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New York State Department of Environmental Conservation

In-Situ Chemical Oxidation Pilot Test Work Plan

Crusher Road Site # 360127

August 1, 2013

In-Situ Chemical Oxidation Pilot Test Work Plan

Crusher Road Site # 360127

Prepared for:
New York State Department of Environmental Conservation

Prepared by:
ARCADIS of New York, Inc.
855 Route 146
Suite 210
Clifton Park
New York 12065
Tel 518 250 7300
Fax 518 250 7301

Our Ref.:
00266414.0000

Date:
August 1, 2013

ARCADIS

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1. Introduction

The New York State Department of Environmental Conservation (NYSDEC) tasked ARCADIS of New York, Inc. (ARCADIS) to perform an in-situ chemical oxidation (ISCO) pilot test at the Crusher Road Site (Site No. 360127), in the Town of Bedford, New York (Figure 1). The ISCO pilot test will be conducted under the NYSDEC State Superfund Standby Contract No. D007618-19.

The Crusher Road site is located at the end of Crusher Road in the Town of Bedford, New York. The 11.8 acre site is located approximately ¼ mile southeast of the intersection of Bedford Road and NY State Rte. 22 (Old Post Road). The site, which is owned and used as a maintenance facility by the Town of Bedford Department of Public Works (DPW), contains a DPW garage building, three storage sheds, a salt storage building and other areas used for storage of gravel, sand, piping, etc. The DPW has used the site for more than 50 years and currently uses it for storage and maintenance of town vehicles, fuel distribution, and storage of stone and salt. The site is currently zoned residential.

The surrounding parcels include residential property to the west and northeast and undeveloped parcels in the remaining directions. A 102-acre former gravel mine is located to the northeast, east and southeast of the site. The adjacent, undeveloped property is predominantly wooded and contains approximately 20 to 25 acres of man-made ponds.

Based on the Remedial Investigation (RI) Report (Leggette, Brashears & Graham, Inc., February 2012), the overburden at the site is 40 to 100 feet thick and consists primarily of stratified fine sand with some clay and gravel. The depth to groundwater is between 3 and 23 feet below ground surface. The direction of groundwater flow is east-southeast toward the Mianus River, located approximately 800 feet east of the site.

Several environmental investigations were conducted in 1987 and the late 1990s on the adjacent former gravel mine property to the east (Bedford Ponds, Site No. 360049) as part of proposed redevelopment plans. Tetrachloroethene (PCE) was present in groundwater samples collected from the southwestern portion of the property but no source area was identified. A Preliminary Site Assessment (PSA), which was conducted on the adjacent former gravel mine property between 2000 and 2002, indicated that the source of PCE in groundwater was the Crusher Road DPW facility. In 2004, the Town applied for, and was accepted into, the Environmental Restoration Program (ERP). An RI Report (Leggette, Brashears & Graham, Inc., February 2012),

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Alternatives Analysis Report (Leggette, Brashears & Graham, Inc., March 2012), and Record of Decision (NYSDEC, March 2012) have been prepared for the site. The site was divided into two operable units: Operable Unit 1 (OU1) is the on-site source area and OU2 consists of the remainder of the site.

The primary contaminants of concern are PCE and its degradation byproducts (trichloroethene, dichloroethene and vinyl chloride). A small PCE source area was identified during the RI on the eastern boundary of the site although soil sample concentrations did not exceed 6 NYCRR Part 375 unrestricted use soil cleanup objectives (SCOs) or protection of groundwater SCOs. An overburden dissolved-phase PCE plume extends east-southeast onto the adjacent property. The groundwater samples with the highest PCE concentrations (up to 4,100 µg/L) were collected from a depth of 20 to 60 feet below ground surface. The plume extends approximately 900 feet to the Mianus River, and ranges in width from 150 to 450 feet and extends 40-85 feet below ground surface. No bedrock contamination has been identified.

The Record of Decision (ROD) calls for treatment of the on-site source area via in-situ chemical oxidation (ISCO) followed with in-situ bioremediation. This work plan summarizes the scope of an ISCO pilot test to evaluate the feasibility of using ISCO to remediate chlorinated volatile organic compounds in the source area. ARCADIS has developed this In-situ Chemical Oxidation Pilot Test Work Plan in accordance with the April 3, 2013 Work Assignment Issuance/Notice to Proceed Correspondence for the site and the June 17, 2013 Schedule 2.11s and Scope of Work.

2. In-Situ Chemical Oxidation Pilot Test

ARCADIS will observe the installation of up to four 1-inch diameter monitoring wells (piezometers) and ten 1-inch diameter injection points near the source treatment area and conduct an in-situ chemical oxidation pilot study. The pilot study will include up to 10 injection locations. The proposed pilot test injection locations are shown on Figure 2. ARCADIS will purchase the oxidant and subcontract with a driller to install 1-inch diameter injection points. ARCADIS will inject the oxidant using an injection skid that is capable of injecting at up to six injection wells simultaneously. Two ARCADIS technicians will conduct the pilot study field activities. It is assumed that the Town of Bedford will clear the pilot study area of brush and debris prior to monitoring well and injection point installation.

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The pilot study will include the injection of sodium permanganate into the subsurface through injection wells. Pre- and post-pilot test confirmatory groundwater samples will be collected by ARCADIS and sent to Con-Test Analyitcal Laboratory (Con-Test) for TCL VOC analysis. Data validation will not be conducted on the laboratory analytical results. A project-specific Health and Safety Plan (Appendix A) and ARCADIS's previously-approved Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) will be used for this project.

The objective of the pilot test is to treat groundwater at DPW-L2-C and DPW-L2-D as well as in the vicinity of B-4 through B-8 (Figure 2). Injections from 10 - 25 feet bgs in this formation will likely result in mounding, which will treat the deepest unsaturated soil concentrations, as well as chlorinated volatile organic compounds (CVOC) that have infiltrated to 25 feet bgs, where there are elevated CVOC concentrations at DPW-L2-C & DPW-L2-D. The concept is the treatment of the deepest unsaturated soil and shallow groundwater will allow uncontaminated groundwater to eventually flush through the formation, diluting down gradient concentrations and, thereby, making monitored natural attenuation and/or in-situ biological treatment a more feasible remedial approach for areas downgradient of the source.

As shown on Figure 2, there is some overlap in the assumed injection radii of influence because injection solutions typically spread in the shape of an ellipse rather than a perfect circle. Under ideal conditions, injection solution would spread radially, but under typical injection scenarios the injection solution will follow the path of least resistance, which results in an irregular, non-circular radius of influence (ROI).

2.1 Monitoring Wells and Injection Point Installation

Four monitoring wells and ten injection points (Figure 2) will be installed using direct push GeoProbe™ technology by Nature's Way Environmental Consultants and Contractors, Inc. (Nature's Way). The injection points will be used to inject the chemical oxidant and evaluate distribution and the effective ROI of the chemical oxidant during the injection event. Baseline monitoring and post-injection monitoring will be performed at monitoring wells as a way to assess overall performance in reducing CVOC concentrations within the source zone.

Borings for the monitoring wells and injection points will be advanced to a depth of 25 feet below ground surface (bgs). No soil samples will be collected for laboratory analysis. Each monitoring well and injection point will be constructed using 1-inch diameter schedule 40 PVC with 15 foot length screen with 10 feet of riser to grade.

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Number 1 sand will be used from 25 feet bgs to 8 feet bgs while the remainder of the annulus will be filled with neat cement grout. Neat cement grout will be used as a seal to reduce the potential for daylighting during injection events. The monitoring wells and injection points will stick up out of the ground and will not be completed with a protective casing but will be flagged.

ARCADIS will develop the monitoring wells and injection points to remove accumulated fines incurred from the installation process. Soil and groundwater generated during monitoring well and injection point installation, development, and sampling will be placed on the ground near the boring in accordance with NYSDEC guidance. It is assumed that no off-site waste disposal will be needed. The location of the proposed monitoring wells will be identified with a hand-held survey-grade GPS unit.

2.2 Baseline Monitoring

Baseline monitoring will be performed at well cluster CW-1 and four proposed monitoring wells following well development activities. Baseline sampling will be performed using low flow sampling methodologies and samples will be analyzed by Con-Test for TCL VOC analysis by USEPA Method 8260B. Additionally, field parameters including depth to water, temperature, dissolved oxygen (DO), pH, conductivity, and oxygen reduction potential (ORP) will be measured and recorded as part of low flow sampling methodology. Field sampling equipment is not expected to be decontaminated because sample tubing will be disposable or dedicated to each sampling location.

The groundwater samples will be collected using the following low flow procedures.

1. **Water Level Measurement:** Measure the depth to groundwater from the top of the well casing using a water level probe. Leave the probe in the well for subsequent water level measurements.

2. **Tubing and Pump Installation:** Slowly lower the tubing into the well so that the bottom of the tubing is a minimum of two-feet above the bottom of the well to prevent disturbing and re-suspending any sediment at the bottom of the well. Connect the tubing to a peristaltic pump with silicone tubing.

3. **Purging:** Begin purging the well at a rate of 200 to 500 milliliters per minute (ml/min) and measure the water level. If excessive drawdown is observed in the well (i.e. greater that 0.3 feet), reduce the flow rate until the water level

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stabilizes. When the water level has stabilized, subsequent measurements should be made on five minute intervals. The flow rate, as well as flow rate adjustments should be recorded on a field purge log.

4. **Field Parameter Monitoring:** Field parameters (pH, conductivity, reduction/oxidation potential, DO, and turbidity) should be recorded every five minutes with water level measurements. The well is considered stable and ready to be sampled once the field parameters are stable over three consecutive readings (USEPA Region 2, 1998). The following criteria identify stabilized field parameters:

   - ± 0.1 for pH
   - ± 3.0 percent for conductivity
   - ± 10.0 mv for redox potential
   - ± 10.0 percent for DO and turbidity

   The pump should not be removed or shut off between purging and sampling. Groundwater samples will be collected after three well volumes have been purged if field parameters do not stabilize.

5. **Sample Collection:** If necessary, reduce the flow rate to 100 to 250 ml/min to reduce turbulence while filling sample containers during sample collection. Where wells are purged at a flow rate less than 100 ml/min, maintain the same flow rate during sample collection. Disconnect the inflow line from the flow through cell and collect the groundwater sample. All sample containers should be filled directly from the tubing. Allow water to flow from the tubing gently down the inside of the containers to minimize turbulence during sample collection.

6. **Pump Removal:** Once sampling is complete, disconnect the pump, slowly remove the tubing from the well, and dispose of the tubing.

2.3 Chemical Oxidant Injection Activities

ARCADIS will inject sodium permanganate into the subsurface via 10 injection points. Sodium permanganate has demonstrated the ability to oxidize the constituents of

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concern at the site [tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2 dichloroethene and vinyl chloride].

The 10 one-inch injection points will be advanced using direct push GeoProbe™ techniques in and around the vicinity of previous sampling locations DPW-L2-C, DPW-L2-D and soil borings B-4 through B-8 (Figure 2). These locations were selected based on elevated concentrations of PCE in groundwater and vadose zone contamination in the aforementioned locations. The oxidant solution will be injected into pre-installed one-inch diameter injection points that will be screened from 10 to 25 feet bgs.

ARCADIS will coordinate the delivery of a 40 percent (%) sodium permanganate concentrated solution. It is assumed that water can be withdrawn from a fire hydrant located near the site to dilute the concentrate to a 3% sodium permanganate solution prior to injection. Application of the 3% solution to the subsurface will be implemented through the use of a mobile injection skid as part of a batching operation. The skid shall consist of, at a minimum, one 500 gallon storage tank, one chemically compatible double diaphragm pump, pressure gauges and all the associated piping and hosing to deliver the solution to the subsurface. Once set up, the system shall be water tested for leaks prior to implementation of the permanganate injection. Injection will occur under pumping conditions with well head pressure not exceeding 10 PSI.

The target ROI for the sodium permanganate solution is 10 feet. The target injection depth will be 10 to 25 feet bgs. The volume of solution required to reach the target ROI is determined by the following equation:

$$V_{inj} = 7.48 \times \pi \times r_{inj}^2 \times h \times \theta_m$$

Where:

V_{inj} = volume of injection (gallons)
r_{inj} = ROI (10 feet)
h = target interval thickness (15 feet)
θ_m = mobile porosity (assumed to be 5%)
7.48 = conversion factor (gallons per cubic foot)

Subsurface lithology within the injection interval consists of fine sands and silts. A mobile porosity of 5% was selected for volumetric calculations as a conservative number for these soil types. The selected permanganate loading (3% by weight) is based on ARCADIS experience given the geology, anticipated natural oxidant demand

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(NOD), and contaminant concentrations. The maximum solubility of sodium permanganate under ambient groundwater temperature is approximately 40% by weight, meaning permanganate will be injected as a dissolved solution. Based on these assumptions, a total of approximately 1,765 gallons of 3% by weight permanganate solution will be needed per injection location to achieve the effective ROI, with an average injection volume of 117.5 gallons per foot over the 15 foot treatment thickness. Therefore, a total of 17,650 gallons will be injected across the 10 temporary injection points. The injection volume calculations are summarized in Appendix B.

Performance monitoring will be completed over the duration of injection activities. Injection performance will be evaluated through the assessment of groundwater parameters. Groundwater will be collected from each monitoring well and processed through a flow-through cell where temperature, pH, specific conductivity, DO and ORP readings will be recorded to evaluate breakthrough of sodium permanganate. Typical field observations indicative of breakthrough are an increase in conductivity, pH and dissolved oxygen. ARCADIS will also evaluate breakthrough through visual observations of permanganate's characteristic purple color and the use of sodium permanganate spectrometric field test kits.

2.4 Post-Injection Activities

Post-Injection monitoring will be completed one month and three months following the injection to evaluate the overall effectiveness and reduction of CVOC concentrations. Groundwater samples will be collected using the methods described in Section 2.2 and will be analyzed for TCL VOCs by USEPA Method 8260B at monitoring well cluster CW-1 and at four proposed monitoring wells locations. Groundwater parameters collected during low flow sampling will be analyzed to assess when the residence time of sodium permanganate solution has ended within the treatment interval. The monitoring wells and injection points will not be abandoned and will be available for future monitoring.

3. Reporting

ARCADIS will prepare a Pilot Study Report upon completion of the pilot study. The report will discuss the pilot test activities and results and describe variations, if any, from this work plan. It will identify:

- A description of the work;

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- Project change orders;
- Sequencing of work;
- Problems encountered;
- Pre- and Post-pilot test analytical data; and
- The areal and vertical extent of the work.

4. Schedule

Project milestones are provided in the following project milestone schedule:

Project Milestone	Estimated Date
Submit Work Plan	August 2013
Install monitoring wells and injection points	August 2013
Baseline groundwater monitoring	August 2013
Conduct ISCO pilot test	September 2013
One-month post-injection monitoring	October 2013
Three-month post-injection monitoring	December 2013
Submit Pilot Study Report	December 2013

The schedule does not account for delays due to unforeseen site conditions (e.g., inclement weather, site access issues). Every attempt will be made to adhere to the schedule presented. Unexpected delays will be documented and reported to the NYSDEC in a timely fashion. In the event that the schedule needs to be modified, ARCADIS will contact the NYSDEC for approval of the updated schedule.

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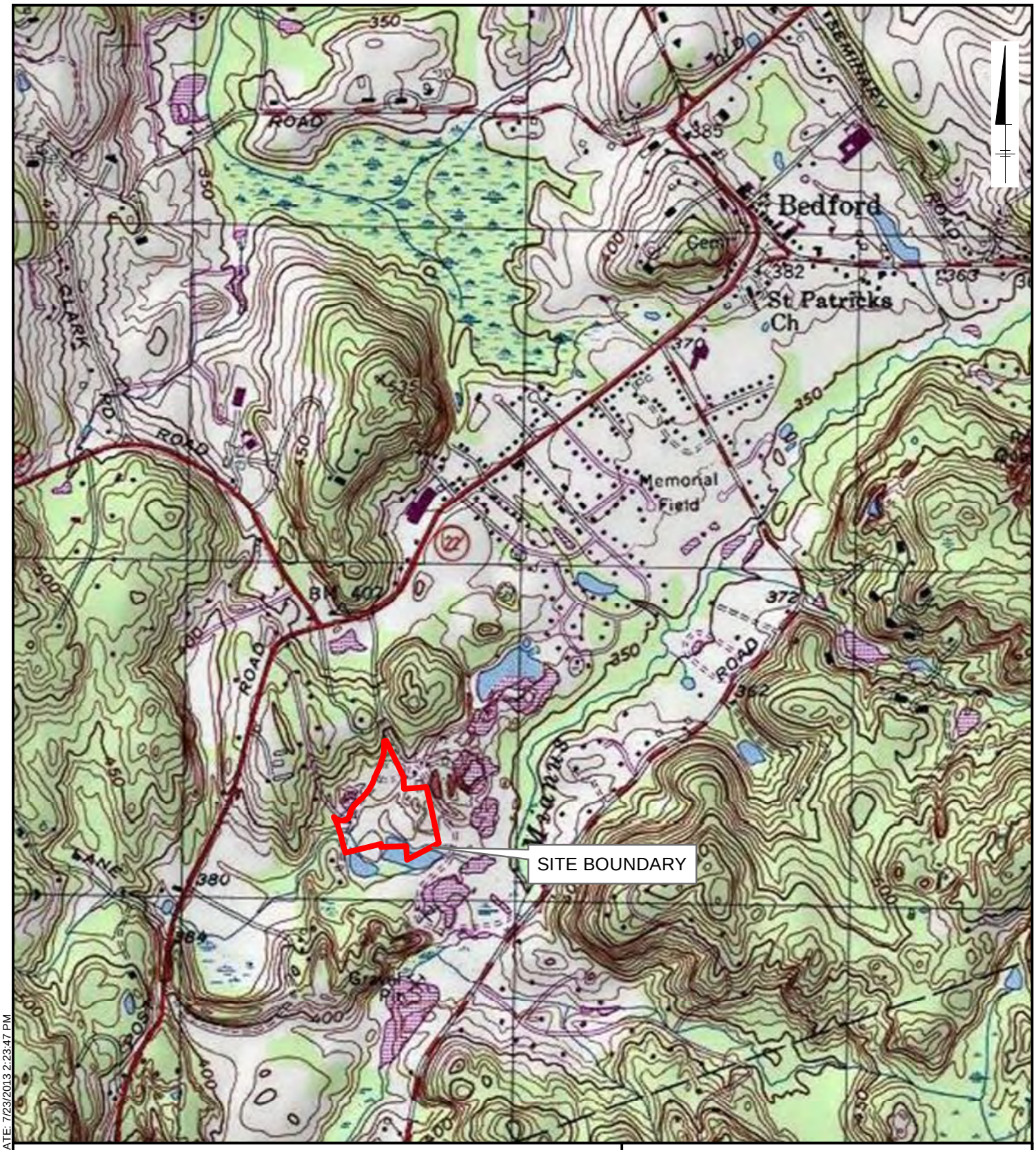
Figures



0 2,000 4,000

SCALE IN FEET

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CRUSHER ROAD, BEDFORD, NEW YORK

SITE LOCATION

ARCADIS

FIGURE
1

CITY:(KNOXVILLE) DIV/GROUP:(ENV/GIS) DB: awalcek LD: PIC: PM: TM: PROJECT: AA000000.0000.00000
FILE: G:\GISMOD\00266414.0000\Topo.mxd DATE: 7/23/2013 2:23:47 PM

LEGEND

PROPERTY LINE

B20 MONITORING WELL

B7 SOURCE AREA SOIL BORING

B1 SOIL BORING

IP-9 PROPOSED INJECTION POINT

PZ-1 PROPOSED PIEZOMETER

CW-1 CLUSTER WELL - INSTALLED DECEMBER 2010

ESTIMATED INJECTION RADIUS OF INFLUENCE

LANDSCAPE

CRUSHER ROAD SITE

ACCESS ROAD

B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 B19 B20

DPW-L2-A DPW-L2-B DPW-L2-C DPW-L2-D DPW-L1-A DPW-L1-B

IP-1 IP-2 IP-3 IP-4 IP-5 IP-6 IP-7 IP-8 IP-9 IP-10

PZ-1 PZ-2 PZ-3 PZ-4

CW-1

B20 B50, B70, B90, B110

0 20’ 40’

GRAPHIC SCALE

TOWN OF BEDFORD, NEW YORK
CRUSHER ROAD SITE

PROPOSED - PIEZOMETER AND CHEMICAL OXIDANT INJECTION LOCATIONS

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FIGURE 2

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Appendix A

Health and Safety Plan

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Infrastructure Water Environment Buildings

Site Specific Health and Safety Plan

Revision 11 9/20/2012

Project Name: In-Situ Chemical Oxidation Pilot Test: Crusher Road Site #360127

Project Number: 00266414.0000
Client Name: NYSDEC
Date: 7/26/2013
Revision: 1

Approvals:

HASP Developer:

HASP Reviewer:

Project Manager:

Emergency Information

Site Address: Crusher Road
Town of Bedford, NY

Emergency Phone Numbers:

Emergency (fire, police, ambulance)		911
Emergency (facility specific, if applicable):		
Emergency Other (specify)		
Client Contact	Keith Gronwald	518-402-9662
WorkCare (non-lifethreatening injury/illness)		1-800-455-6155
Project H&S	Aaron Bobar	518-250-7330
Task Manager	Mark Flusche	518-250-7322
Project Manager	Andy Vitolins	518-250-7359
Corporate H&S Specialist	Julie Santaniello	978-322-4515
Corporate H&S Director	Denis Balcer	614-986-9114

Hospital Name and Address: Northern Westchester Hospital
400 East Main Street
Mt. Kisco, NY 10549

Hospital Phone Number: 914-666-1200

Incident Notification Process

1 Dial 911/Facility Emergency Number/WorkCare as applicable
2 Contact PM/Supervisor — Andy Vitolins
3 Contact Corporate H&S — Denis Balcer
4 Contact Client — Keith Gronwald

Complete below, as applicable, or clear cell contents:

Location of Assembly Area(s): See site map

Route to the Hospital

Driving directions to 400 E Main St, Mt Kisco, NY 10549

Crusher Rd
Bedford, NY 10506

1. Head **north** on **Crusher Rd** toward **Old Post Rd**

0.2 mi

2. Turn left onto **Old Post Rd**

0.1 mi

3. Take the 1st right onto **NY-172 W/S Bedford Rd**

3.8 mi

4. Turn left onto E **Main St**
Destination will be on the right

108 ft

400 E Main St
Mt Kisco, NY 10549

General Information

Site Type (select all applicable where work will be conducted):

- [x] Active
- [ ] Bridge
- [ ] Buildings
- [ ] Commercial
- [ ] Construction
- [x] Government
- [ ] Inactive
- [ ] Industrial
- [ ] Landfill
- [ ] Marine
- [ ] Mining
- [ ] Parking Lot/Private Roadway
- [ ] Railroad
- [ ] Remote Area
- [ ] Residential
- [ ] Retail
- [ ] Roadway (public, inlcuing right-of-way)
- [ ] Secure
- [ ] Unknown
- [ ] Unsecured
- [ ] Utility
- [x] Other (specify): DPW maintenance facility

Surrounding Area and Topography (select one):

- [ ] Surrounding area and topography are presented in the project work plan
- [x] Surrounding area and topography (*briefly describe*):
  The site is flat and paved with loose gravel. Has been used by the Town of Bedford Department of Public Works as a maintenance facility. Residential properties are located to the west and northeast of this site and a 102 acre former gravel mine is located northeast, east and southeast.

Site Background (select one):

- [ ] Site background is presented in the project work plan
- [x] Site background (*briefly describe)* :
  In 2002, a Preliminary Site Assessment (PSA) of an adjacent property found and traced tetrachloroethene to the Crusher Rd. DPW facility. During subsequent investigations the source area was identified on the eastern boundary of the property and the plume extends approximately 900ft. to the Mianus River to the east. Highest concentrations (4,100 µg/L) were found at depths between 20 and 60 ft. below ground surface (bgs). To treat the plume, an ISCO pilot test has been proposed

Project Tasks

The following tasks are identified for this project:

Examples: "Drilling/soil sampling", "Surveying", "General Inspections", "Construction Management/Inspections"

1 Drilling of monitoring wells and injection points
2 Groundwater monitoring
3 Chemical oxidant injection
4
5

☐ Subcontractor H&S information is attached
☐ Utility clearance required.
☐ ARCADIS Standards apply to augment JSA *[list standard(s) below]*
☑ ARCADIS Field H&S Handbook sections apply *(list below)*

Comments:
Sections 2 (Health and Safety Administration), and 3 (General Field Health and Safety Requirements)

Roles and Responsibilities

	Name	*Role*	*Additional Responsibilities (Describe)*
1	Andy Vitolins	PM	
2	Mark Flusche	TM	
3	Chris Trowbridge	Field Lead	
4	Chris Trowbridge	SSO	
5	Rachel Drew	Field Team	
6			

Training

All ARCADIS employees are required to have the following training:	*Selected ARCADIS employees are required to have the following additional training:*	Names or Numbers from above
☑ 40 hr HAZWOPER w current refresh.	☐ Not applicable	
☐ 24 hr HAZWOPER	☑ First aid/CPR/BBP	4
☐ 10 hr Construction	☐ 30 hr Construction	
☐ HazMat #1 (Ground/Air/MOT)	☐ 10 hr Construction	
☐ HazMat #4 (MOT)	☑ HazMat #1 (Gr./Air/MOT)	4, 5
☐ HazCom/Emergency Action Plan	☐ HazMat #4 (MOT)	
☑ H&S Orientation (classroom); or	☐ Confined space entrant	
☐ H&S Orientation (on-line)	☐ Confined space rescue	
☑ PPE	☐ Excavation CP	
☐ Respiratory protection	☐ Electrical (NFPA 70E)	
☐ MSHA	☐ Lockout/Tagout	
☑ Smith System (on-line)	☐ H&S Orientation (class)	
☐ OTS/eRailsafe	☐ OTS/eRailsafe	
☐ Client specific:	☐ Smith Sys. (hands on)	
	☐ Boating safety	
☐ Other:	☐ Other:	

Hazard Analysis

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Division
Environment

Business Unit
REM

Task 1: **Drilling of monitoring wells and injection points**

Hazardous Activity #1

Field-Drilling - Mechanical method (drill rig, DPT, etc)

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	L	Driving	-	Electrical	M
Environmental	-	Gravity	H	Mechanical	H	Motion	H
Personal Safety	-	Pressure	M	Radiation	-	Sound	H

Overall Unmitigated Risk: High Mitigated Risk: Medium if utilizing:
Primary Controls: TRACK Engineering Controls Admin. Controls PPE (see HASP "PPE" section) JSAs Inspections

Secondary Controls: Job Briefing/Site Awareness H&S Standards Cont/Emerg. Planning

Hazardous Activity #2

General-Noise - exposure when working in areas of loud equipment or machinery

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	M

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:
Primary Controls: TRACK H&S Standards Engineering Controls PPE (see HASP "PPE" section)

Secondary Controls: See HASP "Monitoring" section Job Briefing/Site Awareness Admin. Controls

Hazardous Activity #3

Field-Equipment - working on ground in the vicinity of heavy equipment

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	H	Mechanical	H	Motion	H
Personal Safety	-	Pressure	-	Radiation	-	Sound	M

Overall Unmitigated Risk: High Mitigated Risk: Medium. if utilizing:
Primary Controls: TRACK JSAs Job Briefing/Site Awareness Site Awareness

Secondary Controls: HASP H&S Standards Field H&S Handbook Engineering Controls Admin. Controls Specialized Equipment Inspections

Hazardous Activity #4

Chemical-Toxic contaminants or chemicals - exposure to these materials

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	M	Driving	-	Electrical	-
Environmental	M	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:
Primary Controls: TRACK JSAs Engineering Controls PPE (see HASP "PPE" section)

Secondary Controls: HASP Job Briefing/Site Awareness Hazcom Training MSDS (see also HASP Hazcom section) Admin. Controls Specialized Equipment Housekeeping

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 2: **Groundwater monitoring**

Hazardous Activity #1

Field-Biological - wooded, overgrown or work in the vicinity of heavy vegetation

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	M	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Primary Controls: TRACK JSAs Engineering Controls PPE (see HASP "PPE" section)

Secondary Controls: Field H&S Handbook Job Briefing/Site Awareness

Hazardous Activity #2

Field-Ambient environment - exposure heat, cold, sun, weather, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	M	Electrical	L
Environmental	L	Gravity	H	Mechanical	-	Motion	L
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Medium if utilizing:

Primary Controls: TRACK PPE (see HASP "PPE" section) Field H&S Handbook

Secondary Controls: H&S Standards Engineering Controls Admin. Controls Specialized Equipment

Hazardous Activity #3

Field-Contaminated media (contact with impacted soil, water, air, sediment, etc)

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	H	Driving	-	Electrical	-
Environmental	M	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	M	Sound	-

Overall Unmitigated Risk: High Mitigated Risk: Low if utilizing:

Primary Controls: TRACK JSAs Engineering Controls PPE (see HASP "PPE" section)

Secondary Controls: H&S Standards HASP Admin. Controls HAZWOPER Training

Hazardous Activity #4

Field-Sampling - monitoring well sampling with electric, pneumatic or other non-manual pump

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	L	Driving	-	Electrical	L
Environmental	-	Gravity	L	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Low Mitigated Risk: Low if utilizing:

Primary Controls: TRACK JSAs Engineering Controls PPE (see HASP "PPE" section) Inspections

Secondary Controls: Job Briefing/Site Awareness

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 3: Chemical oxidant injection

Hazardous Activity #1

Chemical-Oxidizers - working with or exposure to oxidizers in laboratory work, sample bottle preservatives, decon chemicals, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	M	Driving	-	Electrical	-
Environmental	L	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	M	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Primary Controls: TRACK HASP Engineering Controls PPE (see HASP "PPE" section)

Secondary Controls: JSAs Job Briefing/Site Awareness Hazcom Training MSDS (see also HASP Hazcom section) Admin. Controls Specialized Equipment Housekeeping

Hazardous Activity #2

Chemical-Toxic contaminants or chemicals - exposure to these materials

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	M	Driving	-	Electrical	-
Environmental	M	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Primary Controls: TRACK JSAs Engineering Controls PPE (see HASP "PPE" section)

Secondary Controls: HASP Job Briefing/Site Awareness Hazcom Training MSDS (see also HASP Hazcom section) Admin. Controls Specialized Equipment Housekeeping

Hazardous Activity #3

Field-Equipment - work with energized equipment

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	L	Chemical	-	Driving	-	Electrical	H
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	H	Radiation	-	Sound	-

Overall Unmitigated Risk: High Mitigated Risk: Medium. if utilizing:

Primary Controls: TRACK H&S Standards Electrical (NFPA 70E) Training Lockout/Tagout Training

Secondary Controls: JSAs HASP Job Briefing/Site Awareness Engineering Controls PPE (see HASP "PPE" section) Housekeeping Competent Person Required (designated person)

Hazardous Activity #4

Field-Equipment - work with small pressurized equipment (power washers, air compressors, etc.)

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low):

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	L	Motion	L
Personal Safety	-	Pressure	M	Radiation	-	Sound	-

Overall Unmitigated Risk: Low Mitigated Risk: Low if utilizing:

Primary Controls: TRACK JSAs Specialized Training per Standard Operator Competency per Standard Specialized Equipment

Secondary Controls: HASP H&S Standards Job Briefing/Site Awareness Housekeeping Inspections Competent Person Required (designated person)

Hazard Communication (HazCom)/Global Harmonization System (GHS)

☐ HAZCOM/GHS for this project is managed by the client or general contractor

List the chemicals anticipated to be used by ***ARCADIS*** *on this project per HazCom/GHS requirements.*
(Modify quantities as needed)

	Acids/Bases	Qty
☑	Not applicable	
☐	Hydrochloric acid	<500 ml
☐	Nitric acid	<500 ml
☐	Sulfuric acid	<500 ml
☐	Sodium hydroxide	<500 ml
☐	Zinc acetate	<500 ml
☐	Ascorbic acid	<500 ml
☐	Acetic acid	<500 ml
☐	Other:	
	_____	
	_____	
	_____	

	Decontamination	Qty
☐	Not applicable	
☐	Alconox	≤ 5 lbs
☐	Liquinox	≤ 1 gal
☐	Acetone	≤ 1 gal
☐	Methanol	≤ 1 gal
☐	Hexane	≤ 1 gal
☐	Isopropyl alcohol	≤ 4 gal
☐	Nitric acid	≤ 1 L
☑	Other:	
	sodium thiosulfate	
	_____	
	_____	

	Calibration	Qty.
☑	Not applicable	
☐	Isobutylene/air	1 cyl
☐	Methane/air	1 cyl
☐	Pentane/air	1 cyl
☐	Hydrogen/air	1 cyl
☐	Propane/air	1 cyl
☐	Hydrogen sulfide/air	1 cyl
☐	Carbon monoxide/air	1 cyl
☐	pH standards (4,7,10)	≤ 1 gal
☐	Conductivity standards	≤ 1 gal
☐	Other:	
	_____	

	Fuels	Qty.
☑	Not applicable	
☐	Gasoline	≤ 5 gal
☐	Diesel	≤ 5 gal
☐	Kerosene	≤ 5 gal
☐	Propane	1 cyl
☐	Other:	
	_____	

	Kits	Qty.
☑	Not applicable	
☐	Hach (specify):	_____ 1 kit
☐	DTECH (specify):	_____ 1 kit
☐	EPA 5035 Soil (specify kit):	_____ 1 kit
☐	Other:	
	_____	_____
	_____	_____

	Remediation	Qty.
☐	Not applicable	
☑	Sodium permanganate	
☐	_____	
☐	_____	
☐	_____	
☐	_____	

	Other:	Qty.
☑	Not applicable	
☐	Spray paint	≤ 6 cans
☐	WD-40	≤ 1 can
☐	Pipe cement	≤ 1 can
☐	Pipe primer	≤ 1 can
☐	Mineral spirits	≤ 1 gal

	Qty.
☐	_____
☐	_____
☐	_____
☐	_____
☐	_____
☐	_____

Material safety data sheets (MSDSs)/Safety Data Sheets (SDSs) must be available to field staff.
Indicate below how MSDS information will be provided:

☐ Not applicable
☐ Printed copy in company vehicle
☐ Printed copy in the project trailer/office
☑ Printed copy attached
☐ Electronic copy on field computer

☐ Contractor MSDSs/SDSs are not applicable
☐ Contractor MSDSs/SDSs are attached
☐ Contractor MSDSs/SDSs will be on site and located:
_____

☐ Bulk quantities of the following materials will be stored: _____

Contact the project H&S contact for information in determining code and regulatory requirements associated with bulk storage of materials.

Personal Protective Equipment (PPE)

See JSA for the task being performed for PPE requirements. *If the work is not conducted under a JSA, refer to the governing document for PPE requirements. At a minimum, the following checked PPE is required for all tasks during field work not covered by a JSA on this project:*

Level D or Level D Modified:

☑ Hard hat	☐ Snake chaps/guards	☐ Coveralls:	Specify Type:
☑ Safety glasses	☐ Briar chaps	☐ Apron:	
☐ Safety goggles	☐ Chainsaw chaps	☑ Chem. resistant gloves:	Nitrile
☐ Face shield	☐ Sturdy boot	☐ Gloves other:	
☐ Hearing protection	☑ Steel toe boot	☐ Chemical boot:	
☐ Rain suit	☐ Metatarsal boot	☐ Boot other:	
☐ Other:		☐ Traffic vest:	
		☐ Life vest:	

Task specific PPE:

Comments:

Medical Surveillance (*check all that apply*)

☑ Medical Surveillance is not required for this project.
☐ HAZWOPER medical surveillance applies to all ARCADIS site workers on the project.
☐ HAZWOPER medical surveillance applies to all subcontractors on the project.
☐ HAZWOPER medical surveillance applies to all site workers on the project except:

☐ Other medical surveillance required (describe type and who is required to participate):

☐ Client drug and/or alcohol testing required.

Hazardous Materials Shipping and Transportation (*check all that apply*)

☐ Not applicable, no materials requiring a Shipping Determination will be transported or shipped
☑ A Shipping Determination has been reviewed and provided to field staff
☐ A Shipping Determination is attached
☐ All HazMat will be transported under Materials of Trade by ARCADIS
☐ Other (specify):

Roadway Work Zone Safety (*check all that apply*)

☑ Not applicable for this project
☐ All or portions of the work conducted under a TCP
☐ All or portions of the work conducted under a STAR Plan
☐ TCP or STAR Plan provided to field staff
☐ TCP or STAR Plan attached
☐ Other (specify):

ARCADIS Commercial Motor Vehicles (CMVs)

This section is applicable to ARCADIS operated vehicles only

☐ This project will **not** utilize CMV drivers
☑ This project will utilize CMV drivers

Site Control (*check all that apply*)

- ☐ Not applicable for this project.
- ☑ Site control protocols are addressed in JSA or other supporting document (attach)
- ☐ Maintain an exclusion zone of _____ ft. around the active work area
- ☐ Site control is integrated into the STAR Plan or TCP for the project
- ☐ Level C site control - refer to Level C Supplement attached
- ☐ Other (specify):

Decontamination (*check all that apply*)

- ☐ Not applicable for this project.
- ☐ Decontamination protocols are addressed in JSA or other governing document (attach)
- ☑ Level D work- wash hands and face prior to consuming food, drink or tobacco.
- ☐ Level D Modified work- remove coveralls and contain, wash hands and face prior to consuming food, drink or tobacco. Ensure footwear is clean of site contaminants
- ☐ Level C work - refer to the Level C supplement attached.
- ☐ Other (specify):

Sanitation *(check all that apply)*

- ☑ Mobile operation with access to off-site restrooms and potable water
- ☐ Restroom facilities on site provided by client or other contractor
- ☐ Project to provide portable toilets (1 per 20 workers)
- ☐ Potable water available on site
- ☐ Project to provide potable water (assume 1 gal./person/day)
- ☐ Project requires running water (hot and cold, or tepid) with soap and paper towels

Safety Briefings (*check all that apply*)

- ☑ Safety briefing required daily
- ☐ Safety briefing required twice a day
- ☐ Safety briefings required at the following frequency: _____
- ☐ Subcontractors to participate in ARCADIS safety briefings
- ☐ ARCADIS to participate in client/contractor safety briefings
- ☐ Other (specify):

Safety Equipment and Supplies

Safety equipment/supply requirements are addressed in the JSA for the task being performed. *If work is not performed under a JSA, the following safety equipment is required to be present on site in good condition (Check all that apply):*

- ☑ First aid kit
- ☐ Bloodborne pathogens kit
- ☐ Fire extinguisher
- ☐ Eyewash (ANSI compliant)
- ☑ Eyewash (bottle)
- ☑ Drinking water
- ☐ Other: _____

- ☐ Insect repellent
- ☑ Sunscreen
- ☐ Air horn
- ☐ Traffic cones
- ☐ 2-way radios
- ☐ Heat stress monitor

H&S Program (*check all that apply*)

- ☐ H&S metrics are provided on the account level, refer to account guidance
- ☑ TIP required at the following frequency on this project:
  Select One: _____ mhrs 1 time(s) _____ Define: _____
- ☐ H&S Field Assessment required at the following frequency on this project:
  Select One: _____ mhrs _____ time(s) _____ Define: _____
- ☐ Other (specify):

List tasks anticipated for TIP activity:

_____
_____
_____
_____

Signatures

I have read, understand and agree to abide by the requirements presented in this health and safety plan. I understand that I have the absolute right to stop work if I recognize an unsafe condition affecting my work until corrected.

Printed Name	Signature	Date

Add additional sheets if necessary

- ☐ Subcontractor Acknowledgement Form attached

You have an absolute right to STOP WORK if unsafe conditions exist!

Attachment A

Site Map


Work Area
Evacuation route
Rally point
Site map: Bedford NYSDEC ISCO project evacuation plan

Attachment B

Job Safety Analyses

Job Safety Analysis

General

JSA ID	Crusher Road JSA 1	**Status**	(3) Completed
Job Name	General Industry-Driving - passenger	**Created Date**	7/23/2013
Task Description	Driving Passenger Vehicle or Pick Up	**Completed Date**	
Template	TRUE	**Auto Closed**	FALSE

Client / Project

Client	NYSDEC
Project Number	00266414.0000
Project Name	In-Situ Chemical Oxidation Pilot Test: Crusher Road Site #360127
PIC	Daniel Loewenstein
Project Manager	Andy Vitolins

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kathryn Farris	7/26/2013		Dan Lang	
Quality Reviewer	Aaron Bobar	7/26/2013		Dan Lang	

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Performing Pre-trip inspections and adjustments.	1	Failure to conduct pre- trip inspection of vehicle can lead to vehicle accident.	Use TRACK to conduct inspection of the vehicle. Walk around vehicle to verify tire pressure, no signs of leaking fluids, overall vehicle condition. Use vehicle inspection checklist as necessary.	
		2	Failure to adjust mirrors, seats, and controls prior to driving can lead to vehicle accident.	Adjust all mirrors, seats and vehicle controls prior to driving vehicle. Become familiar with electronic controls, such as turn signals, windshield wipers, air conditioning, and radio prior to vehicle operation.	
		3	Cuts and scrapes to hands and fingers while checking engine fluids.	Use TRACK to plan inspection activity in the engine compartment. Wear protective gloves if reaching in poorly illuminated areas of the engine.	
		4	Pinch and crush hazards to the hands and fingers while checking engine fluids or closing doors.	Identify and keep hands and fingers away from pinch hazards from the doors and vehicle hood or tailgate (if present).	
		5	Awkward body positions while checking tires, spare tire, undercarriage, or engine compartment.	Maintain a neutral body position and avoid awkward reaches under the vehicle or in engine compartment.	
		6	Failure to inspect vehicle emergency equipment may result in extensive vehicle damage or delay treatment in the event of injury	Conduct equipment inspections by visibly inspecting fire extinguisher and first aid kit for cleanliness, in date items/tags, readiness for use.	
2	Vehicle loading and unloading	1	Object placement obstructing rear, side or blindspot view	Avoid placing objects in a manner that obstructs your view, brake equipment down to a smaller more manageable size to keep low profile in vehicle. If hanging clothes in vehicle, place in manner that does not obstruct blind spots.	
		2	Unsecure objects causing pedal, steering or gear shift obstruction or injury during vehicle operation.	Secure all loads in vehicle (both in the bed of trucks and in passenger cabin) to prevent unanticipated movement or shifting that could injure driver, passenger, or affect safe operation of vehicle.	
		3	Obstruction of vehicle safety equipment caused by object placment in vehicle.	Keep emergency equipment clear and unobstructed to ensure ready availablity.	

Job Safety Analysis

General

JSA ID	Crusher Road JSA 1	**Status**	(3) Completed
Job Name	General Industry-Driving - passenger	**Created Date**	7/23/2013
Task Description	Driving Passenger Vehicle or Pick Up	**Completed Date**	
Template	TRUE	**Auto Closed**	FALSE

3	Vehicle operation	1	Failure to use Smith System "5-Keys" increases risk of accident and injruy.	Use the Smith System "5-Keys", maintain space cushion around vehicle, maintain 4 second rule and add a second for each addtional hazard (wet roads, snow, etc). Brake gradually, keep eyes moving, check mirrors every 6-8 seconds, use turn signals, focus on relavent objects, use early lane positioning when approaching turns.	
		2	Injury or death from failure to wear seatbelt	Always wear seatbelts when operating or riding in vehicles.	
		3	Cell phone and electronic device use while driving increases the risk of accident and injury.	Use of cell phones or other electronic devices while driving is prohibited.	
		4	Use of radar detectors encourages speeding, resulting in increased risk for accident or injury.	Use of radar detectors and similar devices is prohibited.	
		5	Intruders attempting to enter vehicle while stopped at intersections, and/or while it is vacant. Doors opening during an accident.	Lock doors before driving vehicle and always after leaving the vehicle- unless client requires vehicles to remain unlocked while onsite.	
4	Routine maintenance	1	Lack of routine vehicle maintenance can lead to engine and control failures, potential vehicle accident.	Vehicle should have routine maintenance and service to keep in good operating condition.	
		2	Pinch and crush hazards to hands and fingers while replacing engine fluids or closing doors/hood.	Inspect and identify the pinch and crush hazards, and keep hands/fingers clear when closing hood, tailgates, or doors.	
		3	Burn hazards to hands from checking/replacing fluids in engine compartment.	When practical allow engine to cool prior to servicing or adding fluids. Use protective gloves.	
		4	Vehicle damage from improper fuse replacement	Never replace a fuse with a higher amperage than the one being replaced. Only replace fuses of type being replaced.	

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Traffic Control	Other	Roadway emergency kit	Required

Job Safety Analysis

General

JSA ID	Crusher Road JSA 2	**Status**	(3) Completed
Job Name	Environmental-Groundwater Sampling and	**Created Date**	
Task Description	Groundwater sampling	**Completed Date**	
Template	FALSE	**Auto Closed**	FALSE

Client / Project

Client	NYSDEC
Project Number	00266414.0000
Project Name	In-Situ Chemical Oxidation Pilot Test: Crusher Road Site #360127
PIC	Daniel Loewenstein
Project Manager	Andy Vitolins

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kathryn Farris	7/26/2013		Dan Lang	☑
Quality Reviewer	Aaron Bobar	7/26/2013		Dan Lang	

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Stage at pre-determined sampling location and set up work zone and sampling equipment	1	Personnel could be hit by vehicluar traffic.	Set-up cones and establish work area. Position vehicle so that field crew is protected from site traffic. Unload as close to work area as safely possible.	
		2	Sampling equipment, tools and monitoring well covers can cause tripping hazard	Keep equipment picked up and use TRACK to assess and changes	
2	Open wells to equilibrate and gauge wells	1	When squatting down, personnel can be difficult to see by vehicular traffic.	Wear Class II traffic vest if wells are located proximal to vehicular traffic. Use tall cones and the buddy system if practicable.	
		2	pinchpoints on well vault can pinch or lacerate fingers	Use correct tools to open well vault/cap. Wear leather gloves when removing well vault lids, and chemical protective gloves while guaging. Wear proper PPE including safety boots, knee pads and safety glasses.	
		3	Lifting sampling equipment can cause muscle strain	Unload as close to work area as safely possible; use proper lifting and reaching techniques and body positioning; don't carry more than you can handle, and get help moving heavy or awkward objects.	
		4	Pressure can build up inside well causing cap to release under pressure	Keep head away from well cap when removing. If pressure relief valves are on well use prior to opening well	
3	Begin Purging Well and Collecting Parameter Measurements	1	Electrical shock can occur when connecting/disconnecting pump from the battery.	Make sure equipment is turned off when connecting/disconnecting. Wear leather gloves. Use GFCIs when using powered tools and pumps. Do not use in the rain or run electrical cords through wet areas.	
		2	Purge water can spill or leak from equipment	Stop purging activities immediately, stop leakage and block any drainage grate with sorbent pads. Call PM to notify them of any reportable spill.	
		3	Water spilling on the ground can cause muddy/slippery conditions	Be careful walking in work area when using plastic around well to protect from spillage	
		4	Lacerations can occur when cutting materials such as plastic tubing	When cutting tubing, use tubing cutter. No open fixed blades should ever be used. When possible wear work gloves, leather type.	
		5	purge water can splash into eyes	Pour water slowly into buckets/drums to minimize splashing. Wear safety glasses	

Job Safety Analysis

General

JSA ID	Crusher Road JSA 2	**Status**	(3) Completed
Job Name	Environmental-Groundwater Sampling and	**Created Date**	
Task Description	Groundwater sampling	**Completed Date**	
Template	FALSE	**Auto Closed**	FALSE

4	Collect GW or Free Product Sample	1	Working with bailer rope can cause rope burns on hands.	Slowly raise and lower the rope or string for the bailer. Wear appropriate gloves for the task.	
		2	Sample containers could break or leak preservative	Discard any broken sampleware or glass properly. Do not overtighten sample containers. Wear chemical protective gloves	
5	Recovery of Free Product from well	1	Exposure to free product	Additional chemical protection may be necessary based on the type of product. Additionally, safety goggles, a faceshield, or respiratory protection may be required. Verify in the HASP.	
6	Staging of Well Purge water and/or Free Product	1	Muscle strains can occur when moving purge water or drums	If using buckets, do not fill buckets up to the top. Always keep lid on buckets when traveling or moving them to another location. Only half fill buckets so when dumping the buckets weigh less. See drum handling JLA for movement of drums.	Drum handling JLA

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Recommended
Miscellaneous PPE	other	Knee pads	Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
Traffic Control	traffic cones		Required

Job Safety Analysis

General

JSA ID	Crusher Road JSA 3	**Status**	(3) Completed
Job Name	Sample Cooler Handling	**Created Date**	7/23/2013
Task Description	Preparing and handling sample cooler	**Completed Date**	
Template	FALSE	**Auto Closed**	FALSE

Client / Project

Client	NYSDEC
Project Number	266414
Project Name	In-Situ Chemical Oxidation Pilot Test: Crusher Road Site #360127
PIC	Daniel Loewenstein
Project Manager	Andy Vitolins

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kathryn Farris	7/26/2013		Dan Lang	☑
Quality Reviewer	Aaron Bobar	7/26/2013		Dan Lang	

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Transfer field samples to sample packing area	1	Lifting heavy coolers may result in muscle strain especially to lower back.	Use proper lifting techniques and keep back straight. Use buddy system for large coolers, Use mechanical aids like hand trucks if readily available to move coolers. Do not over fill coolers with full sample containers for temporary movement to the sample prep area. Ensure an adequate supply of sample coolers are in field.	
		2	Hazards to hands from broken glass caused by over tightening lids or improper placement in cooler	Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Do not over tighten sample lids. Clean up any broken bottles immediately, avoid contact with sample preservatives. Wear leather gloves when handling broken glass.	
		3	Exposure to chemicals (acid preservatives or site contaminants) on the exterior of sample bottles after filling.	Wear protective gloves for acid preservatives and safety glasses with side shields during all sample container handling activities (before and after filling), Once filled follow project specific HASP PPE requirements for skin and eye protection.	
		4	Samples containing hazardous materials may violate DOT/IATA HazMat shipping regulations	All persons filling a sample bottle or preparing a cooler for shipment must have complete ARCADIS DOT HazMat shipping training. Compare the samples collected to the materials described in the Shipping Determination for the Project and ensure consistent. Re-perform all Shipping determinations if free product is collected and not anticipated during planning.	
2	Sample cooler selection	1	Sample coolers with defective handles, lid hinges, lid hasps cracked or otherwise damaged may result in injury (cuts to hands, crushing of feet if handle breaks etc)	Only use coolers that are new or in like new condition, No rope handled coolers unless part of the manufacturer's handle design.	ARCADIS Shipping Guide US-001
		2	Selection of excessively large coolers introduces lifting hazards once the cooler is filled.	Select coolers and instruct lab to only provide coolers of a size appropriate for the material being shipped. For ordinary sample shipping sample coolers should be 48 quart capacity or smaller to reduce lifting hazards.	

Job Safety Analysis

General

JSA ID	Crusher Road JSA 3	**Status**	(3) Completed
Job Name	Sample Cooler Handling	**Created Date**	7/23/2013
Task Description	Preparing and handling sample cooler	**Completed Date**	
Template	FALSE	**Auto Closed**	FALSE

3	Pack Samples	1	Pinch points and abrasions to hands from cooler lid closing unexpectedly	Beware that lid could slam shut; block/brace if needed; be wary of packing in strong winds. New coolers may be more prone to self closing, tilt cooler back slightly to facilitate keeping lid open.	
		2	Awkward body positions and contact stress to legs and knees when preparing coolers on irregular or hard ground surfaces.	Plan cooler prep activities. Situate cooler where neutral body positions can be maintained if practical, like truck tailgate. Avoid cooler prep on rough gravel surfaces unless knees and legs protected during kneeling.	
		3	Frostbite or potential for oxygen deficiency when packing with dry ice. Contact cold stress to fingers handling blue ice or wet ice	Dry ice temperature is -109.30F. Wear thermal protective gloves. DO NOT TOUCH with bare skin! Dry ice sublimates at room temp and could create oxygen deficiency in closed environment. Maintain adequate ventilation! Do not keep dry ice in cab of truck. Wear gloves when handling blue ice or gaging wet ice. Dry Ice is DOT regulated for air shipping, follow procedures in Shipping Determination.	
4	Sealing, labeling and Marking Cooler	1	Cuts to hands and forearms from strapping tape placement or removing old tape and labels	Do not use a fixed, open-blade knife to remove old tags/labels, USE SCISSORS or other safety style cutting device. Only use devices designed for cutting. Do not hurry through task.	
		2	Lifting and awkward body position hazards from taping heavy coolers, dropping coolers on feet during taping.	Do not hurry through the taping tasks, ensure samples in cooler are evenly distributed in cooler to reduce potential for overhanging cooler falling off edge of tailgate/table when taping.	
		3	Improper labeling and marking may result in violation of DOT/IATA HazMat shipping regulations delaying shipment or resulting in regulatory penalty	Do not deviate from ARCADIS Shipping Guide or Shipping Determination marking or labeling requirements.	
5	Offering sample cooler to a carrier or lab courier for shipment.	1	Lifting heavy coolers may result in muscle strain especially to lower back.	See lifting hazard controls above.	
		2	Carrier refusal to accept cooler may cause shipping delay and/or result in violation of DOT HazMat shipping regulations.	Promptly report all rejected and refused shipments to the ARCADIS DOT Program Manager. Do Not re-offer shipment if carrier requires additional labels markings or paperwork inconsistent with your training or Shipping Determination without contacting the ARCADIS DOT Compliance Manager.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	Scissors	Required

Job Safety Analysis

General

JSA ID	Crusher Road JSA 4	**Status**	(3) Completed
Job Name	Environmental-Drilling, soil sampling, well	**Created Date**	7/23/2013
Task Description	Drilling, Direct-Push, Well Installation	**Completed Date**	
Template	FALSE	**Auto Closed**	FALSE

Client / Project

Client	NYSDEC
Project Number	00255414.0000
Project Name	In-Situ Chemical Oxidation Pilot Test: Crusher Road Site #360127
PIC	Daniel Loewenstein
Project Manager	Andy Vitolins

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kathryn Farris	7/26/2013		Dan Lang	☑
Quality Reviewer	Aaron Bobar	7/26/2013		Dan Lang	

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Set up necessary traffic and public access controls	1	Struck by vehicle due to improper traffic controls	Use a buddy system for placing site control cones and/or signage. Position vehicle so that you are protected from moving traffic. Wear Class II traffic vest	
2	General drill rig operation	1	Excessive noise is generated by rig operation.	When the engine is used at high RPMs or soil samples are being collected, use hearing protection.	
		2	During drill rig operation, surfaces will become hot and cause burns if touched, and COCs in the soils more readily vaporize generating airborne contaminates.	Due to friction and lack of a drilling fluid, heat will be produced during this method. Mainly drill augers. Be careful handling split spoons. Wear proper work gloves. When soils and parts become heated, the COC could volatilize. Air monitoring should always be performed in accordance with the HASP.	
		3	Moving parts of the drilling rig can pull you in causing injury. Pinch points on the rig and auger connections can cause pinching or crushing of body parts.	Stay at least 5 feet away from moving parts of the drill rig. Know where the kill switch is, and have the drillers test it to verify that it is working. Do not wear loose clothing, and tie long hair back. Avoid wearing jewelry while drilling. Cone off the work area to keep general public away from the drilling rig	
		4	Dust and debris can cause eye injury and soil cuttings and/or water could contain COCs.	Wear safety glasses and stay as far away from actual drilling. W operation as practicable. Wear appropriate gloves to protect from COCs.	
		5	Drilling equipment laying on the ground (i.e. augers, split spoons, decon equipment, coolers, etc), create a tripping hazard. Water from decon buckets generate mud and cause a slipping hazard.	Keep equipment and trash picked up, and store away from the primary work area.	
		6	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance	

3	Direct push drilling	1	The drill rods will be handled by workers most of the time rather than the rig doing it, therefore pinch points can cause lacerations and crushing of fingers/body parts.	Keep a minimum of 5 feet away from drill rig operation and moving parts.	
		2	The direct push rigs are uaually meant to fit in spaces where larger rig can't. Tight spaces can pin workers.	Do not put yourself between the rig and a fixed object. Use Spotters or a tape measure to ensure clearances in tight areas. Pre-plan equipment movement from one location to the next.	
		3	Some direct push equipment is controlled by wireless devices. These controls can fail and equipment can strike workers or cause damage to property.	The drill rig should be used in a large open area to test wireless controls prior to moving to boring locations. The operator of the rig will test the kill switch with wireless remote prior to use. Operator will stay in range of rig while moving so that wireless signal will not be too weak and cause errors to the controls.	
		4	Sampling sleeves must be cut to obtain access to soil. Cutting can cause lacerations.	Preferably let the driller cut the sleeves open. Many drillers have holders for the sleeve to allow for stability when cutting. If we cut the sleeves, use a hook blade, change blade regularly, and cut away from the body.	
4	Monitoring well installation	1	Same hazards as in Step 2 with general drill rig operation	See step 2	
		2	monitoring well construction materials can clutter the work area causing tripping hazards.	Well construction materials should be picked up during the well installation process.	
		3	Heavy lifting can cause muscle strains, and cutting open bags can cause lacerations.	Well construction materials are usually 50 lbs or greater. Team lift or use drill rig to hoist bags. Always use work gloves while cutting open bags.	
		4	Well pack material (i.e. sand, grout, bentonite) can become airborne and get in your eyes.	Wear safety glasses for protection from airborne sand and dust.	
		5	Cutting the top of the well to size can cause jagged/sharp edges on the top of the well casing.	Wear gloves when working with the top of the well casing, and file any sharp jagged edges that resulted from cutting to size.	

5	Soil cutting and purge water management	1	Moving full drums can cause back injury, or pinching/crushing injury.	Preferably have the drilling contractor move full drums with their equipment. If this is not practicable, use lift assist devices such as drum dollys, lift gates, etc. Employ proper lifting techniques, and perfrom TRACK to identify pinch/crush points. Wear leather work gloves, and clear all walking and work areas of debris prior to moving a drum.	
6	Load equipment and supplies into vehicle	1	Lifting hazards/back strain. Pinch points. Breaking glass in coolers. Spilling decon chemicals.	Use proper lifting technique. Request assistance when lifting heavy equipment. Use dolly to transport coolers, as necessary. Load coolers and decon materials so they will not shift during transport.	
7	Mobilization - Driving to the Site.	1	Vehicle collision. Loss of equipment/supplies from moving vehicle.	Follow safe driving procedures (inspect vehicle prior to driving, safe following distances, headlights, safety belts, etc.) Do not use cell phone while driving. Properly secure all equipment and supplies before operating vehicle.	
8	Working outdoors	1	Temperature-related illnesses (cold/heat stress). Weather. Biological hazards (animals, vegetation, etc).	Drink plenty of fluids, take breaks as needed to avoid heat stress and dress appropriately for weather conditions. Postpone work if lightening is observed or expected.	
9	Tailgate Safety Meetings	1	Injury or property damage due to unknown or known hazards.	Discuss work to be performed and associated hazards. Provide notification for upcoming work and check in/out with facility register and environmental/client contact at beginning and end of work activities. Maintain open communication between team members. All team members sign safety meeting form and review/discuss JLA's. Review available utility drawings and/or markouts. Discuss routes of egress, rally points, and location specific hazards.	
10	Set up work/decon area	1	Slips from uneven terrain, wet ground, wet plastic sheeting. Pinched fingers from moving drums and augers/rods. Strains and sparains. Cuts from metal edges/cutting tools.	Secure staging/decon area with caution tape, cones/barriers. Use ground guide/spotter while moving equipment in staging area. Scan ground ahead of obstacles. Use alternate routes if needed. Avoid placing hands between adjacent objects, ground, and pinch points. Use two people to unload supply truck. Cut away from hands and body with proper tool. Make sure workers have and use proper PPE.	
11	Set up DPT rig	1	Electric shock from overhead power lines. Pinches from moving hydraulics. Contact with hydraulic fluid from busted hose. Uneven ground that could cause rig to turn over. Damage caused by rig while accessing setup location.	Minimum distance 15 ft. from overhead power lines. Check voltage/safe-working distances if overhead lines within work vicinity. Inspect hoses for signs of wear/deterioration prior to start of drilling. Keep hands, feet, clothing at least 2 feet from moving parts. Use parking brake, chock wheels, level rig. Identify/avoid areas where rig could get stuck.	
12	Commence DPT drilling	1	Cross-contamination from previous borehole. Back strain, heat/cold stress, eye injury, noise, exposure to chemicals, hitting underground utility, slip/trip/fall, and equipment failure.	Decontaminate drill equipment after each borehole. Use proper lifting technique. Use proper PPE and air monitoring equipment - be aware of action levels. Stay safe distance from drill rig. Maintain good housekeeping in work area. Maintain spill kit and fir extinguisher near rig. Test/review kill switch operation.	

13	Demobilization	1	Lifting hazards and back strain. Vehicle collision. Loss of equipment/supplies from moving vehicle.	Provide notification for upcoming work and check in/out with facility register and environmental/client contact at beginning and end of work activities. Leave site clean of refuse and debris. Use proper lifting technique. Secure all equipment and supplies before operating vehicle. Use a spotter when backing or positioning large equipment or trailers.	
14	Decontamination Activities	1	Chemical burns to body/face	Wear chemical protective gloves and safety glasses.	
		2	Muscle strains, cuts, and bruises from moving equipment to and from equipment decon site.	Only one person should operate the decon of equipment. Wear gloves and utilize proper lifting techniques when moving equipment. Decon water should be containerized in 55-gallon waste drums.	
		3	Slips, trips and falls	Be cautious of slippery surfaces from spilt water used in the decon process. Avoid uneven walking and work surfaces.	

PPE

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)		Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Required
Dermal Protection	long sleeve shirt/pants		Required
Miscellaneous PPE	traffic vest--Class II or III		Required
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (alconox, brush, bucket, DI water)		Required
Miscellaneous	fire extinguisher		Required
	flashlight		Recommended
	first aid kit		Required
Personal	eye wash (specify type)		Recommended
	insect repellant		Recommended
	sunscreen		Recommended
	water/fluid replacement		Required
Traffic Control	traffic cones		Recommended

Job Safety Analysis

General

JSA ID	Crusher Road JSA 5	**Status**	(3) Completed
Job Name	General Industry- Driving- Commercial	**Created Date**	7/23/2013
Task Description	Trailer Towing	**Completed Date**	
Template	FALSE	**Auto Closed**	FALSE

Client / Project

Client	NYSDEC
Project Number	00266414.0000
Project Name	In-Situ Chemical Oxidation Pilot Test: Crusher Road Site #360127
PIC	Daniel Loewenstein
Project Manager	Andy Vitolins

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kathryn Farris	7/26/2013		Dan Lang	
Quality Reviewer	Aaron Bobar	7/26/2013		Dan Lang	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Inspect trailer and towing vehicle	1	Injuries to personnel and pedestrians, damage to equipment and property	Perform vehicle inspection checklist, and complete trailer checklist prior to using vehicle or trailer. Ensure water wagon (trailer) tires are properly inflated and that all lights are intact. Ensure tires are chocked prior to connecting trailer to vehicle	ARCADIS H&S Hand book: Chapter 3 section V
2	Connecting trailer to towing vehicle	1	Injury to personnel resulting from pinch points, lifting, and backing of vehicle in tow. Damage to trailer, vehicle or property, resulting from collison or improperly connected lights	Use a spotter at all times while backing vehicle and connecting trailer. Driver must maintain visual contact with spotter at all times. Predetermined hand signals should be used in conjunction with verbal commands. Once vehicle is in position to lower trailer onto the hitch, driver must put the vehicle in park and engage the emergency brake to prevent unexpected movement. Check that the trailer wheels are chocked. Avoid placing your hands in pinch points created between the trailer hitch and the vehicle. Crank up the wheel stand to lower the trailer onto the hitch. If trailer and vehicle are not aligned properly do not try to lift the trailer to move it into place. Step back and adjust the position of the vehicle while using the spotter. Ensure hitch is completely on and that the pin is latched down in place. Secure safety chains and plug in trailer lighting cables. Have spotter verify operational readiness.	
3	Driving while towing a trailer	1	Injury to personnel and pedestrians resulting from being struck by trailer	Review the driving JSA prior to operating vehicle. When driving while towing a trailer allow at least 4 seconds between you and other drivers. The trailer adds additional weight to the vehicle and will affect the way the vehicle handles in certain situations. Take corners wide enough to ensure trailer does not cut the corner and hit a curb or strike another vehicle or pedestrian. Use mirrors while taking corners to observe the path of the trailer	

Job Safety Analysis

General

JSA ID	Crusher Road JSA 5	**Status**	(3) Completed
Job Name	General Industry- Driving- Commercial	**Created Date**	7/23/2013
Task Description	Trailer Towing	**Completed Date**	
Template	FALSE	**Auto Closed**	FALSE

4	Parking and backing with the trailer	1	Injury to pedestrians or damage to trailer and property resulting from collision	Avoid parking that requires backing while the trailer is in tow. Once parked, ensure that the vehicle is in park and the emergency brake is set. Chock the trailer tires. If backing is required, use a spotter at all times. Back slowly and maintain visual contact. Use predetermined hand signals to communicate with the spotter	
5	Disconnecting the trailer from towing vehicle	1	Injury to personnel resulting from being struck by vehicle and pinch points	Wear leather gloves to help prevent hand injuries. When disconnecting trailer ensure that the vehicle is in park and the emergency brake is set. Chock trailer tires to prevent movement. Disconnect lighting wiring and safety chains. Remove pin, and disengage trailer hitch latch. Crank down wheel stand until trailer is completely removed from vehicle hitch. Place cones in front and back of vehicle and trailer.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Recommended
Foot Protection	steel-toe boots		Recommended
Hand Protection	work gloves (specify type)	leather	Recommended
Dermal Protection	long sleeve shirt/pants		Recommended
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	first aid kit		Required
Personal	traffic cones		Required

Job Safety Analysis

General

JSA ID	Crusher Road JSA 6	**Status**	(3) Completed
Job Name	Environmental- Chemical Injection	**Created Date**	7/23/2013
Task Description	Chemical Injection	**Completed Date**	
Template	False	**Auto Closed**	False

Client / Project

Client	NYSDEC
Project Number	00266414.0000
Project Name	In-Situ Chemical Oxidation Pilot Test: Crusher Road Site #360127
PIC	Daniel Loewenstein
Project Manager	Andy Vitolins

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Kathryn Farris	7/26/2013	6/3/2013	Dan Lang	☑
Quality Reviewer	Aaron Bobar	7/26/2013		Dan Lang	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Traveling to Site	1	Fatigue from long driving hours, driving early in the morning, or late at night, driving U-haul track/ trailer.	Take breaks during driving if necessary. Use defensive driving techniques. Follow traffic regulation.	
2	Site reconnaissance and walk-around	1	Slips/trips/falls can occur from uneven ground surface, slippery walkways or from tripping over equipment.	Survey the site upon arrival. Note any site conditions that may pose a potential hazard, and make note of any changes since the last injection event.	
		2	Site workers or equipment can be struck by site vehicular traffic	Wear Class II traffic vest and cone off the work area. Follow the JSA and Field H&S Handbook for roadway work. Plan the location where the injection trailer will be set up making sure to not block any ingress/egress to the site.	
3	Make arrangements for chemicals to be shipped safely to site, and stored in secure location	1	Secure storage area	Store on-site supplies in a safe place out of way of normal site operations. Lock the storage container.	
4	Load, unload and set up of required equipment including waterline hoses, injection hoses, flow meters, required PPE and supplies in/out of vehicle or storage area	1	Lifting equipment can cause back/shoulder/arm strains	Use proper lifting techniques. Request assistance when lifting heavy equipment.	
		2	Trip hazards over dragging and unsecured hoses	Keep coiled hose ends secured to coil when loading and unloading, stop and pick up dangling hoses that could be a trip hazard when carrying.	
5	Opening the injection/monitoring wells	1	Biological hazard	Be watchful for biological hazard and practice good housekeeping	
		2	Excessive bending	Wear knee pads to keep proper body position	
		3	Volatile vapor escape from wells	Ventilate the area before commencing the work if necessary	

6	Chemical mixing	1	Contact with chemicals (irritation, burning), exothermic reaction, gas generation during mixing	Read MSDS of the chemicals to be mixed. Wear modified level C PPE (tyvec/tychem cover all, chemical resistance gloves, full face respirator. No food, drink, or ignition source near mixing area. Perform all mixing in secondary containment area.	
		2	Heavy lifting	Use proper lifting technique and use buddy for items over 50 pounds or awkward size or awkward position lifting	
		3	Splash during air mixing	Maintain low pressure and low flow of air during mixing	
7	Injection of mixed solution	1	Contact with solution and spill	Maintain good housekeeping. Wear proper PPE, inspect injection lines prior to and during injection. Use bucket to capture solution during venting the lines and wells.	
8	Pump solution into wells and read pressure and flow gauges.	1	Pressure can build up resulting in hose or flow meter failure leading to possible injury.	Start injections at low flow rate and adjust as needed. Secure cam locks to hoses or flow meters with counter pins. Never place any body part directly over well head.	
		2	Pressure can build up resulting in hose or flow meter failure leading to possible injury.	Monitor pressures and stress points of the system during injection (connections, valves, threaded fittings, etc.). When injection is complete, ensure there is no pressure prior to disassembly. If injecting into bedrock, utilize fittings at the well head that will allow you to seal off residual pressure in the well before disconnecting hoses.	
		3	Slips/trips/falls can occur due to hoses laying on the ground resulting in injury.	Practice good housekeeping techniques. For hoses used during introductions, avoid walking over hoses as much as practicable. Use high visibility marking and warning devices and secure hose if travelling across a designated facility walking area.	
9	Equipment cleaning	1	Slips/trips/falls can occur from water causing slippery surfaces. Tripping can occur from equipment being laid out for cleaning.	Be aware of surroundings when cleaning equipment. Maintain good footing and walk slowly on wet/slippery surfaces. Wear proper PPE.	
		2	Heavy lifting of equipment can cause muscle strain.	Use proper lifting techniques. Request assistance when lifting heavy equipment.	
10	Demobilization of equipment	1	Tripping on equipment laying on the ground	Secure all equipment after use. Leave the site clean and free from any trash or debris. Secure all wells, gates and entrances to the site.	
		2	Heavy lifting can cause muscle strain.	Use proper lifting techniques when loading equipment.	
		3	Contact with chemicals	Wear proper PPE	
		4	Unsecured Loading of equipment	Fasten the loose equipment inside the vehicle or in the truck	
11	Traveling back from site	1	Improperly loading the trailer can cause flying debris on the roadway. Improper trailer connections can cause the trailer to detach during the demob.	Follow JSA for Driving-Commercial Motor Vehicle. Be sure all line items on the checklist are satisfactory before departing from the site.	JSA for Driving-Commercial Motor Vehicles

Job Safety Analysis

General

JSA ID	Crusher Road JSA 6	**Status**	(3) Completed
Job Name	Environmental- Chemical Injection	**Created Date**	
Task Description	Chemical Injection	**Completed Date**	
Template	False	**Auto Closed**	False

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	chemical protective suit (specify type)	Level C	Required
	long sleeve shirt/pants		Required
	splash apron		Required
Eye Protection	faceshield		Recommended
	safety glasses	Goggle type for splash protection	Required
Foot Protection	outer boot covers		Recommended
	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	PVC or equivalent	Required
Head Protection	hard hat		Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Recommended
	walkie talkie		Recommended
Decontamination	Decon supplies (specify type)	Neutralization solution	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)	Sterile rinsing eye wash for chemical injections	Required
Traffic Control	traffic cones		Required

Job Safety Analysis

General

JSA ID	Crusher Road JSA 7	**Status**	(3) Completed
Job Name	General Industry-Driving - Commercial Motor	**Created Date**	7/23/2013
Task Description	CMV Operation	**Completed Date**	
Template	TRUE	**Auto Closed**	FALSE

Client / Project

Client	NYSDEC
Project Number	00266414.0000
Project Name	In-Situ Chemical Oxidation Pilot Test: Crusher Road Site #360127
PIC	Daniel Loewenstein
Project Manager	Andy Vitolins

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Moyers, Sam	4/5/2012	3/22/2012	Coppola, Mija	☑
HASP Reviewer	Edwards, Lauren	4/5/2012	3/26/2012	Balcer, Denis	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	CMV Pre-Trip Inspection	1	Failure to perform inspection may lead to CMV accident, damage to CMV or regulatory citation.	Perform required pre-trip inspections by checking general condition of CMV. Sign the Post-Trip Inspection report from previous day or shift, if any deficiency corrected. Do not operate a CMV with an identified deficiency that will affect operation of CMV. Ensure emergency equipment is present, in good condition and unobstructed.	DOT Fact Sheets 007a and 006d
2	Cargo Inspection	1	Failure to inspect cargo may lead to unstable CMV operation, damage to cargo or CMV, CMV accident or regulatory citation.	Inspect cargo: Loaded properly in bed of truck or on trailer, adequately secured to prevent movement, inspect securing devices. Use edge protection if sharp edged cargo is present and using tiedowns. Use flagging to mark projecting loads. Ensure any required shipping papers are present and in order.	DOT Facts 006b
3	Coupling and Uncoupling Trailers	1	Improper coupling of trailers may lead to separation of trailer from truck during operation, damage trailer and/or truck, create an accident or result in regulatory citation.	Ensure hitch, ball and trailer are compatible. Verify trailer is properly seated on the hitch ball and secure. Ensure safety chains are used and crossed. Ensure electrical connections are compatible and functional, verify lights and braking systems are operational.	DOT Facts 006c
4	Driving the CMV	1	Improper operation of a CMV may result in accident, injury, death or regulatory citation.	Operate CMVs according to local speed laws. Only drive in approved lanes, where regulated. Maintain Smith System 5 Keys while driving, add seconds to 4 second rule when carrying heavy cargo. Keep eyes moving in all directions, including vertically. Use warning devices when stopped on side of roadway.	DOT Facts 005a and 005b
5	Slowing and Stopping the CMV	1	Improper braking or stopping of a CMV may cause load shifts damaging cargo or CMV, create accident by rear ending other vehicles, or cause CMV to be struck by other vehicle or train.	Brake early and gradually, slow and proceed with caution at railroad grade crossings. Stop at railroad grade crossings if transporting placarded quantity of hazmat per ARCADIS Transportation Safety Program. Use gear shifting to aid in slowing CMV, if so equipped. Account for extra cargo weight when applying brakes. Trailers over 1500 pounds GVWR required to have brakes.	DOT Facts 005a
6	Backing and Parking	1	Improper backing may result in striking other objects or persons, cause trailer to jackknife causing damage to trailer, truck or cargo.	Avoid situations where backing will be required. Use Smith System, GOAL prior to backing or ARCADIS spotter program. Plan all backing. Back slowly 1-3 mph. Keep eyes moving continuously and monitor front of the CMV as well as back of the CMV when backing. Avoid blind side backing situations.	DOT Facts 005a
		2	Improper parking of CMV or trailer may create difficulty in leaving parking area potentially resulting in accident, or result in regulatory citation if parked illegally.	Use pull through parking when permitted. Park in open areas of parking lots and select routes that reduce exposure to pedestrians in parking lots. Use horn in a proactive manner to communicate with other drivers and pedestrians.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Hand Protection	work gloves (specify type)	Leather or other during trailer coupling	Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
	Other	Spare fuses	Required
Traffic Control	Other	Warning devices (triangles, etc.)	Required

Attachment C

Shipping Determination Form

ARCADIS SHIPPING/TRANSPORTATION DETERMINATION

(Rev.4, 8/10)

General Information *(Need Help?)*

Revision Number	1
Project Name	Crusher Road
Project Number	00266414.0000
City of Shipment	Mt. Kisco, NY
City of Destination	East Longmeadow, MA
Analytical/MSDS/Hazard Information Attached?	No

Description of Material to be Shipped/Transported

Groundwater samples, a potential mixture of PCE, TCE, and/or their degradation products

Determination

X	Not Restricted/Regulated
	Hazardous Material

Complete for Hazardous Materials (Refer to 49 CFR 172.101 or IATA DGR section 4.2)

Proper Shipping Name	
UN or ID Number	
Hazard Class	
Packing Group	

"X"	*How Do You Want to Ship/Transport This Material?*	*24/7 Emergency Number Required? (FedEx criteria)*	*Packing Instruction / Shipping Guide / Support Package*
	Materials of Trade Exception	No	
	Excepted Quantity	No	
	Limited Quantity (Ltd Qty)	Ground –Yes Air - No	
	Special Permit/49 CFR 173.13	Ltd Qty Ground –Yes Ltd Qty Air – No Non-Ltd Qty- Yes	
	UN Specification Ground, Non-Bulk	Yes	
	UN Specification Ground, Bulk	Yes	
	UN Specification Air, Passenger or Cargo Aircraft	Yes	
	UN Specification Air, Cargo Aircraft Only	Yes	
	Other:	Yes/No	
	Batteries (Excepted)	No	ARCADIS Guide US050
	Compressed Gases (Non-flammable)	Yes	ARCADIS Guide US020
	Dry Ice	No	ARCADIS Guide US015
	Radioactive Material, Excepted Package, Limited Quantity of Material	No	ARCADIS Guide US016
X	Sample Coolers (Print Guide and provide to field staff)	NA	ARCADIS Guide US001

Other Determinations

	This material is a Hazardous Waste (being offered under a Hazardous Waste Manifest)
	This material is a Hazardous Substance (49 CFR 172.101 appendix A)
	This material is a Marine Pollutant or Severe Marine Pollutant (49 CFR 172.101 appendix B)

Method of Shipment/Transportation

	FedEx Freight		Ground (FedEx)	X	Air (FedEx)		Lab Courier
	FedEx Custom Critical		Ground (UPS)		Air (UPS)		Rail
	Freight Other		ARCADIS Transport		Non DOT Spec.		Other
Comments:							

Special Instructions

☐ Sample cooler to be prepared in accordance with ARCADIS Shipping Guide US-001

Rationale for Determination

Based on site history and limited previous sampling, PCE and its degradation byproducts are expected in the samples. Due to the expected concentrations/volume of material in the mixture, the shipments are unregulated. Samples will be shipped using standard ice chests.

Regulatory Reference/Interpretation

49 CFR 172.101

Determination Performed By

Kathryn Farris	Kathryn Farris	7/24/2013
Name Printed	Signature	Date

QA/QC Check Performed By

Mark Flusche	Mark Flusche	7/24/13
Name Printed	Signature	Date

Attachment D

Tailgate Meeting Form

ARCADIS

Control Number:TGM - _____

TGM + *project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year*

TAILGATE HEALTH & SAFETY MEETING FORM

Project Name:			**Project Location:**
Date:	**Time:**	**Conducted by:**	**Signature/Title:**

Issues or concerns from previous day's activities:

Task anticipated to be performed today:

☐ Additonal permits or checklists attached

USE TRACK! Evaluate the hazards (h) for the tasks being performed today and rank as Low (L), Medium (M) or High (H). Use relevant JLAs, FHSHB, permit or other work standard to communicate controls (c) to be used to eliminate or mitigate identified hazards.

☐ Gravity (i.e., ladder, scaffold, trips) (L M H)
h: _____
c: _____

☐ Motion (i.e., traffic, moving water) (L M H)
h: _____
c: _____

☐ Mechanical (i.e., augers, motors) (L M H)
h: _____
c: _____

☐ Electrical (i.e., utilities, lightning) (L M H)
h: _____
c: _____

☐ Pressure (i.e., gas cyl., wells) (L M H)
h: _____
c: _____

☐ Environment (i.e., heat, cold, ice) (L M H)
h: _____
c: _____

☐ Chemical (i.e., fuel, acid, paint) (L M H)
h: _____
c: _____

☐ Biological (i.e., ticks, poison ivy) (L M H)
h: _____
c: _____

☐ Radiation (i.e., alpha, sun, laser) (L M H)
h: _____
c: _____

☐ Sound (i.e., machinery, generators) (L M H)
h: _____
c: _____

☐ Personal (i.e. alone, night, not fit) (L M H)
h: _____
c: _____

☐ Driving (i.e. car, ATV, boat, dozer) (L M H)
h: _____
c: _____

Comments:

Signature and Certification: I have read and understand the project specific HASP for this project.

Printed Name/Signature/Company	Sign In Time	Sign Out Time

Place any additional signatures on the back of this form.

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB,** I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call **WorkCare at 1.800.455.6155** and then notify the field supervisor.

Utility strike, motor vehicle accident or 3rd party protperty damage - field supervisor will immediately notify the Project or Task Manager

Attachment E

MSDSs

RemOx® L
ISCO Reagent

EC- SAFETY DATA SHEET according to Regulation (EC) № 1907/2006 of the European Parliament and of the Council, of 18 December 2006 concerning REACH

Material Safety Data Sheet

Section 1 Chemical Product and Company Identification

PRODUCT NAME: RemOx® L ISCO Reagent **TRADE NAME:** RemOx® L ISCO Reagent	**Revision Date: April 2008**

USES OF SUBSTANCE: RemOx® L ISCO Reagent is a liquid oxidant recommended for in-situ and ex-situ remediation of sites that require a strong oxidant.

COMPANY NAME (Europe): CARUS NALON S.L.	**COMPANY ADDRESS:** Carus Nalon S.L. Barrio Nalon, s/n 33100 Trubia-Oviedo Espana, Spain **INFORMATION:** (34) 985-785-513 (34) 985-785-513 www.caruseurope.com (Web) carus@carusnalon.com (Email) **EMERGENCY TELEPHONE:** (34) 985-785-513
COMPANY NAME (US): CARUS CORPORATION	**COMPANY ADDRESS:** 315 Fifth Street Peru, IL 61354, USA **INFORMATION:** (815)-223-1500 www.caruscorporation.com (Web) salesmkt@caruscorporation.com (Email) **EMERGENCY TELEPHONE:** (800) 435 –6856 (USA) (800) 424-9300 (CHEMTREC, USA) (815-223-1500 (Other countries)

Section 2 Hazards Identification

1. Eye Contact
   RemOx® L ISCO Reagent is damaging to eye tissue on contact. It may cause burns that result in damage to the eye.
2. Skin Contact
   Momentary contact of solution at room temperature may be irritating to the skin, leaving brown stains. Prolonged contact is damaging to the skin.
3. Inhalation
   Acute inhalation toxicity data are not available. However, airborne concentrations of RemOx® L ISCO Reagent in the form of mist may cause irritation to the respiratory tract.
4. Ingestion
   RemOx® L ISCO Reagent if swallowed, may cause burns to mucous membranes of the mouth, throat, esophagus, and stomach.

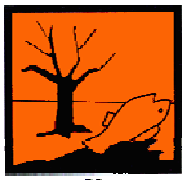
Section 3 Hazardous Ingredients

Material or Component	CAS No.	%	Hazard Data
Sodium Permanganate	10101-50-5	40	**PEL/C** 5 mg Mn per cubic meter of air **TLV-TWA** 0.2 mg Mn per cubic meter of air

HAZARD SYMBOLS:


O


Xn


N

RISK PHRASES:

8 Contact with combustibles may case fire.
22 Harmful if swallowed.
50/53 Very toxic to aquatic organisms, may cause long-term effects in the aquatic environment.

SAFETY PHRASES:

17 Keep away from combustible materials.
24/25 Avoid contact with skin and eyes.
26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice

Section 4 First Aid Measures

1. Eyes
   Immediately flush eyes with large amounts of water for at least 15 minutes holding lids apart to ensure flushing of the entire surface. Do not attempt to neutralize chemically. Seek medical attention immediately. Note to physician: Decomposition products are alkaline.
2. Skin
   Immediately wash contaminated areas with water. Remove contaminated clothing and footwear. (Caution: Solution may ignite certain textiles). Wash clothing and decontaminate footwear before reuse. Seek medical attention immediately if irritation is severe and persistent.
3. Inhalation
   Remove person from contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen if readily available. Seek medical attention immediately.
4. Ingestion
   Never give anything by mouth to an unconscious or convulsing person. If person is conscious, give large quantities of water or milk. Seek medical attention immediately.

Section 5 Fire Fighting Measures

NFPA* HAZARD SIGNS:

Health Hazard 1 = Materials which under fire conditions would give off irritating combustion products. (less than 1 hour exposure) Materials which on the skin could cause irritation.
Flammability Hazard 0 = Materials that will not burn.
Reactivity Hazard 0 = Materials which in themselves are normally stable, even under fire exposure

conditions, and which are not reactive with water.

Special Hazard OX = Oxidizer

***National Fire Protection Association 704**

FIRST RESPONDERS:
Wear protective gloves, boots, goggles, and respirator. In case of fire, wear positive pressure breathing apparatus. Approach incident with caution. Use 2004 Emergency Response Guidebook (U.S. DOT RSPA, TC and STC). Guide No. 140. (http://hazmat.dot.gov/pubs/erg2004/erg2004.pdf).

FLASHPOINT	None
FLAMMABLE OR EXPLOSIVE LIMITS	Lower: Nonflammable Upper: Nonflammable
EXTINGUISHING MEDIA	Use large quantities of water. Water will turn pink to purple if in contact with RemOx® L ISCO Reagent. Dike to contain. Do not use dry chemicals, CO_2Halon® or foams.
SPECIAL FIREFIGHTING PROCEDURES	If material is involved in fire, flood with water. Cool all affected containers with large quantities of water. Apply water from as far as a distance as possible. Wear self-contained breathing apparatus and full protective clothing.
UNUSUAL FIRE AND EXPLOSION	Powerful oxidizing material. May decompose spontaneously if exposed to heat (135°C/275°F). May be explosive in contact with certain other chemicals (Section 10). May react violently with finely divided and readily oxidizable substances. Increases burning rate of combustible material. May ignite wood and cloth.

Section 6 Accidental Release Measures

PERSONAL PRECAUTIONS

Personnel should wear protective clothing suitable for the task. Remove all ignition sources and incompatible materials before attempting clean up.

ENVIRONMENTAL PRECAUTIONS:

Do not flush into sanitary sewer system or surface water. If accidental release into the environment occurs, inform the responsible authorities. Keep the product away from drains, sewers, surface and ground water and soil.

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

Contain spill by collecting the liquid in a pit or holding behind a dam (sand or soil). Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous

salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water. To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as above.

Section 7 Handling and Storage

WORK/HYGIENIC PRACTICES

Wash hands thoroughly with soap and water after handling RemOx® L ISCO Reagent. Do not eat, drink or smoke when working with RemOx® L ISCO Reagent . Wear proper protective equipment. Remove clothing, if it becomes contaminated.

VENTILATION REQUIREMETNS

Provide sufficient mechanical and/or local exhaust to maintain exposure below the TLV/TWA.

CONDITIONS FOR SAFE STORAGE

Store in accordance with NFPA 430 requirements for Class II oxidizers. Protect containers from physical damage. Store in a cool, dry area in closed containers. Segregate from acids, peroxides, formaldehyde, and all combustible, organic, or easily oxidizable materials including antifreeze and hydraulic fluid.

Section 8 Exposure Controls and Personal Protection

RESPIRATORY PROTECTION

In cases where overexposure to mist may occur, the use of an approved NIOSH-MSHA mist respirator or an air supplied respirator is advised. Engineering or administrative controls should be implemented to control mist.

EYE

Faceshield, goggles, or safety glasses with side shields should be worn. Provide eyewash in working area.

GLOVES

Rubber or plastic gloves should be worn.

OTHER PROTECTIVE EQUIPMENT

Normal work clothing covering arms and legs, and rubber, or plastic apron should be worn. Caution: If clothing becomes contaminated, wash off immediately. Spontaneous ignition may occur with cloth or paper.

Section 9 Physical and Chemical Properties

APPEARANCE AND ODOR	Dark purple solution, odorless
BOILING POINT, 760 mm Hg	105 °C
VAPOR PRESSURE (mm Hg)	760 mm at 105ºC
SOLUBILITY IN WATER % BY SOLUTION	Miscible in all proportions
PERCENT VOLATILE BY VOLUME	61% (as water)
EVAPORATION RATE	Same as water
FREEZING POINT	-15.0 °C
SPECIFIC GRAVITY	1.36-1.39

pH	5-9
OXIDIZING PROPERTIES	Strong oxidizer. May ignite wood and cloth.
EXPLOSIVE PROPERTIES	Explosive in contact with sulfuric acid or peroxides, or readily oxidizable substances.

Section 10 Stability and Reactivity

STABILITY	Under normal conditions, the material is stable.
CONDITIONS TO AVOID could	Contact with incompatible materials or heat (135°C / 275ºF) result in violent exothermic chemical reaction.
INCOMPATIBLE MATERIALS	Acids, peroxides, formaldehyde, antifreeze, hydraulic fluids, and all combustible organic or readily oxidizable materials, including metal powders. With hydrochloric acid, toxic chlorine gas is liberated.
HAZARDOUS DECOMPOSITION PRODUCTS	When involved in a fire, liquid permanganate may form corrosive fumes.
CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION	Material is not known to polymerize.

Section 11 Toxicological Information

SODIUM PERMANGANATE: Acute oral LD_{50} not known.

1. Acute toxicity

Irritating to body tissue with which it comes into contact. No acute toxicity data is available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate. The toxicity data for potassium permanganate is given below:

Ingestion:
LD 50 oral rat: 780 mg/kg male (14 days); 525 mg/kg female (14 days).
Harmful if swallowed. ALD: 10g. Ingestion may cause nausea, vomiting, sore throat, stomach-ache and eventually lead to a perforation of the intestine. Liver and kidney injuries may occur.

Skin contact:
LD 50 dermal no data available.
The product may be absorbed into the body through the skin. Major effects of exposure: severe irritation, brown staining of skin.

Inhalation:
LC 50 inhal. no data available.
The product may be absorbed into the body by inhalation. Major effects of exposure: respiratory disorder, cough.

2. Chronic toxicity

No known cases of chronic poisoning due to permanganates have been reported. Prolonged exposure, usually

over many years, to heavy concentrations of manganese oxides in the form of dust and fumes may lead to chronic manganese poisoning, chiefly involving the central nervous system.

3. Carcinogenicity

Sodium permanganate has not been classified as a carcinogen by ACGIH, NIOSH, OSHA, NTP, or IARC.

4. Medical Conditions Generally Aggravated by Exposure

Sodium permanganate solution will cause further irritation of tissue, open wounds, burns or mucous membranes.

Section 12 Ecological Information

Entry to the Environment

Permanganate has a low estimated lifetime in the environment, being readily converted by oxidizable materials to insoluble MnO_2.

Bioconcentration Potential

In non-reducing and non-acidic environments MnO_2 is insoluble and has a very low bioaccumulative potential.

Aquatic Toxicity

No data.

Section 13 Disposal Considerations

Waste Disposal

RemOx® L ISCO Reagent, once it becomes a waste, is considered a D001 hazardous (ignitable) waste. For disposal of RemOx® L ISCO Reagent solutions, follow procedures in Section 6 and deactivate the permanganate to insoluble manganese dioxide. Dispose of it in a permitted landfill. Contact Carus Chemical Company for additional recommendations.

Section 14 Transport Information

USA (land, D.O.T.)	**Proper Shipping Name:** 49 CFR172.101 Permanganates, inorganic, aqueous solution, n.o.s .(contains sodium permanganate **Hazard Class:** 49 CFR172.101….Oxidizer **ID Number:** 49 CFR172.101….UN 3214 **Packing Group:** 49 CFR172.101….II **Division:** 49 CFR172.101….5.1
European Labeling in accordance Road/Rail Transport (ADR/RID)	**ID Number:** UN 3214 **ADR/RID Class** 5.1 **Description of Goods:** Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate) **Hazard Identification No.** 50
European Labeling in accordance with EC directive (Water, I.M.O.)	**Proper Shipping Name:** Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate) **Hazard Class:** Oxidizer **ID Number:** UN 3214

	Packing Group:	II
	Division:	5.1
	Marine Pollutant:	No
European Labeling in accordance with EC directive (Air, I.C.A.O.)	**Proper Shipping Name:**	Permanganates, inorganic, aqueous solution, n.o.s (contains sodium permanganate)
	Hazard Class:	Oxidizer
	ID Number:	UN 3214
	Packing Group:	II
	Division:	5.1

Section 15 Regulatory Information (Sodium Permanganate)

TSCA	Listed in the Toxic Substances Control Act (TSCA) Chemical Substance Inventory.	
CERCLA	Not listed.	
RCRA	Oxidizers such as RemOx® L ISCO Reagent solution meet the criteria of ignitable waste. 40 CFR 261.21.	
SARA TITLE III Information		
	Section 302/303	Extremely hazardous substance: Not listed
	Section 311/312	Hazard categories: Fire, acute and chronic toxicity.
	Section 313	RemOx® L ISCO Reagent contains 40% manganese compounds as part of the chemical and is subject to the reporting requirements of Section 313 of Title III, Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372.
FOREIGN LIST	Canadian Non-Domestic Substance List , EINECS	

Section 16 Other Information

NIOSH	National Institute for Occupational Safety and Health
MSHA	Mine Safety and Health Administration
OSHA	Occupational Safety and Health Administration
NTP	National Toxicology Program
IARC	International Agency for Research on Cancer
PEL	Permissible Exposure Limit
C	Ceiling Exposure Limit
TLV-TWA	Threshold Limit Value-Time Weighted Average
CAS	Chemical Abstract Service
EINECS	Inventory of Existing Chemical Substances (European)

Chithambarathanu Pillai (S.O.F.)
April 2008

Material Safety Data Sheet
Sodium thiosulfate

ACC# 21710

Section 1 - Chemical Product and Company Identification

MSDS Name: Sodium thiosulfate
Catalog Numbers: AC202870000, AC202870010, AC202870025, AC202870050, AC202875000, S75222, S78930-1, S78930-2, S78930-3, S78930-4, S79809, NC9417189, S446-3, S446-500, S446-500LC
Synonyms: Sodium Hyposulfite; Sodium Oxide Sulfide; Thiosulfuric Acid Disodium Salt
Company Identification:

Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410

For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7772-98-7	Sodium thiosulfate	>98	231-867-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: white solid.
Caution! May cause eye, skin, and respiratory tract irritation. Hygroscopic (absorbs moisture from the air).
Target Organs: No data found.

Potential Health Effects
Eye: May cause eye irritation.
Skin: May cause skin irritation. May be harmful if absorbed through the skin.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May be harmful if swallowed.
Inhalation: May cause respiratory tract irritation. May be harmful if inhaled.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes: Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and

lower eyelids. Get medical aid.
Skin: Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid if cough or other symptoms appear.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray, dry chemical, or carbon dioxide.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 1; Flammability: 0; Instability: 1

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with skin and eyes. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a cool, dry, well-ventilated area away from incompatible substances. Keep away from strong acids.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Sodium thiosulfate	none listed	none listed	none listed

OSHA Vacated PELs: Sodium thiosulfate: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to minimize contact with skin.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: white
Odor: odorless
pH: 6.5-8 (solution)
Vapor Pressure: Negligible.
Vapor Density: Not applicable.
Evaporation Rate:negligible
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point:43 deg C
Decomposition Temperature: Not available.
Solubility: Soluble.
Specific Gravity/Density:1.66
Molecular Formula: Na2O3S2
Molecular Weight:158.0978

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures. Deliquescent (tending to absorb atmospheric water vapor and become liquid).
Conditions to Avoid: High temperatures, moisture.
Incompatibilities with Other Materials: Strong acids.
Hazardous Decomposition Products: Oxides of sulfur, hydrogen sulfide, sodium oxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 7772-98-7: XN6476000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 7772-98-7: Not listed by ACGIH, IARC, NTP, or CA Prop 65.

Epidemiology: No information available.
Teratogenicity: No information available.

Reproductive Effects: No information available.
Mutagenicity: Please refer to RTECS# XN6476000 for specific information.
Neurotoxicity: No information available.
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	Not Regulated	Not Regulated
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 7772-98-7 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
CERCLA Hazardous Substances and corresponding RQs
None of the chemicals in this material have an RQ.
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
Section 313 No chemicals are reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.

This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA.
None of the chemicals in this product are listed as Priority Pollutants under the CWA.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 7772-98-7 is not present on state lists from CA, PA, MN, MA, FL, or NJ.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European / International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

Not available.

Risk Phrases:

Safety Phrases:

S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger / Protection)

CAS# 7772-98-7: 0

Canada - DSL / NDSL

CAS# 7772-98-7 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of Not controlled..

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

Section 16 - Additional Information

MSDS Creation Date: 12/12/1997
Revision #5 Date: 2/12/2007

ARCADIS

Appendix B

Injection Volume Calculations

Appendix B
Injection Volumme Calculations
Crusher Road (SITE #360127)
Town Of Bedford, Westchester County, New York

Number of injection points	10	
Estimated injection radius	10	feet
Estimated injection thickness	15	feet
pi	3.14	
Injection "cylinder" volume (pi*r^2*h)	4710	cubic feet
Estimated mobile porosity	5%	
Volume of moble pore space within each injection "cylinder"	235.5	cubic feet
Volume of water in a cubic foot	7.48	gallons per cubic foot
Moble pore space volume across all injection points	17615.4	gallons
Weight of water	8.34	pounds/gallon
Moble pore space liquid weight across all injection points	146912	pounds of solution
Permanganate concentration	3%	
Pounds of pure permanganate needed	4407	pounds of pure permanganate
Pounds of water needed	142505	pounds of water
Desired percent solution of permanganate	40%	
Specific gravity of permanganate	1.4	
Weight of permananate	11.7	pounds/gallon
Volume of solution representing the 40% permanganate by volume	377	gallons
Volume of solution representing the 60% water by volume	566	gallons
Weight of water in the 40% solution	4722	pounds
Weight of permanganate in the 40% solution	4407	pounds
Weight of 40% solution	9130	pounds
Volume of 40% solution	944	gallons