severe reaction has occurred, WorkCare should be called for further guidance.

4.2.5 Staff Substitutions

ERM will not require staff to use chemically treated clothing or repellents if they have health concerns. However, when the project HASP identifies a reasonable potential for ERM staff to be exposed to biting insects, the PM and PIC are responsible to ensure that field staff are properly equipped, educated, and willing to apply topical insect repellent and utilize pretreated clothing. In the event that an employee is not willing to wear treated clothing, apply insect repellent, or identify an effective alternative to either, then their role in the field effort should be reconsidered by the project management.

For more information regarding bite prevention strategies and clothing treatment options, contact your Business Unit Health and Safety Director.

5. References

- ERM Procedure NAM-1310-PR1 (***Personal Protective Equipment***)
- ERM Procedure NAM-1110-PR1 (***Project Health and Safety***)

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Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document	4/29/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/10/17

	Applicability:	Form	Document Number:	Version:
	North America		NAM-1501-FM1	4
	Title: **Site Safety Meeting Form**		**Last Revision Date:**	4/9/18

Project Name/ Location:				**Phone:**	
Project Number:		**Date:**		**Time:**	
Meeting Leader:					

Today's Work Tasks(s)	**Conducted By:**

1. **Review relevant sections of the Health and Safety Plan (HASP), Job Hazard Analyses (JHAs) for planned tasks, and any other applicable procedures. Discuss potential hazards of planned work and control measures to be used to eliminate or reduce risks (including PPE). Pay specific attention to overlapping/ simultaneous operations.**
2. **Review emergency response procedures including emergency phone numbers, location of emergency equipment (fire extinguishers, first aid kit, AED, eyewashes, safety showers, etc.), exit routes, muster points, methods of conducting head count at muster point, and identity of first responders trained in first aid/CPR.**
3. **Does everyone fully understand the task(s)? Are there any changes that need to be assessed? Use SNAP cards to assess risks associated with changed or unplanned tasks.**
4. **Remind the team that everyone on the job site is empowered to stop work if something is unsafe or if there are any questions or concerns regarding safety.**

What tools and equipment are required for today's tasks? Have they been inspected and are they in good condition?

What training/qualifications/experience is necessary for today's assigned tasks?

List any new or Short Service personnel on site today:

Discuss any recent incidents, near misses, field inspection findings, or other safety observations (or observations from similar tasks performed at other sites):

Additional Safety Meeting Topics (check those discussed)
☐ What client safety rules or procedures are applicable to today's activities?
☐ How will you communicate with others on site? How will you communicate with the PIC and PM?
☐ What are the potential impacts of planned activities to visitors, nearby workers, or the public?
☐ Who do you contact if you have questions or before deviating from written procedures?
☐ What happens and who do you contact if there is an injury or other emergency? If working at an active facility, how will you be alerted of an emergency and what will you do?
☐ Where is nearest medical facility and how would we get an injured employee there? If medical help is more than five minutes away, is at least one person on site trained in first aid/CPR? How do you contact them?
☐ Do you have any medical condition or allergy that the project team needs to be aware of? Write this down and keep it in your pocket for reference in the event of an emergency.
☐ Are any work permits required?
☐ Has anything unexpected or out-of-the-ordinary occurred on this job recently to share?
☐ Is there anything different about today's operations as compared to yesterday or previous days?
☐ What is the worst that could happen if something goes wrong today?
☐ What activities occurring today could result in hand injuries? Is everyone aware that the use of fixed open-blade knives is not permitted?
☐ What natural hazards are present (including plants, animals, and insects)?
☐ What areas of the site have slip/trip/fall hazards? Can these be avoided? Are everyone's work boots in good shape?
☐ Is everyone fit for duty today (i.e., in a physical, mental, and emotional state to perform your work assignment in a manner which **does** NOT threaten the safety or health of yourself, your co-workers, property, or the public at large)?
☐ Other items:

Meeting Attendees (including employees, contractors, and visitors)

Name	Company	Sign-In*	Sign-Out**

* Signature/initials in this space verify that the employee is fit for performing work.

** Signature/initials in this space verify that the employee was uninjured during the workday.

1. Overview

The Occupational Safety and Health Administration (OSHA) has outlined use and inspection requirements for extension cords in 29 Code of Federal Regulations (CFR) 1910 Subpart S (***Electrical***) and 29 CFR 1926 Subpart K (***Electrical***). Additional requirements are defined in National Fire Protection Association (NFPA) 70 (***National Electrical Code***).

2. Extension Cord Sets

An extension cord is a length of flexible electrical power cable with a plug on one end and one or more sockets on the other end (usually of the same type as the plug). The most common type of extension cord found at the work site is a manufactured cord set (extension cord) that has been approved as an assembly by a nationally recognized testing laboratory. Within the United States, Underwriters Laboratories (UL) certifies extension cords as complying with the National Electric Code (NEC).

UL listed extension cords come in various ratings for a wide variety of uses. Understanding the differences between extension cords can help ensure safe operation, energy efficiency and high tool performance. In order to determine the correct extension cord for the type of work to be performed, identify the power rating required and the type of environment the cord will be exposed to.

It is important to select an extension cord that can handle the energy requirements of any connected devices. Every extension cord has an upper limit on the amount of electrical current it can conduct safely. If you connect a device(s) that uses current above this level, the device may not function correctly and the cord may overheat.

Current ratings (how much current a device needs to operate, or “amperage”) are often printed on the nameplate of the device being used. If a power rating is given, it is necessary to divide the power rating in watts by the voltage to find the current rating. For example, a 1,000-watt heater plugged into a 120-volt circuit will need almost 10 amps of current. It is important to allow a safety factor based on the type of equipment and use. For example, an electric motor will need up to 200% of its rated current during startup. The extension cord must be chosen with a wire gauge that can handle the total current (including the safety factor). A summary providing extension cord length and gauge requirements based upon total amperage required is provided in Table 1.

Table 1: Extension Cord Length and Gauge Requirements

Extension Cord Length / Gauge Required

Total Amps Required	25'	50'	75'	100'	150'	200'
0 – 5 Amps	16	16	16	14	12	12
5.1 – 8 Amps	16	16	14	12	10	--
8.1 – 12 Amps	14	14	12	10	--	--
12.1 – 15 Amps	12	12	10	10	--	--
15.1 – 20 Amps	10	10	10	--	--	--

Extension cords designed for industrial use have jackets that offer protection from moisture, direct sunlight and abrasion. Some heavy duty cords are also rated for protection against oils, other chemicals or extreme temperatures.

Jacket ratings are coded using letter designations that are found in the NEC. Extension cords are marked every 24 inches to indicate the maximum rated voltage and wire type using the NEC letter code(s). Jacket code examples are included in Table 2.

Table 2: Common Examples of Heavy Service Jacket Codes

Jacket Code	Use
S	Hard Service Flexible Cord
SE	Extra Hard Service Flexible Cord
SO	Hard Service Flexible Cord, Damp Locations
SOO	Hard Service Flexible Cord, Damp Locations, Oil Resistant
SOW	Hard Service Flexible Cord, Wet Locations
SJTW	Hard service cord. Thermoplastic constructed jacket. 300 volt, weather resistant for outdoor use.
SEOW	Extra hard service cord. Thermoplastic elastomer, oil resistant (TPE) construction jacket. 600 volt, weather resistant for outdoor use
HH	High Heat

3. Visual Inspection and Repair

Portable cord and plug connected equipment and extension cords are required to be visually inspected before use for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket). If the equipment or extension cord has remained connected, and has not been exposed to damage, it does not have to be visually inspected until it is relocated.

If there is a defect or evidence of damage that could expose an employee to injury, the defective or damaged extension cord must be removed from service. Repairs such as splices or replacement plugs void the UL listing and are not allowed.

4. Use and Protection from Damage

Ground-fault Circuit Interrupters

Ground-fault circuit interrupters (GFCIs) must be used when the circuit is not a part of the permanent wiring of a building or structure. If the electrical source is not equipped with a GFCI, an extension cord equipped with a GFCI unit must be used. The portable GFCI may be plugged into power source or be an integral part of the cord itself.

Daisy Chain

Plugging one extension cord into another is what many refer to as “daisy chaining.” Daisy chaining increases the likelihood of misuse, excessive voltage drop and overloading the extension cord, and may create a fire or shock hazard (UL 817 - ***Cord Sets and Power-Supply Cords***).

Power Strips

Power strips are designed for use with a number of low-powered loads, such as computers, peripherals, or audio/video components. Power strips are not designed for high power loads such as space heaters, refrigerators and microwave ovens, which can easily exceed the recommended ampere ratings on many power strips. Plugging one power strip into another causes excessive voltage drop and overloading and may create a fire.

Extended Use

Extension cords used to provide temporary electrical power for lighting, remodeling, maintenance, or repair of buildings must be removed immediately upon completion of the project or purpose for which the wiring was installed

OSHA does not consider a single extension cord connected to a permanent receptacle outlet to be a temporary wiring installation. In such situations, extension cords are typically used to extend the length of the power supply cord on a tool or appliance to reach a nearby receptacle outlet. In this application, OSHA considers the extension cord to be part of the utilization equipment (equipment that utilizes electric energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes), and must be removed when use of that temporary equipment has ceased. If a project has a longer-term need for extended electrical use, permanent wiring should be considered.

Protection from Damage

Extension cords may not be used as a substitute for the fixed wiring of a structure; run through holes in walls, ceiling, or floors; run through doorways, windows, or similar openings without protection; attached to building surfaces; or concealed behind building walls, ceilings, or floors.

ERM Vehicle Safety Checklist

Date	Operator	Project#	Mileage
Vehicle Make/Model License#		Company Vehicle? ☐ Y ☐ N	

I. Inspection	Before Driving: OK	Deficient	N/A	Comments
Prior to Use, and Weekly Thereafter for all vehicles used for field work.				
All glass and mirrors	☐	☐	☐	
Engine Fluids (oil, radiator coolant)	☐	☐	☐	
Headlights (incl Hi/Lo lights)	☐	☐	☐	
Horn	☐	☐	☐	
Instrumentation warning lights	☐	☐	☐	
Misc. vibration, noise, loose parts (requires comment)	☐	☐	☐	
Overall vehicle cleanliness/damage	☐	☐	☐	
Reverse warning/alarm	☐	☐	☐	
Seatbelts for all seats	☐	☐	☐	
Tail Lights / Brake lights	☐	☐	☐	
Tires - visual condition/tread/pressure	☐	☐	☐	
Turn signal / hazard lights	☐	☐	☐	
Under vehicle – leaks	☐	☐	☐	
Windshield cleanliness and lack of damage/cracks	☐	☐	☐	
Windshield wipers & fluid	☐	☐	☐	

Required H&S supplies/ equipment	☐ Anti-lock brakes	☐ Air bags	☐ First aid kit	☐ Reflective safety vest (for all occupants)	☐ Spare tire and jack – in good condition	☐ Roadside warning (triangles or flares)
Optional H&S supplies/equipment		☐ Jumper cables	☐ Fire Extinguisher	☐ Torch / flashlight	☐ Camera	

Name & signature of reviewer : ……

Safety Reminders

1. Drive defensively - scan road ahead and anticipate actions of other drivers.
2. Ensure sufficient rest before and during the trip. Take a 15 minute break after every 2 hours of continuous driving.
3. Seat belts to be worn by all passengers and driver at all times.
4. Adjust seat / mirrors / headrest / steering wheel and ensure clean windows with no obstructions; Secure loose items.
5. Eliminate distractions – do not use mobile phones or any other electronic devices while driving. Refer to ERM's ***Global Policy on Mobile/Cellular Telephone and Personal Digital Assistant (PDA) Use While in a Vehicle.***
6. Secure all loose loads.
7. Obey all posted road signs and speed limits.
8. Maintain safe following distance - use "3-second rule." in good weather conditions. Adjust speed / following distance for adverse road/weather conditions.
9. Do not consume any alcohol or drugs, or any other substance or medication that could impair their ability to drive. Refer to ERM's ***Global Policy on Drug and Alcohol Use***.

1. Purpose and Scope

This document establishes the procedures for implementing ERM's incident management strategy in the event of an injury or illness. Developing a strong incident management process is an essential part of promptly responding to occupational injuries and illnesses. This document applies to all ERM field and office locations.

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensure the procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correct deficiencies in the implementation of the procedure as identified by the Business Unit Health and Safety Director.

Project Manager (PM)/Supervisor/Area Manager: Responsible for the following elements:

- Perform observations of ERM work processes to assess whether or not employees are operating in accordance with the procedure; and
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of the procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of the procedure by Business Unit (BU) personnel during ECS reviews; and
- Communicate identified deficiencies to the PIC and BU management teams.

Employee: Responsible for the following elements:

- Report work-related injuries/illnesses as soon as possible to their PM/Supervisor/Area Manager;
- Comply with the requirements of the procedure during response to injury/illness events;
- Work with the ERM management, Health and Safety (H&S), and Human Resources (HR) teams to ensure the best outcome for the employee; and
- Notify the ERM management, H&S, and HR teams of any change in injury/illness status, as well as providing copies of any appropriate paperwork supporting these changes from medical professionals.

3. Definitions

- Work-related injury/illness – An injury or illness that arises out of and in the course of employment.
- Injury – A wound caused by an external force that affects a specific part of function of the body and has an identifiable time and place.
- Illness – Systemic infections, exposure to hazardous materials, repeated stress and strain, and/or other repeated exposures to conditions that result in harm or loss of function, but do not meet the definition of an injury.

4. Procedure

4.1 Pre-Injury Management

4.1.1 Work Site Evaluation

Project sites and offices shall evaluate a location for the potential to cause an injury or illness. This evaluation must consider the following, at a minimum:

- The types of injury or illness that could reasonably occur under given site conditions;
- The location of emergency and non-emergency medical centers;
- The anticipated response time for local emergency services (e.g., ambulance, paramedics, site emergency teams, etc.);
- The presence of hazardous materials or conditions;
- The types of training needed for employees to respond to identified hazards;
- The type of training needed for first aid responders; and
- The type of first aid supplies required for potential response to site hazards.

4.1.2 Risk Assessment

A written health and safety plan (HASP) must be prepared for all field projects. The HASP must contain contact information, including maps and phone numbers, for the nearest emergency medical services/hospital location, as well as for potentially needed emergency services (e.g., fire department, police, ambulance) and for WorkCare, ERM's medical services provider. Advance contact with ambulance services to ensure they are familiar with location, access routes, and hospital locations is advised in remote or new locations.

An Emergency Action Plan (EAP) must be prepared for all ERM office locations. Since ERM offices are typically located in well-populated urban centers, the location of specific emergency

medical services locations are not required to be posted in the EAP; however, emergency contact information for potentially needed emergency services, building management staff, and WorkCare must be provided.

4.1.3 First Aid Services

The availability and application of first aid services, including first aid kits, is discussed in Section 4.1 of ERM H&S Procedure NAM-1840-PR1 (***Medical Services***).

4.1.4 First Aid Responders

Expectations regarding the availability of first aid responders in both field and office settings are discussed in Section 4.1.1 of ERM Procedure NAM-1840-PR1 (***Medical Services***). Trained first aid responders should be designated in such a fashion that employees know who they are and how to contact them.

4.1.5 Eyewash Facilities

If corrosive materials are used, eyewash and body flush facilities must be provided. Where possible, these should provide large quantities of clean water. The water source must be pressure controlled and clearly identified.

4.2 Post-Injury Management

4.2.1 Transportation

When employees require urgent medical attention as the result of a work-related injury/illness, transportation shall be provided to the urgent care facility via ambulance or similar method (if a critical condition) or ERM vehicle. Employees should not be permitted to drive themselves unless safe to do so.

4.2.2 Treatment of Critical Injury/Illness

In the event of a critical injury or illness, employees must be seen by a medical professional as quickly as possible. For purposes of this procedure, critical injuries shall include, but not be limited to:

- Uncontrolled bleeding or significant blood loss;
- Chest pains;
- Breathing difficulty;
- Known or suspected bone fractures;
- Known or suspected internal injuries;
- Known or suspected overexposure to chemical, biological, or radiological hazards;

- Severe electric shock or electrocution;
- Second, third, or fourth degree thermal, chemical, electrical, or radiation burns;
- Loss of consciousness; or
- Sudden behavioral changes, including confusion, disorientation, or aggression.

In these situations, an ERM employee should always accompany the injured or ill employee to medical care. The accompanying employee should contact WorkCare, ERM's medical consultant, as soon as possible to alert them to the injury. Where necessary, WorkCare's occupational physicians will provide peer-to-peer interaction with emergency room physicians to ensure appropriate care is provided to our employees. The accompanying employee shall also be responsible for maintaining contact with appropriate ERM management and H&S team members to alert them to issues relating to the injured/ill employee and their condition.

4.2.3 Treatment of Non-critical Injury/Illness

In the event of a non-critical injury or illness, employees must call WorkCare's Incident Intervention service (available 24 hours per day, 7 days per week). When contacted, an occupational nurse or physician provides medical advice to the injured or ill employee, which may include a referral to a medical clinic. If referral is required, WorkCare's occupational physicians will provide peer-to-peer interaction with medical clinic physicians to ensure the level of care and treatment is appropriate to the symptoms presented. The employee is also responsible for maintaining contact with appropriate ERM management and H&S team members to alert them to issues relating to their condition.

4.2.4 Workers' Compensation

A workers' compensation claim will be filed for each instance where work-related medical treatment is provided to ERM employees. The HR team will be responsible for filing these claims, and will be informed by WorkCare whenever a referral to a medical clinic is made for an ERM employee. Additionally, HR staff will:

- Serve as a point of contact for the workers' compensation insurance carrier adjuster; and
- Work with ERM providers to coordinate disability benefits associated with work-related injury/illness.

4.2.5 Return to Work

Employee supervisors, after consultation with the Business Unit Health and Safety Director and the HR team, may assign an employee who is recovering from a work-related injury or illness transitional employment during their recovery period, if such employment exists. Transitional employment includes temporary modified, restricted, or light duty work covering the time from the injury/illness until the release to full duty by the doctor. Each case will be evaluated individually.

Application of any transitional employment must be documented in writing and signed by a medical doctor before any action can be taken. The change in status will only be allowed for the period of time designated by the doctor. The employee must continue to comply with all doctor-mandated appointments and treatment during this time. Any changes in duty status as a result of an appointment or treatment visit must be provided to the employee supervisor in writing.

At a minimum, and regardless of the employee's current case status (i.e., lost time, restricted duty, etc.), the employee's supervisor will maintain contact with the employee on a weekly basis

A written work release for full and unrestricted duty from a medical doctor is required before the injured/ill employee may return to their original job duties.

5. References

- ERM Procedure NAM-1840-PR1 (***Medical Services***)
- ERM Work Instruction NAM-1210-WI1 (***Injury/Illness Management Flow Chart***)

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Revision History

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All	Revised and edited to meet new Global SMS requirements and update procedures	8/5/14
All	Changed "Case Management" to "Injury/Illness Management".	12/30/14
Intro, 4, 5	Updated Applicability. Updated references in Sections 4 and 5.	1/12/16
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/10/17

1. Lead Exposure Compliance Program

The purpose of this program is to enable compliance with OSHA's Lead Standard (29 CFR 1910.1025 and 1926.62) by:

- Ensuring that no employee is exposed to lead at concentrations greater than 50 micrograms per cubic meter of air ($\mu g/m^3$) averaged over an eight-hour period.
- Knowing that when respirators are used to limit employee exposure as required by paragraph (c) of Section 1926.62, and all the requirements of paragraphs (e)(1) and (f) of Section 1926.62 have been met, employee exposure may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn. Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily time-weighted average (TWA) exposure.

This program applies to all work where one of our employees may be occupationally exposed to lead at levels exceeding established exposure limits and/or action levels for more than 30 consecutive days per year.

2. Exposure Assessment

2.1 Protection of Employees during Exposure Assessment

When tasks are presumed to generate lead exposures greater than the permissible exposure limit (PEL) of 50 $\mu g/m^3$ averaged over an eight hour period, we treat affected employees as if they were exposed above the PEL and implement procedures to protect workers until we perform an employee exposure assessment and document that an employee's lead exposure is not above the PEL.

Our measures to implement employee protective measures during the initial exposure determination include:

- Respiratory protection;
- Proper personal protective clothing and equipment;
- Change areas and hand washing facilities;
- Biological monitoring; and
- Training.

2.2 Initial Determination

We assess each new project through the ERM health and safety plan (HASP) development process to determine if employees may be exposed to lead at or above the action level of 30 µg/m^3 as an 8-hour TWA.

