PILOT TEST WORK PLAN ADDENDUM

IN-SITU CHEMICAL OXIDATION FOR GROUNDWATER

Operable Unit No. 1 (OU-1)

Former Columbia Cement Company, Inc. Facility
159 Hanse Avenue
Freeport, New York

Site # 1-30-052

Prepared for:

Atlantic Richfield Company
4850 East 49th Street
Cuyahoga Heights, Ohio 44125

Prepared by:

URS Corporation
201 Willowbrook Boulevard
Wayne, New Jersey 07470

URS

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On behalf of Atlantic Richfield Company, a BP affiliate (BP), URS Corporation (URS) has prepared this Work Plan Addendum (WP) for Operable Unit 1 (OU-1) of the former Columbia Cement Company (CCC) site located at 159 Hanse Avenue in Freeport, New York ("Site"). The purpose of this Work Plan Addendum is to provide planning, implementation and performance monitoring details for application of in-situ chemical oxidation (ISCO) via injection to address site related constituents in groundwater in 2011. The pilot test was initiated in 2010 using sodium persulfate and hydrogen peroxide. Results and conclusions of the pilot test are summarized along with recommendations for the 2011 application. Specifics about the products, the technology and how it will be implemented are discussed in this Work Plan Addendum along with performance monitoring details and schedule.

Results of the Remedial Investigation (RI) conducted by Delaware Engineering are presented in the Revised Remedial Investigation Report (RIR), December 2003. URS Corporation conducted a Feasibility Study (FS) to evaluate remedial options for the Site and submitted a Draft FS to NYSDEC on April 30, 2004. Following the removal of USTs by Site owner Illinois Tool Works (ITW) in September 2004, subsequent Supplemental Remedial Investigation (SRIR) conducted by URS in 2006, and additional off-site investigation which were completed in September 2007, NYSDEC chose to divide the project into two Operable Units (OUs). OU-1 is the onsite project area and includes the former CCC property, currently owned by ITW. OU-2 is the offsite area including downgradient properties located between Hanse Avenue and Freeport Creek and areas immediately surrounding OU-1. The Final Revised FS addressing OU-1 was submitted to NYSDEC on February 18, 2008. NYSDEC prepared the Proposed Remedial Action Plan (PRAP) in February 2008 based on this FS, issued a Record of Decision in March 2008, and selected ISCO, bioremediation and a sub-slab depressurization system (SSDS) alternatives to address soil, groundwater and soil vapor impacts, respectively, at the Site within OU-1. Bioremediation pilot tests for chloroethane (CA) impacts in groundwater were inconclusive so the selected remedy was modified to ISCO. An ISCO pilot test was initiated which showed promising results. This Work Plan Addendum is the extension of that ISCO pilot test to address residual CA in OU-1 groundwater.

1.1 BACKGROUND INFORMATION

The background information presented below was previously presented in the Pilot Test Work Plan. It is presented again for completeness.

1.1.1 Site Description

Prior to 1969, the Village of Freeport operated the area of the site as a municipal landfill. Dumping at the landfill ceased in the 1960's when the site was developed. CCC was the first occupant of the Site building, beginning in 1969. CCC operated on Site until the sale to ITW

in 1996. CCC manufactured various contact cement and other industrial and commercial adhesive products from 1969 to 1996. A Site Location Map is provided as Figure 1.

The former CCC facility consists of approximately 2 acres in an area of Freeport, New York that is very developed with commercial and industrial facilities. The Site building covers approximately 65,000 square feet, and consists of former offices, material storage, production rooms, and warehousing. The building is currently vacant. Ten 8,000-gallon underground storage tanks (USTs) were located near the southwest corner of the property. These USTs were removed in September 2004. A Site Plan is presented as Figure 2.

Specifics regarding the spill, site geology (e.g. hydrogeologic units, surface water, etc.) can be found in the following reports:

- *Remedial Investigation Report, Columbia Cement Company, Inc., 159 Hanse Avenue, Freeport, New York.* December 2003, Delaware Engineering, P.C. (RIR)

- *Supplemental Remedial Investigation Report, Operable Unit No. 1., Former Columbia Cement Company, Inc. Facility, 159 Hanse Avenue, Freeport, New York.* December 2007. URS Corporation. (OU-1 Supplemental RIR)

- *Revised Feasibility Study Report, Operable Unit No. 1., Former Columbia Cement Company, Inc. Facility, 159 Hanse Avenue, Freeport, New York.* February, 2008. URS Corporation. (OU-1 FS)

1.1.2 TCA Spill

On April 28, 1988, Quadrell Brothers of Rahway, New Jersey was delivering 3,500 gallons of TCA to CCC. While pumping into a storage tank, the tanker truck became pressurized and ruptured. Approximately 1,760 gallons of TCA was spilled to the ground surface and flowed to a storm drain (SD-1) in the UST area.

NYSDEC's Region 1 Spill Response Unit was notified of the spill. The immediate response measures included removal of about 10 cubic yards of soil from SD-1 and removal of liquid from the storm drain line by Chemical Pollution Control. The storm drain line was flushed until water at the Freeport Creek outfall measured less than 50 mg/l of TCA. The Site was entered into the NYSDEC's Inactive Hazardous Waste Disposal Site (State Superfund) Program.

1.1.3 Site Geology

Soil borings advanced during investigation activities at the Site encountered five stratigraphic units beneath the site. In order of increasing depth, these units are: fill material; tidal marsh deposits; gravelly sand; gray clay and silt; and gray sand.

- The fill material encountered across the entire site consists of reworked native soil, pavement sub-base (ballast), and miscellaneous debris including wood, glass, brick, metal, paper materials, gravel, asphalt and UST excavation backfill. The fill ranges in thickness from 3.1 feet (ft) to 22.9 ft, with an average thickness of about 11 ft.

- The tidal marsh deposits are encountered beneath the fill material over most of the site, but are absent in some areas. The tidal marsh deposits consist of brown, dark, gray and black organic clayey silt with some fine to medium sand and varying amounts of roots, wood and peat. Where present, the tidal marsh material is encountered at an average depth of 9.5 ft and has an average thickness of 4 ft.

- The gravelly sand is relatively thick and flat-lying. It is encountered beneath the tidal marsh deposits, and beneath the fill material where the tidal marsh deposits are absent. The unit consists of medium dense, brown to light gray, coarse to fine sand, with little medium to fine subrounded gravel. Minor amounts of silt and clay were found in isolated samples. The gravelly sand thickness ranges from 15 to 30 ft and is thickest in the western portion of the site.

- The gray clay and silt underlies the gravelly sand. It consists of a medium gray clayey silt to silt and clay with little to trace sand and becomes clayier with depth. The depth to the top of the gray clay unit ranged from 34 ft in the spill area to 37 ft along the western Site boundary. Only two borings on Site penetrated the entire clay unit. In those borings, the clay ranged in thickness from 12 to 13 feet.

1.1.4 Site Hydrogeology

The shallow water-bearing units beneath the Site are not utilized as a drinking water source. Deeper confined units include the Jameco, Magothy and Lloyd aquifers, which are used for drinking water in some areas of Long Island. Due to saltwater encroachment near the southern shore of Long Island, these units are not a source of drinking water near the Site. Groundwater beneath the site is classified as Class GA.

Shallow groundwater at the Site is encountered in the fill material at depths ranging from 5.5 to 8.0 feet below grade (fbg). In various areas of the site, the water table is encountered in the fill material, the tidal marsh deposits, or the gravelly sand. Due to this fact and extensive

connectivity between these units, particularly where the tidal marsh unit is thin or absent, these units have been treated collectively as single unconfined aquifer.

As is typical in coastal areas, shallow groundwater at the site is influenced by two tidal cycles per day. Tidal monitoring was performed as part of the Remedial Investigation for Operable Unit No. 2 in November 2009. The tidal monitoring was performed in wells at the western perimeter of OU-1, and in OU-2, including Freeport Creek. At low tide, groundwater flow is to the west (toward Freeport Creek) and the hydraulic gradient between Hanse Avenue and Freeport (across OU-2) was 2.3×10^{-3} ft/ft, which is very low and similar to gradients observed in OU-1. At high tide, the elevation of Freeport Creek is higher than the elevation of the OU-2 wells and groundwater flow is to the east (toward OU-1) with a hydraulic gradient of 6.67×10^{-3} ft/ft. When the mean tide is calculated from this data, the overall groundwater flow gradient and direction at OU-2 is 2.33×10^{-3} ft/ft toward the west. This indicates that the overall flow direction at OU-2 is to the west (from OU-1 toward OU-2), but with a very low hydraulic gradient.

Hydraulic conductivity for the water-bearing units at the Site was estimated by Delaware Engineering in the RI by performing slug tests in Site monitoring wells. The average hydraulic conductivity for the water table wells was 8.88 feet per day (ft/day) [3.13×10^{-3} centimeters per second] (cm/sec). The average hydraulic conductivities for the shallow and deep gravelly sand wells were 66.80 ft/day (2.36×10^{-2} cm/sec) and 49.26 ft/day (1.74×10^{-2} cm/sec), respectively. The average hydraulic conductivity for all the gravelly sand wells was 60.03 ft/day (2.12×10^{-2} cm/sec). The hydraulic conductivity from the single test in the lower gray sand was 48.19 ft/day (1.70×10^{-2} cm/sec).

In October 2005, URS performed slug tests and determined that the estimated average hydraulic conductivity values for the wells screened in the gravelly sand ranged from 34.63 ft/day (1.22×10^{-2} cm/sec) to 44.75 ft/day (1.58×10^{-2} cm/sec). These results agree fairly well with results from the same wells during the RI slug tests.

1.1.5 Contaminant Assessment

Detailed contaminant assessments for OU-1 soil and ground have been presented in previous submittals. Contaminant assessment in soil is discussed in a separate work plan that discusses ISCO for source area soils (*Revised Final Remedial Action Work Plan for Soil, Full Scale In-Situ Chemical Oxidation, Operable Unit No. 1, Former Columbia Cement Company Inc. Facility, Freeport, New York*, June 25, 2009). A detailed contaminant assessment for groundwater was presented in the 2010 ISCO Pilot Test Work Plan. A summary of the groundwater contaminant assessment is presented below.

1.1.5.1 Groundwater Contaminant Assessment Summary

- TCA is currently not present at concentrations exceeding Groundwater Quality Standards (GWQS) in any Site wells outside the spill area. TCA and DCA in spill area are being addressed through a separate ISCO program to treat spill area soils.

- Outside the spill area, DCA and CA are the primary groundwater contaminants of concern. The presence of DCA and CA are strong indicators that natural degradation of TCA is occurring.

- Groundwater data suggests that in the both the shallow and deep wells in the gravelly sand, TCA degrades quickly to DCA, which, in turn, degrades quickly to CA. Presence of DCA is limited to deep wells in the vicinity of the spill area (MW-1D-97, MW-98-8D and MW-00-12D).

- CA does not degrade as quickly to ethane and migrates with the groundwater west beyond OU-1 toward Hanse Avenue and Freeport Creek (OU-2) in both the shallow and deep wells in the gravelly sand.

- CA is the only spill-related compound detected in groundwater at the downgradient property boundary at concentrations exceeding the GWQS, and is the focus of this Work Plan.

1.2 SUMMARY OF PREVIOUS PILOT TESTS

In 2008, an Enhanced Aerobic Bioremediation (EAB) pilot test was conducted in the driveway between the former Columbia Cement building and the 159 Hanse Avenue building, upgradient of monitoring wells MW-98-9D and MW-97-1S. An oxygen–release product called EHC-O® was injected in an attempt to create aerobic conditions in the pilot test area. EHC-O® is a solid peroxide (calcium peroxide) that is designed to release oxygen over a period of 9 to 12 months. Post injection sampling indicated that the EHC-O® did raise the dissolved oxygen levels, resulting in reduced CA concentrations for a short period of time. However, due to the high oxygen demand, these conditions were short-lived and dissolved oxygen and CA levels returned to pre-injection levels within 2 months.

In 2009, a second pilot test, utilizing a combination of EAB and ISCO, was conducted. Klozur-CR, which contains the oxidizer sodium peroxide and the slow oxygen release compound calcium peroxide was injected in the same area. The results of the combined ISCO/EAB pilot test showed that the amendment did have a positive impact on groundwater conditions, but similar to the EAB Pilot Test, the effects could not be maintained over time. The results suggest that because of the extremely anaerobic and reducing aquifer conditions, a remediation strategy that relies on aerobic bioremediation as a component is not feasible.

Because of the high oxygen demand, slow-release oxygen products would have to be applied in large quantities too frequently to be viable.

Details of these pilot tests were presented in the 2010 ISCO Pilot Test Work Plan with a recommendation to apply ISCO technology for the downgradient CA plume. This recommendation was based on the successful application of ISCO to treat spill area soil. A summary of the results of the full-scale ISCO application in the spill area was presented to NYSDEC on May 7, 2010.

2.1 IN-SITU CHEMICAL OXIDATION PILOT TEST

The first two pilot tests concluded that both bioremediation and combination oxidation/bioremediation approaches were ineffective in treating CA in groundwater. A chemical oxidation approach (using activated sodium persulfate) worked previously in treating CA in soils in the spill area. Consequently, it was decided to conduct another pilot test using the ISCO approach to treat CA in groundwater.

The ISCO pilot test was conducted in accordance with the ISCO Pilot Test Work Plan, dated June 11, 2010. The ISCO Pilot Test Work Plan was approved by NYSDEC on June 14, 2010. The pilot test included installation of 51 injection points (17 locations, 3 vertical intervals at each location), and six monitoring wells. Vertically, the injection points were screened from 15 fbg to 21 fbg (shallow); 23 fbg to 29 fbg (intermediate); and 30 fbg to 36 fbg (deep). The locations of several injection points and observation wells differ from those proposed in the Pilot Test Work Plan. The locations were moved based on the location of subsurface utilities identified during utility clearance. Figure 3 shows the locations of injection and monitoring wells used in the pilot test.

The ISCO materials consisted of a sodium persulfate oxidizer activated with an 8% hydrogen peroxide solution. The sodium persulfate is a granular solid that was delivered in 55-pound (lb) bags. The 8% hydrogen peroxide was delivered in a 4,500-gallon tanker that was staged in the rear of the building in a secondary containment unit. The mixing area was constructed inside the loading dock area of the building and consisted of two 1,000-gallon polyethylene mixing tanks inside a secondary containment unit. Hydrogen peroxide solution was pumped into a mixing tank using a diaphragm pump. When the proper amount of hydrogen peroxide solution was in the mixing tank, the sodium persulfate was poured into the mixing tank through an opening on top of the tank and an electric mixer was used to mix the components.

In the shallow zone, a concentration of 10 g/l sodium persulfate was targeted, which was activated with 8% hydrogen peroxide. The molar ratio of hydrogen peroxide to sodium persulfate was 5:1. For each shallow injection point, 288 pounds of sodium persulfate was mixed with approximately 301 gallons of hydrogen peroxide solution.

In the intermediate and deep zone, a concentration of 20 g/l sodium persulfate was targeted which was also activated with 8% hydrogen peroxide. A higher application rate was selected due to the higher concentration of CA in the deep monitoring wells. The molar ratio of hydrogen peroxide to sodium persulfate was also increased to 7:1. For each intermediate injection point, 576 pounds of sodium persulfate was mixed with 397 gallons of hydrogen peroxide solution.

The mixture was injected using a diaphragm pump at a rate of approximately 3 to 4 gallons per minute. At this pumping rate, no daylighting of ISCO materials was observed. During

the injections, air monitoring was conducted in accordance with the Community Air Monitoring Plan presented in the Pilot Test Work Plan. Vapor monitoring was conducted in selected soil vapor points and storm drains to assess the generation of subsurface vapors resulting from the injections.

Following is a summary of the activities completed during the 2010 ISCO Pilot Test:

- Installation of 4 monitoring wells and 51 injection points.
- Baseline soil samples were collected during observation well installation.
- Baseline groundwater samples were collected from wells OW-1 through OW-4 and MW-97-1S and MW-98-9D on September 24, 2010.
- The ISCO injections took place from October 29, 2010 through November 19, 2010.
- On December 7, 2010, field parameter measurements were made and samples were collected for persulfate analysis.
- Approximately 1 week, 2 weeks, 3 weeks, 4 weeks, 6 weeks, 2 months, 3 months and 4 months following injections, field parameter measurements (pH, conductivity,redox potential, dissolved oxygen and turbidity) were made following low-flow purging.
- At 2 weeks, 4 weeks, 6 weeks, 2 months, 3 months and 4 months following injections, groundwater samples were collected and analyzed for persulfate.
- At 1 month, 2 months, 3 months and 4 months following injections, groundwater samples were collected and analyzed for VOCs, dissolved gases (methane, ethane and ethane) total organic carbon (TOC), sulfate and sulfide.
- The 2-month samples were collected on January 20, 2011; the 3-month samples were collected on February 17, 2011; and the 4-month samples were collected on March 24, 2011

2.2 2010 ISCO PILOT TEST RESULTS

2.2.1 Baseline Soil Sampling

During well installation, soil samples were collected from the soil borings for OW-2 and OW-4. In OW-2, soil samples were collected from 11.0 fbg to 11.5 fbg and from 30.0 fbg to 30.5 fbg. In OW-4, soil samples were collected from 12.0 fbg to 12.5 fbg and from 30.0 fbg to 30.5 fbg. Table 1 presents the results of the baseline soil sampling. Soil samples were analyzed for VOCs and soil oxidant demand. Table 1 shows that chloroethane (CA) was detected in 3 of the 4 soil samples collected. CA concentrations in the deep samples ranged from 12 μg/kg to 37 μg/kg. No VOCs were detected at concentrations exceeding NYSDEC

Soil Cleanup Objectives. The soil oxidant demand (SOD) results were higher in the shallow samples than in the deep samples. This is likely due to the landfill debris present in the shallow soils. The SOD in the shallow samples ranged from 92.3 g/kg in OW-2 to 95.1 g/kg in OW-4. In the deep samples, the SOD ranged from 48.9 g/kg in OW-2 to 23.7 g/kg in OW-4.

2.2.2 Baseline Groundwater Sampling

Table 2 presents results of the baseline groundwater sampling. After soil sampling, monitoring wells were installed in borings OW-1 through OW-4. Shallow wells OW-1 and OW-3 are screened from 8.5 fbg to 18.5 fbg and deep wells OW-2 and OW-4 are screened from 23.5 fbg to 33.5 fbg. These depths correspond to the screen intervals of wells MW-97-1S and MW-98-9D in the adjacent driveway.

Baseline groundwater samples were collected on September 24, 2010 from OW-1 through OW-4 and from MW-97-1S and MW-98-9D. Samples were analyzed for VOCs, total organic carbon (TOC) dissolved gasses (ethane, ethene and methane), sulfate and sulfide. In the baseline groundwater samples, CA concentrations in the shallow wells (OW-1, OW-3 and MW-97-1S) ranged from 3.8 µg/l to 74 µg/l. In the deep wells (OW-2, OW-4 and MW-98-9D), CA concentrations ranged from 790 µg/l to 3,400 µg/l.

Methane was detected in all wells at concentrations ranging from 1,300 µg/l to 28,000 µg/l. Ethane were either not detected, or detected at low concentrations. Sulfate was detected at concentrations ranging from 6.5 mg/l to 106 mg/l in four of the six wells. Sulfide was not detected in any of the six wells sampled. TOC concentrations were all within the narrow range of 9.8 mg/l to 10.9 mg/l. The baseline results were used to compare post-injection sampling results to evaluate the effect of the ISCO injections.

2.2.3 Post-Injection Monitoring

2.2.3.1 Volatile Organic Compounds

Samples were collected for VOCs on four occasions at monthly intervals after the injections. At one month after the injections, CA concentrations in all six wells increased over the baseline concentrations. This was likely due to the desorption of CA from the soil matrix into the dissolved phase. The only well in which an increase was not observed was MW-98-9D. It should be noted that MW-97-1S and MW-98-9D are in the area where a combined enhanced bioremediation / ISCO pilot test was previously conducted in 2009 so the potential for a rebound was less likely in this area. At the two-month sampling event in January 2011, CA concentrations decreased in all wells from the one-month levels. However, concentrations increased in the three-month samples for all wells, but these levels remained

below the baseline concentrations. In the four-month samples, collected on March 24, 2011, CA concentrations again decreased.

Graphs of the CA concentrations in the shallow wells and deep wells, from the baseline sampling through the four-month samples, are presented in Figures 5 and 6, respectively. In the four-month samples, CA was not detected in shallow wells MW-97-1S and OW-3. The CA concentration in shallow well OW-1 decreased from 74 µg/l in the baseline sample to 33 µg/l in the four-month post-injection sample, a decrease of 55%. In deep wells MW-98-9D, OW-2 and OW-4, CA concentrations decreased over the same period by 62%, 53% and 94%, respectively. At the four-month sampling, the CA concentrations in all six wells were below their baseline levels. CA concentrations from the baseline and four-month groundwater samples are presented in cross-section on Figure 7.

2.2.3.2 Field Parameters

Following the ISCO injections, pH measurements decreased in all wells, but most notably in MW-98-9D, which decreased from 7.45 to 2.85. The pH values subsequently increased somewhat in all the wells, although MW-98-9D remains rather acidic. The pH in OW-1 and OW-2 are at their baseline level, but the pH in other wells remains somewhat lower than the baseline. The drop in pH may be due to the production of sulfuric acid, a byproduct of sodium persulfate reaction.

Conductivity values in most wells increased by a factor of 2 to 3 following the injections, but in MW-98-9D, conductivity increased from 1.17 milliSiemens per centimeter (mS/cm) to 55 mS/cm, before decreasing somewhat to 11.7 mS/cm. Conductivity, which is a measure of ionic strength of groundwater is expected to increase after ISCO as it introduces sulfate in groundwater. By the four-month sampling, the conductivity in most wells had returned to near baseline levels.

Baseline DO levels ranged from 2.07 mg/l to 2.26 m/l. Following the ISCO injections, the DO levels generally decreased to at or near 0.0 mg/l and remained there through the four-month sampling. One week after the completion of the injections, the DO in MW-97-1S was measured at 13.55 mg/l. This measurement likely represents an instrument error, since the solubility of oxygen in water is about 8 mg/l. The elevated DO in MW-97-1S is likely due to the fact that the acidic conditions in MW-98-9D (see above), which was sampled immediately before MW-97-1S, affected the DO probe. During subsequent measurements, MW-98-9D was measured last and lower DO concentrations were measured. At the one-month and four-month sampling events, the DO in all six wells was measured at 0.0 mg/l. In a typical setting, DO is expected to increase and remain elevated for a few weeks after ISCO injections. In this case, the extremely reducing and anaerobic conditions created by the landfill material may cause a high and an instantaneous demand for oxygen. Consequently, the DO levels did not increase.

During the baseline sampling, the redox potential (ORP) values ranged from -76 mV to -122 mV, indicating reducing conditions. Redox potential values increased after the injections, most significantly in wells OW-4, MW-97-1S and MW-98-9D, which all had ORP measurements greater than 100 mV two weeks following the injections. By the four-month sampling event, the ORP in all wells was again negative, except for MW-98-9D, which remained greater than 100 mV. