NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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February 14, 2019

Arno Bebernitz
GW Lisk Company Inc.
2 South Street
Clifton Springs, NY 14432

Subject: **Draft Final Revised Soil Vapor Intrusion Interim Remedial Measures Work Plan, February 2019**
G.W. Lisk NYSDEC Site No. C835026
Clifton Springs (V), Ontario County

Dear Mr. Bebernitz:

The New York State Departments of Environmental Conservation (NYSDEC) and Health (NYSDOH) collectively referred to as the Departments, have reviewed the "Draft Final Revised Soil Vapor Intrusion Interim Remedial Measures Work Plan," (IRM WP) completed February 2019 for the G.W. Lisk site in the Town of Clifton Springs, Ontario County. The Departments have determined that the IRM WP, with the following comment, substantially addresses the requirements of the Brownfield Cleanup Agreement (BCA):

- The completion dates in the schedule are actual, not estimated and are an enforceable part of the BCA.

With the understanding that the above comment is agreed to, the IRM WP is hereby approved. By March 1, 2019 and before work begins, please distribute final copies as follows:

- Danielle Miles (NYSDEC – Avon, 1 bound hard copy);
- Renata Ockerby (NYSDOH – Albany, electronic file/CD);
- Document Repository (Clifton Springs Public Library – 4 Railroad Ave, hard copy).

If you have questions or concerns, please contact me at (585) 226-5349 or danielle.miles@dec.ny.gov.

Sincerely,

Danielle Miles, EIT
Environmental Engineer

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Jon Fox, ERM
Stephen Mirabello, ERM
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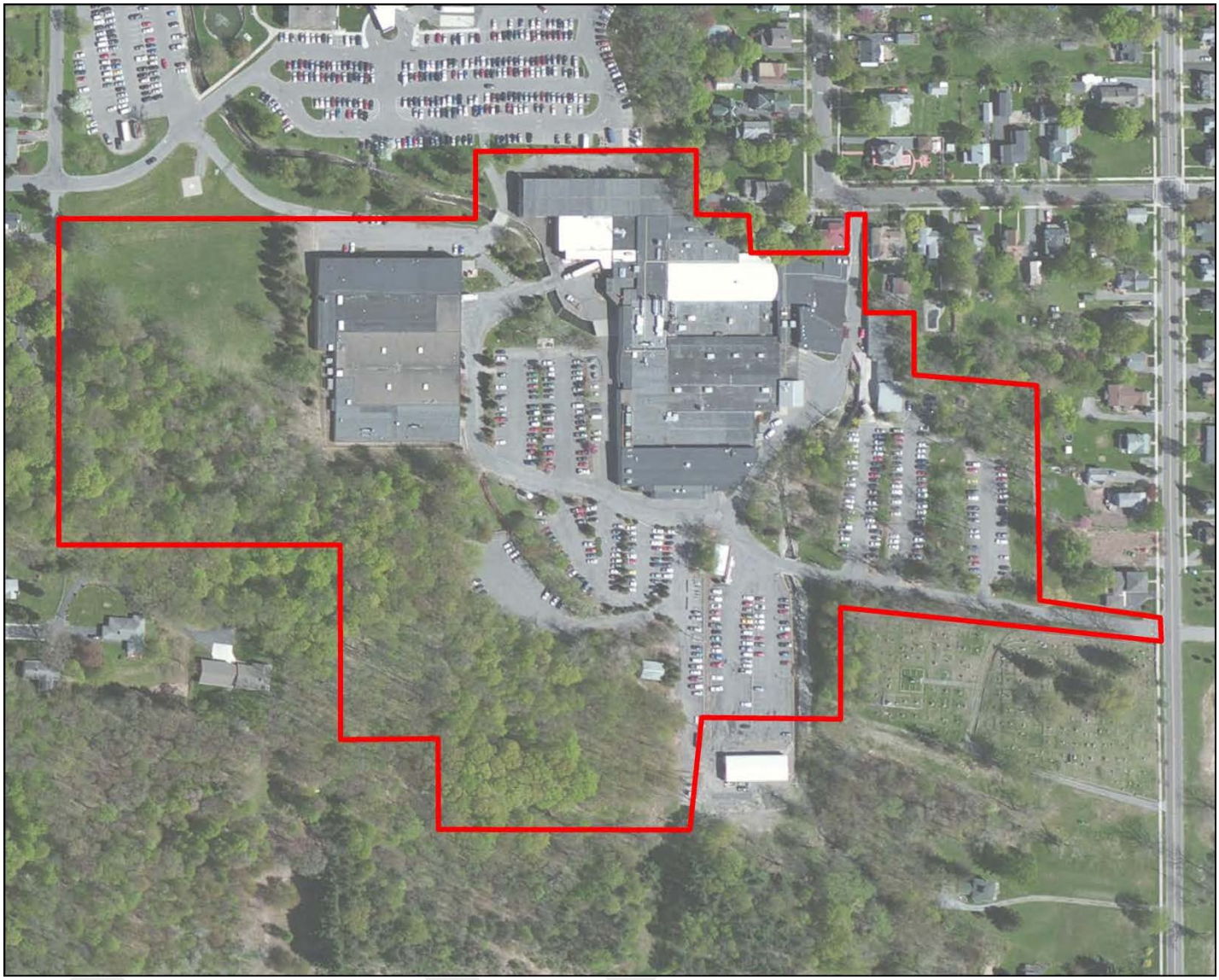

G.W. Lisk Company, Inc.

Draft Final Revised Soil Vapor Intrusion Interim Remedial Measure Work Plan

G.W. Lisk Facility – 2 South Street
Village of Clifton Springs, Ontario County, New York

February 2019

ERM Consulting & Engineering, Inc.
www.erm.com

Draft Final Revised Soil Vapor Intrusion Interim Remedial Measure Work Plan

G.W. Lisk Facility – 2 South Street
Village of Clifton Springs, Ontario County, New York

February 2019

Prepared for:

G.W. Lisk Company, Inc.

Prepared by:
ERM Consulting & Engineering, Inc.
www.erm.com

I, Stephen A. Mirabello, certify that I am currently a NYS registered professional engineer and that this Revised Soil Vapor Intrusion Interim Remedial Measure 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).

Stephen A. Mirabello, P.E.
ERM Consulting & Engineering, Inc.

Date: 2-5-2019

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ACRONYMS AND ABBREVIATIONS

AGI	Amplified Geochemical Imaging, LLC.
AOPC	Area of Potential Concern
ASP	Analytical Services Protocol
AST	Aboveground Storage Tank
BCP	Brownfield Cleanup Program
bgs	below ground surface
CCR	Construction Completion Report
CVOC	Chlorinated Volatile Organic Compound
DCE	Dichloroethene
DER	Division of Environmental Remediation
DSNY	Dig Safely New York
DTW	Depth to Water
DUSR	Data Usability Summary Report
EDS	Electronic Data Summary
EIMS	Electronic Information Management System
ERM	ERM Consulting & Engineering, Inc.
ft	feet
HASP	Health and Safety Plan
IDW	Investigation Derived Waste
IRM	Interim Remedial Measure
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
OSHA	Occupational Safety and Health Administration
PARCC	Precision, Accuracy, Reproducibility, Completeness, and Comparability
PCE	Tetrachloroethene
PPE	Personal Protective Equipment
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
SC	Site Characterization
SCGs	Standards, Criteria, and Guidance
SMP	Site Management Plan
SVI	Soil Vapor Intrusion
TCA	Trichloroethane
TCE	Trichloroethene
$\mu g/m^3$	Micrograms-per-cubic meter
VOC	Volatile Organic Compound

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 1-1. The Site was initially classified as a "P" (potential) site by NYSDEC and identified as Site Number 835026. G.W. Lisk has submitted an application to NYSDEC for entry into the Brownfield Cleanup Program (BCP) and the application has been determined by NYSDEC to be complete. The application was released for public review and comment on 21 November 2018. The Site is currently identified as NYSDEC BCP Site Number C835026.

1.1 PURPOSE AND OBJECTIVES

An Interim Remedial Measure (IRM) was requested by NYSDEC and the New York State Department of Health (NYSDOH) to address potential soil vapor intrusion (SVI) in portions of the facility based on initial results of the SC. An SVI IRM Work Plan was prepared and submitted to NYSDEC and NYSDOH for review. The Final SVI IRM Work Plan dated May 2018 was approved by NYSDEC and NYSDOH in correspondence dated 24 May 2018.

As outlined in the approved SVI IRM Work Plan, additional pre-design characterization sampling of sub-slab soil vapor and indoor air was conducted in August and October 2018 to evaluate and confirm the proposed extent of mitigation. This Revised SVI IRM Work Plan presents the results of the pre-design characterization sampling and analysis effort and proposes an expanded area for mitigation based on those results. It also presents a modified sealant product for use in sealing operations based on recent input from potential mitigation contractors.

This Revised SVI IRM Work Plan addresses required elements for a Remedial Action Work Plan established within Section 5.3 of the NYSDEC's Division of Environmental Remediation (DER) guidance manual DER-10 entitled "Technical Guidance for Site Investigation and Remediation" (NYSDEC, 2010). The objective of the SVI IRM is to minimize the potential for SVI via mitigation of volatile organic

compounds (VOCs) that are present in sub-slab soil vapor at the Site at concentrations above applicable standards, criteria, and guidance (SCGs).

The current use and contemplated future use of the Site is Industrial.

1.1.1 Project Organization

The Site is currently owned by Raer Corporation and operated by G.W. Lisk. The NYSDEC and NYSDOH will evaluate the proposed IRM to verify that the work is performed in accordance with the approved SVI IRM Work Plan. 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 Applicable Standards, Criteria, and Guidance

The following standards and criteria apply to the SVI IRM.

- 6 NYCRR Part 257 – Air Quality Standards
- 6 NYCRR Part 375 - Environmental Remediation Programs
- 29 CFR 1910.120 – OSHA Hazardous Waste Operations and Emergency Response

The following guidance applies to the SVI IRM.

- DER-10 – Technical Guidance for Site Investigation and Remediation (May 2010)
- New York State Department of Health (NYSDOH) – Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, 2006), including recent updates to Decision Matrices dated May 2017 (NYSDOH, 2017)

2.0 SITE INVESTIGATIONS

The Site is located in the south-central portion of the Village of Clifton Springs in Ontario County, New York. Figure 2-1 shows the location of the Site and adjacent areas.

Figure 2-2 shows the layout and land use of the Site including the parcel boundary and surrounding areas. The parcel currently contains approximately 26.654 acres. The Site is located within a mixed industrial, commercial, and residential use area. 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 1910. 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, 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 2-2). 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 SC Work Plan identified several areas of potential concern (AOPCs) at the Site. AOPCs that are potentially relevant to this SVI IRM are summarized below.

- AOPC-4: Former Outfall 011- Plating and solvent wastes were historically discharged for a period of time to a former septic tank at this location. The former septic tank was constructed of concrete and had an associated leach field. The location and design/construction of the leach field is unknown. The former septic tank was removed in 1982 during building expansion activities.
- AOPC-5: Former Outfall 012 - Plating and solvent wastes were historically discharged for a period of time to a former septic tank at this location. The former septic tank was constructed of concrete and had an associated leach field. The location and design/construction of the leach field is unknown. The former septic tank was removed in 1987 during building expansion activities.

- AOPC-8: Former TCE Degreaser with Sump - A former degreaser that utilized TCE was located in this area. The TCE was stored in a former nearby AST designated B4CT1. According to historical information review, no spills or leaks were associated with this degreaser. However, a sump that penetrates the thickness of floor in this area is present at this location, which may have provided a conduit for the release of TCE vapors or liquids to the subsurface.

2.1 SITE CHARACTERIZATION

2.1.1 Geologic Setting

2.1.1.1 Soils

The Site is located within the Erie-Ontario Lowlands physiographic province (Bloom, 1978). The Site is located directly on the Onondaga Escarpment where it intersects Sulphur Creek. 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 1-1 suggests that regional groundwater flow in the mapped area may be north to northeast towards the Canandaigua Outlet.

Native soil at the Site is predominantly of Palmyra gravelly loam, derived from glacial outwash deposits or bedrock (Caldwell, 1988; USDA, 2017). The glacial outwash deposits consist predominantly of gravel with sand and are generally thin or not present in the southeastern portion of the Site and increase in thickness towards the north and west. Near surface soils underlying the facility generally consist of clean fill, including fine sand and gravel. Total overburden thickness in the area is generally less than 20 feet, with overburden thinning towards the southeast to thicknesses of generally less than 3 feet.

Bedrock at the Site consists of the Middle Devonian Onondaga Limestone, which consists predominantly of gray, fine-grained limestone that is locally cherty (Rickard and Fisher, 1970). Depth to bedrock in the vicinity of the Site is typically 2 to 21 feet below ground surface (bgs).

2.1.1.2 *Groundwater*

Groundwater at the Site is typically first encountered in the overburden. Based on measurements in monitoring wells installed during the SC, groundwater was generally encountered at depths ranging from approximately 13 to 22 feet below ground (or floor) surface (bgs.). Depth to groundwater generally increases with increasing overburden thickness.

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. Measured groundwater levels in bedrock monitoring wells are generally slightly lower than in adjacent overburden wells.

2.1.2 *Site Characterization Soil Vapor – Sub Slab and Indoor Air Sampling*

The soil vapor sampling activities completed in accordance with the NYSDEC-approved SC Work Plan (ERM, 2016) are summarized below.

In May 2016, ERM conducted passive soil vapor sampling on an approximate 100-foot sampling grid, supplemented by additional soil vapor points as shown in Figure 2-3. These data were used as a screening technique to identify the presence of potential source areas for VOCs. Passive soil vapor samplers provided by Amplified Geochemical Imaging, LLC of Newark, Delaware (AGI; formerly W.L. Gore and Associates) were installed in each borehole using insertion rods and the borehole backfilled with glass beads or coarse sand. Boreholes were sealed near the surface using a cork or a hydrated bentonite seal. The passive samplers were left in the boreholes for 7 to 10 days and then collected. The samplers were transported to AGI for VOC analysis by thermal desorption/gas chromatography/mass selective detection following United States Environmental Protection Agency (USEPA) Method 8260C quality assurance (QA)/quality control (QC) as appropriate.

In May 2017, ERM performed SVI sampling at the Site. SVI sampling points were installed using an electric hammer drill to a depth of approximately 2 to 3 feet. Stainless steel Cox Colvin Vapor Pins™ were installed and sampled using 24-hour Summa canisters. Upon completion, the Vapor Pins™ were removed and the sampling point was sealed using Quikrete concrete-patching compound.

Five VOCs including trichloroethene (TCE), 1,1-Dichloroethene (DCE), cis-1,2-DCE, 1,1,1-Trichloroethane (TCA), and Tetrachloroethene (PCE) were detected in one or more locations at concentrations above selected action levels in the NYSDOH's SVI guidance document (NYSDOH, 2006). TCE and 1,1,1-TCA were detected at maximum concentrations in soil vapor of 90,300 micrograms per cubic meter (µg/m^3) and 11,000 µg/m^3, respectively. The highest concentrations of TCE and 1,1,1-TCA were detected in sub-slab samples. There were also detections of TCE in indoor air samples with a maximum concentration of 7.42 µg/m^3. Results are provided in Table 2-1.

Following approval of the May 2018 SVI IRM Work Plan (ERM, 2018), ERM performed SVI sampling at the Site in August 2018. SVI sampling points were installed through the concrete slab using an electric hammer drill. Stainless steel Cox Colvin Vapor Pins™ were installed and sampled using Summa canisters with one-hour flow controllers.

The results of the August 2018 sampling were presented to NYSDEC and NYSDOH at a meeting on 6 September 2018. As agreed during the meeting, ERM performed additional SVI sampling at the Site in October 2018 to further define the area proposed for mitigation. SVI sampling points were installed in the concrete slab using an electric hammer drill. Stainless steel Cox Colvin Vapor Pins™ were installed and sampled using 24-hour Summa canisters.

2.2 BUILDING CHEMICAL INVENTORY

Following the completion of the co-located SVI sampling, a supplemental Building Chemical Inventory was completed. Additional chemicals used as a part of regular manufacturing procedures were identified during visits for SC borings and well installations, structural inspections, and through conversations with Site operations personnel.

The updated Building Chemical Inventory is provided in Appendix A. The VOCs methylene chloride and 1,2-DCE have been confirmed as components of one or more industrial products that are currently being used within the facility as a part of routine production operations.

2.3 PREFERENTIAL PATHWAY INSPECTION

An inspection of the facility was conducted by ERM's professional engineer on 2 November 2017. The purpose of the inspection was to

document the current condition of the facility identify potential preferential pathways to vapor migration both above and below grade.

At grade, the inspection focused on controls to minimize the presence of vapor contaminants in the work area. Observations were made about the use and storage practices of potential background vapor sources. This assessment included the potential for vapor to actively or passively migrate between rooms or buildings.

The at-grade inspection also included a visual assessment of the building slabs. The potential for vapor migration through floor cracks, gaps between the wall and floor slab, or openings created for facility operations was documented. Additionally, the overall condition and type of floor coverings was documented.

In general, the facility has either a bare concrete floor with multi-layered epoxy coating, both with and without a textured grip surface. Cracks were observable in the bare concrete floor in several buildings. There were several instances of saw cuts or openings in the floor from past facility improvements or modifications to move and/or stage manufacturing equipment. Several penetrations in the floor to accommodate sub-surface access pits or utility sumps were also observed.

The presence of building foundations and footers between buildings was documented during the facility inspection and guided the sub-surface assessment. Following the at-grade inspection, ERM was provided with typical construction drawings for the foundations and footers across the facility. The drawings indicated that each building had a standard construction of continuous masonry footers that extend at least four feet below grade. These footers could serve as potential barriers for vapor migration between buildings from shallow contamination above the water table.

A photo log of the inspection is available as Appendix B.

3.0 PRE-DESIGN CHARCTERIZATION AND POST-MIITGATION MONITORING ACTIVITIES

3.1 PRE-DESIGN SUB-SLAB VAPOR SAMPLING EVENTS

As described in the May 2018 SVI IRM Work Plan (ERM, 2018), additional sampling was performed to evaluate the presence of sub-slab vapors that may require mitigation. The purpose of the supplemental pre-design samples was to evaluate if the presence of sub-slab vapors may be isolated to specific buildings as a result of building foundations. The pre-characterization sample locations were chosen in buildings adjacent to those with potentially significant detections from the SC, as it was presumed from the pathway inspection that building foundations could provide a barrier to sub-grade vapor migration and could thereby limit the scope of the prescribed mitigation measures and monitoring.

ERM performed SVI sampling at the Site in August 2018 at sub-slab locations SS-AOPC5, SS-Building-4A (chemical waste storage room), SS-Building 4C, SS-Building 4D, SS-Building 7 (actually in Building 6), SS-Building 7B-1, and SS-Building 7B-2. Sample locations are shown on Figure 3-1.

Sub-slab vapor sampling points were installed using an electric hammer drill through the concrete slab and in accordance with NYSDOH SVI guidance Section 2.7.2 (NYSDOH, 2006). Stainless steel Cox Colvin Vapor Pins™ were installed, and surface sealing of vapor points was completed with non-VOC materials. Following purging of three volumes of air from the sample point & tubing, samples were collected in Summa canisters over a 1-hour duration and analyzed for VOCs by USEPA Method TO-15. Quality assurance and quality control (QA/QC) procedures outlined in the Quality Assurance Project Plan (QAPP; see Appendix C) were following during sampling events. The results of data validation are presented in Data Usability Summary Reports (Appendix D).

Five VOCs including TCE, cis-1,2-DCE, TCA, and PCE were detected in sub-slab soil vapor at one or more locations at concentrations above potential action levels in the NYSDOH's SVI guidance document (NYSDOH, 2006). TCE and 1,1,1-TCA were detected at maximum concentrations in soil vapor of 143,000 µg/m^3 and 13,400 µg/m^3, respectively. Results are summarized in Table 2-1.

G.W. Lisk and ERM met with the NYSDEC and the NYSDOH on 6 September 2018 to present and discuss the results of the August 2018 sampling. Review of these data indicates that the extent of VOCs in the

sub-slab was laterally more extensive than shown in the May 2018 SVI IRM Work Plan (ERM, 2018). Specifically, it was agreed that mitigation would be performed in Buildings 4C, 7B and the Vacuum Furnace Room (i.e., the location of AOPC-05). Additionally, it was agreed that further indoor air sampling would be helpful to evaluate a potential need for mitigation at locations Building 4A and Building4D. Further sub-slab sampling was also to be performed at two locations, specifically Building 4M and Building 5.

On 7 September 2018, ERM conducted a Site walk with potential mitigation contractors at the Site. Following the Site walk, contractors submitted questions regarding the Site walk and assumed scope of work. Some vendors expressed concern with the requirement to utilize zero-VOC products as stipulated in the May 2018 SVI IRM Work Plan. While these products are available, the contractors were not confident in their efficacy and requested permission to use industry standard products with low VOC content. On 8 October 2018, ERM held a conference call with NYSDEC and NYSDOH to discuss the implementation of alternate sealant products. It was agreed on the call that low-VOC and CVOC-free products could be acceptable but that manufacturer information would need to be provided in a revised work plan. Specifications for the proposed sealant are provided in Appendix E.

In October 2018, ERM performed sub-slab soil vapor sampling at locations SS-Building 4M and SS-Building-5, and indoor air sampling at SS-Building 4A, SS-Building 4D, SS-Building 4M, and SS-Building-5 (see Figure 3-1). Sub-slab samples were installed and collected using the same methods as described for August 2018. Indoor air samples were collected over a 24-hour period in 6-liter Summa canisters, consistent with previous sampling events.

Analytical results for all pre-design characterization samples are summarized in Table 2-1 and shown in Figure 3-1. Review of these data indicates that pre-design characterization sub-slab samples at SS-AOPC-5, SS-Bldg-4C, SS-Bldg-7, SS-Bldg-7B-1, and SS-Bldg-7B2 had VOC concentrations at above potential action levels (Matrix A compound thresholds, see Figure 3-1) for mitigation contained in the NYSDOH's updated SVI Decision Matrices (NYSDOH, 2017). Sample results from locations SS-Bldg-5, SS-Bldg-6, and SS-Bldg-7B were greater than Matrix B compound thresholds, as shown in Figure 3-1. TCE, a Matrix A compound, was detected in sub-slab soil vapor at 61.8 micrograms per cubic meter ($\mu g/m^3$) at location SS-Bldg-5 compared to the potential action level 60 $\mu g/m^3$. The corresponding indoor air concentration in Building 5 is 0.66 $\mu g/m^3$. Based on these results, ERM recommends collection of additional data (monitoring) at this location and that

mitigation not be performed in Building 5 at this time. Regular monitoring at this location will be performed as part of the remedy to provided additional data that can be used to evaluate whether or not mitigation may be appropriate in Building 5 in the future.

3.2 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 member-company utilities in areas proposed for subsurface intrusive investigation. G.W. Lisk personnel knowledgeable about the location, construction, and status of former and current subsurface utilities will identify any underground utilities associated with current or past plant operations. Additionally, an independent underground utility locating service will be contracted by ERM to evaluate and clear proposed soil boring locations prior to the commencement of subsurface intrusive activities. A minimum 10-foot diameter around each planned drilling location will be scanned and cleared of subsurface utilities by ERM's utility location subcontractor prior to the initiation of drilling.

Proposed sampling locations may have to be adjusted in the field based on the results of the subsurface clearance effort to facilitate the health and safety of personnel, prevent property damage, or to avoid or minimize interference with manufacturing and production operations.

3.3 POST-MITIGATION MONITORING

Following the implementation of mitigation measures described below in Section 4.5, paired sub-slab vapor and indoor air samples will by collected at the locations indicated on Figure 3-2.

A sampling and analysis summary including environmental media, number of samples, laboratory analytical parameters, and methods is presented in Table 3-1. This table does not include quality assurance QA/QC samples referenced in the IRM Work Plan QAPP.

Table 3-1
Monitoring Sampling and Analysis Plan

Environmental Media	Number of Samples	Laboratory Analytical Parameters
Sub-Slab Vapor	11	VOCs by TO-15
Indoor Air	11	VOCs by TO-15

Indoor air sampling will be performed in accordance with NYSDOH guidance Section 2.7.3. Samples will be collected in Summa canisters over a 24-hr duration and analyzed for VOCs by USEPA Method TO-15. Specific procedures are detailed in the IRM QAPP (Appendix C).

3.4 SAMPLE ANALYSES

The laboratory analysis of samples will be performed by a NYSDOH-approved environmental laboratory using analytical methods consistent with the NYSDEC's Analytical Services Protocol (ASP). Laboratory analytical reports will contain ASP Category B deliverables to facilitate data validation and usability review.

Sub-slab vapor and indoor air samples collected as part of the IRM will be analyzed for VOCs using USEPA Method TO-15. The following VOCs will be compared to the NYSDOH's current SVI Decision Matrices:

- Carbon Tetrachloride
- 1,1-DCE
- cis-1,2-DCE
- PCE
- 1,1,1-TCA
- TCE
- Vinyl chloride

3.5 DATA USABILITY

Data usability will be evaluated following procedures for the preparation of a Data Usability Summary Report (DUSR) for samples collected during the IRM. The usability evaluation will be performed 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 3.13.

4.0 SVI INTERIM REMEDY AND TECHNOLOGIES

4.1 NYSDEC/NYSDOH CRITERIA

Sub-slab and indoor air criteria and procedures are discussed in NYSDEC's DER-10 guidance document and NYSDOH's SVI Guidance (NYSDOH, 2006), including the Decision Matrices which were most recently revised in May 2017 (NYSDOH, 2017). The key guide for determining appropriate response actions can be found the Soil Vapor/Indoor Air Decision Matrices. As shown in Table 2-1, there were sub-slab detections for 1,1 DCE, cis-1,2 DCE, TCE, 1,1,1-TCA, and PCE which would apply to either Matrices A or B. Matrix A is used to determine appropriate action which applies to TCE, cis-1,2 DCE and 1,1 DCE. At eight locations the sub-slab concentrations are greater than 60 $\mu g/m^3$ and in general, the indicated response in the Decision Matrices is to mitigate. ERM noted previously that one exception is in Building 5, where the proposed step is regular monitoring and assessment.

4.2 OBJECTIVES/PERFORMANCE STANDARDS

The objective of the SVI IRM is to reduce the potential for SVI via mitigation of VOCs that are present in sub-slab soil vapor at the Site at concentrations above applicable standards, criteria, and guidance (SCGs). The effectiveness of the IRM will be evaluated by the concentration of VOCs in indoor air monitoring samples relative to applicable SCGs. The target concentration in indoor air is below 1 $\mu g/m^3$ for TCE, cis-1,2-DCE and 1,1-DCE and is below 10 $\mu g/m^3$ 1,1,1-TCA and PCE.

4.3 PERMITS

The implementation of all mitigation measures will be performed in accordance with technical requirements of applicable local construction codes. The local authority having jurisdiction (Village of Clifton Springs) will be consulted and local permits will be obtained if necessary. It is anticipated that state or local permits will not be required for the currently-contemplated scope of work described below in Section 4.5.

4.4 SITE ACCESS/PREPARATION

Access to the Site will be coordinated with GW Lisk management and arrangements will be made at least two weeks prior to mobilization.

Equipment, supplies, and subcontractors including the project laboratory and SVI mitigation contractor will be procured. NYSDEC will be notified at least one week prior to the initiation of mitigation work at the Site.

4.5 IRM IMPLEMENTATION

The proposed IRM will utilize multiple approaches consisting of both engineering and institutional control to achieve the recommended mitigation. The effectiveness of the IRM will be assessed though monitoring immediately after implementation and regular intervals thereafter.

4.5.1 Reduce/Remove VOC Products, Modify Air Flow, and Update SOPs

As indicated in Section 2.3, a revised building chemical inventory has been completed (Appendix A) which includes products used and stored at the facility that may be contributing to VOC detections in previous indoor air samples. GW Lisk will proactively reinforce the vapor controls in chemical storage areas to isolate storage spaces from the rest of the facility. These measures include sealing potential openings in the walls and doors of the flammable storage room and overall chemical storage room. The ventilation systems for these two rooms are isolated, discharge directly to the atmosphere, and are not shared with other buildings. Additionally, the isolated ventilation system for these respective rooms will be checked to confirm proper functionality.

Alternate products with no or lower VOC content shall be sought and implemented as practicable and appropriate for the manufacturing processes. GW Lisk's standard operating procedures (SOPs) will be updated to prohibit or restrict the use of products containing VOCs of potential concern. Similarly, the existing inventory of these products is to be removed from the facility to the extent practicable based on facility production and operational needs.

Based on evaluation of TCE concentrations in indoor air samples collected during the SC, G.W. Lisk agreed to perform the above-referenced tasks to evaluate potential sources of TCE and to further minimize the potential for TCE to enter the building's indoor air from below the building slab. Specifically, G.W. Lisk increased the air flow within Buildings 6 and 7 using the existing heating and cooling systems.

GW Lisk will complete implementation of the above-referenced tasks prior to performance of post-mitigation indoor air sampling (see Section 4.5.3).

4.5.2 Seal Preferential Pathways

As indicated in Section 2.3, several potential preferential pathways exist throughout the facility in the form of penetrations in the building slab. At a minimum, preferential pathways will be sealed for the buildings or locations shown on Figure 3-3.

Floor Cracks: cracks and cuts in the middle of the slab are to be sealed with a low-VOC and zero CVOC watertight product that will prevent vapor migration and is compatible with the existing floor coating.

Perimeter gaps are to be sealed with a void filling low-VOC and zero CVOC watertight product up to the floor grade. The edge with walls will also be coated with a low-VOC and zero CVOC product to provide continuous coverage from the floor to at least three inches up the wall. The secondary sealer shall be compatible with the existing floor coating.

Miscellaneous slab penetrations include gaps at mechanical equipment, utility pits, and mechanical support penetrations.

- Gaps at mechanical equipment are to be sealed similar to perimeter gaps. However, the secondary sealer only coats the floor.
- Utility pits open to the subsurface soil are to be sealed with a self-leveling low-VOC and zero CVOC product and cracks in walls are to be sealed similar to floor cracks.
- Mechanical pipe supports are to be sealed similar to floor cracks.

Across the eight buildings included in this IRM, there is estimated to be up to:

- 600 linear feet of floor cracks
- 200 linear feet of perimeter cracks
- 80 feet of mechanical gaps
- 10 square feet of utility pit bottoms

The actual quantities of each type of potential pathway that are sealed will be tracked during the IRM and summarized in the CCR. All sealing products are below the New York VOC product limits and do not contain CVOCs. The proposed products planned to be utilized with manufacturer information sheets are included in Appendix E

4.5.3 *Monitoring*

As shown on Figure 3-3, selected sub-slab/indoor air sample location pairs will be monitored after IRM implementation and on an annual basis thereafter to assess the performance of the IRM. Monitoring efforts after the initial round following the IRM implementation will be detailed in a focused Site Management Plan (SMP).

4.5.4 *Waste Management*

Wastes consisting of sub-slab soil cuttings and concrete will be disposed within the borehole of origin up to a depth within 12-inches of the surface unless non-aqueous phase liquids, sheen, unusual odor, discoloration, or other evidence of gross contamination is observed. Any soil cuttings or concrete exhibiting visual, olfactory, or PID field screening evidence of potential contamination will be containerized into steel 55-gallon drums for subsequent waste characterization sampling and analysis, waste determination by the generator, and disposal.

Fluids from cleaning of sampling equipment will be containerized into steel 55-gallon drums for subsequent waste characterization sampling, analysis, waste determination, and disposal.

All drums will be labeled with generator name, address, contents, container number, waste determination status, and accumulation start date. The waste containers will be moved to a designated, secure on-Site staging area until disposal can be arranged.

On-Site disposal of non-hazardous wastes may be considered if appropriate subsequent to the receipt and review of analytical results and completion of the waste profiling and determination process. If on-site disposal of non-hazardous wastes is contemplated, the NYSDEC will be contacted for approval prior to the disposal of the material.

4.5.5 *Sample Locations and Elevations*

Final sample locations will be measured using GPS equipment, an automatic level, and/or measuring tape. Relative elevations of sampling or other locations may be measured using an automatic level referenced to an arbitrary Site datum. The location and relative elevation of other selected site features may also be measured if deemed useful during the IRM.

4.5.6 Site Restoration

Work areas will be restored to their original condition upon completion of work, with the exception of permanent vapor monitoring points. These points will be flush-mounted, properly sealed, and are generally less than two inches in diameter. They are not anticipated to interfere with production operations.

4.5.7 Institutional Controls/Site Management Plan

In parallel with IRM pathway sealing described in Section 4.5.1, G.W. Lisk will implement internal procedures to prohibit penetration of the slab in areas indicated in the final IRM Work Plan. If penetration cannot be avoided due to site operational, maintenance, or construction considerations, additional procedures will be implemented to minimize the potential for soil vapor intrusion. The procedures to be implemented for any floor penetrations and for maintenance of the IRM will be documented in a focused SMP. The SMP will be prepared in accordance with Section 6.2 of DER-10. A draft of the SMP will be submitted to NYSDEC for review prior to submission of the Draft IRM Construction Completion Report (CCR), and the approved SMP will be appended to the CCR.

4.6 IRM REPORTING

Upon completion of the activities presented in this Revised SVI IRM Work Plan, and submittal/approval of a focused SMP, a Draft CCR will be prepared that conforms to the requirements of DER-10 Section 5.8, and will be based on the most recent template document available at the Department's website. The CCR will include the following items:

1. Signed certification statement following the requirements of DER-10 Section 1.15;

2. Synopsis of all work performed, extent of waste removed from the Site, problems encountered, and changes from the original work plan;

3. Results of all sampling and analyses from the remedial action including QA/QC data and chain-of-custody records;

4. Lists of all laboratories, transporters, and disposal or recycling firms used during the IRM;

5. Copies of all manifests and bills of lading generated in connection with the transportation of materials off-Site;

6. As-built drawings showing final monitoring point locations;

7. Summary of restoration activities;

8. Identification of institutional controls required, including mechanisms to implement, maintain, monitor and enforce such controls;

9. Reference to the previously-submitted and approved SMP.

The CCR will be submitted electronically in accordance with NYSDEC guidance for submittal of electronic documents (DER-10).

With the exception of waste characterization sampling results, ERM will submit the chemistry data collected as part of the remedial action as Electronic Data Deliverables (EDDs) in EQuIS format in accordance with NYSDEC guidance for data submission. The EDD will be e-mailed to the NYSDEC's Electronic Information Management System (EIMS) Administrator and the NYSDEC Project Manager.

4.7 PERFORMANCE MONITORING

The NYSDEC initially requires an annual certification for any mitigation measure that includes an Engineering Control. Regular Site inspections and sampling will be conducted in accordance with the procedures detailed in the NYSDEC-approved SMP as described previously in this Work Plan.

5.0 ASSOCIATED DOCUMENTS

5.1 HEALTH AND SAFETY PLAN

A Site-specific Health and Safety Plan (HASP) is presented in Appendix F. 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 Occupational Safety and Health Administration (OSHA) requirements governing activities at hazardous waste sites and the requirements 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.

5.2 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 IRM along with QA/QC criteria. The QAPP will facilitate generation of data of acceptable precision, accuracy, reproducibility, completeness, and comparability (PARCC).

5.3 PERSONNEL AND QUALIFICATIONS

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

6.0 PROJECT SCHEDULE

An estimated proposed schedule for implementation of the IRM is presented in Table 6-1. The schedule is tentative and is subject to change based on site work schedule, estimated regulatory review times, and other considerations that may affect the final project schedule.

7.0 REFERENCES CITED

Bloom, A. L., 1978. Geomorphology: a systematic analysis of Late Cenozoic landforms. Prentice-Hall, Inc., Englewood Cliffs, pg. 19.

Cadwell, D. H., 1988. Surficial Geologic Map of New York- Finger Lakes Sheet. New York State Museum – Geological Survey, Map and Chart Series Number 40, Albany.

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NYSDOH, 2017. Soil Vapor / Indoor Air Decision Matrices Update. NYSDOH Center for Environmental Health, Bureau of Environmental Exposure Investigation, May 2017.

NYSDEC, 2017. Letter regarding Potential Soil Vapor Intrusion and IRM Work plan. NYSDEC Division of Environmental Remediation Region 8 to G.W. Lisk Company Inc., 2 October 2017

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Figures

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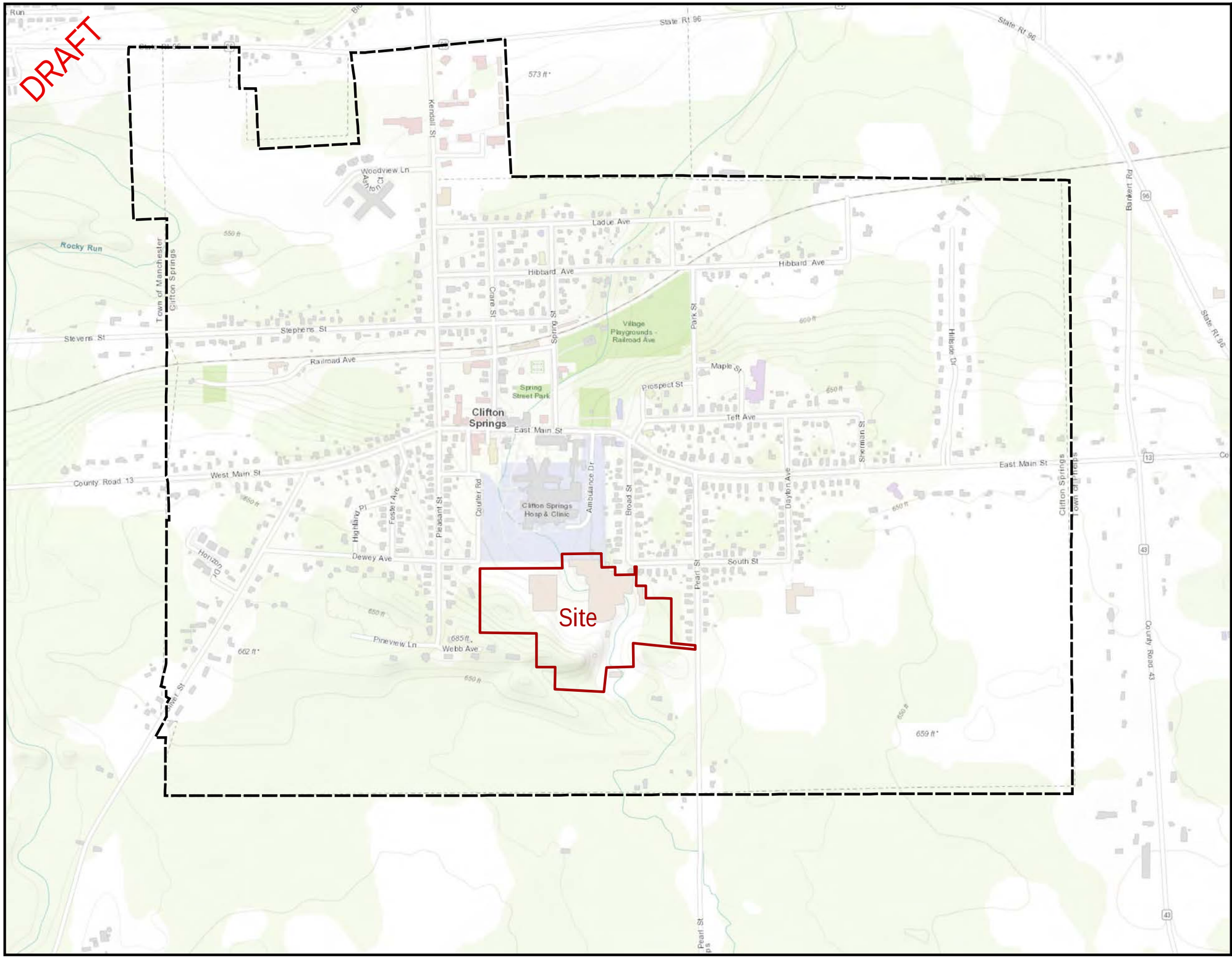

Legend

- Site Property Boundary
- Village of Clifton Springs

N

0 125 250 500 750 1,000

Feet

Figure 2-1: Site Location
G.W. Lisk Company, Inc.
Clifton Springs, NY

ERM

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Coulter Rd

Coulter Rd

Dewey Ave

Sulphur Creek

Broad St

South St

Sulphur Creek

Pearl St

Webb Ave

Legend

- Property Parcel Boundary
- Facility Outline
- Surface Stream
- Covered Stream

NOTES:

- Facility room outlines are approximate in location and converted from AutoCAD models.
- Aerial imagery was captured in 2015 by New York State.

N

0 25 50 100 150 200

Feet

Figure 2-2: Site Layout

G.W. Lisk Company, Inc.

Clifton Springs, NY

ERM

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AA-01
SV-01
SV-02
VI-02
SV-03
SV-04
SV-05
SV-26
VI-05
Steel Room
SV-08
SV-09
SV-10
Offices
SV-06
SV-07
SV-11
SV-12
SV-13
SV-14
VI-03
SV-15
Parts Assembly Industrial Products
Parts Assembly Valves
SV-18
SV-19
VI-04
SV-20
Cafe
VI-01
SV-16
SV-17
SV-21
SV-22
SV-23
SV-24
SV-25

Legend

- Ambient Air Sample Location
- Co-located Sub-Slab and Indoor Air Sample Location
- Passive Soil Vapor Sampling Location
- Facility Outline and Room Designations
- Parcel Boundary (Approximate)

NOTES:

1. Facility room outlines are approximate in location and converted from AutoCAD models.

N

0 12.5 25 50 75 100
Feet

Figure 2-3: Sample Locations and Facility Layout
G.W. Lisk
Clifton Springs, NY

ERM

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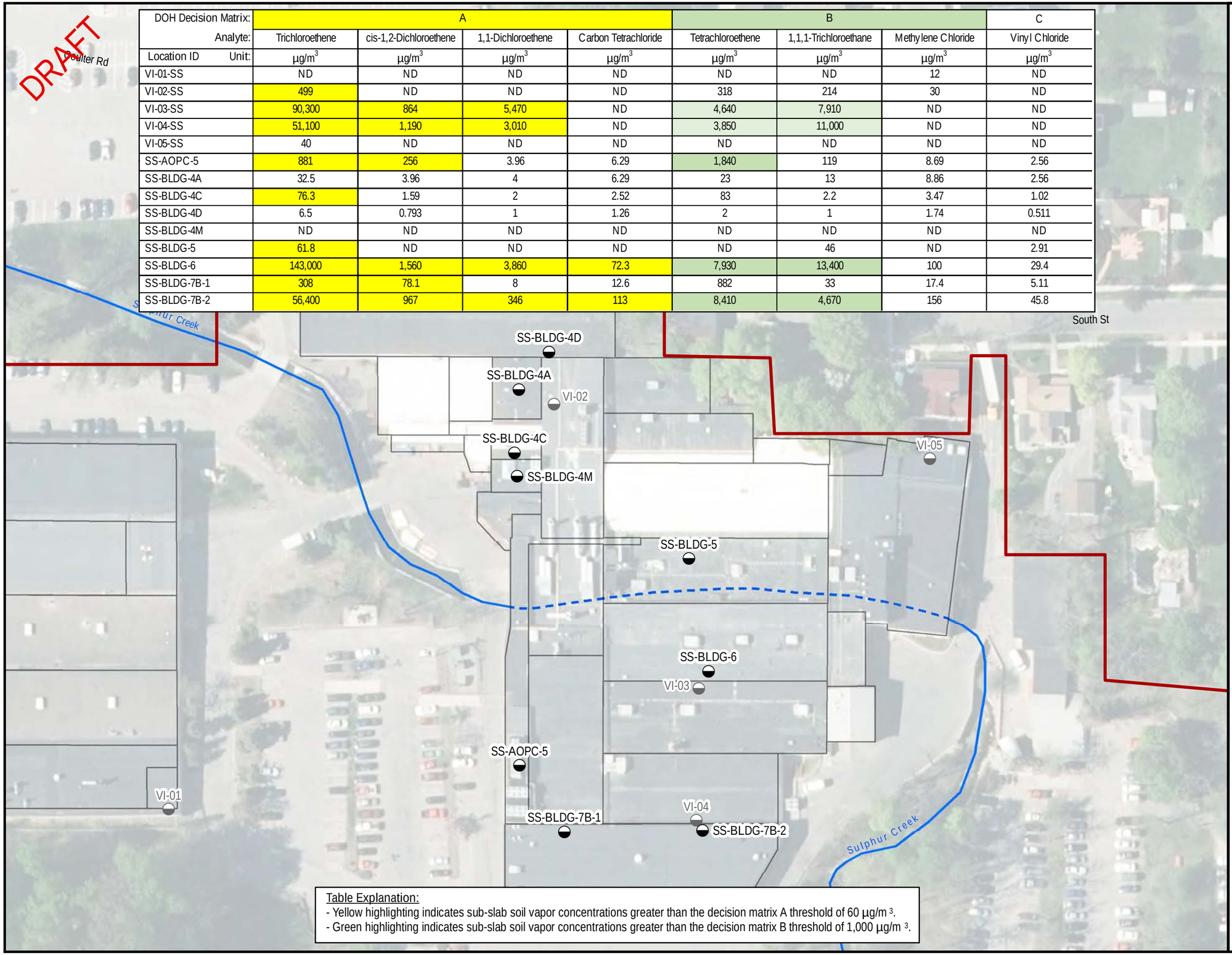
DOH Decision Matrix:	A				B			C
Analyte:	Trichloroethene	cis-1,2-Dichloroethene	1,1-Dichloroethene	Carbon Tetrachloride	Tetrachloroethene	1,1,1-Trichloroethane	Methylene Chloride	Vinyl Chloride
Location ID Unit:	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3	µg/m^3
VI-01-SS	ND	ND	ND	ND	ND	ND	12	ND
VI-02-SS	499	ND	ND	ND	318	214	30	ND
VI-03-SS	90,300	864	5,470	ND	4,640	7,910	ND	ND
VI-04-SS	51,100	1,190	3,010	ND	3,850	11,000	ND	ND
VI-05-SS	40	ND	ND	ND	ND	ND	ND	ND
SS-AOPC-5	881	256	3.96	6.29	1,840	119	8.69	2.56
SS-BLDG-4A	32.5	3.96	4	6.29	23	13	8.86	2.56
SS-BLDG-4C	76.3	1.59	2	2.52	83	2.2	3.47	1.02
SS-BLDG-4D	6.5	0.793	1	1.26	2	1	1.74	0.511
SS-BLDG-4M	ND	ND	ND	ND	ND	ND	ND	ND
SS-BLDG-5	61.8	ND	ND	ND	ND	46	ND	2.91
SS-BLDG-6	143,000	1,560	3,860	72.3	7,930	13,400	100	29.4
SS-BLDG-7B-1	308	78.1	8	12.6	882	33	17.4	5.11
SS-BLDG-7B-2	56,400	967	346	113	8,410	4,670	156	45.8



Legend

- Site Characterization Indoor Air/Sub-Slab Soil Vapor Location
- Pre-Design Indoor Air/Sub-Slab Soil Vapor Location
- Property Parcel Boundary
- Facility Outline
- Surface Stream
- Covered Stream

NOTES:
- SS = Sub-slab sample
- µg/m3 = microgram per cubic meter
- Soil vapor results are provided for compounds listed in the NYSDOH decision matrices dated May 2017.
- Facility room outlines are approximate in location and converted from AutoCAD models.
- Aerial imagery was captured in 2015 by New York State.

0 12.5 25 50 75 100
Feet

N

Table Explanation:
- Yellow highlighting indicates sub-slab soil vapor concentrations greater than the decision matrix A threshold of 60 µg/m^3.
- Green highlighting indicates sub-slab soil vapor concentrations greater than the decision matrix B threshold of 1,000 µg/m^3.

Figure 3-1: Sub-Slab Soil Vapor Sample Results
G.W. Lisk
2 South Street, Clifton Springs, NY

ERM

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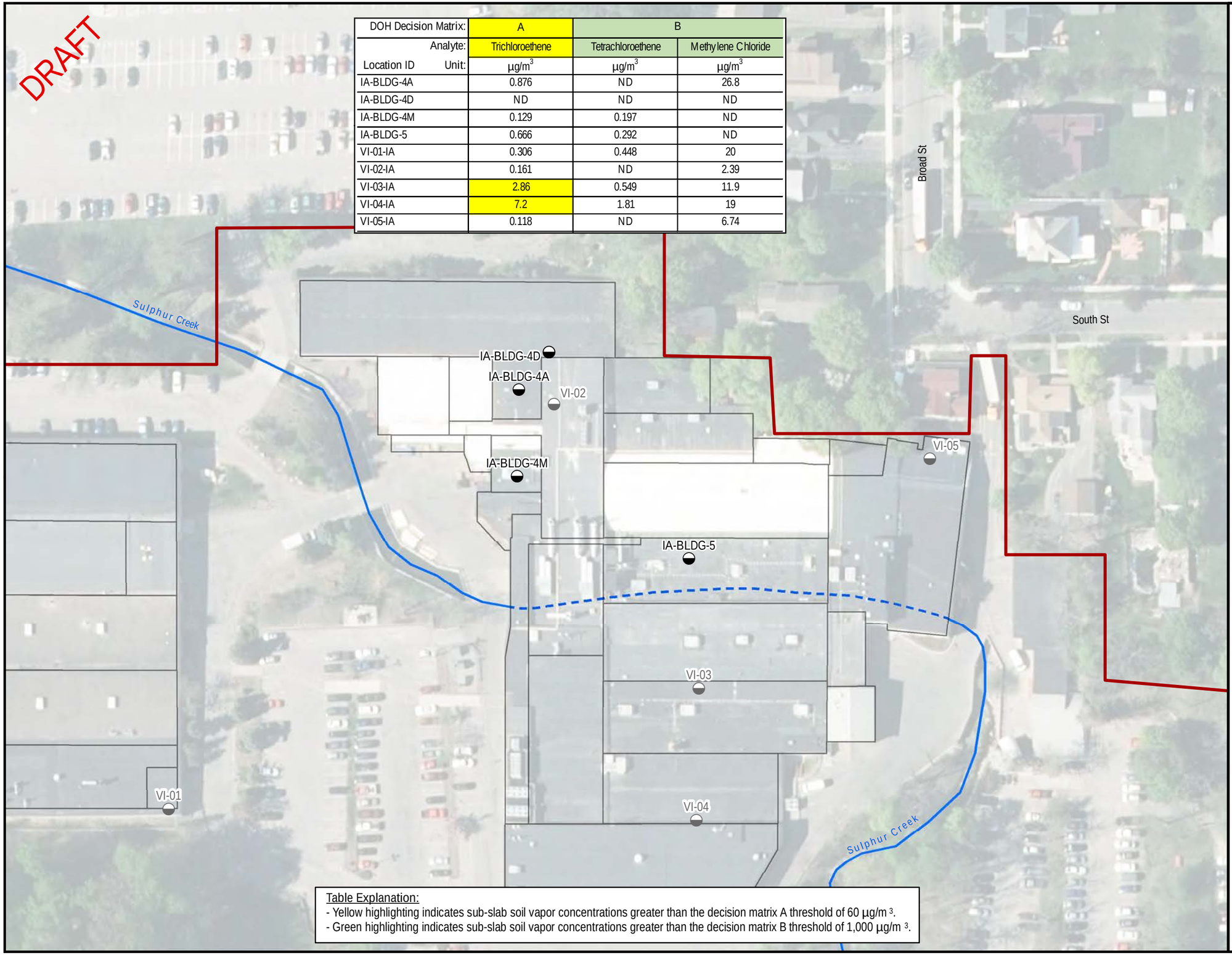
DOH Decision Matrix:	A	B	
Analyte:	Trichloroethene	Tetrachloroethene	Methylene Chloride
Location ID Unit:	µg/m^3	µg/m^3	µg/m^3
IA-BLDG-4A	0.876	ND	26.8
IA-BLDG-4D	ND	ND	ND
IA-BLDG-4M	0.129	0.197	ND
IA-BLDG-5	0.666	0.292	ND
VI-01-IA	0.306	0.448	20
VI-02-IA	0.161	ND	2.39
VI-03-IA	2.86	0.549	11.9
VI-04-IA	7.2	1.81	19
VI-05-IA	0.118	ND	6.74



Legend

- Site Characterization Indoor Air/Sub-Slab Soil Vapor Location
- Pre-Design Indoor Air/Sub-Slab Soil Vapor Location
- Property Parcel Boundary
- Facility Outline
- Surface Stream
- Covered Stream

NOTES:
- IA = Indoor air sample
- µg/m3 = microgram per cubic meter
- Results are provided for compounds listed in the NYSDOH decision matrices dated May 2017.
- Facility room outlines are approximate in location and converted from AutoCAD models.
- Aerial imagery was captured in 2015 by New York State.

N

0 12.5 25 50 75 100
Feet

Table Explanation:
- Yellow highlighting indicates sub-slab soil vapor concentrations greater than the decision matrix A threshold of 60 µg/m^3.
- Green highlighting indicates sub-slab soil vapor concentrations greater than the decision matrix B threshold of 1,000 µg/m^3.

Figure 3-2: Indoor Air Sample Results
G.W. Lisk
2 South Street, Clifton Springs, NY

ERM

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Sulphur Creek

Broad St

South St

Bldg CWS

SS-BLDG-4D

SS-BLDG-4A

VI-02

SS-BLDG-4C

Bldg 4A
Steel Room/
Heat Treat

Bldg 4M

SS-BLDG-4M

SS-BLDG-5

Bldg 5
Inspection Hub/
Engineering Lab

Bldg 5A
Plating

Bldg 6
MIS Assembly

SS-BLDG-6

VI-03

VAC Furnace

Bldg 7
Parts Assembly
Industrial Products

Bldg 6A
M1 Assembly

SS-AOPC-5

Bldg 7A
Parts
Assembly Valves

SS-BLDG-7B-1

VI-04

SS-BLDG-7B-2

Bldg 7B
Elevator, Valve Assembly

Sulphur Creek

Legend

Supplemental IRM Sample Locations

- Indoor Air/Sub-Slab Soil Vapor

Site Characterization Sample Location

- Indoor Air/Sub-Slab Soil Vapor

Proposed Mitigation Region

- Revised Proposed IRM Floor Sealing Area
- Initial Proposed IRM Floor Sealing Area

Facility Foundation Levels

- Level 1
- Level 2
- Level 3
- Property Parcel Boundary
- Facility Outline
- Surface Stream
- Inferred Stream Path

NOTES:

- Facility room outlines are approximate in location and converted from AutoCAD models.
- Aerial imagery was captured in 2015 by New York State.
- Mitigation includes sealing of cracks and gaps in slab and perimeter.

N

0 12.5 25 50 75 100
Feet

Figure 3-3: Mitigation Measures and Sample Locations
G.W. Lisk
2 South Street, Clifton Springs, NY

ERM

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Tables

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Table 2-1
Summary of Site Characterization Soil Vapor Intrusion Data
GW Lisk - Clifton Springs, New York
NYSDEC Site Number 835026

Sample ID	VI-01-IA	VI-01-SS	VI-02-IA	VI-02-SS	VI-03-IA	VI-03-SS	VI-04-IA	VI-04-IA DUP	VI-04-SS	VI-05-IA	VI-05-SS	AA
Lab ID	L1715353-02	L1715353-03	L1715353-04	L1715353-05	L1715353-06	L1715353-07	L1715353-08	L1715353-12	L1715353-09	L1715353-10	L1715353-11	L1715353-01
Sample Date	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17
Method TO15, µg/m3												
1,1,1-Trichloroethane	0.300	< 5.46	< 0.109	214	0.240	7,910	0.589	0.622	11,000	< 0.109	< 5.46	< 0.109
1,1,2,2-Tetrachloroethane	< 1.37	< 6.87	< 1.37	< 13.7	< 1.37	< 321	< 1.37	< 1.37	< 279	< 1.37	< 6.87	< 1.37
1,1,2-Trichloroethane	< 1.09	< 5.46	< 1.09	< 10.9	< 1.09	< 255	< 1.09	< 1.09	< 222	< 1.09	< 5.46	< 1.09
1,1-Dichloroethane	< 0.809	< 4.05	< 0.809	< 8.09	< 0.809	882	< 0.809	< 0.809	334	< 0.809	< 4.05	< 0.809
1,1-Dichloroethene	< 0.079	< 3.96	< 0.079	< 7.93	< 0.079	5,470	0.119	0.123	3,010	< 0.079	< 3.96	< 0.079
1,2,4-Trichlorobenzene	< 1.48	< 7.42	< 1.48	< 14.8	< 1.48	< 347	< 1.48	< 1.48	< 301	< 1.48	< 7.42	< 1.48
1,2,4-Trimethylbenzene	< 0.983	< 4.92	11.3	< 9.83	9.68	< 230	11.1	10.5	< 200	3.32	7.57	< 0.983
1,2-Dichlorobenzene	< 1.20	< 6.01	< 1.20	< 12.0	< 1.20	< 281	< 1.20	< 1.20	< 244	< 1.20	< 6.01	< 1.20
1,2-Dichloroethane	< 0.809	< 4.05	< 0.809	< 8.09	< 0.809	< 189	< 0.809	< 0.809	< 164	< 0.809	< 4.05	< 0.809
1,2-Dichloropropane	< 0.924	< 4.62	< 0.924	< 9.24	< 0.924	< 216	< 0.924	< 0.924	< 188	< 0.924	< 4.62	< 0.924
1,3,5-Trimethylbenzene	< 0.983	< 4.92	5.01	< 9.83	3.99	< 230	4.62	4.27	< 200	1.32	5.31	< 0.983
1,3-Butadiene	< 0.442	< 2.21	< 0.442	< 4.42	< 0.442	< 103	< 0.442	< 0.442	< 89.8	< 0.442	6.95	< 0.442
1,3-Dichlorobenzene	< 1.20	< 6.01	< 1.20	< 12.0	< 1.20	< 281	< 1.20	< 1.20	< 244	< 1.20	< 6.01	< 1.20
1,4-Dichlorobenzene	< 1.20	< 6.01	< 1.20	< 12.0	< 1.20	< 281	< 1.20	< 1.20	< 244	< 1.20	< 6.01	< 1.20
1,4-Dioxane	< 0.721	< 3.60	< 0.721	7.96	< 0.721	< 168	< 0.721	< 0.721	< 146	< 0.721	< 3.60	< 0.721
2,2,4-Trimethylpentane	< 0.934	< 4.67	1.15	< 9.34	1.05	< 218	1.08	1.06	< 190	< 0.934	< 4.67	< 0.934
2-Butanone	1.75	< 7.37	2.28	74.0	2.13	< 345	9.88	9.47	< 301	< 1.47	28.4	< 1.47
2-Hexanone	< 0.820	< 4.10	< 0.820	< 8.20	< 0.820	< 191	< 0.820	< 0.820	< 166	< 0.820	< 4.10	< 0.820
4-Ethyltoluene	< 0.983	< 4.92	1.77	< 9.83	1.68	< 230	1.86	1.69	< 200	< 0.983	< 4.92	< 0.983
4-Methyl-2-pentanone	< 2.05	< 10.2	< 2.05	< 20.5	< 2.05	< 479	16.5	17.6	< 418	< 2.05	< 10.2	< 2.05
Acetone	158	618	96.4	4,920	23.5	725	85.0	90.7	5,580	11.4	556	6.03
Allyl chloride	< 0.626	< 3.13	< 0.626	< 6.26	< 0.626	< 146	< 0.626	< 0.626	< 127	< 0.626	< 3.13	< 0.626
Benzene	< 0.639	8.53	0.764	25.3	< 0.639	< 149	2.24	2.26	< 130	< 0.639	66.4	< 0.639
Benzyl chloride	< 1.04	< 5.18	< 1.04	< 10.4	< 1.04	< 242	< 1.04	< 1.04	< 210	< 1.04	< 5.18	< 1.04
Bromodichloromethane	< 1.34	< 6.70	< 1.34	< 13.4	< 1.34	< 313	< 1.34	< 1.34	< 272	< 1.34	< 6.70	< 1.34
Bromoform	< 2.07	< 10.3	< 2.07	< 20.7	< 2.07	< 483	< 2.07	< 2.07	< 420	< 2.07	< 10.3	< 2.07
Carbon disulfide	< 0.623	< 3.11	23.1	21.3	1.10	< 145	1.08	1.12	< 126	< 0.623	23.4	< 0.623
Carbon tetrachloride	0.403	< 6.29	0.390	< 12.6	0.409	< 294	0.447	0.484	< 255	0.384	< 6.29	0.346
Chlorobenzene	< 0.921	< 4.61	< 0.921	< 9.21	< 0.921	< 215	< 0.921	< 0.921	< 187	< 0.921	< 4.61	< 0.921
Chloroethane	< 0.528	< 2.64	< 0.528	< 5.28	< 0.528	< 123	< 0.528	< 0.528	< 107	< 0.528	< 2.64	< 0.528
Chloroform	< 0.977	< 4.88	< 0.977	< 9.77	< 0.977	242	< 0.977	< 0.977	< 198	< 0.977	< 4.88	< 0.977
cis-1,2-Dichloroethene	0.079	< 3.96	< 0.079	< 7.93	0.131	864	0.119	0.111	1,190	< 0.079	< 3.96	< 0.079
cis-1,3-Dichloropropene	< 0.908	< 4.54	< 0.908	< 9.08	< 0.908	< 212	< 0.908	< 0.908	< 184	< 0.908	< 4.54	< 0.908
Cyclohexane	< 0.688	15.4	< 0.688	185	< 0.688	< 161	< 0.688	< 0.688	< 140	< 0.688	100	< 0.688
Dibromochloromethane	< 1.70	< 8.52	< 1.70	< 17.0	< 1.70	< 398	< 1.70	< 1.70	< 346	< 1.70	< 8.52	< 1.70
Ethanol	34.1	245	28.6	748	42.0	< 2,200	168	194	< 1,920	54.1	754	< 9.42
Ethyl acetate	< 1.80	< 9.01	< 1.80	< 18.0	< 1.80	< 422	< 1.80	< 1.80	< 368	< 1.80	< 9.01	< 1.80
Ethylbenzene	20.5	14.2	< 0.869	< 8.69	1.53	< 203	5.95	5.43	< 176	< 0.869	6.52	< 0.869
Ethylene dibromide	< 1.54	< 7.69	< 1.54	< 15.4	< 1.54	< 359	< 1.54	< 1.54	< 312	< 1.54	< 7.69	< 1.54
Freon 11	11.4	6.97	1.30	< 11.2	5.10	< 262	9.78	10.0	< 228	1.90	< 5.62	1.35
Freon 113	1.56	1,120	< 1.53	88.9	2.02	53,500	3.86	3.76	205,000	< 1.53	< 7.66	< 1.53
Freon 114	< 1.40	< 6.99	< 1.40	< 14.0	< 1.40	< 326	< 1.40	< 1.40	< 284	< 1.40	< 6.99	< 1.40
Freon 12	1.93	12.7	1.86	< 9.89	2.13	354	2.46	2.36	870	2.52	< 4.94	2.13
Heptane	< 0.820	44.3	< 0.820	561	< 0.820	< 191	< 0.820	< 0.820	< 166	< 0.820	184	< 0.820
Hexachlorobutadiene	< 2.13	< 10.7	< 2.13	< 21.3	< 2.13	< 498	< 2.13	< 2.13	< 433	< 2.13	< 10.7	< 2.13
Isopropyl alcohol	349	62.7	102	398	300	< 288	376	410	403	12.5	58.7	< 1.23
Methyl bromide	< 0.777	< 3.88	< 0.777	< 7.77	< 0.777	< 181	< 0.777	< 0.777	< 158	< 0.777	< 3.88	< 0.777

Sample ID	VI-01-IA	VI-01-SS	VI-02-IA	VI-02-SS	VI-03-IA	VI-03-SS	VI-04-IA	VI-04-IA DUP	VI-04-SS	VI-05-IA	VI-05-SS	AA
Lab ID	L1715353-02	L1715353-03	L1715353-04	L1715353-05	L1715353-06	L1715353-07	L1715353-08	L1715353-12	L1715353-09	L1715353-10	L1715353-11	L1715353-01
Sample Date	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17	10-May-17
Methyl chloride	1.33	*< 2.07*	1.27	*< 4.13*	1.19	*< 96.4*	1.16	1.26	*< 83.8*	1.14	2.75	1.21
Methyl tert-butyl ether	*< 0.721*	*< 3.61*	*< 0.721*	*< 7.21*	*< 0.721*	*< 168*	*< 0.721*	*< 0.721*	*< 146*	*< 0.721*	*< 3.61*	*< 0.721*
Methylene chloride	20.0	11.9	2.39	30.4	11.9	*< 406*	19.0	20.2	*< 354*	6.74	*< 8.69*	*< 1.74*
n-Hexane	*< 0.705*	66.6	*< 0.705*	578	0.909	*< 165*	*< 0.705*	*< 0.705*	212	*< 0.705*	259	*< 0.705*
o-Xylene	11.8	8.12	1.61	*< 8.69*	2.10	*< 203*	9.69	8.90	*< 176*	*< 0.869*	9.56	*< 0.869*
Styrene	63.9	43.0	*< 0.852*	*< 8.52*	*< 0.852*	*< 199*	*< 0.852*	*< 0.852*	*< 173*	*< 0.852*	*< 4.26*	*< 0.852*
tert-Butyl alcohol	*< 1.52*	*< 7.58*	*< 1.52*	162	*< 1.52*	*< 355*	*< 1.52*	*< 1.52*	*< 309*	*< 1.52*	24.1	*< 1.52*
Tetrachloroethene	0.448	*< 6.78*	*< 0.136*	318	0.549	4,640	1.81	1.78	3,850	*< 0.136*	*< 6.78*	*< 0.136*
Tetrahydrofuran	*< 1.47*	*< 7.37*	*< 1.47*	*< 14.7*	*< 1.47*	*< 345*	*< 1.47*	*< 1.47*	*< 301*	*< 1.47*	*< 7.37*	*< 1.47*
Toluene	*< 0.754*	11.2	9.27	60.7	1.81	*< 176*	2.59	2.44	*< 153*	1.82	113	*< 0.754*
trans-1,2-Dichloroethene	110	60.3	*< 0.793*	*< 7.93*	43.6	*< 185*	51.5	50.4	*< 161*	*< 0.793*	*< 3.96*	*< 0.793*
trans-1,3-Dichloropropene	*< 0.908*	*< 4.54*	*< 0.908*	*< 9.08*	*< 0.908*	*< 212*	*< 0.908*	*< 0.908*	*< 184*	*< 0.908*	*< 4.54*	*< 0.908*
Trichloroethene	0.306	*< 5.37*	0.161	499	2.86	90,300	7.20	7.42	51,100	0.118	39.8	*< 0.107*
Vinyl bromide	*< 0.874*	*< 4.37*	*< 0.874*	*< 8.74*	*< 0.874*	*< 204*	*< 0.874*	*< 0.874*	*< 178*	*< 0.874*	*< 4.37*	*< 0.874*
Vinyl chloride	*< 0.051*	*< 2.56*	*< 0.051*	*< 5.11*	*< 0.051*	*< 119*	*< 0.051*	*< 0.051*	*< 104*	*< 0.051*	*< 2.56*	*< 0.051*
Xylenes, m/p	74.7	50.4	3.08	21.7	6.60	*< 406*	26.5	24.7	*< 353*	*< 1.74*	37.4	*< 1.74*

Notes:

< - Compound not detected at concentrationsabove the laboratory reporting detection limit.The laboratory reporting detection limit is shown.

µg/m3 - micrograms per cubic meter

Table 6-1
Revised Estimated Project Schedule for SVI IRM Implementation
G.W. Lisk Facility - Clifton Springs, New York
NYSDEC BCP Site Number C835026

Milestone	Estimated Completion Date *
NYSDEC/NYSDOH Approval of SVI IRM Work Plan	24-May-2018
Initiate Pre-Design SVI Sampling	7-Aug-2018
Meeting with NYSDEC/NYSDOH to review Pre-Characterization SVI Sampling Results	6-Sep-2018
Initiate Second Round of Pre-Design SVI Sampling	15-Oct-2018
Submit Draft Revised SVI IRM Work Plan	31-Dec-2018
Receive Comments on Draft Revised SVI IRM Work Plan	4-Feb-2019
Submit Draft Final Revised SVI IRM Work Plan	13-Feb-2019
NYSDEC/NYSDOH Approval of Draft Final Revised SVI IRM Work Plan	February 2019
Provide Final Revised SVI IRM Work Plan to NYSDEC/NYSDOH and Document Repository	March 2019
Initiate SVI IRM Construction Work	March 2019
Complete SVI IRM Construction Work	March 2019
Complete Post Mitigation Sampling	Early April 2019
Submit Draft Construction Completion Report to NYSDEC/NYSDOH, including an Interim Site Management Plan	July 2019

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

Appendix A Structure Sampling Questionnaires and Building Inventory

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

Site Name: GW Lisk | Site Code: 835026 | Operable Unit: 01

Building Code: MB | Building Name: Main Building

Address: 2 South Street | Apt/Suite No:

City: Clifton Springs | State: NY | Zip: 14432 | County: Ontario

Contact Information

Preparer's Name: Michael Fox | Phone No: (315) 481-9566

Preparer's Affiliation: ERM Consulting and Engineering | Company Code: ERM

Purpose of Investigation: SV sampling | Date of Inspection: 5/8/2017

Contact Name: Arno Bebernitz | Affiliation: MANAGER

Phone No: (315) 462-4255 | Alt. Phone No: | Email: abebernitz@gwlisk.com

Number of Occupants (total): 50+ | Number of Children:

☐ Occupant Interviewed? ☐ Owner Occupied? ☐ Owner Interviewed?

Owner Name (if different): | Owner Phone:

Owner Mailing Address:

Building Details

Bldg Type (Res/Com/Ind/Mixed): INDUSTRIAL | Bldg Size (S/M/L): LARGE

If Commercial or Industrial Facility, Select Operations: MANUFACTURING

If Residential Select Structure Type:

Number of Floors: 2 | Approx. Year Construction: 1995 | ☒ Building Insulated? | ☐ Attached Garage?

Describe Overall Building 'Tightness' and Airflows(e.g., results of smoke tests):

Tight

Foundation Description

Foundation Type: ABOVE GRADE | Foundation Depth (bgs): | Unit: FEET

Foundation Floor Material: POURED CONCRETE

Foundation Wall Material: CONCRETE BLOCK

Foundation Floor Thickness: 8

Foundation Wall Thickness:

Unit: INCHES

☐ Floor penetrations? Describe Floor Penetrations:

☐ Wall penetrations? Describe Wall Penetrations:

Basement is: FINISHED | Basement is: DRY | ☐ Sumps/Drains? | Water In Sump?:

Describe Foundation Condition (cracks, seepage, etc.) :

☐ Radon Mitigation System Installed? ☐ VOC Mitigation System Installed? ☐ Mitigation System On?

Heating / Cooling / Ventilation Systems

Heating System: FORCED AIR | Heat Fuel Type: ELECTRIC | ☐ Central A/C Present?

Vented Appliances

Water Heater Fuel Type: | Clothes Dryer Fuel Type:

Water Htr Vent Location: | Dryer Vent Location:

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

PRODUCT INVENTORY

Building Name: Main Building Bldg Code: Date: May 8, 2017

Bldg Address: 2 South Street Apt/Suite No:

Bldg City/State/Zip: Clifton Springs NY, 14432

Make and Model of PID: MiniRae 3000 Date of Calibration: May 8, 2017

Location	Product Name/Description	Size (oz)	Condition *	Chemical Ingredients	PID Reading	COC Y/N?
VI-02	Stoner Cleaner/Degreaser	12	U	1,1,1-trichloroethane, trichloroethene, Citrus Distillates, Petroleum distillates, ether propellant		☐
VI-02	Armor Dry 27		U	1,1,1-trichloroethane		☐
VI-02	Autographs Activating Solven		U	1,1,1-trichloroethane		☐
VI-04	Trump Plus	12	U	1,1,1-trichlorethan, methylene chloride, zinc oxide, propane, N-butane, alyphatic hydrocarbon		☐
General Use	CDC-10	32	U	water, diethylene glycol monobutyl ether, sodium tripolyphosphate, disodium cocampho		☐
Flammables F	TCE drum	drum	U	trichloroethene		☐
General Use	Clorox	19	U	ethanol, isobutane, propane, sodium nitrite, n-alkyl benzyl ammonium chloride, octyl decyl		☐
General Use	Dykem Remover and Prep	12	U	acetone, ethanol, n-propyl acetate, isopropyl alcohol		☐
General Use	Flux Remover	16	U	1,1,1,2,2,3,4,5,5,5-decafluoropentane, 1,2-transdichloroethylene,		☐
General Use	Orange Tough 15	32	U	triethanolamine dodecybenzene sulfonate, dipropylene glycol monobutyl ether,		☐
General Use	Electro Contact Cleaner		U	ethane, 1,1,1,2-tetrafluoro-(hfc-134a),methyl nonafluorobutyl ether, perfluoro compounds,		☐
General Use	WD-40	7	U	alyphatix hydrocarbon, petroleum base oil, LVP alyphatic hydrocarbon, surfactant		☐
Degreaser	Acetone		U		0.7	☐
Degreaser	Iso-propyl		U		4.1	☐
Degreaser	n-propylbromide	7040	U		0.7	☐
Degreaser	Xylene	7040	U		4.19	☐

* Describe the condition of the product containers as **Unopened (UO)**, **Used (U)**, or **Deteriorated (D)**

** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Product Inventory Complete? Yes Were there any elevated PID readings taken on site? Yes ☐ Products with COC?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

Site Name: GW Lisk Site Code: 835026 Operable Unit:

Building Code: Building Name: Main Building

Address: 2 South Street Apt/Suite No:

City: Clifton Springs State: NY Zip: 14432 County: Ontario

Factors Affecting Indoor Air Quailty

Frequency Basement/Lowest Level is Occupied?: FULL TIME Floor Material: CEMENT

☒ Inhabited? ☒ HVAC System On? ☐ Bathroom Exhaust Fan? ☐ Kitchen Exhaust Fan?

Alternate Heat Source: OTHER ☐ Is there smoking in the building?

☐ Air Fresheners? Description/Location of Air Freshener:

☐ Cleaning Products Used Recently?: Description of Cleaning Products:

☐ Cosmetic Products Used Recently?: Description of Cosmetic Products:

☐ New Carpet or Furniture? Location of New Carpet/Furniture:

☐ Recent Dry Cleaning? Location of Recently Dry Cleaned Fabrics:

☐ Recent Painting/Staining? Location of New Painting:

☒ Solvent or Chemical Odors? Describe Odors (if any): organic

☒ Do Any Occupants Use Solvents At Work? If So, List Solvents Used: acetone,iso-propyl,xylene,n-propylbromide

☐ Recent Pesticide/Rodenticide? Description of Last Use:

Describe Any Household Activities (chemical use,/storage, unvented appliances, hobbies, etc.) That May Affect Indoor Air Quality:

Chemical Use
Degreasers
Plating
Waste Storage

☐ Any Prior Testing For Radon? If So, When?:

☒ Any Prior Testing For VOCs? If So, When?: 4/2016

Sampling Conditions

Weather Conditions: PARTLY CLOUDY Outdoor Temperature: 60 °F

Current Building Use: MANUFACTURING Barometric Pressure: 29.97 in(hg)

Product Inventory Complete? Yes ☒ Building Questionnaire Completed?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

Building Code: _____ Address: 2 South Street Clifton Springs, NY 14432

Sampling Information

Sampler Name(s): Tim Daniluk / Michael Fox

Sampler Company Code: ERM

Sample Collection Date: 5/9/2017

Date Samples Sent To Lab: 5/10/2017

Sample Chain of Custody Number: _____

Outdoor Air Sample Location ID: GWL-AA

SUMMA Canister Information

Sample ID:	VI-02-IA	VI-02-SS	VI-03-IA	VI-03-SS	VI-04-IA
Location Code:					
Location Type:	FIRST FLOOR	SUBSLAB	FIRST FLOOR	SUBSLAB	FIRST FLOOR
Canister ID:	939	766	787	1515	956
Regulator ID:	0347	0292	0723	0589	0250
Matrix:	Indoor Air	Subslab Soil	Indoor Air	Subslab Soil	Indoor Air
Sampling Method:	SUMMA AIR SAMPLIN	SUMMA AIR SAM	SUMMA AIR SAM	SUMMA AIR SAM	SUMMA AIR SAM

Sampling Area Info

Slab Thickness (inches):	9"	10		9	
Sub-Slab Material:	FILL	DIRT		DIRT	
Sub-Slab Moisture:	DRY	DRY		DRY	
Seal Type:	MECHANICAL	MECHANICAL		MECHANICAL	
Seal Adequate?:	X	X		X	

Sample Times and Vacuum Readings

Sample Start Date/Time:	05/09/2017 12:14	05/09/2017 12	05/09/2017 12	05/09/2017 12	05/09/2017 12
Vacuum Gauge Start:	-29.35	-28.55	-29.21	-29.25	-29.66
Sample End Date/Time:	05/10/2017 12:14	05/10/2017 12	05/10/2017 12	05/10/2017 12	05/10/2017 12
Vacuum Gauge End:	-7.92	-6.52	-7.73	-11.53	-6.54
Sample Duration (hrs):	24	24	24	24	24
Vacuum Gauge Unit:	in(hg)	in(hg)	in(hg)	in(hg)	in(hg)

Sample QA/QC Readings

Vapor Port Purge:	X	X		X	
Purge PID Reading:	0.0	0.0		0.0	
Purge PID Unit:	ppm	ppm		ppm	
Tracer Test Pass:	X	X		X	

Sample start and end times should be entered using the following format: MM/DD/YYYY HH:MM

Draft

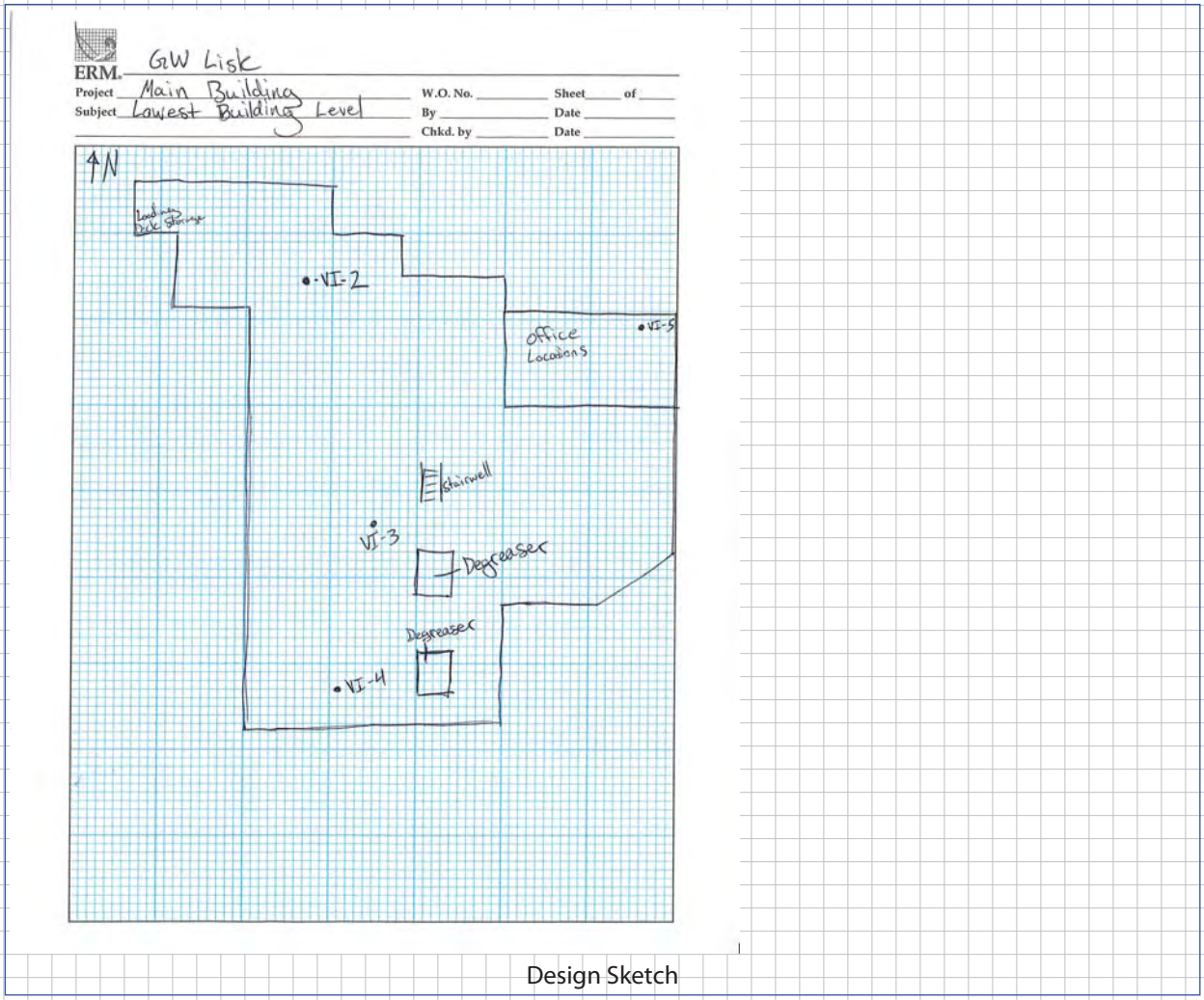
Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

LOWEST BUILDING LEVEL LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the lowest building level . The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image



Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sket
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Structure Sampling Questionnaire and Building Inventory

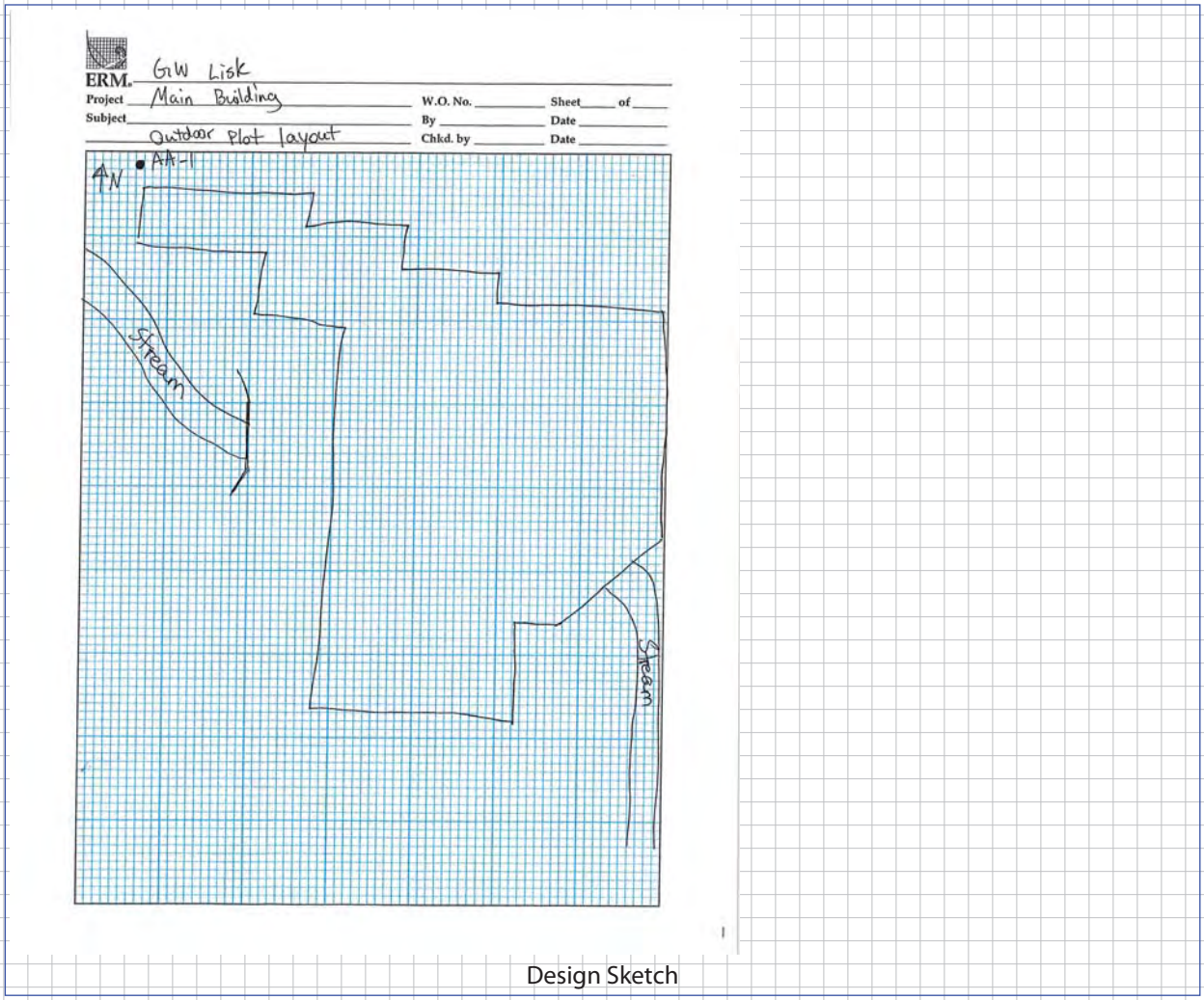
New York State Department of Environmental Conservation

Draft

OUTDOOR PLOT LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the outdoor plot of the building as well as the surrounding area. The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image



Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sket
- Identify the locations of the following features on the layout sketch, using the appropriate symbols:

B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

Site Name: GW Lisk | Site Code: 835026 | Operable Unit: 01

Building Code: MB | Building Name: Main Building

Address: 2 South Street | Apt/Suite No:

City: Clifton Springs | State: NY | Zip: 14432 | County: Ontario

Contact Information

Preparer's Name: Michael Fox | Phone No: (315) 481-9566

Preparer's Affiliation: ERM Consulting and Engineering | Company Code: ERM

Purpose of Investigation: SV sampling | Date of Inspection: 5/8/2017

Contact Name: Arno Bebernitz | Affiliation: MANAGER

Phone No: (315) 462-4255 | Alt. Phone No: | Email: abebernitz@gwlisk.com

Number of Occupants (total): 50+ | Number of Children:

☐ Occupant Interviewed? ☐ Owner Occupied? ☐ Owner Interviewed?

Owner Name (if different): | Owner Phone:

Owner Mailing Address:

Building Details

Bldg Type (Res/Com/Ind/Mixed): INDUSTRIAL | Bldg Size (S/M/L): LARGE

If Commercial or Industrial Facility, Select Operations: MANUFACTURING

If Residential Select Structure Type:

Number of Floors: 2 | Approx. Year Construction: 1995 | ☒ Building Insulated? | ☐ Attached Garage?

Describe Overall Building 'Tightness' and Airflows(e.g., results of smoke tests):

Tight

Foundation Description

Foundation Type: ABOVE GRADE | Foundation Depth (bgs): | Unit: FEET

Foundation Floor Material: POURED CONCRETE

Foundation Wall Material: CONCRETE BLOCK

Foundation Floor Thickness: 8

Foundation Wall Thickness:

Unit: INCHES

☐ Floor penetrations? Describe Floor Penetrations:

☐ Wall penetrations? Describe Wall Penetrations:

Basement is: FINISHED | Basement is: DRY | ☐ Sumps/Drains? | Water In Sump?:

Describe Foundation Condition (cracks, seepage, etc.) :

☐ Radon Mitigation System Installed? ☐ VOC Mitigation System Installed? ☐ Mitigation System On?

Heating / Cooling / Ventilation Systems

Heating System: FORCED AIR | Heat Fuel Type: ELECTRIC | ☐ Central A/C Present?

Vented Appliances

Water Heater Fuel Type: | Clothes Dryer Fuel Type:

Water Htr Vent Location: | Dryer Vent Location:

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

PRODUCT INVENTORY

Building Name: Main Building Bldg Code: Date: May 8, 2017

Bldg Address: 2 South Street Apt/Suite No:

Bldg City/State/Zip: Clifton Springs NY, 14432

Make and Model of PID: MiniRae 3000 Date of Calibration: May 8, 2017

Location	Product Name/Description	Size (oz)	Condition *	Chemical Ingredients	PID Reading	COC Y/N?
VI-02	Stoner Cleaner/Degreaser	12	U	1,1,1-trichloroethane, trichloroethene, Citrus Distillates, Petroleum distillates, ether propellant		☐
VI-02	Armor Dry 27		U	1,1,1-trichloroethane		☐
VI-02	Autographs Activating Solven		U	1,1,1-trichloroethane		☐
VI-04	Trump Plus	12	U	1,1,1-trichlorethan, methylene chloride, zinc oxide, propane, N-butane, alyphatic hydrocarbon		☐
General Use	CDC-10	32	U	water, diethylene glycol monobutyl ether, sodium tripolyphosphate, disodium cocampho		☐
Flammables F	TCE drum	drum	U	trichloroethene		☐
General Use	Clorox	19	U	ethanol, isobutane, propane, sodium nitrite, n-alkyl benzyl ammonium chloride, octyl decyl		☐
General Use	Dykem Remover and Prep	12	U	acetone, ethanol, n-propyl acetate, isopropyl alcohol		☐
General Use	Flux Remover	16	U	1,1,1,2,2,3,4,5,5,5-decafluoropentane, 1,2-transdichloroethylene,		☐
General Use	Orange Tough 15	32	U	triethanolamine dodecybenzene sulfonate, dipropylene glycol monobutyl ether,		☐
General Use	Electro Contact Cleaner		U	ethane, 1,1,1,2-tetrafluoro-(hfc-134a),methyl nonafluorobutyl ether, perfluoro compounds,		☐
General Use	WD-40	7	U	alyphatix hydrocarbon, petroleum base oil, LVP alyphatic hydrocarbon, surfactant		☐
Degreaser	Acetone		U		0.7	☐
Degreaser	Iso-propyl		U		4.1	☐
Degreaser	n-propylbromide	7040	U		0.7	☐
Degreaser	Xylene	7040	U		4.19	☐

* Describe the condition of the product containers as **Unopened (UO)**, **Used (U)**, or **Deteriorated (D)**

** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Product Inventory Complete? Yes Were there any elevated PID readings taken on site? Yes ☐ Products with COC?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

Site Name: GW Lisk Site Code: 835026 Operable Unit:

Building Code: Building Name: Main Building

Address: 2 South Street Apt/Suite No:

City: Clifton Springs State: NY Zip: 14432 County: Ontario

Factors Affecting Indoor Air Quailty

Frequency Basement/Lowest Level is Occupied?: FULL TIME Floor Material: CEMENT

☒ Inhabited? ☒ HVAC System On? ☐ Bathroom Exhaust Fan? ☐ Kitchen Exhaust Fan?

Alternate Heat Source: OTHER ☐ Is there smoking in the building?

☐ Air Fresheners? Description/Location of Air Freshener:

☐ Cleaning Products Used Recently?: Description of Cleaning Products:

☐ Cosmetic Products Used Recently?: Description of Cosmetic Products:

☐ New Carpet or Furniture? Location of New Carpet/Furniture:

☐ Recent Dry Cleaning? Location of Recently Dry Cleaned Fabrics:

☐ Recent Painting/Staining? Location of New Painting:

☒ Solvent or Chemical Odors? Describe Odors (if any): organic

☒ Do Any Occupants Use Solvents At Work? If So, List Solvents Used: acetone,iso-propyl,xylene,n-propylbromide

☐ Recent Pesticide/Rodenticide? Description of Last Use:

Describe Any Household Activities (chemical use,/storage, unvented appliances, hobbies, etc.) That May Affect Indoor Air Quality:

Chemical Use
Degreasers
Plating
Waste Storage

☐ Any Prior Testing For Radon? If So, When?:

☒ Any Prior Testing For VOCs? If So, When?: 4/2016

Sampling Conditions

Weather Conditions: PARTLY CLOUDY Outdoor Temperature: 60 °F

Current Building Use: MANUFACTURING Barometric Pressure: 29.97 in(hg)

Product Inventory Complete? Yes ☒ Building Questionnaire Completed?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

Building Code: _____ Address: 2 South Street Clifton Springs, NY 14432

Sampling Information

Sampler Name(s): Tim Daniluk / Michael Fox

Sampler Company Code: ERM

Sample Collection Date: 5/9/2017

Date Samples Sent To Lab: 5/10/2017

Sample Chain of Custody Number: _____

Outdoor Air Sample Location ID: GWL-AA

SUMMA Canister Information

Sample ID:	VI-04-SS	VI-DUP	VI-05-IA	VI-05-SS	
Location Code:					
Location Type:	SUBSLAB	FIRST FLOOR	SUBSLAB	SUBSLAB	
Canister ID:	2253	1848	987	1863	
Regulator ID:	0237	0341	0249	0203	
Matrix:	Subslab Soil Vapo	Indoor Air	Subslab Soil	Subslab Soil	
Sampling Method:	SUMMA AIR SAMPLIN	SUMMA AIR SAM	SUMMA AIR SAM	SUMMA AIR SAM	

Sampling Area Info

Slab Thickness (inches):	9"			9	
Sub-Slab Material:	FILL			DIRT	
Sub-Slab Moisture:	DRY			DRY	
Seal Type:	MECHANICAL			MECHANICAL	
Seal Adequate?:	X	☐	☐	☒	☐

Sample Times and Vacuum Readings

Sample Start Date/Time:	05/09/2017 12:30	05/09/2017 12	05/09/2017 12	05/09/2017 12	
Vacuum Gauge Start:	-29.97	-29.54	-29.04	-29.85	
Sample End Date/Time:	05/10/2017 12:30	05/10/2017 12	05/10/2017 12	05/10/2017 12	
Vacuum Gauge End:	-8.62	-7.73	-0.14	-8.52	
Sample Duration (hrs):	24	24	24	24	
Vacuum Gauge Unit:	in(hg)	in(hg)	in(hg)	in(hg)	

Sample QA/QC Readings

Vapor Port Purge:	X	☐	☐	☒	☐
Purge PID Reading:	0.0			0.0	
Purge PID Unit:	ppm			ppm	
Tracer Test Pass:	X	☐	☐	☒	☐

Sample start and end times should be entered using the following format: MM/DD/YYYY HH:MM

Draft

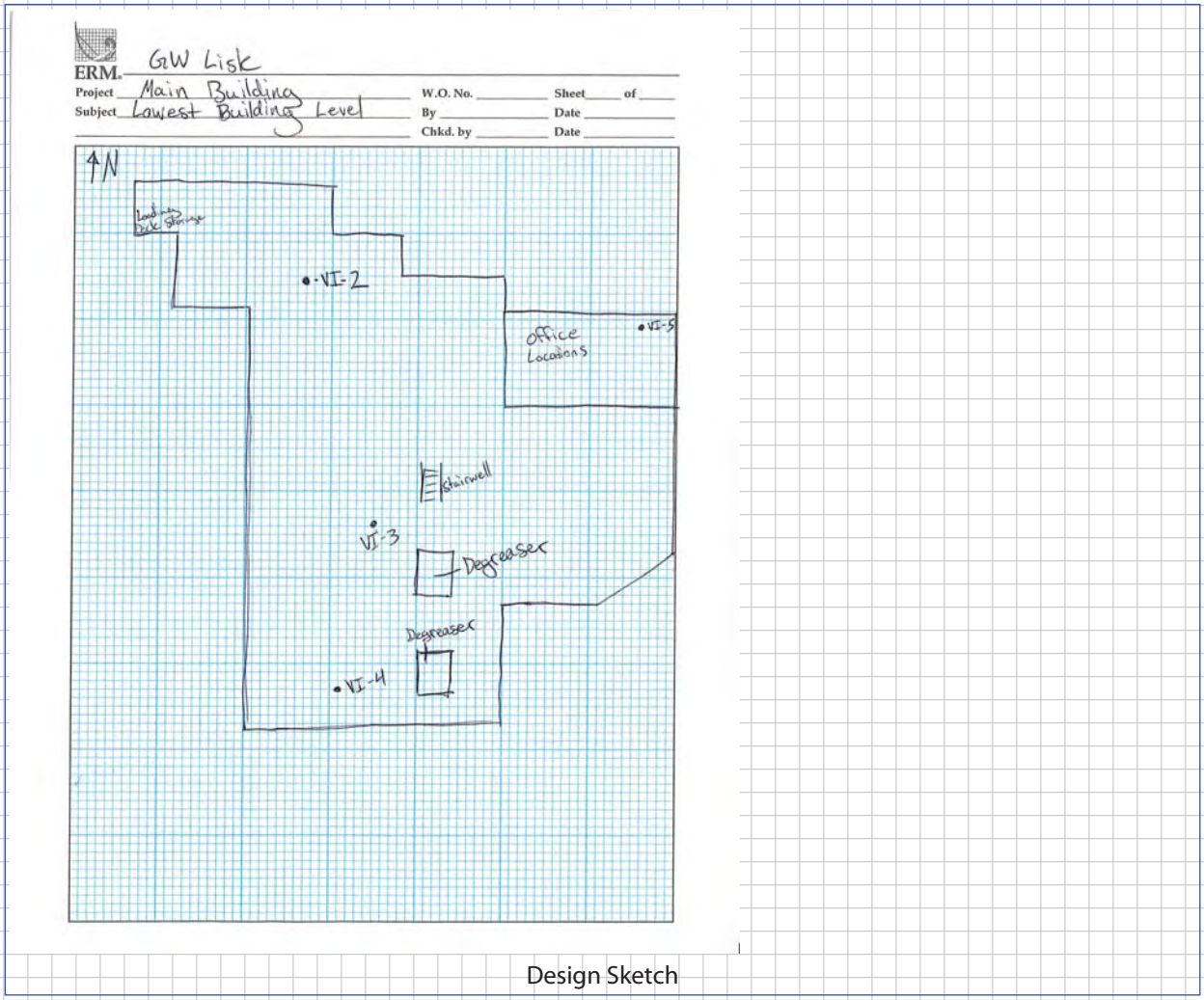
Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

LOWEST BUILDING LEVEL LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the lowest building level . The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image



Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
- Measure the distance of all sample locations from identifiable features, and include on the layout sketch.
- Identify room use (bedroom, living room, den, kitchen, etc.) on the layout sket
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B or **F**	Boiler or Furnace	o	Other floor or wall penetrations (label appropriately)
HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Structure Sampling Questionnaire and Building Inventory

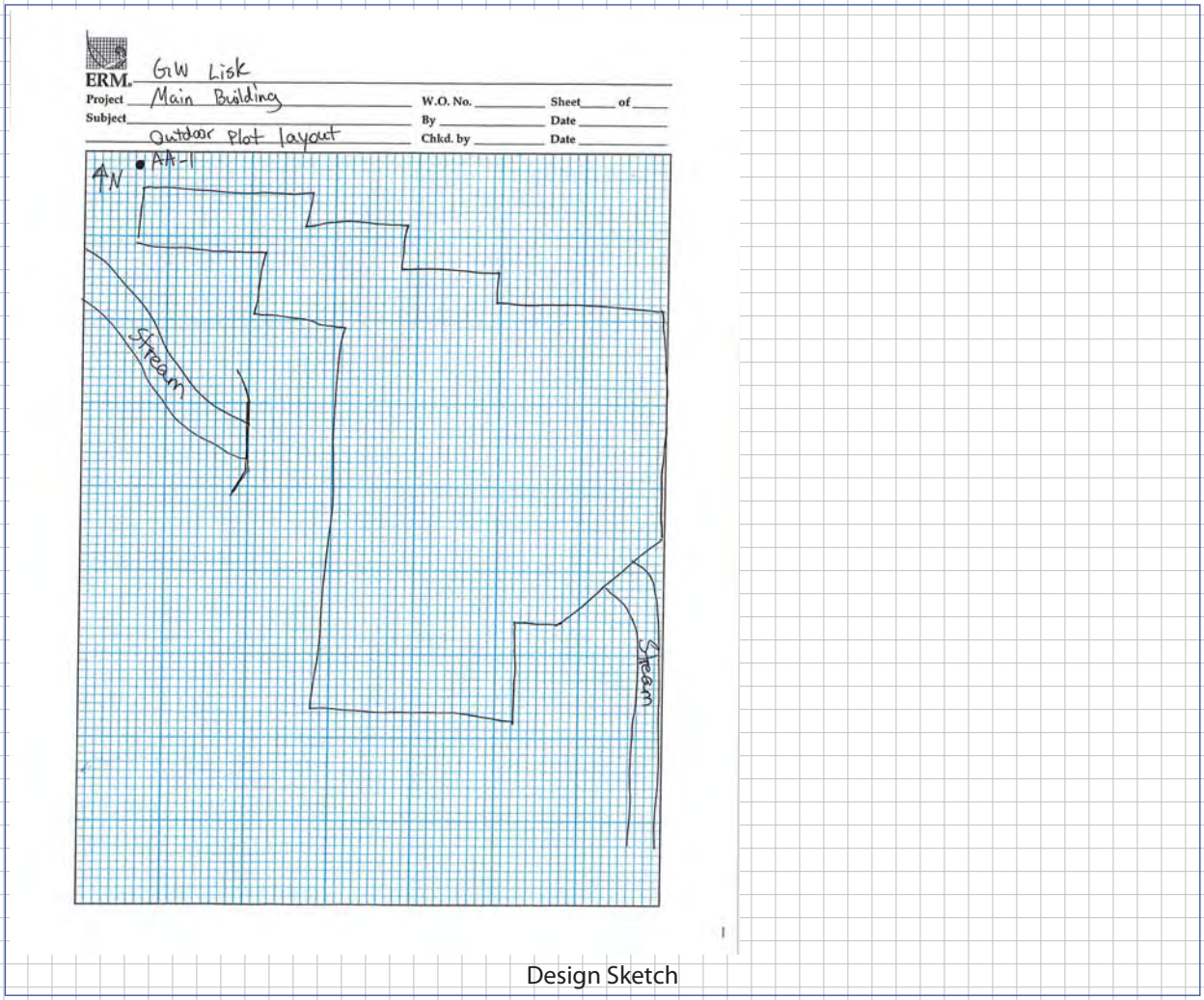
New York State Department of Environmental Conservation

Draft

OUTDOOR PLOT LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the outdoor plot of the building as well as the surrounding area. The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image



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S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Draft

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Site Name: GW Lisk | Site Code: 835026 | Operable Unit: 01

Building Code: HB | Building Name: Hundreds Building

Address: 2 South Street | Apt/Suite No:

City: Clifton Springs | State: NY | Zip: 14432 | County: Ontario

Contact Information

Preparer's Name: Michael Fox | Phone No: (315) 481-9566

Preparer's Affiliation: ERM Consulting and Engineering | Company Code: ERM

Purpose of Investigation: SV sampling / Site Characterization | Date of Inspection: May 8, 2017

Contact Name: Arno Bebernitz | Affiliation: MANAGER

Phone No: (315) 462-4255 | Alt. Phone No: | Email: Abebernitz@gwlisk.com

Number of Occupants (total): 30 | Number of Children: N/A

☐ Occupant Interviewed? ☐ Owner Occupied? ☐ Owner Interviewed?

Owner Name (if different): | Owner Phone:

Owner Mailing Address:

Building Details

Bldg Type (Res/Com/Ind/Mixed): INDUSTRIAL | Bldg Size (S/M/L): LARGE

If Commercial or Industrial Facility, Select Operations: MANUFACTURING

If Residential Select Structure Type:

Number of Floors: 1 | Approx. Year Construction: 1995 | ☒ Building Insulated? | ☐ Attached Garage?

Describe Overall Building 'Tightness' and Airflows(e.g., results of smoke tests):

Tight

Foundation Description

Foundation Type: ABOVE GRADE | Foundation Depth (bgs): | Unit: FEET

Foundation Floor Material: POURED CONCRETE

Foundation Wall Material: CONCRETE BLOCK

Foundation Floor Thickness: | Foundation Wall Thickness: | Unit: INCHES

☐ Floor penetrations? Describe Floor Penetrations:

☐ Wall penetrations? Describe Wall Penetrations:

Basement is: | Basement is: | ☐ Sumps/Drains? | Water In Sump?:

Describe Foundation Condition (cracks, seepage, etc.) : Solid, Whole

☐ Radon Mitigation System Installed? ☐ VOC Mitigation System Installed? ☐ Mitigation System On?

Heating / Cooling / Ventilation Systems

Heating System: NONE | Heat Fuel Type: ELECTRIC | ☐ Central A/C Present?

Vented Appliances

Water Heater Fuel Type: | Clothes Dryer Fuel Type:

Water Htr Vent Location: | Dryer Vent Location:

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

PRODUCT INVENTORY

Building Name: Hundreds Building Bldg Code: HB Date: May 8, 2017

Bldg Address: 2 South Street Apt/Suite No:

Bldg City/State/Zip: Clifton Springs NY, 14432

Make and Model of PID: MiniRae 3000 Date of Calibration: May 8, 2017

Location	Product Name/Description	Size (oz)	Condition *	Chemical Ingredients	PID Reading	COC Y/N?
Cafeteria	Oil Eater	32	U	2-butoxyethanol, sodium metasilicate	1.9	☐
Cafeteria	Lysol	12.5	U	ethanol, isopropyl alcohol, o-phenylphenol	1.9	☐
Cafeteria	Clorox	32	U	sodium hypochlorite, sodium chloride, sodium carbonate, sodium hydroxide	2.0	☐
Cafeteria	Fast and Easy	32	U	propylene glycol n-propyl ether	1.9	☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐
						☐

* Describe the condition of the product containers as **Unopened (UO)**, **Used (U)**, or **Deteriorated (D)**

** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Product Inventory Complete? Yes Were there any elevated PID readings taken on site? Yes ☐ Products with COC?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

Site Name: GW Lisk Site Code: 835026 Operable Unit: 01

Building Code: HB Building Name: Hundreds Building

Address: 2 South Street Apt/Suite No:

City: Clifton Springs State: NY Zip: 14432 County: Ontario

Factors Affecting Indoor Air Quailty

Frequency Basement/Lowest Level is Occupied?: FULL TIME Floor Material: CEMENT

☒ Inhabited? ☒ HVAC System On? ☐ Bathroom Exhaust Fan? ☐ Kitchen Exhaust Fan?

Alternate Heat Source: OTHER ☐ Is there smoking in the building?

☐ Air Fresheners? Description/Location of Air Freshener:

☒ Cleaning Products Used Recently?: Description of Cleaning Products: lysol, clorox

☐ Cosmetic Products Used Recently?: Description of Cosmetic Products:

☐ New Carpet or Furniture? Location of New Carpet/Furniture:

☐ Recent Dry Cleaning? Location of Recently Dry Cleaned Fabrics:

☐ Recent Painting/Staining? Location of New Painting:

☒ Solvent or Chemical Odors? Describe Odors (if any): nail polish

☐ Do Any Occupants Use Solvents At Work? If So, List Solvents Used:

☐ Recent Pesticide/Rodenticide? Description of Last Use:

Describe Any Household Activities (chemical use,/storage, unvented appliances, hobbies, etc.) That May Affect Indoor Air Quality:

kitchen/cafeteria cleaning products use and storage

☐ Any Prior Testing For Radon? If So, When?:

☒ Any Prior Testing For VOCs? If So, When?: 4/2016

Sampling Conditions

Weather Conditions: PARTLY CLOUDY Outdoor Temperature: 60 °F

Current Building Use: MANUFACTURING Barometric Pressure: 29.97 in(hg)

Product Inventory Complete? Yes ☒ Building Questionnaire Completed?

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

Draft

Building Code: HB Address: 2 South Street Clifton Springs , NY 14432

Sampling Information

Sampler Name(s): Tim Daniluk / Mike Fox Sampler Company Code: ERM

Sample Collection Date: May 9, 2017 Date Samples Sent To Lab: May 10, 2017

Sample Chain of Custody Number: Outdoor Air Sample Location ID: GWL-AA(0509

SUMMA Canister Information

Sample ID:	GWL-VI-01-IA(05	GWL-VI-01-S	GWL-AA(0509		
Location Code:					
Location Type:	FIRST FLOOR	SUBSLAB	OUTDOOR		
Canister ID:	625	656	1709		
Regulator ID:	0699	0285	0811		
Matrix:	Indoor Air	Subslab Soil	Ambient Outd		
Sampling Method:	SUMMA AIR SAMPLI	SUMMA AIR SA	SUMMA AIR SA		

Sampling Area Info

Slab Thickness (inches):		9"			
Sub-Slab Material:		FILL			
Sub-Slab Moisture:		DRY			
Seal Type:		MECHANICAL			
Seal Adequate?:	☐	☒	☐	☐	☐

Sample Times and Vacuum Readings

Sample Start Date/Time:	05/09/2017 13:0	05/09/2017 1	05/09/2017 1		
Vacuum Gauge Start:	-29.14	-29.48	-29.74		
Sample End Date/Time:	05/10/2017 13:0	05/10/2017 1	05/10/2017 1		
Vacuum Gauge End:	-9.05	-0.0	-4.07		
Sample Duration (hrs):	24	24	24		
Vacuum Gauge Unit:	in(hg)	in(hg)	in(hg)		

Sample QA/QC Readings

Vapor Port Purge:	☐	☒	☐	☐	☐
Purge PID Reading:		0.0			
Purge PID Unit:		ppm			
Tracer Test Pass:	☐	☒	☐	☐	☐

Sample start and end times should be entered using the following format: MM/DD/YYYY HH:MM

Structure Sampling Questionnaire and Building Inventory

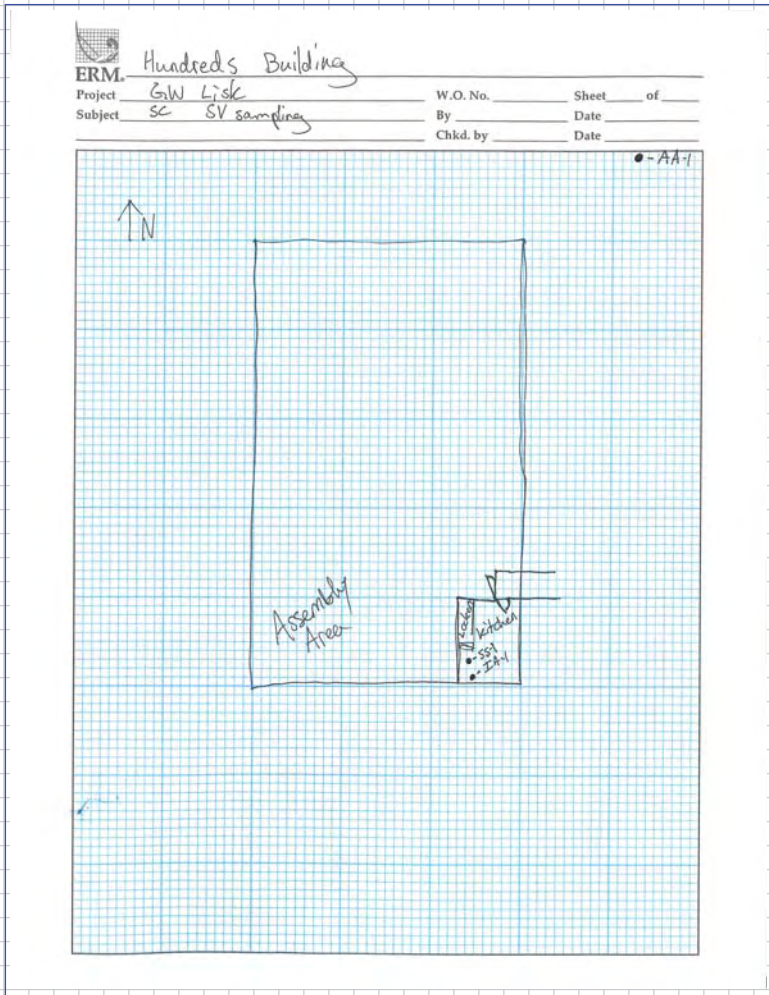
New York State Department of Environmental Conservation

Draft

LOWEST BUILDING LEVEL LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the lowest building level . The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image



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W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

FIRST FLOOR BUILDING LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the first floor of the building.
The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image

Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
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HW	Hot Water Heater	**xxxxxxx**	Perimeter Drains (draw inside or outside outer walls as appropriate)
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Structure Sampling Questionnaire and Building Inventory

New York State Department of Environmental Conservation

OUTDOOR PLOT LAYOUT SKETCH

Please click the box with the blue border below to upload a sketch of the outdoor plot of the building as well as the surrounding area. The sketch should be in a standard image format (.jpg, .png, .tiff)

Clear Image

Design Sketch

Design Sketch Guidelines and Recommended Symbology

- Identify and label the locations of all sub-slab, indoor air, and outdoor air samples on the layout sketch.
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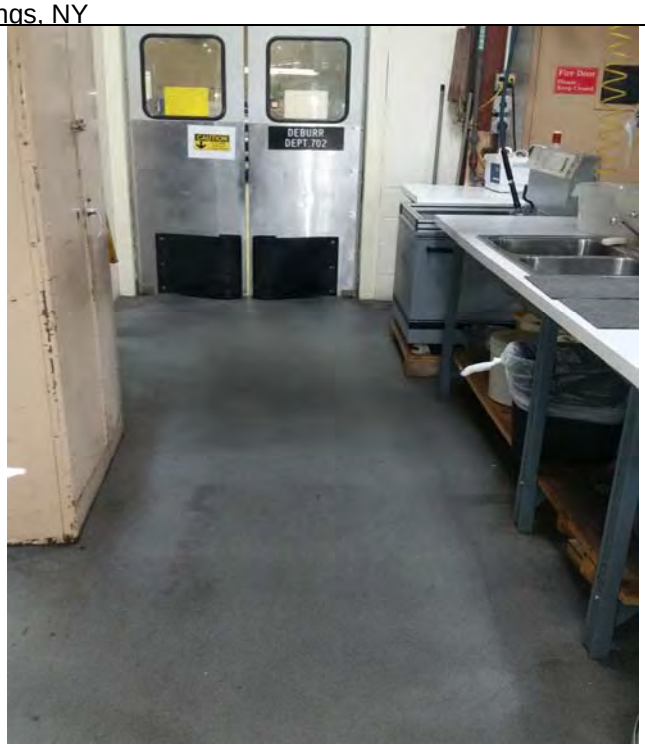
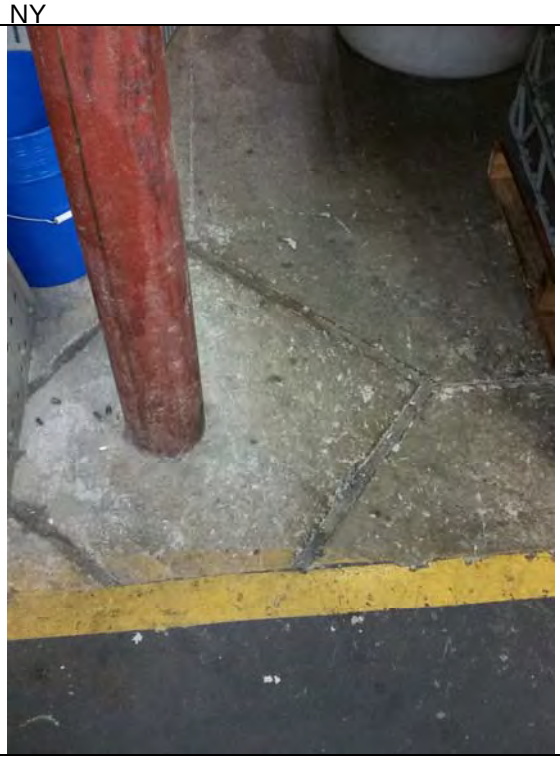
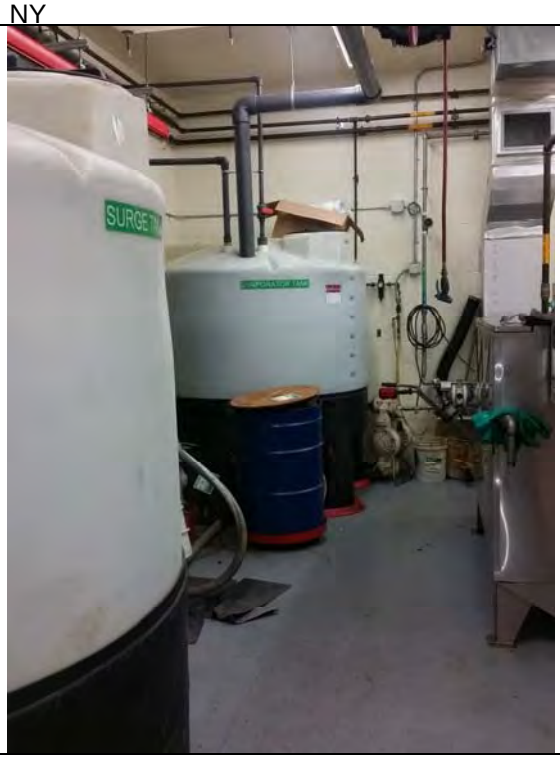
FP	Fireplaces	**######**	Areas of broken-up concrete
WS	Wood Stoves	● SS-1	Location & label of sub-slab samples
W/D	Washer / Dryer	● IA-1	Location & label of indoor air samples
S	Sumps	● OA-1	Location & label of outdoor air samples
@	Floor Drains	● PFET-1	Location and label of any pressure field test holes.

Appendix B
Inspection Photographic Log

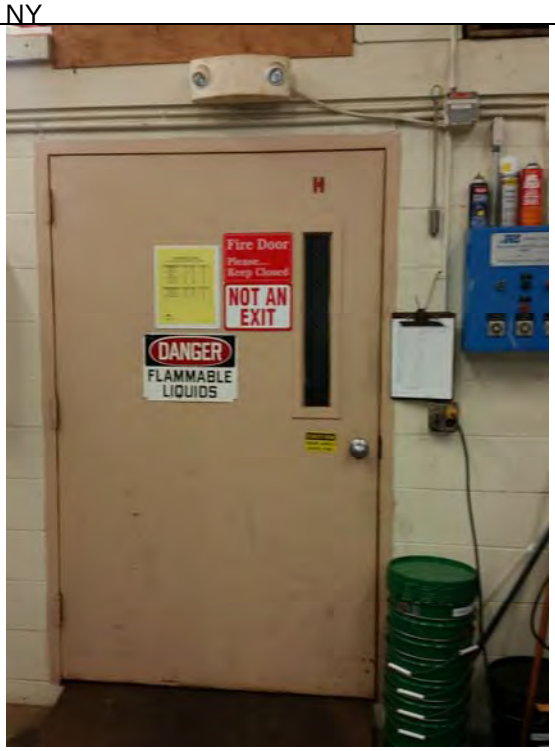
PHOTO LOG

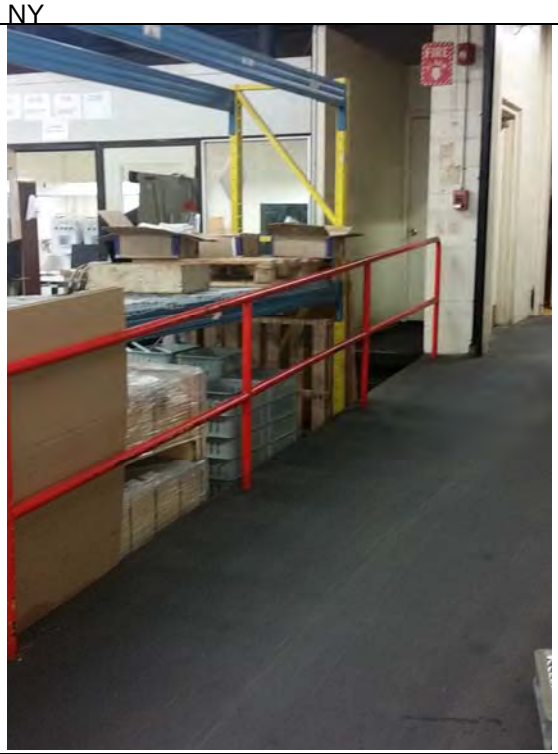
Property ID: GW Lisk	**Property Location:** Clifton Springs, NY
Photo #:1 **Date:2-November-2017**	
Description: Building 3- Looking towards deburr room – grip coated floor – no significant cracks observed.	

Property ID: GW Lisk	**Property Location:** Clifton Springs, NY
Photo #:2 **Date: 2-November-2017**	
Description: Building 4a- Concrete and gap seal around pillar in steel room. Potential pathway to be sealed.	

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:3	**Date: 2-November-2017**	
Description: Evaporator room in Building 4a. Epoxy floor, no significant cracks or gaps observed		

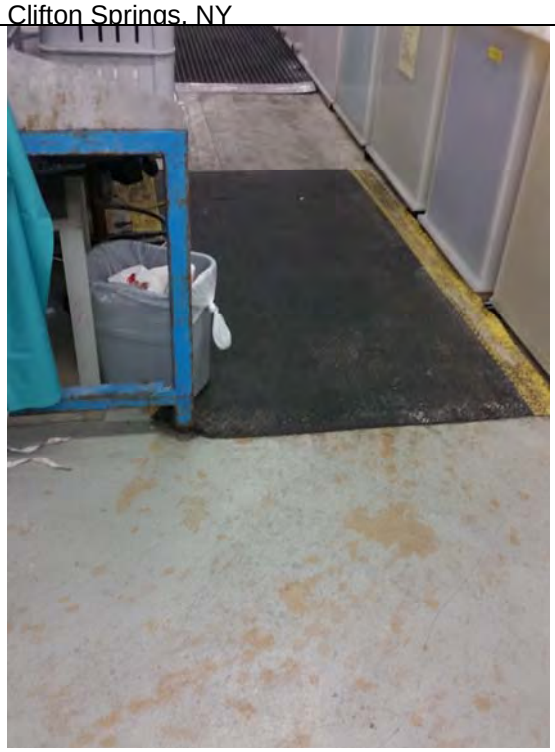
Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:4	**Date: 2-November-2017**	
Description: Building 4a- Chemical Storage Room. Cracks observed in floor. Potential pathway to be sealed.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:5	**Date: 2-November-2017**	
Description: Building 4A- Chemical Storage room - Door to flammable liquid storage room. Routine maintenance on seals/gaps to minimize potential vapor migration.		

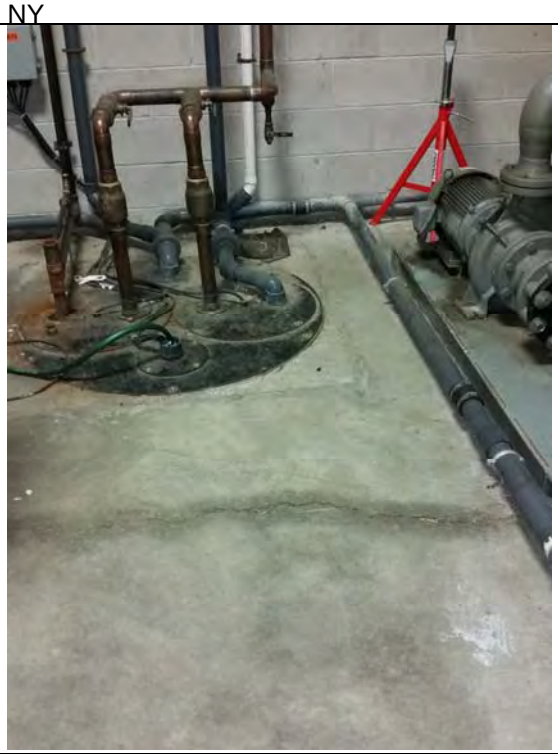
Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:6	**Date: 2-November-2017**	
Description: Building 4B – Ramp entrance facing building 4A.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:7	**Date: 2-November-2017**	
Description: Building 4B – Gap in sealant at wall/floor edge. Typical example.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:8	**Date: 2-November-2017**	
Description: Building 4D – Cracks in floor. Potential pathway to be sealed.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:9	**Date: 2-November-2017**	
Description: Building 5 – Plating room. Epoxy floor. No significant cracks observed.		

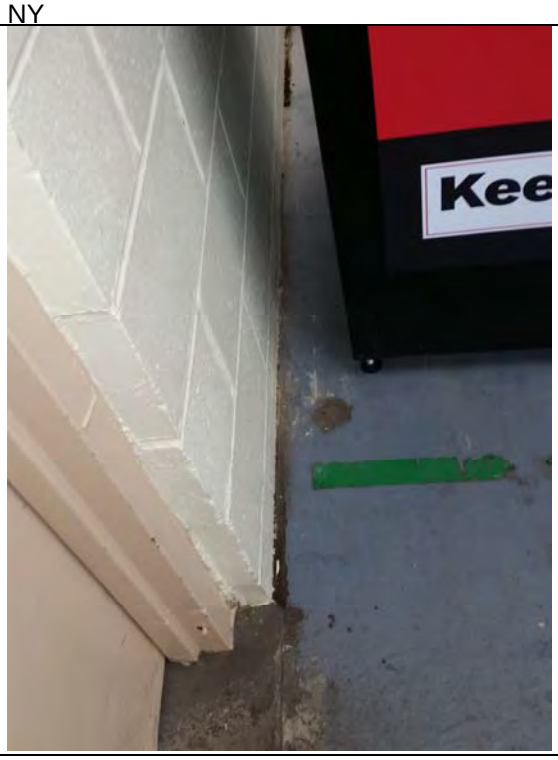
Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:10	**Date: 2-November-2017**	
Description: Building 6 – hallway floor. Grip coating. No significant cracks or wall gap observed.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:11	**Date: 2-November-2017**	
Description: Building 6A – Braze Room – Utility sump in floor and cracks. Potential pathway.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:12	**Date: 2-November-2017**	
Description: Building 6A – Saw cuts in epoxy floor. Potential pathway.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:13	**Date: 2-November-2017**	
Description: Building 6A – Covered sub slab access pit. Potential pathway.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:14	**Date: 2-November-2017**	
Description: Building 6A – Location of SV-13. Epoxy floor.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:15	**Date: 2-November-2017**	
Description: Building 6A – Wall-floor gap. Potential pathway.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:16	**Date: 2-November-2017**	
Description: Building 7- Gap in floor penetration around mechanical equipment.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:17	**Date: 2-November-2017**	
Description: Building 7- Floor penetration for equipment support. Potential pathway.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:18	**Date: 2-November-2017**	
Description: Building 7A – Observed cracks in floor. Potential vapor pathway.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:19	**Date: 2-November-2017**	
Description: Transition between buildings 6A and 7B. Note foundation wall between structures. Minimum depth of 4 foot below grade, potential subsurface vapor barrier.		

Property ID: GW Lisk		**Property Location:** Clifton Springs, NY
Photo #:20	**Date: 2-November-2017**	
Description: Building 7B – Epoxy seal at wall-floor edge. No significant potential pathway observed.		

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

February 2018

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 an Interim Remedial Measure (IRM) 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 IRM 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 2-2 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 INTERIM REMEDIAL MEASURE OBJECTIVES

The primary goal of the IRM is to address and mitigate potential contaminants that are present in sub-slab soil vapor at the Site at concentrations above applicable standards, criteria, and guidance (SCGs).

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.

The Laboratory DQOs are provided in Table 1

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.

The frequency of field QC samples collected will depend on the total number of samples being collected. Specifics of the sampling activities, including collection frequency and sampling procedures, are described in the field procedures. The types of field QC samples that will be generated during the project are defined below.

- **Field (Blind) duplicates –** Field or blind duplicates are used to monitor field and laboratory precision, as well as matrix heterogeneity.

- **Ambient air samples –** Ambient air samples are used to ascertain background levels.

A list of field QC samples is included in Table 2. A list of samples is included in Table 3. A summary of the air sampling program is included in Table 4.

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.

- **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.

Overall QC checks are summarized in Table 5.

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 IRM, 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.

Sub-slab soil vapor and ambient air will be collected for analysis for some or all of the following analytes: volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and United States Environmental Protection Agency (USEPA) Target Analyte List (TAL) metals. 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). A summary of anticipated samples to be collected is presented in Table 3.

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 28 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 27 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 will be responsible for coordination and detailed technical aspects of the project and management of all field activities.

Jason Reynolds will be the field team lead and Field Safety Officer (FSO) for this project. Mr. Reynolds has over five years of professional experience. He has performed many field investigation projects, including projects at designated Brownfield Cleanup Program (BCP) and Voluntary Cleanup Program (VCP) sites. Mr. Reynolds will be responsible for implementing the HASP, SSC protocols, and field activities.

Andrew Coenen, will be the QA/QC Officer for this project. Mr. Coenen has 24 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.

Table 1 – Alpha Analytical
Analytical Laboratory Data Quality Objectives (DQOs)
Precision and Accuracy
Volatile Organic Compounds (VOCs)

Matrix	*QC Compounds*	*CAS Number*[1]	*Reporting Limit (ug/m³)*	*Surrogate Accuracy (% Rec.)* [2]	*Blind Field Duplicate Precision (% RPD)*	*Method Blanks*	*LCS Accuracy (% Rec.)* [2]	*LCS Precision (% RPD)* [2]
Air	All Compounds				≤ 20	≤ RL		
	1,1,1-Trichloroethane	71-55-6	1.09				73-124	25
	1,1-Dichloroethene	75-35-4	0.079				70-129	25
	Carbon Tetrachloride	56-23-5	1.26				72-127	25
	Tetrachloroethene	127-18-4	1.36				68-123	25
	Vinyl Chloride	75-01-4	0.051				75-130	25
	Trichloroethene	79-01-6	1.07				76-118	25
	cis-1,2-Dichloroethene	156-59-2	0.793				76-126	25

Notes:
1. Chemical Abstracts Service (CAS) Registry Number.
2. QC limits as established by Alpha for Method TO-15. Subject to change.

QC = Quality Control; % Rec. = Percent Recovery; % RPD = Relative Percent Difference; LCS = Laboratory Check Sample; RL = Reporting Limit.

TABLE 2
SAMPLE TOTAL SUMMARY

Task	*Analytical Parameters*	*Matrix*	*Number of Samples*	*Blind Field Duplicates*	*MS/MSD Pairs*	*Field Blanks*	*Trip Blanks*
Pre-Characterization Sub-Slab Vapor Sampling	TO-15 - 7 compounds	Air	7	1	0	0	0
Post-Mitigation Sub-Slab Vapor Sampling	TO-15 - 7 compounds	Air	3	1	0	0	0
Post-Mitigation Indoor Air Sampling	TO-15 - 7 compounds	Air	3	1	0	0	0

TABLE 3
SAMPLING LOCATIONS

Task	*Locations to be Sampled*	*Matrix*	*Analysis*
Vapor Intrusion Sampling	SV-Bldg 4A	Air	TO-15
	SV-Bldg 4C	Air	TO-15
	SV-Bldg 4D	Air	TO-15
	SV-AOPC5	Air	TO-15
	SV-Bldg 7	Air	TO-15
	SV-Bldg 7B-1	Air	TO-15
	SV-Bldg 7B-2	Air	TO-15
	VI-02	Air	TO-15
	VI-03	Air	TO-15
	VI-04	Air	TO-15
	SS-02	Air	TO-15
	SS-03	Air	TO-15
	SS-04	Air	TO-15

TABLE 4
DETAILED SUMMARY OF AIR SAMPLING PROGRAM
SAMPLE TOTALS, ANALYTICAL METHODS, PRESERVATIVES, HOLDING TIMES AND CONTAINERS

Analytical Parameters	*Analytical Method Reference*	*Sample Preservation*	*Holding Time*	*Container*
VOCs in Air	TO-15 – 7 Compounds- List	None	30 days	0.5 – 6 liter Summa Canister

TABLE 5
QUALITY CONTROL (QC) CHECK SUMMARY

Quality Control (QC) Checks	*Minimum Frequency*
Field Blank (FB)	Not applicable for vapor samples
Trip Blank (TB)	Not applicable for vapor samples
Blind Field Duplicate (DUP)	1 per matrix per parameter per 20 samples
Surrogate Compound Spike	Not applicable for vapor samples
Matrix Spike (MS)	Not applicable for vapor samples
Matrix Spike Duplicate (MSD)	Not applicable for vapor samples
Laboratory Control Sample (LCS) or Blank Spike Sample (BS)	1 per analytical batch not to exceed 20 samples
Method (Preparation) Blank (MB)	1 per 20 samples or prep/analysis batch per SDG
Internal Standard	Every analytical run

Notes:

1. Sample Delivery Group

Appendix D
Data Usability Summary Reports

ENVIRONMENTAL
Data Services, Inc.

DATA USABILITY SUMMARY REPORT (DUSR)

Client: ERM

Site: G.W. Lisk Facility - Clifton Springs, New York

Laboratory: Alpha Analytical – Mansfield, MA

Lab Number: L1715353

Date: October 19, 2017

EDS Sample ID	Client Sample ID	Laboratory Sample ID	Matrix
01	AA	L1715353-01	Ambient Air
02	VI-01-IA	L1715353-02	Indoor Air
03	VI-01-SS	L1715353-03	Sub-Slab Vapor
04	VI-02-IA	L1715353-04	Indoor Air
05	VI-02-SS	L1715353-05	Sub-Slab Vapor
06	VI-03-IA	L1715353-06	Indoor Air
07	VI-03-SS	L1715353-07	Sub-Slab Vapor
08	VI-04-IA	L1715353-08	Indoor Air
09	VI-04-SS	L1715353-09	Sub-Slab Vapor
10	VI-05-IA	L1715353-10	Indoor Air
11	VI-05-SS	L1715353-11	Sub-Slab Vapor
12	GWL-VI-DUP (GWL-VI-04-IA)	L1715353-12	Indoor Air

VOLATILE ORGANIC COMPOUNDS (VOCs)

Compendium Method TO-15

The samples were analyzed following "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition 1997, EPA/625/R-96/010B", Compendium Method TO-15, "Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/Mass Spectrometry *(GC/MS)*". The data have been evaluated according to the protocols and quality control (QC) requirements of the analytical method, the NYSDEC ASP, the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review (August 2014), the USEPA Region 2 Data Review Standard Operating Procedure (SOP) Number HW-31, Revision 4, October 2006: Validating Volatile Organic Analysis of Ambient Air in canister by Method TO-15, and the reviewer's professional judgment.

Chain-of-Custody (COC) – No discrepancies were identified. The COC requested specific reporting limits (RLs) for certain compounds. More details are provided below in the Reporting Limits/Compound Identification section of this review.

Holding Time (HT) – All HT criteria were met.

Canister Certification – Canisters were batch certified. No positively identified target compounds were observed.

Canister and Flow Controller Receipt – A review of the final canister pressures and a pre/post flow controller calibration check by the lab upon sample receipt indicated samples exhibiting minor discrepancies. EDS IDs 03 and 10 exhibited a pre/post flow controller calibration check with a relative percent difference (RPD) above criteria. No discrepancies were observed with the final canister vacuums for these samples. No qualification of the sample data is required.

Surrogates – Surrogates were not spiked into the samples. No qualification is required.

Lab Control Sample (LCS) – All percent recovery (%R) met QC criteria except those in the table below.

LCS ID	Compound	%R Bias	Associated EDS IDs	Qualifier
WG1004445-3	Propane	66% (Low)	All	None – not a target compound

Laboratory Duplicate (LD) – The LDs were analyzed on EDS ID 02. All RPDs were within QC criteria.

Method Blank (MB) - The MBs contained no positively identified target compounds.

GC/MS Tuning – All tuning criteria were met.

Initial Calibration (ICAL) - The ICAL exhibited acceptable percent relative standard deviation (%RSD) and mean relative response factor (RRF) values.

Continuing Calibration Verifications (CCVs) - The CCVs exhibited acceptable percent difference (%D) and RRF values.

Internal Standard (IS) Area Performance - All IS met response and retention time (RT) criteria.

Blind Field Duplicate – EDS ID 12 is a blind field duplicate of EDS ID 08. All results matched well.

Reporting Limits/Compound Identification – The following seven compounds were analyzed using Selective Ion Monitoring (SIM) mode to achieve lower RLs for all indoor air (IA) and ambient air (AA) samples: Vinyl chloride, 1,1-Dichloroethene, cis-1,2-Dichloroethene, 1,1,1-Trichloroethane, Carbon tetrachloride, Trichloroethene, and Tetrachloroethene.

EDS ID 03, 05, and 11 were analyzed at dilutions (5x, 10x, and 5x) due to the elevated presence of non-target compounds. EDS ID 07 and 09 were analyzed at dilutions (233.6x and 203.3x) due to the elevated presence of target compounds. No qualification of the sample data is required; however the end user should be aware of the elevated RLs.

EDS ID 09 was reanalyzed at a further dilution due to Freon-113 exceeding the calibration range of the instrument in the initial analysis. The lab has flagged Freon-113 with an "E" on the Form I and reported the further diluted result for Freon-113 on a separate Form I. The dilution was justified. The result for Freon-113 from the further diluted analysis is to be reported. All other results are reported from the initial analysis. No qualification of the sample data is required.

Data Qualifier	Definition
None	The compound was positively identified at the associated numerical value which is the concentration of the compound in the sample.
U	Non-Detect. The compound was analyzed for, but not detected. The associated numerical value is the RL. The value is usable as a non-detect at the RL.

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-01	Date Collected	: 05/10/17 11:47
Client ID	: GWL-AA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 17:52
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120152	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	0.431	0.200	--	2.13	0.989	--	
74-87-3	Chloromethane	0.587	0.200	--	1.21	0.413	--	
76-14-2	Freon-114	ND	0.200	--	ND	1.40	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethanol	ND	5.00	--	ND	9.42	--	U
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	2.54	1.00	--	6.03	2.38	--	
75-69-4	Trichlorofluoromethane	0.240	0.200	--	1.35	1.12	--	
67-63-0	Isopropanol	ND	0.500	--	ND	1.23	--	U
75-65-0	Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--	U
75-09-2	Methylene chloride	ND	0.500	--	ND	1.74	--	U
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	ND	0.200	--	ND	0.623	--	U
76-13-1	Freon-113	ND	0.200	--	ND	1.53	--	U
156-60-5	trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--	U
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	ND	0.500	--	ND	1.47	--	U
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	ND	0.200	--	ND	0.705	--	U
71-43-2	Benzene	ND	0.200	--	ND	0.639	--	U
110-82-7	Cyclohexane	ND	0.200	--	ND	0.688	--	U
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-01	Date Collected	: 05/10/17 11:47
Client ID	: GWL-AA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 17:52
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120152	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
540-84-1	2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--	U
142-82-5	Heptane	ND	0.200	--	ND	0.820	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	ND	0.200	--	ND	0.754	--	U
591-78-6	2-Hexanone	ND	0.200	--	ND	0.820	--	U
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	ND	0.200	--	ND	0.869	--	U
179601-23-1	p/m-Xylene	ND	0.400	--	ND	1.74	--	U
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	ND	0.200	--	ND	0.852	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	ND	0.200	--	ND	0.869	--	U
622-96-8	4-Ethyltoluene	ND	0.200	--	ND	0.983	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--	U
95-63-6	1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--	U
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-01	Date Collected	: 05/10/17 11:47
Client ID	: GWL-AA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 17:52
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15-SIM	Analyst	: RY
Lab File ID	: R1120152	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-01-4	Vinyl chloride	ND	0.020	--	ND	0.051	--	U
75-35-4	1,1-Dichloroethene	ND	0.020	--	ND	0.079	--	U
156-59-2	cis-1,2-Dichloroethene	ND	0.020	--	ND	0.079	--	U
71-55-6	1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--	U
56-23-5	Carbon tetrachloride	0.055	0.020	--	0.346	0.126	--	
79-01-6	Trichloroethene	ND	0.020	--	ND	0.107	--	U
127-18-4	Tetrachloroethene	ND	0.020	--	ND	0.136	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-02	Date Collected	: 05/10/17 13:05
Client ID	: GWL-VI-01-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 18:27
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120153	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	0.391	0.200	--	1.93	0.989	--	
74-87-3	Chloromethane	0.645	0.200	--	1.33	0.413	--	
76-14-2	Freon-114	ND	0.200	--	ND	1.40	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethanol	18.1	5.00	--	34.1	9.42	--	
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	66.6	1.00	--	158	2.38	--	
75-69-4	Trichlorofluoromethane	2.03	0.200	--	11.4	1.12	--	
67-63-0	Isopropanol	142	0.500	--	349	1.23	--	
75-65-0	Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--	U
75-09-2	Methylene chloride	5.75	0.500	--	20.0	1.74	--	
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	ND	0.200	--	ND	0.623	--	U
76-13-1	Freon-113	0.203	0.200	--	1.56	1.53	--	
156-60-5	trans-1,2-Dichloroethene	27.7	0.200	--	110	0.793	--	
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	0.595	0.500	--	1.75	1.47	--	
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	ND	0.200	--	ND	0.705	--	U
71-43-2	Benzene	ND	0.200	--	ND	0.639	--	U
110-82-7	Cyclohexane	ND	0.200	--	ND	0.688	--	U
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-02	Date Collected	: 05/10/17 13:05
Client ID	: GWL-VI-01-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 18:27
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120153	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
540-84-1	2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--	U
142-82-5	Heptane	ND	0.200	--	ND	0.820	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	ND	0.200	--	ND	0.754	--	U
591-78-6	2-Hexanone	ND	0.200	--	ND	0.820	--	U
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	4.73	0.200	--	20.5	0.869	--	
179601-23-1	p/m-Xylene	17.2	0.400	--	74.7	1.74	--	
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	15.0	0.200	--	63.9	0.852	--	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	2.72	0.200	--	11.8	0.869	--	
622-96-8	4-Ethyltoluene	ND	0.200	--	ND	0.983	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--	U
95-63-6	1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--	U
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-02	Date Collected	: 05/10/17 13:05
Client ID	: GWL-VI-01-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 18:27
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15-SIM	Analyst	: RY
Lab File ID	: R1120153	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-01-4	Vinyl chloride	ND	0.020	--	ND	0.051	--	U
75-35-4	1,1-Dichloroethene	ND	0.020	--	ND	0.079	--	U
156-59-2	cis-1,2-Dichloroethene	0.020	0.020	--	0.079	0.079	--	
71-55-6	1,1,1-Trichloroethane	0.055	0.020	--	0.300	0.109	--	
56-23-5	Carbon tetrachloride	0.064	0.020	--	0.403	0.126	--	
79-01-6	Trichloroethene	0.057	0.020	--	0.306	0.107	--	
127-18-4	Tetrachloroethene	0.066	0.020	--	0.448	0.136	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-03D	Date Collected	: 05/10/17 13:05
Client ID	: GWL-VI-01-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 08:59
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120174	Instrument ID	: AIRLAB11
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	2.57	1.00	--	12.7	4.94	--	
74-87-3	Chloromethane	ND	1.00	--	ND	2.07	--	U
76-14-2	Freon-114	ND	1.00	--	ND	6.99	--	U
75-01-4	Vinyl chloride	ND	1.00	--	ND	2.56	--	U
106-99-0	1,3-Butadiene	ND	1.00	--	ND	2.21	--	U
74-83-9	Bromomethane	ND	1.00	--	ND	3.88	--	U
75-00-3	Chloroethane	ND	1.00	--	ND	2.64	--	U
64-17-5	Ethanol	130	25.0	--	245	47.1	--	
593-60-2	Vinyl bromide	ND	1.00	--	ND	4.37	--	U
67-64-1	Acetone	260	5.00	--	618	11.9	--	
75-69-4	Trichlorofluoromethane	1.24	1.00	--	6.97	5.62	--	
67-63-0	Isopropanol	25.5	2.50	--	62.7	6.15	--	
75-35-4	1,1-Dichloroethene	ND	1.00	--	ND	3.96	--	U
75-65-0	Tertiary butyl Alcohol	ND	2.50	--	ND	7.58	--	U
75-09-2	Methylene chloride	3.43	2.50	--	11.9	8.69	--	
107-05-1	3-Chloropropene	ND	1.00	--	ND	3.13	--	U
75-15-0	Carbon disulfide	ND	1.00	--	ND	3.11	--	U
76-13-1	Freon-113	146	1.00	--	1120	7.66	--	
156-60-5	trans-1,2-Dichloroethene	15.2	1.00	--	60.3	3.96	--	
75-34-3	1,1-Dichloroethane	ND	1.00	--	ND	4.05	--	U
1634-04-4	Methyl tert butyl ether	ND	1.00	--	ND	3.61	--	U
78-93-3	2-Butanone	ND	2.50	--	ND	7.37	--	U
156-59-2	cis-1,2-Dichloroethene	ND	1.00	--	ND	3.96	--	U
141-78-6	Ethyl Acetate	ND	2.50	--	ND	9.01	--	U
67-66-3	Chloroform	ND	1.00	--	ND	4.88	--	U
109-99-9	Tetrahydrofuran	ND	2.50	--	ND	7.37	--	U
107-06-2	1,2-Dichloroethane	ND	1.00	--	ND	4.05	--	U
110-54-3	n-Hexane	18.9	1.00	--	66.6	3.52	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-03D	Date Collected	: 05/10/17 13:05
Client ID	: GWL-VI-01-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 08:59
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120174	Instrument ID	: AIRLAB11
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	ND	1.00	--	ND	5.46	--	U
71-43-2	Benzene	2.67	1.00	--	8.53	3.19	--	
56-23-5	Carbon tetrachloride	ND	1.00	--	ND	6.29	--	U
110-82-7	Cyclohexane	4.46	1.00	--	15.4	3.44	--	
78-87-5	1,2-Dichloropropane	ND	1.00	--	ND	4.62	--	U
75-27-4	Bromodichloromethane	ND	1.00	--	ND	6.70	--	U
123-91-1	1,4-Dioxane	ND	1.00	--	ND	3.60	--	U
79-01-6	Trichloroethene	ND	1.00	--	ND	5.37	--	U
540-84-1	2,2,4-Trimethylpentane	ND	1.00	--	ND	4.67	--	U
142-82-5	Heptane	10.8	1.00	--	44.3	4.10	--	
10061-01-5	cis-1,3-Dichloropropene	ND	1.00	--	ND	4.54	--	U
108-10-1	4-Methyl-2-pentanone	ND	2.50	--	ND	10.2	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	1.00	--	ND	4.54	--	U
79-00-5	1,1,2-Trichloroethane	ND	1.00	--	ND	5.46	--	U
108-88-3	Toluene	2.98	1.00	--	11.2	3.77	--	
591-78-6	2-Hexanone	ND	1.00	--	ND	4.10	--	U
124-48-1	Dibromochloromethane	ND	1.00	--	ND	8.52	--	U
106-93-4	1,2-Dibromoethane	ND	1.00	--	ND	7.69	--	U
127-18-4	Tetrachloroethene	ND	1.00	--	ND	6.78	--	U
108-90-7	Chlorobenzene	ND	1.00	--	ND	4.61	--	U
100-41-4	Ethylbenzene	3.28	1.00	--	14.2	4.34	--	
179601-23-1	p/m-Xylene	11.6	2.00	--	50.4	8.69	--	
75-25-2	Bromoform	ND	1.00	--	ND	10.3	--	U
100-42-5	Styrene	10.1	1.00	--	43.0	4.26	--	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.00	--	ND	6.87	--	U
95-47-6	o-Xylene	1.87	1.00	--	8.12	4.34	--	
622-96-8	4-Ethyltoluene	ND	1.00	--	ND	4.92	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	1.00	--	ND	4.92	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-03D	Date Collected	: 05/10/17 13:05
Client ID	: GWL-VI-01-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 08:59
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120174	Instrument ID	: AIRLAB11
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	1.00	--	ND	4.92	--	U
100-44-7	Benzyl chloride	ND	1.00	--	ND	5.18	--	U
541-73-1	1,3-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
106-46-7	1,4-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
95-50-1	1,2-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	1.00	--	ND	7.42	--	U
87-68-3	Hexachlorobutadiene	ND	1.00	--	ND	10.7	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-04	Date Collected	: 05/10/17 12:14
Client ID	: GWL-VI-02-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 19:37
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120155	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	0.376	0.200	--	1.86	0.989	--	
74-87-3	Chloromethane	0.616	0.200	--	1.27	0.413	--	
76-14-2	Freon-114	ND	0.200	--	ND	1.40	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethanol	15.2	5.00	--	28.6	9.42	--	
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	40.6	1.00	--	96.4	2.38	--	
75-69-4	Trichlorofluoromethane	0.232	0.200	--	1.30	1.12	--	
67-63-0	Isopropanol	41.4	0.500	--	102	1.23	--	
75-65-0	Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--	U
75-09-2	Methylene chloride	0.689	0.500	--	2.39	1.74	--	
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	7.42	0.200	--	23.1	0.623	--	
76-13-1	Freon-113	ND	0.200	--	ND	1.53	--	U
156-60-5	trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--	U
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	0.774	0.500	--	2.28	1.47	--	
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	ND	0.200	--	ND	0.705	--	U
71-43-2	Benzene	0.239	0.200	--	0.764	0.639	--	
110-82-7	Cyclohexane	ND	0.200	--	ND	0.688	--	U
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-04	Date Collected	: 05/10/17 12:14
Client ID	: GWL-VI-02-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 19:37
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120155	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
540-84-1	2,2,4-Trimethylpentane	0.247	0.200	--	1.15	0.934	--	
142-82-5	Heptane	ND	0.200	--	ND	0.820	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	2.46	0.200	--	9.27	0.754	--	
591-78-6	2-Hexanone	ND	0.200	--	ND	0.820	--	U
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	ND	0.200	--	ND	0.869	--	U
179601-23-1	p/m-Xylene	0.710	0.400	--	3.08	1.74	--	
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	ND	0.200	--	ND	0.852	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	0.370	0.200	--	1.61	0.869	--	
622-96-8	4-Ethyltoluene	0.360	0.200	--	1.77	0.983	--	
108-67-8	1,3,5-Trimethylbenzene	1.02	0.200	--	5.01	0.983	--	
95-63-6	1,2,4-Trimethylbenzene	2.30	0.200	--	11.3	0.983	--	
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-04	Date Collected	: 05/10/17 12:14
Client ID	: GWL-VI-02-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 19:37
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15-SIM	Analyst	: RY
Lab File ID	: R1120155	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-01-4	Vinyl chloride	ND	0.020	--	ND	0.051	--	U
75-35-4	1,1-Dichloroethene	ND	0.020	--	ND	0.079	--	U
156-59-2	cis-1,2-Dichloroethene	ND	0.020	--	ND	0.079	--	U
71-55-6	1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--	U
56-23-5	Carbon tetrachloride	0.062	0.020	--	0.390	0.126	--	
79-01-6	Trichloroethene	0.030	0.020	--	0.161	0.107	--	
127-18-4	Tetrachloroethene	ND	0.020	--	ND	0.136	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-05D	Date Collected	: 05/10/17 12:15
Client ID	: GWL-VI-02-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 01:20
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 10
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120165	Instrument ID	: AIRLAB11
Sample Amount	: 25.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	ND	2.00	--	ND	9.89	--	U
74-87-3	Chloromethane	ND	2.00	--	ND	4.13	--	U
76-14-2	Freon-114	ND	2.00	--	ND	14.0	--	U
75-01-4	Vinyl chloride	ND	2.00	--	ND	5.11	--	U
106-99-0	1,3-Butadiene	ND	2.00	--	ND	4.42	--	U
74-83-9	Bromomethane	ND	2.00	--	ND	7.77	--	U
75-00-3	Chloroethane	ND	2.00	--	ND	5.28	--	U
64-17-5	Ethanol	397	50.0	--	748	94.2	--	
593-60-2	Vinyl bromide	ND	2.00	--	ND	8.74	--	U
67-64-1	Acetone	2070	10.0	--	4920	23.8	--	
75-69-4	Trichlorofluoromethane	ND	2.00	--	ND	11.2	--	U
67-63-0	Isopropanol	162	5.00	--	398	12.3	--	
75-35-4	1,1-Dichloroethene	ND	2.00	--	ND	7.93	--	U
75-65-0	Tertiary butyl Alcohol	53.6	5.00	--	162	15.2	--	
75-09-2	Methylene chloride	8.74	5.00	--	30.4	17.4	--	
107-05-1	3-Chloropropene	ND	2.00	--	ND	6.26	--	U
75-15-0	Carbon disulfide	6.84	2.00	--	21.3	6.23	--	
76-13-1	Freon-113	11.6	2.00	--	88.9	15.3	--	
156-60-5	trans-1,2-Dichloroethene	ND	2.00	--	ND	7.93	--	U
75-34-3	1,1-Dichloroethane	ND	2.00	--	ND	8.09	--	U
1634-04-4	Methyl tert butyl ether	ND	2.00	--	ND	7.21	--	U
78-93-3	2-Butanone	25.1	5.00	--	74.0	14.7	--	
156-59-2	cis-1,2-Dichloroethene	ND	2.00	--	ND	7.93	--	U
141-78-6	Ethyl Acetate	ND	5.00	--	ND	18.0	--	U
67-66-3	Chloroform	ND	2.00	--	ND	9.77	--	U
109-99-9	Tetrahydrofuran	ND	5.00	--	ND	14.7	--	U
107-06-2	1,2-Dichloroethane	ND	2.00	--	ND	8.09	--	U
110-54-3	n-Hexane	164	2.00	--	578	7.05	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-05D	Date Collected	: 05/10/17 12:15
Client ID	: GWL-VI-02-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 01:20
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 10
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120165	Instrument ID	: AIRLAB11
Sample Amount	: 25.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	39.3	2.00	--	214	10.9	--	
71-43-2	Benzene	7.92	2.00	--	25.3	6.39	--	
56-23-5	Carbon tetrachloride	ND	2.00	--	ND	12.6	--	U
110-82-7	Cyclohexane	53.7	2.00	--	185	6.88	--	
78-87-5	1,2-Dichloropropane	ND	2.00	--	ND	9.24	--	U
75-27-4	Bromodichloromethane	ND	2.00	--	ND	13.4	--	U
123-91-1	1,4-Dioxane	2.21	2.00	--	7.96	7.21	--	
79-01-6	Trichloroethene	92.8	2.00	--	499	10.7	--	
540-84-1	2,2,4-Trimethylpentane	ND	2.00	--	ND	9.34	--	U
142-82-5	Heptane	137	2.00	--	561	8.20	--	
10061-01-5	cis-1,3-Dichloropropene	ND	2.00	--	ND	9.08	--	U
108-10-1	4-Methyl-2-pentanone	ND	5.00	--	ND	20.5	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	2.00	--	ND	9.08	--	U
79-00-5	1,1,2-Trichloroethane	ND	2.00	--	ND	10.9	--	U
108-88-3	Toluene	16.1	2.00	--	60.7	7.54	--	
591-78-6	2-Hexanone	ND	2.00	--	ND	8.20	--	U
124-48-1	Dibromochloromethane	ND	2.00	--	ND	17.0	--	U
106-93-4	1,2-Dibromoethane	ND	2.00	--	ND	15.4	--	U
127-18-4	Tetrachloroethene	46.9	2.00	--	318	13.6	--	
108-90-7	Chlorobenzene	ND	2.00	--	ND	9.21	--	U
100-41-4	Ethylbenzene	ND	2.00	--	ND	8.69	--	U
179601-23-1	p/m-Xylene	5.00	4.00	--	21.7	17.4	--	
75-25-2	Bromoform	ND	2.00	--	ND	20.7	--	U
100-42-5	Styrene	ND	2.00	--	ND	8.52	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	2.00	--	ND	13.7	--	U
95-47-6	o-Xylene	ND	2.00	--	ND	8.69	--	U
622-96-8	4-Ethyltoluene	ND	2.00	--	ND	9.83	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	2.00	--	ND	9.83	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-05D	Date Collected	: 05/10/17 12:15
Client ID	: GWL-VI-02-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 01:20
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 10
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120165	Instrument ID	: AIRLAB11
Sample Amount	: 25.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	2.00	--	ND	9.83	--	U
100-44-7	Benzyl chloride	ND	2.00	--	ND	10.4	--	U
541-73-1	1,3-Dichlorobenzene	ND	2.00	--	ND	12.0	--	U
106-46-7	1,4-Dichlorobenzene	ND	2.00	--	ND	12.0	--	U
95-50-1	1,2-Dichlorobenzene	ND	2.00	--	ND	12.0	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	2.00	--	ND	14.8	--	U
87-68-3	Hexachlorobutadiene	ND	2.00	--	ND	21.3	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-06	Date Collected	: 05/10/17 12:37
Client ID	: GWL-VI-03-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 20:12
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120156	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	0.431	0.200	--	2.13	0.989	--	
74-87-3	Chloromethane	0.574	0.200	--	1.19	0.413	--	
76-14-2	Freon-114	ND	0.200	--	ND	1.40	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethanol	22.3	5.00	--	42.0	9.42	--	
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	9.90	1.00	--	23.5	2.38	--	
75-69-4	Trichlorofluoromethane	0.907	0.200	--	5.10	1.12	--	
67-63-0	Isopropanol	122	0.500	--	300	1.23	--	
75-65-0	Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--	U
75-09-2	Methylene chloride	3.43	0.500	--	11.9	1.74	--	
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	0.353	0.200	--	1.10	0.623	--	
76-13-1	Freon-113	0.263	0.200	--	2.02	1.53	--	
156-60-5	trans-1,2-Dichloroethene	11.0	0.200	--	43.6	0.793	--	
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	0.723	0.500	--	2.13	1.47	--	
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	0.258	0.200	--	0.909	0.705	--	
71-43-2	Benzene	ND	0.200	--	ND	0.639	--	U
110-82-7	Cyclohexane	ND	0.200	--	ND	0.688	--	U
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-06	Date Collected	: 05/10/17 12:37
Client ID	: GWL-VI-03-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 20:12
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120156	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
540-84-1	2,2,4-Trimethylpentane	0.225	0.200	--	1.05	0.934	--	
142-82-5	Heptane	ND	0.200	--	ND	0.820	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	0.480	0.200	--	1.81	0.754	--	
591-78-6	2-Hexanone	ND	0.200	--	ND	0.820	--	U
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	0.352	0.200	--	1.53	0.869	--	
179601-23-1	p/m-Xylene	1.52	0.400	--	6.60	1.74	--	
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	ND	0.200	--	ND	0.852	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	0.484	0.200	--	2.10	0.869	--	
622-96-8	4-Ethyltoluene	0.342	0.200	--	1.68	0.983	--	
108-67-8	1,3,5-Trimethylbenzene	0.811	0.200	--	3.99	0.983	--	
95-63-6	1,2,4-Trimethylbenzene	1.97	0.200	--	9.68	0.983	--	
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-06	Date Collected	: 05/10/17 12:37
Client ID	: GWL-VI-03-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 20:12
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15-SIM	Analyst	: RY
Lab File ID	: R1120156	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-01-4	Vinyl chloride	ND	0.020	--	ND	0.051	--	U
75-35-4	1,1-Dichloroethene	ND	0.020	--	ND	0.079	--	U
156-59-2	cis-1,2-Dichloroethene	0.033	0.020	--	0.131	0.079	--	
71-55-6	1,1,1-Trichloroethane	0.044	0.020	--	0.240	0.109	--	
56-23-5	Carbon tetrachloride	0.065	0.020	--	0.409	0.126	--	
79-01-6	Trichloroethene	0.533	0.020	--	2.86	0.107	--	
127-18-4	Tetrachloroethene	0.081	0.020	--	0.549	0.136	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-07D	Date Collected	: 05/10/17 12:36
Client ID	: GWL-VI-03-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 10:04
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 233.6
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120176	Instrument ID	: AIRLAB11
Sample Amount	: 1.07 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	71.5	46.7	--	354	231	--	
74-87-3	Chloromethane	ND	46.7	--	ND	96.4	--	U
76-14-2	Freon-114	ND	46.7	--	ND	326.	--	U
75-01-4	Vinyl chloride	ND	46.7	--	ND	119.	--	U
106-99-0	1,3-Butadiene	ND	46.7	--	ND	103.	--	U
74-83-9	Bromomethane	ND	46.7	--	ND	181.	--	U
75-00-3	Chloroethane	ND	46.7	--	ND	123.	--	U
64-17-5	Ethanol	ND	1170	--	ND	2200	--	U
593-60-2	Vinyl bromide	ND	46.7	--	ND	204.	--	U
67-64-1	Acetone	305	234	--	725	556	--	
75-69-4	Trichlorofluoromethane	ND	46.7	--	ND	262.	--	U
67-63-0	Isopropanol	ND	117	--	ND	288.	--	U
75-35-4	1,1-Dichloroethene	1380	46.7	--	5470	185	--	
75-65-0	Tertiary butyl Alcohol	ND	117	--	ND	355	--	U
75-09-2	Methylene chloride	ND	117	--	ND	406	--	U
107-05-1	3-Chloropropene	ND	46.7	--	ND	146.	--	U
75-15-0	Carbon disulfide	ND	46.7	--	ND	145.	--	U
76-13-1	Freon-113	6980	46.7	--	53500	358	--	
156-60-5	trans-1,2-Dichloroethene	ND	46.7	--	ND	185.	--	U
75-34-3	1,1-Dichloroethane	218	46.7	--	882	189	--	
1634-04-4	Methyl tert butyl ether	ND	46.7	--	ND	168.	--	U
78-93-3	2-Butanone	ND	117	--	ND	345.	--	U
156-59-2	cis-1,2-Dichloroethene	218	46.7	--	864	185	--	
141-78-6	Ethyl Acetate	ND	117	--	ND	422.	--	U
67-66-3	Chloroform	49.5	46.7	--	242	228	--	
109-99-9	Tetrahydrofuran	ND	117	--	ND	345.	--	U
107-06-2	1,2-Dichloroethane	ND	46.7	--	ND	189.	--	U
110-54-3	n-Hexane	ND	46.7	--	ND	165.	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-07D	Date Collected	: 05/10/17 12:36
Client ID	: GWL-VI-03-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 10:04
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 233.6
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120176	Instrument ID	: AIRLAB11
Sample Amount	: 1.07 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	1450	46.7	--	7910	255	--	
71-43-2	Benzene	ND	46.7	--	ND	149.	--	U
56-23-5	Carbon tetrachloride	ND	46.7	--	ND	294.	--	U
110-82-7	Cyclohexane	ND	46.7	--	ND	161.	--	U
78-87-5	1,2-Dichloropropane	ND	46.7	--	ND	216.	--	U
75-27-4	Bromodichloromethane	ND	46.7	--	ND	313.	--	U
123-91-1	1,4-Dioxane	ND	46.7	--	ND	168.	--	U
79-01-6	Trichloroethene	16800	46.7	--	90300	251	--	
540-84-1	2,2,4-Trimethylpentane	ND	46.7	--	ND	218.	--	U
142-82-5	Heptane	ND	46.7	--	ND	191.	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	46.7	--	ND	212.	--	U
108-10-1	4-Methyl-2-pentanone	ND	117	--	ND	479.	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	46.7	--	ND	212.	--	U
79-00-5	1,1,2-Trichloroethane	ND	46.7	--	ND	255.	--	U
108-88-3	Toluene	ND	46.7	--	ND	176.	--	U
591-78-6	2-Hexanone	ND	46.7	--	ND	191.	--	U
124-48-1	Dibromochloromethane	ND	46.7	--	ND	398.	--	U
106-93-4	1,2-Dibromoethane	ND	46.7	--	ND	359.	--	U
127-18-4	Tetrachloroethene	684	46.7	--	4640	317	--	
108-90-7	Chlorobenzene	ND	46.7	--	ND	215.	--	U
100-41-4	Ethylbenzene	ND	46.7	--	ND	203.	--	U
179601-23-1	p/m-Xylene	ND	93.4	--	ND	406.	--	U
75-25-2	Bromoform	ND	46.7	--	ND	483.	--	U
100-42-5	Styrene	ND	46.7	--	ND	199.	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	46.7	--	ND	321.	--	U
95-47-6	o-Xylene	ND	46.7	--	ND	203.	--	U
622-96-8	4-Ethyltoluene	ND	46.7	--	ND	230.	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	46.7	--	ND	230.	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-07D	Date Collected	: 05/10/17 12:36
Client ID	: GWL-VI-03-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 10:04
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 233.6
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120176	Instrument ID	: AIRLAB11
Sample Amount	: 1.07 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	46.7	--	ND	230.	--	U
100-44-7	Benzyl chloride	ND	46.7	--	ND	242.	--	U
541-73-1	1,3-Dichlorobenzene	ND	46.7	--	ND	281.	--	U
106-46-7	1,4-Dichlorobenzene	ND	46.7	--	ND	281.	--	U
95-50-1	1,2-Dichlorobenzene	ND	46.7	--	ND	281.	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	46.7	--	ND	347.	--	U
87-68-3	Hexachlorobutadiene	ND	46.7	--	ND	498.	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-08	Date Collected	: 05/10/17 12:29
Client ID	: GWL-VI-04-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 20:47
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120157	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	0.498	0.200	--	2.46	0.989	--	
74-87-3	Chloromethane	0.562	0.200	--	1.16	0.413	--	
76-14-2	Freon-114	ND	0.200	--	ND	1.40	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethanol	89.2	5.00	--	168	9.42	--	
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	35.8	1.00	--	85.0	2.38	--	
75-69-4	Trichlorofluoromethane	1.74	0.200	--	9.78	1.12	--	
67-63-0	Isopropanol	153	0.500	--	376	1.23	--	
75-65-0	Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--	U
75-09-2	Methylene chloride	5.48	0.500	--	19.0	1.74	--	
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	0.348	0.200	--	1.08	0.623	--	
76-13-1	Freon-113	0.503	0.200	--	3.86	1.53	--	
156-60-5	trans-1,2-Dichloroethene	13.0	0.200	--	51.5	0.793	--	
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	3.35	0.500	--	9.88	1.47	--	
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	ND	0.200	--	ND	0.705	--	U
71-43-2	Benzene	0.700	0.200	--	2.24	0.639	--	
110-82-7	Cyclohexane	ND	0.200	--	ND	0.688	--	U
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-08	Date Collected	: 05/10/17 12:29
Client ID	: GWL-VI-04-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 20:47
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120157	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
540-84-1	2,2,4-Trimethylpentane	0.232	0.200	--	1.08	0.934	--	
142-82-5	Heptane	ND	0.200	--	ND	0.820	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	4.03	0.500	--	16.5	2.05	--	
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	0.687	0.200	--	2.59	0.754	--	
591-78-6	2-Hexanone	ND	0.200	--	ND	0.820	--	U
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	1.37	0.200	--	5.95	0.869	--	
179601-23-1	p/m-Xylene	6.11	0.400	--	26.5	1.74	--	
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	ND	0.200	--	ND	0.852	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	2.23	0.200	--	9.69	0.869	--	
622-96-8	4-Ethyltoluene	0.379	0.200	--	1.86	0.983	--	
108-67-8	1,3,5-Trimethylbenzene	0.940	0.200	--	4.62	0.983	--	
95-63-6	1,2,4-Trimethylbenzene	2.26	0.200	--	11.1	0.983	--	
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-08	Date Collected	: 05/10/17 12:29
Client ID	: GWL-VI-04-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 20:47
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15-SIM	Analyst	: RY
Lab File ID	: R1120157	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-01-4	Vinyl chloride	ND	0.020	--	ND	0.051	--	U
75-35-4	1,1-Dichloroethene	0.030	0.020	--	0.119	0.079	--	
156-59-2	cis-1,2-Dichloroethene	0.030	0.020	--	0.119	0.079	--	
71-55-6	1,1,1-Trichloroethane	0.108	0.020	--	0.589	0.109	--	
56-23-5	Carbon tetrachloride	0.071	0.020	--	0.447	0.126	--	
79-01-6	Trichloroethene	1.34	0.020	--	7.20	0.107	--	
127-18-4	Tetrachloroethene	0.267	0.020	--	1.81	0.136	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-12	Date Collected	: 05/10/17 12:29
Client ID	: GWL-VI-DUP(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 10:39
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120177	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	0.477	0.200	--	2.36	0.989	--	
74-87-3	Chloromethane	0.612	0.200	--	1.26	0.413	--	
76-14-2	Freon-114	ND	0.200	--	ND	1.40	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethanol	103	5.00	--	194	9.42	--	
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	38.2	1.00	--	90.7	2.38	--	
75-69-4	Trichlorofluoromethane	1.78	0.200	--	10.0	1.12	--	
67-63-0	Isopropanol	167	0.500	--	410	1.23	--	
75-65-0	Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--	U
75-09-2	Methylene chloride	5.81	0.500	--	20.2	1.74	--	
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	0.359	0.200	--	1.12	0.623	--	
76-13-1	Freon-113	0.491	0.200	--	3.76	1.53	--	
156-60-5	trans-1,2-Dichloroethene	12.7	0.200	--	50.4	0.793	--	
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	3.21	0.500	--	9.47	1.47	--	
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	ND	0.200	--	ND	0.705	--	U
71-43-2	Benzene	0.707	0.200	--	2.26	0.639	--	
110-82-7	Cyclohexane	ND	0.200	--	ND	0.688	--	U
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-12	Date Collected	: 05/10/17 12:29
Client ID	: GWL-VI-DUP(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 10:39
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120177	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
540-84-1	2,2,4-Trimethylpentane	0.228	0.200	--	1.06	0.934	--	
142-82-5	Heptane	ND	0.200	--	ND	0.820	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	4.29	0.500	--	17.6	2.05	--	
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	0.647	0.200	--	2.44	0.754	--	
591-78-6	2-Hexanone	ND	0.200	--	ND	0.820	--	U
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	1.25	0.200	--	5.43	0.869	--	
179601-23-1	p/m-Xylene	5.68	0.400	--	24.7	1.74	--	
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	ND	0.200	--	ND	0.852	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	2.05	0.200	--	8.90	0.869	--	
622-96-8	4-Ethyltoluene	0.344	0.200	--	1.69	0.983	--	
108-67-8	1,3,5-Trimethylbenzene	0.869	0.200	--	4.27	0.983	--	
95-63-6	1,2,4-Trimethylbenzene	2.13	0.200	--	10.5	0.983	--	
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-12	Date Collected	: 05/10/17 12:29
Client ID	: GWL-VI-DUP(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 10:39
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15-SIM	Analyst	: RY
Lab File ID	: R1120177	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-01-4	Vinyl chloride	ND	0.020	--	ND	0.051	--	U
75-35-4	1,1-Dichloroethene	0.031	0.020	--	0.123	0.079	--	
156-59-2	cis-1,2-Dichloroethene	0.028	0.020	--	0.111	0.079	--	
71-55-6	1,1,1-Trichloroethane	0.114	0.020	--	0.622	0.109	--	
56-23-5	Carbon tetrachloride	0.077	0.020	--	0.484	0.126	--	
79-01-6	Trichloroethene	1.38	0.020	--	7.42	0.107	--	
127-18-4	Tetrachloroethene	0.262	0.020	--	1.78	0.136	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-09D	Date Collected	: 05/10/17 12:30
Client ID	: GWL-VI-04-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 03:27
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 203.3
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120169	Instrument ID	: AIRLAB11
Sample Amount	: 1.23 ml	GC Column	: RTX-1

		ppbV			ug/m3				
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier	
75-71-8	Dichlorodifluoromethane	176	40.6	--	870	201	--		
74-87-3	Chloromethane	ND	40.6	--	ND	83.8	--	U	
76-14-2	Freon-114	ND	40.6	--	ND	284.	--	U	
75-01-4	Vinyl chloride	ND	40.6	--	ND	104.	--	U	
106-99-0	1,3-Butadiene	ND	40.6	--	ND	89.8	--	U	
74-83-9	Bromomethane	ND	40.6	--	ND	158.	--	U	
75-00-3	Chloroethane	ND	40.6	--	ND	107.	--	U	
64-17-5	Ethanol	ND	1020	--	ND	1920	--	U	
593-60-2	Vinyl bromide	ND	40.6	--	ND	178.	--	U	
67-64-1	Acetone	2350	203	--	5580	482	--		
75-69-4	Trichlorofluoromethane	ND	40.6	--	ND	228.	--	U	
67-63-0	Isopropanol	164	102	--	403	251	--		
75-35-4	1,1-Dichloroethene	760	40.6	--	3010	161	--		
75-65-0	Tertiary butyl Alcohol	ND	102	--	ND	309	--	U	
75-09-2	Methylene chloride	ND	102	--	ND	354	--	U	
107-05-1	3-Chloropropene	ND	40.6	--	ND	127.	--	U	
75-15-0	Carbon disulfide	ND	40.6	--	ND	126.	--	U	
76-13-1	Freon-113	~~23700~~	~~40.6~~	--	~~182000~~	~~311~~	--	~~E~~	use from DL
156-60-5	trans-1,2-Dichloroethene	ND	40.6	--	ND	161.	--	U	
75-34-3	1,1-Dichloroethane	82.5	40.6	--	334	164	--		
1634-04-4	Methyl tert butyl ether	ND	40.6	--	ND	146.	--	U	
78-93-3	2-Butanone	ND	102	--	ND	301.	--	U	
156-59-2	cis-1,2-Dichloroethene	300	40.6	--	1190	161	--		
141-78-6	Ethyl Acetate	ND	102	--	ND	368.	--	U	
67-66-3	Chloroform	ND	40.6	--	ND	198	--	U	
109-99-9	Tetrahydrofuran	ND	102	--	ND	301.	--	U	
107-06-2	1,2-Dichloroethane	ND	40.6	--	ND	164.	--	U	
110-54-3	n-Hexane	60.1	40.6	--	212	143	--		

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-09D	Date Collected	: 05/10/17 12:30
Client ID	: GWL-VI-04-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 03:27
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 203.3
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120169	Instrument ID	: AIRLAB11
Sample Amount	: 1.23 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	2010	40.6	--	11000	222	--	
71-43-2	Benzene	ND	40.6	--	ND	130.	--	U
56-23-5	Carbon tetrachloride	ND	40.6	--	ND	255.	--	U
110-82-7	Cyclohexane	ND	40.6	--	ND	140	--	U
78-87-5	1,2-Dichloropropane	ND	40.6	--	ND	188.	--	U
75-27-4	Bromodichloromethane	ND	40.6	--	ND	272.	--	U
123-91-1	1,4-Dioxane	ND	40.6	--	ND	146.	--	U
79-01-6	Trichloroethene	9510	40.6	--	51100	218	--	
540-84-1	2,2,4-Trimethylpentane	ND	40.6	--	ND	190.	--	U
142-82-5	Heptane	ND	40.6	--	ND	166	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	40.6	--	ND	184.	--	U
108-10-1	4-Methyl-2-pentanone	ND	102	--	ND	418.	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	40.6	--	ND	184.	--	U
79-00-5	1,1,2-Trichloroethane	ND	40.6	--	ND	222.	--	U
108-88-3	Toluene	ND	40.6	--	ND	153.	--	U
591-78-6	2-Hexanone	ND	40.6	--	ND	166.	--	U
124-48-1	Dibromochloromethane	ND	40.6	--	ND	346.	--	U
106-93-4	1,2-Dibromoethane	ND	40.6	--	ND	312.	--	U
127-18-4	Tetrachloroethene	568	40.6	--	3850	275	--	
108-90-7	Chlorobenzene	ND	40.6	--	ND	187.	--	U
100-41-4	Ethylbenzene	ND	40.6	--	ND	176.	--	U
179601-23-1	p/m-Xylene	ND	81.3	--	ND	353.	--	U
75-25-2	Bromoform	ND	40.6	--	ND	420.	--	U
100-42-5	Styrene	ND	40.6	--	ND	173.	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	40.6	--	ND	279.	--	U
95-47-6	o-Xylene	ND	40.6	--	ND	176.	--	U
622-96-8	4-Ethyltoluene	ND	40.6	--	ND	200.	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	40.6	--	ND	200.	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-09D	Date Collected	: 05/10/17 12:30
Client ID	: GWL-VI-04-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 03:27
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 203.3
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120169	Instrument ID	: AIRLAB11
Sample Amount	: 1.23 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	40.6	--	ND	200.	--	U
100-44-7	Benzyl chloride	ND	40.6	--	ND	210.	--	U
541-73-1	1,3-Dichlorobenzene	ND	40.6	--	ND	244.	--	U
106-46-7	1,4-Dichlorobenzene	ND	40.6	--	ND	244.	--	U
95-50-1	1,2-Dichlorobenzene	ND	40.6	--	ND	244.	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	40.6	--	ND	301.	--	U
87-68-3	Hexachlorobutadiene	ND	40.6	--	ND	433.	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-09D2	Date Collected	: 05/10/17 12:30
Client ID	: GWL-VI-04-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 06:50
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 403.2
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120170	Instrument ID	: AIRLAB11
Sample Amount	: 0.620 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
76-13-1	Freon-113	26800	80.6	--	205000	618	--	use this result

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-10	Date Collected	: 05/10/17 12:51
Client ID	: GWL-VI-05-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 21:22
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120158	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	0.510	0.200	--	2.52	0.989	--	
74-87-3	Chloromethane	0.553	0.200	--	1.14	0.413	--	
76-14-2	Freon-114	ND	0.200	--	ND	1.40	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethanol	28.7	5.00	--	54.1	9.42	--	
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	4.80	1.00	--	11.4	2.38	--	
75-69-4	Trichlorofluoromethane	0.338	0.200	--	1.90	1.12	--	
67-63-0	Isopropanol	5.08	0.500	--	12.5	1.23	--	
75-65-0	Tertiary butyl Alcohol	ND	0.500	--	ND	1.52	--	U
75-09-2	Methylene chloride	1.94	0.500	--	6.74	1.74	--	
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	ND	0.200	--	ND	0.623	--	U
76-13-1	Freon-113	ND	0.200	--	ND	1.53	--	U
156-60-5	trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--	U
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	ND	0.500	--	ND	1.47	--	U
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	ND	0.200	--	ND	0.705	--	U
71-43-2	Benzene	ND	0.200	--	ND	0.639	--	U
110-82-7	Cyclohexane	ND	0.200	--	ND	0.688	--	U
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-10	Date Collected	: 05/10/17 12:51
Client ID	: GWL-VI-05-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 21:22
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120158	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
540-84-1	2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--	U
142-82-5	Heptane	ND	0.200	--	ND	0.820	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	0.482	0.200	--	1.82	0.754	--	
591-78-6	2-Hexanone	ND	0.200	--	ND	0.820	--	U
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	ND	0.200	--	ND	0.869	--	U
179601-23-1	p/m-Xylene	ND	0.400	--	ND	1.74	--	U
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	ND	0.200	--	ND	0.852	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	ND	0.200	--	ND	0.869	--	U
622-96-8	4-Ethyltoluene	ND	0.200	--	ND	0.983	--	U
108-67-8	1,3,5-Trimethylbenzene	0.269	0.200	--	1.32	0.983	--	
95-63-6	1,2,4-Trimethylbenzene	0.676	0.200	--	3.32	0.983	--	
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-10	Date Collected	: 05/10/17 12:51
Client ID	: GWL-VI-05-IA(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/17/17 21:22
Sample Matrix	: AIR	Dilution Factor	: 1
Analytical Method	: 48,TO-15-SIM	Analyst	: RY
Lab File ID	: R1120158	Instrument ID	: AIRLAB11
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-01-4	Vinyl chloride	ND	0.020	--	ND	0.051	--	U
75-35-4	1,1-Dichloroethene	ND	0.020	--	ND	0.079	--	U
156-59-2	cis-1,2-Dichloroethene	ND	0.020	--	ND	0.079	--	U
71-55-6	1,1,1-Trichloroethane	ND	0.020	--	ND	0.109	--	U
56-23-5	Carbon tetrachloride	0.061	0.020	--	0.384	0.126	--	
79-01-6	Trichloroethene	0.022	0.020	--	0.118	0.107	--	
127-18-4	Tetrachloroethene	ND	0.020	--	ND	0.136	--	U

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-11D	Date Collected	: 05/10/17 12:51
Client ID	: GWL-VI-05-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 09:30
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120175	Instrument ID	: AIRLAB11
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	ND	1.00	--	ND	4.94	--	U
74-87-3	Chloromethane	1.33	1.00	--	2.75	2.07	--	
76-14-2	Freon-114	ND	1.00	--	ND	6.99	--	U
75-01-4	Vinyl chloride	ND	1.00	--	ND	2.56	--	U
106-99-0	1,3-Butadiene	3.14	1.00	--	6.95	2.21	--	
74-83-9	Bromomethane	ND	1.00	--	ND	3.88	--	U
75-00-3	Chloroethane	ND	1.00	--	ND	2.64	--	U
64-17-5	Ethanol	400	25.0	--	754	47.1	--	
593-60-2	Vinyl bromide	ND	1.00	--	ND	4.37	--	U
67-64-1	Acetone	234	5.00	--	556	11.9	--	
75-69-4	Trichlorofluoromethane	ND	1.00	--	ND	5.62	--	U
67-63-0	Isopropanol	23.9	2.50	--	58.7	6.15	--	
75-35-4	1,1-Dichloroethene	ND	1.00	--	ND	3.96	--	U
75-65-0	Tertiary butyl Alcohol	7.96	2.50	--	24.1	7.58	--	
75-09-2	Methylene chloride	ND	2.50	--	ND	8.69	--	U
107-05-1	3-Chloropropene	ND	1.00	--	ND	3.13	--	U
75-15-0	Carbon disulfide	7.50	1.00	--	23.4	3.11	--	
76-13-1	Freon-113	ND	1.00	--	ND	7.66	--	U
156-60-5	trans-1,2-Dichloroethene	ND	1.00	--	ND	3.96	--	U
75-34-3	1,1-Dichloroethane	ND	1.00	--	ND	4.05	--	U
1634-04-4	Methyl tert butyl ether	ND	1.00	--	ND	3.61	--	U
78-93-3	2-Butanone	9.64	2.50	--	28.4	7.37	--	
156-59-2	cis-1,2-Dichloroethene	ND	1.00	--	ND	3.96	--	U
141-78-6	Ethyl Acetate	ND	2.50	--	ND	9.01	--	U
67-66-3	Chloroform	ND	1.00	--	ND	4.88	--	U
109-99-9	Tetrahydrofuran	ND	2.50	--	ND	7.37	--	U
107-06-2	1,2-Dichloroethane	ND	1.00	--	ND	4.05	--	U
110-54-3	n-Hexane	73.4	1.00	--	259	3.52	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-11D	Date Collected	: 05/10/17 12:51
Client ID	: GWL-VI-05-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 09:30
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120175	Instrument ID	: AIRLAB11
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	ND	1.00	--	ND	5.46	--	U
71-43-2	Benzene	20.8	1.00	--	66.4	3.19	--	
56-23-5	Carbon tetrachloride	ND	1.00	--	ND	6.29	--	U
110-82-7	Cyclohexane	29.1	1.00	--	100	3.44	--	
78-87-5	1,2-Dichloropropane	ND	1.00	--	ND	4.62	--	U
75-27-4	Bromodichloromethane	ND	1.00	--	ND	6.70	--	U
123-91-1	1,4-Dioxane	ND	1.00	--	ND	3.60	--	U
79-01-6	Trichloroethene	7.41	1.00	--	39.8	5.37	--	
540-84-1	2,2,4-Trimethylpentane	ND	1.00	--	ND	4.67	--	U
142-82-5	Heptane	44.9	1.00	--	184	4.10	--	
10061-01-5	cis-1,3-Dichloropropene	ND	1.00	--	ND	4.54	--	U
108-10-1	4-Methyl-2-pentanone	ND	2.50	--	ND	10.2	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	1.00	--	ND	4.54	--	U
79-00-5	1,1,2-Trichloroethane	ND	1.00	--	ND	5.46	--	U
108-88-3	Toluene	30.0	1.00	--	113	3.77	--	
591-78-6	2-Hexanone	ND	1.00	--	ND	4.10	--	U
124-48-1	Dibromochloromethane	ND	1.00	--	ND	8.52	--	U
106-93-4	1,2-Dibromoethane	ND	1.00	--	ND	7.69	--	U
127-18-4	Tetrachloroethene	ND	1.00	--	ND	6.78	--	U
108-90-7	Chlorobenzene	ND	1.00	--	ND	4.61	--	U
100-41-4	Ethylbenzene	1.50	1.00	--	6.52	4.34	--	
179601-23-1	p/m-Xylene	8.61	2.00	--	37.4	8.69	--	
75-25-2	Bromoform	ND	1.00	--	ND	10.3	--	U
100-42-5	Styrene	ND	1.00	--	ND	4.26	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.00	--	ND	6.87	--	U
95-47-6	o-Xylene	2.20	1.00	--	9.56	4.34	--	
622-96-8	4-Ethyltoluene	ND	1.00	--	ND	4.92	--	U
108-67-8	1,3,5-Trimethylbenzene	1.08	1.00	--	5.31	4.92	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1715353
Project Name	: GWL	Project Number	: 0346372
Lab ID	: L1715353-11D	Date Collected	: 05/10/17 12:51
Client ID	: GWL-VI-05-SS(05092017)	Date Received	: 05/11/17
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 05/18/17 09:30
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: RY
Lab File ID	: R1120175	Instrument ID	: AIRLAB11
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	1.54	1.00	--	7.57	4.92	--	
100-44-7	Benzyl chloride	ND	1.00	--	ND	5.18	--	U
541-73-1	1,3-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
106-46-7	1,4-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
95-50-1	1,2-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	1.00	--	ND	7.42	--	U
87-68-3	Hexachlorobutadiene	ND	1.00	--	ND	10.7	--	U

ENVIRONMENTAL
Data Services, Inc.

DATA USABILITY SUMMARY REPORT (DUSR)

Client: ERM, Melville, New York

Site: G.W. Lisk Facility - Clifton Springs, New York

Laboratory: Alpha Analytical - Mansfield, MA

Lab Number: L1830687

Date: September 6, 2018

EDS Sample ID	Client Sample ID	Laboratory Sample ID	Matrix
01	SS-BLDG 4A(08072018)	L1830687-01	Air
02	SS-BLDG 4C(08072018)	L1830687-02	Air
03	SS-BLDG 4D(08072018)	L1830687-03	Air
04	SS-AOPC-5(08072018)	L1830687-04	Air
05	SS-BLDG 7B-1(08072018)	L1830687-05	Air
06	SS-BLDG 7(08072018)	L1830687-06	Air
07	SS-BLDG 7B-2(08072018)	L1830687-07	Air
08	DUP08072018	L1830687-08	Air

VOLATILE ORGANIC COMPOUNDS (VOCs)

Compendium Method TO-15

The samples were analyzed following "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition 1997, EPA/625/R-96/010B", Compendium Method TO-15, "Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/Mass Spectrometry *(GC/MS)*". The data have been evaluated according to the protocols and quality control (QC) requirements of the analytical method, the NYSDEC ASP, the USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review (January 2017), the USEPA Region 2 Data Review Standard Operating Procedure (SOP) Number HW-31, Revision 6, September 2016: Validating Volatile Organic Compounds in Air Contained in Cannisters by Method TO-15, and the reviewer's professional judgment.

Chain-of-Custody (COC) – No discrepancies were identified.

Holding Time (HT) – All HT criteria were met.

Canister Certification – Canisters were batch certified. No positively identified target compounds were observed.

Canister and Flow Controller Receipt – All cannister criteria were acceptable.

Surrogates – Surrogates were not spiked into the samples. No qualification is required.

Lab Control Sample (LCS) – All percent recovery (%R) met QC criteria.

Laboratory Duplicate (LD) – The LDs were analyzed on EDS ID 03. All RPDs were within QC criteria.

Method Blank (MB) - The MBs contained no positively identified target compounds.

GC/MS Tuning – All tuning criteria were met.

Initial Calibration (ICAL) - The ICAL exhibited acceptable percent relative standard deviation (%RSD) and mean relative response factor (RRF) values.

Continuing Calibration Verifications (CCVs) - The CCVs exhibited acceptable percent difference (%D) and RRF values.

Internal Standard (IS) Area Performance - All IS met response and retention time (RT) criteria.

Blind Field Duplicate – EDS ID 08 is a blind field duplicate of EDS ID 01. All results matched well.

Reporting Limits/Compound Identification – EDS IDs 04, 05, 06, 07, and 08 were analyzed at dilutions (5x, 10x, 57.6x, 89.61x, and 5x) due to the elevated presence of target compounds. EDS ID 2 was analyzed at a dilution (2x) due to the elevated presence of non-target compounds. No qualification of the sample data is required; however the end user should be aware of the elevated RLs.

EDS IDs 01, 06, and 07 were reanalyzed at a further dilution due to various compounds exceeding the calibration range of the instrument in the initial analysis. The lab has flagged these compounds with an "E" on the Form I and reported the further diluted result for these compounds on a separate Form I. The dilution was justified. The result for these compounds from the further diluted analysis are to be reported. All other results are reported from the initial analysis. No qualification of the sample data is required.

Data Qualifier	Definition
None	The compound was positively identified at the associated numerical value which is the concentration of the compound in the sample.
U	Non-Detect. The compound was analyzed for, but not detected. The associated numerical value is the RL. The value is usable as a non-detect at the RL.

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-01	Date Collected	: 08/07/18 11:10
Client ID	: SS-BLDG 4A(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 02:31
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167433	Instrument ID	: AIRLAB16
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	204 ~~177~~	0.500 ~~0.200~~	--	1010 ~~846~~	2.47 ~~0.989~~	--	E
74-87-3	Chloromethane	ND	0.200	--	ND	0.413	--	U
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethan	ND	0.200	--	ND	1.40	--	U
75-01-4	Vinyl chloride	ND	0.200	--	ND	0.511	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethyl Alcohol	46.5	5.00	--	87.6	9.42	--	
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	14.9	1.00	--	35.4	2.38	--	
75-69-4	Trichlorofluoromethane	0.459	0.200	--	2.58	1.12	--	
67-63-0	iso-Propyl Alcohol	5.39	0.500	--	13.2	1.23	--	
75-35-4	1,1-Dichloroethene	ND	0.200	--	ND	0.793	--	U
75-65-0	tert-Butyl Alcohol	1.10	0.500	--	3.33	1.52	--	
75-09-2	Methylene chloride	2.53	0.500	--	8.79	1.74	--	
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	1.12	0.200	--	3.49	0.623	--	
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	1.39	0.200	--	10.7	1.53	--	
156-60-5	trans-1,2-Dichloroethene	0.257	0.200	--	1.02	0.793	--	
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	2.54	0.500	--	7.49	1.47	--	
156-59-2	cis-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--	U
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	0.655	0.200	--	2.31	0.705	--	

NW 9/5/18

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-01	Date Collected	: 08/07/18 11:10
Client ID	: SS-BLDG 4A(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 02:31
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167433	Instrument ID	: AIRLAB16
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	2.39	0.200	--	13.0	1.09	--	
71-43-2	Benzene	ND	0.200	--	ND	0.639	--	U
56-23-5	Carbon tetrachloride	ND	0.200	--	ND	1.26	--	U
110-82-7	Cyclohexane	0.239	0.200	--	0.823	0.688	--	
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
79-01-6	Trichloroethene	6.04	0.200	--	32.5	1.07	--	
540-84-1	2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--	U
142-82-5	Heptane	0.807	0.200	--	3.31	0.820	--	
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	1.33	0.200	--	5.01	0.754	--	
591-78-6	2-Hexanone	0.225	0.200	--	0.922	0.820	--	
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
127-18-4	Tetrachloroethene	3.36	0.200	--	22.8	1.36	--	
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	0.537	0.200	--	2.33	0.869	--	
179601-23-1	p/m-Xylene	0.991	0.400	--	4.30	1.74	--	
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	ND	0.200	--	ND	0.852	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	0.317	0.200	--	1.38	0.869	--	
622-96-8	4-Ethyltoluene	ND	0.200	--	ND	0.983	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--	U

NW 9/5/18

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-01	Date Collected	: 08/07/18 11:10
Client ID	: SS-BLDG 4A(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 02:31
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167433	Instrument ID	: AIRLAB16
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	0.241	0.200	--	1.18	0.983	--	
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

NW 9/5/18

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-01D	Date Collected	: 08/07/18 11:10
Client ID	: SS-BLDG 4A(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 09:22
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 2.5
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167443	Instrument ID	: AIRLAB16
Sample Amount	: 100 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	204	0.500	--	1010	2.47	--	

Form 1
Volatile Organics

2

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-02D	Date Collected	: 08/07/18 13:25
Client ID	: SS-BLDG 4C(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 03:07
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 2
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167434	Instrument ID	: AIRLAB16
Sample Amount	: 125 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	ND	0.400	--	ND	1.98	--	U
74-87-3	Chloromethane	ND	0.400	--	ND	0.826	--	U
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethan	ND	0.400	--	ND	2.80	--	U
75-01-4	Vinyl chloride	ND	0.400	--	ND	1.02	--	U
106-99-0	1,3-Butadiene	ND	0.400	--	ND	0.885	--	U
74-83-9	Bromomethane	ND	0.400	--	ND	1.55	--	U
75-00-3	Chloroethane	ND	0.400	--	ND	1.06	--	U
64-17-5	Ethyl Alcohol	136	10.0	--	256	18.8	--	
593-60-2	Vinyl bromide	ND	0.400	--	ND	1.75	--	U
67-64-1	Acetone	167	2.00	--	397	4.75	--	
75-69-4	Trichlorofluoromethane	0.482	0.400	--	2.71	2.25	--	
67-63-0	iso-Propyl Alcohol	9.14	1.00	--	22.5	2.46	--	
75-35-4	1,1-Dichloroethene	ND	0.400	--	ND	1.59	--	U
75-65-0	tert-Butyl Alcohol	2.95	1.00	--	8.94	3.03	--	
75-09-2	Methylene chloride	ND	1.00	--	ND	3.47	--	U
107-05-1	3-Chloropropene	ND	0.400	--	ND	1.25	--	U
75-15-0	Carbon disulfide	ND	0.400	--	ND	1.25	--	U
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	0.400	--	ND	3.07	--	U
156-60-5	trans-1,2-Dichloroethene	ND	0.400	--	ND	1.59	--	U
75-34-3	1,1-Dichloroethane	ND	0.400	--	ND	1.62	--	U
1634-04-4	Methyl tert butyl ether	ND	0.400	--	ND	1.44	--	U
78-93-3	2-Butanone	1.15	1.00	--	3.39	2.95	--	
156-59-2	cis-1,2-Dichloroethene	ND	0.400	--	ND	1.59	--	U
141-78-6	Ethyl Acetate	ND	1.00	--	ND	3.60	--	U
67-66-3	Chloroform	ND	0.400	--	ND	1.95	--	U
109-99-9	Tetrahydrofuran	2.69	1.00	--	7.93	2.95	--	
107-06-2	1,2-Dichloroethane	ND	0.400	--	ND	1.62	--	U
110-54-3	n-Hexane	1.16	0.400	--	4.09	1.41	--	

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Form 1
Volatile Organics

2

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-02D	Date Collected	: 08/07/18 13:25
Client ID	: SS-BLDG 4C(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 03:07
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 2
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167434	Instrument ID	: AIRLAB16
Sample Amount	: 125 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	ND	0.400	--	ND	2.18	--	U
71-43-2	Benzene	0.640	0.400	--	2.04	1.28	--	
56-23-5	Carbon tetrachloride	ND	0.400	--	ND	2.52	--	U
110-82-7	Cyclohexane	0.482	0.400	--	1.66	1.38	--	
78-87-5	1,2-Dichloropropane	ND	0.400	--	ND	1.85	--	U
75-27-4	Bromodichloromethane	ND	0.400	--	ND	2.68	--	U
123-91-1	1,4-Dioxane	ND	0.400	--	ND	1.44	--	U
79-01-6	Trichloroethene	14.2	0.400	--	76.3	2.15	--	
540-84-1	2,2,4-Trimethylpentane	ND	0.400	--	ND	1.87	--	U
142-82-5	Heptane	1.62	0.400	--	6.64	1.64	--	
10061-01-5	cis-1,3-Dichloropropene	ND	0.400	--	ND	1.82	--	U
108-10-1	4-Methyl-2-pentanone	ND	1.00	--	ND	4.10	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	0.400	--	ND	1.82	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.400	--	ND	2.18	--	U
108-88-3	Toluene	1.77	0.400	--	6.67	1.51	--	
591-78-6	2-Hexanone	ND	0.400	--	ND	1.64	--	U
124-48-1	Dibromochloromethane	ND	0.400	--	ND	3.41	--	U
106-93-4	1,2-Dibromoethane	ND	0.400	--	ND	3.07	--	U
127-18-4	Tetrachloroethene	12.2	0.400	--	82.7	2.71	--	
108-90-7	Chlorobenzene	ND	0.400	--	ND	1.84	--	U
100-41-4	Ethylbenzene	ND	0.400	--	ND	1.74	--	U
179601-23-1	p/m-Xylene	1.45	0.800	--	6.30	3.47	--	
75-25-2	Bromoform	ND	0.400	--	ND	4.14	--	U
100-42-5	Styrene	ND	0.400	--	ND	1.70	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.400	--	ND	2.75	--	U
95-47-6	o-Xylene	0.770	0.400	--	3.34	1.74	--	
622-96-8	4-Ethyltoluene	0.576	0.400	--	2.83	1.97	--	
108-67-8	1,3,5-Trimethylbenzene	0.712	0.400	--	3.50	1.97	--	

MW 9/5/18

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-02D	Date Collected	: 08/07/18 13:25
Client ID	: SS-BLDG 4C(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 03:07
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 2
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167434	Instrument ID	: AIRLAB16
Sample Amount	: 125 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	2.04	0.400	--	10.0	1.97	--	
100-44-7	Benzyl chloride	ND	0.400	--	ND	2.07	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.400	--	ND	2.40	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.400	--	ND	2.40	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.400	--	ND	2.40	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.400	--	ND	2.97	--	U
87-68-3	Hexachlorobutadiene	ND	0.400	--	ND	4.27	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-03	Date Collected	: 08/07/18 13:42
Client ID	: SS-BLDG 4D(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 03:46
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167435	Instrument ID	: AIRLAB16
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	0.432	0.200	--	2.14	0.989	--	
74-87-3	Chloromethane	ND	0.200	--	ND	0.413	--	U
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethan	ND	0.200	--	ND	1.40	--	U
75-01-4	Vinyl chloride	ND	0.200	--	ND	0.511	--	U
106-99-0	1,3-Butadiene	ND	0.200	--	ND	0.442	--	U
74-83-9	Bromomethane	ND	0.200	--	ND	0.777	--	U
75-00-3	Chloroethane	ND	0.200	--	ND	0.528	--	U
64-17-5	Ethyl Alcohol	195	5.00	--	367	9.42	--	
593-60-2	Vinyl bromide	ND	0.200	--	ND	0.874	--	U
67-64-1	Acetone	17.5	1.00	--	41.6	2.38	--	
75-69-4	Trichlorofluoromethane	0.237	0.200	--	1.33	1.12	--	
67-63-0	iso-Propyl Alcohol	26.4	0.500	--	64.9	1.23	--	
75-35-4	1,1-Dichloroethene	ND	0.200	--	ND	0.793	--	U
75-65-0	tert-Butyl Alcohol	0.674	0.500	--	2.04	1.52	--	
75-09-2	Methylene chloride	ND	0.500	--	ND	1.74	--	U
107-05-1	3-Chloropropene	ND	0.200	--	ND	0.626	--	U
75-15-0	Carbon disulfide	0.248	0.200	--	0.772	0.623	--	
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	0.200	--	ND	1.53	--	U
156-60-5	trans-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--	U
75-34-3	1,1-Dichloroethane	ND	0.200	--	ND	0.809	--	U
1634-04-4	Methyl tert butyl ether	ND	0.200	--	ND	0.721	--	U
78-93-3	2-Butanone	1.08	0.500	--	3.19	1.47	--	
156-59-2	cis-1,2-Dichloroethene	ND	0.200	--	ND	0.793	--	U
141-78-6	Ethyl Acetate	ND	0.500	--	ND	1.80	--	U
67-66-3	Chloroform	ND	0.200	--	ND	0.977	--	U
109-99-9	Tetrahydrofuran	ND	0.500	--	ND	1.47	--	U
107-06-2	1,2-Dichloroethane	ND	0.200	--	ND	0.809	--	U
110-54-3	n-Hexane	0.774	0.200	--	2.73	0.705	--	

NW 9/5/18

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-03	Date Collected	: 08/07/18 13:42
Client ID	: SS-BLDG 4D(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 03:46
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167435	Instrument ID	: AIRLAB16
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	ND	0.200	--	ND	1.09	--	U
71-43-2	Benzene	ND	0.200	--	ND	0.639	--	U
56-23-5	Carbon tetrachloride	ND	0.200	--	ND	1.26	--	U
110-82-7	Cyclohexane	ND	0.200	--	ND	0.688	--	U
78-87-5	1,2-Dichloropropane	ND	0.200	--	ND	0.924	--	U
75-27-4	Bromodichloromethane	ND	0.200	--	ND	1.34	--	U
123-91-1	1,4-Dioxane	ND	0.200	--	ND	0.721	--	U
79-01-6	Trichloroethene	1.20	0.200	--	6.45	1.07	--	
540-84-1	2,2,4-Trimethylpentane	ND	0.200	--	ND	0.934	--	U
142-82-5	Heptane	0.949	0.200	--	3.89	0.820	--	
10061-01-5	cis-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
108-10-1	4-Methyl-2-pentanone	ND	0.500	--	ND	2.05	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	0.200	--	ND	0.908	--	U
79-00-5	1,1,2-Trichloroethane	ND	0.200	--	ND	1.09	--	U
108-88-3	Toluene	1.13	0.200	--	4.26	0.754	--	
591-78-6	2-Hexanone	ND	0.200	--	ND	0.820	--	U
124-48-1	Dibromochloromethane	ND	0.200	--	ND	1.70	--	U
106-93-4	1,2-Dibromoethane	ND	0.200	--	ND	1.54	--	U
127-18-4	Tetrachloroethene	0.225	0.200	--	1.53	1.36	--	
108-90-7	Chlorobenzene	ND	0.200	--	ND	0.921	--	U
100-41-4	Ethylbenzene	0.213	0.200	--	0.925	0.869	--	
179601-23-1	p/m-Xylene	0.593	0.400	--	2.58	1.74	--	
75-25-2	Bromoform	ND	0.200	--	ND	2.07	--	U
100-42-5	Styrene	ND	0.200	--	ND	0.852	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.200	--	ND	1.37	--	U
95-47-6	o-Xylene	ND	0.200	--	ND	0.869	--	U
622-96-8	4-Ethyltoluene	ND	0.200	--	ND	0.983	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	0.200	--	ND	0.983	--	U

NW 9/5/18

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-03	Date Collected	: 08/07/18 13:42
Client ID	: SS-BLDG 4D(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 03:46
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 1
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167435	Instrument ID	: AIRLAB16
Sample Amount	: 250 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	0.200	--	ND	0.983	--	U
100-44-7	Benzyl chloride	ND	0.200	--	ND	1.04	--	U
541-73-1	1,3-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
106-46-7	1,4-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
95-50-1	1,2-Dichlorobenzene	ND	0.200	--	ND	1.20	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	0.200	--	ND	1.48	--	U
87-68-3	Hexachlorobutadiene	ND	0.200	--	ND	2.13	--	U

NW 9/5/18

Form 1
Volatile Organics

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Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-04D	Date Collected	: 08/07/18 13:55
Client ID	: SS-AOPC 5(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 05:01
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167437	Instrument ID	: AIRLAB16
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	4.52	1.00	--	22.4	4.94	--	
74-87-3	Chloromethane	ND	1.00	--	ND	2.07	--	U
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethan	ND	1.00	--	ND	6.99	--	U
75-01-4	Vinyl chloride	ND	1.00	--	ND	2.56	--	U
106-99-0	1,3-Butadiene	ND	1.00	--	ND	2.21	--	U
74-83-9	Bromomethane	ND	1.00	--	ND	3.88	--	U
75-00-3	Chloroethane	ND	1.00	--	ND	2.64	--	U
64-17-5	Ethyl Alcohol	148	25.0	--	279	47.1	--	
593-60-2	Vinyl bromide	ND	1.00	--	ND	4.37	--	U
67-64-1	Acetone	9.34	5.00	--	22.2	11.9	--	
75-69-4	Trichlorofluoromethane	ND	1.00	--	ND	5.62	--	U
67-63-0	iso-Propyl Alcohol	9.82	2.50	--	24.1	6.15	--	
75-35-4	1,1-Dichloroethene	ND	1.00	--	ND	3.96	--	U
75-65-0	tert-Butyl Alcohol	ND	2.50	--	ND	7.58	--	U
75-09-2	Methylene chloride	ND	2.50	--	ND	8.69	--	U
107-05-1	3-Chloropropene	ND	1.00	--	ND	3.13	--	U
75-15-0	Carbon disulfide	2.46	1.00	--	7.66	3.11	--	
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	51.2	1.00	--	392	7.66	--	
156-60-5	trans-1,2-Dichloroethene	11.2	1.00	--	44.4	3.96	--	
75-34-3	1,1-Dichloroethane	15.2	1.00	--	61.5	4.05	--	
1634-04-4	Methyl tert butyl ether	ND	1.00	--	ND	3.61	--	U
78-93-3	2-Butanone	ND	2.50	--	ND	7.37	--	U
156-59-2	cis-1,2-Dichloroethene	64.6	1.00	--	256	3.96	--	
141-78-6	Ethyl Acetate	ND	2.50	--	ND	9.01	--	U
67-66-3	Chloroform	13.3	1.00	--	64.9	4.88	--	
109-99-9	Tetrahydrofuran	ND	2.50	--	ND	7.37	--	U
107-06-2	1,2-Dichloroethane	ND	1.00	--	ND	4.05	--	U
110-54-3	n-Hexane	1.10	1.00	--	3.88	3.52	--	

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-04D	Date Collected	: 08/07/18 13:55
Client ID	: SS-AOPC 5(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 05:01
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167437	Instrument ID	: AIRLAB16
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	21.8	1.00	--	119	5.46	--	
71-43-2	Benzene	ND	1.00	--	ND	3.19	--	U
56-23-5	Carbon tetrachloride	ND	1.00	--	ND	6.29	--	U
110-82-7	Cyclohexane	ND	1.00	--	ND	3.44	--	U
78-87-5	1,2-Dichloropropane	ND	1.00	--	ND	4.62	--	U
75-27-4	Bromodichloromethane	ND	1.00	--	ND	6.70	--	U
123-91-1	1,4-Dioxane	ND	1.00	--	ND	3.60	--	U
79-01-6	Trichloroethene	164	1.00	--	881	5.37	--	
540-84-1	2,2,4-Trimethylpentane	ND	1.00	--	ND	4.67	--	U
142-82-5	Heptane	ND	1.00	--	ND	4.10	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	1.00	--	ND	4.54	--	U
108-10-1	4-Methyl-2-pentanone	ND	2.50	--	ND	10.2	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	1.00	--	ND	4.54	--	U
79-00-5	1,1,2-Trichloroethane	ND	1.00	--	ND	5.46	--	U
108-88-3	Toluene	1.46	1.00	--	5.50	3.77	--	
591-78-6	2-Hexanone	ND	1.00	--	ND	4.10	--	U
124-48-1	Dibromochloromethane	ND	1.00	--	ND	8.52	--	U
106-93-4	1,2-Dibromoethane	ND	1.00	--	ND	7.69	--	U
127-18-4	Tetrachloroethene	272	1.00	--	1840	6.78	--	
108-90-7	Chlorobenzene	ND	1.00	--	ND	4.61	--	U
100-41-4	Ethylbenzene	ND	1.00	--	ND	4.34	--	U
179601-23-1	p/m-Xylene	ND	2.00	--	ND	8.69	--	U
75-25-2	Bromoform	ND	1.00	--	ND	10.3	--	U
100-42-5	Styrene	ND	1.00	--	ND	4.26	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.00	--	ND	6.87	--	U
95-47-6	o-Xylene	ND	1.00	--	ND	4.34	--	U
622-96-8	4-Ethyltoluene	ND	1.00	--	ND	4.92	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	1.00	--	ND	4.92	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-04D	Date Collected	: 08/07/18 13:55
Client ID	: SS-AOPC 5(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 05:01
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167437	Instrument ID	: AIRLAB16
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	1.00	--	ND	4.92	--	U
100-44-7	Benzyl chloride	ND	1.00	--	ND	5.18	--	U
541-73-1	1,3-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
106-46-7	1,4-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
95-50-1	1,2-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	1.00	--	ND	7.42	--	U
87-68-3	Hexachlorobutadiene	ND	1.00	--	ND	10.7	--	U

MW 9/5/18

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-05D	Date Collected	: 08/07/18 14:05
Client ID	: SS-BLDG 7B-1(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 05:37
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 10
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167438	Instrument ID	: AIRLAB16
Sample Amount	: 25.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	522	2.00	--	2580	9.89	--	
74-87-3	Chloromethane	ND	2.00	--	ND	4.13	--	U
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethan	ND	2.00	--	ND	14.0	--	U
75-01-4	Vinyl chloride	ND	2.00	--	ND	5.11	--	U
106-99-0	1,3-Butadiene	ND	2.00	--	ND	4.42	--	U
74-83-9	Bromomethane	ND	2.00	--	ND	7.77	--	U
75-00-3	Chloroethane	ND	2.00	--	ND	5.28	--	U
64-17-5	Ethyl Alcohol	125	50.0	--	236	94.2	--	
593-60-2	Vinyl bromide	ND	2.00	--	ND	8.74	--	U
67-64-1	Acetone	ND	10.0	--	ND	23.8	--	U
75-69-4	Trichlorofluoromethane	ND	2.00	--	ND	11.2	--	U
67-63-0	Iso-Propyl Alcohol	11.6	5.00	--	28.5	12.3	--	
75-35-4	1,1-Dichloroethene	ND	2.00	--	ND	7.93	--	U
75-65-0	tert-Butyl Alcohol	ND	5.00	--	ND	15.2	--	U
75-09-2	Methylene chloride	ND	5.00	--	ND	17.4	--	U
107-05-1	3-Chloropropene	ND	2.00	--	ND	6.26	--	U
75-15-0	Carbon disulfide	ND	2.00	--	ND	6.23	--	U
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	52.2	2.00	--	400	15.3	--	
156-60-5	trans-1,2-Dichloroethene	204	2.00	--	809	7.93	--	
75-34-3	1,1-Dichloroethane	ND	2.00	--	ND	8.09	--	U
1634-04-4	Methyl tert butyl ether	ND	2.00	--	ND	7.21	--	U
78-93-3	2-Butanone	ND	5.00	--	ND	14.7	--	U
156-59-2	cis-1,2-Dichloroethene	19.7	2.00	--	78.1	7.93	--	
141-78-6	Ethyl Acetate	ND	5.00	--	ND	18.0	--	U
67-66-3	Chloroform	ND	2.00	--	ND	9.77	--	U
109-99-9	Tetrahydrofuran	ND	5.00	--	ND	14.7	--	U
107-06-2	1,2-Dichloroethane	ND	2.00	--	ND	8.09	--	U
110-54-3	n-Hexane	ND	2.00	--	ND	7.05	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-05D	Date Collected	: 08/07/18 14:05
Client ID	: SS-BLDG 7B-1(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 05:37
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 10
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167438	Instrument ID	: AIRLAB16
Sample Amount	: 25.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	6.04	2.00	--	33.0	10.9	--	
71-43-2	Benzene	ND	2.00	--	ND	6.39	--	U
56-23-5	Carbon tetrachloride	ND	2.00	--	ND	12.6	--	U
110-82-7	Cyclohexane	ND	2.00	--	ND	6.88	--	U
78-87-5	1,2-Dichloropropane	ND	2.00	--	ND	9.24	--	U
75-27-4	Bromodichloromethane	ND	2.00	--	ND	13.4	--	U
123-91-1	1,4-Dioxane	ND	2.00	--	ND	7.21	--	U
79-01-6	Trichloroethene	57.3	2.00	--	308	10.7	--	
540-84-1	2,2,4-Trimethylpentane	ND	2.00	--	ND	9.34	--	U
142-82-5	Heptane	ND	2.00	--	ND	8.20	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	2.00	--	ND	9.08	--	U
108-10-1	4-Methyl-2-pentanone	ND	5.00	--	ND	20.5	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	2.00	--	ND	9.08	--	U
79-00-5	1,1,2-Trichloroethane	ND	2.00	--	ND	10.9	--	U
108-88-3	Toluene	ND	2.00	--	ND	7.54	--	U
591-78-6	2-Hexanone	ND	2.00	--	ND	8.20	--	U
124-48-1	Dibromochloromethane	ND	2.00	--	ND	17.0	--	U
106-93-4	1,2-Dibromoethane	ND	2.00	--	ND	15.4	--	U
127-18-4	Tetrachloroethene	130	2.00	--	882	13.6	--	
108-90-7	Chlorobenzene	ND	2.00	--	ND	9.21	--	U
100-41-4	Ethylbenzene	ND	2.00	--	ND	8.69	--	U
179601-23-1	p/m-Xylene	ND	4.00	--	ND	17.4	--	U
75-25-2	Bromoform	ND	2.00	--	ND	20.7	--	U
100-42-5	Styrene	ND	2.00	--	ND	8.52	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	2.00	--	ND	13.7	--	U
95-47-6	o-Xylene	ND	2.00	--	ND	8.69	--	U
622-96-8	4-Ethyltoluene	ND	2.00	--	ND	9.83	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	2.00	--	ND	9.83	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-05D	Date Collected	: 08/07/18 14:05
Client ID	: SS-BLDG 7B-1(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 05:37
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 10
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167438	Instrument ID	: AIRLAB16
Sample Amount	: 25.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	2.00	--	ND	9.83	--	U
100-44-7	Benzyl chloride	ND	2.00	--	ND	10.4	--	U
541-73-1	1,3-Dichlorobenzene	ND	2.00	--	ND	12.0	--	U
106-46-7	1,4-Dichlorobenzene	ND	2.00	--	ND	12.0	--	U
95-50-1	1,2-Dichlorobenzene	ND	2.00	--	ND	12.0	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	2.00	--	ND	14.8	--	U
87-68-3	Hexachlorobutadiene	ND	2.00	--	ND	21.3	--	U

MW 9/5/18

Form 1
Volatile Organics

b

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-06D	Date Collected	: 08/07/18 14:10
Client ID	: SS-BLDG 7(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 06:49
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 57.6
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167440	Instrument ID	: AIRLAB16
Sample Amount	: 4.34 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	50.6	11.5	--	250	56.9	--	
74-87-3	Chloromethane	ND	11.5	--	ND	23.7	--	U
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethan	ND	11.5	--	ND	80.4	--	U
75-01-4	Vinyl chloride	ND	11.5	--	ND	29.4	--	U
106-99-0	1,3-Butadiene	ND	11.5	--	ND	25.4	--	U
74-83-9	Bromomethane	ND	11.5	--	ND	44.7	--	U
75-00-3	Chloroethane	ND	11.5	--	ND	30.3	--	U
64-17-5	Ethyl Alcohol	ND	288	--	ND	543	--	U
593-60-2	Vinyl bromide	ND	11.5	--	ND	50.3	--	U
67-64-1	Acetone	115	57.6	--	273	137	--	
75-69-4	Trichlorofluoromethane	ND	11.5	--	ND	64.6	--	U
67-63-0	iso-Propyl Alcohol	ND	28.8	--	ND	70.8	--	U
75-35-4	1,1-Dichloroethene	973	11.5	--	3860	45.6	--	
75-65-0	tert-Butyl Alcohol	ND	28.8	--	ND	87.3	--	U
75-09-2	Methylene chloride	ND	28.8	--	ND	100.	--	U
107-05-1	3-Chloropropene	ND	11.5	--	ND	36.0	--	U
75-15-0	Carbon disulfide	ND	11.5	--	ND	35.8	--	U
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	4500	11.5	--	34500	88.1	--	
156-60-5	trans-1,2-Dichloroethene	24.5	11.5	--	97.1	45.6	--	
75-34-3	1,1-Dichloroethane	260	11.5	--	1050	46.5	--	
1634-04-4	Methyl tert butyl ether	ND	11.5	--	ND	41.5	--	U
78-93-3	2-Butanone	ND	28.8	--	ND	84.9	--	U
156-59-2	cis-1,2-Dichloroethene	394	11.5	--	1560	45.6	--	
141-78-6	Ethyl Acetate	ND	28.8	--	ND	104.	--	U
67-66-3	Chloroform	35.0	11.5	--	171	56.2	--	
109-99-9	Tetrahydrofuran	ND	28.8	--	ND	84.9	--	U
107-06-2	1,2-Dichloroethane	ND	11.5	--	ND	46.5	--	U
110-54-3	n-Hexane	ND	11.5	--	ND	40.5	--	U

nw 9151.8

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-06D	Date Collected	: 08/07/18 14:10
Client ID	: SS-BLDG 7(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 06:49
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 57.6
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167440	Instrument ID	: AIRLAB16
Sample Amount	: 4.34 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	2460	11.5	--	13400	62.7	--	
71-43-2	Benzene	ND	11.5	--	ND	36.7	--	U
56-23-5	Carbon tetrachloride	ND	11.5	--	ND	72.3	--	U
110-82-7	Cyclohexane	ND	11.5	--	ND	39.6	--	U
78-87-5	1,2-Dichloropropane	ND	11.5	--	ND	53.1	--	U
75-27-4	Bromodichloromethane	ND	11.5	--	ND	77.0	--	U
123-91-1	1,4-Dioxane	ND	11.5	--	ND	41.4	--	U
79-01-6	Trichloroethene 26600	~~16500~~	~~11.5~~ 69.4	--	143000 ~~88700~~	~~61.8~~ 373	--	E
540-84-1	2,2,4-Trimethylpentane	ND	11.5	--	ND	53.7	--	U
142-82-5	Heptane	ND	11.5	--	ND	47.1	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	11.5	--	ND	52.2	--	U
108-10-1	4-Methyl-2-pentanone	ND	28.8	--	ND	118.	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	11.5	--	ND	52.2	--	U
79-00-5	1,1,2-Trichloroethane	ND	11.5	--	ND	62.7	--	U
108-88-3	Toluene	ND	11.5	--	ND	43.3	--	U
591-78-6	2-Hexanone	ND	11.5	--	ND	47.1	--	U
124-48-1	Dibromochloromethane	ND	11.5	--	ND	98.0	--	U
106-93-4	1,2-Dibromoethane	ND	11.5	--	ND	88.4	--	U
127-18-4	Tetrachloroethene	1170	11.5	--	7930	78.0	--	
108-90-7	Chlorobenzene	ND	11.5	--	ND	53.0	--	U
100-41-4	Ethylbenzene	ND	11.5	--	ND	50.0	--	U
179601-23-1	p/m-Xylene	ND	23.0	--	ND	99.9	--	U
75-25-2	Bromoform	ND	11.5	--	ND	119.	--	U
100-42-5	Styrene	ND	11.5	--	ND	49.0	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	11.5	--	ND	79.0	--	U
95-47-6	o-Xylene	ND	11.5	--	ND	50.0	--	U
622-96-8	4-Ethyltoluene	ND	11.5	--	ND	56.5	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	11.5	--	ND	56.5	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-06D	Date Collected	: 08/07/18 14:10
Client ID	: SS-BLDG 7(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 06:49
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 57.6
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167440	Instrument ID	: AIRLAB16
Sample Amount	: 4.34 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	11.5	--	ND	56.5	--	U
100-44-7	Benzyl chloride	ND	11.5	--	ND	59.5	--	U
541-73-1	1,3-Dichlorobenzene	ND	11.5	--	ND	69.1	--	U
106-46-7	1,4-Dichlorobenzene	ND	11.5	--	ND	69.1	--	U
95-50-1	1,2-Dichlorobenzene	ND	11.5	--	ND	69.1	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	11.5	--	ND	85.4	--	U
87-68-3	Hexachlorobutadiene	ND	11.5	--	ND	123.	--	U

NW 9/5/18

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-06D2	Date Collected	: 08/07/18 14:10
Client ID	: SS-BLDG 7(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 09:58
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 347.2
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167444	Instrument ID	: AIRLAB16
Sample Amount	: 0.720 ml	GC Column	: RTX-1

use original

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
79-01-6	Trichloroethene	26600	69.4	--	143000	373	--	

NW 9151.8

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-07D	Date Collected	: 08/07/18 14:20
Client ID	: SS-BLDG 7B-2(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 11:30
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 89.61
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167445	Instrument ID	: AIRLAB16
Sample Amount	: 2.79 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	20.5	17.9	--	101	88.5	--	
74-87-3	Chloromethane	ND	17.9	--	ND	37.0	--	U
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethan	ND	17.9	--	ND	125.	--	U
75-01-4	Vinyl chloride	ND	17.9	--	ND	45.8	--	U
106-99-0	1,3-Butadiene	ND	17.9	--	ND	39.6	--	U
74-83-9	Bromomethane	ND	17.9	--	ND	69.5	--	U
75-00-3	Chloroethane	ND	17.9	--	ND	47.2	--	U
64-17-5	Ethyl Alcohol	ND	448	--	ND	844	--	U
593-60-2	Vinyl bromide	ND	17.9	--	ND	78.3	--	U
67-64-1	Acetone	ND	89.6	--	ND	213	--	U
75-69-4	Trichlorofluoromethane	ND	17.9	--	ND	101.	--	U
67-63-0	iso-Propyl Alcohol	ND	44.8	--	ND	110	--	U
75-35-4	1,1-Dichloroethene	87.3	17.9	--	346	71.0	--	
75-65-0	tert-Butyl Alcohol	ND	44.8	--	ND	136.	--	U
75-09-2	Methylene chloride	ND	44.8	--	ND	156	--	U
107-05-1	3-Chloropropene	ND	17.9	--	ND	56.0	--	U
75-15-0	Carbon disulfide	ND	17.9	--	ND	55.7	--	U
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	1190	17.9	--	9120	137	--	
156-60-5	trans-1,2-Dichloroethene	30.6	17.9	--	121	71.0	--	
75-34-3	1,1-Dichloroethane	44.7	17.9	--	181	72.4	--	
1634-04-4	Methyl tert butyl ether	ND	17.9	--	ND	64.5	--	U
78-93-3	2-Butanone	ND	44.8	--	ND	132.	--	U
156-59-2	cis-1,2-Dichloroethene	244	17.9	--	967	71.0	--	
141-78-6	Ethyl Acetate	ND	44.8	--	ND	161.	--	U
67-66-3	Chloroform	19.1	17.9	--	93.3	87.4	--	
109-99-9	Tetrahydrofuran	ND	44.8	--	ND	132.	--	U
107-06-2	1,2-Dichloroethane	ND	17.9	--	ND	72.4	--	U
110-54-3	n-Hexane	ND	17.9	--	ND	63.1	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-07D	Date Collected	: 08/07/18 14:20
Client ID	: SS-BLDG 7B-2(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 11:30
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 89.61
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167445	Instrument ID	: AIRLAB16
Sample Amount	: 2.79 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	856	17.9	--	4670	97.7	--	
71-43-2	Benzene	ND	17.9	--	ND	57.2	--	U
56-23-5	Carbon tetrachloride	ND	17.9	--	ND	113.	--	U
110-82-7	Cyclohexane	ND	17.9	--	ND	61.6	--	U
78-87-5	1,2-Dichloropropane	ND	17.9	--	ND	82.7	--	U
75-27-4	Bromodichloromethane	ND	17.9	--	ND	120.	--	U
123-91-1	1,4-Dioxane	ND	17.9	--	ND	64.5	--	U
79-01-6	Trichloroethene	10500 9640	17.9 35.7	--	56400 51800	96.2 192	--	E
540-84-1	2,2,4-Trimethylpentane	ND	17.9	--	ND	83.6	--	U
142-82-5	Heptane	ND	17.9	--	ND	73.4	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	17.9	--	ND	81.3	--	U
108-10-1	4-Methyl-2-pentanone	ND	44.8	--	ND	184.	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	17.9	--	ND	81.3	--	U
79-00-5	1,1,2-Trichloroethane	ND	17.9	--	ND	97.7	--	U
108-88-3	Toluene	ND	17.9	--	ND	67.5	--	U
591-78-6	2-Hexanone	ND	17.9	--	ND	73.4	--	U
124-48-1	Dibromochloromethane	ND	17.9	--	ND	152.	--	U
106-93-4	1,2-Dibromoethane	ND	17.9	--	ND	138.	--	U
127-18-4	Tetrachloroethene	1240	17.9	--	8410	121	--	
108-90-7	Chlorobenzene	ND	17.9	--	ND	82.4	--	U
100-41-4	Ethylbenzene	ND	17.9	--	ND	77.7	--	U
179601-23-1	p/m-Xylene	ND	35.8	--	ND	155.	--	U
75-25-2	Bromoform	ND	17.9	--	ND	185.	--	U
100-42-5	Styrene	ND	17.9	--	ND	76.2	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	17.9	--	ND	123.	--	U
95-47-6	o-Xylene	ND	17.9	--	ND	77.7	--	U
622-96-8	4-Ethyltoluene	ND	17.9	--	ND	88.0	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	17.9	--	ND	88.0	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-07D	Date Collected	: 08/07/18 14:20
Client ID	: SS-BLDG 7B-2(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 11:30
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 89.61
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167445	Instrument ID	: AIRLAB16
Sample Amount	: 2.79 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	17.9	--	ND	88.0	--	U
100-44-7	Benzyl chloride	ND	17.9	--	ND	92.7	--	U
541-73-1	1,3-Dichlorobenzene	ND	17.9	--	ND	108.	--	U
106-46-7	1,4-Dichlorobenzene	ND	17.9	--	ND	108.	--	U
95-50-1	1,2-Dichlorobenzene	ND	17.9	--	ND	108.	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	17.9	--	ND	133.	--	U
87-68-3	Hexachlorobutadiene	ND	17.9	--	ND	191.	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-07D2	Date Collected	: 08/07/18 14:20
Client ID	: SS-BLDG 7B-2(08072018)	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 12:19
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 178.6
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167446	Instrument ID	: AIRLAB16
Sample Amount	: 1.40 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
79-01-6	Trichloroethene	10500	35.7	--	56400	192	--	

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-08D	Date Collected	: 08/07/18 13:00
Client ID	: DUP08072018	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 06:12
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167439	Instrument ID	: AIRLAB16
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
75-71-8	Dichlorodifluoromethane	208	1.00	--	1030	4.94	--	
74-87-3	Chloromethane	ND	1.00	--	ND	2.07	--	U
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethan	ND	1.00	--	ND	6.99	--	U
75-01-4	Vinyl chloride	ND	1.00	--	ND	2.56	--	U
106-99-0	1,3-Butadiene	ND	1.00	--	ND	2.21	--	U
74-83-9	Bromomethane	ND	1.00	--	ND	3.88	--	U
75-00-3	Chloroethane	ND	1.00	--	ND	2.64	--	U
64-17-5	Ethyl Alcohol	45.7	25.0	--	86.1	47.1	--	
593-60-2	Vinyl bromide	ND	1.00	--	ND	4.37	--	U
67-64-1	Acetone	11.4	5.00	--	27.1	11.9	--	
75-69-4	Trichlorofluoromethane	ND	1.00	--	ND	5.62	--	U
67-63-0	iso-Propyl Alcohol	5.20	2.50	--	12.8	6.15	--	
75-35-4	1,1-Dichloroethene	ND	1.00	--	ND	3.96	--	U
75-65-0	tert-Butyl Alcohol	ND	2.50	--	ND	7.58	--	U
75-09-2	Methylene chloride	2.55	2.50	--	8.86	8.69	--	
107-05-1	3-Chloropropene	ND	1.00	--	ND	3.13	--	U
75-15-0	Carbon disulfide	1.03	1.00	--	3.21	3.11	--	
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	1.36	1.00	--	10.4	7.66	--	
156-60-5	trans-1,2-Dichloroethene	ND	1.00	--	ND	3.96	--	U
75-34-3	1,1-Dichloroethane	ND	1.00	--	ND	4.05	--	U
1634-04-4	Methyl tert butyl ether	ND	1.00	--	ND	3.61	--	U
78-93-3	2-Butanone	ND	2.50	--	ND	7.37	--	U
156-59-2	cis-1,2-Dichloroethene	ND	1.00	--	ND	3.96	--	U
141-78-6	Ethyl Acetate	ND	2.50	--	ND	9.01	--	U
67-66-3	Chloroform	ND	1.00	--	ND	4.88	--	U
109-99-9	Tetrahydrofuran	ND	2.50	--	ND	7.37	--	U
107-06-2	1,2-Dichloroethane	ND	1.00	--	ND	4.05	--	U
110-54-3	n-Hexane	ND	1.00	--	ND	3.52	--	U

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Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-08D	Date Collected	: 08/07/18 13:00
Client ID	: DUP08072018	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 06:12
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167439	Instrument ID	: AIRLAB16
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
71-55-6	1,1,1-Trichloroethane	2.27	1.00	--	12.4	5.46	--	
71-43-2	Benzene	ND	1.00	--	ND	3.19	--	U
56-23-5	Carbon tetrachloride	ND	1.00	--	ND	6.29	--	U
110-82-7	Cyclohexane	ND	1.00	--	ND	3.44	--	U
78-87-5	1,2-Dichloropropane	ND	1.00	--	ND	4.62	--	U
75-27-4	Bromodichloromethane	ND	1.00	--	ND	6.70	--	U
123-91-1	1,4-Dioxane	ND	1.00	--	ND	3.60	--	U
79-01-6	Trichloroethene	5.55	1.00	--	29.8	5.37	--	
540-84-1	2,2,4-Trimethylpentane	ND	1.00	--	ND	4.67	--	U
142-82-5	Heptane	ND	1.00	--	ND	4.10	--	U
10061-01-5	cis-1,3-Dichloropropene	ND	1.00	--	ND	4.54	--	U
108-10-1	4-Methyl-2-pentanone	ND	2.50	--	ND	10.2	--	U
10061-02-6	trans-1,3-Dichloropropene	ND	1.00	--	ND	4.54	--	U
79-00-5	1,1,2-Trichloroethane	ND	1.00	--	ND	5.46	--	U
108-88-3	Toluene	1.56	1.00	--	5.88	3.77	--	
591-78-6	2-Hexanone	ND	1.00	--	ND	4.10	--	U
124-48-1	Dibromochloromethane	ND	1.00	--	ND	8.52	--	U
106-93-4	1,2-Dibromoethane	ND	1.00	--	ND	7.69	--	U
127-18-4	Tetrachloroethene	3.02	1.00	--	20.5	6.78	--	
108-90-7	Chlorobenzene	ND	1.00	--	ND	4.61	--	U
100-41-4	Ethylbenzene	ND	1.00	--	ND	4.34	--	U
179601-23-1	p/m-Xylene	ND	2.00	--	ND	8.69	--	U
75-25-2	Bromoform	ND	1.00	--	ND	10.3	--	U
100-42-5	Styrene	ND	1.00	--	ND	4.26	--	U
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.00	--	ND	6.87	--	U
95-47-6	o-Xylene	ND	1.00	--	ND	4.34	--	U
622-96-8	4-Ethyltoluene	ND	1.00	--	ND	4.92	--	U
108-67-8	1,3,5-Trimethylbenzene	ND	1.00	--	ND	4.92	--	U

nw 9/5/18

Form 1
Volatile Organics

Client	: ERM, Inc.	Lab Number	: L1830687
Project Name	: GW LISK	Project Number	: 0471313
Lab ID	: L1830687-08D	Date Collected	: 08/07/18 13:00
Client ID	: DUP08072018	Date Received	: 08/07/18
Sample Location	: CLIFTON SPRINGS, NY	Date Analyzed	: 08/16/18 06:12
Sample Matrix	: SOIL_VAPOR	Dilution Factor	: 5
Analytical Method	: 48,TO-15	Analyst	: MB
Lab File ID	: R167439	Instrument ID	: AIRLAB16
Sample Amount	: 50.0 ml	GC Column	: RTX-1

		ppbV			ug/m3			
CAS NO.	Parameter	Results	RL	MDL	Results	RL	MDL	Qualifier
95-63-6	1,2,4-Trimethylbenzene	ND	1.00	--	ND	4.92	--	U
100-44-7	Benzyl chloride	ND	1.00	--	ND	5.18	--	U
541-73-1	1,3-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
106-46-7	1,4-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
95-50-1	1,2-Dichlorobenzene	ND	1.00	--	ND	6.01	--	U
120-82-1	1,2,4-Trichlorobenzene	ND	1.00	--	ND	7.42	--	U
87-68-3	Hexachlorobutadiene	ND	1.00	--	ND	10.7	--	U

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Appendix E
Proposed Mitigation Products

SAFETY DATA SHEET

Radon Pro Sealant

1. PRODUCT IDENTIFICATION

IDENTIFICATION of the SUBSTANCE or PREPARATION

TRADE NAME (AS LABELED):	**RADON PRO SEALANT**
PRODUCT DESCRIPTION:	STPU Silicone / Urethane One-Part Hybrid
CHEMICAL NAME/CLASS:	Silyl Terminated Polyurethane (STPU) Silicone / Urethane One-Part Hybrid
SYNONYMS:	None
RELEVANT USE:	General Purpose Polyurethane Sealant
USES ADVISED AGAINST:	Other Than Relevant Use

COMPANY/UNDERTAKING IDENTIFICATION:

SUPPLIER/MANUFACTURER'S NAME:	**RadonAway®**
ADDRESS:	3 Saber Way, Ward Hill, MA 01835
EMERGENCY PHONE:	800-424-9300 (CHEMTREC, 24-hours)
BUSINESS PHONE:	800-767-3703 (Mon–Fri, 8 AM–5 PM ET), www.radonaway.com

PREPARATION DATE:	June 26, 2017
REVISION DATE:	March 16, 2018

This product is sold for commercial use. This SDS has been developed to address safety concerns of those individuals working with bulk quantities of this material, as well as those of potential users of this product in industrial/occupational settings. ALL United States Occupational Safety and Health Administration Standard (29 CFR 1910.1200), U.S. State equivalent Standards, Canadian WHMIS 2015 and the Global Harmonization required information is included in appropriate sections based on the Global Harmonization Standard format. This product has been classified in accordance with the hazard criteria of the countries listed above and the SDS contains all the information required by the Canadian WHMIS 2015 [HPR-GHS] , the Global Harmonization Standard and OSHA 1910.120.

2. HAZARD IDENTIFICATION

GLOBAL HARMONIZATION LABELING AND CLASSIFICATION: Classified in accordance with Global Harmonization Standard under U.S. OSHA Hazard Communication Standard, Canadian WHMIS HPR-GHS 2015.

Classification: Mutagenic Toxicity Cat. 2, Reproductive Toxicity Cat. 2, Acute Oral Toxicity Cat. 5, Eye Irritation Cat. 2, Skin Irritation Cat. 3, Skin Sensitization Cat. 1B, Respiratory Sensitization Cat. 1B, STOT (Immune System, Liver, Urinary System) RE Cat. 2, Aquatic Acute Toxicity Cat. 3, Aquatic Chronic Toxicity Cat. 3

Signal Word: Danger

Hazard Statement Codes: H341, H361fd, H303, H315, H319, H317, H334, H373, H412

Precautionary Statement Codes: P201, P202, P260, P264, P271, P272, P273, P280, P284, P308 + P313, P305 + P351 + P338, P337 + P313, P302 + P352, P321, P333 + P313, P362 + P364, P304 + P340, P342 + P311, P321, P403 + P233, P273, P501

Hazard Symbols/Pictograms: GHS07, GHS08

EMERGENCY OVERVIEW:

Physical Description: This product is a heavy paste with a slight odor and comes in several colors.

Health Hazards: WARNING! May cause eye and skin, especially if exposure is prolonged. May be harmful if ingested. May cause skin and respiratory sensitization in susceptible individuals. Contains compounds with potential adverse effects to organs by ingestion and/or inhalation. Contains trace compound with suspected adverse mutagenic and reproductive toxicity effects. The Titanium Dioxide component may cause cancer by inhalation of particles; however, due to the form of this product, this cancer hazard is not expected to be significant.

Flammability Hazard: This product is expected to be combustible and may ignite if exposed to high temperature or direct flame.

Reactivity Hazard: This product is not reactive. Exposure of containers to temperatures higher than 177ºC (350ºF) can cause pressure build-up and potential rupture.

Environmental Hazard: This product has not been tested for environmental impact. This product contains a trace compounds that can cause acute and chronic aquatic toxicity.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM (HMIS®)

Health	**2***
Flammability	**1**
Physical Hazard	**0**

See Section 16 for definitions of ratings

0 = Minimal
1 = Slight
2 = Moderate
3 = Serious
4 = Severe
* = Chronic

HMIS® is a registered trademark of the National Paint and Coatings Association.

CANADIAN WHMIS (HPR-GHS) 2015 CLASSIFICATION AND SYMBOLS: See Section 16 for in Classification and Symbols under HPR-GHS 2015.

U.S. OSHA REGULATORY STATUS: This material has a classification under the Global Harmonization Standard, as applied under OSHA regulations, as given earlier in this Section.

3. MATERIAL IDENTIFICATION

Chemical Name	CAS #	W/W%	LABEL ELEMENTS GHS Classification under U.S. OSHA Hazard Communication Standard & Canadian WHMIS (HPR-GHS) 2015 Hazard Statement Codes
Calcium Carbonate (Limestone) Calcium Carbonate, Synthetic	1317-65-3 471-34-1	40.0-60.0	NOTIFIED CLASSIFICATION Classification: Skin Irritation Cat. 2 Hazard Statement Codes: H315
Diisodecyl Phthalate	68515-49-1	20.0-30.0	Classification: Not Applicable
Proprietary Polyol Mixture		10.0-15.0	Classification: Not Applicable
Proprietary Silicones and Siloxanes		2.0-5.0	Classification: Not Applicable
Vinyltrimethoxysilane	2768-02-7	1.0-5.0	NOTIFIED CLASSIFICATION Classification: Flammable Liquid Cat. 3, Acute Inhalation Toxicity Cat. 4, STOT (Urinary System) RE Cat. 2 Hazard Statement Codes: H226, H332, H373 PROPOSED HARMONIZED CLASSIFICATION UNDER ANNEX VI of EU CLP Classification: Skin Sensitization Cat. 1B Hazard Statement Codes: H317
Amino Silane	3069-29-2	0.5-0.7	NOTIFIED CLASSIFICATION Classification: Eye Damage Cat. 1A, Skin Irritation Cat. 2, Acute Skin Sensitization Cat. 1B Hazard Statement Codes: H318, H315, H317
Isophorone Diisocyanate	4098-71-9	0.5-0.7	HARMONISED CLASSIFICATION - ANNEX VI OF REGULATION (EC) NO 1272/2008 (CLP REGULATION) Classification: Acute Inhalation Toxicity Cat. 2, Skin Irritation Cat. 2, 3, Eye Irritation Cat. 2A, STOT (Inhalation-Respiratory Irritation) SE Cat. 3, Respiratory Sensitization Cat. 1, Skin Sensitization Cat. 1, Aquatic Chronic Toxicity Cat. 2 Hazard Statement Codes: H331, H315, H319, H335, H334, H317, H411
Proprietary Methylated Sebacate Mixture		0.1-0.5	NOTIFIED CLASSIFICATION Classification: Aquatic Acute Toxicity Cat. 1, Aquatic Chronic Toxicity Cat. 1 Hazard Statement Codes: H400, H410
Amino Alkoxysilane	1760-24-3	0.1-0.3	NOTIFIED CLASSIFICATION Classification: Eye Damage Cat. 1A, Acute Skin Sensitization Cat. 1B, Acute Inhalation Toxicity Cat. 4 Hazard Statement Codes: H318, H317, H332 ADDITIONAL SELF-CLASSIFICATION Classification: Flammable Liquid Cat. 4, Acute Oral Toxicity Cat. 5, Acute Dermal Toxicity Cat. 5 Hazard Statement Codes: H227, H303 + H313
Dibutyl Maleate	105-76-0	0.1-0.3	NOTIFIED CLASSIFICATION Classification: Acute Skin Sensitization Cat. 1B, STOT (Urinary System) RE Cat. 2 Hazard Statement Codes: H317, H373
Proprietary Organofunctional Silane		0.1-0.3	NOTIFIED CLASSIFICATION Classification: Eye Corrosion/Damage Cat. 1B, Skin Irritation Cat. 2 Hazard Statement Codes: H318, H315
Dibutyltin Dilaurate	77-58-7	0.1	NOTIFIED CLASSIFICATION Classification: Reproductive Toxicity Cat. 2, Germ Cell Mutagen Classification Cat. 2, Skin Corrosion Cat. 1B, Acute Oral Toxicity Cat. 4, Skin Sensitization Cat. 1B, Aquatic Acute Toxicity Cat. 1 Hazard Statement Codes: H341, H361fd, H314, H302, H317, H400 PROPOSED HARMONIZED CLASSIFICATION UNDER ANNEX VI of EU CLP Classification: Germ Cell Mutagen Cat. 2, Reproductive Toxicity Cat. 1B, STOT (Immune System) RE Cat. 1 Hazard Statement Codes: H341, H360FD, H372
The following is component information for some of the individual pigmented colors of this product:			
Iron Oxide Pigment	Mixture	0.0-2.0	SELF-CLASSIFICATION BASED ON MFG SDS Classification: Skin Irritation Cat. 2, Skin Sensitization Cat. 1B, STOT (Inhalation-Respiratory Irritation) SE Cat. 3 Hazard Statement Codes: H315, H317, H335
Titanium Dioxide	13463-67-7	0.1-2.0	SELF-CLASSIFICATION Classification: Carcinogenic Cat. 2 Hazard Statement Codes: H351i
Other components. Each of the other components is present in less than 1 percent concentration (0.1% concentration for potential carcinogens, reproductive toxins, respiratory tract sensitizers, and mutagens).		Balance	Classification: Not Applicable

The specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret.

4. FIRST-AID MEASURES

PROTECTION OF FIRST AID RESPONDERS: Rescuers should not attempt to retrieve victims of exposure to this material without adequate personal protective equipment. Rescuers should be taken for medical attention, if necessary.

DESCRIPTION OF FIRST AID MEASURES: Remove victim(s) to fresh air, as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Remove and isolate contaminated clothing and shoes. Seek immediate medical attention. Take copy of label and MSDS to physician or other health professional with victim(s).

INHALATION: If dusts of this material are inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions.

SKIN EXPOSURE: If the material contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 20 minutes. Do not interrupt flushing. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention.

EYE EXPOSURE: If this product enters the eyes, open victim's eyes while under gently running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 20 minutes. Do not interrupt flushing.

INGESTION: If this material is swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. DO NOT INDUCE VOMITING, unless directly by medical personnel. Have victim rinse mouth with water or give several cupfuls of water, if conscious. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or unable to swallow. If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain an open airway and prevent aspiration.

4. FIRST-AID MEASURES (Continued)

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Dermatitis or other pre-existing skin disorders may be aggravated by exposure to this product.

INDICATION OF IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT IF NEEDED: Treat symptoms and eliminate exposure.

5. FIRE-FIGHTING MEASURES

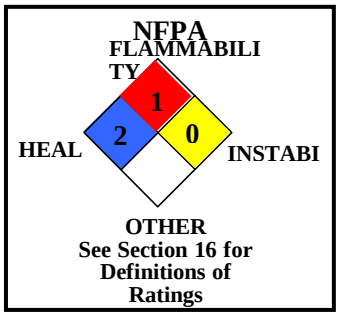
FLASH POINT: > 93.2°C (> 200°F) AUTOIGNITION: Unknown.

FLAMMABLE LIMITS IN AIR: Unknown.

EXTINGUISHING MEDIA:

Suitable Extinguishing Media: Use extinguishing material suitable to the surrounding fire, including foam, halon, carbon dioxide and dry chemical.

Unsuitable Extinguishing Media: None known.



PROTECTION OF FIREFIGHTERS:

Special Hazards Arising From the Substance: This product is combustible and can be ignited when exposed to its flashpoint. Not sensitive to mechanical impact under normal conditions. Not sensitive to static discharge under normal conditions. At temperatures greater than 177ºC (350ºF), the trace isocyanate component forms carbodiimides with the release of CO_2 which can cause pressure build-up; closed containers may develop pressure and rupture in event of fire.

Special Protective Actions for Fire-Fighters: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Move containers from fire area if it can be done without risk to personnel. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS AND EMERGENCY PROCEDURES: An accidental release can result in a fire if exposed to ignition source. Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. Use only non-sparking tools and equipment during the response. The atmosphere must at least 19.5 percent Oxygen before non-emergency personnel can be allowed in the area without Self-Contained Breathing Apparatus and fire protection.

PERSONAL PROTECTIVE EQUIPMENT: Responders should wear the level of protection appropriate to the type of chemical released, the amount of the material spilled, and the location where the incident has occurred.

Small Spills: For releases of 1 drum or less, Level D Protective Equipment (gloves, chemical resistant apron, boots, and eye protection) should be worn.

Large Spills: Minimum Personal Protective Equipment should be rubber gloves, rubber boots, face shield, and Tyvek suit. Minimum level of personal protective equipment for releases in which the level of oxygen is less than 19.5% or is unknown must be **Level B: triple-gloves (rubber gloves and nitrile gloves over latex gloves), chemical resistant suit, fire-retardant clothing and boots, hard hat, and Self-Contained Breathing Apparatus.**

METHODS FOR CLEAN-UP AND CONTAINMENT:

All Spills: Access to the spill area should be restricted. Spread should be limited by gently covering the spill with polypads. Scrape up or pick-up spilled material, placing in suitable containers. Absorb any residual on appropriate material, such as sand. All contaminated absorbents and other materials should be placed in an appropriate container and seal. Do not mix with wastes from other materials. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations). Dispose of recovered material and report spill per regulatory requirements. Remove all residue before decontamination of spill area. Clean spill area with soap and copious amounts of water.

ENVIRONMENTAL PRECAUTIONS: Minimize use of water to prevent environmental contamination. Prevent spill or rinsate from contaminating storm drains, sewers, soil or groundwater. Place all spill residues in a suitable container and seal. Do not discharge effluent containing this product into streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA.

OTHER INFORMATION: U.S. regulations may require reporting of spills of this material that reach surface waters if a sheen is formed. If necessary, the toll-free phone number for the US Coast Guard National Response Center is 1-800-424-8802.

REFERENCE TO OTHER SECTIONS: See information in Section 8 (Exposure Controls – Personal Protection) and Section 13 (Disposal Considerations) for additional information.

7. HANDLING and STORAGE

PRECAUTIONS FOR SAFE HANDLING: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat or drink while handling this material. Avoid contact with eyes, skin, and clothing. Avoid breathing fumes, dusts, vapors or mist. Do not taste or swallow. Use only with adequate ventilation. Keep away from heat and flame. In the event of a spill, follow practices indicated in Section 6: ACCIDENTAL RELEASE MEASURES.

CONDITIONS FOR SAFE STORAGE: This product is stable under ordinary conditions of handling, use and storage. Store containers in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Store away from incompatible materials (see Section 10: STABILITY AND REACTIVITY). Keep container tightly closed when not in use. Inspect all incoming containers before storage, to ensure containers are properly labeled and not damaged.

7. HANDLING and STORAGE (Continued)

CONDITIONS FOR SAFE STORAGE (continued): To prolong shelf life, store at temperatures below 26°C (80°F).
PRODUCT END USE: This product is used as a sealant. Follow all industry standards for use of this product.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/CONTROL PARAMETERS:

Ventilation And Engineering Controls: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below.
Occupational/Workplace Exposure Limits/Guidelines:

Chemical Name	CAS #	Guideline	Value
Amino Alkoxysilane	1760-24-3	NE	NE
Amino Silane	3069-29-2	NE	NE
Calcium Carbonate, Natural Calcium Carbonate, Synthetic	1317-65-3 471-34-1	OSHA PEL TWA NIOSH REL TWA	15 mg/m^3 total dust 5 mg/m^3 respirable fraction 10 mg/m^3 total dust 5 mg/m^3 respirable fraction
Dibutyl Maleate	105-76-0	NE	NE
Dibutyltin Dilaurate Exposure limits given are for Di-n-compounds, as Sn	77-58-7	DFG MAK TWA DFG MAK PEAK	0.004 ppm (skin; for n-butyltin compounds whose organic ligands were already designated 'SA' or ,'SH', these designations also apply
Diisodecyl Phthalate	68515-49-1	NE	NE
Isophorone Polyisocyanate	4098-71-9	ACGIH TLV TWA OSHA PEL TWA OSHA PEL STEL NIOSH REL TWA NIOSH REL STEL DFG MAK TWA DFG MAK PEAK DFG MAK Pregnancy Risk Classification	0.005 ppm 0.005 ppm (vacated 1989 PEL) 0.02 ppm [skin] (vacated 1989 PEL) 0.005 ppm [skin] 0.02 ppm [skin] 0.005 ppm 1•MAK 15 minute average value, 1-hr interval, 4 per shift; 0.01 (ceiling) D Danger of Sensitization of the Sensitization of the Skin and Airways
Proprietary Iron Oxide Exposure limits given are for CAS# 1309-37-1		ACGIH TLV TWA OSHA PEL TWA NIOSH REL TWA DFG MAKs TWA/PEAK	5 mg/m^3 (respiratory fraction) 10 mg/m^3 (fume) 5 mg/m^3 (dust and fume, as Fe) With the exception of Iron Oxides which are not biologically available
Proprietary Methylated Sebacate Mixture		NE	NE
Proprietary Organofunctional Silane		NE	NE
Proprietary Polyol		NE	NE
Proprietary Silicones and Siloxanes		NE	NE
Titanium Dioxide	13463-67-7	ACGIH TLV TWA OSHA PEL TWA NIOSH REL DFG MAK TWA	10 mg/m^3 15 mg/m^3 total dust Lowest feasible concentration (LOQ 0.2 mg/m^3) 1.5 mg/m^3 respirable fraction
Vinyl Trimethoxysilane	2768-02-7	NE	NE

NE = Not Established. See Section 16 for Definitions of Terms Used.

Biological Exposure Indices (BEIs): Currently, no BEI's have been established for components of this product.

PERSONAL PROTECTIVE EQUIPMENT (PPE): *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, including the Respiratory Protection Standard (29 CFR 1910.134*), *Eye Protection Standard 29 CFR 1910.13, the Hand Protection Standard 29 CFR 1910.138, and the Foot Protection Standard 29 CFR 1910.136), equivalent standards of Canada (including the Canadian CSA Respiratory Standard Z94.4-93-02, the CSA Eye Protection Standard Z94.3-M1982*, *Industrial Eye and Face Protectors and the Canadian CSA Foot Protection Standard Z195-M1984, Protective Footwear). Please reference applicable regulations and standards for relevant details.*

Eye/Face Protection: Use approved safety goggles or safety glasses. If necessary, refer to appropriate regulations and standards.

Skin Protection: Wear chemical impervious gloves (e.g., Nitrile or Neoprene). Use triple gloves for spill response. If necessary, refer to appropriate regulations and standards.

Body Protection: Use body protection appropriate for task (e.g., lab coat, coveralls, Tyvek suit). If necessary, refer to the OSHA Technical Manual (Section VII: Personal Protective Equipment) or appropriate Standards of Canada. 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 appropriate regulations and standards.

Respiratory Protection: If mists or sprays from this product are created during use, use appropriate respiratory protection. If necessary, use only respiratory protection authorized in appropriate regulations. 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 appropriate regulations and standards. The following NIOSH respiratory equipment guidelines for components that present an inhalation hazard are presented for additional assistance in respiratory protective equipment selection.

POLYISOCYANATE

CONCENTRATION	RESPIRATORY PROTECTION
Up to 0.05 ppm:	Any Supplied-Air Respirator (SAR).
Up to 0.125 ppm:	Any SAR operated in a continuous-flow mode.
Up to 0.25 ppm:	Any Self-Contained Breathing Apparatus (SCBA) with a full facepiece, or any SAR with a full facepiece.
Up to 1 ppm:	Any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.
Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions:	Any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode, or any SAR that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode.
Escape:	Any Air-Purifying, Full-Facepiece Respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister, or any appropriate escape-type, SCBA.

9. PHYSICAL and CHEMICAL PROPERTIES

FORM: Heavy paste.
COLORS: Various.
MOLECULAR WEIGHT: Mixture.
MOLECULAR FORMULA: Mixture.
ODOR: Mild
ODOR THRESHOLD: Not available.
SPECIFIC GRAVITY: 1.3-1.4
VAPOR PRESSURE, mm Hg @ 20°C: Not established.
RELATIVE VAPOR DENSITY (air = 1): Heavier than air.
EVAPORATION RATE (BuAc = 1): < 1
SOLUBILITY IN WATER: Insoluble.
OTHER SOLUBILITIES: Not available.
MELTING/FREEZING POINT: Not available.
BOILING POINT: Not available.
VOC: < 15 g/L
WEIGHT % VOC: Not available.
FLASH POINT: > 93.2°C (> 200°F)
AUTOIGNITION TEMPERATURE: Not established.
pH: Not available.
FLAMMABLE LIMITS (in air by volume, %): Lower: Not established; Upper: Not established.
COEFFICIENT OF OIL/WATER DISTRIBUTION (PARTITION COEFFICIENT): Not established.
HOW TO DETECT THIS SUBSTANCE (IDENTIFYING PROPERTIES): The appearance of this product may act as an identifying property in the event of an accidental release.

10. STABILITY and REACTIVITY

CHEMICAL STABILITY: Stable under normal circumstances of use and handling. Will slowly cure upon exposure to air.
CONDITIONS TO AVOID: Avoid contact with incompatible chemicals and exposure to extreme temperatures. Keep containers sealed to avoid spontaneous curing.
INCOMPATIBLE MATERIALS: This product is not compatible with strong acids and oxidizers and may have some incompatibility with aluminum, ammonium salts and mercury/hydrogen mixtures.
HAZARDOUS DECOMPOSITION PRODUCTS: Combustion: Thermal decomposition of this product can generate formaldehyde, furans, aluminum, propylene, carbon and nitrogen oxides, methanol, hydrogen cyanide, isocyanates and isocyanic acid. Hydrolysis: Not known.
POSSIBILITY OF HAZARDOUS REACTIONS/POLYMERIZATION: This product is not expected to undergo hazardous polymerization, decomposition, condensation, or self-reactivity as this product contains stabilizers. Product slowly cures upon contact with moisture in air. At temperatures greater than 177ºC (350ºF), the isocyanate component forms carbodiimides with the release of CO2 which can cause pressure build-up; closed containers may develop pressure and rupture in event of fire or exposure to high temperature.

11. TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS: The most significant routes of occupational exposure are inhalation and contact with skin and eyes. The symptoms of exposure to this product are as follows:

Contact with Skin or Eyes: Contact may mildly irritate the skin and cause redness and discomfort. Prolonged or repeated skin contact may cause dermatitis (dry, red skin). Eye contact may cause redness, pain, and tearing.

Skin Absorption: The components of this product are not known to be absorbed through intact skin. Skin contact may cause sensitization and allergic reaction in susceptible individuals. Symptoms may include redness, itching and rash.

Ingestion: If the product is swallowed, it may mildly irritate the mouth, throat, and other tissues of the gastro-intestinal system and may cause nausea, vomiting, and diarrhea. Chronic ingestion may cause adverse effects on the kidneys, liver and immune and urinary systems.

Inhalation: Exposure to vapors of this product generated during curing, or dusts of this product generated during use after curing may mildly irritate the respiratory tract and cause coughing and sneezing. Vapors or fumes when used in an enclosed space, if heated or during curing may cause irritation of the respiratory system. Symptoms include nose irritation, dry or sore or burning throat, runny nose, shortness of breath, dizziness, incoordination. Inhalation may cause respiratory sensitization and allergic reaction.

Injection: Accidental injection of this product (e.g. puncture with a contaminated object) may cause burning, redness, and swelling in addition to the wound.

Target Organs: Acute: Skin, eyes, central nervous system. Chronic: Skin, respiratory system.

Chronic Effects: Prolonged or repeated skin contact may cause dermatitis (dry, red skin), sensitization to the skin and respiratory system or adverse liver, kidney, immune and urinary system effects.

TOXICITY DATA: There are currently no toxicity data available for this product; the following toxicology information is available for components greater than 1% in concentration. Due to the large amount of data available for Titanium Dioxide, only available irritation data and mutagenic data are presented (no human data, LD50 or LC50 data are available). Carcinogenic data for rats by inhalation are also presented, but not for other routes of exposure.

CALCIUM CARBONATE, NATURAL:

TDLo (Intravenous-Rat) 30 mg/kg: Vascular: BP lowering not characterized in autonomic section; Lungs, Thorax, or Respiration: changes in lung weight; Blood: other changes

TCLo (Inhalation-Rat) 84 mg/m^3/4 hours/40 weeks-intermittent: Lungs, Thorax, or Respiration: fibrosis (interstitial); Liver: other changes; Kidney/Ureter/Bladder: other changes

TCLo (Inhalation-Rat) 250 mg/m^3/2 hours/24 weeks-intermittent: Lungs, Thorax, or Respiration: fibrosis, focal (pneumoconiosis)

CALCIUM CARBONATE, SYNTHETIC:

Standard Draize Test (Skin-Rabbit) 500 mg/24 hours: Moderate

Standard Draize Test (Eye-Rabbit) 750 µg/24 hours: Severe

TDLo (Oral-Human) 4.08 gm/kg/30 days-intermittent: Vascular: BP elevation not characterized in autonomic section; Gastrointestinal: changes in structure or function of endocrine pancreas; Biochemical: Metabolism (Intermediary): effect on inflammation or mediation of inflammation

LD_{50} (Oral-Rat) 6450 mg/kg

TDLo (Oral-Rat) 60 gm/kg: Gastrointestinal: hypermotility, diarrhea, other changes

TDLo (Oral-Rat) 10 mg/kg: Biochemical: Metabolism (Intermediary): effect on inflammation or mediation of inflammation

PROPRIETARY SILICONES & SILOXANES:

TCLo (Inhalation-Rat) 30 mg/kg/6 hours/4 weeks-intermittent: Lungs, Thorax, or Respiration: other changes; Blood: hemorrhage; Related to Chronic Data: death

TITANIUM DIOXIDE:

Standard Draize Test (Skin-Human) 300 µg/3 days-intermittent: Mild

TC (Inhalation-Rat) 10 mg/m^3/18 hours/2 years-intermittent: Tumorigenic: carcinogenic by RTECS criteria; Lungs, Thorax, or Respiration: tumors

TCLo (Inhalation-Rat) 1 mg/kg: Lungs, Thorax, or Respiration: other changes; Biochemical: Metabolism (Intermediary): effect on inflammation or mediation of inflammation

TCLo (Inhalation-Rat) 250 mg/m^3/6 hours/4 weeks-intermittent: Lungs, Thorax, or Respiration: chronic pulmonary edema, other changes

TCLo (Inhalation-Rat) 50 mg/m^3/6 hours/13 weeks-intermittent: Lungs, Thorax, or Respiration: structural or functional change in trachea or bronchi

TCLo (Inhalation-Rat) 10 mg/m^3/6 hours/13 weeks-intermittent: Lungs, Thorax, or Respiration: fibrosis (interstitial), other changes; Biochemical: Metabolism (Intermediary): effect on inflammation or mediation of inflammation

11. TOXICOLOGICAL INFORMATION (Continued)

TOXICITY DATA (continued):

TITANIUM DIOXIDE (continued):

TCLo (Inhalation-Rat) 10 mg/m^3/13 weeks-intermittent: Lungs, Thorax, or Respiration: other changes; Biochemical: Metabolism (Intermediary): effect on inflammation or mediation of inflammation

TCLo (Inhalation-Rat) 50 mg/m^3/13 weeks-intermittent: Lungs, Thorax, or Respiration: sputum; Blood: changes in cell count (unspecified); Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: dehydrogenases

TCLo (Inhalation-Rat) 250 mg/m^3/13 weeks-intermittent: Lungs, Thorax, or Respiration: other changes; Blood: changes in cell count (unspecified); Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: dehydrogenases

TCLo (Inhalation-Rat) 274 mg/m^3/5 days-intermittent: Lungs, Thorax, or Respiration: changes in lung weight; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: multiple enzyme effects, Metabolism (Intermediary): effect on inflammation or mediation of inflammation

TCLo (Inhalation-Rat) 250 mg/m^3/6 hours/2 years-intermittent: Tumorigenic: carcinogenic by RTECS criteria; Lungs, Thorax, or Respiration: tumors

DNA Damage (Human Lung) 100 µg/plate

DNA Damage (Human Lung) 20 µg/disk/4 hours

Sister Chromatid Exchange (Human Lymphocyte) 2 µmol/L/72 hours

TITANIUM DIOXIDE (continued):

Micronucleus Test (Human Lymphocyte) 5 µmol/L/72 hours

Micronucleus Test (Intraperitoneal-Mouse) 3 gm/kg/3 days-continuous

Micronucleus Test (Hamster Ovary) 5 µmol/L

DNA Inhibition (Hamster Lung) 500 mg/L

Sister Chromatid Exchange (Hamster Ovary) 1 µmol/L

VINYLTRIMETHOXYSILANE:

Standard Draize Test (Skin-Rabbit) 500 mg/24 hours: Mild

Standard Draize Test (Skin-Rabbit) 500 mg/24 hours: Mild

LD_{50} (Oral-Rat) 7340 µL/kg: Sense Organs and Special Senses (Olfaction): effect, not otherwise specified; Behavioral: somnolence (general depressed activity); Skin and Appendages: hair

LD_{50} (Skin-Rabbit) 3360 µL/kg: Behavioral: somnolence, (general depressed activity) ataxia; Skin and Appendages: dermatitis, other (after systemic exposure)

LC_{50} (Inhalation-Rat) 2773 ppm: Sense Organs and Special Senses (Eye): lacrymation; Behavioral: somnolence (general depressed activity); Skin and Appendages: hair

TCLo (Inhalation-Rat) 400 ppm/14 weeks-intermittent: Kidney/Ureter/Bladder: other changes

TCLo (Inhalation-Rat) 750 ppm/6 hours/9 days-intermittent: Behavioral: fluid intake; Kidney/Ureter/Bladder: hematuria; Nutritional and Gross Metabolic: weight loss or decreased weight gain

CARCINOGENIC POTENTIAL: The following table summarizes the carcinogenicity listing for the components of this product. "NO" indicates that the substance is not considered to be or suspected to be a carcinogen by the listed agency, see section 16 for definitions of other ratings.

CHEMICAL	EPA	IARC	NTP	NIOSH	ACGIH	OSHA	DFG	PROP 65
Amino Alkoxysilane	No	No	No	No	No	No	No	No
Amino Silane	No	No	No	No	No	No	No	No
Proprietary Methylated Sebacate Mixture	No	No	No	No	No	No	No	No
Calcium Carbonate (Natural & Synthetic)	No	No	No	No	No	No	No	No
Dibutyl Maleate	No	No	No	No	No	No	No	No
Dibutyltin Dilaurate (as a Di-n-compound, as Sn	No	No	No	No	No	No	4	No
Diisodecyl Phthalate	No	No	No	No	No	No	No	No
Isophorone Diisocyanate	No	No	No	No	No	No	No	No
Proprietary Iron Oxides	No	3	No	No	A4	No	3B	No
Proprietary Organofunctional Silane	No	No	No	No	No	No	No	No
Proprietary Polyol Mixture	No	No	No	No	No	No	No	No
Proprietary Silicones and Siloxanes	No	No	No	No	No	No	No	No
Titanium Dioxide	No	2B	No	Ca	A4	No	3A	Unbound Particles of Respirable Size
Vinyl Trimethoxysilane	No	No	No	No	No	No	No	No

IARC-2B: Possibly Carcinogenic to Humans. IARC-3: Possibly Carcinogenic to Humans. NIOSH-Ca: Potential Occupational Carcinogen, with No Further Categorization. ACGIH TLV-A4: Not Classifiable as a Human Carcinogen.

IRRITANCY OF PRODUCT: This product may mildly irritate contaminated tissue, especially if contact is prolonged. Eye irritation may be more pronounced.

SENSITIZATION TO THE PRODUCT: This product contains a diisocyanate compound, which is a known human skin and respiratory sensitizers and other components that are skin sensitizers. Exposure can cause allergic reactions. Cross-sensitization between different isocyanates may occur.

Respiratory Sensitization: Initial symptoms of respiratory reactions may appear to be a cold or mild hay fever. However, severe asthmatic symptoms can develop and include wheezing, chest tightness, shortness of breath, difficulty breathing and/or coughing. Fever, chills, general feelings of discomfort, headache, and fatigue can also occur. Symptoms may occur immediately upon exposure (within an hour), several hours after exposure or both, and/or at night. Typically, the asthma improves with removal from exposure (e.g. weekends or vacations) and returns, in some cases, in the form of an "acute attack", on renewed exposure. Sensitized people who continue to work with diisocyanates may develop symptoms sooner after each exposure. The number and severity of symptoms may increase. Death has occurred in sensitized individuals accidently exposed to relatively low concentrations of diisocyanates. Following removal from exposure, some sensitized workers may continue to show a slow decline in lung function and have persistent respiratory problems such as asthmatic symptoms, chronic bronchitis and hypersensitivity for months or years. Exposure to isocyanates is likely to aggravate existing respiratory disease, such as chronic bronchitis, and emphysema.

Skin Sensitization: Repeated skin contact with diisocyanates has caused skin sensitization in humans, although the condition is not common. Once a person is sensitized, contact with even a small amount can cause outbreaks of dermatitis with symptoms such as redness, rash, itching and swelling. This can spread from the hands or arms to the face and body. Some people who have inhaled diisocyanate developed extensive skin rashes can last weeks.

Additional information is available on some other components.

Dibutyl Maleate: Dibutyl Maleate may be a sensitizer based on human and animal information. A positive patch test to 10% Dibutyl Maleate in acetone for 72 hours was obtained in 10/20 workers occupationally exposed to Dibutyl Maleate containing polyvinyl acetate glue (11/20 workers had dermatitis). Negative results were obtained in 20 volunteers as controls. In a Guinea Pig Maximization Test using Freund's Complete Adjuvant, a strong sensitizing effect was obtained in guinea pigs following a challenge application of 0.2 mL Dibutyl Maleate. A positive response (erythema (grade 1-2) was seen in 16/20 guinea pigs after 24 hours and in 14/20 after 48 hours. No response was seen in the controls.

Proprietary Methylated Sebacate Mixture: Suspected skin sensitizer: CAESAR skin sensitization model in VEGA (Q)SAR platform predicts that the chemical is Sensitizer (good reliability). (Guinea pigs) Strong skin sensitizing potential, with 20/209 animals sensitized in epidermal challenge.

11. TOXICOLOGICAL INFORMATION (Continued)

TOXICOLOGICAL SYNERGISTIC PRODUCTS: None known.

REPRODUCTIVE TOXICITY INFORMATION: This product has not been tested for reproductive toxicity.

Mutagenicity/Embryotoxicity/ Teratogenicity/Reproductive Toxicity: Some reproductive studies of Dibutyltin Dilaurate on rats and mice have indicated exposure may cause reduced fetal weight increase in fetal deaths skeletal malformations by exposure via ingestion, inhalation and skin contact.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

MOBILITY: This product has not been tested for mobility in soil.

Dibutyltin Dilaurate: Dibutyltin Dilaurate is expected to dissociate in water forming the cation, dibutyltin. Volatilization from moist soil and water surfaces is not expected to be an important fate process because the cation is not expected to volatilize. Dibutyltin Dilaurate is not expected to volatilize from dry soil surfaces based upon an estimated vapor pressure of 4.5X10-9 mm Hg, determined from a fragment constant method.

PERSISTENCE AND BIODEGRADABILITY: This product has not been tested for persistence or biodegradability. The following information is available for some components.

Dibutyltin Dilaurate: If released to air, an estimated vapor pressure of 4.5X10-9 mm Hg at 25°C indicates Dibutyltin Dilaurate will exist solely in the particulate phase in the ambient atmosphere. Particulate-phase Dibutyltin Dilaurate will be removed from the atmosphere by wet and dry deposition. In soil and water, Dibutyltin Dilaurate may dissociate forming the cation, dibutyltin. If released to soil, dibutyltin is expected to adsorb to organic carbon and clay. Volatilization from moist soil surfaces is not expected to be an important fate process because the cation will not volatilize. Dibutyltin Dilaurate may also biodegrade in soil and water since tributyltins are converted to dibutyltin and monobutyltin. If released into water, dibutyltin is expected to adsorb to suspended solids and sediment. Volatilization from water surfaces will not be an important fate process because the cation will not volatilize.

Proprietary Methylated Sebacate Mixture: Components suspected persistent in the environment: The Danish QSAR database contains information indicating that these substances are predicted as non readily biodegradable.

BIO-ACCUMULATION POTENTIAL: This product has not been tested for bio-accumulation potential.

Dibutyltin Dilaurate: The observed BCF for Dibutyltin Dilaurate in round crucian carp (*Carassius carassius grandoculis*) muscle, vertebra, liver, and kidney tissue were 31, 54, 813, and 138, respectively. According to a classification scheme, a BCF value of 31 suggests bioconcentration in aquatic organisms is low.

ECOTOXICITY: This product has not been tested for aquatic or animal toxicity. Although no data are not available, under the Global Harmonization Standard, the Isophorone Diisocyanate component is classified as having chronic aquatic toxicity. Additionally, the following information is available for other components.

Dibutyltin Dilaurate:

EC_{50} (Daphnia water flea) 24 hours = 0.66 mg/L

LC_{50} (Leuciscus idus) 48 hours = 2 mg/L

Proprietary Methylated Sebacate Mixture Component #1: Suspected hazardous to the aquatic environment: DEMETRA Daphnia Magna toxicity model in VEGA (Q)SAR platform predicts that the chemical has a 48h EC_{50} of 0.0077 mg/L (moderate reliability); Fathead Minnow toxicity model (EPA) in VEGA (Q)SAR platform predicts that the chemical has a 96h LC_{50} of 1.82 mg/L (moderate reliability); Fish toxicity classification (SarPy/IRFMN) model in VEGA (Q)SAR platform predicts that the chemical is Toxic-2 (between 1 and 10 mg/L) (good reliability); The Danish QSAR database contains information indicating that the substance has a 96h EC_{50} to green algae of <1 mg/L.

Proprietary Methylated Sebacate Mixture Component #2: Suspected hazardous to the aquatic environment: DEMETRA Daphnia Magna toxicity model in VEGA (Q)SAR platform predicts that the chemical has a 48h EC_{50} of 0.1405 mg/L (moderate reliability); Fathead Minnow toxicity model (EPA) in VEGA (Q)SAR platform predicts that the chemical has a 96h LC_{50} of 5.05 mg/L (moderate reliability); Fish toxicity classification (SarPy/IRFMN) model in VEGA (Q)SAR platform predicts that the chemical is Toxic-2 (between 1 and 10 mg/L) (good reliability); The Danish QSAR database contains information indicating that the substance has a 96h EC_{50} to green algae of < 1 mg/L.

OTHER ADVERSE EFFECTS: This material is not expected to have any ozone depletion potential.

ENVIRONMENTAL EXPOSURE CONTROLS: Controls should be engineered to prevent release to the environment, including procedures to prevent spills, atmospheric release and release to waterways.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: As supplied, this product would not be a hazardous waste as defined by U.S. federal regulation (40 CFR 261) if discarded or disposed. State and local regulations may differ from federal regulations. The generator of the waste is responsible for proper waste determination and management.

U.S. EPA WASTE NUMBER: Not applicable.

14. TRANSPORTATION INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION: 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 SHIPPING INFORMATION (IATA): This product is NOT classified as dangerous goods, per the International Air Transport Association.

INTERNATIONAL MARITIME ORGANIZATION SHIPPING INFORMATION (IMO): This product is not classified as dangerous goods, per the International Maritime Organization.

15. REGULATORY INFORMATION

U.S. REGULATIONS:

U.S. SARA Reporting Requirements: The following components of this product are subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act.

CHEMICAL	SECTION 302 EHS (TPQ) (40 CFR 355, Appendix A)	SECTION 304 RQ (40 CFR Table 302.4)	SECTION 313 TRI (threshold) (40 CFR 372.65)
Isophorone Diisocyanate	Yes	Yes	Member of EPCRA Section 313 diisocyanate category.

U.S. SARA 302 Extremely Hazardous Threshold Planning Quantity (TPQ): Isophorone Diisocyanate: 500 lb (227 kg)

U.S. SARA 304 Extremely Hazardous Reportable Quantity (RQ): Isophorone Diisocyanate: 500 lb (227 kg)

U.S. SARA Hazard Categories (Section 311/312, 40 CFR 370-21): ACUTE: Yes; CHRONIC: Yes; FIRE: No; REACTIVE: No; SUDDEN RELEASE: No

15. REGULATORY INFORMATION (Continued)

U.S. REGULATIONS (continued):

U.S. TSCA Inventory Status: All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

U.S. CERCLA Reportable Quantity (RQ): Not applicable.

U.S. Clean Air Act (CA 112r) Threshold Quantity (TQ): Not applicable.

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65): This product also contains Titanium Dioxide, a suspect carcinogen which is on the list. Due to the form of the product, the Proposition 65 warning for Titanium Dioxide is not applicable. However, this product also contains trace amounts of Diisodecyl Phthalate, which is on the list as a developmental toxin. This product can expose you to chemicals including Diisodecyl Phthalate, which is known to the State of California to cause cancer. For more information go to P65Warnings.ca.gov.

In addition, to the warning text provided above, the following symbol must be displayed. Where the sign, label or shelf tag for the product is not printed using the color yellow, the symbol may be printed in black and white. The symbol shall be placed to the left of the text of the warning, in a size no smaller than the height of the word "WARNING". The symbol and new warning text are required to be included by August 2018.

CANADIAN REGULATIONS:

Canadian DSL/NDSL Inventory Status: The components of this product listed by CAS# in Section 3 are on the DSL Inventory.

Canadian Environmental Protection Act (CEPA) Priorities Substances Lists: No component is on the CEPA Priority Substances lists.

Canadian WHMIS (HPR-GHS) 2015 Classification and Symbols: See Section 16 in Classification and Symbols under HPR-GHS 2015.

MEXICAN REGULATIONS:

Mexican Workplace Regulations (NOM-018-STPS-2000): This product is not classified as hazardous.

16. OTHER INFORMATION

WARNINGS (per ANSI Z129.1): WARNING! MAY CAUSE EYE AND SKIN, ESPECIALLY IF EXPOSURE IS PROLONGED. MAY BE HARMFUL IF INGESTED. MAY CAUSE SKIN AND RESPIRATORY SENSITIZATION IN SUSCEPTIBLE INDIVIDUALS. CONTAINS COMPOUNDS WITH POTENTIAL ADVERSE EFFECTS TO ORGANS BY INGESTION AND/OR INHALATION. CONTAINS TRACE COMPOUND WITH SUSPECTED ADVERSE MUTAGENIC AND REPRODUCTIVE TOXICITY EFFECTS. THE TITANIUM DIOXIDE COMPONENT MAY CAUSE CANCER BY INHALATION OF PARTICLES; HOWEVER, DUE TO THE FORM OF THIS PRODUCT, THIS CANCER HAZARD IS NOT EXPECTED TO BE SIGNIFICANT. CONTAINS TRACE COMPOUNDS THAT MAY CAUSE ACUTE AND CHRONIC AQUATIC ADVERSE EFFECTS. COMBUSTIBLE – MAY IGNITE IF EXPOSED TO DIRECT FLAME. Avoid contact with eyes, skin, and clothing. Avoid breathing fumes, dusts, vapors or mist. Do not taste or swallow. Wash thoroughly after handling. Keep container tightly closed. Use only with adequate ventilation. Keep away from heat and flame. Wear gloves, eye protection, respiratory protection, and appropriate body protection. FIRST-AID: In case of contact, immediately flush skin and eyes with plenty of water. Remove contaminated clothing and shoes. Get medical attention if irritation develops or persists. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, do not induce vomiting. Get medical attention. IN CASE OF FIRE: Use water fog, foam, dry chemical, or CO_2. IN CASE OF SPILL: Absorb spilled product with polypads or other suitable absorbing material. Place all spill residue in an appropriate container and seal. Dispose of in accordance with U.S. Federal, State, and local hazardous waste disposal regulations and those of Canada.

GLOBAL HARMONIZATION LABELING AND CLASSIFICATION: Classified in accordance with the Global Harmonization Standard.

Classification: Mutagenic Toxicity Category 2, Reproductive Toxicity Category 2, Acute Oral Toxicity Category 5, Eye Irritation Category 2, Skin Irritation Category 3, Skin Sensitization Category 1B, Respiratory Sensitization Category 1B, Specific Target Organ Toxicity (Immune System, Liver, Urinary System) Repeated Exposure Category 2, Aquatic Acute Toxicity Category 3, Aquatic Chronic Toxicity Category 3

Signal Word: Danger

Hazard Statements: H341: Suspected of causing genetic effects. H361fd: Suspected of damaging fertility. Suspected of damaging the unborn child. H303: May be harmful if ingested. H315: Causes skin irritation. H319: Causes serious eye irritation. H317: May cause an allergic skin reaction. H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled. H373: May cause damage to the liver, kidneys, immune and urinary systems through prolonged or repeated exposure. H412: Harmful to aquatic life with long-lasting effects.

Precautionary Statements:

Prevention: P201: Obtain special instructions before use. P202: Do not handle until all safety precautions have been read and understood. P260: Do not breathe gas/mist/vapours/spray. P264: Wash thoroughly after handling. P271: Use only outdoors or in a well-ventilated area. P272: Contaminated work clothing should not be allowed out of the workplace. P273: Avoid release to the environment. P280: Wear protective gloves/protective clothing/eye protection/face protection. P284: Wear respiratory protection.

Response: P308 + P313: IF exposed or concerned: Get medical advice/attention. P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. P337 + P313: If eye irritation persists: Get medical advice/attention. P302 + P352: IF ON SKIN: Wash with plenty of soap and water. P333 + P313: If skin irritation or rash occurs: Get medical advice/attention. P362 + P364: Take off contaminated clothing and wash it before reuse. P304 + P340: If inhaled, remove victim to fresh air and keep at rest in a position comfortable for breathing. P342 + P311: If experiencing respiratory symptoms: Call a POISON CENTER or doctor. P321: Specific treatment (remove from exposure and treat symptoms).

Storage: P403 + P233: Store in a well-ventilated place. Keep container tightly closed.

Disposal: P501: Dispose of contents/containers in accordance with all local, regional, national and international regulations.

Hazard Symbols/Pictogram: GHS07, GHS08

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES

The information presented in this Material Safety Data Sheet is presented in good faith based on data believed to be accurate as of the date this Material Safety Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THIS PRODUCT, OR THE HAZARDS RELATED TO ITS USE. In no case shall the descriptions, information, data or designs provided be considered a part of our terms and conditions of sale.

16. OTHER INFORMATION (Continued)

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES (continued)

All materials may present hazards and should be used with caution. Because many factors may affect processing or application/use, we recommend that you make tests to determine the suitability of a product for your particular purpose prior to use. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices or applicable federal, state, or local laws or regulations. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

REERENCES AND DATA SOURCES: Contact the supplier for information.

METHODS OF EVALUATING INFORMATION FOR THE PURPOSE OF CLASSIFICATION: Bridging principles were used to classify this product.

REVISION DETAILS: New.

DATE OF PRINTING April 25, 2018

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these, which are commonly used, include the following:

KEY ACRONYMS:

CHEMTREC: Chemical Transportation Emergency Center, a 24-hour emergency information and/or emergency assistance to emergency responders.

CEILING LEVEL: The concentration that shall not be exceeded during any part of the working exposure.

DFG MAKs: Federal Republic of Germany Maximum Concentration Values in the workplace. Exposure limits are given as TWA (Time-Weighted Average) or PEAK (short-term exposure) values.

DFG MAK Germ Cell Mutagen Categories: 1: Germ cell mutagens that have been shown to increase the mutant frequency in the progeny of exposed humans. **2:** Germ cell mutagens that have been shown to increase the mutant frequency in the progeny of exposed mammals. **3A:** Substances that have been shown to induce genetic damage in germ cells of human of animals, or which produce mutagenic effects in somatic cells of mammals *in vivo* and have been shown to reach the germ cells in an active form. **3B:** Substances that are suspected of being germ cell mutagens because of their genotoxic effects in mammalian somatic cell *in vivo*; in exceptional cases, substances for which there are no *in vivo* data, but that are clearly mutagenic in vitro and structurally related to known in vivo mutagens. **4:** Not applicable (Category 4 carcinogenic substances are those with non-genotoxic mechanisms of action. By definition, germ cell mutagens are genotoxic. Therefore, a Category 4 for germ cell mutagens cannot apply. At some time in the future, it is conceivable that a Category 4 could be established for genotoxic substances with primary targets other than DNA [e.g. purely aneugenic substances] if research results make this seem sensible.) **5:** Germ cell mutagens, the potency of which is considered to be so low that, provided the MAK value is observed, their contribution to genetic risk for humans is expected not to be significant.

DFG MAK Pregnancy Risk Group Classification: Group A: A risk of damage to the developing embryo or fetus has been unequivocally demonstrated. Exposure of pregnant women can lead to damage of the developing organism, even when MAK and BAT (Biological Tolerance Value for Working Materials) values are observed. **Group B:** Currently available information indicates a risk of damage to the developing embryo or fetus must be considered to be probable. Damage to the developing organism cannot be excluded when pregnant women are exposed, even when MAK and BAT values are observed. **Group C:** There is no reason to fear a risk of damage to the developing embryo or fetus when MAK and BAT values are observed. **Group D:** Classification in one of the groups A–C is not yet possible because, although the data available may indicate a trend, they are not sufficient for final evaluation.

IDLH: Immediately Dangerous to Life and Health. This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury.

LOQ: Limit of Quantitation.

NE: Not Established. When no exposure guidelines are established, an entry of NE is made for reference.

NIC: Notice of Intended Change.

NIOSH CEILING: The exposure that shall not be exceeded during any part of the workday. If instantaneous monitoring is not feasible, the ceiling shall be assumed as a 15-minute TWA exposure (unless otherwise specified) that shall not be exceeded at any time during a workday.

NIOSH RELs: NIOSH's Recommended Exposure Limits.

PEL: OSHA's Permissible Exposure Limits. This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL" is placed next to the PEL that was vacated by Court Order.

SKIN: Used when a there is a danger of cutaneous absorption.

STEL: Short Term Exposure Limit, usually a 15-minute time-weighted average (TWA) exposure that should not be exceeded at any time during a workday, even if the 8-hr TWA is within the TLV-TWA, PEL-TWA or REL-TWA.

TLV: Threshold Limit Value. An airborne concentration of a substance that represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour.

TWA: Time Weighted Average exposure concentration for a conventional 8-hr (TLV, PEL) or up to a 10-hr (REL) workday and a 40-hr workweek.

WEEL: Workplace Environmental Exposure Limits from the AIHA.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS:

This rating system was developed by the National Paint and Coating Association and has been adopted by industry to identify the degree of chemical hazards.

HEALTH HAZARD: **0** Minimal Hazard: No significant health risk, irritation of skin or eyes not anticipated. *Skin Irritation*: Essentially non-irritating. Mechanical irritation may occur. PII or Draize = 0. *Eye Irritation*: Essentially non-irritating, minimal effects clearing in < 24 hours. Mechanical irritation may occur. Draize = 0. *Oral Toxicity LD_{50} Rat*: > 5000 mg/kg. *Dermal Toxicity LD_{50} Rat or Rabbit*: > 2000 mg/kg. *Inhalation Toxicity 4-hrs LC_{50} Rat*: > 20 mg/L. **1** Slight Hazard: Minor reversible injury may occur; may irritate the stomach if swallowed; may defat the skin and exacerbate existing dermatitis. *Skin Irritation*: Slightly or mildly irritating. PII or Draize > 0 < 5. *Eye Irritation*: Slightly to mildly irritating, but reversible within 7 days. Draize > 0 ≤ 25. *Oral Toxicity LD_{50} Rat*: > 500–5000 mg/kg. *Dermal Toxicity LD_{50} Rat or Rabbit*: > 1000–2000 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 2–20 mg/L. **2** Moderate Hazard: Temporary or transitory injury may occur; prolonged exposure may affect the CNS. *Skin Irritation*: Moderately irritating; primary irritant; sensitizer. PII or Draize ≥ 5, with no destruction of dermal tissue. *Eye Irritation*: Moderately to severely irritating; reversible corneal opacity; corneal involvement or irritation clearing in 8–21 days. Draize = 26–100, with reversible effects. *Oral Toxicity LD_{50} Rat*: > 50–500 mg/kg. *Dermal Toxicity LD_{50} Rat or Rabbit*: > 200–1000 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 0.5–2 mg/L. **3** Serious Hazard: Major injury likely unless prompt action is taken and medical treatment is given; high level of toxicity; corrosive. *Skin Irritation*: Severely irritating and/or corrosive; may cause destruction of dermal tissue, skin burns, and dermal necrosis. PII or Draize > 5–8, with destruction of tissue. *Eye Irritation*: Corrosive, irreversible destruction of ocular tissue; corneal involvement or irritation persisting for more than 21 days. Draize > 80 with effects irreversible in 21 days.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

HEALTH HAZARD (continued): **2 (continued):** *Oral Toxicity LD_{50} Rat*: > 1–50 mg/kg. *Dermal Toxicity LD_{50} Rat or Rabbit*: > 20–200 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: > 0.05–0.5 mg/L.**4** Severe Hazard: Life-threatening; major or permanent damage may result from single or repeated exposures; extremely toxic; irreversible injury may result from brief contact. *Skin Irritation*: Not appropriate. Do not rate as a 4, based on skin irritation alone. *Eye Irritation*: Not appropriate. Do not rate as a 4, based on eye irritation alone. *Oral Toxicity LD_{50} Rat*: ≤ 1 mg/kg. *Dermal Toxicity LD_{50} Rat or Rabbit*: ≤ 20 mg/kg. *Inhalation Toxicity LC_{50} 4-hrs Rat*: ≤ 0.05 mg/L.

FLAMMABILITY HAZARD: **0** Minimal Hazard: Materials that will not burn in air when exposure to a temperature of 815.5°C (1500°F) for a period of 5 minutes. **1** Slight Hazard: Materials that must be pre-heated before ignition can occur. Material requires considerable pre-heating, under all ambient temperature conditions before ignition and combustion can occur. This usually includes the following: Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes or less; Liquids, solids and semisolids having a flash point at or above 93.3°C (200°F) (i.e. OSHA Class IIIB); and Most ordinary combustible materials (e.g. wood, paper, etc.). **2** Moderate Hazard: Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not, under normal conditions, form hazardous atmospheres in air, but under high ambient temperatures or moderate heating may release vapor in sufficient quantities to produce hazardous atmospheres with air. This usually includes the following: Liquids having a flash-point at or above 37.8°C (100°F); Solid materials in the form of course dusts that may burn rapidly but that generally do not form explosive atmospheres; Solid materials in a fibrous or shredded form that may burn rapidly and create flash fire hazards (e.g. cotton, sisal, hemp); and Solids and semisolids (e.g. viscous and slow flowing as asphalt) that readily give off flammable vapors. **3** Serious Hazard: Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures, or, unaffected by ambient temperature, are readily ignited under almost all conditions. This usually includes the following: Liquids having a flash point below 22.8°C (73°F) and having a boiling point at or above 38°C (100°F) and those liquids having a flash point at or above 22.8°C (73°F) and below 37.8°C (100°F) (i.e. OSHA Class IB and IC); Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air (e.g., dusts of combustible solids, mists or droplets of flammable liquids); and Materials that burn extremely rapidly, usually by reason of self-contained oxygen (e.g. dry nitrocellulose and many organic peroxides). **4** Severe Hazard: Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air, and that will burn readily. This usually includes the following: Flammable gases; Flammable cryogenic materials; Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C (73°F) and a boiling point below 37.8°C (100°F) (i.e. OSHA Class IA); and Materials that ignite spontaneously when exposed to air at a temperature of 54.4°C (130°F) or below (pyrophoric).

PHYSICAL HAZARD: **0** *Water Reactivity*: Materials that do not react with water. *Organic Peroxides*: Materials that are normally stable, even under fire conditions and will not react with water. *Explosives*: Substances that are Non-Explosive. *Compressed Gases*: No Rating. *Pyrophorics*: No Rating. *Oxidizers*: No 0 rating. *Unstable Reactives*: Substances that will not polymerize, decompose, condense, or self-react.). **1** *Water Reactivity*: Materials that change or decompose upon exposure to moisture. *Organic Peroxides*: Materials that are normally stable, but can become unstable at high temperatures and pressures. These materials may react with water, but will not release energy violently. *Explosives*: Division 1.5 & 1.6 explosives. Substances that are very insensitive explosives or that do not have a mass explosion hazard. *Compressed Gases*: Pressure below OSHA definition. *Pyrophorics*: No Rating. *Oxidizers*: Packaging Group III oxidizers; Solids: any material that in either concentration tested, exhibits a mean burning time less than or equal to the mean burning time of a 3:7 potassium bromate/cellulose mixture and the criteria for Packing Group I and II are not met. Liquids: any material that exhibits a mean pressure rise time less than or equal to the pressure rise time of a 1:1 nitric acid (65%)/cellulose mixture and the criteria for Packing Group I and II are not met. *Unstable Reactives*: Substances that may decompose condense, or self-react, but only under conditions of high temperature and/or pressure and have little or no potential to cause significant heat generation or explosion hazard. Substances that readily undergo hazardous polymerization in the absence of inhibitors. **2** *Water Reactivity*: Materials that may react violently with water. *Organic Peroxides*: Materials that, in themselves, are normally unstable and will readily undergo violent chemical change, but will not detonate. These materials may also react violently with water. *Explosives*: Division 1.4 explosives. Explosive substances where the explosive effects are largely confined to the package and no projection of fragments of appreciable size or range are expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package. *Compressed Gases*: Pressurized and meet OSHA definition but < 514.7 psi absolute at 21.1°C (70°F) [500 psig]. *Pyrophorics*: No Rating. *Oxidizers*: Packing Group II oxidizers. Solids: any material that, either in concentration tested, exhibits a mean burning time of less than or equal to the mean burning time of a 2:3 potassium bromate/cellulose mixture and the criteria for Packing Group I are not met. Liquids: any material that exhibits a mean pressure rise time less than or equal to the pressure rise of a 1:1 aqueous sodium chlorate solution (40%)/cellulose mixture and the criteria for Packing Group I are not met. *Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure, but have a low potential (or low risk) for significant heat generation or explosion. Substances that readily form peroxides upon exposure to air or oxygen at room temperature. **3** *Water Reactivity*: Materials that may form explosive reactions with water. *Organic Peroxides*: Materials that are capable of detonation or explosive reaction, but require a strong initiating source or must be heated under confinement before initiation; or materials that react explosively with water. *Explosives*: Division 1.3 explosives. Explosive substances that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but do not have a mass explosion hazard. *Compressed Gases*: Pressure ≥ 514.7 psi absolute at 21.1°C (70°F) [500 psig].

DEFINITIONS OF TERMS (Continued)

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM HAZARD RATINGS (continued):

PHYSICAL HAZARD (continued): **3 (continued):** *Pyrophorics*: No Rating. *Oxidizers*: Packing Group I oxidizers. Solids: any material that, in either concentration tested, exhibits a mean burning time less than the mean burning time of a 3:2 potassium bromate/cellulose mixture. Liquids: any material that spontaneously ignites when mixed with cellulose in a 1:1 ratio, or which exhibits a mean pressure rise time less than the pressure rise time of a 1:1 perchloric acid (50%)/cellulose mixture. *Unstable Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure and have a moderate potential (or moderate risk) to cause significant heat generation or explosion. **4** *Water Reactivity*: Materials that react explosively with water without requiring heat or confinement. *Organic Peroxides*: Materials that are readily capable of detonation or explosive decomposition at normal temperature and pressures. *Explosives*: Division 1.1 & 1.2 explosives. Explosive substances that have a mass explosion hazard or have a projection hazard. A mass explosion is one that affects almost the entire load instantaneously. *Compressed Gases*: No Rating. *Pyrophorics*: Add to the definition of Flammability 4. *Oxidizers*: No 4 rating. *Unstable Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure and have a high potential (or high risk) to cause significant heat generation or explosion. *Pyrophorics*: Add to the definition of Flammability 4. *Oxidizers*: No 4 rating. *Unstable Reactives*: Substances that may polymerize, decompose, condense, or self-react at ambient temperature and/or pressure and have a high potential (or high risk) to cause significant heat generation or explosion.

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS

HEALTH HAZARD: **0** Materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials. Gases and vapors with an LC_{50} for acute inhalation toxicity greater than 10,000 ppm. Dusts and mists with an LC_{50} for acute inhalation toxicity greater than 200 mg/L. Materials with an LD_{50} for acute dermal toxicity greater than 2000 mg/kg. Materials with an LD_{50} for acute oral toxicity greater than 2000 mg/kg. Materials essentially non-irritating to the respiratory tract, eyes, and skin. HEALTH HAZARD: **1** Materials that, under emergency conditions, can cause significant irritation. Gases and vapors with an LC_{50} for acute inhalation toxicity greater than 5,000 ppm but less than or equal to 10,000 ppm. Dusts and mists with an LC_{50} for acute inhalation toxicity greater than 10 mg/L but less than or equal to 200 mg/L. Materials with an LD_{50} for acute dermal toxicity greater than 1000 mg/kg but less than or equal to 2000 mg/kg. Materials that slightly to moderately irritate the respiratory tract, eyes and skin. Materials with an LD_{50} for acute oral toxicity greater than 500 mg/kg but less than or equal to 2000 mg/kg. **2** Materials that, under emergency conditions, can cause temporary incapacitation or residual injury. Gases with an LC_{50} for acute inhalation toxicity greater than 3,000 ppm but less than or equal to 5,000 ppm. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than one-fifth its LC_{50} for acute inhalation toxicity, if its LC_{50} is less than or equal to 5000 ppm and that does not meet the criteria for either degree of hazard 3 or degree of hazard 4. Dusts and mists with an LC_{50} for acute inhalation toxicity greater than 2 mg/L but less than or equal to 10 mg/L. Materials with an LD_{50} for acute dermal toxicity greater than 200 mg/kg but less than or equal to 1000 mg/kg. Compressed liquefied gases with boiling points between -30°C (-22°F) and -55°C (-66.5°F) that cause severe tissue damage, depending on duration of exposure. Materials that are respiratory irritants. Materials that cause severe, but reversible irritation to the eyes or are lachrymators. Materials that are primary skin irritants or sensitizers. Materials whose LD_{50} for acute oral toxicity is greater than 50 mg/kg but less than or equal to 500 mg/kg. **3** Materials that, under emergency conditions, can cause serious or permanent injury. Gases with an LC_{50} for acute inhalation toxicity greater than 1,000 ppm but less than or equal to 3,000 ppm. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater its LC_{50} for acute inhalation toxicity, if its LC_{50} is less than or equal to 3000 ppm and that does not meet the criteria for degree of hazard 4. Dusts and mists with an LC_{50} for acute inhalation toxicity greater than 0.5 mg/L but less than or equal to 2 mg/L. Materials with an LD_{50} for acute dermal toxicity greater than 40 mg/kg but less than or equal to 200 mg/kg. Materials that are corrosive to the respiratory tract. Materials that are corrosive to the eyes or cause irreversible corneal opacity. Materials corrosive to the skin. Cryogenic gases that cause frostbite and irreversible tissue damage. Compressed liquefied gases with boiling points below -55°C (-66.5°F) that cause frostbite and irreversible tissue damage. Materials with an LD_{50} for acute oral toxicity greater than 5 mg/kg but less than or equal to 50 mg/kg. **4** Materials that, under emergency conditions, can be lethal. Gases with an LC_{50} for acute inhalation toxicity less than or equal to 1,000 ppm. Any liquid whose saturated vapor concentration at 20°C (68°F) is equal to or greater than ten times its LC_{50} for acute inhalation toxicity, if its LC_{50} is less than or equal to 1000 ppm. Dusts and mists whose LC_{50} for acute inhalation toxicity is less than or equal to 0.5 mg/L. Materials whose LD_{50} for acute dermal toxicity is less than or equal to 40 mg/kg. Materials whose LD_{50} for acute oral toxicity is less than or equal to 5 mg/kg.

FLAMMABILITY HAZARD: **0** Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand. Materials that will not burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in according with Annex D of NFPA 704. **1** Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur: Materials that will burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in according with Annex D of NFPA 704. Liquids, solids, and semisolids having a flash point at or above 93.4°C (200°F) (i.e. Class IIIB liquids). Liquids with a flash point greater than 35°C (95°F) that do not sustain combustion when tested using the *Method of Testing for Sustained Combustibility*, per 49 CFR 173, Appendix H or the UN *Recommendations on the Transport of Dangerous Goods, Model Regulations* (current edition) and the related *Manual of Tests and Criteria* (current edition). Liquids with a flash point greater than 35°C (95°F) in a water-miscible solution or dispersion with a water non-combustible liquid/solid content of more than 85% by weight. Liquids that have no fire point when tested by ASTM D 92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup*, up to the boiling point of the liquid or up to a temperature at which the sample being tested shows an obvious physical change. Combustible pellets with a representative diameter of greater than 2 mm (10 mesh). Most ordinary combustible materials. Solids containing greater than 0.5% by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. **2** Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air. Liquids having a flash point at or above 37.8°C (100°F) and below 93.4°C (200°F) (i.e. Class II and Class IIIA liquids.) Solid materials in the form of powders or coarse dusts of representative diameter between 420 microns (40 mesh) and 2 mm (10 mesh) that burn rapidly but that generally do not form explosive mixtures with air. Solid materials in fibrous or shredded form that burn rapidly and create flash fire hazards, such as cotton, sisal, and hemp. Solids and semisolids that readily give off flammable vapors. Solids containing greater than 0.5% by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.

NATIONAL FIRE PROTECTION ASSOCIATION HAZARD RATINGS (continued):

FLAMMABILITY HAZARD (continued): **3** Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. Liquids having a flash point below 22.8°C (73°F) and having a boiling point at or above 37.8°C (100°F) and those liquids having a flash point at or above 22.8°C (73°F) and below 37.8°C (100°F) (i.e. Class IB and IC liquids). Materials that on account of their physical form or environmental conditions can form explosive mixtures with air and are readily dispersed in air. Flammable or combustible dusts with representative diameter less than 420 microns (40 mesh). Materials that burn with extreme rapidity, usually by reason of self-contained oxygen (e.g. dry nitrocellulose and many organic peroxides). Solids containing greater than 0.5% by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent. **4** Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily. Flammable gases. Flammable cryogenic materials. Any liquid or gaseous materials that is liquid while under pressure and has a flash point below 22.8°C (73°F) and a boiling point below 37.8°C (100°F) (i.e. Class IA liquids). Materials that ignite when exposed to air, Solids containing greater than 0.5% by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.

INSTABILITY HAZARD: **0** Materials that in themselves are normally stable, even under fire conditions. Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) below 0.01 W/mL. Materials that do not exhibit an exotherm at temperatures less than or equal to 500°C (932°F) when tested by differential scanning calorimetry.**1** Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures. Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 0.01 W/mL and below 10 W/mL. **2** Materials that readily undergo violent chemical change at elevated temperatures and pressures. Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 10 W/mL and below 100W/mL. **3** Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation. Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) at or above 100 W/mL and below 1000 W/mL. Materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures. **4** Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. Materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures. Materials that have an estimated instantaneous power density (product of heat of reaction and reaction rate) at 250°C (482°F) of 1000 W/mL or greater.

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point: Minimum temperature at which a liquid gives off sufficient vapor to form an ignitable mixture with air near the surface of the liquid or within the test vessel used. Autoignition Temperature: Minimum temperature of a solid, liquid, or gas required to initiate or cause self-sustained combustion in air with no other source of ignition. LEL: Lowest concentration of a flammable vapor or gas/air mixture that will ignite and burn with a flame. UEL: Highest concentration of a flammable vapor or gas/air mixture that will ignite and burn with a flame.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. LD_{50}: Lethal Dose (solids & liquids) that kills 50% of the exposed animals. LC_{50}: Lethal Concentration (gases) that kills 50% of the exposed animals. ppm: Concentration expressed in parts of material per million parts of air or water. mg/m^3: Concentration expressed in weight of substance per volume of air. mg/kg: Quantity of material, by weight, administered to a test subject, based on their body weight in kg. TDLo: Lowest dose to cause a symptom. TCLo: Lowest concentration to cause a symptom. TDo, LDLo, and LDo, or TC, TCo, LCLo, and LCo: Lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** IARC: International Agency for Research on Cancer. NTP: National Toxicology Program. RTECS: Registry of Toxic Effects of Chemical Substances. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** BEI: ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV.

REPRODUCTIVE INFORMATION: A mutagen is a chemical that causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical that 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 that causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance that interferes in any way with the reproductive process.

ECOLOGICAL INFORMATION:

EC: Effect concentration in water. BCF: Bioconcentration Factor, which is used to determine if a substance will concentrate in life forms that consume contaminated plant or animal matter. TLm: Median threshold limit. $\log K_{OW}$ or $\log K_{OC}$: Coefficient of Oil/Water Distribution is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION: This section explains the impact of various laws and regulations on the material.

U.S.:

EPA: U.S. Environmental Protection Agency. ACGIH: American Conference of Governmental Industrial Hygienists, a professional association that establishes exposure limits. OSHA: U.S. Occupational Safety and Health Administration. NIOSH: National Institute of Occupational Safety and Health, which is the research arm of OSHA. DOT: U.S. Department of Transportation. TC: Transport Canada. SARA: Superfund Amendments and Reauthorization Act. TSCA: U.S. Toxic Substance Control Act. CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act. Marine Pollutant status according to the DOT; CERCLA or Superfund; and various state regulations. This section also includes information on the precautionary warnings that appear on the material's package label.

CANADA:

WHMIS: Canadian Workplace Hazardous Materials Information System. TC: Transport Canada. DSL/NDSL: Canadian Domestic/Non-Domestic Substances List.

RadonAway®
The world's leading radon fan manufacturer

RADON PRO HYBRID SEALANT

EXCLUSIVELY FROM RADONAWAY®

RadonAway® Radon Pro Hybrid Sealant (P/N 28523) meets most basement and crawlspace needs. Use our hybrid sealant for sealing expansion and control joints (i.e., wall joints, copings, window and door perimeters, etc.). This easy-to-use, professional grade sealant is long-lasting, self-leveling, non-sag and moisture curing. It contains little to no solvent and is virtually odor free.

FEATURES

- Professional grade polyurethane*
- Non-yellowing limestone color
- Moisture-curing
- Elastomeric (non-sag)
- Allows ±50% joint movement
- Long-lasting seal
- Low VOC content
- Meets radon standards

*silicone/urethane hybrid

Available in Single Tubes
or 12-Pack Contractor Box

SEALANT COMPARISON TABLE

SEALANT TYPE	CONCRETE ADHESION	SHRINKAGE	MAX. ALLOWABLE JOINT MOVEMENT
Polyurethane (Pro Sealant)	Excellent	<10%	High
Butyl	Excellent	Up to 20%	Low
Silicone	Good	<10%	Moderate
Elastomeric Copolymer	Good	<10%	Moderate
Elastomeric Acrylic	Moderate	Up to 30%	Low

RECOMMENDED ACCESSORIES

Dripless® Caulking Gun
P/N 74003

HarcoPaint® MiracleWipes
P/N 68110

Caulk Saver
P/N 68085

Appendix F
Health and Safety Plan

This Level 2 health and safety plan (HASP) is intended to provide 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 (ERMNASafetyLeads@erm.com). 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 SVI IRM	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 #: 0346375
Partner in Charge: Ernest Rossano	Revision Number and Date: 2, 2/5/2018
Project Manager: Jon Fox P.G	Field Work Start Date: 5/8/2018
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: Michael Fox, Caldwell Payne	SSE Mentor: Click here to enter text.

H&S Team Review

Reviewer Name: Ernie Sweet Review Date: 12/27/2017	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. Following the Site Characterization (SC) investigation, ERM will be directing an Interim Remedial Measure (IRM) to mitigate potential concerns regarding soil gas and indoor air. The purpose of the IRM 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: Private Utility Locate oversight	☒ JHA Attached?
ERM Task 2: Sealing Possible Pathways	☒ JHA Attached?
ERM Task 3: Soil Vapor Sampling	☐ JHA Attached?
ERM Task 4: Click here to enter text.	☐ JHA Attached?
ERM Task 5: Click here to enter text.	☐ 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, subcontractor will seal facility floor in areas identified as possibly compromised. Lab to analyze air samples.

Contractor Task 1: Private Utility Locate	☐ JHA Reviewed?
Contractor Task 2: Seal Potential Pathways	☐ JHA Reviewed?
Contractor Task 3: Soil Vapor Sampling	☐ JHA Reviewed?
Contractor Task 4: Click here to enter text.	☐ JHA Reviewed?
Contractor Task 5: Click here to enter text.	☐ JHA Reviewed?
Contractor Task 6: Click here to enter text.	☐ 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. Environmental Waste Minimization, 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.	
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)

☐	Aerial Lift Use (e.g., Scissor Lifts, Cherry Pickers)[1]	☐	Helicopter/Fixed Wing Aircraft Transportation[3]
☐	All-Terrain Vehicle/Snowmobile Use[1]	☒	High Noise (>85 dBa)
☐	ASTs/USTs	☐	Hot Work (Welding, Cutting, Brazing)[2]
☐	Biological Hazards	☐	International Travel[4]
☒	Chemical Exposure Potential (including asbestos)	☐	Long Distance/Duration Driving[5]
☐	Chemical Mixing/Injection	☐	Mining (Surface/Underground)
☐	Compressed Gas	☒	Natural Hazards (Plants, Animals, Insects)
☐	Confined Space Entry[2]	☐	Off-Shore Platform Work[6]
☐	Construction[1]	☐	Overhead Power Lines
☐	Control of Hazardous Energy (i.e., Lockout/Tagout)[2]	☐	Portable/Fixed Ladders
☐	DDD Operations[1]	☐	Radiation (Ionizing/Non-ionizing)
☐	Diving[1]	☐	Rigging/Lifting[2]
☒	Ergonomics/Material Handling	☐	Scaffold Use
☐	Excavation/Trenching/Drilling[2]	☒	Shift Work (e.g., night work)
☐	Extended or Nonstandard Work Shifts (>14 hours)	☐	Short Service Employees
☐	Extreme Weather	☒	Slips/Trips
☐	Explosives Use[1]	☒	Subsurface Clearance (Buried Utilities)[2]
☐	Falls from height (>4 feet)[1]	☐	Working on/over/near Water (including transport)[1]
☐	Forklift/Industrial Truck Use[1]	☐	Unexploded Ordnance/Munitions and Explosives of Concern (UXO/MEC)[1]
☒	Hand/Power Tool Use		
☐	Heavy Equipment Use	☐	Other (specify): Click here to enter text.

1 High hazard work requiring H&S team coordination. Additional control measures may be required beyond JHA.
2 Permit-required high hazard work requiring H&S Team coordination and ERM or equivalent client-required permit to be completed.
3 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*).
4 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.
5 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.
6 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)
☐ Hydrochloric 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. These chemicals include OSHA-regulated potential carcinogens (29 CFR 1910.1003 through 1016) as well as those chemicals for which OSHA has established specific respiratory protection requirements (29 CFR 1910.134). A list of these chemicals is provided in Section 3 of ERM Standard NAM-1340-PR1 (*Chemical Hazards*).

Are any of the chemicals that appear on the list in Section 3 of NAM-1340-PR1 known or suspected to be present 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	☐	☒
Other (specify): Click here to enter text.	☐	☐	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.

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.

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
Will container size be greater than or equal to one gallon? ☐ Yes ☒ No
If the answer to both of these questions 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
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	Matt Botzler	Philadelphia, PA	*Work:* *Cell:*
Regional H&S Director	Brain Desrosiers	Hartford, CT	Work: 860-466-8510 Cell: 603-540-7731
Contractor Contact	TBD	TBD	Work: TBD Cell: Click here to enter text.
Client Contact	Arno Biebernitz	Clifton Springs, NY	Work: 315-462-2611

			Cell: Click here to enter text.
Additional Contact	Click here to enter text.	Click here to enter text.	Work: Click here to enter text. Cell: Click here to enter text.

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	
Michael Fox		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:	Click here to enter a date.
Partner-in-Charge	**Date**

	Typed Name: Ernie Rossano Signature File: Ernest Rossano	1/4/2018

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-ST1)
☒ 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	Stop Work Authority
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'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 lessons from the large and small events that are part of our daily experience.**	**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.**

NORTH

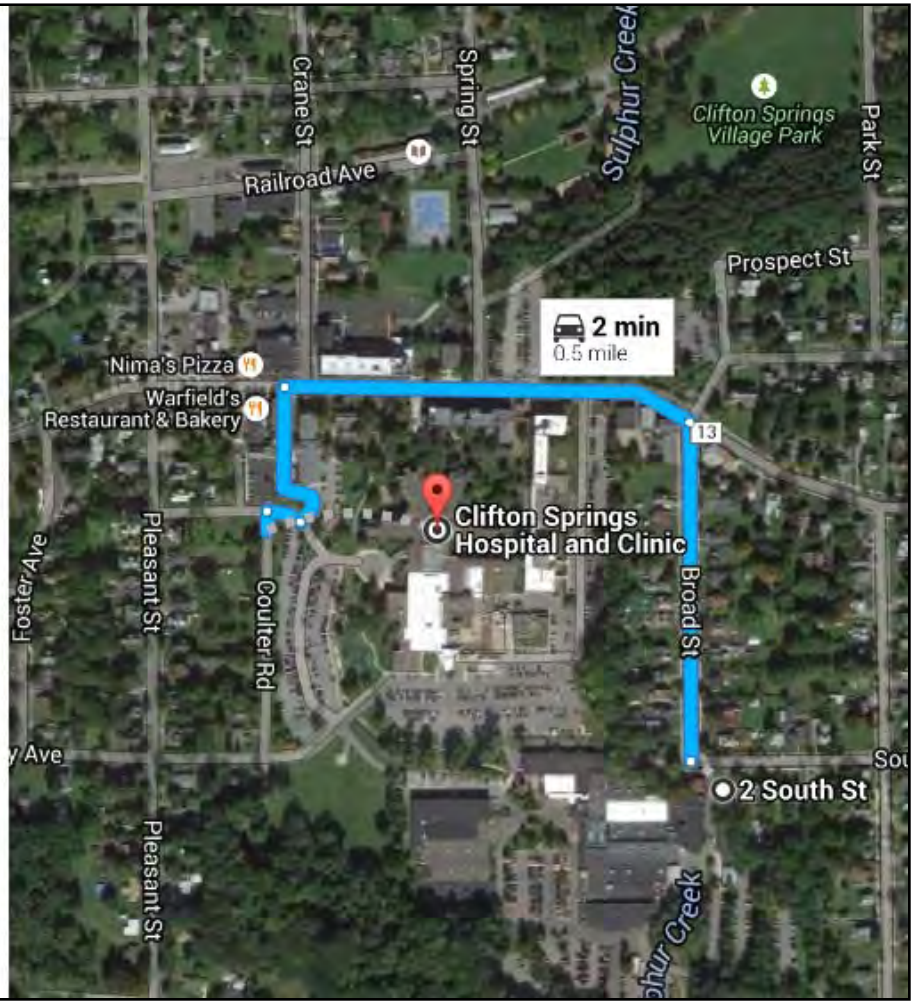
2 min (0.5 mile)

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**

JHA
Job Hazard Analysis

Project Number:	0346375	Project / Client Name:	G.W. Lisk IRM
Project Manager:	Jon Fox	Location:	2 South Street, Clifton Springs, New York 14432
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	12/1/2017, Rev. 1

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 Weat 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
Associated Forms:	S1-ERM-008-FM2 - Vehicle Inspection Checklist	Associated Procedures:	S1-ERM-008-PR - Driver and Vehicle Safety

JHA Developed / Reviewed By:			JHA Review In Field
Name / Job Title:	Name / Job Title:	Name / Job Title:	Field Safety Officer (FSO) 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. **FSO Signature/Date:**
Mike Fox/Staff Scientist			
Dana Hall/Project Scientist			

Task Steps[1]		Potential Hazards & Consequences[2]		select	Likelihood	Severity	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.
		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.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Likelihood	Severity	RISK	Controls to Eliminate or Reduce Risks[3]	
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.
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.
		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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4. Select the likelihood of occurrence and severity 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:	0346375	Project / Client Name:	GW Lisk IRM
Project Manager:	Jon Fox	Location:	Clifton Springs, NY
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	12/1/2017 Rev 1

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 <enter type and cartridge type> ☑ 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:**
Michael Fox/ Staff Scientist			
Tim Daniluk/ Project 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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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.

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

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

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JHA
Job Hazard Analysis

Project Number:	0346375	Project / Client Name:	G.W. Lisk IRM
Project Manager:	Jon Fox	Location:	2 South Street, Clifton Springs, New York 14432
Partner-in-Charge:	Ernest Rossano	Date and Revision Number:	12/1/2017, Rev. 1

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): NA ☑ Safety Glasses ☑ Reflective Vest ☑ Gloves cut resistant ☑ PPE clothing long sleeves, pants		
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
Associated Forms:	NA	Associated Procedures:	S3-NAM-046-PR - Safe Use of Cutting Tools

JHA Developed / Reviewed By:			JHA Review In Field
Name / Job Title:	Name / Job Title:	Name / Job Title:	Field Safety Officer (FSO) 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. **FSO Signature/Date:**
Mike Fox/Staff Scientist			
Dana Hall/Project Scientist			

Update Tasks and hazards in the field

Task Steps[1]		Potential Hazards & Consequences[2]		select	Likelihood	Severity	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.
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.

Task Steps[1]		Potential Hazards & Consequences[2]		select	Likelihood	Severity	RISK	Controls to Eliminate or Reduce Risks[3]	
		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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Subsurface Clearance Field Process Checklist

Site/Project Name: GWL Interim Remedial Measure (IRM)
Client: G.W. Lisk
ERM Project No.: 0346375
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 Interim Remedial Measure (IRM)
Client:	G.W. Lisk
ERM Project No.:	0346375
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 Field Process Checklist

Site/Project Name:	GWL Interim Remedial Measure (IRM)
Client:	G.W. Lisk
ERM Project No.:	0346375
SSC Exp. Person:	Jason Reynolds/Tim Daniluk

Subsurface Clearance Location Disturbance Permit

Disturbance Location Designation:

ERM Project No.: 0346375

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 PROJECT PLAN
Addendum to HASP
GMS Project No: 0346375

This Subsurface Clearance (SSC) Project Plan should be completed for each phase of ground disturbance activities at a project location, and included as an addendum to the Project-Specific Health & Safety Plan (HASP).

Ground disturbance activities that fall under this SSC Project Plan include ALL activities which require penetration of the ground surface (regardless of 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 decommissioning by over-drilling
- Excavation (by hand or with mechanical equipment)
- Trenching
- Grading
- Concrete coring
- Driving of posts, stakes, rods, poles, or sheet pile.

This SSC Project Plan summarizes the types and sources of SSC information obtained, describes the Site Services Model, and documents any waivers to ERM's Global SSC Process. The ERM Partner-in-Charge (PIC), Project Manager (PM), and SSC Experienced Person (EP)[1] must review and approve this SSC Project Plan, and maintain a copy (1) at the project location for the duration of ground disturbance activities and (2) in the project files.
All waivers must be approved by BOTH: (1) the ERM PIC and (2) the Business Unit Managing Partner (BU MP) or the BU MP's designee (cannot be the same person as the PIC).

Administrative Information		
	Project Name and Location: GWL Interim Remedial Measure (IRM), G.W. Lisk Facility, 2 South Street, Clifton Springs, New York	
	Scope of Ground Disturbance Activities: *Check all that apply:* X☐ Point disturbances ☐ Excavation / trenching ☐ Removal of engineered surfaces ☐ Other - Describe:	*Use field documentation to document SSC:* • *Process Checklist – broadly across the site* • *Remote/Greenfield Site Process Checklist – broadly across the site for those projects that meet these criteria and where ONLY hand digging will occur (refer to SSC Process Document Section 1.2)* • *Location Disturbance Permit – for each location inside a Critical Zone*
	SSC Project Plan Date:	Field Work Start Date: 5/4/2017
	Project Manager: Jon S Fox Signature:	Partner In Charge: Ernest Rossano Signature:
	SSC EP: Jason Reynolds Signature:	BU MP (req'd for waivers): John Kuhn Signature:

[1] SSC EP not required for project sites determined to be Remote/Greenfield sites (as defined in the ERM Global SSC Process), where ONLY hand digging will occur.

Subsurface Clearance Information Sources Summary	Information Sources	Yes	No	N/A	Comments
	Facility-provided as-built drawings, maps, site plans showing subsurface structures / utilities	☒	☐	☐	Date(s):

	List any SSC General Employees (GEs) working on this project: Caldwell Payne, Michael Fox

Document the information sources that ERM used or will use to locate Subsurface Structures on site.	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):
	Knowledgeable Contact Person	☒	☐	☐	Who: Arno Biebernitz Time in Job: Unknown Time at Site: Unknown
	Utility Markouts	**Yes**	**No**	**N/A**	**Comments**
	Site is Remote/Greenfield site AND only hand digging will occur	☐	☒	☐	*If "YES", utility markouts are not required by ERM process (Note that public markouts may be legally required based on jurisdiction of project site – it is the responsibility of the PIC and PM to determine these requirements and comply)*
	Public Utility Markouts (where they are available)	☒	☐	☐	*Required where available – if not available check "N/A". If available and checked "NO", a Waiver is required (if legally able to do so).* Who: 811
	Private Utility Markouts	☒	☐	☐	*If checked "NO" and site is not a Remote/Greenfield site, a Waiver is required* ERM employee ☐ or Subcontractor ☒ Who: NYLD List methods / equipment used:

For Remote/Greenfield Sites where ONLY hand digging will occur – the remaining sections of this SSC Project Plan do not apply and can be left blank.

Site Services Model **List the utilities or other below ground services present on site.** **Do we know the locations of these services, their conveyance on site (to the site boundary, as appropriate) and the location of isolation switches or valves?** **If "Present" and not located or "Unknown", comment on how those gaps will be addressed.** **Attach a site plan / drawing (to scale) showing planned ground disturbance location(s), the locations/routes of all identified or suspected subsurface structures and services, and associated critical zones.**	**Utility / Service**	**Present**	**Anticipated Depth (note units)**	**Located?**		**Absent**	**Unknown**	**Status (active/ inactive/ abandoned)**	**Comment** *(how located? Lines of evidence – types and quality. How will gaps be addressed?)*
				Yes	No				
	Electricity	☐		☐	☐	☐	☐		Voltage: To be determined by the GPRS survey at the site
	Gas	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Petroleum Pipeline	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Other Pressurized Lines	☐		☐	☐	☐	☐		Type: To be determined by the GPRS survey at the site
	Process Sewer	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Sanitary Sewer	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Storm Sewer	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Potable Water	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Telephone / Communication	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Fiber Optic	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Plant air / steam	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Fuel / oil	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Reclaimed / waste water	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Fire suppression	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Underground tank(s)	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Other:	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site

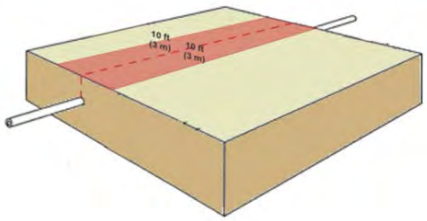
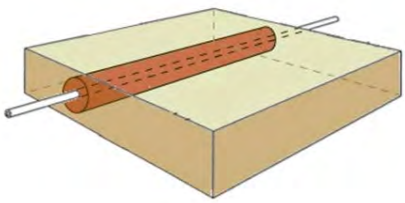
Subsurface Clearance Process Waivers **Document any waivers to the process approved by BOTH the PIC and BU MP.** **Legally required steps cannot be waived.**	Process Component Being Waived:	Waived By (PIC)	Waived by (BU MP)	Date	Reason
	Performance of Public Utility Markouts (where they are available)				
	Performance of Private Utility Markouts				
	No ground disturbance inside a Critical Zone				
	Physical Clearance to required depth(s) and diameters(s) at Point Disturbance Location(s). Indicate specific location(s):				
	Requirement for SSC EP to be present on site, when ONLY hand digging/hand augering will occur in the uppermost 1 foot (0.3 meters)				

Subsurface and Overhead Utility Clearance Map	**Attach a site plan / drawing (to scale) showing planned ground disturbance location(s), the locations/routes of all identified or suspected subsurface structures and services, associated critical zones, and location of all isolation devices and/or shutoff valves.**

Subsurface Clearance (SSC)
Field Review Checklist for Contractors

Site Name:	Interim Remedial Measure (IRM) – GW Lisk
Client:	G.W. Lisk
ERM Project No.:	0346375
Contractor activities to be performed on Site:	

Use this form to conduct and document review with contractor field personnel, to ensure they have been properly briefed on the applicable components of ERM's SSC Process.

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 jobsite conditions change, work should be stopped and the potential H&S effect of the change discussed.	☐	☐	
Ground disturbance activities may NOT be performed at any location without authorization by the ERM SSC Experienced Person (EP). Clearance activities may NOT be performed at any location unless the ERM EP is physically present.	☐	☐	
Unless explicitly authorized by ERM's Partner-in-Charge and Business Unit Managing Partner, ground disturbance may NOT be performed within 10 feet (3 meters) distance (referred to as the "Critical Zone") of the surface projection of: • Any known or suspected underground pipes, cables, conduits, drains, galleries, edges of tanks, or any other useful property; or • Aboveground structures with associated subsurface pipes and/or cables, including but not limited to pump islands, pump galleries, manifolds, electrical transformers, compressors, production wells, loading racks, or other process equipment.	☐	☐	**"The Critical Zone"** 
Unless authorized by the ERM 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 Business Unit Managing Partner, all borehole and small test pit locations must be physically cleared prior to use of mechanized equipment. Required physical clearance depths and diameters for point disturbances are as follows: • Physically clear to a diameter at least 125% of the largest downhole tool to be used. • Physically clear to the deeper of: o 2 feet (0.6 meters) beyond the bottom of the frost line at the site, or: o Outside Critical Zones to 5 feet (1.5 meters), or o Inside Critical Zones to the deeper of: 8 feet (2.4 meters), or 2 feet (0.6 meters) deeper than the expected invert elevation of the subsurface structure.	☐	☐	**"The Excavation Buffer"** 

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 using non-conductive tools.	☐	☐	
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.	☐	☐	
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.	☐	☐	
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 be immediately reported to the ERM EP or field supervisor. Contractor personnel must participate, as requested, in investigations of near misses and incidents.	☐	☐	
Other topics discussed:	☐	☐	

N/A = Not applicable to this project.

REQUIREMENTS FOR TOOLS AND EQUIPMENT:

- Hand digging tools must have a non-conductive handle (e.g., fiberglass, wood, composite) AND / OR fully insulated handles and upper shaft. It is a best practice to also wear insulated electrical gloves certified to appropriate standards.
- Blades on shovels and post-hole diggers must have rounded or blunt edges.
- Pick axes or pointed spades are not to be used for physical clearance.
- Electric-powered equipment must have ground fault protection. If this is not feasible, fully insulated electrical gloves certified to appropriate standards must be worn at all times during equipment use/operation.
- Equipment must be inspected prior to use, maintained according to manufacturer recommendations, and operated only by trained personnel.
- Rig- or stand-mounted concrete coring equipment must be anchored to the ground/floor using proper anchors.

Checklist Completed By: (SSC Experienced Person)		
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 minimum requirements for subsurface obstruction and utility clearance [collectively, Subsurface Clearance (SSC)], and applies to all ERM project-related ground disturbance activities. This document is supported by the mandatory requirements in the *Global Subsurface Clearance Process Document*.

2. Roles and Responsibilities

Business Unit Managing Partner (BU MP). Review and either approve or reject any waiver associated with the SSC process for projects under their control. Ensure field verification audits are conducted in accordance with the *Global Subsurface Clearance Process Document.*

Partner in Charge (PIC). Ensure all elements of the SSC process are implemented on their project; determine if a project site meets the criteria for a Remote/Greenfield site.

Project Manager (PM). Ensure a qualified SSC Experienced Person (EP) participates in all projects involving ground disturbance activities.

SSC Experienced Person (EP). Lead the execution of the SSC Process on projects not considered Remote/Greenfield; complete required SSC documentation and field forms; be present in the field during all clearance activities.

3. Definitions

Critical Zone: 10 feet (3 meters) distance in all directions from the surface projection of:

- All known or suspected underground pipes, cables, conduits, drains, galleries, edges of tanks, or any other useful property; and
- Aboveground structures with associated subsurface pipes and/or cables.

Ground Disturbance Activities: activities which require penetration of the ground surface and/or the drilling, coring, or removal of engineered surfaces.

Point Disturbance: ground disturbance activities associated with soil borings; well installation; well over-drilling; or digging small test pits.

Remote/Greenfield Site: a site (or portion of a site) meeting the requirements in Appendix F of the *Global Subsurface Clearance Process Document*, as determined by the PIC.

4. Requirements

4.1 Subsurface Clearance

No ground disturbance activities, with the exception of Remote/Greenfield sites, shall occur without at least one person in the field being a designated SSC EP. This is subject to waiver when only hand digging will occur in the uppermost 1 foot (0.3 meters) below ground surface. The SSC EP is responsible for ensuring that the SSC Process as defined in the *Global Subsurface Clearance Process Document* is fully implemented.

No ground disturbance activities are permitted within the Critical Zone unless a waiver is granted and the Subsurface Clearance Location Disturbance Permit has been completed.

All point disturbance activities require physical clearance, unless a waiver is granted, and shall meet the following minimum requirements:

- 125% of the outer diameter (OD) of the largest downhole tool to the following depth:
  i. 2 feet (0.6 meters) beyond the bottom of the frost line at the site, or:
  ii. Inside Critical Zones:
    - To 2 feet (0.6 meters) deeper than the known or suspected invert elevation of the subsurface structure, or
    - If the depth of the service is unknown, physical clearance should be performed to 8 feet (2.4 meters).
  iii. Outside Critical Zones: 5 feet (1.5 meters).

For all excavation and trenching, mechanical digging is prohibited within 2 feet (0.6 meter) of subsurface structures. There can be no waiver of this requirement.

4.2 Remote/Greenfield Site

It is the responsibility of the PIC to ensure that the Remote/Greenfield Subsurface Clearance Process, as defined in the *Global Subsurface Clearance Process Document* is fully implemented.

Mechanical digging is prohibited if the site is to be cleared using the Remote/Greenfield Subsurface Clearance Process. There can be no waiver of this requirement.

4.3 Training Requirements

It is the responsibility of the project PIC to ensure that all ERM employees working on or managing projects are trained in accordance with the *Global Subsurface Clearance Process Document.*

SSC EPs shall complete competency testing as described in the *Global Subsurface Clearance Process Document*.

All personnel training required by this standard shall be documented in ERM Academy.

4.4 Issuance of a Waiver

There are five waivers to the SSC Process that may potentially be issued:

1. Waive the requirement for an SSC EP to be present on site, when ONLY hand digging will occur in the uppermost 1 foot (0.3 meters) below ground surface;
2. Waive the requirement for Public Utility markouts (where allowed by law);
3. Waive the requirement for Private Utility markouts;
4. Waive the requirement for full physical clearance of point disturbance locations; and
5. Allow ground disturbance activities within Critical Zones.

Both the Project PIC and BU MP (or designee) must approve any waivers; all waivers shall be documented in the Subsurface Clearance Project Plan.

4.5 Field Verification Auditing

It is the responsibility of the BU MP to ensure that field verification audits are completed in accordance with the *Global Subsurface Clearance Process Document.* Identified findings shall be managed in accordance with the *Event and Non-conformance Management Procedure*.

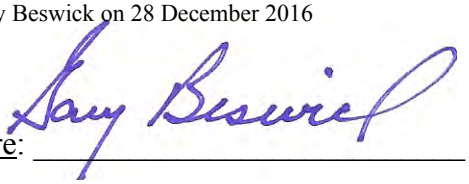
5. References

- ERM-1511-WI1 - Global Subsurface Clearance Process Document
- ERM-1200-PR1 - Event and Non-conformance Management Procedure

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
3, 4.1, 4.2, 4.4	1.1: Changed definition of ground disturbance; changed definition of point disturbance, added waiver for shallow hand digging; revised language for clarity.	15 May 2015
5	2.0: Corrected link to SSC Global Process document	21 Jan 2016
All	2.1: Updated links, tagline, and document number	28 Dec 2016

Subsurface Clearance (SSC) Field Audit Form

Site Name:	Clifton Springs Facility
Client:	G.W. Lisk
ERM Project No.:	0346375
Activities Observed on Site:	

1.0	OFFICE / PRE-MOBILIZATION	YES	NO	N/A	N/O	COMMENTS (Refer to Follow-Up Items if needed)
1.1	Have subcontractor(s) working at the project site been pre-qualified and approved by ERM?	☐	☐	☐	☐	
1.2	Has an SSC "Experienced Person" been assigned to manage SSC activities and identified in the site HASP?	☒	☐	☐	☐	
1.3	Have all ERM staff at project site received SSC training? (record names & dates)	☐	☐	☐	☐	
1.4	Are "SSC mentee(s)" working at the site and identified in the site HASP?	☐	☐	☐	☐	
1.5	Have the Level 2 HASP and SSC Project Plan been completed?	☐	☐	☐	☐	
1.6	Has a knowledgeable site contact person been identified? Are they present to participate in site walk and approve disturbance locations?	☐	☐	☐	☐	
1.7	Have available as-builts, maps, aerial photos, etc. been obtained and reviewed?	☐	☐	☐	☐	
1.8	Other:	☐	☐	☐	☐	

2.0	FIELD ACTIVITIES: PRE-CLEARANCE	YES	NO	N/A	N/O	COMMENTS (Refer to Follow-Up Items if needed)
2.1	Are ground disturbance locations/points clearly marked?	☐	☐	☐	☐	
2.2	Have public and private utility locate and markout have been conducted? By who? When?	☐	☐	☐	☐	
2.3	If utility locate/markout was conducted by ERM staff, how is employee qualified to execute locate service? Provide details of training/qualifications.	☐	☐	☐	☐	
2.4	If utility locate/markout was conducted by ERM staff, has location equipment been adequately maintained and calibrated? Provide date of last calibration.	☐	☐	☐	☐	
2.5	Has the ERM *SSC Checklist & Disturbance Permit* been utilized to assess **each** ground disturbance location?	☐	☐	☐	☐	
2.6	Have Critical Zones been identified on the *Site Services Model* and marked?	☐	☐	☐	☐	
2.7	If UXO/MEC are known or suspected to be present, has the site been assessed by a UXO/MEC specialist?	☐	☐	☐	☐	
2.8	Are any Process Waivers being applied? If so, is PIC and BU MP approval documented?	☐	☐	☐	☐	
2.9	Other:	☐	☐	☐	☐	

3.0	FIELD ACTIVITIES: PHYSICAL CLEARANCE	YES	NO	N/A	N/O	COMMENTS (Refer to Follow-Up Items if needed)
3.1	Has Critical Zone (CZ) distance* has been effectively maintained during project?	☐	☐	☐	☐	
3.2	Was physical subsurface clearance to minimum requirements** executed? What methods/equipment were used?	☐	☐	☐	☐	
3.3	If project is a trench or excavation, was the minimum 2-foot (0.6 meters) buffer zone maintained around exposed lines?	☐	☐	☐	☐	
3.4	Was mechanical equipment used within 2-foot (0.6 meters) buffer zones?	☐	☐	☐	☐	
3.5	Have SSC-related safety events been reported per ERM *Subsurface Clearance Procedure*?	☐	☐	☐	☐	
3.6	Were any changes from HASP / SSC Plan observed? If so, were Management of Change procedures implemented per ERM *Subsurface Clearance Procedure*?	☐	☐	☐	☐	
3.7	Other:	☐	☐	☐	☐	

N/A = Not applicable to this project.

N/O = Not observed during audit.

* *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.*

** *Clearance must meet or exceed 125% the outside diameter of the largest downhole tool. In Critical Zones, physical clearance to 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)*

FOLLOW UP ITEMS:

- If a checklist item was corrected in the field, please mark as YES and note in the COMMENT area how the correction was implemented.
- If a checklist item was unable to be corrected in the field, please list below the follow-up items for ERM/Client/Sub-Contractor to implement to correct the deficiency or improve the process.

Follow Up Items:

Attach additional comments, as necessary, to a new page.

Prepared By: Jason Reynolds/Jon Fox
(print)

Reviewed By: _____
(print)

_____
(print)

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.

	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)

	Applicability:	Guideline	Document Number:	Version:
ERM	North America		NAM-1110-GU1	2
	Title:	**Project Manager H&S Checklist**	**Last Revision Date:**	1/16/17

Project Name:	Site Characterization/ G.W. Lisk
Project Manager (PM):	Jon S. Fox
Start/End Date:	5/4/2017
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)	
☒ Y ☐ N	Risks of travel have been identified (Travel Risk Assessment or Journey Management Plan)?	
☐ Y ☐ N	Health and Safety (H&S) team has reviewed Level 2 or Level 3 HASPs	
☐ Y ☐ N	For all levels of HASP, the project PIC has given written approval	
☐ Y ☐ N	For projects that must undergo Project Liability Analysis (PLAN) analysis, risk review is provided to H&S team during HASP review	
☐ Y ☐ N	Job Hazard Analyses (JHAs) s obtained from contractors and provided to H&S team during HASP review	
☐ Y ☐ N	Personal protective equipment (PPE) requirements have been determined for each task	
☐ Y ☐ N	Real-time/industrial hygiene/noise monitoring requirements have been determined based on chemical exposure potential at the site	
☐ Y ☐ N	Contractors utilized for the project are green-flagged in PICS	
☒ Y ☐ N	Medical surveillance requirements for ERM and contractor employees have been determined	
☒ Y ☐ N	Training requirement, including client-specific HS requirements, for ERM and subcontractor employees have been determined	
☒ Y ☐ N	Applicable permits, notifications, and registrations have been identified	
☒ Y ☐ N	ERM personnel identified and assigned to the project meet training/medical requirements	
☒ Y ☐ N	Trained and qualified ERM FSO has been identified and assigned to the project (as applicable)	
☒ 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	
☐ Y ☐ N	ERM HASP provided to each contractor firm involved in the project along with minimum health and safety requirements each firm must meet	

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?	
☒ Y ☐ N	Health and safety included in initial project kickoff meeting or separate health and safety kickoff meeting has been planned	
☒ 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	
☒ 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	
☒ Y ☐ N	All PPE and emergency equipment identified in the HASP and JHAs is present at the project site	
☒ Y ☐ N	Emergency contact information, emergency evacuation/assembly point and route to nearest medical facility are included in HASP and posted at the site	
☒ Y ☐ N	Guidance on how to handle a regulatory inspection (*NAM-1944-PR1*) is at the project site	
☐ Y ☐ N	Training/medical surveillance documents are collected by PM for each contractor employee	
☒ Y ☐ N	Safety Data Sheets (SDS) are located at the project site for each chemical ERM or contractor brings to the site	
☐ Y ☐ N	Method to keep site visitors out of ERM work areas has been determined and managed by FSO	
☒ 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	
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	
☐ Y ☐ N	Project team has performed a post-project brainstorming session to close any ECS events and determine any lessons learned	

Project Name:	G.W. Lisk - Site Characterization
Project Manager (PM):	Jon S. Fox
Partner-in-Charge (PIC):	Ernest Rossano
Start/End Date:	5/4/2017 - TBD

Part I: Project Scope and Team

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

The purpose of the SC Work Plan is to propose a plan to evaluate whether contamination exists in areas identified during the Records Search. If contamination does exist, ERM will evaluate whether it is present at concentrations requiring further investigation or remediation. 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
Parratt Wolff	Soil Boring, Monitoring Well installation
Alpha Analytical	Sample Analyses
NYLD	Subsurface utility location
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, Section 3.3

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 SC Work Plan will be consistent with applicable requirements contained in DER-10, Section 3.3. 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 by contract to investigate and report findings related to an event, or as required by the *Event and Non-Conformity Management* Procedure.

2. Roles and Responsibilities

Partner in Charge (PIC) or Office Head. Coordinate event investigation for Actual Severity 5 events or lower.

Regional CEO. Coordinate event investigation for Actual or Potential Severity 7 or 10 event.

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

3. Definitions

Event. Any occurrence, act, condition or observation which includes incidents, near misses, or hazardous condition which could impact our health, safety or environmental (HSE) performance.

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

Event Potential. A means of assessing outcome of an incident or near miss that could have occurred, but did not, 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 actual 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 the *Event and Non-Conformity Management* Procedure. At the discretion of the responsible investigation coordinator, additional investigation team members may include:

- Project Manager;
- BU MP/Regional Practice Leader;
- Division Managing Director;
- Local/BU/Regional H&S Lead;
- Global H&S Director (GHSD);
- Other legally required local function(s); and
- Subject matter experts.

4.3 Investigation Process

4.3.1 All Investigations

The team will follow an appropriate investigation technique (as agreed to by the PIC/Office Head, Regional H&S Lead and Legal) 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, Parts/Equipment, Position and Paper/Documentation and other factors involved in the event, as presented in *Event Investigation Considerations*.
- Determination of direct cause(s) and root causes using techniques agreed to by the lead investigator and H&S Lead. (Note: Example root cause investigation tools include “5 Why’s”, TapRoot, Fishbone Diagram, etc.).

4.3.2 Actual Severity 5 or Lower Investigations

The Investigation Team will summarize the investigation by completing the appropriate fields within ECS. All findings and recommended corrective actions will also be entered into the ECS. This information will be entered into ECS within 10 calendar days following the event unless otherwise agreed by the PIC/Office Head and Regional H&S Lead.

4.3.3 Actual Severity 7 or 10 Investigations

The Investigation Team will prepare a Preliminary Investigation Report, signed by the RCEO, documenting all findings and recommended corrective actions within 10 calendar days following the event unless otherwise agreed by the RCEO and GHSD. In addition to any event with an Actual Severity rated as 7 or 10, the GHSD and/or Global Programs Director may require any event, regardless of Actual Severity, to be escalated for investigation and review through a more senior, Global Review team.

The report format for all events classified as Actual or Potential Severity 7 or 10 shall follow the sample template provided in *Event Investigation Report*. All Actual Severity 7 or 10 communications and reports shall be prepared at the direction of Legal and shall be marked “Attorney Client Privileged Communication”.

All Actual Severity 7 or 10 investigations will involve a formal conference call to review the preliminary investigation report. The investigation review conference call will be arranged by the Regional CEO and shall occur no later than 5 calendar days following issuance of the Preliminary Investigation Report (unless otherwise directed by the ERM Chief Executive Office, Legal or GHSD).

Required participants for the conference call will include:

- Regional CEO, responsible Regional Practice Area Leader, responsible Division Managing Partner, responsible BU MP;
- Regional Legal;
- Responsible Line Manager (office-based) or PIC and Project Manager (project-based) of the injured/involved employee;
- Regional H&S Lead and
- GHSD.

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

- Global/Regional HR
- 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 Regional CEO, under the direction of Legal, shall issue a final Investigation Report to the ERM Chief Executive Officer and GHSD. Corrective actions identified by the investigation process must be formally tracked to closure by the Regional H&S Lead; and the ECS event cannot be closed until approved by the GHSD.

4.4 Communication of Investigation Results

Any and all written investigation reports for Actual Severity 7 or 10 events (including drafts) must first be reviewed by Legal. All drafts shall include "Attorney-Client Work-Product Privilege" at the top of such reports.

Where appropriate based on the type, severity and/or scope of the event, a formal Alert should be prepared by the lead investigator and responsible Regional H&S Lead. The Alert will be communicated to the most appropriate audience (i.e., regional, national, practice area only, etc.).

Action items and corrective actions identified by the investigation teams will be tracked to completion by the responsible Regional H&S Lead. Additionally, the results will be utilized to

develop appropriate regional, national and practice 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.

4.4.1 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 legal professional privilege. 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 professional privilege, it is important to ensure that all communication is also copied to ERM internal and/or external legal and is marked “Attorney-Client Work-Product Privilege."

Before creating any written documentation relating to an Actual Severity 7 or 10 event, ERM employees should contact the ERM PIC or Line Manager 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

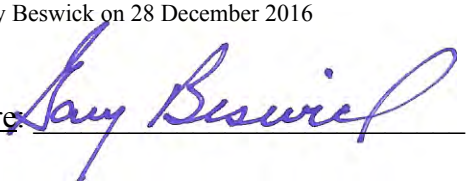
5. References

- 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 December 2016

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

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.

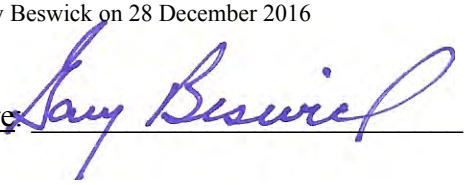
5. References

- 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

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.

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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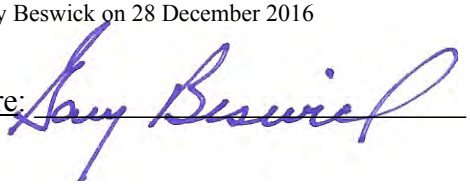
Approval Signature: 

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

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

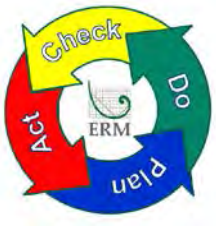
Procedure Number	Procedure Title
S1-ERM-007-WI	Subsurface Clearance Work Instruction
S1-ERM-007-FM1	SSC Field Process Checklist
S1-ERM-007-FM2	SSC Field Process Checklist for RG Sites
S1-ERM-007-FM3	SSC Location Disturbance Permit
S1-ERM-007-FM4	SSC Project Plan
S1-ERM-007-FM5	SSC Field Audit Form
S1-ERM-007-FM6	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

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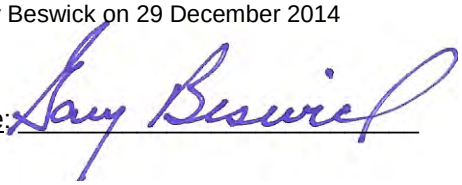
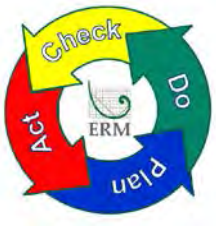
Approval Signature: 

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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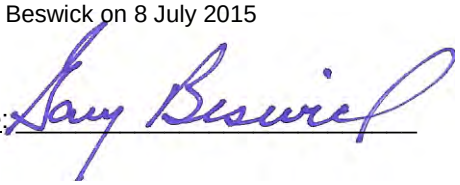
Approval Signature: 

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;
- 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***)

Document Control Information

Original Effective Date: 6/9/11

Policy Approval by: Mark Hickey

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

1. Purpose and Scope

This procedure describes:

- Contractor health, safety, security, and environmental (HSSE) performance expectations;
- The pre-evaluation process for approval of contractors, their safety programs, and their insurance documents;
- The evaluation of contractor safety performance while working for ERM; and
- The responsibilities of the ERM project team with respect to implementation of this program and oversight of contractor safety.

The procedure applies to all ERM work activities which are contracted to an outside firm, except those specifically excluded elsewhere in this document. This procedure does not apply to third party contractors which may be working on the same site as ERM, but do not have a contractual relationship with ERM.

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;
- Appoint a Project Manager/Supervisor who will manage all aspects of conformance with this procedure;
- Approve and execute contractor agreements for each contractor working on ERM projects/sites and may participate in negotiations, as necessary;
- Assess, in conjunction with the Project Manager/Supervisor, the performance of ERM contractors based on observations and assessments in the field;
- Correct, in conjunction with the Project Manager/Supervisor, any observed deficiencies in the performance of the ERM contractor; and
- Correct any deficiencies in the implementation of the program as identified by the Business Unit Health and Safety Director.

Project Manager/Supervisor: Responsible for the following elements:

- Perform observations of contractor work processes to assess whether or not the contractor is operating in accordance with applicable health and safety requirements;
- Verify contractors are approved to provide services to ERM as established by this procedure and ERM's Global Contractor Management Program (***ERM-1130-PR1***);

- Communicate ERM and client driven HSSE requirements to project contractors by providing the standard contractor agreement or a project- or client-specific contractor agreement during project planning or scoping;
- Understand and confirm the competency of ERM contractor staff who will be providing field project support;
- Request required documentation from contractors as defined in any project-specific agreements (i.e., Contractor Health and Safety Plans, Job Hazard Analyses (JHAs), work procedures, etc.);
- Interact with and mentor contractors during the working relationship;
- Evaluate best practices provided by contractor personnel for potential inclusion in project work planning;
- Stop work where deviations from accepted health and safety requirements are observed;
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the performance of the contractor;
- Work with the contractor to complete incident investigations and, where needed, root cause evaluations, for incidents and high-value near misses which occur on ERM job sites; and
- Contact ERM Legal in the event of serious or repeated breaches of health and safety requirements and assess whether action is warranted under the contract.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of these policies during health and safety plan reviews and project audits; and
- Communicate identified deficiencies to the PIC.

ERM Staff: Responsible for the following elements:

- Attend and interact with contractors during safety meetings to ensure that the scope of work, risks and precautions are understood by all project participants;
- Raise any concerns of job performance with the project management and contractors as established in the project communications plan, including implementing stop work authority if there is an imminent risk of injury or property damage; and
- Utilize the Event Communication System (ECS) to report any incidents, near misses, unsafe acts and conditions and safe behaviors observed during work with contractors.

3. Definitions

A contractor is defined as 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. The term "contractor" may include contractors, subcontractors, consultants, sub-consultants, vendors, and suppliers.

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.

4. Procedure

4.1 Contractor Prequalification and Selection

Contractors desiring to perform work for ERM shall be required to be pre-qualified in accordance with ERM's Global Contractor Management Program. In the USA, Avetta, a third-party service provider, qualifies and maintains updated information about suppliers and contractors based on the requirements of its clients. Contractors will submit a variety of information to Avetta, including insurance limits, OSHA logs, safety and training programs, bonding capability, and diversity information. Potential contractors also have to agree to adhere to ERM's policies, including our Anti-Bribery and Corruption (ABC) Policy and Business Conduct and Ethics Agreement, and Subsurface Clearance Program (as applicable).

Avetta shall evaluate the information provided by the proposed contractor and compare it to a detailed list of requirements provided by ERM. Information submitted by the contractor must be updated at least annually.

ERM's minimum safety criteria for US firms are as follows:

- No fatalities in the past 5 years;
- A Total Recordable Incidence Rate (TRIR) at or below the industry average for the past 3 years based on North American Industrial Classification System (NAICS) code;
- A Days Away/Restricted/Transfer (DART) rate at or below the industry average for the past 3 years based on NAICS code;
- An Experience Modification Rate (EMR) at or below 1.0 for the past 3 years; and
- No open or unresolved regulatory citations within the past 3 years.

Companies that service ERM offices such as coffee vendors, vending machine companies, water cooler vendors, etc. do not have to be qualified under this procedure. Additionally, retailers providing point-of-sale purchases (e.g., purchase of a tool from Home Depot) do not have to be qualified under this procedure.

Further information on prequalification can be found on the Contractor Management Program section of the North America Health and Safety page on Minerva.

4.2 Contractor Interactions/Expectations

The Project Manager/Supervisor must ensure that the contractor is provided with necessary information to work safely, including, but not limited to:

- ERM contact name and phone number;
- ERM health and safety requirements;
- Client health and safety requirements (including any drug and alcohol policies);
- Site-specific emergency action plans; and
- Safety information from other ERM contractors or third-party contractors at the site.

The Project Manager/Supervisor must ensure that contractor personnel participate in site-related safety meetings, including pre-job meetings, safety orientations, daily tailgate safety meetings, and any job-related safety inspections.

Contractors must conform to all regulatory and policy driven HSSE requirements. Contractors are contractually and legally responsible for providing personnel who are qualified to meet or exceed the expectations of ERM and customer work scopes. Contractor agreements are used to clearly define contractor accountabilities and responsibilities.

Contractors are expected to conform to their internal HSSE policies and requirements as well as those of ERM and ERM clients. Where conflicts exist between these policies and requirements, contractors must adhere to the most stringent policy and requirement. Where needed, the contractor should have the capability to develop additional safety procedures or hazard assessments for work that is performed exclusively by their employees and for which they may have superior knowledge.

Contractors will provide, upon request and at the time of proposing services, a description of their HSSE system, as well as resumes, training certificates, course rosters, and other documents confirming contractor employee qualifications and competencies. ERM or our selected pre-qualification vendors may audit these systems and documentation for conformance with defined expectations. Contractors will be provided the opportunity to close any gaps identified during this evaluation and Project Managers/Supervisors will ensure gaps are closed before work begins.

4.3 Assessment of Contractor Performance

The Project Manager/Supervisor should regularly assess the contractor's operations to determine their level of compliance with applicable health and safety requirements. This should also

include a review of required health and safety documentation. Assessment can be performed directly by the Project Manager/Supervisor or delegated to appropriate field staff.

Where ERM personnel observe safety events (i.e., incidents, near misses, unsafe acts/conditions) related to contractor operations, they should bring the events to the attention of ERM's Project Manager/Supervisor as well as the contractor management team for immediate resolution. Events should also be posted in ERM's Event Communication System (ECS). Staff shall take the opportunity to also note remarkable safe behaviors to leverage positive activities for continuous improvement in projects.

The Project Manager/Supervisor will evaluate the contractor's performance following completion of the contracted work activities. If a contractor's performance is such that the PIC or the Project Manager/Supervisor feels that they should be barred from further use by ERM, a formal variance should be sent to the Business Unit Managing Partner (BU MP) providing the reasons for the request. The BU MP will make a decision regarding the contractor after consultation with appropriate ERM team members and can decide to change the contractor's approval flag status in Avetta.

5. References

- Avetta Global Supply Chain Management Solutions (***www.avetta.com***)
- ERM Procedure ERM-1130-PR1 (***Contractor Management***)

Document Control Information

Original Effective Date: 8/1/14

Policy Approval by: Mark Hickey

Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document	3/6/14
All	Revised format to meet new Global SMS requirements	7/3/14
All	Changed "subcontractor" to "contractor" throughout; addressed comments of Regional H&S Director	8/1/14
4.2	Updated to include transmission of client's drug and alcohol policies	5/19/15
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/9/17

1. Purpose and Scope

This procedure defines the requirements to ensure that safety events are being properly reported and investigated within ERM operations. This document applies to all ERM 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 H&S 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 persons involved in the event, including injured personnel and witnesses;
- A brief description of the event;
- Immediate actions taken in response to the event;
- 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 and Reporting 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 Form 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 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 no less than two business days after all immediate response measures have been taken and the situation is under control. 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. A;; 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.

Target deadlines for completing an RCA are as follows:

- Conduct interviews within five working days after the event;
- Distribute draft RCA report to the RCA team for review within 10 working days after the event; and
- Issue the final RCA report, including photos and an RCA flowchart, within 15 working days after the event.

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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Policy Approval by: Mark Hickey

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)	1/10/17
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

1. Purpose and Scope

This procedure is designed to ensure that information necessary for the safe use, handling, and storage of hazardous chemicals is provided and made available to all ERM employees. This document applies to all ERM employees and covers all ERM work activities.

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

Labels on all containers of chemicals, whether used, handled, or stored in the field or on ERM property, 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.

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 person who transferred the chemical into the portable container is the only person who will use the chemical; 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***).

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 will be made available, upon request, to any ERM employee, 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. 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;
- 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 work/handling practices, use of PPE, and emergency response procedures;
- How to read and use SDS and labels; 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, etc. 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***)

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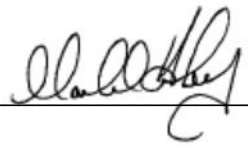
Approval Signature: 

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 (Section 5)	1/6/17

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 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.

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 Protective 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 training on PPE. 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 ***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 Conservation***)
- ERM Procedure NAM-1324-PR1 (***Safe Use of Cutting Tools***)

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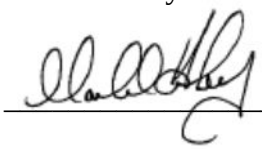
Approval Signature: 

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

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.

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 who are 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.

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***)

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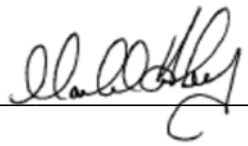
Approval Signature: 

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. 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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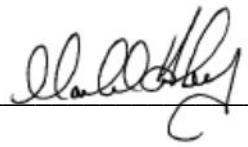
Approval Signature: 

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. Fatal is 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 sufficient to accommodate all 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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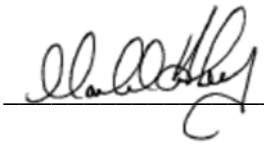
Approval Signature: 

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); changed 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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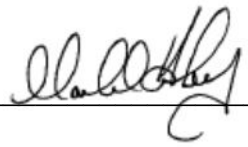
Policy Approval by: Mark Hickey

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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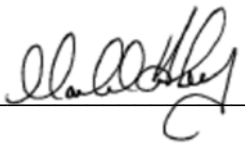
Approval Signature: 

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

Introduction

This form must be filled out for all known 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.

To use this form:

1. Click on the tab entitled "Chemicals of Concern".
2. Click on the cell to the right of "Chemical Name".
3. Click the down arrow, then choose the chemical of concern from the drop down list.
4. Once selected, the remaining data (target organs, published exposure limits, exposure symptoms, etc.) for the chemical will atumatically populate.
5. Up to five chemicals can be presented per page. Use additional sheets as neceesary to record all known or suspected chemicals of concern on the site.
6. Note that known/suspected carcinogens will flash red in the "Carcinogen" box when chosen.
7. If the chemical you are searching for is not present in the list, click on the tab entitled "Unlisted Chemicals of Concern" and add the requested data manually.

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:	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:	0.050 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:	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:				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 ex
must be provided to all team members. Add additional sheets as necessary to address all chemical concerns.

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

posed. Information on each chemical

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

Chemical	Target	Route	Symptoms	O PEL	O STEL
Acetaldehyde	Eyes, skin, respiratory system, kidneys	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, throat; eye,	200 ppm	NA
Acetone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, throat; head	1000 ppm	NA
Acetonitrile	Respiratory system, cardiovascular sys	Inhalation, skin absorption, ingestion,	Irritation nose, throat; asphyxia;	40 ppm	NA
Acrolein	Eyes, skin, respiratory system, heart	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	0.1 ppm	NA
Acrylonitrile	Eyes, skin, cardiovascular system, live	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; asphyxia; he	2 ppm	NA
Allyl alcohol	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Eye irritation, tissue damage; irri	2 ppm	NA
Aluminum (respirable)	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory s	5 mg/m3	NA
Aluminum (total)	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory s	15 mg/m3	NA
Ammonia	Eyes, skin, respiratory system	Inhalation, ingestion (solution), skin a	Irritation eyes, nose, throat; dysp	50 ppm	NA
Aniline	Blood, cardiovascular system, eyes, li	Inhalation, skin absorption, ingestion,	Headache, lassitude, dizziness; c	5 ppm	NA
Antimony	Eyes, skin, respiratory system, cardiov	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	0.5 mg/m3	NA
Arsenic (inorganic)	Liver, kidneys, skin, lungs, lymphatic	Inhalation, skin absorption, skin and/o	Ulceration of nasal septum, derm	0.01 mg/m3	NA
Asbestos	Respiratory system, eyes	Inhalation, ingestion, skin and/or eye c	Asbestosis (chronic exposure): d	0.1 f/cc	NA
Barium	Eyes, skin, respiratory system, heart, c	Inhalation, ingestion, skin and/or eye c	Irritation of eyes, skin, upper resp	0.5 mg/m3	NA
Benzene	Eyes, skin, respiratory system, blood,	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, respira	1 ppm	5 ppm
Benzyl chloride	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; lassitu	1 ppm	NA
Beryllium	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact	Berylliosis (chronic exposure): a	.002 mg/m3	NA
Bromochloromethane	Eyes, skin, respiratory system, liver, k	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, throat; confu	200 pm	NA
Bromoform	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	0.5 ppm	NA
Butane	Central nervous system	Inhalation, skin and/or eye contact (liq	Drowsiness, narcosis, asphyxia; l	NA	NA
2-Butanol	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	150 ppm	NA
2-Butanone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; headac	200 ppm	NA
2-Butoxyethanol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	50 ppm	NA
Butyl acrylate	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, upper respira	NA	NA
Butyl alcohol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose, throat; head	100 ppm	NA
sec-Butyl alcohol	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	150 ppm	NA
tert-Butyl alcohol	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	100 ppm	NA
Butyl glycidyl ether	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; skin se	50 ppm	NA
Butyl mercaptan	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin; muscle weak	10 ppm	NA
Butylamine	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	NA	NA
Cadmium	Respiratory system, kidneys, prostate,	Inhalation, ingestion	Pulmonary edema, dyspnea, coug	.005 mg/m3	NA
Calcium arsenate	Eyes, respiratory system, liver, skin, c	Inhalation, skin absorption, ingestion,	Lassitude; gastrointestinal disturb	.010 mg/m3	NA
Camphor	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, mucous men	2 mg/m3	NA
Carbon disulfide	Central nervous system, peripheral ner	Inhalation, skin absorption, ingestion,	Dizziness, headache, poor sleep,	20 ppm	NA
Carbon tetrachloride	Central nervous system, eyes, lungs, li	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; central nerv	10 ppm	NA
Cathecol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	NA	NA

Chlorobenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; drowsi	75 ppm	NA
Chlorobromomethane	Eyes, skin, respiratory system, liver, k	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, throat; confu	200 pm	NA
Chlorodiphenyl (42%) - PCB	Skin, eyes, liver, reproductive system	Inhalation, skin absorption, ingestion,	Irritation eyes, chloracne; liver da	1 mg/m3	NA
Chlorodiphenyl (54%) - PCB	Eyes, skin, liver, reprodcutive system	Inhalation, skin absorption, ingestion,	Irritation eyes, chloracne; liver da	0.5 mg/m3	NA
Chloroform	Liver, kidneys, heart, eyes, skin, centra	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; dizziness, m	NA	NA
Chloromethylbenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; lassitu	1 ppm	NA
Chromic acid/chromates (Cr	Blood, respiratory system, liver, kidne	Inhalation, ingestion, skin and/or eye c	Irritation respiratory system; nasa	.005 mg/m3	NA
Chromium II/III compounds	Eyes, skin	Inhalation, ingestion, skin and/or eye c	Irritation eyes; sensitization derm	0.5 mg/m3	NA
Chromium metal	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin; lung fibrosis	1 mg/m3	NA
Coal tar pitch volatiles	Respiratory system, skin, bladder, kidı	Inhalation, skin and/or eye contact	Dermatitis, bronchitis	0.2 mg/m3	NA
Cobalt	Skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Cough, dyspnea, wheezing, decre	0.1 mg/m3	NA
Copper (fume)	Eyes, skin, respiratory system, liver, k	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, pharynx; na	0.1 mg/m3	NA
Copper (metal)	Eyes, skin, respiratory system, liver, k	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, pharynx; na	1 mg/m3	NA
p-Cresol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, mucous men	5 ppm	NA
Cyclohexanol	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	50 ppm	NA
Cyclohexanone	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, mucous men	50 ppm	NA
2,4-D	Skin, central nervous system, liver, kic	Inhalation, skin absorption, ingestion,	Lassitude, stupor, hyporeflexia, r	10 mg/m3	NA
DDT	Eyes, skin, central nervous system, kic	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; paresthesia t	1 mg/m3	NA
1,2-Dichlorobenzene	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; liver, kidney	NA	NA
1,4-Dichlorobenzene	Liver, respiratory system, eyes, kidney	Inhalation, skin absorption, ingestion,	Eye irritation, swelling periorbita	75 ppm	NA
Dichlorobenzene (ortho)	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; liver, kidney	NA	NA
Dichlorobenzene (para)	Liver, respiratory system, eyes, kidney	Inhalation, skin absorption, ingestion,	Eye irritation, swelling periorbita	75 ppm	NA
Dichlorodifluoromethane	Cardiovascular system, peripheral ner	Inhalation, skin and/or eye contact (liq	Dizziness, tremor, asphyxia, unc	1000 ppm	NA
1,1-Dichloroethane	Skin, liver, kidneys, lungs, central ner	Inhalation, ingestion, skin and/or eye c	Irritation skin; central nervous sy	100 ppm	NA
1,2-Dichloroethane	Eyes, skin, kidneys, liver, central nerv	Inhalation, ingestion, skin absorption,	Irritation eyes, corneal opacity; c	50 ppm	NA
1,2-Dichloroethylene	Eyes, respiratory system, central nervo	Inhalation, ingestion, skin and/or eye c	Irritation eyes, respiratory systen	200 ppm	NA
Dichloroethyl ether	Eyes, respiratory system, liver	Inhalation, skin absorption, ingestion,	Irritation nose, throat, respiratory	15 ppm	NA
Dichloromethane	Eyes, skin, cardiovascular system, cen	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; lassitude, dr	25 ppm	125 ppm
1,3-Dichloropropene	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	NA	NA
Dieldrin	Central nervous system, liver, kidneys	Inhalation, skin absorption, ingestion,	Headache, dizziness; nausea, vor	0.25 mg/m3	NA
Diethanolamine	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	NA	NA
Diethylamine	Eyes, skin, respiratory system, cardiov	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	25 ppm	NA
2-Diethylaminoethanol	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	10 ppm	NA
Diisopropylamine	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	5 ppm	NA
Dimethyl acetamide	Skin, liver, central nervous system	Inhalation, skin absorption, ingestion,	Irritation skin; jaundice, liver dar	10 ppm	NA
Dimethyl sulfate	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; headache; d	1 ppm	NA
Dimethylamine	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact (liq	Irritation nose, throat; sneezing, c	10 ppm	NA

Dimethylformamide	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	10 ppm	NA
Dinitrobenzene (meta)	Eyes, skin, blood, liver, cardiovascula	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; visual disturba	1 mg/m3	NA
Dinitrobenzene (ortho)	Eyes, skin, blood, liver, cardiovascula	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; visual disturba	1 mg/m3	NA
Dinitrobenzene (para)	Eyes, skin, blood, liver, cardiovascula	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; visual disturba	1 mg/m3	NA
Dinitro-o-cresol	Cardiovascular system, endocrine syst	Inhalation, skin absorption, ingestion,	Sense of well being; headache, fe	0.2 mg/m3	NA
Dinitrotoluene	Blood, liver, cardiovascular system, re	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; anemia, jaundi	1.5 mg/m3	NA
Dioxane	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	100 ppm	NA
Endrin	Central nervous system, liver	Inhalation, skin absorption, ingestion,	Epileptiform convulsions; stupor	0.1 mg/m3	NA
Epichlorohydrin	Eyes, skin, respiratory system, kidneys	Inhalation, skin absorption, ingestion,	Irritation eyes, skin with deep pai	5 ppm	NA
Ethyl alcohol	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; headac	1000 ppm	NA
Ethyl benzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	100 ppm	NA
Ethyl chloride	Liver, kidneys, respiratory system, car	Inhalation, skin absorption (liquid), in	Incoordination, inebriation; abdo	1000 ppm	NA
Ethylene dichloride	Eyes, skin, kidneys, liver, central nerv	Inhalation, ingestion, skin absorption,	Irritation eyes, corneal opacity; c	50 ppm	NA
Formaldehyde	Eyes, respiratory system	Inhalation, skin and/or eye contact	Irritation eyes, nose, throat, respi	0.75 ppm	2 ppm
Furfural	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, upper respira	5 ppm	NA
Hepatchlor	Central nervous system, liver	Inhalation, skin absorption, ingestion,	Tremor, convulsions; liver damag	0.5 mg/m3	NA
Heptane	Skin, respiratory system, central nervo	Inhalation, ingestion, skin and/or eye c	Dizziness, stupor, incoordination	500 ppm	NA
Hexachlorocyclopentadiene	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	NA	NA
Hexane	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose; nausea, hea	500 ppm	NA
2-Hexanone	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; peripheral n	100 ppm	NA
Iron oxide dust/fume	Respiratory system	Inhalation	Benign pneumoconiosis with X-r	10 mg/m3	NA
Isopropyl alcohol	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, throat; drow	400 ppm	NA
Isopropyl ether	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; resp di	500 ppm	NA
Lead	Eyes, gastrointestinal tract, central ner	Inhalation, ingestion, skin and/or eye c	Lassitude, insomnia; facial pallor	.050 mg/m3	NA
Lindane	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	0.5 mg/m3	NA
Manganese compounds/fume	Respiratory system, central nervous sy	Inhalation, ingestion	Manganism; asthenia, insomnia,	NA	NA
Methyl acetate	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	200 ppm	NA
Methyl alcohol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, upper respira	200 ppm	NA
Methyl bromide	Eyes, skin, respiratory system, central	Inhalation, skin absorption (liquid), sk	Irritation eyes, skin, respiratory s	NA	NA
Methyl butyl ketone	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; peripheral n	100 ppm	NA
Methyl chloride	Central nervous system, liver, kidneys	Inhalation, skin and/or eye contact (liq	Dizziness, nausea, vomiting; visu	100 ppm	NA
Methyl chloroform	Eyes, skin, central nervous system, car	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin; headache, la	350 ppm	NA
Methyl ethyl ketone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; headac	200 ppm	NA
Methyl mercaptan	Eyes, skin, respiratory system, central	Inhalation, skin and/or eye contact (liq	Irritation eyes, skin, respiratory s	NA	NA
Methyl methacrylate	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	100 ppm	NA
Methyl propyl ketone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	200 ppm	NA
Methylamine	Eyes, skin, respiratory system	Inhalation, skin absorption (solution),	Irritation eyes, skin, respiratory s	10 ppm	NA

Methylene chloride	Eyes, skin, cardiovascular system, cen	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; lassitude, dr	25 ppm	125 ppm
Morpholine	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, respira	20 ppm	NA
Naphthalene	Eyes, skin, blood, liver, kidneys, centr	Inhalation, skin absorption, ingestion,	Irritation eyes; headache, confusi	10 ppm	NA
Nickel	Nasal cavities, lungs, skin	Inhalation, ingestion, skin and/or eye c	Sensitization dermatitis, allergic	1 mg/m3	NA
Nitrobenzene	Eyes, skin, blood, liver, kidneys, cardi	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; anoxia; dern	1 ppm	NA
Nitrotoluene (meta)	Blood, central nervous system, cardiov	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; headache, lass	5 ppm	NA
Nitrotoluene (ortho)	Blood, central nervous system, cardiov	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; headache, lass	5 ppm	NA
Nitrotoluene (para)	Blood, central nervous system, cardiov	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; headache, lass	5 ppm	NA
Octane	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose; drowsiness;	500 ppm	NA
Pentane	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; derma	1000 ppm	NA
2-Pentanone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	200 ppm	NA
Perchlorethylene	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat,	100 ppm	NA
Phenol	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, nose, throat; anor	5 ppm	NA
Propane	Central nervous system	Inhalation, skin and/or eye contact (liq	Dizziness, confusion, excitation,	1000 ppm	NA
Propylene dichloride	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	75 ppm	NA
Pyridine	Eyes, skin, central nervous system, liv	Inhalation, skin absorption, ingestion,	Irritation eyes; headache, anxiety	5 ppm	NA
Resorcinol	Eyes, skin, respiratory system, cardiov	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	NA	NA
Sodium hydroxide	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	2 mg/m3	NA
Styrene	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose, respiratory s	100 ppm	NA
TCE	Eyes, skin, respiratory system, heart, li	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; headache, vi	100 ppm	NA
1,1,2,2-Tetrachloroethane	Skin, liver, kidneys, central nervous sy	Inhalation, skin absorption, ingestion,	Nausea, vomiting, abdominal pai	5 ppm	NA
Tetrachloroethylene	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat,	100 ppm	NA
Tetraethyl lead	Central nervous system, cardiovascula	Inhalation, skin absorption, ingestion,	Insomnia, lassitude, anxiety; trem	.075 mg/m3	NA
Tetrahydrofuran	Eyes, respiratory system, central nervo	Inhalation, skin and/or eye contact, ing	Irritation eyes, upper respiratory	200 ppm	NA
Tin	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory s	2 mg/m3	NA
Toluene	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; lassitude, co	200 ppm	NA
o-Toluidine	Eyes, skin, blood, kidneys, liver, cardi	Inhalation, skin absorption, ingestion,	Irritation eyes; anoxia, headache,	5 ppm	NA
1,2,4-Trichlorobenzene	Eyes, skin, respiratory system, liver, re	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, mucous men	NA	NA
1,1,1-Trichloroethane	Eyes, skin, central nervous system, car	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin; headache, la	350 ppm	NA
Trichloroethylene	Eyes, skin, respiratory system, heart, li	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; headache, vi	100 ppm	NA
Trimethylamine	Eyes, skin, respiratory system	Inhalation, ingestion (solution), skin a	Irritation eyes, skin, nose, throat,	NA	NA
1,2,3-Trimethylbenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	NA	NA
1,2,4-Trimethylbenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	NA	NA
1,3,5-Trimethylbenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	NA	NA
Vinyl chloride	Liver, central nervous system, blood, r	Inhalation, skin and/or eye contact (liq	Lassitude; abdominal pain, gastro	1 ppm	NA
Vinyl toluene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, upper respira	100 ppm	NA
Xylene (meta)	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	100 ppm	NA

Xylene (ortho)	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	100 ppm	NA
Xylene (para)	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	100 ppm	NA

O CEIL	O PEAK	N REL	N STEL	N CEIL	A TLV	A STEL	A CEIL	IDLH	IP	Sample	Carc	CAS
NA	NA	NA	NA	NA	NA	NA	25 ppm	2000 ppm	10.22 eV	NIOSH 201	Yes	75-07-0
NA	NA	250 ppm	NA	NA	500 ppm	750 ppm	NA	2500 ppm	9.69 eV	NIOSH 130	No	67-64-1
NA	NA	20 ppm	NA	NA	20 ppm	NA	NA	500 ppm	12.20 eV	NIOSH 160	No	75-05-8
NA	NA	0.1 ppm	0.3 ppm	NA	NA	NA	0.1 ppm	2 ppm	10.13 eV	NIOSH 250	No	107-02-8
pm (15 min)	NA	1 ppm	NA	pm (15 min)	2 ppm	NA	NA	85 ppm	10.91 eV	NIOSH 160	Yes	107-13-1
NA	NA	2 ppm	4 ppm	NA	0.5 ppm	NA	NA	20 ppm	9.63 eV	NIOSH 140	No	107-18-6
NA	NA	5 mg/m3	NA	NA	5 mg/m3	NA	NA	NA	NA	NIOSH 701	No	7429-90-5
NA	NA	10 mg/m3	NA	NA	10 mg/m3	NA	NA	NA	NA	NIOSH 701	No	7429-90-5
NA	NA	25 ppm	35 ppm	NA	25 ppm	35 ppm	NA	300 ppm	10.18 eV	NIOSH 3800, 6015, 601		7664-41-7
NA	NA	NA	NA	NA	2 ppm	NA	NA	100 ppm	7.70 eV	NIOSH 200	Yes	62-53-3
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	NA	NA	NIOSH 730	No	7440-36-0
NA	NA	NA	NA	m3 (15 min)	0.01 mg/m3	NA	NA	5 mg/m3	NA	NIOSH 730	Yes	7440-38-2
NA	NA	NA	NA	NA	0.1 f/cc	NA	NA	NA	NA	NIOSH 740	Yes	1332-21-4
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	50 mg/m3	NA	NIOSH 7056; OSHA ID-		7440-39-3
NA	NA	0.1 ppm	1 ppm	NA	0.5 ppm	2.5 ppm	NA	500 ppm	9.24 eV	NIOSH 150	Yes	71-43-2
NA	NA	NA	NA	pm (15 min)	1 ppm	NA	NA	10 ppm	NA	NIOSH 100	No	100-44-7
m3 (30 min)	.025 mg/m3	NA	NA	0005 mg/m3	0005 mg/m3	NA	NA	4 mg/m3	NA	NIOSH 730	Yes	7440-41-7
NA	NA	200 ppm	NA	NA	200 ppm	NA	NA	2000 ppm	10.77 eV	NIOSH 100	No	74-97-5
NA	NA	0.5 ppm	NA	NA	0.5 ppm	NA	NA	850 ppm	10.48 eV	NIOSH 100	No	75-25-2
NA	NA	800 ppm	NA	NA	1000 ppm	NA	NA	ND	10.63 eV	OSHA PV2	No	106-97-8
NA	NA	100 ppm	150 ppm	NA	100 ppm	NA	NA	2000 ppm	10.10 eV	NIOSH 140	No	78-92-2
NA	NA	200 ppm	300 ppm	NA	200 ppm	300 ppm	NA	3000 ppm	9.54 eV	NIOSH 250	No	78-93-3
NA	NA	5 ppm	NA	NA	20 ppm	NA	NA	700 ppm	10.00 eV	NIOSH 140	No	111-76-2
NA	NA	10 ppm	NA	NA	2 ppm	NA	NA	ND	NA	OSHA PV2	No	141-32-2
NA	NA	NA	NA	50 ppm	20 ppm	NA	NA	1400 ppm	10.04 eV	NIOSH 140	No	71-36-3
NA	NA	100 ppm	150 ppm	NA	100 ppm	NA	NA	2000 ppm	10.10 eV	NIOSH 140	No	78-92-2
NA	NA	100 ppm	150 ppm	NA	100 ppm	NA	NA	1600 ppm	9.70 eV	NIOSH 140	No	75-65-0
NA	NA	NA	NA	pm (15 min)	25 ppm	NA	NA	250 ppm	NA	NIOSH 161	No	2426-08-6
NA	NA	NA	NA	pm (15 min)	0.5 ppm	NA	NA	500 ppm	9.15 eV	NIOSH 252	No	109-79-5
5 ppm	NA	NA	NA	5 ppm	NA	NA	5 ppm	300 ppm	8.71 eV	NIOSH 201	No	109-73-9
NA	NA	NA	NA	NA	0.01 mg/m3	NA	NA	9 mg/m3	NA	NIOSH 704	Yes	7440-43-9
NA	NA	NA	NA	m3 (15 min)	NA	NA	NA	5 mg/m3	NA	NIOSH 790	Yes	7778-44-1
NA	NA	2 mg/m3	NA	NA	2 ppm	3 ppm	NA	200 mg/m3	NA	NIOSH 130	No	76-22-2
30 ppm	100 ppm	1 ppm	10 ppm	NA	10 ppm	NA	NA	500 ppm	10.08 ev	NIOSH 160	No	75-15-0
25 ppm	ppm (5 min)	NA	pm (60 min)	NA	5 ppm	10 ppm	NA	200 ppm	11.47 eV	NIOSH 100	Yes	56-23-5
NA	NA	5 ppm	NA	NA	5 ppm	NA	NA	ND	NA	OSHA PV2	No	120-80-9

NA	NA	NA	NA	NA	10 ppm	NA	NA	1000 ppm	9.07 eV	NIOSH 100	No	108-90-7
NA	NA	200 ppm	NA	NA	200 ppm	NA	NA	2000 ppm	10.77 eV	NIOSH 100	No	74-97-5
NA	NA	.001 mg/m3	NA	NA	1 mg/m3	NA	NA	5 mg/m3	NA	NIOSH 550	Yes	53469-21-9
NA	NA	.001 mg/m3	NA	NA	0.5 mg/m3	NA	NA	5 mg/m3	NA	NIOSH 550	Yes	11097-69-1
50 ppm	NA	NA	pm (60 min)	NA	10 ppm	NA	NA	500 ppm	11.42 eV	NIOSH 100	Yes	67-66-3
NA	NA	NA	NA	pm (15 min)	1 ppm	NA	NA	10 ppm	NA	NIOSH 100	No	100-44-7
NA	NA	0002 mg/m3	NA	NA	0.01 mg/m3	NA	NA	15 mg/m3	NA	NIOSH 760	Yes	1333-82-0
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	25 mg/m3	NA	NIOSH 702	No	Varies
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	250 mg/m3	NA	NIOSH 702	No	7440-47-3
NA	NA	0.1 mg/m3	NA	NA	0.2 mg/m3	NA	NA	80 mg/m3	NA	OSHA 58	Yes	65996-93-2
NA	NA	0.05 mg/m3	NA	NA	0.02 mg/m3	NA	NA	20 mg/m3	NA	NIOSH 702	No	7440-48-4
NA	NA	0.1 mg/m3	NA	NA	0.2 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 702	No	1317-38-0
NA	NA	1 mg/m3	NA	NA	1 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 702	No	7440-50-8
NA	NA	2.3 ppm	NA	NA	5 ppm	NA	NA	250 ppm	8.97 eV	NIOSH 254	No	106-44-5
NA	NA	50 ppm	NA	NA	50 ppm	NA	NA	400 ppm	10.00 eV	NIOSH 140	No	108-93-0
NA	NA	25 ppm	NA	NA	20 ppm	50 ppm	NA	700 ppm	9.14 eV	NIOSH 130	No	108-94-1
NA	NA	10 mg/m3	NA	NA	10 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 500	No	94-75-7
NA	NA	0.5 mg/m3	NA	NA	1 mg/m3	NA	NA	500 mg/m3	NA	NIOSH S27	Yes	50-29-3
50 ppm	NA	NA	NA	50 ppm	25 ppm	50 ppm	NA	200 ppm	9.06 eV	NIOSH 100	No	95-50-1
NA	NA	NA	NA	NA	10 ppm	NA	NA	150 ppm	8.98 eV	NIOSH 100	Yes	106-46-7
50 ppm	NA	NA	NA	50 ppm	25 ppm	50 ppm	NA	200 ppm	9.06 eV	NIOSH 100	No	95-50-1
NA	NA	NA	NA	NA	10 ppm	NA	NA	150 ppm	8.98 eV	NIOSH 100	Yes	106-46-7
NA	NA	1000 ppm	NA	NA	10 ppm	NA	NA	15000 ppm	11.75 eV	NIOSH 101	No	75-71-8
NA	NA	100 ppm	NA	NA	100 ppm	NA	NA	3000 ppm	11.06 eV	NIOSH 100	No	75-34-3
100 ppm	5 min/3 hrs)	1 ppm	2 ppm	NA	10 ppm	NA	NA	50 ppm	11.05 eV	NIOSH 100	Yes	107-06-2
NA	NA	200 ppm	NA	NA	200 ppm	NA	NA	1000 ppm	9.65 eV	NIOSH 100	No	540-59-0
NA	NA	5 ppm	pm (60 min)	NA	5 ppm	10 ppm	NA	100 ppm	NA	NIOSH 100	Yes	111-44-4
NA	NA	NA	NA	NA	50 ppm	NA	NA	2300 ppm	11.32 eV	NIOSH 100	Yes	75-09-2
NA	NA	1 ppm	NA	NA	1 ppm	NA	NA	NA	NA	NA	Yes	542-75-6
NA	NA	0.25 mg/m3	NA	NA	0.25 mg/m3	NA	NA	50 mg/m3	NA	NIOSH S28	Yes	60-57-1
NA	NA	3 ppm	NA	NA	2 mg/m3	NA	NA	ND	NA	NIOSH 350	No	111-42-2
NA	NA	10 ppm	25 ppm	NA	5 ppm	15 ppm	NA	200 ppm	8.01 eV	NIOSH 201	No	109-89-7
NA	NA	10 ppm	NA	NA	2 ppm	NA	NA	100 ppm	NA	NIOSH 200	No	100-37-8
NA	NA	5 ppm	NA	NA	5 ppm	NA	NA	200 ppm	7.73 eV	NIOSH S14	No	108-18-9
NA	NA	10 ppm	NA	NA	10 ppm	NA	NA	300 ppm	8.81 eV	NIOSH 200	No	127-19-5
NA	NA	0.1 ppm	NA	NA	0.1 ppm	NA	NA	7 ppm	NA	NIOSH 252	Yes	77-78-1
NA	NA	10 ppm	NA	NA	5 ppm	15 ppm	NA	500 ppm	8.24 eV	NIOSH 201	No	124-40-3

NA	NA	10 ppm	NA	NA	10 ppm	NA	NA	500 ppm	9.12 eV	NIOSH 200	No	68-12-2
NA	NA	1 mg/m3	NA	NA	0.15 mg/3	NA	NA	50 mg/m3	10.43 eV	NIOSH S21	No	99-65-0
NA	NA	1 mg/m3	NA	NA	0.15 mg/3	NA	NA	50 mg/m3	10.71 eV	NIOSH S21	No	528-29-0
NA	NA	1 mg/m3	NA	NA	0.15 mg/3	NA	NA	50 mg/m3	10.50 eV	NIOSH S21	No	100-25-4
NA	NA	0.2 mg/m3	NA	NA	0.2 mg/m3	NA	NA	5 mg/m3	NA	NIOSH S16	No	534-52-1
NA	NA	1.5 mg/m3	NA	NA	0.2 mg/m3	NA	NA	50 mg/m3	NA	OSHA 44	Yes	25321-14-6
NA	NA	NA	NA pm (30 min)		20 ppm	NA	NA	500 ppm	9.13 eV	NIOSH 160	Yes	123-91-1
NA	NA	0.1 mg/m3	NA	NA	0.1 mg/m3	NA	NA	2 mg/m3	NA	NIOSH 551	No	72-20-8
NA	NA	NA	NA	NA	0.5 ppm	NA	NA	75 ppm	10.60 eV	NIOSH 101	Yes	106-89-8
NA	NA	1000 ppm	NA	NA	1000 ppm	NA	NA	3300 ppm	10.47 eV	NIOSH 140	No	64-17-5
NA	NA	100 ppm	125 ppm	NA	100 ppm	125 ppm	NA	800 ppm	8.76 eV	NIOSH 150	No	100-41-4
NA	NA	NA	NA	NA	100 ppm	NA	NA	3800 ppm	10.97 eV	NIOSH 251	No	75-00-3
100 ppm	5 min/3 hrs)	1 ppm	2 ppm	NA	10 ppm	NA	NA	50 ppm	11.05 eV	NIOSH 100	Yes	107-06-2
NA	NA	0.016 ppm	NA pm (15 min)		NA	NA	0.3 ppm	20 ppm	10.88 eV	NIOSH 201	Yes	50-00-0
NA	NA	NA	NA	NA	2 ppm	NA	NA	100 ppm	9.21 eV	NIOSH 252	No	98-01-1
NA	NA	0.5 mg/m3	NA	NA	0.05 mg/m3	NA	NA	35 mg/m3	NA	NIOSH S28	Yes	76-44-8
NA	NA	85 ppm	NA pm (15 min)		2 ppm	NA	NA	750 ppm	9.90 eV	NIOSH 150	No	142-82-5
NA	NA	0.01 ppm	NA	NA	0.01 ppm	NA	NA	ND	NA	NIOSH 251	No	77-47-4
NA	NA	50 ppm	NA	NA	50 ppm	NA	NA	1100 ppm	10.18 eV	NIOSH 150	No	110-54-3
NA	NA	1 ppm	NA	NA	5 ppm	10 ppm	NA	1600 ppm	9.34 eV	NIOSH 130	No	591-78-6
NA	NA	5 mg/m3	NA	NA	5 mg/m3	NA	NA	2500 mg/m3	NA	NIOSH 730	No	1309-37-1
NA	NA	400 ppm	500 ppm	NA	200 ppm	400 ppm	NA	2000 ppm	10.10 eV	NIOSH 140	No	67-63-0
NA	NA	500 ppm	NA	NA	250 ppm	310 ppm	NA	1400 ppm	9.20 eV	NIOSH 161	No	108-20-3
NA	NA	.050 mg/m3	NA	NA	0.05 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 708	No	7439-92-1
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	50 mg/m3	NA	NIOSH 550	No	58-89-9
5 mg/m3	NA	1 mg/m3	3 mg/m3	NA	0.2 mg/m3	NA	NA	500 mg/m3	NA	NIOSH 730	No	7439-96-5
NA	NA	200 ppm	250 ppm	NA	200 ppm	250 ppm	NA	3100 ppm	10.27 eV	NIOSH 145	No	79-20-9
NA	NA	200 ppm	250 ppm	NA	200 ppm	250 ppm	NA	6000 ppm	10.84 eV	NIOSH 200	No	67-56-1
20 ppm	NA	NA	NA	NA	1 ppm	NA	NA	250 ppm	10.54 eV	NIOSH 252	Yes	74-83-9
NA	NA	1 ppm	NA	NA	5 ppm	10 ppm	NA	1600 ppm	9.34 eV	NIOSH 130	No	591-78-6
200 ppm	5 min/3 hrs)	NA	NA	NA	50 ppm	100 ppm	NA	2000 ppm	11.28 eV	NIOSH 100	Yes	74-87-3
NA	NA	NA	NA pm (15 min)		350 ppm	450 ppm	NA	700 ppm	11.00 eV	NIOSH 100	No	71-55-6
NA	NA	200 ppm	300 ppm	NA	200 ppm	300 ppm	NA	3000 ppm	9.54 eV	NIOSH 250	No	78-93-3
10 ppm	NA	NA	NA pm (15 min)		0.5 ppm	NA	NA	150 ppm	9.44 eV	NIOSH 254	No	74-93-1
NA	NA	100 ppm	NA	NA	50 ppm	100 ppm	NA	1000 ppm	9.70 eV	NIOSH 253	No	80-62-6
NA	NA	150 ppm	NA	NA	200 ppm	250 ppm	NA	1500 ppm	9.39 eV	NIOSH 130	No	107-87-9
NA	NA	10 ppm	NA	NA	5 ppm	15 ppm	NA	100 ppm	8.97 eV	OSHA 40	No	74-89-5

NA	NA	NA	NA	NA	50 ppm	NA	NA	2300 ppm	11.32 eV	NIOSH 100	Yes	75-09-2
NA	NA	20 ppm	30 ppm	NA	20 ppm	NA	NA	1400 ppm	8.88 eV	NIOSH S15	No	110-91-8
NA	NA	10 ppm	15 ppm	NA	10 ppm	15 ppm	NA	250 ppm	8.12 eV	NIOSH 150	No	91-20-3
NA	NA	.015 mg/m3	NA	NA	1.5 mg/m3	NA	NA	10 mg/m3	NA	NIOSH 730	Yes	7440-02-0
NA	NA	1 ppm	NA	NA	1 ppm	NA	NA	200 ppm	9.92 eV	NIOSH 200	No	98-95-3
NA	NA	2 ppm	NA	NA	2 ppm	NA	NA	200 ppm	9.48 eV	NIOSH 200	No	99-08-1
NA	NA	2 ppm	NA	NA	2 ppm	NA	NA	200 ppm	9.43 eV	NIOSH 200	No	88-72-2
NA	NA	2 ppm	NA	NA	2 ppm	NA	NA	200 ppm	9.50 eV	NIOSH 200	No	99-99-0
NA	NA	75 ppm	NA	pm (15 min)	300 ppm	NA	NA	1000 ppm	9.82 eV	NIOSH 150	No	111-65-9
NA	NA	120 ppm	NA	pm (15 min)	NA	NA	NA	1500 ppm	10.34 eV	NIOSH 150	No	109-66-0
NA	NA	150 ppm	NA	NA	200 ppm	250 ppm	NA	1500 ppm	9.39 eV	NIOSH 130	No	107-87-9
5 min/3 hrs)	300 ppm	NA	NA	NA	25 ppm	100 ppm	NA	50 ppm	9.32 eV	NIOSH 100	Yes	127-18-4
NA	NA	5 ppm	NA	pm (60 min)	5 ppm	NA	NA	250 ppm	8.50 eV	NIOSH 254	No	108-95-2
NA	NA	1000 ppm	NA	NA	1000 ppm	NA	NA	2100 ppm	11.07 eV	NIOSH S87	No	74-98-6
NA	NA	NA	NA	NA	75 ppm	110 ppm	NA	400 ppm	10.87 eV	NIOSH 101	Yes	78-87-5
NA	NA	5 ppm	NA	NA	1 ppm	NA	NA	1000 ppm	9.27 eV	NIOSH 161	No	110-86-1
NA	NA	10 ppm	20 ppm	NA	10 ppm	20 ppm	NA	ND	8.63 eV	NIOSH 570	No	108-46-3
NA	NA	NA	NA	2 mg/m3	NA	NA	2 mg/m3	10 mg/m3	NA	NIOSH 740	No	1310-73-2
200 ppm	5 min/3 hrs)	50 ppm	100 ppm	NA	20 ppm	40 ppm	NA	700 ppm	8.40 eV	NIOSH 150	No	100-42-5
200 ppm	5 min/2 hrs)	NA	NA	NA	50 ppm	100 ppm	NA	1000 ppm	9.45 eV	NIOSH 102	Yes	79-01-6
NA	NA	1 ppm	NA	NA	1 ppm	NA	NA	100 ppm	11.10 eV	NIOSH 101	Yes	79-34-5
5 min/3 hrs)	300 ppm	NA	NA	NA	25 ppm	100 ppm	NA	50 ppm	9.32 eV	NIOSH 100	Yes	127-18-4
NA	NA	.075 mg/m3	NA	NA	0.1 mg/m3	NA	NA	40 mg/m3	NA	NIOSH 253	No	78-00-2
NA	NA	200 ppm	250 ppm	NA	50 ppm	100 ppm	NA	2000 ppm	9.45 eV	NIOSH1608	No	109-99-9
NA	NA	2 mg/m3	NA	NA	2 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 730	No	7440-31-5
300 ppm	pm (10 min)	100 ppm	150 ppm	NA	50 ppm	NA	NA	500 ppm	8.82 eV	NIOSH 150	No	108-88-3
NA	NA	NA	NA	NA	2 ppm	NA	NA	50 ppm	7.44 eV	NIOSH 200	Yes	95-53-4
NA	NA	NA	NA	5 ppm	NA	NA	5 ppm	ND	NA	NIOSH 551	No	120-82-1
NA	NA	NA	NA	pm (15 min)	350 ppm	450 ppm	NA	700 ppm	11.00 eV	NIOSH 100	No	71-55-6
200 ppm	5 min/2 hrs)	NA	NA	NA	50 ppm	100 ppm	NA	1000 ppm	9.45 eV	NIOSH 102	Yes	79-01-6
NA	NA	10 ppm	15 ppm	NA	5 ppm	15 ppm	NA	ND	7.82 eV	OSHA PV2	Yes	75-50-3
NA	NA	25 ppm	NA	NA	25 ppm	NA	NA	ND	8.48 eV	OSHA PV2	No	526-73-8
NA	NA	25 ppm	NA	NA	25 ppm	NA	NA	ND	8.27 eV	OSHA PV2	No	95-63-6
NA	NA	25 ppm	NA	NA	25 ppm	NA	NA	ND	8.39 eV	OSHA PV2	No	108-67-8
pm (15 min)	NA	NA	NA	NA	1 ppm	NA	NA	ND	9.99 eV	NIOSH 100	Yes	75-01-4
NA	NA	100 ppm	NA	NA	50 ppm	100 ppm	NA	400 ppm	8.20 eV	NIOSH 150	No	25013-15-4
NA	NA	100 ppm	150 ppm	NA	100 ppm	150 ppm	NA	900 ppm	8.56 eV	NIOSH 150	No	108-38-3

NA	NA	100 ppm	150 ppm	NA	100 ppm	150 ppm	NA	900 ppm	8.56 eV	NIOSH 150	No	95-47-6
NA	NA	100 ppm	150 ppm	NA	100 ppm	150 ppm	NA	900 ppm	8.44 eV	NIOSH 150	No	106-42-3

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.

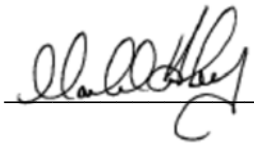
5. References

- Compressed Gas Association – Pamphlet P1 (***Safe Handling of Compressed Gases in Containers***)
- ISO Standard 11625 (***Gas Cylinders – Safe Handling***)

Document Control Information

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***)

Document Control Information

Original Effective Date: 4/29/16

Policy Approval by: Mark Hickey

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	3
	Title: **Site Safety Meeting Form**		**Last Revision Date:**	1/16/17

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?
☐ 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.

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:** _____

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

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.

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 (*S1-ERM-003-FM1*).

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.

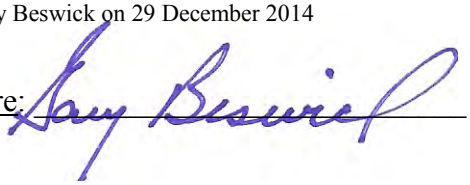
5. References

- S1-ERM-003-FM1 - SSE Mentor Assessment Form

Document Control Information

Original Effective Date: 1 April 2015

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

ERM Vehicle Safety Checklist

Date	Operator	Project# 0304393	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 criteria for consistent reporting and recording for work-related injuries and illnesses, and the methodology for calculating injury/illness related reporting metrics. **Figure 1** summarizes the Recordability Decision process.

In certain circumstances, ERM employees and entities may have a duty to record and report data on injuries and illnesses of certain ERM Agents or Contractors if the work of an Agent or Contractor is directly supervised by an ERM employee on a daily basis.

2. Roles and Responsibilities

Global H&S Director (GHSD). Issue a final determination on whether an injury/illness is ERM Recordable in the event of disagreement, in consultation with the responsible Regional H&S Lead, Regional CEO, ERM Legal Department and Executive Committee.

Regional Health and Safety (H&S) Lead. Determine Recordability within 3 days of receiving notice of an injury or illness via ERM's Event Communication System (ECS); update the record as required until the event is complete and the employee has returned to normal duties; communicate with regulatory authorities regarding Regulatory Reportable or Recordable Injuries/Illnesses (in consultation with the GHSD and the Legal Department, and following approval by a member of the Executive Committee).

All employees. Immediately notify the PIC (for project-related events) or Office Head (for non-project related events), and the BU H&S Lead of a suspected work-related injury or illness, and enter the event into ECS within 24 hours.

3. Definitions

Agent. Any member of any ERM entity board, any officer of any ERM entity, hired personnel, consultants, intermediaries, lobbyists, agents, representatives, independent contractors, subcontractors, and any others who act on ERM's behalf.

Aggravated Pre-existing Condition. When an event or exposure in the work environment results in any of the following:

- Death provided that the pre-existing injury or illness would likely not have resulted in death but for the occupational event or exposure.
- Loss of consciousness provided that the pre-existing injury or illness would likely not have resulted in loss of consciousness but for the occupational event or exposure.
- One or more days away from work, or days of restricted work, or days of job transfer that otherwise would not have occurred but for the occupational event or exposure.

- Medical treatment in a case where no previous medical treatment was needed for the pre-existing injury or illness before the workplace event or exposure, or a change in medical treatment was necessitated by the workplace event or exposure.

Employee. Any personnel hired directly by ERM (regardless of status classification of full-time, part-time, temporary, contract, etc.); interns (even if an intern does not receive payment by ERM); employees of other companies seconded into ERM, and any ERM employee seconded to a non-ERM company.

ERM Recordable Incident: A Medical Treatment Incident (MTI), Restricted Work Incident (RWI), Lost Time Incident (LTI), or fatality that meets the requirements in this procedure and which is used in establishing our externally reported Total Recordable Incident Rate (TRIR)..

First aid. First Aid Incident is any injury or illness that does not require medical treatment, require work restrictions or result in Lost Time away from work as defined below. The following are examples of this definition (but not limited to):

- Using a non-prescription medication at non-prescription strength (for medications available in both prescription and non-prescription form, a recommendation by a physician or other licensed health care professional to use a non-prescription medication at prescription strength is considered medical treatment);
- Administering routine preventative tetanus immunizations;
- Cleaning, flushing or soaking wounds on the surface of the skin;
- Using wound coverings such as bandages, Band-Aids™, gauze pads, etc.; or using butterfly bandages or Steri-Strips™ (other wound closing devices such as sutures, staples, etc., are considered medical treatment);
- Using hot or cold therapy;
- Using any non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc. (devices with rigid stays or other systems designed to immobilize parts of the body are considered medical treatment);
- Using temporary immobilization devices while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.);
- Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;
- Using eye patches;
- Removing foreign bodies from the eye using only irrigation or a cotton swab;
- Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;
- Using finger guards;
- Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes); or
- Drinking fluids for relief of heat stress.

Note: The above are considered first aid, whether or not treatment is accepted

Lost Time Incident (LTI – Days Away from Work Recordable): A work-related injury or illness that results in the affected party being unable to report to work for one or more days, excluding the day of injury or onset of illness.

Medical Treatment Incident (MTI – Other Recordable): A work-related injury or illness that requires professional medical treatment, not defined as first aid above, that should be administered by a physician. The following are examples of this definition (but not limited to):

- Sutures,
- Broken bones
- Recommendation of prescription medication
- Loss of consciousness
- Other injury or illness that is not considered first aid

Note: Observation, counselling and scans (xrays, MRI's etc) are not medical treatment.

Near Miss: An unplanned event that did NOT result in injury, illness, or damage – but had the potential to do so. Only a fortunate break in the chain of events prevented an injury, illness, property damage or environmental impact. For example, slipping on a staircase and falling to the ground that results in no injury, visible bruising and/or lasting impacts (i.e. pain/discomfort). If the same event were to result in visible bruising and/or lasting impacts with no medical treatment, the event would be classified as first-aid.

Regulatory Recordable Incident: An injury or illness that is considered recordable within the jurisdiction of the affected employee. These requirements may be more or less stringent than the ERM Recordable definition.

Reportable Injury: Any injury or illness that must be reported to a governmental authority within the jurisdiction of the affected employee.

Restricted Work Incident (RWI). A work-related injury or illness where:

- The employee is restricted by an ERM manager from performing one or more of the routine functions of his or her job, or from working the full workday that he or she would otherwise have been scheduled to work; or
- A physician or other licensed health care professional recommends that the employee not perform one or more of the routine functions of his or her job, or not work the full workday that he or she would otherwise have been scheduled to work.

Routine functions. For recordkeeping purposes, an employee's "routine functions" are those work activities the employee regularly performs at least once per week.

Workplace: Any location where one or more employees are directly engaged in activities related to the performance of their work assignment, or are present as a condition of their employment.

The workplace includes not only physical locations, but also the equipment or materials used by the employee during the course of work.

Work Related: An injury or illness is considered work-related if an event or exposure in the workplace either:

- caused or contributed to the resulting condition; or
- significantly aggravated a pre-existing injury or illness.

The following exceptions to "work-related" apply:

- At the time of the injury or illness, the employee was present in the work environment as a member of the general public rather than as an employee.
- The injury or illness involves signs or symptoms that surface at work but result solely from a non-work-related event or exposure that occurs outside the work environment.
- The injury or illness results solely from voluntary participation in a wellness program or in a medical, fitness, or recreational activity such as blood donation, physical examination, flu shot, exercise class, racquetball, or baseball.
- The injury or illness is solely the result of an employee eating, drinking, or preparing food or drink for personal consumption (whether bought on the employer's premises or brought in).
- The injury or illness is solely the result of an employee doing personal tasks (unrelated to their employment) at the establishment outside of the employee's assigned working hours.
- The injury or illness is solely the result of personal grooming, self medication for a non-work-related condition, or is intentionally self-inflicted.
- The injury or illness is caused by a motor vehicle accident and occurs on a company parking lot or company access road while the employee is commuting to or from work.
- The illness is the common cold or flu (note: other contagious diseases such as tuberculosis, brucellosis, hepatitis A, or plague may be considered work-related if the employee is confirmed as having been infected at work).
- The illness is a mental illness.

4. Procedure

4.1 Mandatory Notification

All Employees shall immediately notify their supervisor of any injury and/or illness suspected to be work-related.

Any injury or illness known or suspected to be work related shall also be verbally disclosed as quickly as possible following the occurrence, and no later than the end of the current work shift, to the PIC (for project-related events) or Office Head (for non-project related events), and the

BU H&S Lead. In addition, the employee shall enter the event into ECS within 24 hours (if able; otherwise, the employee's Line Manager shall enter the event).

4.2 ERM Recordable Injury

Within three (3) days of receiving notification of an injury or illness, the Regional H&S Lead, or designee, shall document whether an event is Recordable within ECS. If information relevant to the injury or illness becomes available after the initial submittal of the event into ECS, the Regional H&S Lead shall update the record as soon as practical.

A separate ECS entry shall be completed for each ERM employee with an injury/illness.

In the event of dispute/disagreement, the GHSD, in consultation with the responsible Regional H&S Lead, RCEO, ERM Legal Department and Executive Committee leadership, will make final case determinations regarding ERM Recording of work-related injury and illness cases. Interpretation of the recording rationale will be documented and maintained by the GHSD, The final determination will be documented by the GHSD within 90 days of the incident, to the extent practicable based on the availability of necessary information.

4.2.1 Determination of Work Related

The Regional H&S Lead shall determine if an injury is Work Related, based on the definitions and exceptions in Section 3. Two special conditions are discussed below.

Injury/illness while traveling. An injury/illness that occurs while an employee is travelling for business is work-related if, at the time of the injury or illness, the employee was engaged in work activities "in the interest of the employer" (e.g., travel to and from clients, conducting job tasks, site visits, and business entertaining). Exceptions to this requirement include:

- Home away from home. When a travelling employee checks into a hotel, motel, or into another temporary residence, he or she establishes a "home away from home." The employee's activities after he or she checks into the hotel, motel, or other temporary residence must be evaluated for their work-relatedness in the same manner as the activities of a non-travelling employee. When the employee checks into the temporary residence, he or she is considered to have left the work environment. When the employee begins work each day, he or she re-enters the work environment. If the employee has established a "home away from home" and is reporting to a fixed worksite each day, injuries/illnesses are not work-related if they occur while the employee is commuting between the temporary residence and the job location.
- Injuries that occur during a Personal Detour. Injuries or illnesses are not considered work-related if they occur while the employee is on a personal detour from a reasonably direct route of travel (e.g, has taken a side trip for personal reasons).

Injury/illness while working at home. An injury/illness that occurs while an employee is working at home, including work in a home office, is work-related if the injury/illness occurs while the

employee is performing work for pay or compensation in the home, and the injury or illness is directly related to the performance of work rather than to the general home environment or setting.

4.2.2 Determination of ERM Recordable

A work-related injury or illness incurred by an ERM employee is considered ERM Recordable if it results in one or more of the following:

- Death;
- Days away from work;
- Restricted work or transfer to another job;
- Medical treatment beyond first aid;
- Loss of consciousness;
- Constitutes a needle stick or sharp injury; or
- A significant injury or illness diagnosed by a physician or other licensed health care professional as work related

The following medical activities are specifically excluded from the definition of "medical treatment" and do not trigger a recording requirement:

- Visits to a physician or other licensed health care professional solely for observation or counselling; and
- The conduct of diagnostic procedures, such as x-rays and blood tests, including the administration of prescription medications (as defined by local jurisdictions) used solely for diagnostic purposes (e.g., eye drops to dilate pupils)
- First aid.
- If medical prophylaxis is used for the prevention of malaria or other diseases while travelling.
- If herbal or natural supplements are used.
- If oxygen is used while working at elevations as used a part of a normal work practice, not for the treatment of altitude sickness of other working at higher elevation illnesses.
- If medications for the prevention of seasickness or motion sickness are used.

4.2.3 Determining Duration of Hospitalization, Lost Time and Restricted Work

Within 3 days of receiving notice of an injury/illness from ECS, the Regional H&S Lead shall make a general estimate of the number of days that the employee may experience:

- Hospitalization: time spent within a hospital or other in-patient medical facility.
- Lost time: time spent away from work as designated by a physician or other licensed health care professional.

- Restricted work: time when an employee cannot perform their routine duties, at the direction of a physician or other licensed health care professional, or their ERM Line Manager.

If the estimated duration has elapsed without the condition being resolved, the Regional H&S Lead shall update ECS with a revised estimate. Once the actual duration of these conditions is known, the Regional H&S Lead shall update ECS with the actual duration.

When determining duration, the following considerations apply:

- Do not count the day that the injury/illness occurred.
- Count calendar days from day following the occurrence of the injury/illness.
- If the injury/illness occurs prior to a day that the employee was not scheduled to work (e.g., holiday or weekend), these unscheduled days are only counted if you receive information from the physician or other licensed health care professional that the employee should not have worked, or should have performed restricted work, during the unscheduled period.
- The maximum total days of lost time plus restricted work that shall be recorded is 180 days (the 180-day cap).

4.3 Regulatory Recordable Injury and Reporting

Local regulatory recording and reporting requirements may be different from ERM recording requirements.

As appropriate following a proper review of the conditions/circumstances associated with the injury or illness, and in accordance with promulgated time expectations for reporting by the appropriate regulatory authorities, ERM will submit the required information to the respective entity(ies) [such as U.S. OSHA, U.S. Mine Safety and Health Administration (MSHA), UK Health and Safety Executive (HSE), etc.]. Communications with regulatory authorities will be conducted by the Business Unit Managing Partner (or designee), in consultation with the Regional H&S Lead, GHSD and the Legal Department.

4.4 Record Keeping

ERM maintains statistics associated with Injury and Illness Reporting that are submitted to the Senior Leadership Team on a monthly basis. The reports document, among other things, the Total Recordable Incident Rate (TRIR) and the number of Restricted Work Days and Lost Time Days.

4.4.1 Calculating TRIR

TRIR is calculated as:

$$TRIR = \frac{(Number\ of\ ERM\ Recordable\ Injuries\ \&\ Illnesses) * 200{,}000}{Number\ of\ Hours\ Worked\ by\ ERM}$$

Where:

- "Number of ERM Recordable Injuries & Illnesses" is as defined in Section 4.2. The calculation shall be based upon the rational identified within the completed "Recordability Review Form." If further investigation of the event results in a modification to the information on the form, the TRIR number will be modified accordingly.
- "200,000" is a standard normalization factor based on the typical number of hours worked by 100 employees
- "Number of Hours Worked by ERM" is based on info obtained from GMS for full- or part-time employees, and does not include recorded sick time, vacation time or holidays.

4.4.2 Calculating Restricted Work Day and Lost Time Days

Restricted Work Days and Lost Time Days shall be calculated as follows:

- The number of days reported on a monthly basis will be either:
  - For completed (or "Closed") events, where the employee has returned to full duty, the actual number of restricted or lost time days shall be reported.
  - For ongoing (or "Open") events, where the employee remains on restricted duty or off work, the number of total days reported shall be estimated.

- The number of days reported on annual reports will be either:
  - For completed (or "Closed") events, where the employee has returned to full duty, the actual number of restricted or lost time days shall be reported.
  - For ongoing (or "Open") events, where the employee remains on restricted duty or off work, the number of days reported shall be estimated, unless otherwise indicated. In this case, when the actual number of days becomes known, the subsequent annual report shall, if appropriate, report the revised "Final" data for the previous reporting year.

5. References

None

Document Control Information

Original Effective Date: 1 April 2015

Approved by: Gary Beswick on 29 December 2014

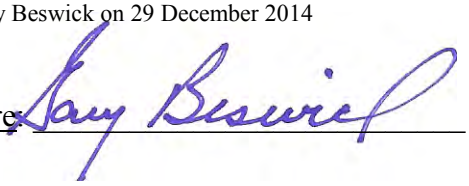
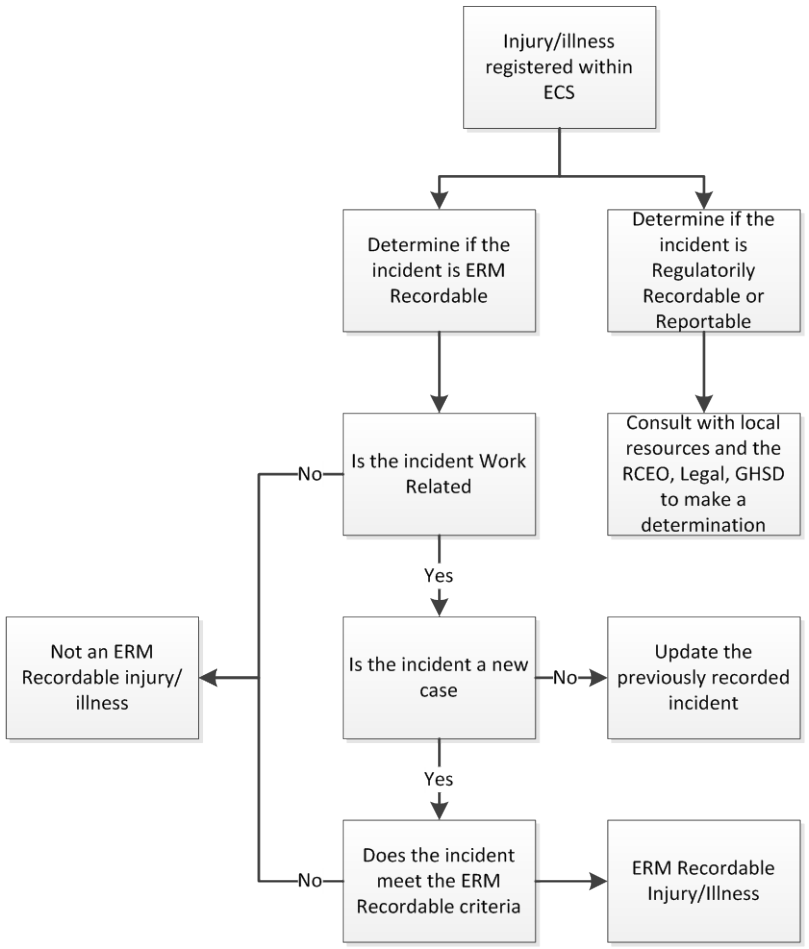
Approval Signature: 

Figure 1 – Recordability Decision Process



Revision History

Section	Version: Reason for Revision	Date
All	1.0: New document.	29 Dec 2014

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.

"Worst Case" Vapor Exposure Calculation
Volatile Compounds in Water

Common Volatile Contaminants	Concentration (site water) (ug/l)	Water Solubility (mg/l)	Vapor Pressure (torr)	OSHA PEL (ppm)	Concentr'n in Air (ppm)	Total vapor in Air (% by ppm)	Concentr'n in Air % of PEL
Acetone	0.E0	1,000,000.	180	1000	0.000	#DIV/0!	0.00%
Benzene	0.E0	1,750.	75	1	0.000	#DIV/0!	0.00%
Bromochloromethane	0.E0	15,000.	115	200	0.000	#DIV/0!	0.00%
Carbon Disulfide	0.E0	1,190.	297	20	0.000	#DIV/0!	0.00%
Carbon Tetrachloride	0.E0	793.	91	10	0.000	#DIV/0!	0.00%
Chlorobenzene	0.E0	500.	9	75	0.000	#DIV/0!	0.00%
Chloroform	0.E0	7,920.	160	50	0.000	#DIV/0!	0.00%
Cresol	0.E0	20,000.	0.18	5	0.000	#DIV/0!	0.00%
1,2-Dichlorobenzene	0.E0	156.	1	50	0.000	#DIV/0!	0.00%
1,4-Dichlorobenzene	0.E0	74.	1.3	75	0.000	#DIV/0!	0.00%
1,1-Dichloroethane	0.E0	6,000.	182	100	0.000	#DIV/0!	0.00%
1,2-Dichloroethane	0.E0	9,000.	64	50	0.000	#DIV/0!	0.00%
cis-1,2-Dichloroethylene	0.E0	3,500.	200	200	0.000	#DIV/0!	0.00%
trans-1,2-Dichloroethylene	0.E0	6,300.	200	200	0.000	#DIV/0!	0.00%
1,4-Dioxane	0.E0	1,000,000.	29	100	0.000	#DIV/0!	0.00%
Ethyl Benzene	0.E0	170.	7	100	0.000	#DIV/0!	0.00%
Ethyl Chloride	0.E0	6,000.	1000	1000	0.000	#DIV/0!	0.00%
2-Hexanone	0.E0	20,000.	11	100	0.000	#DIV/0!	0.00%
Methyl Chloride	0.E0	5,000.	3800	100	0.000	#DIV/0!	0.00%
Methyl Ethyl Ketone	0.E0	280,000.	78	200	0.000	#DIV/0!	0.00%
Methylene Chloride	0.E0	13,000.	350	25	0.000	#DIV/0!	0.00%
Naphthalene	0.E0	31.	0.08	10	0.000	#DIV/0!	0.00%
Propylene Dichloride	0.E0	3,000.	40	75	0.000	#DIV/0!	0.00%
Styrene	0.E0	310.	5	100	0.000	#DIV/0!	0.00%
1,1,2,2-Tetrachloroethane	0.E0	2,970.	5	5	0.000	#DIV/0!	0.00%
Tetrachloroethylene	0.E0	200.	14	200	0.000	#DIV/0!	0.00%
Toluene	0.E0	526.	21	200	0.000	#DIV/0!	0.00%
1,1,1-Trichloroethane	0.E0	1,330.	100	350	0.000	#DIV/0!	0.00%
1,1,2-Trichloroethane	0.E0	4,420.	19	10	0.000	#DIV/0!	0.00%
Trichloroethylene	0.E0	1,100.	58	100	0.000	#DIV/0!	0.00%
Vinyl Chloride	0.E0	2,760.	2508	1	0.000	#DIV/0!	0.00%
Xylene	0.E0	175.	8.3	100	0.000	#DIV/0!	0.00%
Totals	Combined Volatiles Level (ppm)				.	#DIV/0!	
Totals	Fraction Combined Exposure Limit						0.00%

Instructions: To estimate the potential "worst case" exposure, enter the known water concentration (in micrograms per liter, or ug/l) of the contaminant of concern in the box to the right of the known contaminant. If more than one contaminant is present, enter information for each. If the 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.

"Worst Case" Vapor Exposure Calculation
Volatile Compounds in Soil

Carbon Fraction = 0.1

Common Volatile Contaminants	Concentration (site soil) (mg/Kg)	Water Solubility (mg/l)	Vapor Pressure (torr)	Organic Carbon Partition Coefficient	OSHA PEL (ppm)	Saturation Concentration in Air (ppm)	Fraction of Total Vapor in Air (% by ppm)	Saturation Concentration in Air (% of PEL)
Acetone	0.E0	1,000,000.	180	0.23	1000	0.E+0	#DIV/0!	0.00%
Benzene	0.E0	1,750.	75	83	1	0.E+0	#DIV/0!	0.00%
Bromochloromethane	0.E0	15,000.	115	13	200	0.E+0	#DIV/0!	0.00%
Carbon Disulfide	0.E0	1,190.	297	54	20	0.E+0	#DIV/0!	0.00%
Carbon Tetrachloride	0.E0	793.	91	110	10	0.E+0	#DIV/0!	0.00%
Chlorobenzene	0.E0	500.	9	330	75	0.E+0	#DIV/0!	0.00%
Chloroform	0.E0	7,920.	160	31	50	0.E+0	#DIV/0!	0.00%
1,2-Dichlorobenzene	0.E0	156.	1	1700	50	0.E+0	#DIV/0!	0.00%
1,4-Dichlorobenzene	0.E0	74.	1.3	1700	75	0.E+0	#DIV/0!	0.00%
1,1-Dichloroethane	0.E0	6,000.	182	30	100	0.E+0	#DIV/0!	0.00%
1,2-Dichloroethane	0.E0	9,000.	64	14	50	0.E+0	#DIV/0!	0.00%
cis-1,2-Dichloroethylene	0.E0	3,500.	200	59	200	0.E+0	#DIV/0!	0.00%
trans-1,2-Dichloroethylene	0.E0	6,300.	200	59	200	0.E+0	#DIV/0!	0.00%
1,4-Dioxane	0.E0	1,000,000.	29	3.5	100	0.E+0	#DIV/0!	0.00%
Ethyl Benzene	0.E0	170.	7	1100	100	0.E+0	#DIV/0!	0.00%
Ethyl Chloride	0.E0	6,000.	1000	11	1000	0.E+0	#DIV/0!	0.00%
2-Hexanone	0.E0	20,000.	11	9.8	100	0.E+0	#DIV/0!	0.00%
Methyl Chloride	0.E0	5,000.	3800	35	100	0.E+0	#DIV/0!	0.00%
Methyl Ethyl Ketone	0.E0	280,000.	78	4.5	200	0.E+0	#DIV/0!	0.00%
Methylene Chloride	0.E0	13,000.	350	8.8	25	0.E+0	#DIV/0!	0.00%
Naphthalene	0.E0	31.	0.08	400	10	0.E+0	#DIV/0!	0.00%
Propylene Dichloride	0.E0	3,000.	40	40.1	75	0.E+0	#DIV/0!	0.00%
Styrene	0.E0	310.	5	365	100	0.E+0	#DIV/0!	0.00%
1,1,2,2-Tetrachloroethane	0.E0	2,970.	5	118	5	0.E+0	#DIV/0!	0.00%
Tetrachloroethylene	0.E0	200.	14	364	200	0.E+0	#DIV/0!	0.00%
Toluene	0.E0	526.	21	300	200	0.E+0	#DIV/0!	0.00%
1,1,1-Trichloroethane	0.E0	1,330.	100	152	350	0.E+0	#DIV/0!	0.00%
Trichloroethylene	0.E0	1,100.	58	126	100	0.E+0	#DIV/0!	0.00%
Vinyl Chloride	0.E0	2,760.	2508	57	1	0.E+0	#DIV/0!	0.00%
Xylene	0.E0	175.	8.3	240	100	0.E+0	#DIV/0!	0.00%
Totals	Combined Volatiles Level (ppm)					.	#DIV/0!	
								0.00%

Instructions: To estimate the potential "worst case" exposure, 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. If more than one contaminant is present, enter information for each. If the 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.

INSTRUCTIONS:

Use **Areas of Inquiry Sheet** to prompt discussions with investigation team / project team and person(s) involved. An answer of "NO" to any question should be further investigated through root cause analysis.

Once all data / facts / information have been gathered, add these to the **General Information** tab, including any photos, sketches, etc.

Complete RCA Worksheet - instructions are provided on the form. Only an ERM-trained RCA facilitator should lead the RCA and complete this form.

Example RCA worksheets are provided on the purple tabs.

If you need help completing this sheet or if you have questions or comments, please contact your Division H&S Leader.

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?		

General Information - (Event Description)

Briefly describe the event here

Provide additional relevant details here

ERM Root Cause Analysis Worksheet, Americas Version 1.2

Project Name: _____

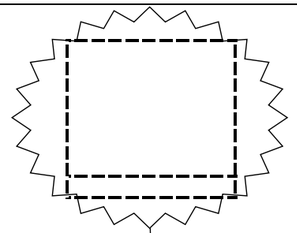
Project Number: _____

Completed By: _____

RCA Team Members: _____ _____ _____

(include name and title) _____ _____ _____

_____ _____ _____



Briefly describe the incident and negative consequence(s) that occurred.
For near misses or unsafe acts/conditions, describe the incident and negative consequence(s) that ***could have*** occurred.

Select event type from list

AND AND AND AND

Cause: [ADD] | Cause: [ADD] | Cause: [ADD] | This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet. This row: For last cause in chain, select "RC", "CF" or "OC" - otherwise leave blank | Cause: [ADD] | Cause: [ADD]

Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]

These rows: Briefly describe each successive cause by asking the question "why did the cause listed in the box above occur, or how did the cause listed above occur?" Use branches for more than one cause. If a root cause is reached, select "RC" in bottom of cell. Use the line connectors at bottom of page to make proper connections between boxes (copy / paste and position connector appropriately), or print out worksheet and draw connections by hand.

Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]

Add corrective actions for each identified RC

Copy and paste this connector line to connect boxes vertically: |

Copy and paste these connector lines to connect boxes that branch: ┌ ┐

For last cause in chain:

RC Root Cause - the underlying cause, for which we have control (usually a management system cause or not following an established system) - "Why did it happen?"

CF Causal or Contributing Factor - action or condition that directly caused the event - "How did it happen?"

OC Factor Outside ERM's Control, or a Proper Condition

ERM Root Cause Analysis Worksheet, v1.1
FIELD VERSION

Project Name: _____

Project Number: _____

Completed By: _____

RCA Team Members: _____ _____ _____
(include name and title) _____ _____ _____
_____ _____ _____

Incident | Near Miss | Usafe Act/Condition

Briefly describe the event and negative consequence(s) that occurred.
For near misses or unsafe acts/conditions, describe the incident and negative consequence(s) that ***could have*** occurred.

Circle event type

AND AND AND AND

Cause: | Cause: | Cause: | This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet. If a root cause, circle box and indicate "RC" | Cause: | Cause:

Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):

These rows: Briefly describe each successive cause by asking the question "why did the cause listed in the box above occur, or how did the cause listed above occur?" Draw connectors between boxes and use branches for more than one cause. If a root cause is reached, circle the box and indicate with "RC."

ERM Example #1 - ERM Truck Damaged

While backing an ERM F150 truck out of the designated basement parking space at an ERM office, the driver-side mirror was damaged when it struck a cement pillar.
During incident follow-up and data gathering, it was determined that this was the first time the employee had driven the ERM truck or attempted to back out of the assigned space. He received no orientation or training on driving hazards associated with truck or parking garage. The parking garage is not well lit. There is a cement wall on the opposite side of the garage, so that one cannot back straight out of the space, but instead must turn to avoid hitting the wall. The white pillar is not highly visible against the white walls of the garage. The employee was focused on not hitting the ERM van parked in the adjacent stall, or hitting the wall on the opposite side. The employee stated that he "could benefit from some refresher training" on proper scanning techniques during backing up.

ERM Root Cause Analysis Worksheet, v1.0

Project Name:	Parking Garage at ERM Office	RCA Team Members:	Person involved	Safety advisor			
Project Number:	n/a	(include name and title)	Witness (passenger)	PM			
Completed By:	Safety Advisor		Fleet manager	PIC			

ERM Truck Damaged After Backing Into Cement Pillar
Incident

Briefly describe the incident and negative consequence(s) that occurred.
For near misses, describe the incident and negative consequence(s) that ***almost*** occurred.

Select event type from list

AND AND AND AND

	Cause: Pillar present **proper condition**		Cause: Driver backing out **proper condition**		Cause: Driver contacted pillar	This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet. If a root cause, select "RC"	Cause: [ADD]		Cause: [ADD]	
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Pillar not very visible	Cause: Lack of experience driving F150, backing out of this stall	Cause: Scanning technique while backing not adequate to prevent accident	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Building mgmnt did not install adequate lighting **beyond control**	Cause: Painted same white color as walls, doesn't stand out very well	Cause: No procedure in place to train new drivers on F150, backing in/out of tight spaces in parking garage **RC**	Cause: Employee not familiar with proper scanning techniques	Cause: No spotter used	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Building management painted that way **RC**	Cause: [ADD]	Cause: Employee had not had driver safety training in several years (since he got his license)	Cause: Not required by policy **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Training not required by Management **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]

These rows: Briefly describe each successive cause by asking the question "why did the cause listed above occur?" Use branches for more than one cause. If a root cause is reached, select "RC" in bottom of cell. Use the line connectors at bottom of page to make proper connections between boxes (copy/ paste and position connector appropriately), or print out worksheet and draw connections by hand.

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Non-ERM Example #1 - Forklift Accident

from ChevronTexaco EMC Root Cause Analysis / Incident Investigation Two Day Facilitator Training, March 2006

Employee "A" was using a 6' ladder to change a light bulb in a warehouse. Employee "B" was driving a forklift loaded with a pallet of lubricating oil. The forklift moved down the aisle and struck the ladder, knocking employee "A" off the ladder and injuring him. Employee "B" stopped the forklift, ran to the injured employee "A" and administered first aid until paramedics arrived. After the incident, the forklift operator stated: "I could not stop in time to avoid the ladder and no one told me the ladder was there."
Data collection revealed that the brakes were worn beyond recommended replacement tolerances. It was also revealed that while there was a maintenance plan for the forklift dated January 1995, it had not been followed for a long time. It was last inspected in April. The investigation also revealed that the reporting process for maintenance items didn't work well and was rarely used. It was also a common practice not prohibited by procedures, to perform tasks in aisles without providing for some means of barricade or protection for the maintenance workers and the forklift drivers. Since the bulb was the only one in the area by design, the lighting was inadequate after the bulb went out.

ERM Root Cause Analysis Worksheet, v1.0

Project Name: Forklift Scenario

Project Number: 54321

Completed By: M. Boardman

RCA Team Members: (include name and title)

M. Boardman, ND Safety Advisor
J. Dylan, PIC
K. Stevenson, Employee A
B. Rickman, Employee B
R. Ecord, Americas Safety Leader

Fall Off Ladder Resulting in Injury
Incident

Briefly describe the incident and negative consequence(s) that occurred.
For near misses, describe the incident and negative consequence(s) that ***almost*** occurred.

Select event type from list

AND AND AND AND

This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet
If a root cause, select "RC"

Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Standing On Ladder	Cause: Forklift Struck ladder	Cause: [ADD]	Cause: [ADD]				
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Change light bulb	Cause: Ladder in aisle	Cause: Forklift moving down aisle	Cause: Forklift operator didn't know ladder in aisle	Cause: [ADD]	Cause: Forklift operator could not stop in time to avoid hitting ladder	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Bulb burned out after 6 years of service	Cause: Change light bulb	Cause: Poor lighting	Cause: No barricades / cones	Cause: Not communicated	Cause: Worn brakes	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Bulb burned out after 6 years of service	Cause: Only one bulb in area	Cause: Not required by procedures **RC**	Cause: Not required by work permitting system **RC**	Cause: Normal wear and tear	Cause: Brakes not inspected per maintenance plan	Cause: Problem not reported
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Poor design **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Inspection process not enforced **RC**	Cause: Reporting process inadequate **RC**
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]

These rows: Briefly describe each successive cause by asking the question "why did the cause listed in the box above occur, or how did the cause listed above occur?" Use branches for more than one cause. If a root cause is reached, select "RC" in bottom of cell. Use the line connectors at bottom of page to make proper connections between boxes (copy / paste and position connector appropriately), or print out worksheet and draw connections by hand.

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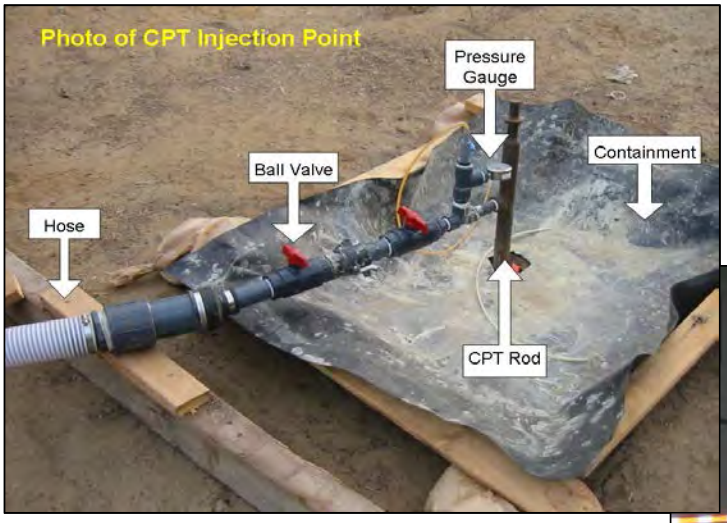
Copy and paste these connector lines to connect boxes that branch: ⌐ ¬

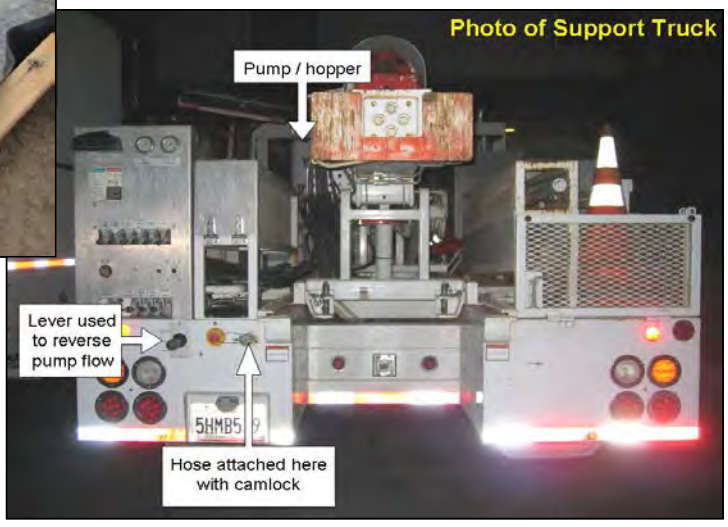
ERM Example #2 - Chemical Exposure During Injection

A chemical reductant (high pH, corrosive) was being injected into the subsurface to remediate metals contamination at a project site. The reductant was being injected under pressure into cone penetrometer test (CPT) rods using a 200 psi pump mounted on the back of a support truck. Immediately after starting to inject, high pressures were observed at the injection point and the camlock fitting connecting the injection hose to the back of the support truck began to leak. The system was immediately shut down and the pressure released by pumping solution back into the hopper on the support truck. However, there was still some pressure in the hose when it was disconnected from the support truck in an attempt to fix the leak, and solution sprayed out onto the employees. The employees were wearing Tyvek suits, goggles, and faceshields, but at the time of the incident, both employees had their faceshields up. As a result, the chemical sprayed on their faces, causing moderate skin irritation.

Data gathering indicated the following:

1. After emplacement of the CPT rods at the target depth, they were retracted to create an opening for the chemical to be injected. However, the disposable drive point at the end of the rods did not come off due to geologic conditions, resulting in no opening for the solution to flow out. There was no protocol established for checking that the drive point had been removed prior to the solution being pumped.
2. The hoses, fittings, and pressure gauge used for the project were designed for gravity feeding or low pressure injection, and were not compatible with the high pressures generated by the pump. After gravity feeding proved to be very slow, the injection method was modified to use the high pressure pump, without involvement of supervisors and senior engineering support to evaluate the impact of this change. The existing procedures were also not revised to account for this change and the potential hazards of pressurized injection.
3. No risk team review occurred, as the project team was not aware of this requirement and did not budget for it. The PIC did not enforce this requirement since he had skipped this process on prior projects with no consequences. The project budget proposal was prepared by a Jr. PM with limited experience (no one else was available to help at the time).
4. The project was behind schedule due to weather-related delays, and the switch to high-pressure injection was done to keep the project from going over schedule / over budget.
5. The resulting high pressures generated by the pump and the failure of the drive point to dislodge caused leaks to occur at the camlock fittings, which were not rated for such high pressures.
6. Pumping of solution back through the line and into the hopper was not adequate to dissipate pressure in the line, due to lack of experience by the operator and no localized pressure gauge at the discharge end of the pump. The operator had not received any training on the use of the pump, and the subcontractor JHA didn't include procedures for safe operation of the pump.
7. PPE use on the project was specified in the procedures, but working without lowering faceshields had become accepted practice over time on the site. Employees had decided it was OK to leave faceshields up because they didn't believe the chemical posed much risk and that the goggles alone would protect them.
8. Employees indicated that the PIC and PM had only visited the site once, on the first day for the kick-off meeting, and no field audits had occurred. PIC / PM were not aware of existing audit requirements.





ERM Root Cause Analysis Worksheet, v1.0

Project Name:	Chemical Injection, Client X Site	RCA Team Members:	B. Mucketymuck, PIC	J Doe, Subcontractor employee	R. Lewis, ERM Injection SME
Project Number:	12345	(include name and title)	D. Hall, SD Safety Advisor	R. Smith, Subcontractor supervisor	
Completed By:	D. Hall		IB Involved, ERM Field Geologist	D. Thomas, Project PM	

Incident: Employees splashed with chemical, causing skin irritation

Briefly describe the incident and negative consequence(s) that occurred. For near misses, describe the incident and negative consequence(s) that ***almost*** occurred.

Select event type from list

This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet

If a root cause, select "RC"

AND	AND	AND	AND
	Cause: Excess Pressure in Hose		Cause: Hose Connection Undone before Pressure Dissipated	Cause: Not Wearing PPE
Cause: CPT drive point didn't dislodge; no opening for chemical to enter subsurface	Cause: High-pressure pump used, not compatible with hoses / fittings	Cause: Pressure not fully dissipated	Cause: Operator mistakenly thought pressure was fully dissipated	Cause: Accepted practice
Cause: Geologic conditions	Cause: To speed up injection	Cause: Incompatibility not ID'd	Cause: No localized gauge to assess pressure	Cause: Operator didn't reverse pump flow long enough	Cause: Field employees didn't see the risk, thought goggles were enough	Cause: PPE use not audited	Cause: PPE use not enforced **RC**
Cause: [ADD]	Cause: No procedure **RC**	Cause: Didn't know to check	Cause: Schedule pressure	Cause: No risk review prior to changing process / equipment	Cause: Need for gauge not identified	Cause: Not trained / experienced **RC**	Cause: Procedures didn't specify how to do this **RC**	Cause: Lacked training on PPE, hazards of chemical **RC**	Cause: Audit requirements not well understood	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: Lack of experience / training	Cause: Weather delays	Cause: Not enforced by mgmnt **RC**	Cause: Not budgeted	Cause: Project Team not aware of this requirement	Cause: [ADD]	Cause: [ADD]	Cause: Process for communicating requirements inadequate **RC**	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: Training process inadequate **RC**	Cause: [ADD]	Cause: [ADD]	Cause: Jr PM prepared budget, lacked experience	Cause: Process for communicating requirements inadequate **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Lack of adequate resources **RC**	Cause: Not trained in budget estimating **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]

These rows: Briefly describe each successive cause by asking the question "why did the cause listed in the box above occur, or how did the cause listed above occur?" Use branches for more than one cause. If a root cause is reached, select "RC" in bottom of cell. Use the line connectors at bottom of page to make proper connections between boxes (copy / paste and position connector appropriately), or print out worksheet and draw connections by hand.

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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.

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 Division Health and Safety (H&S) Leader.

Project Manager (PM)/Supervisor/Branch Manager (BM): 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 Division H&S Leader, any observed deficiencies in the implementation of this procedure.

Division H&S Leader: 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.

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 Z308.1-2014. Specifically, first aid kits placed in ERM offices should be ANSI/ISEA Class B, Type 1 kits (use in stationary indoor settings) and should contain the following items:

- Adhesive bandages, 1” x 3” (50 total)
- Adhesive tape, 2.5 yards each (2 total)
- Antibiotic applications, 0.5 grams each (25 total)
- Antiseptic applications, 0.5 grams each (50 total)
- Breathing barrier (1 total)
- Burn dressing, 4” x 4” (2 total)
- Burn treatment applications, 0.9 grams each (25 total)
- Cold pack, 4” x 5” (2 total)
- Eye covering (with means of attachment), 2.9 square inches (2 total)
- Eye/skin wash, 4 fluid ounces total
- First aid guide
- Hand sanitizer, 0.9 grams each (10 total)
- Medical exam gloves, 4 pair
- Roller bandage, 2” by 4 yards (2 total)
- Roller bandage, 4” by 4 yards (1 total)
- Scissors (1 total)
- Splint, 4” x 24” (1 total)
- Sterile pads, 3” x 3” minimum (4 total), non-stick
- Tourniquet, 1” width (1 total)
- Trauma pad, 5” x 9” (4 total)

- Triangular bandage, 40” x 40” x 56” (2 total)

First aid kits placed in ERM field vehicles or field trailers should be ANSI/ISEA Class A, Type IV kits (mobile, waterproof, and subject to rougher handling) and should contain the following items:

- Adhesive bandages, 1” x 3” (16 total)
- Adhesive tape, 2.5 yards each (1 total)
- Antibiotic applications, 0.5 grams each (10 total)
- Antiseptic applications, 0.5 grams each (10 total)
- Breathing barrier (1 total)
- Burn dressing, 4” x 4” (1 total)
- Burn treatment applications, 0.9 grams each (10 total)
- Cold pack, 4” x 5” (1 total)
- Eye covering (with means of attachment), 2.9 square inches (2 total)
- Eye/skin wash, 1 fluid ounce total
- First aid guide
- Hand sanitizer, 0.9 grams each (6 total)
- Medical exam gloves, 2 pair
- Roller bandage, 2” by 4 yards (1 total)
- Scissors (1 total)
- Sterile pads, 3” x 3” minimum (2 total), non-stick
- Trauma pad, 5” x 9” (2 total)
- Triangular bandage, 40” x 40” x 56” (1 total)

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 Branch Manager (BM) 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.

4.2 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 H&S 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 Division H&S Leader for more information regarding AED use.

ERM H&S staff should also be informed of the need to render first aid or seek additional medical treatment.

4.3 Bloodborne Pathogens Program

4.3.1 Exposure Determination

Due to the nature of ERM's typical office and field activities, it is highly unlikely that incidents involving ERM employees would result in exposure to blood or potentially infectious bodily fluids. Therefore, compliance with 29 CFR 1910.1030, ***Bloodborne Pathogens***, is not required. Although a written exposure control plan is not required, the following sections outline basic requirements to be followed if ERM employees voluntarily render first aid/CPR. Exposure determinations, as well as the precautions and work practices discussed below, are without regard to the use of personal protective equipment.

4.3.2 Training and Recordkeeping

ERM periodically offers first aid/CPR training that includes bloodborne pathogens training to employees as part of the overall health and safety program. 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 staff such projects.

Training, if needed, will be provided at or before the time of initial assignment and will be repeated annually (i.e., within one year of previous training) for as long as the employee remains in a work environment requiring exposure to bloodborne pathogens. Training records will be maintained in ERM's Academy Learning Management System (LMS). Any records maintained within the Academy LMS are available upon request by employees or their representatives and any government official.

The Medical Recordkeeping Coordinator is responsible for maintaining all medical records. Issues such as, but not limited to, access to medical records, transfer of records and retention of records are addressed in S3-NAM-003-PR (***Access to Exposure and Medical Records***). WorkCare currently serves as the Medical Recordkeeping Coordinator for ERM.

4.3.3 Universal Precautions

If an ERM employee voluntarily renders first aid/CPR, all human blood and bodily fluids will be treated as infectious for bloodborne pathogens.

4.3.4 Engineering Controls, Work Practices, and PPE

Since ERM is a consulting firm, there are no typical operations applicable to bloodborne pathogens requiring engineering controls. However, if conditions warrant (e.g., significant and continued exposure to sharps, site cleanups involving medical or infectious wastes) the use of engineering controls with regard to bloodborne pathogens, appropriate engineering controls will be developed, examined, and maintained or replaced on an annual basis to ensure their effectiveness.

While performing field-based work activities, toilet and hand-washing facilities must be available to employees. Hand-washing facilities will be provided with an appropriate combination of the following:

- Hot and cold running water or tepid running water;
- Soap or an antiseptic hand cleanser;
- Individual hand towels or warm air blowers; and
- Pre-moistened individual wipes.

If an ERM employee voluntarily renders first aid/CPR, the following PPE, supplied by ERM, will be used as appropriate:

- Nitrile surgical-type gloves; and
- CPR mouth guard (where needed).

These are provided to ERM employees in the PPE field bag issued upon their hire. Any blood or other bodily fluid-contaminated materials will be placed in red leak-proof plastic bags for disposal. Bags will be labeled with a biohazard sign and the words "Biohazard" in contrasting colors. Surfaces that have been contaminated with blood or other bodily fluids will be cleaned with a disinfecting product as soon as practical.

4.3.5 Hepatitis B Vaccine

Since it is highly unlikely that incidents involving ERM employees would result in exposure to blood or potentially infectious bodily fluids, a Hepatitis B vaccination program is not typically required for ERM staff. However, if an employee believes that they have come into contact with potentially infectious blood or other bodily fluids while voluntarily rendering first aid/CPR, medical examinations, including Hepatitis B vaccine, will be made available at no charge to the employee.

4.3.6 Access to Written Program

All employees or their representatives and governmental officials may request a copy of any written program by contacting the Division H&S Leader in their respective office.

5. References

- ERM Procedure S3-NAM-003-PR – ***Access to Medical and Exposure Records***
- Occupational Safety and Health Administration (OSHA) 29 CFR 1910.151, ***"Medical Services and First Aid"***
- OSHA 29 CFR 1910.1030, ***"Bloodborne Pathogens"***
- ANSI/ISEA Z308.1-2015, ***"Minimum Requirements for Workplace First Aid Kits and Supplies"***

Document Control Information

Original Effective Date: February 14, 2014

Policy Approval by: Philip Platcow on 2/14/14

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

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.

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

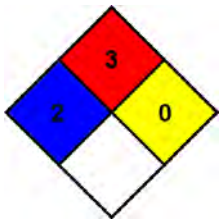
Full text of H-phrases:

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

Hospital Map

NORTH

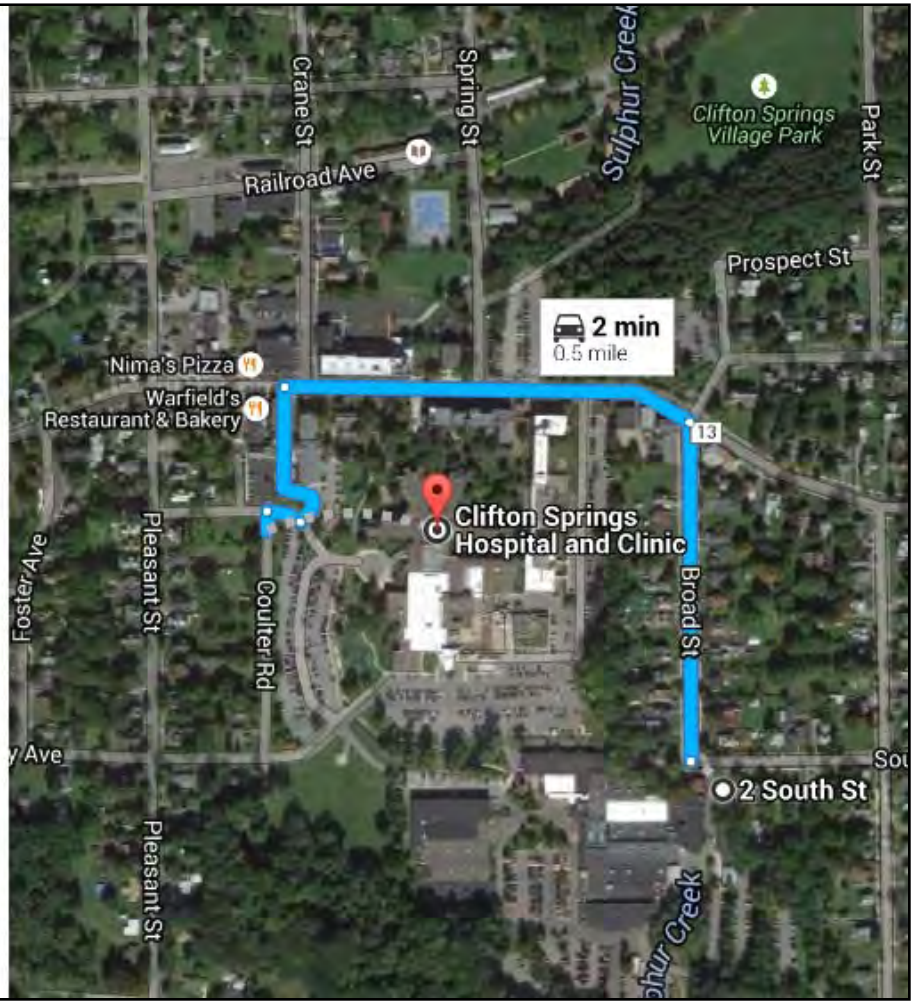
2 min (0.5 mile)

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**

Supporting Documents

Subsurface Clearance Field Process Checklist

Site/Project Name: GWL Interim Remedial Measure (IRM)
Client: G.W. Lisk
ERM Project No.: 0346375
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 Interim Remedial Measure (IRM)
Client:	G.W. Lisk
ERM Project No.:	0346375
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 Field Process Checklist

Site/Project Name:	GWL Interim Remedial Measure (IRM)
Client:	G.W. Lisk
ERM Project No.:	0346375
SSC Exp. Person:	Jason Reynolds/Tim Daniluk

Subsurface Clearance Location Disturbance Permit

Disturbance Location Designation:

ERM Project No.: 0346375

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 PROJECT PLAN
Addendum to HASP
GMS Project No: 0346375

This Subsurface Clearance (SSC) Project Plan should be completed for each phase of ground disturbance activities at a project location, and included as an addendum to the Project-Specific Health & Safety Plan (HASP).

Ground disturbance activities that fall under this SSC Project Plan include ALL activities which require penetration of the ground surface (regardless of 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 decommissioning by over-drilling
- Excavation (by hand or with mechanical equipment)
- Trenching
- Grading
- Concrete coring
- Driving of posts, stakes, rods, poles, or sheet pile.

This SSC Project Plan summarizes the types and sources of SSC information obtained, describes the Site Services Model, and documents any waivers to ERM's Global SSC Process. The ERM Partner-in-Charge (PIC), Project Manager (PM), and SSC Experienced Person (EP)[1] must review and approve this SSC Project Plan, and maintain a copy (1) at the project location for the duration of ground disturbance activities and (2) in the project files.
All waivers must be approved by BOTH: (1) the ERM PIC and (2) the Business Unit Managing Partner (BU MP) or the BU MP's designee (cannot be the same person as the PIC).

Administrative Information		
	Project Name and Location: GWL Interim Remedial Measure (IRM), G.W. Lisk Facility, 2 South Street, Clifton Springs, New York	
	Scope of Ground Disturbance Activities: *Check all that apply:* X☐ Point disturbances ☐ Excavation / trenching ☐ Removal of engineered surfaces ☐ Other - Describe:	*Use field documentation to document SSC:* • *Process Checklist – broadly across the site* • *Remote/Greenfield Site Process Checklist – broadly across the site for those projects that meet these criteria and where ONLY hand digging will occur (refer to SSC Process Document Section 1.2)* • *Location Disturbance Permit – for each location inside a Critical Zone*
	SSC Project Plan Date:	Field Work Start Date: 5/4/2017
	Project Manager: Jon S Fox Signature:	Partner In Charge: Ernest Rossano Signature:
	SSC EP: Jason Reynolds Signature:	BU MP (req'd for waivers): John Kuhn Signature:

[1] SSC EP not required for project sites determined to be Remote/Greenfield sites (as defined in the ERM Global SSC Process), where ONLY hand digging will occur.

Subsurface Clearance Information Sources Summary	Information Sources	Yes	No	N/A	Comments
	Facility-provided as-built drawings, maps, site plans showing subsurface structures / utilities	☒	☐	☐	Date(s):

	List any SSC General Employees (GEs) working on this project: Caldwell Payne, Michael Fox

Document the information sources that ERM used or will use to locate Subsurface Structures on site.	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):
	Knowledgeable Contact Person	☒	☐	☐	Who: Arno Biebernitz Time in Job: Unknown Time at Site: Unknown
	Utility Markouts	**Yes**	**No**	**N/A**	**Comments**
	Site is Remote/Greenfield site AND only hand digging will occur	☐	☒	☐	*If "YES", utility markouts are not required by ERM process (Note that public markouts may be legally required based on jurisdiction of project site – it is the responsibility of the PIC and PM to determine these requirements and comply)*
	Public Utility Markouts (where they are available)	☒	☐	☐	*Required where available – if not available check "N/A". If available and checked "NO", a Waiver is required (if legally able to do so).* Who: 811
	Private Utility Markouts	☒	☐	☐	*If checked "NO" and site is not a Remote/Greenfield site, a Waiver is required* ERM employee ☐ or Subcontractor ☒ Who: NYLD List methods / equipment used:

For Remote/Greenfield Sites where ONLY hand digging will occur – the remaining sections of this SSC Project Plan do not apply and can be left blank.

Site Services Model **List the utilities or other below ground services present on site.** **Do we know the locations of these services, their conveyance on site (to the site boundary, as appropriate) and the location of isolation switches or valves?** **If "Present" and not located or "Unknown", comment on how those gaps will be addressed.** **Attach a site plan / drawing (to scale) showing planned ground disturbance location(s), the locations/routes of all identified or suspected subsurface structures and services, and associated critical zones.**	**Utility / Service**	**Present**	**Anticipated Depth (note units)**	**Located?**		**Absent**	**Unknown**	**Status (active/ inactive/ abandoned)**	**Comment** *(how located? Lines of evidence – types and quality. How will gaps be addressed?)*
				Yes	No				
	Electricity	☐		☐	☐	☐	☐		Voltage: To be determined by the GPRS survey at the site
	Gas	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Petroleum Pipeline	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Other Pressurized Lines	☐		☐	☐	☐	☐		Type: To be determined by the GPRS survey at the site
	Process Sewer	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Sanitary Sewer	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Storm Sewer	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Potable Water	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Telephone / Communication	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Fiber Optic	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Plant air / steam	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Fuel / oil	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Reclaimed / waste water	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Fire suppression	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Underground tank(s)	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site
	Other:	☐		☐	☐	☐	☐		To be determined by the GPRS survey at the site

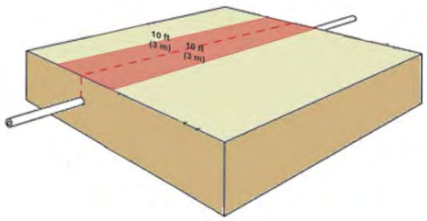
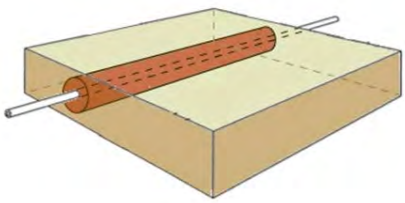
Subsurface Clearance Process Waivers **Document any waivers to the process approved by BOTH the PIC and BU MP.** **Legally required steps cannot be waived.**	Process Component Being Waived:	Waived By (PIC)	Waived by (BU MP)	Date	Reason
	Performance of Public Utility Markouts (where they are available)				
	Performance of Private Utility Markouts				
	No ground disturbance inside a Critical Zone				
	Physical Clearance to required depth(s) and diameters(s) at Point Disturbance Location(s). Indicate specific location(s):				
	Requirement for SSC EP to be present on site, when ONLY hand digging/hand augering will occur in the uppermost 1 foot (0.3 meters)				

Subsurface and Overhead Utility Clearance Map	**Attach a site plan / drawing (to scale) showing planned ground disturbance location(s), the locations/routes of all identified or suspected subsurface structures and services, associated critical zones, and location of all isolation devices and/or shutoff valves.**

Subsurface Clearance (SSC)
Field Review Checklist for Contractors

Site Name:	Interim Remedial Measure (IRM) – GW Lisk
Client:	G.W. Lisk
ERM Project No.:	0346375
Contractor activities to be performed on Site:	

Use this form to conduct and document review with contractor field personnel, to ensure they have been properly briefed on the applicable components of ERM's SSC Process.

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 jobsite conditions change, work should be stopped and the potential H&S effect of the change discussed.	☐	☐	
Ground disturbance activities may NOT be performed at any location without authorization by the ERM SSC Experienced Person (EP). Clearance activities may NOT be performed at any location unless the ERM EP is physically present.	☐	☐	
Unless explicitly authorized by ERM's Partner-in-Charge and Business Unit Managing Partner, ground disturbance may NOT be performed within 10 feet (3 meters) distance (referred to as the "Critical Zone") of the surface projection of: • Any known or suspected underground pipes, cables, conduits, drains, galleries, edges of tanks, or any other useful property; or • Aboveground structures with associated subsurface pipes and/or cables, including but not limited to pump islands, pump galleries, manifolds, electrical transformers, compressors, production wells, loading racks, or other process equipment.	☐	☐	**"The Critical Zone"** 
Unless authorized by the ERM 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 Business Unit Managing Partner, all borehole and small test pit locations must be physically cleared prior to use of mechanized equipment. Required physical clearance depths and diameters for point disturbances are as follows: • Physically clear to a diameter at least 125% of the largest downhole tool to be used. • Physically clear to the deeper of: o 2 feet (0.6 meters) beyond the bottom of the frost line at the site, or: o Outside Critical Zones to 5 feet (1.5 meters), or o Inside Critical Zones to the deeper of: 8 feet (2.4 meters), or 2 feet (0.6 meters) deeper than the expected invert elevation of the subsurface structure.	☐	☐	**"The Excavation Buffer"** 

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 using non-conductive tools.	☐	☐	
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.	☐	☐	
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.	☐	☐	
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 be immediately reported to the ERM EP or field supervisor. Contractor personnel must participate, as requested, in investigations of near misses and incidents.	☐	☐	
Other topics discussed:	☐	☐	

N/A = Not applicable to this project.

REQUIREMENTS FOR TOOLS AND EQUIPMENT:

- Hand digging tools must have a non-conductive handle (e.g., fiberglass, wood, composite) AND / OR fully insulated handles and upper shaft. It is a best practice to also wear insulated electrical gloves certified to appropriate standards.
- Blades on shovels and post-hole diggers must have rounded or blunt edges.
- Pick axes or pointed spades are not to be used for physical clearance.
- Electric-powered equipment must have ground fault protection. If this is not feasible, fully insulated electrical gloves certified to appropriate standards must be worn at all times during equipment use/operation.
- Equipment must be inspected prior to use, maintained according to manufacturer recommendations, and operated only by trained personnel.
- Rig- or stand-mounted concrete coring equipment must be anchored to the ground/floor using proper anchors.

Checklist Completed By: (SSC Experienced Person)		
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 minimum requirements for subsurface obstruction and utility clearance [collectively, Subsurface Clearance (SSC)], and applies to all ERM project-related ground disturbance activities. This document is supported by the mandatory requirements in the *Global Subsurface Clearance Process Document*.

2. Roles and Responsibilities

Business Unit Managing Partner (BU MP). Review and either approve or reject any waiver associated with the SSC process for projects under their control. Ensure field verification audits are conducted in accordance with the *Global Subsurface Clearance Process Document.*

Partner in Charge (PIC). Ensure all elements of the SSC process are implemented on their project; determine if a project site meets the criteria for a Remote/Greenfield site.

Project Manager (PM). Ensure a qualified SSC Experienced Person (EP) participates in all projects involving ground disturbance activities.

SSC Experienced Person (EP). Lead the execution of the SSC Process on projects not considered Remote/Greenfield; complete required SSC documentation and field forms; be present in the field during all clearance activities.

3. Definitions

Critical Zone: 10 feet (3 meters) distance in all directions from the surface projection of:

- All known or suspected underground pipes, cables, conduits, drains, galleries, edges of tanks, or any other useful property; and
- Aboveground structures with associated subsurface pipes and/or cables.

Ground Disturbance Activities: activities which require penetration of the ground surface and/or the drilling, coring, or removal of engineered surfaces.

Point Disturbance: ground disturbance activities associated with soil borings; well installation; well over-drilling; or digging small test pits.

Remote/Greenfield Site: a site (or portion of a site) meeting the requirements in Appendix F of the *Global Subsurface Clearance Process Document*, as determined by the PIC.

4. Requirements

4.1 Subsurface Clearance

No ground disturbance activities, with the exception of Remote/Greenfield sites, shall occur without at least one person in the field being a designated SSC EP. This is subject to waiver when only hand digging will occur in the uppermost 1 foot (0.3 meters) below ground surface. The SSC EP is responsible for ensuring that the SSC Process as defined in the *Global Subsurface Clearance Process Document* is fully implemented.

No ground disturbance activities are permitted within the Critical Zone unless a waiver is granted and the Subsurface Clearance Location Disturbance Permit has been completed.

All point disturbance activities require physical clearance, unless a waiver is granted, and shall meet the following minimum requirements:

- 125% of the outer diameter (OD) of the largest downhole tool to the following depth:
  i. 2 feet (0.6 meters) beyond the bottom of the frost line at the site, or:
  ii. Inside Critical Zones:
    - To 2 feet (0.6 meters) deeper than the known or suspected invert elevation of the subsurface structure, or
    - If the depth of the service is unknown, physical clearance should be performed to 8 feet (2.4 meters).
  iii. Outside Critical Zones: 5 feet (1.5 meters).

For all excavation and trenching, mechanical digging is prohibited within 2 feet (0.6 meter) of subsurface structures. There can be no waiver of this requirement.

4.2 Remote/Greenfield Site

It is the responsibility of the PIC to ensure that the Remote/Greenfield Subsurface Clearance Process, as defined in the *Global Subsurface Clearance Process Document* is fully implemented.

Mechanical digging is prohibited if the site is to be cleared using the Remote/Greenfield Subsurface Clearance Process. There can be no waiver of this requirement.

4.3 Training Requirements

It is the responsibility of the project PIC to ensure that all ERM employees working on or managing projects are trained in accordance with the *Global Subsurface Clearance Process Document.*

SSC EPs shall complete competency testing as described in the *Global Subsurface Clearance Process Document*.

All personnel training required by this standard shall be documented in ERM Academy.

4.4 Issuance of a Waiver

There are five waivers to the SSC Process that may potentially be issued:

1. Waive the requirement for an SSC EP to be present on site, when ONLY hand digging will occur in the uppermost 1 foot (0.3 meters) below ground surface;
2. Waive the requirement for Public Utility markouts (where allowed by law);
3. Waive the requirement for Private Utility markouts;
4. Waive the requirement for full physical clearance of point disturbance locations; and
5. Allow ground disturbance activities within Critical Zones.

Both the Project PIC and BU MP (or designee) must approve any waivers; all waivers shall be documented in the Subsurface Clearance Project Plan.

4.5 Field Verification Auditing

It is the responsibility of the BU MP to ensure that field verification audits are completed in accordance with the *Global Subsurface Clearance Process Document.* Identified findings shall be managed in accordance with the *Event and Non-conformance Management Procedure*.

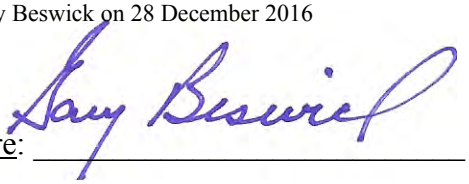
5. References

- ERM-1511-WI1 - Global Subsurface Clearance Process Document
- ERM-1200-PR1 - Event and Non-conformance Management Procedure

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
3, 4.1, 4.2, 4.4	1.1: Changed definition of ground disturbance; changed definition of point disturbance, added waiver for shallow hand digging; revised language for clarity.	15 May 2015
5	2.0: Corrected link to SSC Global Process document	21 Jan 2016
All	2.1: Updated links, tagline, and document number	28 Dec 2016

Subsurface Clearance (SSC) Field Audit Form

Site Name:	Clifton Springs Facility
Client:	G.W. Lisk
ERM Project No.:	0346375
Activities Observed on Site:	

1.0	OFFICE / PRE-MOBILIZATION	YES	NO	N/A	N/O	COMMENTS (Refer to Follow-Up Items if needed)
1.1	Have subcontractor(s) working at the project site been pre-qualified and approved by ERM?	☐	☐	☐	☐	
1.2	Has an SSC "Experienced Person" been assigned to manage SSC activities and identified in the site HASP?	☒	☐	☐	☐	
1.3	Have all ERM staff at project site received SSC training? (record names & dates)	☐	☐	☐	☐	
1.4	Are "SSC mentee(s)" working at the site and identified in the site HASP?	☐	☐	☐	☐	
1.5	Have the Level 2 HASP and SSC Project Plan been completed?	☐	☐	☐	☐	
1.6	Has a knowledgeable site contact person been identified? Are they present to participate in site walk and approve disturbance locations?	☐	☐	☐	☐	
1.7	Have available as-builts, maps, aerial photos, etc. been obtained and reviewed?	☐	☐	☐	☐	
1.8	Other:	☐	☐	☐	☐	

2.0	FIELD ACTIVITIES: PRE-CLEARANCE	YES	NO	N/A	N/O	COMMENTS (Refer to Follow-Up Items if needed)
2.1	Are ground disturbance locations/points clearly marked?	☐	☐	☐	☐	
2.2	Have public and private utility locate and markout have been conducted? By who? When?	☐	☐	☐	☐	
2.3	If utility locate/markout was conducted by ERM staff, how is employee qualified to execute locate service? Provide details of training/qualifications.	☐	☐	☐	☐	
2.4	If utility locate/markout was conducted by ERM staff, has location equipment been adequately maintained and calibrated? Provide date of last calibration.	☐	☐	☐	☐	
2.5	Has the ERM *SSC Checklist & Disturbance Permit* been utilized to assess **each** ground disturbance location?	☐	☐	☐	☐	
2.6	Have Critical Zones been identified on the *Site Services Model* and marked?	☐	☐	☐	☐	
2.7	If UXO/MEC are known or suspected to be present, has the site been assessed by a UXO/MEC specialist?	☐	☐	☐	☐	
2.8	Are any Process Waivers being applied? If so, is PIC and BU MP approval documented?	☐	☐	☐	☐	
2.9	Other:	☐	☐	☐	☐	

3.0	FIELD ACTIVITIES: PHYSICAL CLEARANCE	YES	NO	N/A	N/O	COMMENTS (Refer to Follow-Up Items if needed)
3.1	Has Critical Zone (CZ) distance* has been effectively maintained during project?	☐	☐	☐	☐	
3.2	Was physical subsurface clearance to minimum requirements** executed? What methods/equipment were used?	☐	☐	☐	☐	
3.3	If project is a trench or excavation, was the minimum 2-foot (0.6 meters) buffer zone maintained around exposed lines?	☐	☐	☐	☐	
3.4	Was mechanical equipment used within 2-foot (0.6 meters) buffer zones?	☐	☐	☐	☐	
3.5	Have SSC-related safety events been reported per ERM *Subsurface Clearance Procedure*?	☐	☐	☐	☐	
3.6	Were any changes from HASP / SSC Plan observed? If so, were Management of Change procedures implemented per ERM *Subsurface Clearance Procedure*?	☐	☐	☐	☐	
3.7	Other:	☐	☐	☐	☐	

N/A = Not applicable to this project.

N/O = Not observed during audit.

* *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.*

** *Clearance must meet or exceed 125% the outside diameter of the largest downhole tool. In Critical Zones, physical clearance to 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)*

FOLLOW UP ITEMS:

- If a checklist item was corrected in the field, please mark as YES and note in the COMMENT area how the correction was implemented.
- If a checklist item was unable to be corrected in the field, please list below the follow-up items for ERM/Client/Sub-Contractor to implement to correct the deficiency or improve the process.

Follow Up Items:

Attach additional comments, as necessary, to a new page.

Prepared By: Jason Reynolds/Jon Fox
(print)

Reviewed By: _____
(print)

_____
(print)

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.

	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)

	Applicability:	Guideline	Document Number:	Version:
ERM	North America		NAM-1110-GU1	2
	Title:	**Project Manager H&S Checklist**	**Last Revision Date:**	1/16/17

Project Name:	Site Characterization/ G.W. Lisk
Project Manager (PM):	Jon S. Fox
Start/End Date:	5/4/2017
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)	
☒ Y ☐ N	Risks of travel have been identified (Travel Risk Assessment or Journey Management Plan)?	
☐ Y ☐ N	Health and Safety (H&S) team has reviewed Level 2 or Level 3 HASPs	
☐ Y ☐ N	For all levels of HASP, the project PIC has given written approval	
☐ Y ☐ N	For projects that must undergo Project Liability Analysis (PLAN) analysis, risk review is provided to H&S team during HASP review	
☐ Y ☐ N	Job Hazard Analyses (JHAs) s obtained from contractors and provided to H&S team during HASP review	
☐ Y ☐ N	Personal protective equipment (PPE) requirements have been determined for each task	
☐ Y ☐ N	Real-time/industrial hygiene/noise monitoring requirements have been determined based on chemical exposure potential at the site	
☐ Y ☐ N	Contractors utilized for the project are green-flagged in PICS	
☒ Y ☐ N	Medical surveillance requirements for ERM and contractor employees have been determined	
☒ Y ☐ N	Training requirement, including client-specific HS requirements, for ERM and subcontractor employees have been determined	
☒ Y ☐ N	Applicable permits, notifications, and registrations have been identified	
☒ Y ☐ N	ERM personnel identified and assigned to the project meet training/medical requirements	
☒ Y ☐ N	Trained and qualified ERM FSO has been identified and assigned to the project (as applicable)	
☒ 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	
☐ Y ☐ N	ERM HASP provided to each contractor firm involved in the project along with minimum health and safety requirements each firm must meet	

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?	
☒ Y ☐ N	Health and safety included in initial project kickoff meeting or separate health and safety kickoff meeting has been planned	
☒ 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	
☒ 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	
☒ Y ☐ N	All PPE and emergency equipment identified in the HASP and JHAs is present at the project site	
☒ Y ☐ N	Emergency contact information, emergency evacuation/assembly point and route to nearest medical facility are included in HASP and posted at the site	
☒ Y ☐ N	Guidance on how to handle a regulatory inspection (*NAM-1944-PR1*) is at the project site	
☐ Y ☐ N	Training/medical surveillance documents are collected by PM for each contractor employee	
☒ Y ☐ N	Safety Data Sheets (SDS) are located at the project site for each chemical ERM or contractor brings to the site	
☐ Y ☐ N	Method to keep site visitors out of ERM work areas has been determined and managed by FSO	
☒ 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	
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	
☐ Y ☐ N	Project team has performed a post-project brainstorming session to close any ECS events and determine any lessons learned	

Project Name:	G.W. Lisk - Site Characterization
Project Manager (PM):	Jon S. Fox
Partner-in-Charge (PIC):	Ernest Rossano
Start/End Date:	5/4/2017 - TBD

Part I: Project Scope and Team

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

The purpose of the SC Work Plan is to propose a plan to evaluate whether contamination exists in areas identified during the Records Search. If contamination does exist, ERM will evaluate whether it is present at concentrations requiring further investigation or remediation. 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
Parratt Wolff	Soil Boring, Monitoring Well installation
Alpha Analytical	Sample Analyses
NYLD	Subsurface utility location
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, Section 3.3

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 SC Work Plan will be consistent with applicable requirements contained in DER-10, Section 3.3. 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 by contract to investigate and report findings related to an event, or as required by the *Event and Non-Conformity Management* Procedure.

2. Roles and Responsibilities

Partner in Charge (PIC) or Office Head. Coordinate event investigation for Actual Severity 5 events or lower.

Regional CEO. Coordinate event investigation for Actual or Potential Severity 7 or 10 event.

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

3. Definitions

Event. Any occurrence, act, condition or observation which includes incidents, near misses, or hazardous condition which could impact our health, safety or environmental (HSE) performance.

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

Event Potential. A means of assessing outcome of an incident or near miss that could have occurred, but did not, 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 actual 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 the *Event and Non-Conformity Management* Procedure. At the discretion of the responsible investigation coordinator, additional investigation team members may include:

- Project Manager;
- BU MP/Regional Practice Leader;
- Division Managing Director;
- Local/BU/Regional H&S Lead;
- Global H&S Director (GHSD);
- Other legally required local function(s); and
- Subject matter experts.

4.3 Investigation Process

4.3.1 All Investigations

The team will follow an appropriate investigation technique (as agreed to by the PIC/Office Head, Regional H&S Lead and Legal) 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, Parts/Equipment, Position and Paper/Documentation and other factors involved in the event, as presented in *Event Investigation Considerations*.
- Determination of direct cause(s) and root causes using techniques agreed to by the lead investigator and H&S Lead. (Note: Example root cause investigation tools include “5 Why’s”, TapRoot, Fishbone Diagram, etc.).

4.3.2 Actual Severity 5 or Lower Investigations

The Investigation Team will summarize the investigation by completing the appropriate fields within ECS. All findings and recommended corrective actions will also be entered into the ECS. This information will be entered into ECS within 10 calendar days following the event unless otherwise agreed by the PIC/Office Head and Regional H&S Lead.

4.3.3 Actual Severity 7 or 10 Investigations

The Investigation Team will prepare a Preliminary Investigation Report, signed by the RCEO, documenting all findings and recommended corrective actions within 10 calendar days following the event unless otherwise agreed by the RCEO and GHSD. In addition to any event with an Actual Severity rated as 7 or 10, the GHSD and/or Global Programs Director may require any event, regardless of Actual Severity, to be escalated for investigation and review through a more senior, Global Review team.

The report format for all events classified as Actual or Potential Severity 7 or 10 shall follow the sample template provided in *Event Investigation Report*. All Actual Severity 7 or 10 communications and reports shall be prepared at the direction of Legal and shall be marked “Attorney Client Privileged Communication”.

All Actual Severity 7 or 10 investigations will involve a formal conference call to review the preliminary investigation report. The investigation review conference call will be arranged by the Regional CEO and shall occur no later than 5 calendar days following issuance of the Preliminary Investigation Report (unless otherwise directed by the ERM Chief Executive Office, Legal or GHSD).

Required participants for the conference call will include:

- Regional CEO, responsible Regional Practice Area Leader, responsible Division Managing Partner, responsible BU MP;
- Regional Legal;
- Responsible Line Manager (office-based) or PIC and Project Manager (project-based) of the injured/involved employee;
- Regional H&S Lead and
- GHSD.

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

- Global/Regional HR
- 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 Regional CEO, under the direction of Legal, shall issue a final Investigation Report to the ERM Chief Executive Officer and GHSD. Corrective actions identified by the investigation process must be formally tracked to closure by the Regional H&S Lead; and the ECS event cannot be closed until approved by the GHSD.

4.4 Communication of Investigation Results

Any and all written investigation reports for Actual Severity 7 or 10 events (including drafts) must first be reviewed by Legal. All drafts shall include "Attorney-Client Work-Product Privilege" at the top of such reports.

Where appropriate based on the type, severity and/or scope of the event, a formal Alert should be prepared by the lead investigator and responsible Regional H&S Lead. The Alert will be communicated to the most appropriate audience (i.e., regional, national, practice area only, etc.).

Action items and corrective actions identified by the investigation teams will be tracked to completion by the responsible Regional H&S Lead. Additionally, the results will be utilized to

develop appropriate regional, national and practice 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.

4.4.1 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 legal professional privilege. 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 professional privilege, it is important to ensure that all communication is also copied to ERM internal and/or external legal and is marked “Attorney-Client Work-Product Privilege."

Before creating any written documentation relating to an Actual Severity 7 or 10 event, ERM employees should contact the ERM PIC or Line Manager 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

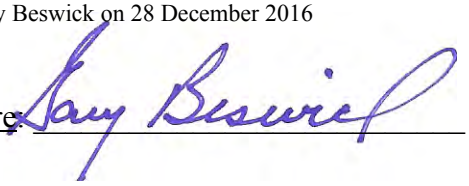
5. References

- 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 December 2016

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

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.

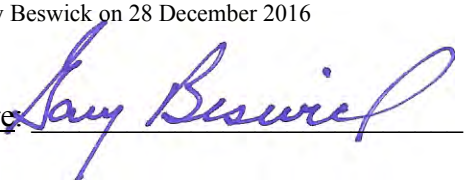
5. References

- 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

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.

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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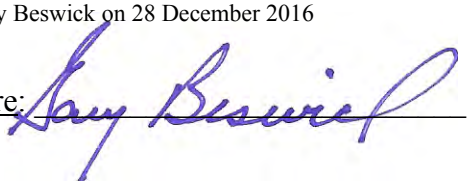
Approval Signature: 

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

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

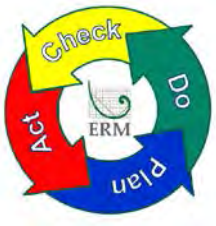
Procedure Number	Procedure Title
S1-ERM-007-WI	Subsurface Clearance Work Instruction
S1-ERM-007-FM1	SSC Field Process Checklist
S1-ERM-007-FM2	SSC Field Process Checklist for RG Sites
S1-ERM-007-FM3	SSC Location Disturbance Permit
S1-ERM-007-FM4	SSC Project Plan
S1-ERM-007-FM5	SSC Field Audit Form
S1-ERM-007-FM6	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

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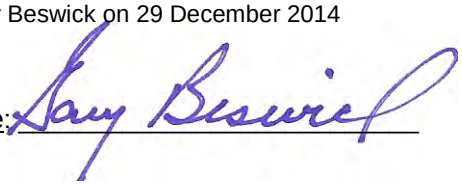
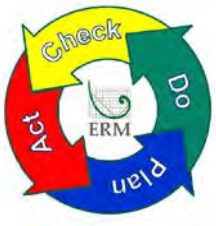
Approval Signature: 

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

Document Control Information

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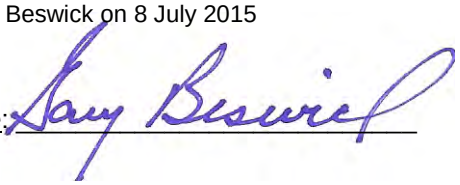
Approved by: Gary Beswick on 8 July 2015

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;
- 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***)

Document Control Information

Original Effective Date: 6/9/11

Policy Approval by: Mark Hickey

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

1. Purpose and Scope

This procedure describes:

- Contractor health, safety, security, and environmental (HSSE) performance expectations;
- The pre-evaluation process for approval of contractors, their safety programs, and their insurance documents;
- The evaluation of contractor safety performance while working for ERM; and
- The responsibilities of the ERM project team with respect to implementation of this program and oversight of contractor safety.

The procedure applies to all ERM work activities which are contracted to an outside firm, except those specifically excluded elsewhere in this document. This procedure does not apply to third party contractors which may be working on the same site as ERM, but do not have a contractual relationship with ERM.

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;
- Appoint a Project Manager/Supervisor who will manage all aspects of conformance with this procedure;
- Approve and execute contractor agreements for each contractor working on ERM projects/sites and may participate in negotiations, as necessary;
- Assess, in conjunction with the Project Manager/Supervisor, the performance of ERM contractors based on observations and assessments in the field;
- Correct, in conjunction with the Project Manager/Supervisor, any observed deficiencies in the performance of the ERM contractor; and
- Correct any deficiencies in the implementation of the program as identified by the Business Unit Health and Safety Director.

Project Manager/Supervisor: Responsible for the following elements:

- Perform observations of contractor work processes to assess whether or not the contractor is operating in accordance with applicable health and safety requirements;
- Verify contractors are approved to provide services to ERM as established by this procedure and ERM's Global Contractor Management Program (***ERM-1130-PR1***);

- Communicate ERM and client driven HSSE requirements to project contractors by providing the standard contractor agreement or a project- or client-specific contractor agreement during project planning or scoping;
- Understand and confirm the competency of ERM contractor staff who will be providing field project support;
- Request required documentation from contractors as defined in any project-specific agreements (i.e., Contractor Health and Safety Plans, Job Hazard Analyses (JHAs), work procedures, etc.);
- Interact with and mentor contractors during the working relationship;
- Evaluate best practices provided by contractor personnel for potential inclusion in project work planning;
- Stop work where deviations from accepted health and safety requirements are observed;
- Correct, in conjunction with the PIC and the Business Unit Health and Safety Director, any observed deficiencies in the performance of the contractor;
- Work with the contractor to complete incident investigations and, where needed, root cause evaluations, for incidents and high-value near misses which occur on ERM job sites; and
- Contact ERM Legal in the event of serious or repeated breaches of health and safety requirements and assess whether action is warranted under the contract.

Business Unit Health and Safety Director: Responsible for the following elements:

- Evaluate implementation of these policies during health and safety plan reviews and project audits; and
- Communicate identified deficiencies to the PIC.

ERM Staff: Responsible for the following elements:

- Attend and interact with contractors during safety meetings to ensure that the scope of work, risks and precautions are understood by all project participants;
- Raise any concerns of job performance with the project management and contractors as established in the project communications plan, including implementing stop work authority if there is an imminent risk of injury or property damage; and
- Utilize the Event Communication System (ECS) to report any incidents, near misses, unsafe acts and conditions and safe behaviors observed during work with contractors.

3. Definitions

A contractor is defined as 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. The term "contractor" may include contractors, subcontractors, consultants, sub-consultants, vendors, and suppliers.

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.

4. Procedure

4.1 Contractor Prequalification and Selection

Contractors desiring to perform work for ERM shall be required to be pre-qualified in accordance with ERM's Global Contractor Management Program. In the USA, Avetta, a third-party service provider, qualifies and maintains updated information about suppliers and contractors based on the requirements of its clients. Contractors will submit a variety of information to Avetta, including insurance limits, OSHA logs, safety and training programs, bonding capability, and diversity information. Potential contractors also have to agree to adhere to ERM's policies, including our Anti-Bribery and Corruption (ABC) Policy and Business Conduct and Ethics Agreement, and Subsurface Clearance Program (as applicable).

Avetta shall evaluate the information provided by the proposed contractor and compare it to a detailed list of requirements provided by ERM. Information submitted by the contractor must be updated at least annually.

ERM's minimum safety criteria for US firms are as follows:

- No fatalities in the past 5 years;
- A Total Recordable Incidence Rate (TRIR) at or below the industry average for the past 3 years based on North American Industrial Classification System (NAICS) code;
- A Days Away/Restricted/Transfer (DART) rate at or below the industry average for the past 3 years based on NAICS code;
- An Experience Modification Rate (EMR) at or below 1.0 for the past 3 years; and
- No open or unresolved regulatory citations within the past 3 years.

Companies that service ERM offices such as coffee vendors, vending machine companies, water cooler vendors, etc. do not have to be qualified under this procedure. Additionally, retailers providing point-of-sale purchases (e.g., purchase of a tool from Home Depot) do not have to be qualified under this procedure.

Further information on prequalification can be found on the Contractor Management Program section of the North America Health and Safety page on Minerva.

4.2 Contractor Interactions/Expectations

The Project Manager/Supervisor must ensure that the contractor is provided with necessary information to work safely, including, but not limited to:

- ERM contact name and phone number;
- ERM health and safety requirements;
- Client health and safety requirements (including any drug and alcohol policies);
- Site-specific emergency action plans; and
- Safety information from other ERM contractors or third-party contractors at the site.

The Project Manager/Supervisor must ensure that contractor personnel participate in site-related safety meetings, including pre-job meetings, safety orientations, daily tailgate safety meetings, and any job-related safety inspections.

Contractors must conform to all regulatory and policy driven HSSE requirements. Contractors are contractually and legally responsible for providing personnel who are qualified to meet or exceed the expectations of ERM and customer work scopes. Contractor agreements are used to clearly define contractor accountabilities and responsibilities.

Contractors are expected to conform to their internal HSSE policies and requirements as well as those of ERM and ERM clients. Where conflicts exist between these policies and requirements, contractors must adhere to the most stringent policy and requirement. Where needed, the contractor should have the capability to develop additional safety procedures or hazard assessments for work that is performed exclusively by their employees and for which they may have superior knowledge.

Contractors will provide, upon request and at the time of proposing services, a description of their HSSE system, as well as resumes, training certificates, course rosters, and other documents confirming contractor employee qualifications and competencies. ERM or our selected pre-qualification vendors may audit these systems and documentation for conformance with defined expectations. Contractors will be provided the opportunity to close any gaps identified during this evaluation and Project Managers/Supervisors will ensure gaps are closed before work begins.

4.3 Assessment of Contractor Performance

The Project Manager/Supervisor should regularly assess the contractor's operations to determine their level of compliance with applicable health and safety requirements. This should also

include a review of required health and safety documentation. Assessment can be performed directly by the Project Manager/Supervisor or delegated to appropriate field staff.

Where ERM personnel observe safety events (i.e., incidents, near misses, unsafe acts/conditions) related to contractor operations, they should bring the events to the attention of ERM's Project Manager/Supervisor as well as the contractor management team for immediate resolution. Events should also be posted in ERM's Event Communication System (ECS). Staff shall take the opportunity to also note remarkable safe behaviors to leverage positive activities for continuous improvement in projects.

The Project Manager/Supervisor will evaluate the contractor's performance following completion of the contracted work activities. If a contractor's performance is such that the PIC or the Project Manager/Supervisor feels that they should be barred from further use by ERM, a formal variance should be sent to the Business Unit Managing Partner (BU MP) providing the reasons for the request. The BU MP will make a decision regarding the contractor after consultation with appropriate ERM team members and can decide to change the contractor's approval flag status in Avetta.

5. References

- Avetta Global Supply Chain Management Solutions (***www.avetta.com***)
- ERM Procedure ERM-1130-PR1 (***Contractor Management***)

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Policy Approval by: Mark Hickey

Approval Signature: 

Revision History

Section	Reason for Revision	Date
All	New document	3/6/14
All	Revised format to meet new Global SMS requirements	7/3/14
All	Changed "subcontractor" to "contractor" throughout; addressed comments of Regional H&S Director	8/1/14
4.2	Updated to include transmission of client's drug and alcohol policies	5/19/15
All	Updated Document Number; updated titles (Section 2); updated paragraph alignment throughout; updated referenced document numbers (Section 4); updated References (Section 5)	1/9/17

1. Purpose and Scope

This procedure defines the requirements to ensure that safety events are being properly reported and investigated within ERM operations. This document applies to all ERM 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 H&S 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 persons involved in the event, including injured personnel and witnesses;
- A brief description of the event;
- Immediate actions taken in response to the event;
- 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 and Reporting 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 Form 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 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 no less than two business days after all immediate response measures have been taken and the situation is under control. 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. A;; 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.

Target deadlines for completing an RCA are as follows:

- Conduct interviews within five working days after the event;
- Distribute draft RCA report to the RCA team for review within 10 working days after the event; and
- Issue the final RCA report, including photos and an RCA flowchart, within 15 working days after the event.

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*)

Document Control Information

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Policy Approval by: Mark Hickey

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)	1/10/17
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

1. Purpose and Scope

This procedure is designed to ensure that information necessary for the safe use, handling, and storage of hazardous chemicals is provided and made available to all ERM employees. This document applies to all ERM employees and covers all ERM work activities.

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

Labels on all containers of chemicals, whether used, handled, or stored in the field or on ERM property, 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.

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 person who transferred the chemical into the portable container is the only person who will use the chemical; 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***).

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 will be made available, upon request, to any ERM employee, 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. 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;
- 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 work/handling practices, use of PPE, and emergency response procedures;
- How to read and use SDS and labels; 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, etc. 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***)

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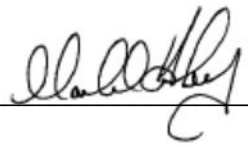
Policy Approval by: Mark Hickey

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 (Section 5)	1/6/17

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 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.

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 Protective 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 training on PPE. 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 ***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 Conservation***)
- ERM Procedure NAM-1324-PR1 (***Safe Use of Cutting Tools***)

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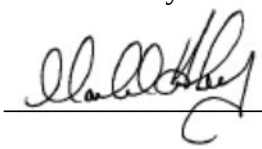
Approval Signature: 

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

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.

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 who are 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.

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***)

Document Control Information

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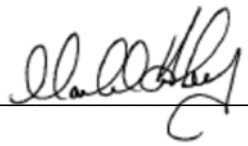
Approval Signature: 

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. 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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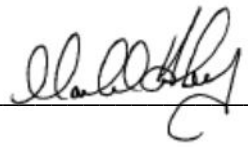
Approval Signature: 

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. Fatal is 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 sufficient to accommodate all 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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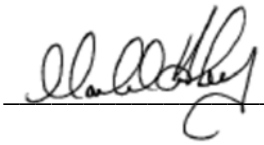
Approval Signature: 

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); changed 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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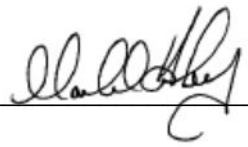
Approval Signature: 

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)

Document Control Information

Original Effective Date: 6/29/15

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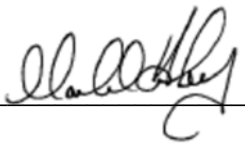
Approval Signature: 

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

Introduction

This form must be filled out for all known 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.

To use this form:

1. Click on the tab entitled "Chemicals of Concern".
2. Click on the cell to the right of "Chemical Name".
3. Click the down arrow, then choose the chemical of concern from the drop down list.
4. Once selected, the remaining data (target organs, published exposure limits, exposure symptoms, etc.) for the chemical will atumatically populate.
5. Up to five chemicals can be presented per page. Use additional sheets as neceesary to record all known or suspected chemicals of concern on the site.
6. Note that known/suspected carcinogens will flash red in the "Carcinogen" box when chosen.
7. If the chemical you are searching for is not present in the list, click on the tab entitled "Unlisted Chemicals of Concern" and add the requested data manually.

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:	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:	0.050 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:	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:				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 ex
must be provided to all team members. Add additional sheets as necessary to address all chemical concerns.

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

Chemical Name:				CAS Number:	
Target Organs:		**Routes of Exposure:**		**Exposure Symptoms:**	
OSHA		**NIOSH**		**ACGIH**	
PEL:		**REL**		**TLV**	
STEL:		**STEL**		**STEL**	
Ceiling:		**Ceiling:**		**Ceiling:**	
Peak:		**Sampling Methods:**			

posed. Information on each chemical

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

[redacted]

Additional	
IDLH Level:	
Ionization Potential:	
Known/Pot. Carcinogen?	

Chemical	Target	Route	Symptoms	O PEL	O STEL
Acetaldehyde	Eyes, skin, respiratory system, kidneys	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, throat; eye,	200 ppm	NA
Acetone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, throat; head	1000 ppm	NA
Acetonitrile	Respiratory system, cardiovascular sys	Inhalation, skin absorption, ingestion,	Irritation nose, throat; asphyxia;	40 ppm	NA
Acrolein	Eyes, skin, respiratory system, heart	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	0.1 ppm	NA
Acrylonitrile	Eyes, skin, cardiovascular system, live	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; asphyxia; he	2 ppm	NA
Allyl alcohol	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Eye irritation, tissue damage; irri	2 ppm	NA
Aluminum (respirable)	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory s	5 mg/m3	NA
Aluminum (total)	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory s	15 mg/m3	NA
Ammonia	Eyes, skin, respiratory system	Inhalation, ingestion (solution), skin a	Irritation eyes, nose, throat; dysp	50 ppm	NA
Aniline	Blood, cardiovascular system, eyes, li	Inhalation, skin absorption, ingestion,	Headache, lassitude, dizziness; c	5 ppm	NA
Antimony	Eyes, skin, respiratory system, cardiov	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	0.5 mg/m3	NA
Arsenic (inorganic)	Liver, kidneys, skin, lungs, lymphatic	Inhalation, skin absorption, skin and/o	Ulceration of nasal septum, derm	0.01 mg/m3	NA
Asbestos	Respiratory system, eyes	Inhalation, ingestion, skin and/or eye c	Asbestosis (chronic exposure): d	0.1 f/cc	NA
Barium	Eyes, skin, respiratory system, heart, c	Inhalation, ingestion, skin and/or eye c	Irritation of eyes, skin, upper resp	0.5 mg/m3	NA
Benzene	Eyes, skin, respiratory system, blood,	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, respira	1 ppm	5 ppm
Benzyl chloride	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; lassitu	1 ppm	NA
Beryllium	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact	Berylliosis (chronic exposure): a	.002 mg/m3	NA
Bromochloromethane	Eyes, skin, respiratory system, liver, k	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, throat; confu	200 pm	NA
Bromoform	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	0.5 ppm	NA
Butane	Central nervous system	Inhalation, skin and/or eye contact (liq	Drowsiness, narcosis, asphyxia; l	NA	NA
2-Butanol	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	150 ppm	NA
2-Butanone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; headac	200 ppm	NA
2-Butoxyethanol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	50 ppm	NA
Butyl acrylate	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, upper respira	NA	NA
Butyl alcohol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose, throat; head	100 ppm	NA
sec-Butyl alcohol	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	150 ppm	NA
tert-Butyl alcohol	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	100 ppm	NA
Butyl glycidyl ether	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; skin se	50 ppm	NA
Butyl mercaptan	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin; muscle weak	10 ppm	NA
Butylamine	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	NA	NA
Cadmium	Respiratory system, kidneys, prostate,	Inhalation, ingestion	Pulmonary edema, dyspnea, coug	.005 mg/m3	NA
Calcium arsenate	Eyes, respiratory system, liver, skin, c	Inhalation, skin absorption, ingestion,	Lassitude; gastrointestinal disturb	.010 mg/m3	NA
Camphor	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, mucous men	2 mg/m3	NA
Carbon disulfide	Central nervous system, peripheral ner	Inhalation, skin absorption, ingestion,	Dizziness, headache, poor sleep,	20 ppm	NA
Carbon tetrachloride	Central nervous system, eyes, lungs, li	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; central nerv	10 ppm	NA
Cathecol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	NA	NA

Chlorobenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; drowsi	75 ppm	NA
Chlorobromomethane	Eyes, skin, respiratory system, liver, k	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, throat; confu	200 pm	NA
Chlorodiphenyl (42%) - PCB	Skin, eyes, liver, reproductive system	Inhalation, skin absorption, ingestion,	Irritation eyes, chloracne; liver da	1 mg/m3	NA
Chlorodiphenyl (54%) - PCB	Eyes, skin, liver, reprodcutive system	Inhalation, skin absorption, ingestion,	Irritation eyes, chloracne; liver da	0.5 mg/m3	NA
Chloroform	Liver, kidneys, heart, eyes, skin, centra	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; dizziness, m	NA	NA
Chloromethylbenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; lassitu	1 ppm	NA
Chromic acid/chromates (Cr	Blood, respiratory system, liver, kidne	Inhalation, ingestion, skin and/or eye c	Irritation respiratory system; nasa	.005 mg/m3	NA
Chromium II/III compounds	Eyes, skin	Inhalation, ingestion, skin and/or eye c	Irritation eyes; sensitization derm	0.5 mg/m3	NA
Chromium metal	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin; lung fibrosis	1 mg/m3	NA
Coal tar pitch volatiles	Respiratory system, skin, bladder, kidı	Inhalation, skin and/or eye contact	Dermatitis, bronchitis	0.2 mg/m3	NA
Cobalt	Skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Cough, dyspnea, wheezing, decre	0.1 mg/m3	NA
Copper (fume)	Eyes, skin, respiratory system, liver, k	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, pharynx; na	0.1 mg/m3	NA
Copper (metal)	Eyes, skin, respiratory system, liver, k	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, pharynx; na	1 mg/m3	NA
p-Cresol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, mucous men	5 ppm	NA
Cyclohexanol	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	50 ppm	NA
Cyclohexanone	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, mucous men	50 ppm	NA
2,4-D	Skin, central nervous system, liver, kic	Inhalation, skin absorption, ingestion,	Lassitude, stupor, hyporeflexia, r	10 mg/m3	NA
DDT	Eyes, skin, central nervous system, kic	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; paresthesia t	1 mg/m3	NA
1,2-Dichlorobenzene	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; liver, kidney	NA	NA
1,4-Dichlorobenzene	Liver, respiratory system, eyes, kidney	Inhalation, skin absorption, ingestion,	Eye irritation, swelling periorbita	75 ppm	NA
Dichlorobenzene (ortho)	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; liver, kidney	NA	NA
Dichlorobenzene (para)	Liver, respiratory system, eyes, kidney	Inhalation, skin absorption, ingestion,	Eye irritation, swelling periorbita	75 ppm	NA
Dichlorodifluoromethane	Cardiovascular system, peripheral ner	Inhalation, skin and/or eye contact (liq	Dizziness, tremor, asphyxia, unc	1000 ppm	NA
1,1-Dichloroethane	Skin, liver, kidneys, lungs, central ner	Inhalation, ingestion, skin and/or eye c	Irritation skin; central nervous sy	100 ppm	NA
1,2-Dichloroethane	Eyes, skin, kidneys, liver, central nerv	Inhalation, ingestion, skin absorption,	Irritation eyes, corneal opacity; c	50 ppm	NA
1,2-Dichloroethylene	Eyes, respiratory system, central nervo	Inhalation, ingestion, skin and/or eye c	Irritation eyes, respiratory systen	200 ppm	NA
Dichloroethyl ether	Eyes, respiratory system, liver	Inhalation, skin absorption, ingestion,	Irritation nose, throat, respiratory	15 ppm	NA
Dichloromethane	Eyes, skin, cardiovascular system, cen	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; lassitude, dr	25 ppm	125 ppm
1,3-Dichloropropene	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	NA	NA
Dieldrin	Central nervous system, liver, kidneys	Inhalation, skin absorption, ingestion,	Headache, dizziness; nausea, vor	0.25 mg/m3	NA
Diethanolamine	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	NA	NA
Diethylamine	Eyes, skin, respiratory system, cardiov	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	25 ppm	NA
2-Diethylaminoethanol	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	10 ppm	NA
Diisopropylamine	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	5 ppm	NA
Dimethyl acetamide	Skin, liver, central nervous system	Inhalation, skin absorption, ingestion,	Irritation skin; jaundice, liver dar	10 ppm	NA
Dimethyl sulfate	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; headache; d	1 ppm	NA
Dimethylamine	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact (liq	Irritation nose, throat; sneezing, c	10 ppm	NA

Dimethylformamide	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	10 ppm	NA
Dinitrobenzene (meta)	Eyes, skin, blood, liver, cardiovascula	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; visual disturba	1 mg/m3	NA
Dinitrobenzene (ortho)	Eyes, skin, blood, liver, cardiovascula	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; visual disturba	1 mg/m3	NA
Dinitrobenzene (para)	Eyes, skin, blood, liver, cardiovascula	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; visual disturba	1 mg/m3	NA
Dinitro-o-cresol	Cardiovascular system, endocrine syst	Inhalation, skin absorption, ingestion,	Sense of well being; headache, fe	0.2 mg/m3	NA
Dinitrotoluene	Blood, liver, cardiovascular system, re	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; anemia, jaundi	1.5 mg/m3	NA
Dioxane	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	100 ppm	NA
Endrin	Central nervous system, liver	Inhalation, skin absorption, ingestion,	Epileptiform convulsions; stupor	0.1 mg/m3	NA
Epichlorohydrin	Eyes, skin, respiratory system, kidneys	Inhalation, skin absorption, ingestion,	Irritation eyes, skin with deep pai	5 ppm	NA
Ethyl alcohol	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; headac	1000 ppm	NA
Ethyl benzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	100 ppm	NA
Ethyl chloride	Liver, kidneys, respiratory system, car	Inhalation, skin absorption (liquid), in	Incoordination, inebriation; abdo	1000 ppm	NA
Ethylene dichloride	Eyes, skin, kidneys, liver, central nerv	Inhalation, ingestion, skin absorption,	Irritation eyes, corneal opacity; c	50 ppm	NA
Formaldehyde	Eyes, respiratory system	Inhalation, skin and/or eye contact	Irritation eyes, nose, throat, respi	0.75 ppm	2 ppm
Furfural	Eyes, skin, respiratory system	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, upper respira	5 ppm	NA
Hepatchlor	Central nervous system, liver	Inhalation, skin absorption, ingestion,	Tremor, convulsions; liver damag	0.5 mg/m3	NA
Heptane	Skin, respiratory system, central nervo	Inhalation, ingestion, skin and/or eye c	Dizziness, stupor, incoordination	500 ppm	NA
Hexachlorocyclopentadiene	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	NA	NA
Hexane	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose; nausea, hea	500 ppm	NA
2-Hexanone	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; peripheral n	100 ppm	NA
Iron oxide dust/fume	Respiratory system	Inhalation	Benign pneumoconiosis with X-r	10 mg/m3	NA
Isopropyl alcohol	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose, throat; drow	400 ppm	NA
Isopropyl ether	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; resp di	500 ppm	NA
Lead	Eyes, gastrointestinal tract, central ner	Inhalation, ingestion, skin and/or eye c	Lassitude, insomnia; facial pallor	.050 mg/m3	NA
Lindane	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	0.5 mg/m3	NA
Manganese compounds/fume	Respiratory system, central nervous sy	Inhalation, ingestion	Manganism; asthenia, insomnia,	NA	NA
Methyl acetate	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	200 ppm	NA
Methyl alcohol	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, upper respira	200 ppm	NA
Methyl bromide	Eyes, skin, respiratory system, central	Inhalation, skin absorption (liquid), sk	Irritation eyes, skin, respiratory s	NA	NA
Methyl butyl ketone	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; peripheral n	100 ppm	NA
Methyl chloride	Central nervous system, liver, kidneys	Inhalation, skin and/or eye contact (liq	Dizziness, nausea, vomiting; visu	100 ppm	NA
Methyl chloroform	Eyes, skin, central nervous system, car	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin; headache, la	350 ppm	NA
Methyl ethyl ketone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; headac	200 ppm	NA
Methyl mercaptan	Eyes, skin, respiratory system, central	Inhalation, skin and/or eye contact (liq	Irritation eyes, skin, respiratory s	NA	NA
Methyl methacrylate	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat;	100 ppm	NA
Methyl propyl ketone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	200 ppm	NA
Methylamine	Eyes, skin, respiratory system	Inhalation, skin absorption (solution),	Irritation eyes, skin, respiratory s	10 ppm	NA

Methylene chloride	Eyes, skin, cardiovascular system, cen	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; lassitude, dr	25 ppm	125 ppm
Morpholine	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, respira	20 ppm	NA
Naphthalene	Eyes, skin, blood, liver, kidneys, centr	Inhalation, skin absorption, ingestion,	Irritation eyes; headache, confusi	10 ppm	NA
Nickel	Nasal cavities, lungs, skin	Inhalation, ingestion, skin and/or eye c	Sensitization dermatitis, allergic	1 mg/m3	NA
Nitrobenzene	Eyes, skin, blood, liver, kidneys, cardi	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; anoxia; dern	1 ppm	NA
Nitrotoluene (meta)	Blood, central nervous system, cardiov	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; headache, lass	5 ppm	NA
Nitrotoluene (ortho)	Blood, central nervous system, cardiov	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; headache, lass	5 ppm	NA
Nitrotoluene (para)	Blood, central nervous system, cardiov	Inhalation, skin absorption, ingestion,	Anoxia, cyanosis; headache, lass	5 ppm	NA
Octane	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, nose; drowsiness;	500 ppm	NA
Pentane	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose; derma	1000 ppm	NA
2-Pentanone	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	200 ppm	NA
Perchlorethylene	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat,	100 ppm	NA
Phenol	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, nose, throat; anor	5 ppm	NA
Propane	Central nervous system	Inhalation, skin and/or eye contact (liq	Dizziness, confusion, excitation,	1000 ppm	NA
Propylene dichloride	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, respiratory s	75 ppm	NA
Pyridine	Eyes, skin, central nervous system, liv	Inhalation, skin absorption, ingestion,	Irritation eyes; headache, anxiety	5 ppm	NA
Resorcinol	Eyes, skin, respiratory system, cardiov	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	NA	NA
Sodium hydroxide	Eyes, skin, respiratory system	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, mucous men	2 mg/m3	NA
Styrene	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose, respiratory s	100 ppm	NA
TCE	Eyes, skin, respiratory system, heart, li	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; headache, vi	100 ppm	NA
1,1,2,2-Tetrachloroethane	Skin, liver, kidneys, central nervous sy	Inhalation, skin absorption, ingestion,	Nausea, vomiting, abdominal pai	5 ppm	NA
Tetrachloroethylene	Eyes, skin, respiratory system, liver, k	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat,	100 ppm	NA
Tetraethyl lead	Central nervous system, cardiovascula	Inhalation, skin absorption, ingestion,	Insomnia, lassitude, anxiety; trem	.075 mg/m3	NA
Tetrahydrofuran	Eyes, respiratory system, central nervo	Inhalation, skin and/or eye contact, ing	Irritation eyes, upper respiratory	200 ppm	NA
Tin	Eyes, skin, respiratory system	Inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory s	2 mg/m3	NA
Toluene	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, nose; lassitude, co	200 ppm	NA
o-Toluidine	Eyes, skin, blood, kidneys, liver, cardi	Inhalation, skin absorption, ingestion,	Irritation eyes; anoxia, headache,	5 ppm	NA
1,2,4-Trichlorobenzene	Eyes, skin, respiratory system, liver, re	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, mucous men	NA	NA
1,1,1-Trichloroethane	Eyes, skin, central nervous system, car	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin; headache, la	350 ppm	NA
Trichloroethylene	Eyes, skin, respiratory system, heart, li	Inhalation, skin absorption, ingestion,	Irritation eyes, skin; headache, vi	100 ppm	NA
Trimethylamine	Eyes, skin, respiratory system	Inhalation, ingestion (solution), skin a	Irritation eyes, skin, nose, throat,	NA	NA
1,2,3-Trimethylbenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	NA	NA
1,2,4-Trimethylbenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	NA	NA
1,3,5-Trimethylbenzene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, nose, throat,	NA	NA
Vinyl chloride	Liver, central nervous system, blood, r	Inhalation, skin and/or eye contact (liq	Lassitude; abdominal pain, gastro	1 ppm	NA
Vinyl toluene	Eyes, skin, respiratory system, central	Inhalation, ingestion, skin and/or eye c	Irritation eyes, skin, upper respira	100 ppm	NA
Xylene (meta)	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	100 ppm	NA

Xylene (ortho)	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	100 ppm	NA
Xylene (para)	Eyes, skin, respiratory system, central	Inhalation, skin absorption, ingestion,	Irritation eyes, skin, nose, throat;	100 ppm	NA

O CEIL	O PEAK	N REL	N STEL	N CEIL	A TLV	A STEL	A CEIL	IDLH	IP	Sample	Carc	CAS
NA	NA	NA	NA	NA	NA	NA	25 ppm	2000 ppm	10.22 eV	NIOSH 201	Yes	75-07-0
NA	NA	250 ppm	NA	NA	500 ppm	750 ppm	NA	2500 ppm	9.69 eV	NIOSH 130	No	67-64-1
NA	NA	20 ppm	NA	NA	20 ppm	NA	NA	500 ppm	12.20 eV	NIOSH 160	No	75-05-8
NA	NA	0.1 ppm	0.3 ppm	NA	NA	NA	0.1 ppm	2 ppm	10.13 eV	NIOSH 250	No	107-02-8
pm (15 min)	NA	1 ppm	NA	pm (15 min)	2 ppm	NA	NA	85 ppm	10.91 eV	NIOSH 160	Yes	107-13-1
NA	NA	2 ppm	4 ppm	NA	0.5 ppm	NA	NA	20 ppm	9.63 eV	NIOSH 140	No	107-18-6
NA	NA	5 mg/m3	NA	NA	5 mg/m3	NA	NA	NA	NA	NIOSH 701	No	7429-90-5
NA	NA	10 mg/m3	NA	NA	10 mg/m3	NA	NA	NA	NA	NIOSH 701	No	7429-90-5
NA	NA	25 ppm	35 ppm	NA	25 ppm	35 ppm	NA	300 ppm	10.18 eV	NIOSH 3800, 6015, 601		7664-41-7
NA	NA	NA	NA	NA	2 ppm	NA	NA	100 ppm	7.70 eV	NIOSH 200	Yes	62-53-3
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	NA	NA	NIOSH 730	No	7440-36-0
NA	NA	NA	NA	m3 (15 min)	0.01 mg/m3	NA	NA	5 mg/m3	NA	NIOSH 730	Yes	7440-38-2
NA	NA	NA	NA	NA	0.1 f/cc	NA	NA	NA	NA	NIOSH 740	Yes	1332-21-4
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	50 mg/m3	NA	NIOSH 7056; OSHA ID-		7440-39-3
NA	NA	0.1 ppm	1 ppm	NA	0.5 ppm	2.5 ppm	NA	500 ppm	9.24 eV	NIOSH 150	Yes	71-43-2
NA	NA	NA	NA	pm (15 min)	1 ppm	NA	NA	10 ppm	NA	NIOSH 100	No	100-44-7
m3 (30 min)	.025 mg/m3	NA	NA	0005 mg/m3	0005 mg/m3	NA	NA	4 mg/m3	NA	NIOSH 730	Yes	7440-41-7
NA	NA	200 ppm	NA	NA	200 ppm	NA	NA	2000 ppm	10.77 eV	NIOSH 100	No	74-97-5
NA	NA	0.5 ppm	NA	NA	0.5 ppm	NA	NA	850 ppm	10.48 eV	NIOSH 100	No	75-25-2
NA	NA	800 ppm	NA	NA	1000 ppm	NA	NA	ND	10.63 eV	OSHA PV2	No	106-97-8
NA	NA	100 ppm	150 ppm	NA	100 ppm	NA	NA	2000 ppm	10.10 eV	NIOSH 140	No	78-92-2
NA	NA	200 ppm	300 ppm	NA	200 ppm	300 ppm	NA	3000 ppm	9.54 eV	NIOSH 250	No	78-93-3
NA	NA	5 ppm	NA	NA	20 ppm	NA	NA	700 ppm	10.00 eV	NIOSH 140	No	111-76-2
NA	NA	10 ppm	NA	NA	2 ppm	NA	NA	ND	NA	OSHA PV2	No	141-32-2
NA	NA	NA	NA	50 ppm	20 ppm	NA	NA	1400 ppm	10.04 eV	NIOSH 140	No	71-36-3
NA	NA	100 ppm	150 ppm	NA	100 ppm	NA	NA	2000 ppm	10.10 eV	NIOSH 140	No	78-92-2
NA	NA	100 ppm	150 ppm	NA	100 ppm	NA	NA	1600 ppm	9.70 eV	NIOSH 140	No	75-65-0
NA	NA	NA	NA	pm (15 min)	25 ppm	NA	NA	250 ppm	NA	NIOSH 161	No	2426-08-6
NA	NA	NA	NA	pm (15 min)	0.5 ppm	NA	NA	500 ppm	9.15 eV	NIOSH 252	No	109-79-5
5 ppm	NA	NA	NA	5 ppm	NA	NA	5 ppm	300 ppm	8.71 eV	NIOSH 201	No	109-73-9
NA	NA	NA	NA	NA	0.01 mg/m3	NA	NA	9 mg/m3	NA	NIOSH 704	Yes	7440-43-9
NA	NA	NA	NA	m3 (15 min)	NA	NA	NA	5 mg/m3	NA	NIOSH 790	Yes	7778-44-1
NA	NA	2 mg/m3	NA	NA	2 ppm	3 ppm	NA	200 mg/m3	NA	NIOSH 130	No	76-22-2
30 ppm	100 ppm	1 ppm	10 ppm	NA	10 ppm	NA	NA	500 ppm	10.08 ev	NIOSH 160	No	75-15-0
25 ppm	ppm (5 min)	NA	pm (60 min)	NA	5 ppm	10 ppm	NA	200 ppm	11.47 eV	NIOSH 100	Yes	56-23-5
NA	NA	5 ppm	NA	NA	5 ppm	NA	NA	ND	NA	OSHA PV2	No	120-80-9

NA	NA	NA	NA	NA	10 ppm	NA	NA	1000 ppm	9.07 eV	NIOSH 100	No	108-90-7
NA	NA	200 ppm	NA	NA	200 ppm	NA	NA	2000 ppm	10.77 eV	NIOSH 100	No	74-97-5
NA	NA	.001 mg/m3	NA	NA	1 mg/m3	NA	NA	5 mg/m3	NA	NIOSH 550	Yes	53469-21-9
NA	NA	.001 mg/m3	NA	NA	0.5 mg/m3	NA	NA	5 mg/m3	NA	NIOSH 550	Yes	11097-69-1
50 ppm	NA	NA	pm (60 min)	NA	10 ppm	NA	NA	500 ppm	11.42 eV	NIOSH 100	Yes	67-66-3
NA	NA	NA	NA	pm (15 min)	1 ppm	NA	NA	10 ppm	NA	NIOSH 100	No	100-44-7
NA	NA	0002 mg/m3	NA	NA	0.01 mg/m3	NA	NA	15 mg/m3	NA	NIOSH 760	Yes	1333-82-0
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	25 mg/m3	NA	NIOSH 702	No	Varies
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	250 mg/m3	NA	NIOSH 702	No	7440-47-3
NA	NA	0.1 mg/m3	NA	NA	0.2 mg/m3	NA	NA	80 mg/m3	NA	OSHA 58	Yes	65996-93-2
NA	NA	0.05 mg/m3	NA	NA	0.02 mg/m3	NA	NA	20 mg/m3	NA	NIOSH 702	No	7440-48-4
NA	NA	0.1 mg/m3	NA	NA	0.2 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 702	No	1317-38-0
NA	NA	1 mg/m3	NA	NA	1 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 702	No	7440-50-8
NA	NA	2.3 ppm	NA	NA	5 ppm	NA	NA	250 ppm	8.97 eV	NIOSH 254	No	106-44-5
NA	NA	50 ppm	NA	NA	50 ppm	NA	NA	400 ppm	10.00 eV	NIOSH 140	No	108-93-0
NA	NA	25 ppm	NA	NA	20 ppm	50 ppm	NA	700 ppm	9.14 eV	NIOSH 130	No	108-94-1
NA	NA	10 mg/m3	NA	NA	10 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 500	No	94-75-7
NA	NA	0.5 mg/m3	NA	NA	1 mg/m3	NA	NA	500 mg/m3	NA	NIOSH S27	Yes	50-29-3
50 ppm	NA	NA	NA	50 ppm	25 ppm	50 ppm	NA	200 ppm	9.06 eV	NIOSH 100	No	95-50-1
NA	NA	NA	NA	NA	10 ppm	NA	NA	150 ppm	8.98 eV	NIOSH 100	Yes	106-46-7
50 ppm	NA	NA	NA	50 ppm	25 ppm	50 ppm	NA	200 ppm	9.06 eV	NIOSH 100	No	95-50-1
NA	NA	NA	NA	NA	10 ppm	NA	NA	150 ppm	8.98 eV	NIOSH 100	Yes	106-46-7
NA	NA	1000 ppm	NA	NA	10 ppm	NA	NA	15000 ppm	11.75 eV	NIOSH 101	No	75-71-8
NA	NA	100 ppm	NA	NA	100 ppm	NA	NA	3000 ppm	11.06 eV	NIOSH 100	No	75-34-3
100 ppm	5 min/3 hrs)	1 ppm	2 ppm	NA	10 ppm	NA	NA	50 ppm	11.05 eV	NIOSH 100	Yes	107-06-2
NA	NA	200 ppm	NA	NA	200 ppm	NA	NA	1000 ppm	9.65 eV	NIOSH 100	No	540-59-0
NA	NA	5 ppm	pm (60 min)	NA	5 ppm	10 ppm	NA	100 ppm	NA	NIOSH 100	Yes	111-44-4
NA	NA	NA	NA	NA	50 ppm	NA	NA	2300 ppm	11.32 eV	NIOSH 100	Yes	75-09-2
NA	NA	1 ppm	NA	NA	1 ppm	NA	NA	NA	NA	NA	Yes	542-75-6
NA	NA	0.25 mg/m3	NA	NA	0.25 mg/m3	NA	NA	50 mg/m3	NA	NIOSH S28	Yes	60-57-1
NA	NA	3 ppm	NA	NA	2 mg/m3	NA	NA	ND	NA	NIOSH 350	No	111-42-2
NA	NA	10 ppm	25 ppm	NA	5 ppm	15 ppm	NA	200 ppm	8.01 eV	NIOSH 201	No	109-89-7
NA	NA	10 ppm	NA	NA	2 ppm	NA	NA	100 ppm	NA	NIOSH 200	No	100-37-8
NA	NA	5 ppm	NA	NA	5 ppm	NA	NA	200 ppm	7.73 eV	NIOSH S14	No	108-18-9
NA	NA	10 ppm	NA	NA	10 ppm	NA	NA	300 ppm	8.81 eV	NIOSH 200	No	127-19-5
NA	NA	0.1 ppm	NA	NA	0.1 ppm	NA	NA	7 ppm	NA	NIOSH 252	Yes	77-78-1
NA	NA	10 ppm	NA	NA	5 ppm	15 ppm	NA	500 ppm	8.24 eV	NIOSH 201	No	124-40-3

NA	NA	10 ppm	NA	NA	10 ppm	NA	NA	500 ppm	9.12 eV	NIOSH 200	No	68-12-2
NA	NA	1 mg/m3	NA	NA	0.15 mg/3	NA	NA	50 mg/m3	10.43 eV	NIOSH S21	No	99-65-0
NA	NA	1 mg/m3	NA	NA	0.15 mg/3	NA	NA	50 mg/m3	10.71 eV	NIOSH S21	No	528-29-0
NA	NA	1 mg/m3	NA	NA	0.15 mg/3	NA	NA	50 mg/m3	10.50 eV	NIOSH S21	No	100-25-4
NA	NA	0.2 mg/m3	NA	NA	0.2 mg/m3	NA	NA	5 mg/m3	NA	NIOSH S16	No	534-52-1
NA	NA	1.5 mg/m3	NA	NA	0.2 mg/m3	NA	NA	50 mg/m3	NA	OSHA 44	Yes	25321-14-6
NA	NA	NA	NA pm (30 min)		20 ppm	NA	NA	500 ppm	9.13 eV	NIOSH 160	Yes	123-91-1
NA	NA	0.1 mg/m3	NA	NA	0.1 mg/m3	NA	NA	2 mg/m3	NA	NIOSH 551	No	72-20-8
NA	NA	NA	NA	NA	0.5 ppm	NA	NA	75 ppm	10.60 eV	NIOSH 101	Yes	106-89-8
NA	NA	1000 ppm	NA	NA	1000 ppm	NA	NA	3300 ppm	10.47 eV	NIOSH 140	No	64-17-5
NA	NA	100 ppm	125 ppm	NA	100 ppm	125 ppm	NA	800 ppm	8.76 eV	NIOSH 150	No	100-41-4
NA	NA	NA	NA	NA	100 ppm	NA	NA	3800 ppm	10.97 eV	NIOSH 251	No	75-00-3
100 ppm	5 min/3 hrs)	1 ppm	2 ppm	NA	10 ppm	NA	NA	50 ppm	11.05 eV	NIOSH 100	Yes	107-06-2
NA	NA	0.016 ppm	NA pm (15 min)		NA	NA	0.3 ppm	20 ppm	10.88 eV	NIOSH 201	Yes	50-00-0
NA	NA	NA	NA	NA	2 ppm	NA	NA	100 ppm	9.21 eV	NIOSH 252	No	98-01-1
NA	NA	0.5 mg/m3	NA	NA	0.05 mg/m3	NA	NA	35 mg/m3	NA	NIOSH S28	Yes	76-44-8
NA	NA	85 ppm	NA pm (15 min)		2 ppm	NA	NA	750 ppm	9.90 eV	NIOSH 150	No	142-82-5
NA	NA	0.01 ppm	NA	NA	0.01 ppm	NA	NA	ND	NA	NIOSH 251	No	77-47-4
NA	NA	50 ppm	NA	NA	50 ppm	NA	NA	1100 ppm	10.18 eV	NIOSH 150	No	110-54-3
NA	NA	1 ppm	NA	NA	5 ppm	10 ppm	NA	1600 ppm	9.34 eV	NIOSH 130	No	591-78-6
NA	NA	5 mg/m3	NA	NA	5 mg/m3	NA	NA	2500 mg/m3	NA	NIOSH 730	No	1309-37-1
NA	NA	400 ppm	500 ppm	NA	200 ppm	400 ppm	NA	2000 ppm	10.10 eV	NIOSH 140	No	67-63-0
NA	NA	500 ppm	NA	NA	250 ppm	310 ppm	NA	1400 ppm	9.20 eV	NIOSH 161	No	108-20-3
NA	NA	.050 mg/m3	NA	NA	0.05 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 708	No	7439-92-1
NA	NA	0.5 mg/m3	NA	NA	0.5 mg/m3	NA	NA	50 mg/m3	NA	NIOSH 550	No	58-89-9
5 mg/m3	NA	1 mg/m3	3 mg/m3	NA	0.2 mg/m3	NA	NA	500 mg/m3	NA	NIOSH 730	No	7439-96-5
NA	NA	200 ppm	250 ppm	NA	200 ppm	250 ppm	NA	3100 ppm	10.27 eV	NIOSH 145	No	79-20-9
NA	NA	200 ppm	250 ppm	NA	200 ppm	250 ppm	NA	6000 ppm	10.84 eV	NIOSH 200	No	67-56-1
20 ppm	NA	NA	NA	NA	1 ppm	NA	NA	250 ppm	10.54 eV	NIOSH 252	Yes	74-83-9
NA	NA	1 ppm	NA	NA	5 ppm	10 ppm	NA	1600 ppm	9.34 eV	NIOSH 130	No	591-78-6
200 ppm	5 min/3 hrs)	NA	NA	NA	50 ppm	100 ppm	NA	2000 ppm	11.28 eV	NIOSH 100	Yes	74-87-3
NA	NA	NA	NA pm (15 min)		350 ppm	450 ppm	NA	700 ppm	11.00 eV	NIOSH 100	No	71-55-6
NA	NA	200 ppm	300 ppm	NA	200 ppm	300 ppm	NA	3000 ppm	9.54 eV	NIOSH 250	No	78-93-3
10 ppm	NA	NA	NA pm (15 min)		0.5 ppm	NA	NA	150 ppm	9.44 eV	NIOSH 254	No	74-93-1
NA	NA	100 ppm	NA	NA	50 ppm	100 ppm	NA	1000 ppm	9.70 eV	NIOSH 253	No	80-62-6
NA	NA	150 ppm	NA	NA	200 ppm	250 ppm	NA	1500 ppm	9.39 eV	NIOSH 130	No	107-87-9
NA	NA	10 ppm	NA	NA	5 ppm	15 ppm	NA	100 ppm	8.97 eV	OSHA 40	No	74-89-5

NA	NA	NA	NA	NA	50 ppm	NA	NA	2300 ppm	11.32 eV	NIOSH 100	Yes	75-09-2
NA	NA	20 ppm	30 ppm	NA	20 ppm	NA	NA	1400 ppm	8.88 eV	NIOSH S15	No	110-91-8
NA	NA	10 ppm	15 ppm	NA	10 ppm	15 ppm	NA	250 ppm	8.12 eV	NIOSH 150	No	91-20-3
NA	NA	.015 mg/m3	NA	NA	1.5 mg/m3	NA	NA	10 mg/m3	NA	NIOSH 730	Yes	7440-02-0
NA	NA	1 ppm	NA	NA	1 ppm	NA	NA	200 ppm	9.92 eV	NIOSH 200	No	98-95-3
NA	NA	2 ppm	NA	NA	2 ppm	NA	NA	200 ppm	9.48 eV	NIOSH 200	No	99-08-1
NA	NA	2 ppm	NA	NA	2 ppm	NA	NA	200 ppm	9.43 eV	NIOSH 200	No	88-72-2
NA	NA	2 ppm	NA	NA	2 ppm	NA	NA	200 ppm	9.50 eV	NIOSH 200	No	99-99-0
NA	NA	75 ppm	NA	pm (15 min)	300 ppm	NA	NA	1000 ppm	9.82 eV	NIOSH 150	No	111-65-9
NA	NA	120 ppm	NA	pm (15 min)	NA	NA	NA	1500 ppm	10.34 eV	NIOSH 150	No	109-66-0
NA	NA	150 ppm	NA	NA	200 ppm	250 ppm	NA	1500 ppm	9.39 eV	NIOSH 130	No	107-87-9
5 min/3 hrs)	300 ppm	NA	NA	NA	25 ppm	100 ppm	NA	50 ppm	9.32 eV	NIOSH 100	Yes	127-18-4
NA	NA	5 ppm	NA	pm (60 min)	5 ppm	NA	NA	250 ppm	8.50 eV	NIOSH 254	No	108-95-2
NA	NA	1000 ppm	NA	NA	1000 ppm	NA	NA	2100 ppm	11.07 eV	NIOSH S87	No	74-98-6
NA	NA	NA	NA	NA	75 ppm	110 ppm	NA	400 ppm	10.87 eV	NIOSH 101	Yes	78-87-5
NA	NA	5 ppm	NA	NA	1 ppm	NA	NA	1000 ppm	9.27 eV	NIOSH 161	No	110-86-1
NA	NA	10 ppm	20 ppm	NA	10 ppm	20 ppm	NA	ND	8.63 eV	NIOSH 570	No	108-46-3
NA	NA	NA	NA	2 mg/m3	NA	NA	2 mg/m3	10 mg/m3	NA	NIOSH 740	No	1310-73-2
200 ppm	5 min/3 hrs)	50 ppm	100 ppm	NA	20 ppm	40 ppm	NA	700 ppm	8.40 eV	NIOSH 150	No	100-42-5
200 ppm	5 min/2 hrs)	NA	NA	NA	50 ppm	100 ppm	NA	1000 ppm	9.45 eV	NIOSH 102	Yes	79-01-6
NA	NA	1 ppm	NA	NA	1 ppm	NA	NA	100 ppm	11.10 eV	NIOSH 101	Yes	79-34-5
5 min/3 hrs)	300 ppm	NA	NA	NA	25 ppm	100 ppm	NA	50 ppm	9.32 eV	NIOSH 100	Yes	127-18-4
NA	NA	.075 mg/m3	NA	NA	0.1 mg/m3	NA	NA	40 mg/m3	NA	NIOSH 253	No	78-00-2
NA	NA	200 ppm	250 ppm	NA	50 ppm	100 ppm	NA	2000 ppm	9.45 eV	NIOSH1608	No	109-99-9
NA	NA	2 mg/m3	NA	NA	2 mg/m3	NA	NA	100 mg/m3	NA	NIOSH 730	No	7440-31-5
300 ppm	pm (10 min)	100 ppm	150 ppm	NA	50 ppm	NA	NA	500 ppm	8.82 eV	NIOSH 150	No	108-88-3
NA	NA	NA	NA	NA	2 ppm	NA	NA	50 ppm	7.44 eV	NIOSH 200	Yes	95-53-4
NA	NA	NA	NA	5 ppm	NA	NA	5 ppm	ND	NA	NIOSH 551	No	120-82-1
NA	NA	NA	NA	pm (15 min)	350 ppm	450 ppm	NA	700 ppm	11.00 eV	NIOSH 100	No	71-55-6
200 ppm	5 min/2 hrs)	NA	NA	NA	50 ppm	100 ppm	NA	1000 ppm	9.45 eV	NIOSH 102	Yes	79-01-6
NA	NA	10 ppm	15 ppm	NA	5 ppm	15 ppm	NA	ND	7.82 eV	OSHA PV2	Yes	75-50-3
NA	NA	25 ppm	NA	NA	25 ppm	NA	NA	ND	8.48 eV	OSHA PV2	No	526-73-8
NA	NA	25 ppm	NA	NA	25 ppm	NA	NA	ND	8.27 eV	OSHA PV2	No	95-63-6
NA	NA	25 ppm	NA	NA	25 ppm	NA	NA	ND	8.39 eV	OSHA PV2	No	108-67-8
pm (15 min)	NA	NA	NA	NA	1 ppm	NA	NA	ND	9.99 eV	NIOSH 100	Yes	75-01-4
NA	NA	100 ppm	NA	NA	50 ppm	100 ppm	NA	400 ppm	8.20 eV	NIOSH 150	No	25013-15-4
NA	NA	100 ppm	150 ppm	NA	100 ppm	150 ppm	NA	900 ppm	8.56 eV	NIOSH 150	No	108-38-3

NA	NA	100 ppm	150 ppm	NA	100 ppm	150 ppm	NA	900 ppm	8.56 eV	NIOSH 150	No	95-47-6
NA	NA	100 ppm	150 ppm	NA	100 ppm	150 ppm	NA	900 ppm	8.44 eV	NIOSH 150	No	106-42-3

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.

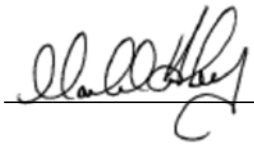
5. References

- Compressed Gas Association – Pamphlet P1 (***Safe Handling of Compressed Gases in Containers***)
- ISO Standard 11625 (***Gas Cylinders – Safe Handling***)

Document Control Information

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***)

Document Control Information

Original Effective Date: 4/29/16

Policy Approval by: Mark Hickey

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	3
	Title: **Site Safety Meeting Form**		**Last Revision Date:**	1/16/17

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?
☐ 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.

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:** _____

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

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.

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 (*S1-ERM-003-FM1*).

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.

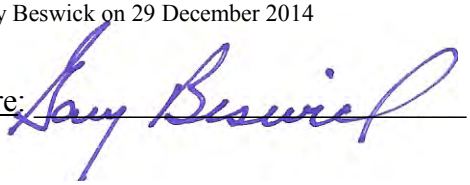
5. References

- S1-ERM-003-FM1 - SSE Mentor Assessment Form

Document Control Information

Original Effective Date: 1 April 2015

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

ERM Vehicle Safety Checklist

Date	Operator	Project# 0304393	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 criteria for consistent reporting and recording for work-related injuries and illnesses, and the methodology for calculating injury/illness related reporting metrics. **Figure 1** summarizes the Recordability Decision process.

In certain circumstances, ERM employees and entities may have a duty to record and report data on injuries and illnesses of certain ERM Agents or Contractors if the work of an Agent or Contractor is directly supervised by an ERM employee on a daily basis.

2. Roles and Responsibilities

Global H&S Director (GHSD). Issue a final determination on whether an injury/illness is ERM Recordable in the event of disagreement, in consultation with the responsible Regional H&S Lead, Regional CEO, ERM Legal Department and Executive Committee.

Regional Health and Safety (H&S) Lead. Determine Recordability within 3 days of receiving notice of an injury or illness via ERM's Event Communication System (ECS); update the record as required until the event is complete and the employee has returned to normal duties; communicate with regulatory authorities regarding Regulatory Reportable or Recordable Injuries/Illnesses (in consultation with the GHSD and the Legal Department, and following approval by a member of the Executive Committee).

All employees. Immediately notify the PIC (for project-related events) or Office Head (for non-project related events), and the BU H&S Lead of a suspected work-related injury or illness, and enter the event into ECS within 24 hours.

3. Definitions

Agent. Any member of any ERM entity board, any officer of any ERM entity, hired personnel, consultants, intermediaries, lobbyists, agents, representatives, independent contractors, subcontractors, and any others who act on ERM's behalf.

Aggravated Pre-existing Condition. When an event or exposure in the work environment results in any of the following:

- Death provided that the pre-existing injury or illness would likely not have resulted in death but for the occupational event or exposure.
- Loss of consciousness provided that the pre-existing injury or illness would likely not have resulted in loss of consciousness but for the occupational event or exposure.
- One or more days away from work, or days of restricted work, or days of job transfer that otherwise would not have occurred but for the occupational event or exposure.

- Medical treatment in a case where no previous medical treatment was needed for the pre-existing injury or illness before the workplace event or exposure, or a change in medical treatment was necessitated by the workplace event or exposure.

Employee. Any personnel hired directly by ERM (regardless of status classification of full-time, part-time, temporary, contract, etc.); interns (even if an intern does not receive payment by ERM); employees of other companies seconded into ERM, and any ERM employee seconded to a non-ERM company.

ERM Recordable Incident: A Medical Treatment Incident (MTI), Restricted Work Incident (RWI), Lost Time Incident (LTI), or fatality that meets the requirements in this procedure and which is used in establishing our externally reported Total Recordable Incident Rate (TRIR)..

First aid. First Aid Incident is any injury or illness that does not require medical treatment, require work restrictions or result in Lost Time away from work as defined below. The following are examples of this definition (but not limited to):

- Using a non-prescription medication at non-prescription strength (for medications available in both prescription and non-prescription form, a recommendation by a physician or other licensed health care professional to use a non-prescription medication at prescription strength is considered medical treatment);
- Administering routine preventative tetanus immunizations;
- Cleaning, flushing or soaking wounds on the surface of the skin;
- Using wound coverings such as bandages, Band-Aids™, gauze pads, etc.; or using butterfly bandages or Steri-Strips™ (other wound closing devices such as sutures, staples, etc., are considered medical treatment);
- Using hot or cold therapy;
- Using any non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc. (devices with rigid stays or other systems designed to immobilize parts of the body are considered medical treatment);
- Using temporary immobilization devices while transporting an accident victim (e.g., splints, slings, neck collars, back boards, etc.);
- Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;
- Using eye patches;
- Removing foreign bodies from the eye using only irrigation or a cotton swab;
- Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;
- Using finger guards;
- Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes); or
- Drinking fluids for relief of heat stress.

Note: The above are considered first aid, whether or not treatment is accepted

Lost Time Incident (LTI – Days Away from Work Recordable): A work-related injury or illness that results in the affected party being unable to report to work for one or more days, excluding the day of injury or onset of illness.

Medical Treatment Incident (MTI – Other Recordable): A work-related injury or illness that requires professional medical treatment, not defined as first aid above, that should be administered by a physician. The following are examples of this definition (but not limited to):

- Sutures,
- Broken bones
- Recommendation of prescription medication
- Loss of consciousness
- Other injury or illness that is not considered first aid

Note: Observation, counselling and scans (xrays, MRI's etc) are not medical treatment.

Near Miss: An unplanned event that did NOT result in injury, illness, or damage – but had the potential to do so. Only a fortunate break in the chain of events prevented an injury, illness, property damage or environmental impact. For example, slipping on a staircase and falling to the ground that results in no injury, visible bruising and/or lasting impacts (i.e. pain/discomfort). If the same event were to result in visible bruising and/or lasting impacts with no medical treatment, the event would be classified as first-aid.

Regulatory Recordable Incident: An injury or illness that is considered recordable within the jurisdiction of the affected employee. These requirements may be more or less stringent than the ERM Recordable definition.

Reportable Injury: Any injury or illness that must be reported to a governmental authority within the jurisdiction of the affected employee.

Restricted Work Incident (RWI). A work-related injury or illness where:

- The employee is restricted by an ERM manager from performing one or more of the routine functions of his or her job, or from working the full workday that he or she would otherwise have been scheduled to work; or
- A physician or other licensed health care professional recommends that the employee not perform one or more of the routine functions of his or her job, or not work the full workday that he or she would otherwise have been scheduled to work.

Routine functions. For recordkeeping purposes, an employee's "routine functions" are those work activities the employee regularly performs at least once per week.

Workplace: Any location where one or more employees are directly engaged in activities related to the performance of their work assignment, or are present as a condition of their employment.

The workplace includes not only physical locations, but also the equipment or materials used by the employee during the course of work.

Work Related: An injury or illness is considered work-related if an event or exposure in the workplace either:

- caused or contributed to the resulting condition; or
- significantly aggravated a pre-existing injury or illness.

The following exceptions to "work-related" apply:

- At the time of the injury or illness, the employee was present in the work environment as a member of the general public rather than as an employee.
- The injury or illness involves signs or symptoms that surface at work but result solely from a non-work-related event or exposure that occurs outside the work environment.
- The injury or illness results solely from voluntary participation in a wellness program or in a medical, fitness, or recreational activity such as blood donation, physical examination, flu shot, exercise class, racquetball, or baseball.
- The injury or illness is solely the result of an employee eating, drinking, or preparing food or drink for personal consumption (whether bought on the employer's premises or brought in).
- The injury or illness is solely the result of an employee doing personal tasks (unrelated to their employment) at the establishment outside of the employee's assigned working hours.
- The injury or illness is solely the result of personal grooming, self medication for a non-work-related condition, or is intentionally self-inflicted.
- The injury or illness is caused by a motor vehicle accident and occurs on a company parking lot or company access road while the employee is commuting to or from work.
- The illness is the common cold or flu (note: other contagious diseases such as tuberculosis, brucellosis, hepatitis A, or plague may be considered work-related if the employee is confirmed as having been infected at work).
- The illness is a mental illness.

4. Procedure

4.1 Mandatory Notification

All Employees shall immediately notify their supervisor of any injury and/or illness suspected to be work-related.

Any injury or illness known or suspected to be work related shall also be verbally disclosed as quickly as possible following the occurrence, and no later than the end of the current work shift, to the PIC (for project-related events) or Office Head (for non-project related events), and the

BU H&S Lead. In addition, the employee shall enter the event into ECS within 24 hours (if able; otherwise, the employee's Line Manager shall enter the event).

4.2 ERM Recordable Injury

Within three (3) days of receiving notification of an injury or illness, the Regional H&S Lead, or designee, shall document whether an event is Recordable within ECS. If information relevant to the injury or illness becomes available after the initial submittal of the event into ECS, the Regional H&S Lead shall update the record as soon as practical.

A separate ECS entry shall be completed for each ERM employee with an injury/illness.

In the event of dispute/disagreement, the GHSD, in consultation with the responsible Regional H&S Lead, RCEO, ERM Legal Department and Executive Committee leadership, will make final case determinations regarding ERM Recording of work-related injury and illness cases. Interpretation of the recording rationale will be documented and maintained by the GHSD, The final determination will be documented by the GHSD within 90 days of the incident, to the extent practicable based on the availability of necessary information.

4.2.1 Determination of Work Related

The Regional H&S Lead shall determine if an injury is Work Related, based on the definitions and exceptions in Section 3. Two special conditions are discussed below.

Injury/illness while traveling. An injury/illness that occurs while an employee is travelling for business is work-related if, at the time of the injury or illness, the employee was engaged in work activities "in the interest of the employer" (e.g., travel to and from clients, conducting job tasks, site visits, and business entertaining). Exceptions to this requirement include:

- Home away from home. When a travelling employee checks into a hotel, motel, or into another temporary residence, he or she establishes a "home away from home." The employee's activities after he or she checks into the hotel, motel, or other temporary residence must be evaluated for their work-relatedness in the same manner as the activities of a non-travelling employee. When the employee checks into the temporary residence, he or she is considered to have left the work environment. When the employee begins work each day, he or she re-enters the work environment. If the employee has established a "home away from home" and is reporting to a fixed worksite each day, injuries/illnesses are not work-related if they occur while the employee is commuting between the temporary residence and the job location.
- Injuries that occur during a Personal Detour. Injuries or illnesses are not considered work-related if they occur while the employee is on a personal detour from a reasonably direct route of travel (e.g, has taken a side trip for personal reasons).

Injury/illness while working at home. An injury/illness that occurs while an employee is working at home, including work in a home office, is work-related if the injury/illness occurs while the

employee is performing work for pay or compensation in the home, and the injury or illness is directly related to the performance of work rather than to the general home environment or setting.

4.2.2 Determination of ERM Recordable

A work-related injury or illness incurred by an ERM employee is considered ERM Recordable if it results in one or more of the following:

- Death;
- Days away from work;
- Restricted work or transfer to another job;
- Medical treatment beyond first aid;
- Loss of consciousness;
- Constitutes a needle stick or sharp injury; or
- A significant injury or illness diagnosed by a physician or other licensed health care professional as work related

The following medical activities are specifically excluded from the definition of "medical treatment" and do not trigger a recording requirement:

- Visits to a physician or other licensed health care professional solely for observation or counselling; and
- The conduct of diagnostic procedures, such as x-rays and blood tests, including the administration of prescription medications (as defined by local jurisdictions) used solely for diagnostic purposes (e.g., eye drops to dilate pupils)
- First aid.
- If medical prophylaxis is used for the prevention of malaria or other diseases while travelling.
- If herbal or natural supplements are used.
- If oxygen is used while working at elevations as used a part of a normal work practice, not for the treatment of altitude sickness of other working at higher elevation illnesses.
- If medications for the prevention of seasickness or motion sickness are used.

4.2.3 Determining Duration of Hospitalization, Lost Time and Restricted Work

Within 3 days of receiving notice of an injury/illness from ECS, the Regional H&S Lead shall make a general estimate of the number of days that the employee may experience:

- Hospitalization: time spent within a hospital or other in-patient medical facility.
- Lost time: time spent away from work as designated by a physician or other licensed health care professional.

- Restricted work: time when an employee cannot perform their routine duties, at the direction of a physician or other licensed health care professional, or their ERM Line Manager.

If the estimated duration has elapsed without the condition being resolved, the Regional H&S Lead shall update ECS with a revised estimate. Once the actual duration of these conditions is known, the Regional H&S Lead shall update ECS with the actual duration.

When determining duration, the following considerations apply:

- Do not count the day that the injury/illness occurred.
- Count calendar days from day following the occurrence of the injury/illness.
- If the injury/illness occurs prior to a day that the employee was not scheduled to work (e.g., holiday or weekend), these unscheduled days are only counted if you receive information from the physician or other licensed health care professional that the employee should not have worked, or should have performed restricted work, during the unscheduled period.
- The maximum total days of lost time plus restricted work that shall be recorded is 180 days (the 180-day cap).

4.3 Regulatory Recordable Injury and Reporting

Local regulatory recording and reporting requirements may be different from ERM recording requirements.

As appropriate following a proper review of the conditions/circumstances associated with the injury or illness, and in accordance with promulgated time expectations for reporting by the appropriate regulatory authorities, ERM will submit the required information to the respective entity(ies) [such as U.S. OSHA, U.S. Mine Safety and Health Administration (MSHA), UK Health and Safety Executive (HSE), etc.]. Communications with regulatory authorities will be conducted by the Business Unit Managing Partner (or designee), in consultation with the Regional H&S Lead, GHSD and the Legal Department.

4.4 Record Keeping

ERM maintains statistics associated with Injury and Illness Reporting that are submitted to the Senior Leadership Team on a monthly basis. The reports document, among other things, the Total Recordable Incident Rate (TRIR) and the number of Restricted Work Days and Lost Time Days.

4.4.1 Calculating TRIR

TRIR is calculated as:

$$TRIR = \frac{(Number\ of\ ERM\ Recordable\ Injuries\ \&\ Illnesses) * 200{,}000}{Number\ of\ Hours\ Worked\ by\ ERM}$$

Where:

- "Number of ERM Recordable Injuries & Illnesses" is as defined in Section 4.2. The calculation shall be based upon the rational identified within the completed "Recordability Review Form." If further investigation of the event results in a modification to the information on the form, the TRIR number will be modified accordingly.
- "200,000" is a standard normalization factor based on the typical number of hours worked by 100 employees
- "Number of Hours Worked by ERM" is based on info obtained from GMS for full- or part-time employees, and does not include recorded sick time, vacation time or holidays.

4.4.2 Calculating Restricted Work Day and Lost Time Days

Restricted Work Days and Lost Time Days shall be calculated as follows:

- The number of days reported on a monthly basis will be either:
  - For completed (or "Closed") events, where the employee has returned to full duty, the actual number of restricted or lost time days shall be reported.
  - For ongoing (or "Open") events, where the employee remains on restricted duty or off work, the number of total days reported shall be estimated.

- The number of days reported on annual reports will be either:
  - For completed (or "Closed") events, where the employee has returned to full duty, the actual number of restricted or lost time days shall be reported.
  - For ongoing (or "Open") events, where the employee remains on restricted duty or off work, the number of days reported shall be estimated, unless otherwise indicated. In this case, when the actual number of days becomes known, the subsequent annual report shall, if appropriate, report the revised "Final" data for the previous reporting year.

5. References

None

Document Control Information

Original Effective Date: 1 April 2015

Approved by: Gary Beswick on 29 December 2014

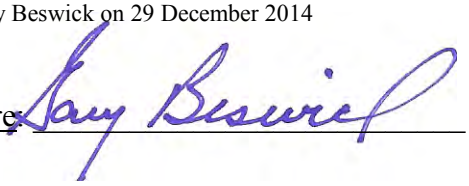
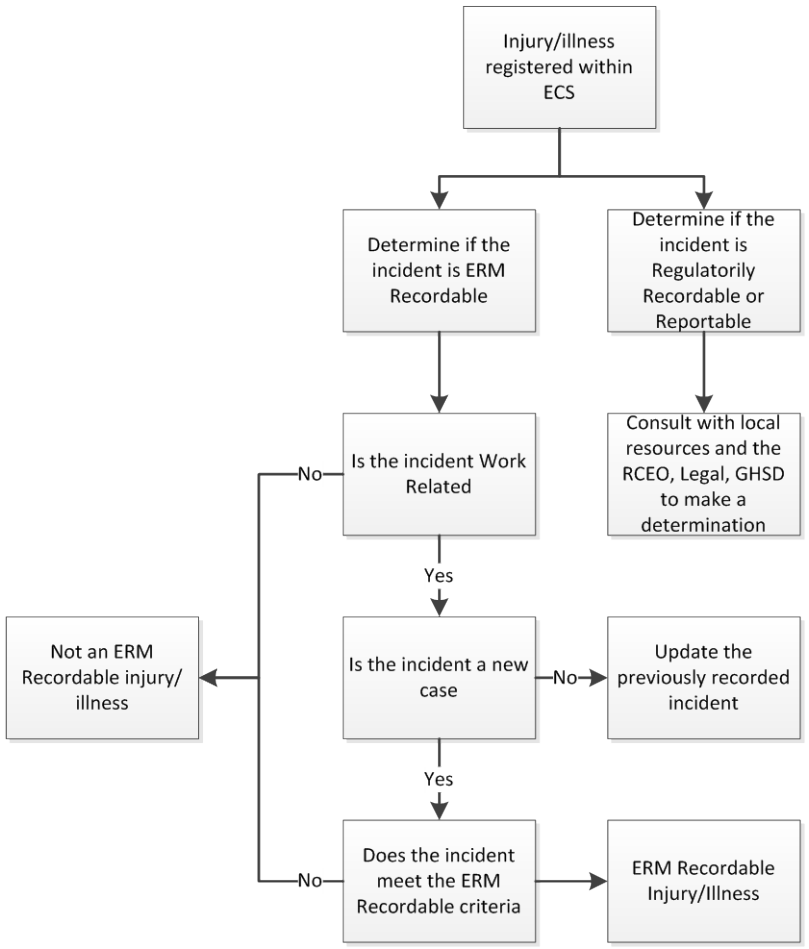
Approval Signature: 

Figure 1 – Recordability Decision Process



Revision History

Section	Version: Reason for Revision	Date
All	1.0: New document.	29 Dec 2014

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.

"Worst Case" Vapor Exposure Calculation
Volatile Compounds in Water

Common Volatile Contaminants	Concentration (site water) (ug/l)	Water Solubility (mg/l)	Vapor Pressure (torr)	OSHA PEL (ppm)	Concentr'n in Air (ppm)	Total vapor in Air (% by ppm)	Concentr'n in Air % of PEL
Acetone	0.E0	1,000,000.	180	1000	0.000	#DIV/0!	0.00%
Benzene	0.E0	1,750.	75	1	0.000	#DIV/0!	0.00%
Bromochloromethane	0.E0	15,000.	115	200	0.000	#DIV/0!	0.00%
Carbon Disulfide	0.E0	1,190.	297	20	0.000	#DIV/0!	0.00%
Carbon Tetrachloride	0.E0	793.	91	10	0.000	#DIV/0!	0.00%
Chlorobenzene	0.E0	500.	9	75	0.000	#DIV/0!	0.00%
Chloroform	0.E0	7,920.	160	50	0.000	#DIV/0!	0.00%
Cresol	0.E0	20,000.	0.18	5	0.000	#DIV/0!	0.00%
1,2-Dichlorobenzene	0.E0	156.	1	50	0.000	#DIV/0!	0.00%
1,4-Dichlorobenzene	0.E0	74.	1.3	75	0.000	#DIV/0!	0.00%
1,1-Dichloroethane	0.E0	6,000.	182	100	0.000	#DIV/0!	0.00%
1,2-Dichloroethane	0.E0	9,000.	64	50	0.000	#DIV/0!	0.00%
cis-1,2-Dichloroethylene	0.E0	3,500.	200	200	0.000	#DIV/0!	0.00%
trans-1,2-Dichloroethylene	0.E0	6,300.	200	200	0.000	#DIV/0!	0.00%
1,4-Dioxane	0.E0	1,000,000.	29	100	0.000	#DIV/0!	0.00%
Ethyl Benzene	0.E0	170.	7	100	0.000	#DIV/0!	0.00%
Ethyl Chloride	0.E0	6,000.	1000	1000	0.000	#DIV/0!	0.00%
2-Hexanone	0.E0	20,000.	11	100	0.000	#DIV/0!	0.00%
Methyl Chloride	0.E0	5,000.	3800	100	0.000	#DIV/0!	0.00%
Methyl Ethyl Ketone	0.E0	280,000.	78	200	0.000	#DIV/0!	0.00%
Methylene Chloride	0.E0	13,000.	350	25	0.000	#DIV/0!	0.00%
Naphthalene	0.E0	31.	0.08	10	0.000	#DIV/0!	0.00%
Propylene Dichloride	0.E0	3,000.	40	75	0.000	#DIV/0!	0.00%
Styrene	0.E0	310.	5	100	0.000	#DIV/0!	0.00%
1,1,2,2-Tetrachloroethane	0.E0	2,970.	5	5	0.000	#DIV/0!	0.00%
Tetrachloroethylene	0.E0	200.	14	200	0.000	#DIV/0!	0.00%
Toluene	0.E0	526.	21	200	0.000	#DIV/0!	0.00%
1,1,1-Trichloroethane	0.E0	1,330.	100	350	0.000	#DIV/0!	0.00%
1,1,2-Trichloroethane	0.E0	4,420.	19	10	0.000	#DIV/0!	0.00%
Trichloroethylene	0.E0	1,100.	58	100	0.000	#DIV/0!	0.00%
Vinyl Chloride	0.E0	2,760.	2508	1	0.000	#DIV/0!	0.00%
Xylene	0.E0	175.	8.3	100	0.000	#DIV/0!	0.00%
Totals	Combined Volatiles Level (ppm)				.	#DIV/0!	
Totals	Fraction Combined Exposure Limit						0.00%

Instructions: To estimate the potential "worst case" exposure, enter the known water concentration (in micrograms per liter, or ug/l) of the contaminant of concern in the box to the right of the known contaminant. If more than one contaminant is present, enter information for each. If the 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.

"Worst Case" Vapor Exposure Calculation
Volatile Compounds in Soil

Carbon Fraction = 0.1

Common Volatile Contaminants	Concentration (site soil) (mg/Kg)	Water Solubility (mg/l)	Vapor Pressure (torr)	Organic Carbon Partition Coefficient	OSHA PEL (ppm)	Saturation Concentration in Air (ppm)	Fraction of Total Vapor in Air (% by ppm)	Saturation Concentration in Air (% of PEL)
Acetone	0.E0	1,000,000.	180	0.23	1000	0.E+0	#DIV/0!	0.00%
Benzene	0.E0	1,750.	75	83	1	0.E+0	#DIV/0!	0.00%
Bromochloromethane	0.E0	15,000.	115	13	200	0.E+0	#DIV/0!	0.00%
Carbon Disulfide	0.E0	1,190.	297	54	20	0.E+0	#DIV/0!	0.00%
Carbon Tetrachloride	0.E0	793.	91	110	10	0.E+0	#DIV/0!	0.00%
Chlorobenzene	0.E0	500.	9	330	75	0.E+0	#DIV/0!	0.00%
Chloroform	0.E0	7,920.	160	31	50	0.E+0	#DIV/0!	0.00%
1,2-Dichlorobenzene	0.E0	156.	1	1700	50	0.E+0	#DIV/0!	0.00%
1,4-Dichlorobenzene	0.E0	74.	1.3	1700	75	0.E+0	#DIV/0!	0.00%
1,1-Dichloroethane	0.E0	6,000.	182	30	100	0.E+0	#DIV/0!	0.00%
1,2-Dichloroethane	0.E0	9,000.	64	14	50	0.E+0	#DIV/0!	0.00%
cis-1,2-Dichloroethylene	0.E0	3,500.	200	59	200	0.E+0	#DIV/0!	0.00%
trans-1,2-Dichloroethylene	0.E0	6,300.	200	59	200	0.E+0	#DIV/0!	0.00%
1,4-Dioxane	0.E0	1,000,000.	29	3.5	100	0.E+0	#DIV/0!	0.00%
Ethyl Benzene	0.E0	170.	7	1100	100	0.E+0	#DIV/0!	0.00%
Ethyl Chloride	0.E0	6,000.	1000	11	1000	0.E+0	#DIV/0!	0.00%
2-Hexanone	0.E0	20,000.	11	9.8	100	0.E+0	#DIV/0!	0.00%
Methyl Chloride	0.E0	5,000.	3800	35	100	0.E+0	#DIV/0!	0.00%
Methyl Ethyl Ketone	0.E0	280,000.	78	4.5	200	0.E+0	#DIV/0!	0.00%
Methylene Chloride	0.E0	13,000.	350	8.8	25	0.E+0	#DIV/0!	0.00%
Naphthalene	0.E0	31.	0.08	400	10	0.E+0	#DIV/0!	0.00%
Propylene Dichloride	0.E0	3,000.	40	40.1	75	0.E+0	#DIV/0!	0.00%
Styrene	0.E0	310.	5	365	100	0.E+0	#DIV/0!	0.00%
1,1,2,2-Tetrachloroethane	0.E0	2,970.	5	118	5	0.E+0	#DIV/0!	0.00%
Tetrachloroethylene	0.E0	200.	14	364	200	0.E+0	#DIV/0!	0.00%
Toluene	0.E0	526.	21	300	200	0.E+0	#DIV/0!	0.00%
1,1,1-Trichloroethane	0.E0	1,330.	100	152	350	0.E+0	#DIV/0!	0.00%
Trichloroethylene	0.E0	1,100.	58	126	100	0.E+0	#DIV/0!	0.00%
Vinyl Chloride	0.E0	2,760.	2508	57	1	0.E+0	#DIV/0!	0.00%
Xylene	0.E0	175.	8.3	240	100	0.E+0	#DIV/0!	0.00%
Totals	Combined Volatiles Level (ppm)					.	#DIV/0!	
								0.00%

Instructions: To estimate the potential "worst case" exposure, 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. If more than one contaminant is present, enter information for each. If the 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.

INSTRUCTIONS:

Use **Areas of Inquiry Sheet** to prompt discussions with investigation team / project team and person(s) involved. An answer of "NO" to any question should be further investigated through root cause analysis.

Once all data / facts / information have been gathered, add these to the **General Information** tab, including any photos, sketches, etc.

Complete RCA Worksheet - instructions are provided on the form. Only an ERM-trained RCA facilitator should lead the RCA and complete this form.

Example RCA worksheets are provided on the purple tabs.

If you need help completing this sheet or if you have questions or comments, please contact your Division H&S Leader.

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?		

General Information - (Event Description)

Briefly describe the event here

Provide additional relevant details here

ERM Root Cause Analysis Worksheet, Americas Version 1.2

Project Name: _____

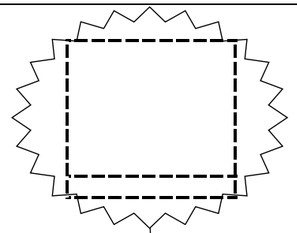
Project Number: _____

Completed By: _____

RCA Team Members: _____ _____ _____

(include name and title) _____ _____ _____

_____ _____ _____



Briefly describe the incident and negative consequence(s) that occurred.
For near misses or unsafe acts/conditions, describe the incident and negative consequence(s) that ***could have*** occurred.

Select event type from list

AND AND AND AND

Cause: [ADD] | Cause: [ADD] | Cause: [ADD] | This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet. This row: For last cause in chain, select "RC", "CF" or "OC" - otherwise leave blank | Cause: [ADD] | Cause: [ADD]

Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]

These rows: Briefly describe each successive cause by asking the question "why did the cause listed in the box above occur, or how did the cause listed above occur?" Use branches for more than one cause. If a root cause is reached, select "RC" in bottom of cell. Use the line connectors at bottom of page to make proper connections between boxes (copy / paste and position connector appropriately), or print out worksheet and draw connections by hand.

Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]	Corrective Action(s): [ADD]

Add corrective actions for each identified RC

Copy and paste this connector line to connect boxes vertically: |

Copy and paste these connector lines to connect boxes that branch: ┌ ┐

For last cause in chain:

RC Root Cause - the underlying cause, for which we have control (usually a management system cause or not following an established system) - "Why did it happen?"

CF Causal or Contributing Factor - action or condition that directly caused the event - "How did it happen?"

OC Factor Outside ERM's Control, or a Proper Condition

ERM Root Cause Analysis Worksheet, v1.1
FIELD VERSION

Project Name: _____

Project Number: _____

Completed By: _____

RCA Team Members: _____ _____ _____
(include name and title) _____ _____ _____
_____ _____ _____

Incident | Near Miss | Usafe Act/Condition

Briefly describe the event and negative consequence(s) that occurred.
For near misses or unsafe acts/conditions, describe the incident and negative consequence(s) that ***could have*** occurred.

Circle event type

AND AND AND AND

Cause: | Cause: | Cause: | This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet. If a root cause, circle box and indicate "RC" | Cause: | Cause:

Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:	Cause:
Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):	Corrective Action(s):

These rows: Briefly describe each successive cause by asking the question "why did the cause listed in the box above occur, or how did the cause listed above occur?" Draw connectors between boxes and use branches for more than one cause. If a root cause is reached, circle the box and indicate with "RC."

ERM Example #1 - ERM Truck Damaged

While backing an ERM F150 truck out of the designated basement parking space at an ERM office, the driver-side mirror was damaged when it struck a cement pillar.
During incident follow-up and data gathering, it was determined that this was the first time the employee had driven the ERM truck or attempted to back out of the assigned space. He received no orientation or training on driving hazards associated with truck or parking garage. The parking garage is not well lit. There is a cement wall on the opposite side of the garage, so that one cannot back straight out of the space, but instead must turn to avoid hitting the wall. The white pillar is not highly visible against the white walls of the garage. The employee was focused on not hitting the ERM van parked in the adjacent stall, or hitting the wall on the opposite side. The employee stated that he "could benefit from some refresher training" on proper scanning techniques during backing up.

ERM Root Cause Analysis Worksheet, v1.0

Project Name:	Parking Garage at ERM Office	RCA Team Members:	Person involved	Safety advisor			
Project Number:	n/a	(include name and title)	Witness (passenger)	PM			
Completed By:	Safety Advisor		Fleet manager	PIC			

ERM Truck Damaged After Backing Into Cement Pillar
Incident

Briefly describe the incident and negative consequence(s) that occurred.
For near misses, describe the incident and negative consequence(s) that ***almost*** occurred.

Select event type from list

AND AND AND AND

	Cause: Pillar present **proper condition**		Cause: Driver backing out **proper condition**		Cause: Driver contacted pillar	This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet. If a root cause, select "RC"	Cause: [ADD]		Cause: [ADD]	
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Pillar not very visible	Cause: Lack of experience driving F150, backing out of this stall	Cause: Scanning technique while backing not adequate to prevent accident	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Building mgmnt did not install adequate lighting **beyond control**	Cause: Painted same white color as walls, doesn't stand out very well	Cause: No procedure in place to train new drivers on F150, backing in/out of tight spaces in parking garage **RC**	Cause: Employee not familiar with proper scanning techniques	Cause: No spotter used	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Building management painted that way **RC**	Cause: [ADD]	Cause: Employee had not had driver safety training in several years (since he got his license)	Cause: Not required by policy **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Training not required by Management **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]

These rows: Briefly describe each successive cause by asking the question "why did the cause listed above occur?" Use branches for more than one cause. If a root cause is reached, select "RC" in bottom of cell. Use the line connectors at bottom of page to make proper connections between boxes (copy/ paste and position connector appropriately), or print out worksheet and draw connections by hand.

Copy and paste to connect boxes vertically:

Copy and paste these connector lines to connect boxes that branch:

Non-ERM Example #1 - Forklift Accident

from ChevronTexaco EMC Root Cause Analysis / Incident Investigation Two Day Facilitator Training, March 2006

Employee "A" was using a 6' ladder to change a light bulb in a warehouse. Employee "B" was driving a forklift loaded with a pallet of lubricating oil. The forklift moved down the aisle and struck the ladder, knocking employee "A" off the ladder and injuring him. Employee "B" stopped the forklift, ran to the injured employee "A" and administered first aid until paramedics arrived. After the incident, the forklift operator stated: "I could not stop in time to avoid the ladder and no one told me the ladder was there."
Data collection revealed that the brakes were worn beyond recommended replacement tolerances. It was also revealed that while there was a maintenance plan for the forklift dated January 1995, it had not been followed for a long time. It was last inspected in April. The investigation also revealed that the reporting process for maintenance items didn't work well and was rarely used. It was also a common practice not prohibited by procedures, to perform tasks in aisles without providing for some means of barricade or protection for the maintenance workers and the forklift drivers. Since the bulb was the only one in the area by design, the lighting was inadequate after the bulb went out.

ERM Root Cause Analysis Worksheet, v1.0

Project Name: Forklift Scenario

Project Number: 54321

Completed By: M. Boardman

RCA Team Members: (include name and title)

M. Boardman, ND Safety Advisor
J. Dylan, PIC
K. Stevenson, Employee A
B. Rickman, Employee B
R. Ecord, Americas Safety Leader

Fall Off Ladder Resulting in Injury
Incident

Briefly describe the incident and negative consequence(s) that occurred.
For near misses, describe the incident and negative consequence(s) that ***almost*** occurred.

Select event type from list

AND AND AND AND

This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet
If a root cause, select "RC"

Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Standing On Ladder	Cause: Forklift Struck ladder	Cause: [ADD]	Cause: [ADD]				
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Change light bulb	Cause: Ladder in aisle	Cause: Forklift moving down aisle	Cause: Forklift operator didn't know ladder in aisle	Cause: [ADD]	Cause: Forklift operator could not stop in time to avoid hitting ladder	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Bulb burned out after 6 years of service	Cause: Change light bulb	Cause: Poor lighting	Cause: No barricades / cones	Cause: Not communicated	Cause: Worn brakes	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Bulb burned out after 6 years of service	Cause: Only one bulb in area	Cause: Not required by procedures **RC**	Cause: Not required by work permitting system **RC**	Cause: Normal wear and tear	Cause: Brakes not inspected per maintenance plan	Cause: Problem not reported
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Poor design **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Inspection process not enforced **RC**	Cause: Reporting process inadequate **RC**
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]

These rows: Briefly describe each successive cause by asking the question "why did the cause listed in the box above occur, or how did the cause listed above occur?" Use branches for more than one cause. If a root cause is reached, select "RC" in bottom of cell. Use the line connectors at bottom of page to make proper connections between boxes (copy / paste and position connector appropriately), or print out worksheet and draw connections by hand.

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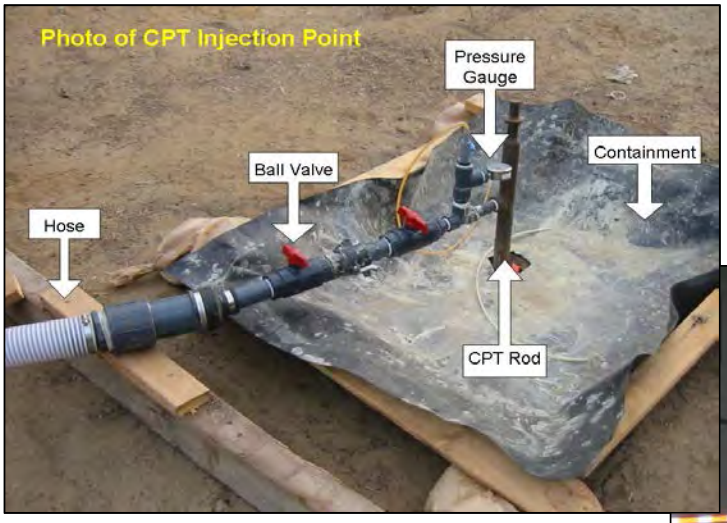
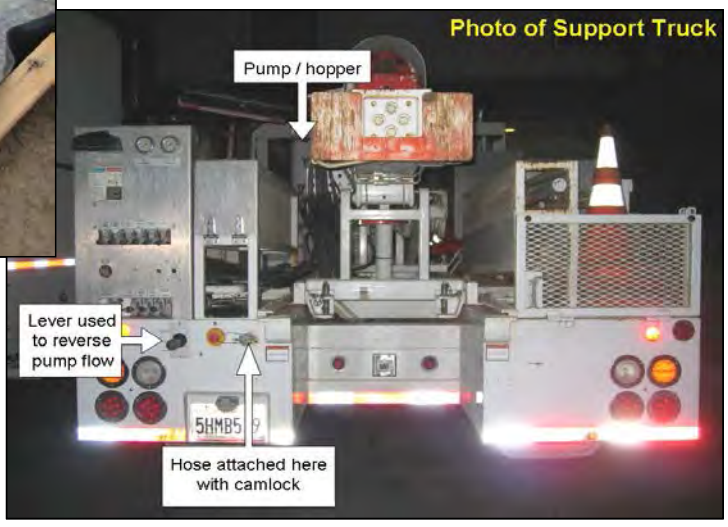
ERM Example #2 - Chemical Exposure During Injection

A chemical reductant (high pH, corrosive) was being injected into the subsurface to remediate metals contamination at a project site. The reductant was being injected under pressure into cone penetrometer test (CPT) rods using a 200 psi pump mounted on the back of a support truck. Immediately after starting to inject, high pressures were observed at the injection point and the camlock fitting connecting the injection hose to the back of the support truck began to leak. The system was immediately shut down and the pressure released by pumping solution back into the hopper on the support truck. However, there was still some pressure in the hose when it was disconnected from the support truck in an attempt to fix the leak, and solution sprayed out onto the employees. The employees were wearing Tyvek suits, goggles, and faceshields, but at the time of the incident, both employees had their faceshields up. As a result, the chemical sprayed on their faces, causing moderate skin irritation.

Data gathering indicated the following:

1. After emplacement of the CPT rods at the target depth, they were retracted to create an opening for the chemical to be injected. However, the disposable drive point at the end of the rods did not come off due to geologic conditions, resulting in no opening for the solution to flow out. There was no protocol established for checking that the drive point had been removed prior to the solution being pumped.
2. The hoses, fittings, and pressure gauge used for the project were designed for gravity feeding or low pressure injection, and were not compatible with the high pressures generated by the pump. After gravity feeding proved to be very slow, the injection method was modified to use the high pressure pump, without involvement of supervisors and senior engineering support to evaluate the impact of this change. The existing procedures were also not revised to account for this change and the potential hazards of pressurized injection.
3. No risk team review occurred, as the project team was not aware of this requirement and did not budget for it. The PIC did not enforce this requirement since he had skipped this process on prior projects with no consequences. The project budget proposal was prepared by a Jr. PM with limited experience (no one else was available to help at the time).
4. The project was behind schedule due to weather-related delays, and the switch to high-pressure injection was done to keep the project from going over schedule / over budget.
5. The resulting high pressures generated by the pump and the failure of the drive point to dislodge caused leaks to occur at the camlock fittings, which were not rated for such high pressures.
6. Pumping of solution back through the line and into the hopper was not adequate to dissipate pressure in the line, due to lack of experience by the operator and no localized pressure gauge at the discharge end of the pump. The operator had not received any training on the use of the pump, and the subcontractor JHA didn't include procedures for safe operation of the pump.
7. PPE use on the project was specified in the procedures, but working without lowering faceshields had become accepted practice over time on the site. Employees had decided it was OK to leave faceshields up because they didn't believe the chemical posed much risk and that the goggles alone would protect them.
8. Employees indicated that the PIC and PM had only visited the site once, on the first day for the kick-off meeting, and no field audits had occurred. PIC / PM were not aware of existing audit requirements.





ERM Root Cause Analysis Worksheet, v1.0

Project Name:	Chemical Injection, Client X Site	RCA Team Members:	B. Mucketymuck, PIC	J Doe, Subcontractor employee	R. Lewis, ERM Injection SME
Project Number:	12345	(include name and title)	D. Hall, SD Safety Advisor	R. Smith, Subcontractor supervisor	
Completed By:	D. Hall		IB Involved, ERM Field Geologist	D. Thomas, Project PM	

Incident: Employees splashed with chemical, causing skin irritation

Briefly describe the incident and negative consequence(s) that occurred. For near misses, describe the incident and negative consequence(s) that ***almost*** occurred.

Select event type from list

This row: briefly describe each causal factor from RCA "Areas of Inquiry" Worksheet

If a root cause, select "RC"

AND	AND	AND	AND
	Cause: Excess Pressure in Hose		Cause: Hose Connection Undone before Pressure Dissipated	Cause: Not Wearing PPE
Cause: CPT drive point didn't dislodge; no opening for chemical to enter subsurface	Cause: High-pressure pump used, not compatible with hoses / fittings	Cause: Pressure not fully dissipated	Cause: Operator mistakenly thought pressure was fully dissipated	Cause: Accepted practice
Cause: Geologic conditions	Cause: To speed up injection	Cause: Incompatibility not ID'd	Cause: No localized gauge to assess pressure	Cause: Operator didn't reverse pump flow long enough	Cause: Field employees didn't see the risk, thought goggles were enough	Cause: PPE use not audited	Cause: PPE use not enforced **RC**
Cause: [ADD]	Cause: No procedure **RC**	Cause: Didn't know to check	Cause: Schedule pressure	Cause: No risk review prior to changing process / equipment	Cause: Need for gauge not identified	Cause: Not trained / experienced **RC**	Cause: Procedures didn't specify how to do this **RC**	Cause: Lacked training on PPE, hazards of chemical **RC**	Cause: Audit requirements not well understood	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: Lack of experience / training	Cause: Weather delays	Cause: Not enforced by mgmnt **RC**	Cause: Not budgeted	Cause: Project Team not aware of this requirement	Cause: [ADD]	Cause: [ADD]	Cause: Process for communicating requirements inadequate **RC**	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: Training process inadequate **RC**	Cause: [ADD]	Cause: [ADD]	Cause: Jr PM prepared budget, lacked experience	Cause: Process for communicating requirements inadequate **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: Lack of adequate resources **RC**	Cause: Not trained in budget estimating **RC**	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]
Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]	Cause: [ADD]

These rows: Briefly describe each successive cause by asking the question "why did the cause listed in the box above occur, or how did the cause listed above occur?" Use branches for more than one cause. If a root cause is reached, select "RC" in bottom of cell. Use the line connectors at bottom of page to make proper connections between boxes (copy / paste and position connector appropriately), or print out worksheet and draw connections by hand.

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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.

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 Division Health and Safety (H&S) Leader.

Project Manager (PM)/Supervisor/Branch Manager (BM): 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 Division H&S Leader, any observed deficiencies in the implementation of this procedure.

Division H&S Leader: 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.

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 Z308.1-2014. Specifically, first aid kits placed in ERM offices should be ANSI/ISEA Class B, Type 1 kits (use in stationary indoor settings) and should contain the following items:

- Adhesive bandages, 1” x 3” (50 total)
- Adhesive tape, 2.5 yards each (2 total)
- Antibiotic applications, 0.5 grams each (25 total)
- Antiseptic applications, 0.5 grams each (50 total)
- Breathing barrier (1 total)
- Burn dressing, 4” x 4” (2 total)
- Burn treatment applications, 0.9 grams each (25 total)
- Cold pack, 4” x 5” (2 total)
- Eye covering (with means of attachment), 2.9 square inches (2 total)
- Eye/skin wash, 4 fluid ounces total
- First aid guide
- Hand sanitizer, 0.9 grams each (10 total)
- Medical exam gloves, 4 pair
- Roller bandage, 2” by 4 yards (2 total)
- Roller bandage, 4” by 4 yards (1 total)
- Scissors (1 total)
- Splint, 4” x 24” (1 total)
- Sterile pads, 3” x 3” minimum (4 total), non-stick
- Tourniquet, 1” width (1 total)
- Trauma pad, 5” x 9” (4 total)

- Triangular bandage, 40” x 40” x 56” (2 total)

First aid kits placed in ERM field vehicles or field trailers should be ANSI/ISEA Class A, Type IV kits (mobile, waterproof, and subject to rougher handling) and should contain the following items:

- Adhesive bandages, 1” x 3” (16 total)
- Adhesive tape, 2.5 yards each (1 total)
- Antibiotic applications, 0.5 grams each (10 total)
- Antiseptic applications, 0.5 grams each (10 total)
- Breathing barrier (1 total)
- Burn dressing, 4” x 4” (1 total)
- Burn treatment applications, 0.9 grams each (10 total)
- Cold pack, 4” x 5” (1 total)
- Eye covering (with means of attachment), 2.9 square inches (2 total)
- Eye/skin wash, 1 fluid ounce total
- First aid guide
- Hand sanitizer, 0.9 grams each (6 total)
- Medical exam gloves, 2 pair
- Roller bandage, 2” by 4 yards (1 total)
- Scissors (1 total)
- Sterile pads, 3” x 3” minimum (2 total), non-stick
- Trauma pad, 5” x 9” (2 total)
- Triangular bandage, 40” x 40” x 56” (1 total)

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 Branch Manager (BM) 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.

4.2 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 H&S 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 Division H&S Leader for more information regarding AED use.

ERM H&S staff should also be informed of the need to render first aid or seek additional medical treatment.

4.3 Bloodborne Pathogens Program

4.3.1 Exposure Determination

Due to the nature of ERM's typical office and field activities, it is highly unlikely that incidents involving ERM employees would result in exposure to blood or potentially infectious bodily fluids. Therefore, compliance with 29 CFR 1910.1030, ***Bloodborne Pathogens***, is not required. Although a written exposure control plan is not required, the following sections outline basic requirements to be followed if ERM employees voluntarily render first aid/CPR. Exposure determinations, as well as the precautions and work practices discussed below, are without regard to the use of personal protective equipment.

4.3.2 Training and Recordkeeping

ERM periodically offers first aid/CPR training that includes bloodborne pathogens training to employees as part of the overall health and safety program. 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 staff such projects.

Training, if needed, will be provided at or before the time of initial assignment and will be repeated annually (i.e., within one year of previous training) for as long as the employee remains in a work environment requiring exposure to bloodborne pathogens. Training records will be maintained in ERM's Academy Learning Management System (LMS). Any records maintained within the Academy LMS are available upon request by employees or their representatives and any government official.

The Medical Recordkeeping Coordinator is responsible for maintaining all medical records. Issues such as, but not limited to, access to medical records, transfer of records and retention of records are addressed in S3-NAM-003-PR (***Access to Exposure and Medical Records***). WorkCare currently serves as the Medical Recordkeeping Coordinator for ERM.

4.3.3 Universal Precautions

If an ERM employee voluntarily renders first aid/CPR, all human blood and bodily fluids will be treated as infectious for bloodborne pathogens.

4.3.4 Engineering Controls, Work Practices, and PPE

Since ERM is a consulting firm, there are no typical operations applicable to bloodborne pathogens requiring engineering controls. However, if conditions warrant (e.g., significant and continued exposure to sharps, site cleanups involving medical or infectious wastes) the use of engineering controls with regard to bloodborne pathogens, appropriate engineering controls will be developed, examined, and maintained or replaced on an annual basis to ensure their effectiveness.

While performing field-based work activities, toilet and hand-washing facilities must be available to employees. Hand-washing facilities will be provided with an appropriate combination of the following:

- Hot and cold running water or tepid running water;
- Soap or an antiseptic hand cleanser;
- Individual hand towels or warm air blowers; and
- Pre-moistened individual wipes.

If an ERM employee voluntarily renders first aid/CPR, the following PPE, supplied by ERM, will be used as appropriate:

- Nitrile surgical-type gloves; and
- CPR mouth guard (where needed).

These are provided to ERM employees in the PPE field bag issued upon their hire. Any blood or other bodily fluid-contaminated materials will be placed in red leak-proof plastic bags for disposal. Bags will be labeled with a biohazard sign and the words "Biohazard" in contrasting colors. Surfaces that have been contaminated with blood or other bodily fluids will be cleaned with a disinfecting product as soon as practical.

4.3.5 Hepatitis B Vaccine

Since it is highly unlikely that incidents involving ERM employees would result in exposure to blood or potentially infectious bodily fluids, a Hepatitis B vaccination program is not typically required for ERM staff. However, if an employee believes that they have come into contact with potentially infectious blood or other bodily fluids while voluntarily rendering first aid/CPR, medical examinations, including Hepatitis B vaccine, will be made available at no charge to the employee.

4.3.6 Access to Written Program

All employees or their representatives and governmental officials may request a copy of any written program by contacting the Division H&S Leader in their respective office.

5. References

- ERM Procedure S3-NAM-003-PR – ***Access to Medical and Exposure Records***
- Occupational Safety and Health Administration (OSHA) 29 CFR 1910.151, ***"Medical Services and First Aid"***
- OSHA 29 CFR 1910.1030, ***"Bloodborne Pathogens"***
- ANSI/ISEA Z308.1-2015, ***"Minimum Requirements for Workplace First Aid Kits and Supplies"***

Document Control Information

Original Effective Date: February 14, 2014

Policy Approval by: Philip Platcow on 2/14/14

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

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.

Appendix G
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 24 years of diversified professional scientific and environmental consulting experience including contaminated site investigation, remediation, and site management; project management; Brownfields program management; regulatory negotiations; geological evaluation; inspection and corrective action of storage tank systems; operations management; expert witness and litigation support services; immunoassay field screening; petrographic analyses; geophysics; statistical analysis of geologic data, wetlands evaluation; petroleum exploration geology and development; and professional geologic instruction.

Mr. Fox 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:

- Brownfield Opportunity Areas and Tax Credits
- Technical Guidance on Site Investigation and Remediation
- Remote Sensing Techniques
- Structural and Hydro-Structural Geology
- Surface Geophysics for Hydrogeological and Geotechnical Applications
- Hydrogeology and Management of Karst Ground Water Resources
- Erosion and Sediment Control Workshops.

Registrations & Professional Affiliations

- Qualified Environmental Professional (New York)
- Licensed Professional Geologist (Pennsylvania)
- Certified in Underground Storage Tank Decommissioning (International Code Council)
- American Chemical Society
- Central New York Association of Professional Geologists
- Corporate Wetlands Restoration Partnership
- Geological Society of America
- International Society of Environmental Forensics
- National Ground Water Association
- New England Interstate Water Pollution Control Commission
- New York State Council of Professional Geologists

Fields of Competence

- Geological Sciences and Hydrogeology
- Environmental Investigation & Remediation
- Petroleum Storage Tank Systems
- Environmental Forensic Analysis
- Geochemistry and Geophysics
- Environmental Regulations
- Wetland Hydrology
- Statistical Analysis
- Petroleum Exploration and Development
- Radioactivity
- Environmental Fungi

Education

- M.A., Geology, University of North Dakota, 1993
- B.S., Geology, State University of New York at Oswego, 1988 (Honors: Outstanding Geology Graduate)

Publications

Misra, G., Sartain, H., and Fox, J.S., 2008. Contaminated soil cleanup objective assessment through statistical analyses: selected case studies (abstract). *Proceedings, 6th International Conference on the Remediation of Chlorinated and Recalcitrant Compounds;* Battelle Institute, Monterey, CA, 19-22 May 2008.

Otz, M.H., Sents, R.C., Fox, J.S., Myers, D.W., and Wells, J., 2008. Effective delineation of jet fuel-contaminated ground water using background fluorescence analysis (abstract). *Proceedings, 6th International Conference on the Remediation of Chlorinated and Recalcitrant Compounds;* Battelle Institute, Monterey, CA, 19-22 May 2008.

Sents, R.C., Otz, M.H., Fox, J.S., and Wunderlich, C.D., 2007. Fluorescent dye-tracing used to investigate fast flowing preferential flow paths in a heavily DNAPL-contaminated aquifer (abstract). *2nd International Conference on DNAPL: Characterization and Remediation.* Niagara Falls, New York, September 2007.

Otz, M. H., Hinchey, E.J., Fox, J.S., Wunderlich, C.D., and Perritt, K., 2005. Intrinsic background fluorescence analysis as an easy tool to delineate organic contaminant plumes (abstract). *Geological Society of America Abstracts with Programs*, Vol. 37, No.1, p. 80, February 2005.

Fox, J.D. and Fox, J.S., 2002. Metrological considerations in flame atomic absorption analyses versus certified reference materials of soils from Onondaga County, New York State (USA) for background trace metals content. *Accreditation and Quality Assurance*, Vol. 7., pp. 520-528.

Fox, J.S. and Fox, J.D., 2001. Variation in background concentrations of selected metals in soil based on parent geologic material. *Geological Society of America Abstracts with Programs*, Vol. 33, No. 6, p. A-187.

Hinchey, E.H., Fox, J.S., and Tayeh, H.C., 2001. Evaluation of MTBE in middle distillate petroleum products in the northeastern United States (abs.). National Ground Water Association, National FOCUS Conference, Baltimore, Maryland - June 2001, *Conference Proceedings* pp. 130-131.

Fox, J.S. and Videtich, P.E., 1997. Revised estimate of $\delta^{34}S$ for marine sulfates from the Upper Ordovician: data from the Williston basin, North Dakota, U.S.A.: *Applied Geochemistry*, v. 12, no. 1, p. 97-103.

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), *American Association of Petroleum Geologists History of the Oil Industry Symposium Guidebook*: American Association of Petroleum Geologists, Tulsa, pp. 37-44.

Key Projects

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.

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
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, North Dakota (USA), and Ontario (Canada).

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.

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.