Where employee exposure to inorganic lead may occur above published exposure limits, ERM will perform pre- and post-project biological monitoring for employees working on this project. Additionally, air samples will be collected to determine actual levels of exposure to inorganic lead at the jobsite.

Results of air sample collection will be reviewed by the project Field Safety Officer (FSO). Exposures above the action level of 30 µg/m^3 will prompt the FSO to consult their Division HSSE Leader for direction on work continuance

2.3 Additional Exposure Assessments

If changes in equipment, process, control personnel, or tasks occur after the initial determination, ERM will re-evaluate to determine if employees are exposed to higher concentrations of lead.

2.4 Employee Notification

Within five working days of completing an exposure assessment, we notify each employee of his or her assessment results individually in writing. These notifications will be placed in the project file along with the HASP.

2.5 Methods of Compliance

ERM's lead exposure control program is implemented when employee exposure exceeds the permissible exposure limit (PEL). This program is our written strategy for protecting ERM employees from lead exposure, and incorporates all relevant information that relates to this goal, so that we determine whether we appropriately analyzed problems and solutions (including alternatives) relating to lead exposure.

This program is intended to reduce employee exposure to at or below the PEL. When all feasible engineering and work practice controls that can be instituted are not sufficient to reduce employee exposure to acceptable levels, appropriate respiratory protection will be provided to supplement such controls.

The job site, materials, and equipment are regularly inspected. ERM reviews this program regularly to revise it as necessary. Activities which may cause lead exposures are listed in the project-specific HASP. Methods to reduce and maintain employee exposures to lead at or below the PEL, including engineering and work practice controls, will be identified in the HASP and the task-specific Job Hazard Analysis (JHA).

Work practice programs such as the use of personal protective equipment, appropriate housekeeping, and establishment of hygienic facilities and practices are required by OSHA. Where required by site activities, these programs will be developed and included in the HASP for this project.

When ERM's work with lead may potentially lead to exposure to contractors or other employers in the area, we will develop communication tools to fully inform these employers of the potential exposure to lead and establish cooperative efforts to control exposure. These tools will be defined in the project HASP.

As an employer we want to keep our employees fully informed of all aspects of this plan. The Project Manager, FSO, or ERM safety representative will make frequent and regular inspections of this jobsite, materials, and equipment, and ensure a copy of our project-specific HASP and all associated JHAs is available at this worksite. We will review and update our written plan at least annually to reflect the current status of the program.

3. Respiratory Protection

During our exposure assessment to document that our employees are not exposed above the PEL, we treat employees performing certain operations as if they were exposed above the PEL. During this period, we will provide our employees with appropriate respiratory protection. Use of respiratory protection will be in compliance with S3-NAM-026-PR (***Respiratory Protection***), as well as applicable regulatory requirements. The HASP will contain any additional information regarding respiratory protection.

4. Protective Work Clothing and Equipment

ERM provides PPE as interim protection for employees during exposure assessment, since our employees may be exposed to lead above the PEL without regard to the use of respirators or to lead compounds which may cause skin or eye irritation. Practices regarding PPE use are contained in the HASP for this project. ERM provides protective clothing and equipment at no cost to our employees.

Work conditions with lead exposures over 200 $\mu g/m^3$ as an 8-hour TWA without regard to use of a respirator require replacement of protective clothing each day. Daily inspection of PPE and respiratory protection will be conducted. Any equipment found to be damaged or in non-working order will be replaced. Impaired equipment shall not be used.

5. Housekeeping

ERM believes that a rigorous housekeeping program is necessary in jobs where there is lead exposure or the potential of lead exposure to keep airborne lead levels below permissible levels.

This will require a regular housekeeping schedule adapted to exposure conditions on site. This schedule shall be identified in the project-specific HASP as well as associated JHAs.

6. Hygiene Facilities and Practices

ERM will provide appropriate hygienic facilities for our workers and assure they follow good hygiene practices. ERM prohibits smoking, eating, applying cosmetics, and the presence of tobacco products, food, beverage, or cosmetics in all work areas where employees are exposed to lead above the PEL.

7. Medical Surveillance

ERM supports the practices necessary for early detection of lead exposure. The medical surveillance program supplements the primary goals of this guideline of preventing disease through elimination or reduction of airborne concentrations of lead and sources of ingestion. The medical surveillance provisions incorporate both initial and ongoing medical surveillance.

ERM provides initial medical surveillance to employees who are occupationally exposed to airborne lead levels at or above the PEL. This monitoring consists of sampling blood and analyzing it for lead and zinc protoporphyrin levels. The frequency of biological monitoring is determined by ERM's occupational physician WorkCare. WorkCare also arranges laboratories meeting OSHA requirements to analyze blood lead samples.

8. Employee Information and Training

Employees can do much to protect themselves from the risks of occupational lead exposure if they know about them. ERM training programs inform employees of the specific hazards associated with their work environment, protective measures that can be taken, and their rights under regulatory standards. Awareness training is performed for any ERM employee who may potentially be exposed to inorganic lead during their work on ERM projects. This training covers the contents of this exposure control plan as well as pertinent information from regulatory standards.

9. Signs

Because exposure to lead is a serious health hazard, ERM posts signs that warn employees of lead hazards and of the possible need to use respirators and other protective equipment in the area whenever possible. At times, the fact that ERM works mostly on client-owned sites does not make this possible. In these situations, employees are informed of lead hazards through training and the site-specific HASP.

10. Recordkeeping

ERM maintains accurate biological and environmental monitoring records of employee exposures to potentially toxic materials, including lead. These records are kept along with health and safety plans in project-specific files. We allow employees access to their records.

We include the following exposure monitoring records:

- Exposure assessment;
- Medical surveillance results;
- Medical removals;
- Objective data for exemption from requirement for initial monitoring;
- Procedures for making records available, and
- Procedures for transfer of records.

Action Level Development for Particulate Contaminants in Soil using a Direct-Read Particulate Monitor

Safety Factor = 2

Common Particulate Contaminants	Concentration (site soil) (mg/Kg)	OSHA PEL (mg/m3)	Calculated Action Level (mg/m3)	Safety Factor Derived Action Level (mg/m3)
Aluminum	0.E0	15	#DIV/0!	#DIV/0!
Antimony	0.E0	0.5	#DIV/0!	#DIV/0!
Arsenic (inorganic)	0.E0	0.01	#DIV/0!	#DIV/0!
Beryllium	0.E0	0.002	#DIV/0!	#DIV/0!
Cadmium	0.E0	0.005	#DIV/0!	#DIV/0!
Calcium arsenate	0.E0	0.01	#DIV/0!	#DIV/0!
Camphor	0.E0	2	#DIV/0!	#DIV/0!
Chromium (VI)	0.E0	0.1	#DIV/0!	#DIV/0!
Chromium (II)	0.E0	0.5	#DIV/0!	#DIV/0!
Chromium (III)	0.E0	0.5	#DIV/0!	#DIV/0!
Chromium metal	0.E0	1	#DIV/0!	#DIV/0!
Coal tar pitch volatiles	0.E0	0.2	#DIV/0!	#DIV/0!
Cobalt	0.E0	0.1	#DIV/0!	#DIV/0!
Copper	0.E0	1	#DIV/0!	#DIV/0!
2,4-D	0.E0	10	#DIV/0!	#DIV/0!
DDT	0.E0	1	#DIV/0!	#DIV/0!
Dieldrin	0.E0	0.25	#DIV/0!	#DIV/0!
Dinitrobenzenes	0.E0	1	#DIV/0!	#DIV/0!
Dinitro-o-cresol	0.E0	0.2	#DIV/0!	#DIV/0!
Dinitrotoluene	0.E0	1.5	#DIV/0!	#DIV/0!
Endrin	0.E0	0.1	#DIV/0!	#DIV/0!
Hepatchlor	0.E0	0.5	#DIV/0!	#DIV/0!
Iron oxide dust	0.E0	10	#DIV/0!	#DIV/0!
Lead	0.E0	0.05	#DIV/0!	#DIV/0!
Lindane	0.E0	0.5	#DIV/0!	#DIV/0!
Manganese	0.E0	5	#DIV/0!	#DIV/0!
Nickel	0.E0	1	#DIV/0!	#DIV/0!
Sodium hydroxide	0.E0	2	#DIV/0!	#DIV/0!
Tin	0.E0	2	#DIV/0!	#DIV/0!

Instructions: To develop an action level for a specific contaminant, first enter the known soil concentration (in milligrams per kilogram of soil, or mg/Kg) of the contaminant of concern in the box to the right of the known contaminant. Next, determine what safety factor you want to use and place in the green box in the upper right corner of the form. Typically use a safety factor of "2" if you have high confidence in your data,"4" if you have limited confidence in your data, and "10" if you have no confidence in your data.

If more than one contaminant is present, enter information for each. Choose the contaminant with the lowest safety factor derived action level as your guideline. If your contaminant is not on the primary list provided, additional analytes and their respective data are provided below the table and can be cut and pasted into the table. Contaminants with an asterisk (*) adjacent their name do not have an OSHA PEL; NIOSH RELs have been inserted into the table for these contaminants.

Root Cause Analysis – Causal Factor Worksheet

This worksheet is meant to be used as part of the incident investigation procedure and to determine areas requiring further analysis via root cause analysis (i.e. "the why tree"). After conducting the incident investigation and collecting the necessary information, answer the following "Areas of Inquiry" questions providing comments as appropriate to ensure clarification of the answer. An answer of "N" to any question should be further investigated through root cause analysis.

Summary Statement of the Incident

A. Personnel		
Question	**Response**	**Notes**
1. Were workers experienced / trained in the tasks they were assigned to?		
2. Were workers performing tasks in accordance with training/direction provided?		
3. Was the work adequately staffed?		
4. Were workers using equipment / tools / materials properly?		
5. Were workers physically capable of safely performing the work?		
6. Can worker fatigue or undue stress be ruled out as a contributing factor?		
7. Can possible substance abuse be ruled out as a contributing factor?		

B. Management		
Question	**Response**	**Notes**
1. Was there an adequate process for ID'ing H&S concerns and hazards (Regulatory? Client and ERM requirements?		
2. Were safety requirements and expectations effectively communicated to employees?		
3. Was safety involved / integrated into project planning and performance?		
4. Were safety-related roles and responsibilities adequately defined, assigned, and communicated?		
5. Were safety requirements effectively monitored and enforced?		
6. Was supervision at the worksite adequate?		
7. Were measures taken to ensure that safety and health hazards would be recognized, evaluated and controlled?		
8. Was management oversight of subs / visitors / other non-ERM personnel relevant to the work adequate?		
9. Were regular safety communications and inspections assigned and implemented?		
10. Were processes in place to address H&S concerns identified during inspections / communications?		
11. Did project / site management foster effective leadership and example pertaining to health and safety?		
12. Can other management related direct causes be ruled out as contributing factors?		

Summary Statement of the Incident

C. Task		
Question	**Response**	**Notes**
1. Was a task hazard analysis performed (HASP/JHAother)?		
2. Was the job hazard analysis appropriate / complete / communicated?		
3. Was an ERM-approved practice / procedure available and used?		
4. Was the safe work practice/ procedure appropriate for the task?		
5. Did site conditions remain the same throughout performance of the task?		
6. Were the appropriate equipment, tools and materials available?		
7. Were appropriate equipment, tools, and materials properly used?		
8. Were safety devices available / used / working properly?		
9. Can other task related direct causes be ruled out as contributing factors?		

D. Tools / Materials / Equipment		
Question	**Response**	**Notes**
1. Were the appropriate materials and equipment identified and used for the task involved in the incident?		
2. Did equipment operate correctly?		
3. Was the equipment / material used in accordance with the manufacturer's intentions?		
4. Can other material / equipment related direct causes be ruled out as contributing factors?		

D. Work Environment		
Question	**Response**	**Notes**
1. Were there no extreme weather conditions in the work area at the time of the incident?		
2. Was housekeeping in the area adequate?		
3. Were ambient sound levels in the work area below 85 dBA?		
4. Was ERM the only company operating in the immediate work area?		
5. Were temperatures in the work area fairly mild?		
6. Was there adequate illumination in the work area?		
7. Were there no hazardous substances present in the work environment?		
8. Can other environment-related direct causes be ruled out as contributing factors?		

1. Purpose and Scope

This document establishes the procedures to ensure that ERM employees are provided with appropriate medical services as needed. This document applies to all ERM field and office locations in North America

2. Roles and Responsibilities

Partner in Charge (PIC): Responsible for the following elements:

- Ensuring this procedure is implemented, understood, and followed by employees under their charge and working on their projects; and
- Correcting any deficiencies in the implementation of this procedure as identified by the Business Unit Health and Safety Director.

Project Manager (PM)/Supervisor/Area Manager: Responsible for the following elements:

- Performing observations of ERM work processes to assess whether or not employees are operating in accordance with this procedure;
- Pausing or stopping work where deviations from this procedure are observed; and
- Correcting, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the implementation of this procedure.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluating implementation of this procedure during health and safety plan reviews and project audits; and
- Communicating identified deficiencies to the PIC.

3. Definitions

Field Safety Officers: Employees who are responsible for the day-to-day implementation of ERM's health and safety processes on project sites.

Floor Wardens: Employees responsible for monitoring the presence of co-workers and visitors within the immediate seating area or zone of their office, and assisting in the orderly and safe evacuation of those personnel during a building evacuation or emergency.

4. Procedure

4.1 First Aid Services

4.1.1 First Aid Responders

It is the expectation of ERM that our personnel who are qualified as Field Safety Officers (FSO) or who serve as Floor Wardens in our offices be trained and certified to render appropriate first aid, CPR, and be capable of operating an automated external defibrillator (AED). Other ERM employees are not obligated to participate in provided first aid/CPR training; however, if a session is offered staff participation is encouraged to fill any open positions in the training. If a client requires personnel working on their site to be first aid/CPR trained, ERM will ensure that appropriately trained personnel are assigned to such projects.

These trained individuals will be readily available to assist injured workers in the office or field, and will serve as first responders in the event of an emergency. They will be available at all times during business operations requiring their presence. Trained individuals who are unwilling or uncomfortable in providing assistance to injured employees will not be assigned to the FSO or Floor Warden roles.

Acceptable training courses for ERM first aid responders will include courses certified by the American Red Cross, the American Heart Association, Canadian Red Cross, Ambulance St-John, or an equivalent certificate through authorized training provider. Documentation of training must be received by the employee from the certifying trainer and/or agency. Documentation will be posted to ERM's Academy Learning Management System (LMS).

4.1.2 First Aid Kits

First aid supplies must be maintained and easily accessible at ERM job and office sites. At a minimum, first aid kits should comply with American National Standards Institute/International Safety Equipment Association (ANSI/ISEA) Standard Z308.1-2015, or as stipulated in Canadian provincial regulation listed hereinafter in Section 5.

On project sites, the contents of the kit must be inspected by the FSO prior to the start of the job and at least weekly during the job to ensure that items being used are replaced. Office first aid kits shall be inspected at least monthly.

4.1.3 Emergency Information

On project sites, the PM will identify the mode in which medical services and first aid will be administered in the health and safety plan (HASP). A drive to the hospital to ensure that directions are accurate is recommended. On complicated project sites, an emergency medical services drill may be advised.

In offices, the Area Manager will identify the mode in which medical services and first aid will be administered in the local Emergency Action Plan (EAP).

These documents shall include directions and a map to the nearest medical facility, along with emergency telephone numbers. From time to time, emergency medical services drills may be in order to ensure proper response on the part of the responders and ERM staff.

4.1.4 Eyewash/Drench Facilities

At any jobsite where the eyes or body of any employee may be exposed to corrosive or otherwise hazardous chemicals, eyewash and body drench facilities must be available

4.1.5 Emergency Communications

At any jobsite or office, a reliable means of emergency communication will be made available (e.g., cell phone, landline, radio, etc.) in order to communicate with emergency response personnel.

4.2 Availability of Medical Services

ERM has retained the services of WorkCare, Inc., a firm specializing in occupational medicine, to provide advice on medical issues and to administer physical and medical examinations as required for our medical surveillance program. Medical surveillance programs will be established with input from WorkCare to properly track the health status of ERM staff based upon their exposure risks. The Regional Health and Safety Director should be involved in establishing the examination criteria.

WorkCare additionally provides incident intervention services to our employees (and subcontractors as appropriate) 24 hours per day, 7 days per week, each day of the year.

Whenever first aid is administered by one of our employees, it is expected that WorkCare's Incident Intervention services will also be contacted for guidance.

Automatic external defibrillators are also available in all offices of ERM. WorkCare must be involved anytime an AED is used at ERM. Contact your Business Unit Health and Safety Director for more information regarding AED use.

ERM safety staff should also be informed of the need to render first aid or seek additional medical treatment.

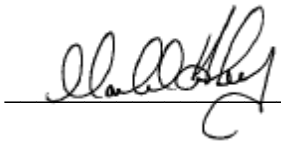
References

- ERM Procedure NAM-1811-PR1 (*Access to Medical and Exposure Records*)
- ERM Work Instruction NAM-1840-WI1 (*ANSI First Aid Kit Contents*)
- Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.151 (*Medical Services and First Aid*)
- American National Standards Institute (ANSI)/International Safety Equipment Association (ISEA) Z308.1-2015 (*Minimum Requirements for Workplace First Aid Kits and Supplies*)
- WorkSafeBC Part 3 Occupational Heath and Safety Regulations - Schedule 3-A (*Minimum Levels of First Aid*)
- Ontario Workplace Safety and Insurance Board (WSIB) Regulation 1101 (*First Aid Requirements*)

Document Control Information

Original Effective Date: February 14, 2014

Policy Approval by: Mark Hickey

Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document.	2/14/14
All	Reformatted to meet new Global documentation requirements.	5/28/14
All	Updated first aid kit content lists and references; minor language changes for clarity	7/20/15
4	Updated first aid kit references; deleted 4.3 (Bloodborne Pathogens)	2/15/16
4.1.1, 4.1.5	Clarified role of first responders; added information on emergency communications	7/14/16
4.1.1	Added information on acceptable training organizations	8/2/16
All	Updated document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4): updated References (Section 5)	1/6/17
4, 5	Added reference to approved Canadian training agencies and removed list of ANSI first aid kit requirements (Section 4); updated References (Section 5)	6/27/18

28.0 SAFE BEHAVIORS AND FEEDBACK

ERM strives to ensure that everyone – ERM employees, ERM subcontractors or anyone who comes within the ERM work environment – goes home safely at the end of each work day. This is one of ERM's Core Values. We live this Core Value through our Safety Culture, which is embodied by the phrase "You See It. You Own It. And Share It."

It means that:

- We know that we have a responsibility to look out for each other, to intervene with each other when necessary, to be proactive and to help keep safety issues from becoming problems.
- We also look out for ourselves. If we recognize that a situation is unsafe, we are expected to stop what we're doing, reassess the situation and consult with others if necessary before proceeding safely.
- We assign no blame to anyone who raises safety issues.
- We strive to learn big lessons from the big and especially small events that are part of our daily experience.

ERM believes that sustainable path to world-class safety performance is one where safe behaviors are engrained in the actions and decisions of our people.

28.1 Stop Work Authorization

It is ERM policy that all ERM and ERM subcontractor employees have the authority, without fear of reprimand or retaliation to:

- Immediately stop any work activity that presents a danger to the site team or the public.
- Get involved, question and rectify any situation or work activity that is identified as not being in compliance with the HASP or with broader ERM health & safety policies.
- Report any unsafe acts or conditions to supervision or, preferably, intervene to safely correct such acts or conditions themselves.

28.2The Observation & Feedback Program

The Observation & Feedback Program (OFP) is a comprehensive behavior-based approach to health and safety that stresses the importance of individuals acting as leaders to constructively challenge others' thoughts and actions about safety. ERM employees and ERM Subcontractors participate in OFP.

OFP is supported by three main processes:

- Seeing
- Owning
- Sharing

All ERM employees are trained in the elements of Observation & Feedback, described below.

28.3 Observation & Feedback Elements

Every employee at ERM is empowered to identify (See), intervene and correct (Own) unsafe acts and conditions both in the office and in the field – even if that requires calling a stop to work activities. ERM employees are likewise empowered to provide positive feedback to colleagues when they observe safe behaviors. This empowerment extends to ERM subcontractors.

The lessons learned from individual safety events which are seen, owned, and shared are pooled to form a robust operational picture of ERM's safety program in action. This picture can be used to highlight trends within or across projects that require attention or to identify innovative practices and exemplary behaviors that are worthy of elevation and recognition.

Operationally, this entails the following.

28.3.1 Seeing

The "See" element involves a specific safety scanning technique whereby ERM employees are better able to recognize unsafe acts and unsafe conditions in their field of vision. "Seeing" emphasizes rapid hazard recognition, risk assessment and evaluating work spaces and tasks before beginning work.

28.3.2 Owning

The "Own" element reinforces the empowerment that ERM employees have, as safety leaders, to safely correct unsafe conditions at work and unsafe actions they may see others doing through personal intervention, even if such requires issuing a "Stop Work" order. The Own element imparts Socratic teaching and coaching techniques to ERM employees that are designed to make personal safety interventions immediately effective and transformative in the long-run. The ultimate goal is to get the intervention target to "See" and "Own" the situation for themselves.

28.3.3 Sharing

ERM seeks to lever what is learned from the individual events "Seen" and "Owned" through sharing of experiences through the Event Communication System (ECS; see S3-NAM-016-PR). The ECS allows data analysis to occur on the safety events entered or shared within the system. ERM can track trends occurring on a global scale, and issue Safety Alerts and Lessons Learned in real-time.

Safety Data Sheets

1,1-Dichloroethane

Safety Data Sheet 1100512

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Date of issue: 06/09/2016 Version: 1.0

SECTION 1: Identification

1.1. Identification

Product form	:	Substance
Substance name	:	1,1-Dichloroethane
CAS No	:	75-34-3
Product code	:	1100-5-12
Formula	:	C2H4Cl2
Synonyms	:	Ethylidene chloride
Other means of identification	:	MFCD00013673

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

Use of the substance/mixture	:	Laboratory chemicals Manufacture of substances Scientific research and development

1.3. Details of the supplier of the safety data sheet

SynQuest Laboratories, Inc.
P.O. Box 309
Alachua, FL 32615 - United States of America
T (386) 462-0788 - F (386) 462-7097
info@synquestlabs.com - www.synquestlabs.com

1.4. Emergency telephone number

Emergency number	:	(844) 523-4086 (3E Company - Account 10069)

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

Classification (GHS-US)

Flam. Liq. 2	H225 -	Highly flammable liquid and vapour
Acute Tox. 4 (Oral)	H302 -	Harmful if swallowed
Skin Irrit. 2	H315 -	Causes skin irritation
Eye Irrit. 2A	H319 -	Causes serious eye irritation
STOT SE 3	H335 -	May cause respiratory irritation
Aquatic Acute 3	H402 -	Harmful to aquatic life
Aquatic Chronic 3	H412 -	Harmful to aquatic life with long lasting effects

Full text of H-phrases: see section 16

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :

GHS02 GHS07

Signal word (GHS-US) : Danger

Hazard statements (GHS-US) :
H225 - Highly flammable liquid and vapor
H302 - Harmful if swallowed
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation
H412 - Harmful to aquatic life with long lasting effects

Precautionary statements (GHS-US) :
P210 - Keep away from heat/sparks/open flames/hot surfaces. No smoking
P233 - Keep container tightly closed
P240 - Ground/bond container and receiving equipment
P241 - Use explosion-proof electrical/ventilating/lighting equipment
P242 - Use only non-sparking tools
P243 - Take precautionary measures against static discharge
P261 - Avoid breathing fumes, mist, spray, vapors
P264 - Wash skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product

P271 - Use only outdoors or in a well-ventilated area
P273 - Avoid release to the environment
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P301+P312 - If swallowed: Call a POISON CENTER or doctor/ physician if you feel unwell
P302+P352 - If on skin: Wash with plenty of soap and water
P303+P361+P353 - If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P312 - Call a POISON CENTER or doctor/physician if you feel unwell
P321 - Specific treatment (see supplemental first aid instructions on this label)
P330 - Rinse mouth
P332+P313 - If skin irritation occurs: Get medical advice/attention
P337+P313 - If eye irritation persists: Get medical advice/attention
P362+P364 - Take off contaminated clothing and wash it before reuse
P370+P378 - In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish
P403+P233 - Store in a well-ventilated place. Keep container tightly closed
P403+P235 - Store in a well-ventilated place. Keep cool
P405 - Store locked up
P501 - Dispose of contents/container to an approved waste disposal plant

2.3. Other hazards

No additional information available

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substance

Substance type : Mono-constituent

Name	Product identifier	%	Classification (GHS-US)
1,1-Dichloroethane (Main constituent)	(CAS No) 75-34-3	<= 100	Flam. Liq. 2, H225 Acute Tox. 4 (Oral), H302 Skin Irrit. 2, H315 Eye Irrit. 2A, H319 STOT SE 3, H335 Aquatic Acute 3, H402 Aquatic Chronic 3, H412

Full text of H-phrases: see section 16

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). Move the affected personnel away from the contaminated area.

First-aid measures after inhalation : Remove person to fresh air and keep comfortable for breathing. If not breathing, give artificial respiration. Get immediate medical advice/attention.

First-aid measures after skin contact : Wash with plenty of soap and water. Get immediate medical advice/attention.

First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

First-aid measures after ingestion : Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth out with water. Get immediate medical advice/attention.

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

Symptoms/injuries : The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11.

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

Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Alcohol resistant foam. Carbon dioxide. Dry powder. Water spray. Use extinguishing media appropriate for surrounding fire.

5.2. Special hazards arising from the substance or mixture

Fire hazard : Thermal decomposition generates: Carbon oxides. Hydrogen chloride.

Explosion hazard : Risk of explosion if heated under confinement. Use water spray or fog for cooling exposed containers. May form flammable/explosive vapor-air mixture.

5.3. Advice for firefighters

Firefighting instructions : In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion.

Protection during firefighting : Wear gas tight chemically protective clothing in combination with self contained breathing apparatus. For further information refer to section 8: "Exposure controls/personal protection".

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Evacuate unnecessary personnel. Ensure adequate air ventilation. Do not breathe gas, fumes, vapor or spray.

6.1.1. For non-emergency personnel

Emergency procedures : Only qualified personnel equipped with suitable protective equipment may intervene.

6.1.2. For emergency responders

Protective equipment : Do not attempt to take action without suitable protective equipment. For further information refer to section 8: "Exposure controls/personal protection".

Emergency procedures : Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level. Consider the risk of potentially explosive atmospheres. Eliminate every possible source of ignition.

6.2. Environmental precautions

Avoid release to the environment. Notify authorities if product enters sewers or public waters.

6.3. Methods and material for containment and cleaning up

For containment : Stop leak if safe to do so. Dike for recovery or absorb with appropriate material.

Methods for cleaning up : Take up large spills with pump or vacuum and finish with dry chemical absorbent. Use explosion-proof equipment. Take up small spills with dry chemical absorbent. Sweep or shovel spills into appropriate container for disposal. Ventilate area.

Other information : For disposal of solid materials or residues refer to section 13 : "Disposal considerations".

6.4. Reference to other sections

No additional information available

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Additional hazards when processed : Handle empty containers with care because residual vapors are flammable.

Precautions for safe handling : Do not handle until all safety precautions have been read and understood. Ensure good ventilation of the work station. Do not breathe fumes, mist, spray, vapors. Wear personal protective equipment. Avoid contact with skin and eyes. Keep away from ignition sources (including static discharges). Proper grounding procedures to avoid static electricity should be followed. Use only non-sparking tools.

Hygiene measures : Handle in accordance with good industrial hygiene and safety procedures. Do not eat, drink or smoke when using this product. Always wash hands after handling the product.

7.2. Conditions for safe storage, including any incompatibilities

Technical measures : Comply with applicable regulations.

Storage conditions : Keep container closed when not in use. Keep away from ignition sources.

Incompatible materials : Refer to Section 10 on Incompatible Materials.

Storage area : Store in dry, cool, well-ventilated area.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

1,1-Dichloroethane (75-34-3)		
ACGIH	ACGIH TWA (ppm)	100 ppm
ACGIH	Remark (ACGIH)	URT & eye irr; liver & kidney dam
OSHA	OSHA PEL (TWA) (mg/m³)	400 mg/m³
OSHA	OSHA PEL (TWA) (ppm)	100 ppm

8.2. Exposure controls

Appropriate engineering controls	:	Ensure good ventilation of the work station. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Hand protection	:	Protective gloves. 29 CFR 1910.138: Hand Protection.
Eye protection	:	Chemical goggles or safety glasses. Face shield. 29 CFR 1910.133: Eye and Face Protection.
Skin and body protection	:	Wear suitable protective clothing.
Respiratory protection	:	In case of inadequate ventilation wear respiratory protection. 29 CFR 1910.134: Respiratory Protection.
Other information	:	Safety shoes. 29 CFR 1910.136: Foot Protection.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	:	Liquid
Appearance	:	Colorless, oily liquid.
Color	:	Colorless
Odor	:	chloroform-like
Odor threshold	:	No data available
pH	:	No data available
Melting point	:	-98 °C
Freezing point	:	No data available
Boiling point	:	57 °C
Flash point	:	-10 °C
Relative evaporation rate (butyl acetate=1)	:	11.6
Flammability (solid, gas)	:	No data available
Explosion limits	:	No data available
Explosive properties	:	No data available
Oxidizing properties	:	No data available
Vapor pressure	:	180 mm Hg (at 20 °C)
Relative density	:	No data available
Relative vapor density at 20 °C	:	No data available
Specific gravity / density	:	1.18 g/ml (@ 20 °C)
Molecular mass	:	98.96 g/mol
Solubility	:	No data available
Log Pow	:	1.79
Auto-ignition temperature	:	458 °C
Decomposition temperature	:	No data available
Viscosity	:	No data available
Viscosity, kinematic	:	No data available
Viscosity, dynamic	:	No data available

9.2. Other information

No additional information available

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

The product is stable at normal handling and storage conditions.

10.3. Possibility of hazardous reactions

No additional information available

10.4. Conditions to avoid

Keep away from heat, sparks and flame.

10.5. Incompatible materials

Strong oxidizing agents.

10.6. Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced. Hazardous decomposition products in case of fire, see Section 5.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Oral: Harmful if swallowed.

1,1-Dichloroethane (75-34-3)	
LD50 oral rat	14.1 g/kg
LC50 inhalation rat (ppm)	13000 ppm/4h
ATE US (oral)	500.000 mg/kg body weight
ATE US (gases)	13000.000 ppmV/4h

Skin corrosion/irritation : Causes skin irritation.

Serious eye damage/irritation : Causes serious eye irritation.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : May cause respiratory irritation.

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1. Toxicity

1,1-Dichloroethane (75-34-3)	
LC50 fish 1	550 mg/l (Exposure time: 96 h - Species: Lepomis macrochirus [static])

12.2. Persistence and degradability

No additional information available

12.3. Bioaccumulative potential

1,1-Dichloroethane (75-34-3)	
Log Pow	1.79

12.4. Mobility in soil

No additional information available

12.5. Other adverse effects

No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Regional legislation (waste) : U.S. - RCRA (Resource Conservation & Recovery Act) - Basis for Listing - Appendix VII. U.S. - RCRA (Resource Conservation & Recovery Act) - Constituents for Detection Monitoring. U.S. - RCRA (Resource Conservation & Recovery Act) - Hazardous Constituents - Appendix VIII to 40 CFR 261. U.S. - RCRA (Resource Conservation & Recovery Act) - List for Hazardous Constituents. U.S. - RCRA (Resource Conservation & Recovery Act) - Part 268 Appendix III - Halogenated Organic Compounds (HOCs). U.S. - RCRA (Resource Conservation & Recovery Act) - Phase 4 LDR Rule - Universal Treatment Standards. U.S. - RCRA (Resource Conservation & Recovery Act) - TSD Facilities Ground Water Monitoring. U.S. - RCRA (Resource Conservation & Recovery Act) - U Series Wastes - Acutely Toxic Wastes & Other Hazardous Characteristics.

Waste treatment methods : Remove to an authorized incinerator equipped with an afterburner and a flue gas scrubber.

Waste disposal recommendations	:	Dispose of contents/container in accordance with licensed collector's sorting instructions.
Additional information	:	Recycle the material as far as possible.

SECTION 14: Transport information

Department of Transportation (DOT)

In accordance with DOT

Transport document description	:	UN2362 1,1-Dichloroethane, 3, II
UN-No.(DOT)	:	UN2362
Proper Shipping Name (DOT)	:	1,1-Dichloroethane
Transport hazard class(es) (DOT)	:	3 - Class 3 - Flammable and combustible liquid 49 CFR 173.120
Hazard labels (DOT)	:	3 - Flammable liquid

Packing group (DOT)	:	II - Medium Danger
DOT Packaging Non Bulk (49 CFR 173.xxx)	:	202
DOT Packaging Bulk (49 CFR 173.xxx)	:	242
DOT Special Provisions (49 CFR 172.102)	:	IB2 - Authorized IBCs: Metal (31A, 31B and 31N); Rigid plastics (31H1 and 31H2); Composite (31HZ1). Additional Requirement: Only liquids with a vapor pressure less than or equal to 110 kPa at 50 C (1.1 bar at 122 F), or 130 kPa at 55 C (1.3 bar at 131 F) are authorized. T4 - 2.65 178.274(d)(2) Normal..... 178.275(d)(3) TP1 - The maximum degree of filling must not exceed the degree of filling determined by the following: Degree of filling = 97 / 1 + a (tr - tf) Where: tr is the maximum mean bulk temperature during transport, and tf is the temperature in degrees celsius of the liquid during filling.
DOT Packaging Exceptions (49 CFR 173.xxx)	:	150
DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27)	:	5 L
DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75)	:	60 L
DOT Vessel Stowage Location	:	B - (i) The material may be stowed ''on deck'' or ''under deck'' on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers, or one passenger per each 3 m of overall vessel length; and (ii) ''On deck only'' on passenger vessels in which the number of passengers specified in paragraph (k)(2)(i) of this section is exceeded.
DOT Vessel Stowage Other	:	40 - Stow ''clear of living quarters''
Emergency Response Guide (ERG) Number	:	130
Other information	:	No supplementary information available.

TDG

No additional information available

Transport by sea

UN-No. (IMDG)	:	2362
Proper Shipping Name (IMDG)	:	1,1-DICHLOROETHANE
Class (IMDG)	:	3 - Flammable liquids
Packing group (IMDG)	:	II - substances presenting medium danger

Air transport

UN-No. (IATA)	:	2362
Proper Shipping Name (IATA)	:	1,1-Dichloroethane
Class (IATA)	:	3 - Flammable Liquids
Packing group (IATA)	:	II - Medium Danger

SECTION 15: Regulatory information

15.1. US Federal regulations

1,1-Dichloroethane (75-34-3)	
Listed on the United States TSCA (Toxic Substances Control Act) inventory Subject to reporting requirements of United States SARA Section 313	
EPA TSCA Regulatory Flag	T - T - indicates a substance that is the subject of a Section 4 test rule under TSCA.
SARA Section 313 - Emission Reporting	1.0 %

All components of this product are listed, or excluded from listing, on the United States Environmental Protection Agency Toxic Substances Control Act (TSCA) inventory

Chemical(s) subject to the reporting requirements of Section 313 or Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and 40 CFR Part 372.

1,1-Dichloroethane	CAS No 75-34-3	100%

15.2. International regulations

CANADA

1,1-Dichloroethane (75-34-3)	
Listed on the Canadian NDSL (Non-Domestic Substances List)	
WHMIS Classification	Class B Division 2 - Flammable Liquid

EU-Regulations

No additional information available

National regulations

1,1-Dichloroethane (75-34-3)
Listed on the AICS (Australian Inventory of Chemical Substances) Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China) Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory Listed on the Japanese ISHL (Industrial Safety and Health Law) Listed on the Korean ECL (Existing Chemicals List) Listed on NZIoC (New Zealand Inventory of Chemicals) Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances) Listed on the Canadian IDL (Ingredient Disclosure List) Listed on INSQ (Mexican national Inventory of Chemical Substances)

15.3. US State regulations

1,1-Dichloroethane (75-34-3)	
U.S. - California - Proposition 65 - Carcinogens List	Yes
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
No significant risk level (NSRL)	100 µg/day
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List U.S. - Pennsylvania - RTK (Right to Know) List

California Proposition 65 - This product contains, or may contain, trace quantities of a substance(s) known to the state of California to cause cancer and/or reproductive toxicity

SECTION 16: Other information

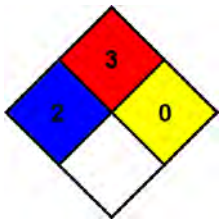
Full text of H-phrases:

Acute Tox. 4 (Oral)	Acute toxicity (oral) Category 4
Aquatic Acute 3	Hazardous to the aquatic environment - Acute Hazard Category 3
Aquatic Chronic 3	Hazardous to the aquatic environment - Chronic Hazard Category 3
Eye Irrit. 2A	Serious eye damage/eye irritation Category 2A
Flam. Liq. 2	Flammable liquids Category 2
Skin Irrit. 2	Skin corrosion/irritation Category 2
STOT SE 3	Specific target organ toxicity (single exposure) Category 3
H225	Highly flammable liquid and vapor
H302	Harmful if swallowed
H315	Causes skin irritation
H319	Causes serious eye irritation
H335	May cause respiratory irritation
H402	Harmful to aquatic life
H412	Harmful to aquatic life with long lasting effects

NFPA health hazard : 2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.

NFPA fire hazard : 3 - Liquids and solids that can be ignited under almost all ambient conditions.

NFPA reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health : 2 Moderate Hazard - Temporary or minor injury may occur

* - Chronic (long-term) health effects may result from repeated overexposure

Flammability : 3 Serious Hazard - Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash points below 73 F and boiling points above 100 F. as well as liquids with flash points between 73 F and 100 F. (Classes IB & IC)

Physical : 0 Minimal Hazard - Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.

SDS US (GHS HazCom 2012)

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is offered solely for your consideration, investigation, and verification. It does not represent any guarantee of the properties of the product nor that the hazard precautions or procedures described are the only ones which exist. SynQuest shall not be held liable or any damage resulting from handling or from contact with the above product.

SAFETY DATA SHEET

Version 4.8
Revision Date 03/03/2015
Print Date 07/20/2015

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : 1,1,1-Trichloroethane

Product Number : 402877
Brand : Sigma-Aldrich
Index-No. : 602-013-00-2

CAS-No. : 71-55-6

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

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

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

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

1.4 Emergency telephone number

Emergency Phone # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Inhalation (Category 4), H332
Skin irritation (Category 2), H315

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

2.2 GHS Label elements, including precautionary statements

Pictogram

Signal word Warning

Hazard statement(s)
H315 Causes skin irritation.
H332 Harmful if inhaled.

Precautionary statement(s)
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves.
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P312 Call a POISON CENTER or doctor/ physician if you feel unwell.
P321 Specific treatment (see supplemental first aid instructions on this label).

P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.

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

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms	:	'Chlorothene' Methylchloroform
Formula	:	$C_2H_3Cl_3$
Molecular weight	:	133.40 g/mol
CAS-No.	:	71-55-6
EC-No.	:	200-756-3
Index-No.	:	602-013-00-2

Hazardous components

Component	Classification	Concentration
1,1,1-Trichloroethane		
	Acute Tox. 4; Skin Irrit. 2; H315, H332	<= 100 %

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

4. FIRST AID MEASURES

4.1 Description of first aid measures

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

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

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

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

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

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

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

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

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

5.2 Special hazards arising from the substance or mixture
Carbon oxides, Hydrogen chloride gas

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

5.4 Further information
No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

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

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

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

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
1,1,1-Trichloroethane	71-55-6	TWA	350.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Liver damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		STEL	450.000000 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Liver damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		C	350.000000 ppm 1,900.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C 15 minute ceiling value		
		TWA	350.000000 ppm 1,900.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
1,1,1-Trichloroethane	71-55-6	Methyl chloroform	40ppm	In end-exhaled air	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to last shift of workweek			
		Trichloroacetic acid	10.0000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of the workweek (After four or five consecutive working days with exposure)			
		Total trichloroethanol	30.0000 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			
		Total trichloroethanol	1.0000 mg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

8.2 Exposure controls

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

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

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

Full contact
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.4 mm
Break through time: 60 min
Material tested:Camatril® (KCL 730 / Aldrich Z677442, Size M)

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

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

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls.

If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Do not let product enter drains.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid, clear Colour: colourless
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	-35.0 °C (-31.0 °F)
f)	Initial boiling point and boiling range	72.0 - 75.0 °C (161.6 - 167.0 °F)
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 15 %(V) Lower explosion limit: 7.5 %(V)
k)	Vapour pressure	133.3 hPa (100.0 mmHg) at 20.0 °C (68.0 °F)
l)	Vapour density	No data available
m)	Relative density	1.34 g/cm3
n)	Water solubility	1.25 g/l at 23 °C (73 °F)
o)	Partition coefficient: n-octanol/water	log Pow: 2.49
p)	Auto-ignition temperature	537.0 °C (998.6 °F)
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.
Contains the following stabiliser(s):
Low alkyl epoxide (<=0.05 %)

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong oxidizing agents, Potassium, Magnesium, Sodium/sodium oxides, Zinc, Strong bases

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

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 9,600 mg/kg
Remarks: Cardiac:Pulse rate. Nutritional and Gross Metabolic:Weight loss or decreased weight gain.

LD50 Oral - Mouse - 6,000 mg/kg
Remarks: Cardiac:Pulse rate. Nutritional and Gross Metabolic:Weight loss or decreased weight gain.

LC50 Inhalation - Mouse - 2 h - 3911 ppm
Remarks: Behavioral:Excitement.

Dermal: No data available

LD50 Intraperitoneal - Rat - 3,593 mg/kg

LD50 Intraperitoneal - Mouse - 2,568 mg/kg

LD50 Subcutaneous - Mouse - 16.0 mg/kg
Remarks: Drowsiness Behavioral:Ataxia.

LD50 Intraperitoneal - Dog - 3,100 mg/kg
Remarks: Liver:Liver function tests impaired.

Skin corrosion/irritation
Skin - Rabbit
Result: Skin irritation - 24 h

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Mild eye irritation

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available

Carcinogenicity

IARC:	3 - Group 3: Not classifiable as to its carcinogenicity to humans (1,1,1-Trichloroethane)
NTP:	No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: Not available

burning sensation, Cough, wheezing, laryngitis, Shortness of breath, Headache, Nausea, Vomiting, Exposure to and/or consumption of alcohol may increase toxic effects., prolonged or repeated exposure can cause:, narcosis, Liver injury may occur., Kidney injury may occur.

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 42.3 mg/l - 96 h

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential

Bioaccumulation	Lepomis macrochirus (Bluegill) - 28 d - 0.0734 mg/l
	Bioconcentration factor (BCF): 9

12.4 Mobility in soil
No data available

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

12.6 Other adverse effects

No data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 2831 Class: 6.1 Packing group: III
Proper shipping name: 1,1,1-Trichloroethane
Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 2831 Class: 6.1 Packing group: III EMS-No: F-A, S-A
Proper shipping name: 1,1,1-TRICHLOROETHANE

IATA
UN number: 2831 Class: 6.1 Packing group: III
Proper shipping name: 1,1,1-Trichloroethane

15. REGULATORY INFORMATION

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

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

	CAS-No.	Revision Date
1,1,1-Trichloroethane	71-55-6	2007-07-01

SARA 311/312 Hazards
Acute Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloroethane	71-55-6	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloroethane	71-55-6	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
1,1,1-Trichloroethane	71-55-6	2007-07-01

California Prop. 65 Components
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

16. OTHER INFORMATION

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

Acute Tox.	Acute toxicity
H315	Causes skin irritation.
H332	Harmful if inhaled.
Skin Irrit.	Skin irritation

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

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

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

Version: 4.8 Revision Date: 03/03/2015 Print Date: 07/20/2015

Established in 1981 megaloid laboratories limited
2221 Ninth Line | Oakville, ON L6H 7G7
Phone: 905-337-7411 | Fax: 905-337-1686
megaloid.ca

Safety Data Sheet

1. PRODUCT IDENTIFICATION

Name **Trichloroethylene**
Synonyms **1,1,2-trichloroethylene, acetylene trichloride, TCE & trade names**
CAS# **79-01-6**
Europe EC# **201-167-4**
Product Uses **cleaning solvent for vapour degreasing**

EMERGENCY INFORMATION
Canada **Call CANUTEC (collect)** **(613) 996-6666**
U.S.A. **Call CHEMTREC** **(800) 424-9300**

2. HAZARDS

GHS Class (Category)	***skin irritant (2)***	***eye irritant (2)***	***STOT (3)***	***carcinogen (1B)***	***aquatic chronic (2)***
Signal Words	***WARNING***	***WARNING***	***WARNING***	***DANGER***	***no Signal Word***
Hazard Statements	*causes skin irritation (H315)*	*causes serious eye irritation (H319)*	*may cause drowsiness or dizziness (H336)*	*may cause cancer (H350)*	*toxic to aquatic life with long-lasting effects (H411)*

GHS Precautionary Statements for Labelling

P261 P271	**Avoid breathing vapour. Use only in a well ventilated area**
P262 P264	**Do not get in eyes, on skin or on clothing. Wash thoroughly after handling.**
P270	**Do not eat, drink or smoke when using this product.**
P280	**Wear eye protection, protective gloves and clothing of butyl or "Viton".**
P273 P391	**Avoid release to the environment. Collect spillage.**

Canada – WHMIS Key: **D 1B, D 2A, D 2B**
B 2 *– Flash Point <38°C,* ***B 3*** *– Flash Point >38°C & <93°C*
D 1 *– Immediately Toxic,* ***D 2*** *– Chronic Toxicity*
C *– Oxidising Substance,* ***E*** *– Corrosive,* ***F*** *– Reactive Substance*

3. COMPOSITION

	%	TWAEV / TLV ppm / mg/m^3	LD_{50} (mg/kg) ORAL	LD_{50} (mg/kg) SKIN	LC_{50} ppm INHALATION
1,1,2-trichloroethylene	100%	10 / 55	2400	29,280	7175

4. FIRST AID

SKIN: Wash with soap & plenty of water. Remove contaminated clothing and do not reuse until thoroughly laundered.
EYES: Wash eyes with plenty of water, holding eyelids open. Seek medical assistance promptly if irritation persists.
INHALATION: Remove from contaminated area promptly. ***CAUTION: Rescuer must not endanger himself!*** If breathing stops, administer artificial respiration and seek medical aid promptly.
INGESTION: Give plenty of water to dilute product. Do not induce vomiting (NOTE below). Keep victim quiet. If vomiting occurs, lower victim's head below hips to prevent inhalation of vomited material. Seek medical help promptly.

Inadvertent inhalation of vomited material may seriously damage the lungs. The danger of this is greater than the risk of poisoning through absorption of this relatively low-toxicity substance. The stomach should only be emptied under medical supervision, and after the installation of an airway to protect the lungs.

Please ensure that this SDS is given to, and explained to people using this product.

5. FIRE FIGHTING & FLAMMABILITY

Flash Point	will not flash[1]
Autoignition Temperature	410°C / 770°F[1]
Flammable Limits	8% – 50% – *only burns in continuous contact with ignition source*
Combustion Products	hydrogen chloride & chlorine (*both corrosive*), plus phosgene (*highly toxic*)
Firefighting Precautions	as for substances sustaining fire; firefighters must wear SCBA
Static Discharge	will accumulate a static charge, but cannot be ignited by a spark

NOTE: *Trichloroethylene may ignite in the presence of a welding torch – and then produce highly hazardous vapours.*

6. ACCIDENTAL RELEASE MEASURES

Leak Precaution	dyke to control spillage; dyke must be able to contain the entire volume of a bulk storage tank
Handling Spill	ventilate contaminated area; recover free liquid with suitable pumps; absorb residue on an inert sorbent, sweep shovel & store in closed containers for recycling or disposal

7. HANDLING & STORAGE

Store in a cool environment, away from substances named in Part 10 (below).

Avoid breathing product vapour. Product should be used in equipment designed for the purpose (eg: vapour degreaser) Use with adequate ventilation. If dealing with a spill, and ventilation is impossible or impractical, wear a suitable respirator (see Part 8). ***Do not routinely wear a respirator for handling this product! Effective ventilation or engineering control of vapour is the ONLY acceptable way to protect people working with this product.***

When transferring product, if there is any danger of contact, wear appropriate protective clothing.

Never cut, drill, weld or grind on or near this container. Avoid contact with skin and wash work clothes frequently. An eye bath and safety shower must be available near the workplace.

NOTE: *Although trichloroethylene is hard to ignite, fire can convert vapours into highly toxic, corrosive gases – Part 5, above.*

8. EXPOSURE CONTROL & PERSONAL PROTECTION

Ontario TWAEV	10ppm / 55mg/m^3	Ontario STEV	25ppm / 135mg/m^3
ACGIH TLV	10ppm / 55mg/m^3	ACGIH STEL	25ppm / 135mg/m^3
OSHA PEL	50ppm / 270mg/m^3	OSHA STEL	200ppm / 1080mg/m^3

Ventilation	product should only be used in specially designed equipment (eg: vapour degreaser); mechanical ventilation should not be required so long as the equipment is working properly; ***using this product in open air and relying on mechanical ventilation is NOT ACCEPTABLE;*** a respirator with organic vapour cartridge should be available for escape purposes, should vapour containment fail (*always store respirators in airtight containers [eg: "Tupperware"] to maintain cartridge "freshness"*)
Hands	"Viton" gloves – *other types also protect, always confirm suitability with supplier*
Eyes	safety glasses with side shields or chemical goggles – *always protect eyes!*
Clothing	impermeable (hands, above) apron, boots, long sleeves, if splashing is anticipated

9. PHYSICAL PROPERTIES

Odour & Appearance	clear, colourless, liquid with mild, sweet, *pleasant* ether odour
Odour Threshold	80ppm – 100ppm – *well above the TLV; hazardous below odour threshold!*
Vapour Pressure	60mmHg / 8kPa (20°C/ 68°F); also 74.5mmHg / 9.9kPa (25°C / 77°F)[1]
Evaporation Rate (*Butyl Acetate = 1*)	4.5-4.9
Vapour Density (air = 1)	4.5
Boiling Point	87°C / 189°F
Freezing Point	-73°C / -99°F; also -85°C / -121°F[1]
Specific Gravity	1.46 (20/20°C)
Water Solubility	1.1 grams/litre (20°C / 68°F)
- in other solvents	most organic solvents
Log $P_{O/W}$ (Octanol/H_2O partition)	2.53[1]
Viscosity	0.58centipoise (20°C / 68°F)[1]
pH	none – *does not yield hydrogen ions in solution*
Conversion Factor	1ppm = 5.36mg/m^3
Molecular Weight	131

10. REACTIVITY

Dangerously Reactive With	strong oxidising agents or reducing agents; reactive metals (eg: Na, K, Ca, Ba)
Also Reactive With	strong alkalies forming explosive dichloroacetylene gas; copper reacts with any dichloroethylene present to form explosive acetylides; reactive with epoxides; unstabilised trichloroethylene may corrode aluminium, copper, zinc in presence of moisture
Chemical Stability	stable; will not polymerize – except under x-ray or other radiation source, or in the presence of aluminium chloride
Decomposes in Presence of	iron, copper, zinc or aluminium at 250-600°C cause decomposition to phosgene; reactive metals cause decomposition to dichloroacetylene
Decomposition Products	apart from Hazardous Combustion Products – dichloroacetylene
Mechanical Impact	not sensitive

11. TOXICITY

Effects, Acute Exposure

Skin Contact	severely irritating if not removed promptly; chemical burns if contact is prolonged (*>5 minutes*)
Skin Absorption	slight – no systemic toxic effects by this route
Eye Contact	liquid severely irritating, may damage eyes; vapour irritates some above 160ppm, others at 350ppm blurred vision & other disturbances have been reported following contact with eyes
Inhalation	headache, dizzyness, drowsiness, intoxication may occur at above 350ppm; irritating above 1000ppm; high concentrations can lead to unconsciousness & death, numbness & muscle weakness also reported
Ingestion	burning sensation in mouth & throat; headache, dizzyness, drowsiness, intoxication & vomiting, followed by muscle weakness, plus possible delayed heart, kidney & liver damage
LD_{50} (oral)	4920 & 5620mg/kg (rat), 2400mg/kg (mouse), >7330mg/kg (rabbit), >5865mg/kg (cat), 5680mg/kg (dog)
LD_{50} (skin)	29,280mg/kg (rabbit)
LC_{50} (inhalation)	7175, 7440, 8450, 40,920 & 48,730ppm (mouse), 7250 & 26,170ppm (rat)

Effects, Chronic Exposure

General	prolonged or repeated exposure may cause dermatitis; neurological damage (headache, sleeplessness, mood change), plus blurred or tunnel vision may be seen; loss of sensation in hands & feet may occur
Sensitising	not a sensitiser
Carcinogen/Tumorigen	probable carcinogen – IARC – Group 1, ACGIH – A2; the NTP rates trichloroethylene a carcinogen
Reproductive Effect	no known effect on humans or animals
Mutagen	mutagen in a few animal tests, but not in others[1]; not known to be a mutagen or teratogen in humans
Synergistic With	alcohol – prior exposure to trichloroethylene followed by alcohol consumption causes upper body flush – called "*degreasers flush*"

12. ECOLOGICAL INFORMATION

Bioaccumulation	trichloroethylene metabolised & excreted (½-life ~40hr) and will not bioaccumulate
Biodegradation	biodegrades in aerobic sewage treatment facilities, but only in the presence of other carbon sources; biodegradation is much slower under anaerobic conditions
Abiotic Degradation	reacts with atmospheric hydroxyl (OH) radicals; estimated ½-life in air 5-7 days
Mobility in soil, water	shown to have moderate mobility in soil and the water column
Marine Toxicity	
LC_{50} (96 hr) Fish	28 & 63mg/litre/96hr (Jordanella floridae), 41mg/litre/96hr (Pimephelas promelas), 16mg/litre Limada limada), 52 & 99mg/litre (Cyprinodon variegatus), 45mg/litre (Lepomis macrochirus)
LC_{50} (48hr) Shrimp	58mg/litre/ (Daphnia cucullata), 2.2, 8, 21 & 42-97mg/litre (Daphnia magna) & others
EC_{50} (Algae)	450mg/litre (Scenedesmus subspicatus), 175mg/litre (Selenastrum capricornutum), 95 & 150mg/litre (Skeletonema costatum)
EC_{50} (Bacteria)	235mg/litre (Bacillus subtilis), >400mg/litre (Chilomonas paramecium), 975mg/litre (Photobacterium phosphoreum) & others

13. DISPOSAL

Waste Disposal	**do not flush to sewer**, recycle solvent if possible, may be incinerated in approved facility ***with flue gas monitoring and scrubbing*** *after mixing with a suitable flammable waste solvent*
Containers	**Drums** should be reused. Recondition and pressure test by a licensed reconditioner prior to re-use. **Pails** must be vented and thoroughly dried prior to crushing and recycling. **IBCs** (intermediate bulk containers): polyethylene bottle must be pressure tested & recertified at 30 months. Replace at 60 months (5yrs). Steel containers must be inspected, pressure tested & recertified every 5 years. ***Never cut, drill, weld or grind on or near this container, even if empty***

14. TRANSPORT CLASSIFICATION

Canada TDG	**PIN**	**UN-1710**
AND	**Shipping Name**	**trichloroethylene**
U.S.A. 49 CFR	**Class**	**6.1**
	Packing Group	**III**
Marine Pollutant		not a marine pollutant
ERAP Required		**NO**

15. REGULATIONS

Canada DSL	**on inventory**
U.S.A. TSCA	**on inventory**
Europe EINECS	**on inventory**

U.S.A. Regulations:

Immediately Dangerous to Life or Health: 1000 ppm; NIOSH considers trichloroethylene to be a potential occupational carcinogen.

Allowable Tolerances: Tolerances are established for residues of trichloroethylene resulting from its use as a solvent in the manufacture of foods as follows:

Food	Parts per million
Decaffeinated ground coffee	25
Decaffeinated soluble (instant) coffee extract	10
Spice oleoresins	30 parts per million (*provided that if residues of other chlorinated solvents are also present, the total of all residues of such solvents in spice oleoresins shall not exceed 30 parts per million*).

OSHA Standards: Permissible Exposure Limit: Table Z-2 8-hr Time Weighted Avg: 100 ppm. Permissible Exposure Limit: Table Z-2 Acceptable Ceiling Concentration: 200 ppm. Permissible Exposure Limit: Table Z-2 Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift. Concentration: 300 ppm. Maximum Duration: 5 minutes in any 2 hours. Vacated 1989 OSHA PEL TWA 50 ppm (270 mg/cu m); STEL 200 ppm (1080 mg/cu m) is still enforced in some states.

NIOSH Recommendations: NIOSH considers trichloroethylene to be a potential occupational carcinogen. NIOSH usually recommends that occupational exposures to carcinogens be limited to the lowest feasible concentration. Recommended Exposure Limit: 60 Minute Ceiling Value: 2 ppm. /During the usage of trichloroethylene as an anesthetic agent/ Recommended Exposure Limit: 10 Hour Time-Weighted Average: 25 ppm. /During exposures to trichloroethylene other than as an anesthetic agent/

15. REGULATIONS, cont'd

Threshold Limit Values: 8 hr Time Weighted Avg (TWA): 10 ppm; 15min Short Term Exposure Limit (STEL) 25 ppm, A2: Suspected human carcinogen.

Atmospheric Standards: This action promulgates standards of performance for equipment leaks of Volatile Organic Compounds (VOC) in the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The intended effect of these standards is to require all newly constructed, modified, and reconstructed SOCMI process units to use the best demonstrated system of continuous emission reduction for equipment leaks of VOC, considering costs, non air quality health and environmental impact and energy requirements. Trichloroethylene is produced, as an intermediate or a final product, by process units covered under this subpart. Listed as a hazardous air pollutant (HAP) generally known or suspected to cause serious health problems. The Clean Air Act, as amended in 1990, directs EPA to set standards requiring major sources to sharply reduce routine emissions of toxic pollutants. EPA is required to establish and phase in specific performance based standards for all air emission sources that emit one or more of the listed pollutants. Trichloroethylene is included on this list.

Federal Drinking Water Standards: Maximum contaminant level goals for organic contaminants: Trichloroethylene, MCLG: zero. Maximum contaminant levels (MCL) for organic contaminants apply to community and non-transient, non-community water systems: Trichloroethylene, MCL 0.005 mg/L. EPA 5 ug/l

State Drinking Water Standards: Florida 3 ug/l, New Jersey 1 ug/l

State Drinking Water Guidelines: Arizona 3.2 ug/l, Connecticut 5 ug/l, Maine 32 ug/l, Minnesota 5 ug/L

Clean Water Act Requirements: Toxic pollutant designated pursuant to section 307(a)(1) of the Federal Water Pollution Control Act and is subject to effluent limitations. Trichloroethylene is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. This designation includes any isomers and hydrates, as well as any solutions and mixtures containing this substance.

CERCLA Reportable Quantities: Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 100 lb or 45.4 kg. The toll free number of the NRC is (800) 424-8802. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b).

RCRA Requirements: As stipulated in 40 CFR 261.33, when trichloroethylene, as a commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate, becomes a waste, it must be managed according to Federal and/or State hazardous waste regulations. Also defined as a hazardous waste is any residue, contaminated soil, water, or other debris resulting from the cleanup of a spill, into water or on dry land, of this waste. Generators of small quantities of this waste may qualify for partial exclusion from hazardous waste regulations (40 CFR 261.5). A solid waste containing trichloroethylene may or may not become characterized as a hazardous waste when subjected to the Toxicity Characteristic Leaching Procedure listed in 40 CFR 261.24, and if so characterized, must be managed as a hazardous waste. When trichloroethylene is a spent solvent, it is classified as a hazardous waste from a nonspecific source, as stated in 40 CFR 261.31, and must be managed according to state and/or federal hazardous waste regulations.

FDA Requirements: Trichloroethylene is an indirect food additive for use as a component of adhesives. Tolerances are established for residues of trichloroethylene resulting from its use as a solvent in the manufacture of foods as follows:

Food	Parts per million
Decaffeinated ground coffee	25
Decaffeinated soluble (instant) coffee extract	10
Spice oleoresins	30 parts per million (*provided that if residues of other chlorinated solvents are also present, the total of all residues of such solvents in spice oleoresins shall not exceed 30 parts per million*).

16. OTHER INFORMATION

Prepared for Megaloid Laboratories by Peter Bursztyn, (705) 734-1577
*Data from **RTECS**, **HSDB** (Haz. Substance Data Base), **Cheminfo** (CCOHS), **IUCLID** Datasheets (ESIS – European Chem. Substance Info. System), & others.*
*Preparation Date: **May 2005** Revision Date: **June 2008, June 2011, June 2014***

European Chemicals Agency (EChA) dossier for Trichloroethylene:
http://apps.echa.europa.eu/registered/data/dossiers/DISS-9c83a2d3-4a9f-1ff5-e044-00144f67d249/DISS-9c83a2d3-4a9f-1ff5-e044-00144f67d249_DISS-9c83a2d3-4a9f-1ff5-e044-00144f67d249.html

SAFETY DATA SHEET

Creation Date 10-Dec-2009 **Revision Date** 26-May-2017 **Revision Number** 4

1. Identification

Product Name **Tetrachloroethylene**

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

Synonyms Perchloroethylene

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

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

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

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

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Carcinogenicity	Category 1B
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
May cause cancer
May cause damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
If eye irritation persists: Get medical advice/attention
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Toxic to aquatic life with long lasting effects
WARNING! This product contains a chemical known in the State of California to cause cancer.

3. Composition / information on ingredients

Component	CAS-No	Weight %
Tetrachloroethylene	127-18-4	>95

4. First-aid measures

General Advice If symptoms persist, call a physician.

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

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.

Inhalation Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.

Ingestion Clean mouth with water and drink afterwards plenty of water.

Most important symptoms/effects None reasonably foreseeable. May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable Extinguishing Media No information available

Flash Point No information available
Method - No information available

Autoignition Temperature No information available
Explosion Limits
Upper No data available
Lower No data available
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

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

Hazardous Combustion Products
Chlorine Hydrogen chloride gas Phosgene
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions Use personal protective equipment. Ensure adequate ventilation.
Environmental Precautions Do not flush into surface water or sanitary sewer system.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Ensure adequate ventilation. Avoid ingestion and inhalation.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from sunlight.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Tetrachloroethylene	TWA: 25 ppm STEL: 100 ppm	(Vacated) TWA: 25 ppm (Vacated) TWA: 170 mg/m^3 Ceiling: 200 ppm TWA: 100 ppm	IDLH: 150 ppm	TWA: 100 ppm TWA: 670 mg/m^3 TWA: 200 ppm TWA: 1250 mg/m^3 STEL: 200 ppm STEL: 1340 mg/m^3

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

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

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

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

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic, sweet
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-22 °C / -7.6 °F
Boiling Point/Range	120 - 122 °C / 248 - 251.6 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	6.0 (Ether = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	18 mbar @ 20 °C
Vapor Density	No information available
Density	1.619
Specific Gravity	1.625
Solubility	0.15 g/L water (20°C)
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	> 150°C
Viscosity	0.89 mPa s at 20 °C
Molecular Formula	C2 Cl4
Molecular Weight	165.83

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under normal conditions.

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

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

Hazardous Decomposition Products Chlorine, Hydrogen chloride gas, Phosgene

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tetrachloroethylene	LD50 = 2629 mg/kg (Rat)	LD50 > 10000 mg/kg (Rat)	LC50 = 27.8 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

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

Irritation Irritating to eyes and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Tetrachloroethylene	127-18-4	Group 2A	Reasonably Anticipated	A3	X	A3

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans
NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen
A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)
Mexico - Occupational Exposure Limits - Carcinogens
A1 - Confirmed Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Confirmed Animal Carcinogen
A4 - Not Classifiable as a Human Carcinogen
A5 - Not Suspected as a Human Carcinogen

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Central nervous system (CNS)
STOT - repeated exposure Kidney Liver Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest

pain, muscle pain or flushing

Endocrine Disruptor Information

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

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

12. Ecological information

Ecotoxicity

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

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

Persistence and Degradability Insoluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

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

Component	log Pow
Tetrachloroethylene	2.88

13. Disposal considerations

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

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Tetrachloroethylene - 127-18-4	U210	-

14. Transport information

DOT

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

TDG

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

IATA

UN-No UN1897
Proper Shipping Name TETRACHLOROETHYLENE
Hazard Class 6.1

Packing Group	III

IMDG/IMO

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

15. Regulatory information

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

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Tetrachloroethylene	X	X	-	204-825-9	-		X	X	X	X	X

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

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Tetrachloroethylene	127-18-4	>95	0.1

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Tetrachloroethylene	-	-	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Tetrachloroethylene	X		-

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive

Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Tetrachloroethylene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Tetrachloroethylene	127-18-4	Carcinogen	14 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

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

U.S. Department of Transportation

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

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

Other International Regulations

Mexico - Grade No information available

16. Other information

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

Creation Date 10-Dec-2009
Revision Date 26-May-2017
Print Date 26-May-2017
Revision Summary This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

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

End of SDS

AIR LIQUIDE™

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NONFLAMMABLE GAS MIXTURE

Containing One or More of the Following Components in a Nitrogen Balance Gas: Oxygen 0-23.5%; Isobutylene, 0.0005-0.9%

SYNONYMS: Not Applicable **CHEMICAL FAMILY NAME:** Not Applicable **FORMULA:** Not Applicable

Document Number: 50054

Note: The Material Safety Data Sheet is for this gas mixture supplied in cylinders with 33 cubic feet (935 liters) or less gas capacity (DOT - 39 cylinders). This MSDS has been developed for various gas mixtures with the composition of components within the ranges listed in Section 2 (Composition and Information on Ingredients). Refer to the product label for information on the actual composition of the product.

PRODUCT USE:	Calibration of Monitoring and Research Equipment
U.S. SUPPLIER/MANUFACTURER'S NAME:	CALGAZ
ADDRESS:	821 Chesapeake Drive Cambridge, MD 21613
BUSINESS PHONE:	1-410-228-6400 (8 a.m. to 5 p.m. U.S. EST)
General MSDS Information**:**	1-713-868-0440
Fax on Demand:	1-800-231-1366
EMERGENCY PHONE:	
Chemtrec: United States/Canada/Puerto Rico:	1-800-424-9300 [24-hours]
Chemtrec International:	1-703-527-3887 [24-hours]

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH-TLV		OSHA-PEL		NIOSH	OTHER
			TWA ppm	STEL ppm	TWA ppm	STEL ppm	IDLH ppm	ppm
Isobutylene	115-11-7	0.0005-0.9%	There are no specific exposure limits for Isobutylene.					
Oxygen	7782-44-7	0-23.5%	There are no specific exposure limits for Oxygen.					
Nitrogen	7727-37-9	Balance	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					

NE = Not Established. See Section 16 for Definitions of Terms Used.

NOTE (1): ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. This gas mixture has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This is a colorless, odorless gas mixture. Releases of this gas mixture may produce oxygen-deficient atmospheres (especially in confined spaces or other poorly-ventilated environments); individuals in such atmospheres may be asphyxiated. Isobutylene, a component of this gas mixture, may cause drowsiness and other central nervous system effects in high concentrations; however, due to its low concentration in this gas mixture, this is unlikely to occur.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this gas mixture is by inhalation.

INHALATION: Due to the small size of an individual cylinder of this gas mixture, no unusual health effects from over-exposure to the product are anticipated under routine circumstances of use. The chief health hazard associated with this gas mixture is when this gas mixture contains less than 19.5% Oxygen and is released in a small, poorly-ventilated area (i.e. an enclosed or confined space). Under this circumstance, an oxygen-deficient environment may occur. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN	OBSERVED EFFECT
12-16% Oxygen:	Breathing and pulse rate increase, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea, vomiting, collapse, or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to this gas mixture may cause the following health effects:

ACUTE: Due to the small size of the individual cylinder of this gas mixture, no unusual health effects from exposure to the product are anticipated under routine circumstances of use. The most significant hazard associated with this gas mixture when it contains less than 19.5% oxygen is the potential for exposure to oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, ringing in ears, headaches, shortness of breath, wheezing, headache, dizziness, indigestion, nausea, unconsciousness, and death. The skin of a victim of over-exposure may have a blue color. Additionally, Isobutylene, a component of this gas mixture, may cause drowsiness or central nervous system effects in high concentrations; however, due to its low concentration in this gas mixture, this is unlikely to occur.

CHRONIC: Chronic exposure to oxygen-deficient atmospheres (below 18% oxygen in air) may affect the heart and nervous system.

TARGET ORGANS: ACUTE: Respiratory system, eyes. CHRONIC: Heart, cardiovascular system, central nervous system.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD	(BLUE)	1
FLAMMABILITY HAZARD	(RED)	0
PHYSICAL HAZARD	(YELLOW)	0

PROTECTIVE EQUIPMENT

EYES	RESPIRATORY	HANDS	BODY
See Section 8			

For Routine Industrial Use and Handling Applications

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS GAS MIXTURE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus must be worn.

No unusual health effects are anticipated after exposure to this gas mixture, due to the small cylinder size. If any adverse symptom develops after over-exposure to this gas mixture, remove victim(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation if necessary. Victim(s) who experience any adverse effect after over-exposure to this gas mixture must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions may be aggravated by over-exposure to this gas mixture.

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary; treat symptoms and eliminate exposure.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.
Upper (UEL): Not applicable.

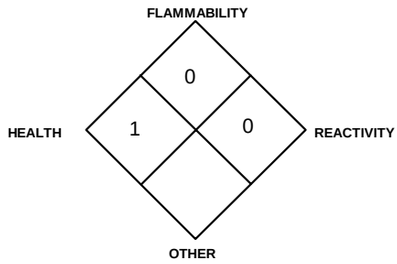
FIRE EXTINGUISHING MATERIALS: Non-flammable gas mixture. Use extinguishing media appropriate for surrounding fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire.

Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment.

NFPA RATING



6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Due to the small size and content of the cylinder, an accidental release of this gas mixture presents significantly less risk of an oxygen deficient environment and other safety hazards than a similar release from a larger cylinder. However, as with any chemical release, extreme caution must be used during emergency response procedures. In the event of a release in which the atmosphere is unknown, and in which other chemicals are potentially involved, evacuate immediate area. Such releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a leak, clear the affected area, protect people, and respond with trained personnel.

Allow the gas mixture to dissipate. If necessary, monitor the surrounding area (and the original area of the release) for oxygen. Oxygen levels must be above 19.5% before non-emergency personnel are allowed to re-enter area.

If leaking incidentally from the cylinder, contact your supplier.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES: Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of this gas mixture could occur without any significant warning symptoms, due to oxygen deficiency. Do not attempt to repair, adjust, or in any other way modify the cylinders containing this gas mixture. If there is a malfunction or another type of operational problem, contact nearest distributor immediately.

STORAGE AND HANDLING PRACTICES: Cylinders should be firmly secured to prevent falling or being knocked-over. Cylinders must be protected from the environment, and preferably kept at room temperature (approximately 21°C [70°F]). Cylinders should be stored in dry, well-ventilated areas, away from sources of heat, ignition, and direct sunlight. Protect cylinders against physical damage. Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. These cylinders are not refillable. **WARNING! Do not refill DOT 39 cylinders. To do so may cause personal injury or property damage.**

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: WARNING! Compressed gases can present significant safety hazards. During cylinder use, use equipment designed for these specific cylinders. Ensure all lines and equipment are rated for proper service pressure.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: No special ventilation systems or engineering controls are needed under normal circumstances of use. As with all chemicals, use this gas mixture in well-ventilated areas. If this gas mixture is used in a poorly-ventilated area, install automatic monitoring equipment to detect the levels of Nitrous Oxide and Oxygen.

RESPIRATORY PROTECTION: No special respiratory protection is required under normal circumstances of use. Maintain oxygen levels above 19.5% in the workplace. Use supplied air respiratory protection when oxygen levels are below 19.5%, or during emergency response to a release of this gas mixture. During an emergency situation, before entering the area, check the concentration of Methane and Oxygen. If respiratory protection is needed, use only protection authorized in the U.S. Federal OSHA Standard (29 CFR 1910.134), applicable U.S. State regulations, or the Canadian CSA Standard Z94.4-93 and applicable standards of Canadian Provinces. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998).

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Wear leather gloves when handling cylinders. Chemically resistant gloves should be worn when using this gas mixture. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: No special protection is needed under normal circumstances of use. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR 1910.136.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for Nitrogen, a main component of this gas mixture.

GAS DENSITY @ 32°F (0°C) and 1 atm: 0.072 lbs/ ft^3 (1.153 kg/m^3)
BOILING POINT: -195.8°C (-320.4°F)
FREEZING/MELTING POINT @ 10 psig: -210°C (-345.8°F)
SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 0.906
pH: Not applicable.
SOLUBILITY IN WATER vol/vol @ 32°F (0°C) and 1 atm: 0.023
MOLECULAR WEIGHT: 28.01
EVAPORATION RATE (nBuAc = 1): Not applicable.
EXPANSION RATIO: Not applicable.
ODOR THRESHOLD: Not applicable.
SPECIFIC VOLUME (ft^3/lb): 13.8
VAPOR PRESSURE @ 70°F (21.1°C) psig: Not applicable.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for Oxygen, a main component of this gas mixture.

GAS DENSITY @ 32°F (0°C) and 1 atm: 0.083 lb/cu ft (1.326 kg/m^3)
FREEZING/MELTING POINT @ 10 psig: -218.8°C (-361.8°F)
BOILING POINT: -183.0°C (-297.4°F)
SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 1.105
pH: Not applicable.
SOLUBILITY IN WATER vol/vol at 32°F (0°C) and 1 atm: 0.04.91
MOLECULAR WEIGHT: 32.00
EVAPORATION RATE (nBuAc = 1): Not applicable.
EXPANSION RATIO: Not applicable.
ODOR THRESHOLD: Not applicable.
VOLUME (ft^3/lb): 12.1
VAPOR PRESSURE @ 70°F (21.1°C) psig: Not applicable.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

The following information is for the gas mixture.

APPEARANCE AND COLOR: This is a colorless, odorless gas mixture.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no unusual warning properties associated with a release of this gas mixture. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Normally stable in gaseous state.
DECOMPOSITION PRODUCTS: The thermal decomposition products of Isobutylene include carbon oxides. The other components of this gas mixture do not decompose, per se, but can react with other compounds in the heat of a fire.
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Titanium will burn in the Nitrogen component of this gas mixture. Lithium reacts slowly with Nitrogen at ambient temperatures. The Isobutylene component of this gas mixture is also incompatible with strong oxidizers (i.e. chlorine, bromine pentafluoride, oxygen difluoride, and nitrogen trifluoride).
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicology data are available for the components of this gas mixture:

ISOBUTYLENE:
LC_{50} (inhalation, rat) = 620,000 mg/kg/4 hours
LC_{50} (inhalation, mouse) = 415,000 mg/kg
NITROGEN:
There are no specific toxicology data for Nitrogen. Nitrogen is a simple asphyxiant, which acts to displace oxygen in the environment.

SUSPECTED CANCER AGENT: The components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, and IARC; therefore, they are not considered to be, nor suspected to be, cancer-causing agents by these agencies.
IRRITANCY OF PRODUCT: Contact with rapidly expanding gases can be irritating to exposed skin and eyes.
SENSITIZATION TO THE PRODUCT: The components of this gas mixture are not known to cause human skin or respiratory sensitization.
REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this gas mixture and its components on the human reproductive system.

Mutagenicity: No mutagenicity effects have been described for the components in this gas mixture.
Embryotoxcity: No embryotoxic effects have been described for the components in this gas mixture.
Teratogenicity: No teratogenicity effects have been described for the components in this gas mixture.
Reproductive Toxicity: No reproductive toxicity effects have been described for the components in gas mixture.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.
BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for the components of this gas mixture.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The components of this gas mixture occur naturally in the atmosphere. The gas will be dissipated rapidly in well-ventilated areas. The following environmental data are applicable to the components of this gas mixture.

OXYGEN: Water Solubility = 1 volume Oxygen/32 volumes water at 20°C. Log K_{ow} = -0.65
NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C. 1.6 volumes Nitrogen/100 volumes water at 20°C.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on the effects of this gas mixture on plant and animal life.
EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on the effects of this gas mixture on aquatic life.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Cylinders with undesired residual product may be safely vented outdoors with the proper regulator. For further information, refer to Section 16 (Other Information).

14. TRANSPORTATION INFORMATION

THIS GAS MIXTURE IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (*Oxygen, Nitrogen)*or the gas component with the next highest concentration next to Nitrogen.
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
PACKING GROUP: Not applicable.
DOT LABEL(S) REQUIRED: Class 2.2 (Non-Flammable Gas)
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126
MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).
SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.
Note: DOT 39 Cylinders ship in a strong outer carton (outer package). Pertinent shipping information goes on the outside of the outer package. DOT 39 Cylinders do not have transportation information on the cylinder itself.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as Dangerous Goods, per regulations of Transport Canada.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (*Oxygen, Nitrogen)*or the gas component with the next highest concentration next to Nitrogen.
HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
PACKING GROUP: Not Applicable
HAZARD LABEL: Class 2.2 (Non-Flammable Gas)
SPECIAL PROVISIONS: None
EXPLOSIVE LIMIT AND LIMITED QUANTITY INDEX: 0.12
ERAP INDEX: None
PASSENGER CARRYING SHIP INDEX: None
PASSENGER CARRYING ROAD VEHICLE OR PASSENGER CARRYING RAILWAY VEHICLE INDEX: 75
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126
NOTE: Shipment of compressed gas cylinders via Public Passenger Road Vehicle is a violation of Canadian law (Transport Canada Transportation of Dangerous Goods Act, 1992).

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:
U.S. SARA REPORTING REQUIREMENTS: The components of this gas mixture are not subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act.
U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this gas mixture. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.
U.S. TSCA INVENTORY STATUS: The components of this gas mixture are listed on the TSCA Inventory.
U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.
OTHER U.S. FEDERAL REGULATIONS:

- No component of this gas mixture is subject to the requirements of CFR 29 1910.1000 (under the 1989 PELs).
- Isobutylene is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 pounds.
- The regulations of the Process Safety Management of Highly Hazardous Chemicals are not applicable (29 CFR 1910.119).
- This gas mixture does not contain any Class I or Class II ozone depleting chemicals (40 CFR Part 82).

15. REGULATORY INFORMATION (continued)

- Nitrogen and Oxygen are not listed as Regulated Substances, per 40 CFR, Part 68, of the Risk Management for Chemical Releases. Isobutylene is listed under this regulation in Table 3 as Regulated Substances (Flammable Substances), in quantities of 10,000 lbs (4,554 kg) or greater.

U.S. STATE REGULATORY INFORMATION: The components of this gas mixture are covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: No.
California - Permissible Exposure Limits for Chemical Contaminants: Nitrogen.
Florida - Substance List: Oxygen, Isobutylene.
Illinois - Toxic Substance List: No.
Kansas - Section 302/313 List: No.
Massachusetts - Substance List: Oxygen, Isobutylene.
Michigan - Critical Materials Register: No.
Minnesota - List of Hazardous Substances: No.
Missouri - Employer Information/Toxic Substance List: No.
New Jersey - Right to Know Hazardous Substance List: Oxygen, Nitrogen, Isobutylene.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.
Pennsylvania - Hazardous Substance List: Oxygen, Nitrogen, Isobutylene.
Rhode Island - Hazardous Substance List: Oxygen, Nitrogen.
Texas - Hazardous Substance List: No.
West Virginia - Hazardous Substance List: No.
Wisconsin - Toxic and Hazardous Substances: : No.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): No component of this gas mixture is on the California Proposition 65 lists.

ADDITIONAL CANADIAN REGULATIONS:
CANADIAN DSL/NDSL INVENTORY STATUS: The components of this gas mixture are listed on the DSL Inventory.
CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: The components of this gas mixture are not on the CEPA Priorities Substances Lists.
CANADIAN WHMIS REGULATIONS: This gas mixture is categorized as a Controlled Product, Hazard Class A, as per the Controlled Product Regulations.

16. OTHER INFORMATION

INFORMATION ABOUT DOT-39 NRC (Non-Refillable Cylinder) PRODUCTS

DOT 39 cylinders ship as hazardous materials when full. Once the cylinders are relieved of pressure (empty) they are not considered hazardous material or waste. Residual gas in this type of cylinder is not an issue because toxic gas mixtures are prohibited. Calibration gas mixtures typically packaged in these cylinders are Nonflammable n.o.s., UN 1956. A small percentage of calibration gases packaged in DOT 39 cylinders are flammable or oxidizing gas mixtures.

For disposal of used DOT-39 cylinders, it is acceptable to place them in a landfill if local laws permit. Their disposal is no different than that employed with other DOT containers such as spray paint cans, household aerosols, or disposable cylinders of propane (for camping, torch etc.). When feasible, we recommended recycling for scrap metal content. CALGAZ will do this for any customer that wishes to return cylinders to us prepaid. All that is required is a phone call to make arrangements so we may anticipate arrival. Scrapping cylinders involves some preparation before the metal dealer may accept them. We perform this operation as a service to valued customers who want to participate.

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information about the handling of compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1 *"Safe Handling of Compressed Gases in Containers"*
AV-1 *"Safe Handling and Storage of Compressed Gases"*
"Handbook of Compressed Gases"

AIR LIQUIDE™

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**ALCONOX®**
CHEMICAL FAMILY NAME:	Detergent.
PRODUCT USE:	Critical-cleaning detergent for laboratory, healthcare and industrial applications
U.N. NUMBER:	Not Applicable
U.N. DANGEROUS GOODS CLASS:	Non-Regulated Material
SUPPLIER/MANUFACTURER'S NAME:	Alconox, Inc.
ADDRESS:	30 Glenn St., Suite 309, White Plains, NY 10603. USA
EMERGENCY PHONE:	**TOLL-FREE in USA/Canada** 800-255-3924
	International calls 813-248-0585
BUSINESS PHONE:	914-948-4040
DATE OF PREPARATION:	May 2011
DATE OF LAST REVISION:	February 2008

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS

EUROPEAN and (GHS) Hazard Symbols

Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1
EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 207-638-8 Index# 011-005-00-2
EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):

Eye Irritant Category 2A

Hazard Statement(s):

H319: Causes serious eye irritation

Precautionary Statement(s):

P260: Do not breath dust/fume/gas/mist/vapors/spray
P264: Wash hands thoroughly after handling
P271: Use only in well ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):

[Xi] Irritant

Risk Phrases:
R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:
S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS: ACUTE: Eye, respiratory System, Skin CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard *JIS Z 7250: 2000*.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing dificulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

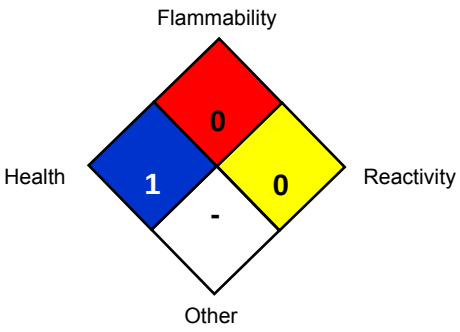
RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT: Not Flammable
AUTOIGNITION TEMPERATURE: Not Applicable
FLAMMABLE LIMITS (in air by volume, %): Lower (LEL): NA Upper (UEL): NA
FIRE EXTINGUISHING MATERIALS: As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This product is non-flammable and has no known explosion hazards.
Explosion Sensitivity to Mechanical Impact: Not Sensitive.
Explosion Sensitivity to Static Discharge: Not Sensitive
SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD (BLUE)	1
FLAMMABILITY HAZARD (RED)	0
PHYSICAL HAZARD (YELLOW)	0

PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8

For Routine Industrial Use and Handling Applications

Hazard Scale: **0** = Minimal **1** = Slight **2** = Moderate **3** = Serious **4** = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.
SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m³	5 mg/m³	5 mg/m³
Sodium Carbonate	497-19-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable
DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.
SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.
REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.
ENVIRONMENTAL STABILITY: No Data available at this time.
EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
PROPER SHIPPING NAME: Non-Regulated Material
HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable
UN IDENTIFICATION NUMBER: Not Applicable
PACKING GROUP: Not Applicable.
DOT LABEL(S) REQUIRED: Not Applicable
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable
MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:
This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:
This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):
This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:
This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health: Yes Chronic Health: No Fire: No Reactivity: No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory if Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

Appendix B
Community Air Monitoring Plan

COMMUNITY AIR MONITORING PLAN
G.W. LISK FACILITY
2 SOUTH STREET – CLIFTON SPRINGS, NEW YORK

This Community Air Monitoring Plan (CAMP) involves real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of the designated work area when intrusive activities are in progress. Intrusive activities may include soil excavation, grading, staging, movement, or handling; test pitting or trenching; and/or the installation of soil borings and monitoring wells. The CAMP provides a measure of protection for on-Site workers and the downwind community (i.e., potential off-Site receptors including residences, parks, businesses, etc.) not directly involved with the subject work activities. Routine monitoring is required to evaluate concentrations and corrective action and/or work stoppage may be required to abate emissions detected at concentrations above specified action levels. Routine data collected during implementation of the CAMP may also help document that work activities did not spread compounds of potential concern off-Site through the air. Reliance on the procedures and action levels described in this CAMP should not preclude simple, common sense measures to keep VOCs, dust, and odors at a minimum around work areas.

COMMUNITY AIR MONITORING PLAN

VOC concentrations in air will be measured using calibrated photoionization detectors (PIDs). Particulate matter concentrations will be measured using calibrated electronic aerosol monitors.

Relevant weather conditions including wind direction, speed, humidity, temperature, and precipitation will be evaluated and recorded prior to the initiation of subsurface intrusive activities. Background readings of VOCs and particulate matter will be collected on Site prior to the initiation of field work on each day that subsurface intrusive work will be performed. Additional background measurements may be collected if weather conditions change significantly.

Continuous monitoring for VOCs and particulate matter will be performed upwind and downwind of the work area during subsurface intrusive activities.

Periodic monitoring for VOCs will be performed during non-intrusive activities if requested by a New York State Department of Environmental Conservation (NYSDEC) and/or New York State Department of Health (NYSDOH) on-Site representative. Non-intrusive activities include any work activity that does not disturb the subsurface or staged soil piles, including routine Site visits,

installation of remedial equipment, operations and maintenance (O&M), surveying, etc. Periodic monitoring, if performed, will consist of collecting readings downwind of the work area at the following intervals:

- upon arrival at a sample location or other work activity location;
- during performance of the relevant work activity; and
- prior to leaving a sample location or other work activity location.

VOC MONITORING, RESPONSE LEVELS, AND ACTIONS

VOCs will be monitored at the downwind perimeter on a continuous basis during intrusive activities. Upwind concentrations will be measured continuously or at the start of each workday, during the work activity, and at the end of each work day to establish background conditions. Monitoring equipment will be calibrated at least once a day (excludes equipment that requires factory calibration). Calibration may be performed more frequently if Site conditions or instrument operating conditions are highly variable. The monitoring equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below. The monitoring equipment will be equipped with an alarm to indicate an exceedance of a specified action level.

1. If the ambient air concentration of total VOCs at the downwind perimeter exceeds 5 parts per million (ppm) above background (upwind perimeter) for the 15-minute time-weighted average, work activities will be temporarily halted and monitoring continued. If the total VOC concentration readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total VOC concentrations at the downwind perimeter persists at concentrations greater than 5 ppm over background but less than 25 ppm, work activities will be halted, the source of the VOCs identified, corrective action will be taken to abate emissions (if the source is related to Site remedial activities), and monitoring will be continued. After these steps, work activities will resume provided that the total VOC concentration 200 feet downwind of the work area, or half the distance to the nearest potential receptor, whichever is less (but in no case less than 20 feet), is below 5 ppm above background for the 15-minute average.

3. If the total VOC concentration is greater than 25 ppm above background at the downwind perimeter, intrusive work activities will be halted and the source of the VOCs will be identified. Work will resume when additional continuous monitoring demonstrates that VOC concentrations have dropped below 25 ppm for a minimum of one-half hour, and the total VOC concentration 200 feet downwind of the work area, or half the distance to the

nearest potential receptor, whichever is less (but in no case less than 20 feet), is below 5 ppm above background for the 15-minute time-weighted average.

4. All 15-minute readings will be recorded and will be available for review by NYSDEC and/or NYSDOH personnel. Instantaneous VOC readings (if any) used for decision purposes will also be recorded.

PARTICULATE MONITORING, RESPONSE LEVELS, AND ACTIONS

Fugitive dust migration from the work area will be visually assessed during intrusive activities. Particulate concentrations will be monitored continuously at the downwind perimeter during intrusive activities. Particulate monitoring will be performed using real-time electronic aerosol monitoring equipment capable of measuring particulate matter less than 10-micrometers in size (PM-10) and capable of integrating over a period of 15 minutes for comparison to the airborne particulate action levels referenced below. The monitoring equipment will be equipped with an alarm to indicate an exceedance of a specified action level.

1. If the downwind PM-10 concentration is 100 micrograms per cubic meter ($\mu g/m^3$) greater than background for the 15-minute period, or if airborne dust is observed leaving the work area, dust suppression techniques will be employed. Work may continue with dust suppression techniques provided that downwind PM-10 concentration does not exceed 150 $\mu g/m^3$ above background and provided that significant visible dust is not migrating from the work area.

2. If downwind PM-10 concentrations are greater than 150-$\mu g/m^3$ above background after the implementation of dust suppression activities, intrusive activities will be stopped and a re-evaluation of the intrusive activities will be initiated. Work can resume provided that dust suppression measures and/or other controls are successful in reducing the downwind PM-10 concentration to within 150 mcg/m^3 of background and in preventing significant visible dust migration.

3. All 15-minute readings will be recorded and will be available for review by NYSDEC and/or NYSDOH personnel. Instantaneous readings (if any) used for decision purposes will also be recorded.

Appendix C
Quality Assurance Project Plan

G.W. Lisk Company, Inc.

Quality Assurance Project Plan

G.W. Lisk Facility
2 South Street
Clifton Springs, New York

April 2019

ERM Consulting & Engineering, Inc.
www.erm.com

TABLE OF CONTENTS

1.0 INTRODUCTION

On behalf of G.W. Lisk Company, Inc., (G.W. Lisk), ERM Consulting and Engineering, Inc. (ERM) has prepared this Quality Assurance Project Plan (QAPP) for a Remedial Investigation (RI) at the G.W. Lisk Inc. Facility located at 2 South Street in the Village of Clifton Springs, Ontario County, New York (the Site).

The figure numbers referenced in this QAPP are the same figures referenced in the narrative portion of the RI Work Plan.

1.1 PURPOSE AND OBJECTIVES

This QAPP identifies the necessary procedures for an orderly, accurate, and efficient data collection and analysis program for the project, and ensures that data meet quality objectives. The objectives for monitoring and ensuring data quality include the following:

- identify key responsibilities and qualifications of staff responsible for data quality monitoring;
- ensure that samples are properly managed both in the field and the laboratory;
- ensure realistic data quality goals that will produce data of known and acceptable quality are established; and
- ensure that data are accurate, complete, and verifiable.

1.2 SITE LOCATION

The Site is located at 2 South Street in the Village of Clifton Springs, Ontario County, New York.

1.3 SITE HISTORY

Figure 2 shows the layout of the Site including specific parcels and surrounding areas. The G.W. Lisk Property encompasses two parcels which together comprise approximately 26.654 acres. The Site is located within a primarily residential area. Prior to the 1910s, this area was developed as agricultural land. Land use became

increasingly residential in nature throughout the early to mid-1900s. The Site was originally developed with one building by 1910. Between 1985 and 1995 the Site was increasingly developed with building expansions and property improvements, including paved parking areas. The Site has existed in its current configuration since 2006.

1.4 REMEDIAL INVESTIGATION OBJECTIVES

Based on the results of the SC presented in the NYSDEC-approved SC Report (ERM, 2018) and consistent with NYSDEC technical requirements contained in the Final Technical Guidance for Site Investigation and Remediation (DER-10; NYSDEC, 2010), a Remedial Investigation (RI) scope of work has been developed by G.W. Lisk to meet specific goals. These goals include defining the nature and extent of contamination, identify contaminant source areas, evaluate potential exposures, and produce data of sufficient quantity and quality to support the development of an acceptable of Remedial Alternatives Analysis (AA) or Remedial Action Work Plan (RAWP).

If appropriate, the RI should also identify additional removal, treatment, containment, or other interim remedial measures (IRMs) to remove, treat, or contain any source areas identified, and prevent, mitigate, or remedy potential exposure to Compounds of Potential Concern (COPCs) while remedial alternatives are being evaluated.

2.0 QUALITY ASSURANCE OBJECTIVES

Quality objectives ensure that data collected are sufficient to meet the intended project goals. Quality objectives are pre-established goals that are used to monitor and assess the progress and quality of the work performed. It is essential to define quality objectives prior to initiation of any project work to ensure that activities yield data sufficient to meet project objectives.

Quality objectives are divided into two categories: data quality objectives (DQOs) and quality assurance objectives (QAOs). The DQOs are associated with the overall project objective as it relates to data collection. The QAOs define acceptance limits for project-generated data as they relate to data quality.

2.1 DATA QUALITY OBJECTIVES

DQOs are qualitative and quantitative criteria required to support the decision making process. DQOs define the uncertainty in a data set and are expressed in terms of precision, accuracy, representatives, completeness, and comparability (PARCC). The DQOs apply to both characterization and confirmation samples at the site. These parameters are defined as follows:

- **Precision:** a measure of mutual agreement among measurements of the same property usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist depending upon the "prescribed similar conditions".
- **Accuracy:** the degree of agreement of a measurement (or an average of measurements) with an accepted reference of "true value". Accuracy is one estimate of the bias in a system.
- **Representativeness**: expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.
- **Completeness:** a measure of the amount of valid data obtained from a measurement system compared to the

amount that was expected to be obtained under correct normal conditions

- **Comparability:** expresses the confidence with which one data set can be compared with another. Comparability is a qualitative, not quantitative measurement, as in the case of accuracy and precision. Comparability is assessed by reviewing results or procedures for data that do not agree with expected results.

It is the responsibility of the field team to collect representative and complete samples. It is the responsibility of the field-screening chemist at the laboratory to analyze these samples using accepted protocols resulting in data that meet PARCC standards.

2.2 FIELD SAMPLING QUALITY OBJECTIVES

The overall quality of sample results depends on proper sample management. Management of samples begins at the time of collection and continues throughout the analytical process. To ensure samples are collected and managed properly and consistently, field procedures for sample collection activities have been developed for the project. The laboratory also has procedures that ensure a proper and consistent analytical process.

Field procedures include descriptions of equipment and procedures required to perform a specific task. The purpose is to increase reproducibility and to document each of the steps required to perform the task. Approved and correctly implemented field procedures should produce data of acceptable quality that meet project DQOs.

2.3 LABORATORY DATA QUALITY OBJECTIVES

The laboratory will demonstrate analytical precision and accuracy by the analysis of laboratory duplicates and by adherence to accepted manufacture and procedural methodologies.

The performance of the laboratory will be evaluated by the Project Manager and Project Quality Assurance Officer during data reduction. The evaluation will include a review of all deliverables for completeness and accuracy when applicable.

3.0 QUALITY CONTROL PROCEDURES

This section presents a general overview of the quality assurance and quality control procedures that will be implemented during the Site Characterization.

These quality control procedures are to be implemented as follows:

- in the field; and
- in the laboratory utilized for selected sample analyses.

3.1 FIELD QC ACTIVITIES

Several types of field QC samples will be collected and submitted for analysis during the project. Each type of QC sample monitors a different aspect of the field effort. Analytical results for QC samples provide information regarding the adequacy of the sample collection and transportation of samples.

Field (Blind) Duplicates, Field Blanks, and MS/MSD Pairs (two samples) will be collected at a frequency of five percent (1 per 20 field samples). More frequent collection may be warranted based on field conditions/ observations and/ or at the discretion of the Field Leader. Trip Blanks and Temperature Blanks are designated one per cooler. Specifics of the sampling activities, including collection frequency and sampling procedures, are described in the field procedures. The five types of field QC samples that will be generated during the project are defined below.

- **Trip blanks –** Trip blank samples monitor for contamination due to handling, transport, cross contamination from other samples during storage, or laboratory contamination.

- **Temperature blank –** Temperature blanks are used to monitor temperature within a sample cooler. Temperature blank results that are outside of acceptable limits (2° to 6° C) indicate possible sample preservation issues and may require qualification of data or the recollection of samples.

- **Rinsate (Field) blanks –** Rinsate or field blank samples are used to monitor equipment decontamination procedures.

- **Field (Blind) duplicates –** Field or blind duplicates are used to monitor field and laboratory precision, as well as matrix heterogeneity.

- **Matrix Spikes –** Matrix Spikes (MS) are used to monitor precision and accuracy of the analytical method on various matrices.

3.2 LABORATORY QC ACTIVITIES

Laboratory QC samples will include the use of method blanks, MS, laboratory control samples, laboratory duplicates, and surrogate spikes. The five types of laboratory QC samples are defined below.

- **Method blanks** – Method blanks are used to monitor and ensure that the analytical system is free of contamination due either to carryover from previous samples or from laboratory procedures.

- **Matrix Spike samples –** Matrix Spike samples monitor and assess the effects of the sample matrix on the sample analysis and verify the accuracy and precision of the analysis.

- **Laboratory Control samples –** Laboratory control samples are used to monitor the accuracy of the analytical procedure without the potential interferences of a matrix.

- **Laboratory Duplicate samples** – Laboratory duplicate samples are used to monitor and assess laboratory precision, as well as potential matrix heterogeneity.

- **Surrogate Spikes** - Surrogate Spikes are utilized to monitor potential interferences from the sample matrix. Surrogate spikes are required for organic analyses only.

4.0 CALIBRATION PROCEDURES

Calibration is an integral part of ensuring that results are quantitated correctly. Instruments that are not calibrated either to manufacturers and/or method specifications are likely to produce unreliable results. Proper procedures must be followed and sufficient documentation maintained to ensure calibrations are performed correctly and that sample quantitations accurately reflect sample concentrations.

During the course of this RI, instruments that may be used in the field in conjunction with sampling activities include a photoionization detector (PID) and particulate (i.e., dust) meters. A maintenance, calibration, and operation program will be implemented to ensure that routine calibration and maintenance is performed on all field instruments. The program will be monitored by the Field Team Leader. Trained team members will perform scheduled calibration, field calibrations, checks, and instrument maintenance prior to use each day. Additionally, calibration will be checked as necessary to ascertain that proper measurements are being taken.

Team members are familiar with the field calibration, operation, and maintenance of the equipment, and will perform the prescribed field operating procedures outlined in the operation and field manuals accompanying the respective instrument. Field personnel will keep records of all field instruments calibrations and field checks in the field logbooks. Calibration information recorded in field logbooks will include date, time, instrument model and serial number, a description of calibration or field check procedure, and any instrument deviations.

If on-site monitoring equipment should fail, the Field Team Leader will be contacted immediately. Replacement equipment will be provided or the malfunction will be repaired in a timely fashion.

5.0 ANALYTICAL PROCEDURES AND DATA EVALUATION

Groundwater, surface water, soil, sediment, sub-slab soil vapor, indoor air, and ambient air will be collected for analysis for some or all of the following analytes: volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), phenols, United States Environmental Protection Agency (USEPA) Target Analyte List (TAL) metals, pH and total organic carbon (TOC), and geochemical parameters. In general, laboratory analytical procedures will adhere to USEPA SW-846 methodology, although other methods will be utilized as appropriate. Samples will be analyzed by a New York State Department of Health (NYSDOH)-approved environmental laboratory familiar with Contract Laboratory Protocols (CLP). The laboratory will be required to achieve detection and reporting limits that are below applicable cleanup levels whenever possible. A summary of anticipated samples to be collected is presented in Table 6.

Upon receipt of analytical reports from the laboratory, ERM will evaluate data packages and confirm that samples were analyzed within required holding time and at proper detection limits. The laboratory will provide NYSDEC Analytical Services Protocol (ASP) Category B deliverables.

The project Quality Assurance/Quality Control (QA/QC) officer will review the data packages and prepare a Data Usability Summary Report (DUSR) in accordance with NYSDEC guidance in DER-10
(NYSDEC, 2010). At a minimum, the following information will be evaluated:

- chain-of-custody forms;
- date sampled/date analyzed;
- raw data;
- initial and continuing instrument calibrations;
- matrix spikes;
- laboratory duplicate analyses;
- surrogate recoveries (organics); and
- laboratory control samples (inorganics).

Data reduction will consist of presenting analytical results on summary tables. Data resulting from characterization analyses will then be used to evaluate potential remedial options.

6.0 PROJECT PERSONNEL

ERM will staff this project with persons having expertise in the tasks to be performed and experience working on NYSDEC-regulated sites. Key project personnel that will be involved with this project are summarized below.

Ernie Rossano will be the Partner-in-Charge for this project. Mr. Rossano has over 31 years of environmental remediation and varied hydrogeologic experience. His experience includes the design of monitoring well networks, surface and subsurface water quality monitoring, management of large scale remedial investigations and remedial actions, aquifer test analysis, tank removal and associated soils assessment, fate and transport modeling, construction monitoring, and data management using GIS systems. Mr. Rossano will be responsible for all ERM activities on the project and assists the ERM Project Manager in planning, coordinating, and controlling all work performed on this project. He has overall responsibility for developing the QAPP, monitoring the quality of the technical and managerial aspects of the project, and implementing the QAPP and corrective measures, where necessary.

Jon Fox P.G. will be the senior project manager, lead geologist, and Qualified Environmental Professional for this project. Mr. Fox is a licensed Professional Geologist and has over 30 years of diversified professional scientific and environmental consulting experience including project management, geologic and hydrogeologic investigations, site remediation, regulatory negotiations, litigation support services, geologic mapping, document reviews, immunoassay field screening, petrographic analyses, geophysics, statistical analysis of geologic data, petroleum exploration and development, and professional geologic instruction. Mr. Fox has extensive experience with NYSDEC remediation programs and will be responsible for coordination and detailed technical aspects of the project and management of all field activities.

Tim Daniluk P.G. will serve as Field Safety Officer (FSO). Mr. Daniluk has extensive experience as a field team leader on many projects located around the country and leads field efforts on projects ranging from routine monitoring to investigations in high profile areas with media attention, and has a specialized skill set with emerging contaminants and includes knowledge of special procedures necessary for proper preparation, sample collection and analysis. Mr. Daniluk has extensive familiarity with procedures in

the field and in management roles. Mr. Daniluk also serves as a project hydrogeologist with experience leading data collection and analysis.

Andrew Coenen, will be the QA/QC Officer for this project. Mr. Coenen has 27 years of general analytical chemistry experience, six years of analytical laboratory experience, and 15 years of environmental consulting experience, including analytical data validation, sampling and analysis programs, quality assurance programs, technical support, and QA oversight for fixed laboratory and field analysis. Mr. Coenen has knowledge of numerous analytical methodologies and experience in data validation of analytical data package deliverables for adherence to USEPA CLP and non-CLP and NYSDEC ASP protocols. Mr. Coenen will be responsible for establishing and maintaining an accurate and representative database for data collected during the investigation, monitoring data quality, conducting data review, and preparing a DUSR in accordance with NYSEDC guidelines.

Appendix D
Investigation Personnel and Qualifications

Ernest Rossano, CPG

Mr. Ernest Rossano is a Senior Partner within ERM based in Melville, New York. He has 28 years of varied hydrogeologic experience, including 3 years as a Project Manager for the United States Geological Survey, Water Resources Division on Long Island. His experience includes the design of monitoring well networks for volatile organics, hydrocarbons, and collection of basic hydrogeologic parameters; seismic, downhole geophysical, and sample log analysis and correlation; supervision and analysis of pump tests in confined and unconfined strata; numerical modeling of ground water flow and solute transport; and management of large scale remedial investigations and remedial actions. His experience includes work in unconsolidated sediments and in fractured rock environments. Mr. Rossano has extensive experience with the New York State Brownfield Cleanup Program, which includes the successful completion of multiple projects in the New York City area.

Mr. Rossano is also an acting board member for the New York City Brownfield Partnership, whose mission is to provide benefits to the communities they serve by working to redevelop Brownfield areas in New York City. He works closely with both NYSDEC and the New York City Mayor's Office of Environmental Remediation (OER).

Registrations & Professional Affiliations

- Certified Professional Geologist
- National Ground Water Association
- American Institute of Professional Geologists
- Association of Ground Water Scientists & Engineers

Fields of Competence

- Management of ground water pollution investigations
- Analysis of surface and ground water flow systems
- Surface and subsurface water quality monitoring
- In-situ permeability testing
- Infiltration testing
- Stratigraphic analysis, correlation and interpretation
- Multi-media sampling
- Tank removal and associated soils assessment
- Aquifer test analysis
- Ground water modeling
- Fate & Transport modeling
- Applied geophysics
- Municipal water supply
- Soil Vapor Extraction
- Air Sparging
- Bioventing/Biosparging
- Design & Installation of Horizontal Wells
- Construction Management
- Data Management using GIS Systems

Education

- M.S. Hydrogeology, State University of New York at Stony Brook, 1992
- B.S. Geology, Southampton College, New York, 1984

Key Projects

Water Quality, Long Island, New York
Comparison of major land use with the overall water quality of Long Island, New York.

Management and Supervision of Monitoring Well Network
Management and supervision of monitoring well network using over 1,000 wells. Correlation of data for use in USGS-published annual reports.

Stream gauging and surface water, Long Island, New York, NASQAN and NAWQA
Stream gauging and surface water sampling on Long Island for the USGS National Stream Quality Accounting Network (NASQAN) and National Water Quality Assessment (NAWQA) programs.

Supervision of Field Activities
Supervision of field activities including aquifer testing, test borings, well installation, recovery well construction, soil vapor and ground water sampling, and data evaluation.

Design and Installation of a Static Hydrocarbon Recovery System
Design and installation of a static hydrocarbon recovery system using 29 wells to recover more than 450,000 gallons of product.

Supervision of Tank Removal
Supervision of tank removal and subsequent soils evaluation for contamination.

Design and Installation of Municipal Supply Well
Design and installation of a municipal supply well yielding more than 1,000 gallons per minute. Supervised all aspects of well construction and acceptance testing.

Three-Dimensional Ground Water Flow Model, New Jersey
Three-dimensional ground water flow model of New Jersey Coastal Plain deposits, to determine recovery well locations and rates, and feasibility of recharging treated effluent.

Pilot Testing of Soil Vapor Extraction
Pilot testing of soil vapor extraction and air sparging at several sites with varied hydrogeologic settings.

Pilot Testing of Bioventing and Biosparging
Pilot testing of bioventing and biosparging in glacial outwash deposits in New York.

PM for Design, Construction, and Operation of 4000 scfm Air Sparge and 6200 scfm Soil Vapor Extraction System
Project Manager for the design, construction and operation of a 4000 scfm air sparge and 6200 scfm soil vapor extraction system consisting of 181 vertical and three horizontal sparge wells and 33 vertical and 1 horizontal soil vapor extraction wells. Provided direct construction management supervision for installation of four horizontal wells averaging 1100 feet in length. As project manager was responsible for construction management of above ground treatment system components.

Constructed a Transport Model of Hydrocarbons in Glacial Terrain
Regional scale three-dimensional flow and solute transport model of hydrocarbons in glacial terrain in New York used to negotiate favorable cleanup criteria for the client.

Constructed a Flow and Transport Model of Chlorinated Solvent Plume, Long Island, NY
Flow and transport model of a chlorinated solvent plume on Long Island, New York. Constructed a model involving the movement of groundwater and chlorinated solvents in highly permeable glacial sediments. This model utilized the MT3D code and site-specific decay rates to demonstrate fate and transport.

Constructed a Flow and Transport Model of Chlorinated Solvent Plume, New Jersey
Flow and transport model of a chlorinated solvent plume in East Rutherford, New Jersey. Constructed a model involving the movement of ground water and chlorinated solvents in overburden sediments and wetland areas. This model utilized the RT3D code and site-specific decay rates to develop a Classification Exception Area and demonstrate monitored natural attenuation.

Site Decommissioning and Remedial Investigation New York
Managed a site decommissioning and remedial investigation for a large defense industry client. Investigation results indicated significant chromium contamination in soil and ground water and led to inclusion in the New York State Voluntary Cleanup Program. Sediment and surface water samples were collected from multiple locations in the East River as part of the remedial investigation. Additional investigation and remediation are pending NYSDEC review. Chosen remedial methods were excavation and in situ stabilization/reduction. As project manager was responsible for construction management aspect of implementing the remedial strategy.

Database Setup and Management for Remedial Investigation Projects
Database setup and management for multiple large remedial investigation projects using GIS/Key. Database outputs include geologic and chemical cross sections, isoconcentration maps, graphs, data tables, and statistical analysis. Exports from databases have been used in ground water flow and solute transport modeling.

Management of ISRA Project
Management of a large ISRA project on a site contaminated with metals and chlorinated solvents. Key aspects of this project include; litigation support, active ground water remediation, off site plume delineation, ground water monitoring, data management and soil remediation.

Brownfield Projects, New York City
Principal in charge of multiple Brownfield projects in New York City area including two sites in the Bronx that were managed from the initial stage supporting the Brownfield Program application through the issuance of Certificates of Completion. The two Bronx, NY properties were remediated prior to redevelopment as mixed income housing. Both sites had known underground storage tanks and it was suspected that additional tanks were likely present based on past operations. One site had an open spill case with significant free-phase gasoline contamination. Previous investigations had revealed that both sites contained "urban fill" contaminated with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), heavy metals, and PCBs. Groundwater was impacted by VOCs, SVOCs, and metals. ERM completed a thorough remedial investigation, a remedial design, a qualitative risk assessment, remedial design including bid specifications and drawings. Specifications included the need for underpinning several multiple story buildings, sheeting and shoring and dewatering. The excavation plan required a combination of sidewall sloping, sheet pilings, underpinning and tiebacks for structural support. In accordance with the Brownfield's cleanup program, a comprehensive community participation plan was prepared and fact sheets produced for the various elements of the project.

Principal in charge of a brownfield site in Jamaica, NY utilizing the New York City Voluntary Cleanup Program administered by the New York City Mayor's Office of Environmental Remediation (OER). This site was "e" designated for hazardous materials and noise. ERM supervised the remediation of the site to achieve a Track 1 cleanup by excavation of the entire site to fourteen feet. This cleanup allows for completely unrestricted development of the site.

Principal in charge of remediation of a brownfield site located on Webster Avenue in the Bronx, NY. Work on this site included demolition of the existing building and excavation of soil to varying depths across the site to allow for the construction of two buildings. One building was designated for affordable housing and the other as supportive housing. Each of these buildings had a vapor barrier installed and the affordable housing building also required a sub slab depressurization system to prevent potentially harmful vapors from entering the building which was constructed as slab on grade. The supportive housing building had a basement dug out to fourteen feet which was in close proximity to the water table and required a specialized foundation to prevent both water and vapor intrusion.

Petroleum Remediation JFK Airport
Principal in charge of a petroleum remediation project at a major New York airport. The remediation consisted of the installation of an SVE/air sparge system which operated for approximately one year. Work included negotiations with the Port Authority and NYSDEC, pilot testing, system design, system operation and following closure system abandonment.

Jon S. Fox, P.G.

Jon Fox has more than 30 years of diversified professional scientific and environmental consulting experience including contaminated site investigation and remediation; site management; program and project management; Brownfields program management; regulatory negotiations; geologic and hydrogeologic evaluation; private water well system inspection, sampling, and corrective action; inspection and corrective action of storage tank systems; operations management; expert witness and litigation support; immunoassay field screening; petrographic analyses; geochemistry and geophysics; statistical analysis of geologic data; wetlands evaluation; petroleum exploration geology and development; and professional geologic instruction.

Jon stays current on topics useful to clients with resolution of environmental problems in a manner consistent with the client's business goals and objectives through participation in relevant and timely conferences, seminars, and continuing professional education courses. Recent examples include:

- PFAS Investigation and Remediation
- Technical Guidance on Site Investigation and Remediation
- Public and Private Water Well Systems
- Brownfields and Tax Credits
- Remote Sensing Techniques
- Structural and Hydro-Structural Geology
- Surface Geophysics for Hydrogeological and Geotechnical Applications
- Hydrogeology and Management of Karst Ground Water Resources

Registrations & Professional Affiliations

- Qualified Environmental Professional (New York)
- Licensed Professional Geologist (New York and Pennsylvania)
- Certified in Underground Storage Tank Decommissioning (International Code Council)
- Geological Society of America
- International Society of Environmental Forensics
- National Ground Water Association
- New York State Council of Professional Geologists
- New York State Geological Association
- Central New York Association of Professional Geologists
- Pennsylvania Council of Professional Geologists
- New England Interstate Water Pollution Control Commission
- Air & Waste Management Association
- Manufacturer's Association

Fields of Competence

- Geological Sciences and Hydrogeology
- Environmental Investigation & Remediation
- Private Water Well Systems
- Petroleum Storage Tank Systems
- Environmental Forensic Analysis
- Geochemistry and Geophysics
- Environmental Regulations
- Wetland Hydrology
- Statistical Analysis
- Radioactivity
- Petroleum Exploration and Development

Education

- M.A., Geology and Geochemistry, University of North Dakota, 1993
- B.S., Geology, State University of New York at Oswego, 1988 (Honors: Outstanding Geology Graduate)

Publications and Presentations

Fox, J.S., 2015. New York State Brownfield Cleanup Program Technical Changes in 2015. *Air & Waste Management Association - CNY Chapter Meeting*, Syracuse (NY), 21 April 2015.

Fox, J.S., Mohlin, J.P., and Kuhn, J., 2014. The effects of TENORM discovery on remedial action scope, schedule, and budget. *Air & Waste Management Association - Genesee/Finger Lakes Chaper Annual Technical Seminar,* Rochester (NY), 12 February 2014.

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Fox, J.S., 1996. Accuracy and comparability of immunoassay field screening for PCBs at two Superfund sites in New York State: in A. Scott Weber (editor), Hazardous and Industrial Wastes: *Proceedings of the 28th Mid-Atlantic Industrial and Hazardous Waste Conference*. Technonic Publishing Cp., Lancaster (PA), p. 804.

Fox, J.S. and Videtich, P.E., 1992. Subaqueous deposition of the "C" zone, Red River Formation (Upper Ordovician), Williston basin (abs.): *American Association of Petroleum Geologists Bulletin*, v. 76, p. 1259.

Pees, S.T. and Fox, J.S., 1990. Northwest Pennsylvania should have more Cambrian potential: *Oil and Gas Journal*, Oct. 8, pp. 129-134.

Fox, J.S., 1988. Some geological aspects of the Oil Creek Valley Region: in C. Burgchardt (editor), *AAPG History of the Oil Industry Symposium Guidebook*: American Association of Petroleum Geologists, Tulsa, pp. 37-44.

Key Projects

PFAS Investigation and Remediation
New York State
Coordinated and managed environmental investigation and remediation efforts associated with per- and polyfluoroalkyl substances (PFAS) at numerous properties in New York State. Worked with regulators, the public, local governmental agencies, and contractors to evaluate and implement effective investigation and remediation approaches under the oversight of applicable State and Federal Regulatory Agencies.

Brownfields Program Management
New York State
Senior Consultant and Project Manager for the successful completion of a large Brownfields project at a complex industrial property in western New York State (USA) through the State's Brownfield Cleanup Program (BCP). Performed regulatory negotiations and managed environmental aspects of the decommissioning and decontamination of an abandoned paper mill and the concurrent construction of a new state-of-the-art fiberboard recycling facility in its place. Total project cost = $450 Million, Environmental project cost = $18 Million. The Site contained multiple areas of concern affected by multiple contaminants. Assembled and managed the project team that performed Site investigation and remediation activities in an expedited manner concurrent with site demolition and construction activities (2 years from start to finish). Ensured compliance with applicable environmental regulations and technical requirements for site investigation and remediation. The successful completion of the BCP at the Site resulted in issuance of a regulatory Certificate of Completion, liability release, and the securing of approximately $40 Million in state tax credits for the client.

Industrial Remediation Management
New York State
Senior Project Manager for the investigation and remediation of a complex industrial property in western New York State (USA) through the State's Voluntary Cleanup Program. The site contained multiple areas of concern affected by releases of chlorinated solvents and/or varnish. Site investigation and remediation activities are being performed in distinct phases including a baseline investigation, data gap investigation, interim remedial measures, feasibility study, remedial design, and remedial implementation.

Ground Water Remediation
Implemented remediation of petroleum-affected soil and ground water through use of various remedial strategies, including natural attenuation strategies, with the approval of the State Regulatory Agency.
Private Water Well Sampling and Corrective Action
Directed the inspection and sampling of private water supply wells at numerous residential properties in New York, New Jersey, Pennsylvania, and Connecticut in association with the investigation and remediation of petroleum or chemical spills. Worked with engineers and water treatment vendors to evaluate and implement effective point-of-entry water treatment systems at numerous residential properties under the oversight of the applicable State Regulatory Agencies.

Commercial Remediation Management
Western New York State
Senior Project Manager for the investigation and remediation of a commercial property in western New York State (USA) through the State's Voluntary Cleanup Program. The site contained two areas of concern affected by releases of a chlorinated solvent and metals. Site investigation and remediation activities are being performed in distinct phases including a baseline investigation, data gap investigation, remedial work plan development, remedial design investigation, and remedial implementation.

Environmental Investigation and Remediation Coordination
New England Region
Coordinated, supervised, and managed environmental investigation and remediation efforts associated with releases of petroleum, solvents, and/or metals at numerous properties in New York, New Jersey, Connecticut, Pennsylvania, and Massachusetts. Projects typically involve soil and ground water investigation, remediation, and regulatory negotiations. Obtained regulatory closure for numerous projects.

Military Remediation Property Management
Central New York State
Senior Project Manager for the remediation of a military property in central New York State (USA) through a Record of Decision with the State Regulatory Agency. The area of concern involves ground water that was affected by releases of aviation fuel (JP-4 and JP-8). The remediation involves development of a work plan, full-scale design phase, construction of the remedial system, and operations and maintenance. The selected technology involves a combination of air sparging, soil vapor extraction, and enhanced microbiological degradation of petroleum residuals in ground water.

Underground Storage Tank Inspection
Performed inspections of hundreds of underground storage tank and aboveground storage tank systems (including associated piping) for the purpose of confirming proper tank decommissioning procedures and to evaluate whether or not the tank system released petroleum or other chemicals into the environment.

Geological Services
New York State
Provided expert geological services, including attendance and presentations at public and governmental meetings, to assist a global energy company with the State Environmental Quality Review Act process for planning, siting, construction, and operation and maintenance of a 140-turbine wind energy farm in northern New York State.

Environmental Investigation
New England
Performed document reviews and managed environmental investigation and remediation efforts in New York, New Jersey, Connecticut, Pennsylvania, and Massachusetts for numerous insurance carriers. Projects typically involve environmental investigation to assist the client's coverage determination and/or preparation of reports used by client's counsel in successful motions for Summary Judgment, inter-company arbitration, or other litigation support scenarios.

Litigation Support
Upstate New York
Provided litigation support services on numerous projects including expert testimony at trial in a civil action associated with a petroleum release at a residential property in upstate New York.

Litigation Support
Western New York
Provided litigation support services associated with a CERCLA action against a former owner of a Site in western New York State (USA). Services were focused on objective evaluation of the consistency of the investigation and remediation to date with the National Contingency Plan. Services provided helped the client secure a very favorable decision by the Court regarding cost recovery and apportionment of ongoing and future remedial costs.

Property Remediation Management
Managed a project involving investigation and remediation of residential and commercial properties with landscaped areas affected by boron allegedly derived from mulch produced by a commercial operation. The mulch was accidentally contaminated by scraps derived from wood treated with a wood preservative compound. Directed and mitigated negotiations between affected and potentially-affected parties, the client, the insured, counsel, and the State Regulatory Agency.

Site Investigation
Employed innovative site investigation methodologies focused on three-dimensional delineation of ground water affected by the gasoline oxygenate methyl-tert-butyl ether (MTBE) and other volatile organic compounds.

Contractor Oversight
Provided oversight of environmental contractors engaged in investigative or remedial efforts at numerous petroleum spill sites; in many cases, ERM's oversight resulted in significant cost savings through reduction in scope of work and/or negotiated reductions of environmental contractor invoices.

Surface and Subsurface Hydrogeological Investigations
New York State
Performed surface and subsurface hydrogeologic investigations at an unpermitted industrial landfill in northern New York State as part of remedial investigation/feasibility studies and remedial design investigations.

Site Delineation
Central New York State
Delineated areas affected by PCBs from a transformer fluid release at an industrial site through the application of immunoassay field screening technology; also provided oversight and documentation of remedial efforts associated with the implementation of the site remediation plan and regulatory negotiations.

Ground Water Remediation
Central New York State
Managed a project involving investigation and remediation of a petroleum release and ground water/facility issues regarding an unknown chlorinated solvent release at an industrial property in central New York State (USA).

Soil Remediation
Northern New York State
Coordinated efforts with state and local government officials related to the remediation of gasoline-affected soil through the planned construction and operation of an ex-situ treatment cell utilizing soil vapor extraction at a project site in northern New York State (USA).

Bedrock Sampling
Various States
Developed analytical protocol and sampling methodologies for investigation of porosity and permeability characteristics in numerous bedrock formations in New York, Pennsylvania, Ohio, and North Dakota (USA).

Regional Subsurface Structural Investigations
Various States
Developed and performed extensive regional subsurface structural investigations in portions of New York, Pennsylvania, Ohio, and North Dakota (USA).

Stephen A. Mirabello, P.E.

Mr. Stephen A. Mirabello is a Senior Engineer with 11 years of experience in the field of contaminated site investigations and remediation. He is experienced with remedial design, site investigations, project management, bedrock and overburden well installations, geological logging, soil, groundwater, and sediment sampling, field analysis, operation and maintenance of groundwater treatment systems, facility decommissioning, hydrogeological assessments, and permitting.

He has worked closely with both private and public sector clients to manage contaminated sites for chlorinated VOC, SVOC, PCB, TPH, PAH, and metals in soil, sediment, groundwater, and vapors. Private sector client include pharmaceutical, manufacturing, and power and utilities. He has also worked with NYSDEC, NJDEP, EPA and US Army Corps of Engineers on remedial investigations and designs on respective superfund sites in NY and NJ.

He has completed designs for remedial measures including excavation, air-sparge, soil vapor extraction, sub-slab depressurization, in-situ chemical oxidation injections, bioremediation injections, groundwater extraction, source stabilization, and monitored natural attenuation.

Professional Affiliations & Registrations

- Professional Engineer – New York – 2011
- Professional Engineer – New Jersey– 2013

Fields of Competence

- Contaminated site remedial design.
- Contaminated site investigation.
- Facility decommissioning.
- Project management.

Education

- MS, Environmental Engineering, Cornell University, 2006
- BS, Forest Engineering, SUNY ESF, NY, 2004.

Certifications

- 40-hr OSHA HAZWOPER Training
- 8-hr OSHA HAZWOPER Supervisor
- 8-hr Confined Space Entry
- 10-hr OSHA Construction Safety
- CPR/First Aid

Languages

- English, native speaker

Key Industry Sectors

- Power
- Chemical
- Manufacturing & Pharmaceutical
- Government

Publications

Mirabello, S.A., Marabello D.A, Chenenko, R.A, Evans, P.J, "Demonstration of an Effective Natural Attenuation Remedy for a *Methylene Chloride Source at a Former Pharmaceutical Site in New Jersey." Presented at the 2nd International Symposium on Bioremediation and Sustainable Environmental Technologies. Jacksonville Florida, June 2013.*

Key Projects

Fuel Oil Pipeline 20-in Decommissioning & Remedial Measure, Brooklyn-Queens NY
Project Manager – Lead Engineer
Mr. Mirabello managed the field oversight of the decommissioning of a 20-in 4.5 mile long buried fuel oil pipeline. Components of the work included plan preparation, contractor submittal review, CAMP implementation, pigging/cleaning, grouting in-place, and regular communication with NYSDEC regarding plan deviations. Post closure activities include the preparation of the Final Engineering Report that was accepted by NYSDEC.

Fuel Oil Pipeline 10-in Decommissioning Design, Queens NY
Project Manager – Lead Engineer
Mr. Mirabello coordinated the preparation of the specifications and drawings for bid documents for the decommissioning of a 10 in, 2-mile long fuel oil pipeline that is both buried or present in. Special considerations and procedures were developed for portions of the pipeline that passed through environmentally sensitive or contaminated areas. In addition a field effort inclusive of plan preparation, CAMP implementation, pigging/cleaning, and pressure integrity testing is part of the design.

PCB Contaminated Superfund Site, Edison, NJ
Lead Engineer
Mr. Mirabello was the project engineer for the pre-design investigation and remedial design consisting of excavation and off-site disposal, rail spur construction, flood control, soil consolidation, site regrading, soil capping, and wetland and vegetative restoration. In total over 150,000 CY of TSCA and Subtitle-D soils over 50 acres are to be removed as part of the design. This interdisplinary project requires coordination with EPA, US Army Corps of Engineers, Conrail, NJDEP and internal teams.

Generating Station Demolition Design, Brooklyn-Queens, NY
Project Manager – Lead Engineer
Mr. Mirabello led the demolition design and site restoration bid package a generating station building and property. The design included demolition of the building interior/exterior structures and utilities, filling of tunnels and trenches with clean sand, site regrading and restoration of sidewalks. In addition, Mr. Mirabello was the engineer-of-record and signed and sealed engineering drawings to be used by the remedial contractor for the New York City Department of Buildings Permit application, inclusive of a builder's pavement plan.

Utility Tunnel – Feasibility Study, Bronx, NY
Project Manager – Lead Engineer
Mr. Mirabello coordinated the preparation of an environmental feasibility study for the installation of new 36-inch Transmission Pressure Steel Gas Main across the Bronx River between Soundview Park and Hunts Point in the borough of Bronx, NY. The environmental study was concerned with determining costs and viability of removing existing 42" retired cast iron gas mains currently in the tunnel to allow placement of the new main. Specific tasks included the sampling of both the interior and exterior of the pipeline. Exterior samples included asbestos, lead paint and PCBs on both the surface and support structures. Following surface abatement, the pipe was opened to perform the interior investigation, inclusive of waste water characterization, pipeline video surveying, and sludge sampling. Cleaning and demolition work plans were developed as part of the feasibility study.

Service Station Demolition Design, Roe Park, NY
Lead Engineer
Mr. Mirabello was the lead engineer for the design specification and drawings for the demolition of a former service station in Roe Park NY. Components of the work include management of hazardous building materials, excavation of underground storage tanks, removal of contaminated soils, demolition of the property building and other above ground structures, and site restoration including backfill.

Chlorinated Solvents - AS/SVE Designs, Long Island, NY
Lead Engineer
For multiple chlorinated solvents sites overseen by the NYSDEC cleanup program, Mr. Mirabello was a project engineer for the performance based design and construction of remedial measures to mitigate vapor intrusion as a result of a chlorinated solvent spill. Components included multiple SVE and AS wells, treated with vapor phase carbon adsorption. Responsibilities included analyzing pilot test data to determine radius of influence, system loss and sizing calculations and preparation the specifications.

Timothy Daniluk, P.G.

Mr. Timothy Daniluk is a project scientist within ERM based in Syracuse, NY with over 6 years of experience in the field of hydrogeology. Mr. Daniluk is a graduate of Syracuse University with a Master of Science degree in hydrogeology. While in graduate school, he taught at the Branson Field Camp in Lander, Wyoming, operated by the University of Missouri. There, he instructed students on various field methods and calculations, including measurement of stream discharge using flow meters, slug tests, differential gauging, end member mixing, and dye tracing. His master's thesis focused on geochemical analysis of conservative and redox-sensitive solutes and heat transport modeling to quantify vertical fluxes in the hyporheic zone of restored streams and their associated reference sites. Previously, Mr. Daniluk's undergraduate work included surficial and groundwater work in a karst system contaminated with TCE.

At ERM, Tim has been involved with a wide variety of projects. Tim has completed wetland, maintains a groundwater treatment system, and is an experienced groundwater, surface water, sediment, and sub-slab air sampler. He is also an experienced subsurface clearance person and has over 6 years of experience logging soils and performing well installations. Tim has performed in-situ chemical oxidation (ISCO) and biological injections to mitigate contamination plumes. In addition, Tim has performed and provided erosion and sediment control inspections, construction oversight, low flow sampling, slug testing, step-drawdown testing, aquifer testing, and associated calculations and reporting.

Tim has extensive experience as a field team leader on many projects around the country. Tim has led field efforts on many projects ranging from routine monitoring to investigations in high profile areas with media attention. Tim has a specialized skill set with emerging contaminants including 1,4-Dioxane and perfluorinated compounds (PFCs) and includes knowledge of special procedures necessary for proper preparation, sample collection and analysis. Tim also has experience in the design, oversight and execution, and analysis of advanced techniques such as Membrane Interface Probe (MIP), and Waterloo^{APS} site investigations for site characterizations and remedial investigations.

Tim has regular communication with clients and subcontractors to properly allocate ERM resources to drive project execution and client satisfaction. Tim has experience in project management and the development of proposals, subcontracts, and budgets for large projects managed by others.

Tim has been a key member of many large CSM and IAP report teams. He has been responsible for coordinating the successful completion of large reports with graphics, data management, and report writing teams. Tim regularly works with personnel outside his local project group.

Professional Affiliations & Registrations

- New York State Licensed Professional Geologist (License Number: 000275-1)
- Central New York Association of Professional Geologists

Fields of Competence

- Subsurface clearance experienced person
- Well design, installation and development
- Construction oversight
- Remedial injections
- Groundwater, surface water, and sediment sampling
- Low-flow sampling
- Slug testing and analysis
- Erosion and sediment control
- Hydraulic conductivity testing
- Phase II investigations
- Vapor Intrusion assessment
- Aqtesolv
- PFC sampling
- Reporting
- Proposals and budgeting
- Project management

Education

- Midwest Geosciences Group *Aquifer Testing for Improved Hydrogeologic Site Characterization*. Fort Collins, CO, USA. October 2017.
- Nielsen Environmental Field School groundwater, surface water, and sediment field courses. Las Cruces, NM, USA. October 2011.
- Nielsen Environmental Field School monitoring well design, construction, and development field course. San Diego, CA, USA. April 2012.
- MS Hydrogeology, Syracuse University, Syracuse, NY, USA. August 2011.
- BS Water Resources, SUNY Brockport, Brockport, NY, USA. May 2009.

Languages

- English, native speaker

Publications

- Daniluk, TL, LK Lautz, RP Gordon, TE Endreny. 2012. Impacts of stream restoration on surface water-groundwater interaction. *Hydrological Processes*. Vol. 27, Issue 25, pp 3730-3746.

- Daniluk, TL, LK Lautz, RP Gordon. 2010. Water, heat and solute fluxes through hyporheic zones at stream restoration sites and their associated reference stream. *Abstract, American Geophysical Union*.

- Gordon, RP, **LK Lautz**, TL Daniluk. 2013. Spatial patterns of hyporheic exchange and biogeochemical cycling around cross-vane restoration structures: The role of the hyporheic zone and implications for stream restoration design. *Water Resources Research*. Vol 49, Issue 4, pp 2040-2055.

- Proceedings of the American Geophysical Union Annual Meeting, December 13-17, 2010: San Francisco, California: Groundwater-surface water interactions: dynamics and patterns across spatial and temporal scales.

Key Projects

Erosion and Sediment Control Inspection
Susquehanna County, PA
Erosion and sediment control inspections for pipeline projects, wetland delineation for pipeline routing, and spill response. Completed SWPPP inspections for completed pipelines and stockyards.

SWPPP Inspections and Quarterly Monitoring
Norwich, NY
Monitoring and application well installation and development, subsequent Site monitoring. Initiated onsite calibration plan and procedure to ensure QA/QC standards.

Surface and Groundwater Technology Review
New York, NY
Reviewing technology for determining surface water and groundwater contributions to surface water, and review of work plan to use remote sensing in the watershed. Reviewed groundwater modeling plan, provided technical guidance to client.

Pump and Treat System Maintenance
Finger Lakes, NY
Responsible for maintaining a pump and treat system.

Brownfield Cleanup Program
Seneca Falls, NY
Served as environmental professional providing construction oversite for construction/excavation project at Brownfield site. Monitored excavated material and wastewater leaving site and tracking materials brought onsite in accordance with NYSDEC BCP guidelines.

Site Investigation
Finger Lakes, NY
Directed all subsurface activities for the PM in the field, including MIP and Waterloo^{APS} technologies. Integral in design and placement of monitoring well network, sediment and surface water sampling, tree core sampling, and subsequent analysis of data and CSM development. Designed and led several rounds of hydrogeologic characterization efforts, and performed all analyses. Coordinated final reporting efforts for PM.

Wetland Delineation
Susquehanna County, PA
Performed USACE wetland delineations in the field for Oil and Gas client routing pipelines for shale gas in Pennsylvania.

Groundwater Intrusion Study
New York, NY
Reviewed vertical surface water profiles, Thermal Infrared Imagery (TIR), geochemical parameters, and samples from pore water, surface water, groundwater, sediment and soil to analyze locations of potential groundwater influence.

Remedial Injection
Minnesota ANG
Injected emulsified soybean oil and KB-1 bacteria to break down chlorinated solvent contamination, and monitored site for "daylighting" of injectants. Implemented immediate response for containment of spills or daylighting.

Phase II
Syracuse, NY
Conducted field operations of Phase II subsurface investigation including logging of soils and collecting samples for laboratory analysis.

Phase II Subsurface Investigation
Mechanicville, NY
Conducted field operations of Phase II subsurface investigation including logging of soils, collecting soil samples, directing well installation, well development and low flow sampling for laboratory analysis.

Vapor Intrusion Assessment
Finger Lakes, NY
Installed and Helium tested *VaporPins* in facility slab, collected air samples, and conducted indoor chemical survey at multiple client sites.

Aquifer Testing
Norwich, NY and Finger Lakes, NY
Designed and conducted step-drawdown pumping tests and performed data analysis using Aqtesolv to generate hydraulic conductivity values.

Water Impact Assessment at Coal Power Plants
North Carolina
Collected surface water, groundwater, and sediment samples for site characterization, including metals speciation samples.

Slug Testing and Analysis
North Carolina
Directed slug testing operations at client Site, including instruction on methodology to field personnel. Later analyzed data collected to generate hydraulic conductivity values for use in Site specific reports.

Site Lead
North Carolina
Directed teams of 2 during field operations including well development, groundwater sampling, and slug testing. Was responsible for ERM's performance on Site, collecting and submitting all information to client, in addition to directing ERM field staff to fulfill client needs.

Field Team Leader
Upstate New York
Directed Waterloo^{APS} profiling, surface water and sediment sampling operations at a high profile project with significant media attention for an emerging contaminant Site. Served as rotating Site leader.

PFA Sampling
Extensive experience sampling for PFA's in various media.

Sediment Sampling
Collected and directed the collection of sediment samples from various water bodies using a variety of methods. Was asked by a client to observe and critique sediment sampling activities of other consultants on a superfund project near New York City.

Aquifer Testing
Michigan
Onsite field leader for 72-hour constant rate pumping test. Performed subsequent hydrogeologic analysis and generated report and deliverable.

Site Characterization
Finger Lakes, NY
Led field teams and coordinated completion of Site Characterization Report for a high value client.

Andrew Coenen

Mr. Coenen has 19 years of general analytical chemistry experience, 6 years of analytical laboratory experience, and 13 years of environmental consulting experience, including analytical data validation, sampling and analysis programs, quality assurance programs, technical support, laboratory audits, and QA oversight for fixed laboratory and field analysis. Mr. Coenen has knowledge of numerous analytical methodologies and experience in data validation of analytical data package deliverables for adherence to USEPA CLP and non-CLP, NYSDEC ASP, and NJDEP protocols. He is proficient with GIS/Key environmental management software and has operated a mobile gas chromatograph laboratory used to test soil and water samples for quick-turn volatile analysis.

Mr. Coenen is an expert in GIS Solutions GIS\Key software, and has implemented the system's cutting edge data management protocols and processes for numerous large and small scale site investigation and remediation projects throughout the Uniteed States.

GIS\Key is a comprehensive, environmental data management and reporting tool. The software suite includes specific modules for storing and presenting Chemistry, Geology, Hydrology, NPDES, and Radiology data.

Fields of Competence

- Analytical data review and validation
- Environmental Database Management (GIS/Key)
- Laboratory Subcontractor Management
- Analytical protocols for pollutants by USEPA methodologies
- Methods of analysis of organic and inorganic parameters
- Review and preparation of QA/QC plans
- Field analytical techniques
- Multi-Media Sampling

Education

- 8-Hour OSHA Annual Refresher Training, 1999 - current
- 40-Hour OSHA [29 CFR 1910.120 (e) (2)] Health and Safety Training, 1998
- Rutgers University/Cook College - NJDEP Using GIS for Environmental Evaluations, October 1999
- Computer Aided Drafting, 50-Hour Course, Island Drafting and Technical Institute, 1998
- Immunoassay Testing Training Program, Strategic Diagnostics Inc., 1998
- B.S. Chemistry, University of Michigan, 1991

Languages

- English, native speaker
- Knowledge of German and Spanish

Key Projects

Environmental Data Management: Contaminated Site Management

Data validation for numerous projects located in New York, New Jersey, California, Connecticut, Illinois, Iowa, Indiana, Maryland, Massachusetts, Michigan, Pennsylvania, Rhode Island, and Wisconsin, involving evaluation of aqueous, soil, sediment, leachate, and air samples analyzed by USEPA Contract Laboratory Protocols, State Protocols and numerous methodologies for organic, inorganic, wet chemistry parameters, TPH, and various other analyses.

Reviewed sampling and laboratory chemical data for adherence to New Jersey Department of Environmental Protection protocols and New York State Department of Environmental Conservation on numerous projects. Also constructed electronic deliverables for submission to NJDEP and NYSDEC in required electronic formats.

Database construction & management for numerous investigations utilizing GIS/Key software. Compiled field and laboratory data and generated result summary tables, contours, isopleths, contaminant plume maps, cross-sections, and boring logs.

Prepared numerous Sampling and Analysis Plans (SAPs) and Quality Assurance Project Plans (QAPPs) for adherence to state and federal guidelines.

Project Manager responsible for the coordination and performance of a major hydrogeologic investigation for an ISRA site (NJDEP Site Remediation) in East Rutherford, NJ. Conducted an extensive volatile organic compound plume delineation, a vapoer intrusion investigation, installation of an extensive ground water monitoring well network, ground water sampling.

Quality Assurance Officer responsible for review of all data collected at several sites including the former Brooklyn Navy Yard Industrial Park, several NYSDEC Standby Contract Projects, Sherwin Williams Superfund Site, Hydrite Chemical Company in Waterloo, Iowa.

Project management and technical support for Special Analytical Services required to delineate low-level PAH contamination at a Superfund Site. This included method development and validation of a Selected Ion Monitoring (SIM) GC/MS technique.

Utilized Immunoassay test kits for field measurement of PCB contamination at the former Brooklyn Navy Yard, Brooklyn, New York. Performed data validation of all field analytical samples and off-site laboratory samples and compared off-site results to test kits.

Conducted subsurface investigations with a Geoprobe. Performed various field tests.

Supervision of tank removal and subsequent soils evaluation for contamination.

Appendix E
NYSDEC Approval Correspondence

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Region 8
6274 East Avon-Lima Road, Avon, NY 14414-9516
P: (585) 226-5353 | F: (585) 226-8139
www.dec.ny.gov

December 13, 2019

Arno Bebernitz
GW Lisk Company Inc.
2 South Street
Clifton Springs, NY 14432

Re: Remedial Investigation Work Plan
G.W. Lisk NYSDEC Site No. C835026
Clifton Springs, Ontario County

Dear Mr. Bebernitz:

The New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH) (collectively, the "Departments") have completed their review of the *Remedial Investigation Work Plan* (RIWP) dated October 2019 and prepared by ERM Consulting & Engineering, Inc. The Departments have determined that the Work Plan, with the following modifications, substantially addresses the requirements of the Brownfield Cleanup Program and is hereby approved:

1. Section 2.3: The passive soil vapor sampling will be performed prior to other sampling activities as a screening tool to focus the installation of soil borings and wells, as needed, towards areas of suspected highest contamination. The passive soil vapor sample results will be submitted to the Departments for review. Four sub-slab soil vapor and co-located indoor air samples within the Hundreds Building will be collected during the 2019-2020 heating season to evaluate the potential for exposures.
2. Section 2.5, Table 6, Figure 9: Sediment will be sampled for PCBs, metals, SVOCs, and VOCs. An additional sediment sample will be collected downstream where the bed and banks are not consistently hardened. This should be from the first sediment depositional area downstream of the consistently hardened surfaces.
3. Section 2.11: A Part 2 FWRIA may be needed and will be determined by the Departments. If a Part 2 is needed, a supplemental RIWP will be submitted for review.

Per 6 NYCRR 375-1.6, please notify me in writing by December 27, 2019 which of the following options you will choose to address these comments:

- Accept the above modifications and distribute the final RIWP with this letter attached as follows:
  - Danielle Miles (NYSDEC – Avon, 1 bound hard copy);
  - Renata Ockerby (NYSDOH – Albany, electronic file/CD); and
  - The document repository located at the Clifton Springs Public Library – 4 Railroad Ave Clifton Springs, NY 14432 (1 bound hard copy);
- invoke dispute resolution; or
- terminate the Brownfield Cleanup Agreement.

If you have any questions or concerns on this matter, please contact me at (585) 226-5349 or danielle.miles@dec.ny.gov.

Sincerely,

Danielle Miles, EIT
Assistant Engineer

ec: Jon Fox, ERM
Tim Daniluk, ERM
Stephen Mirabello, ERM
Ernie Rossano, ERM
Leslie Connolly, HSE Law
Frank Sowers, NYSDEC
Dave Pratt, NYSDEC
Michael Cruden, NYSDEC
Dudley Loew, NYSDEC
Renata Ockerby, NYSDEC
Justin Deming, NYSDEC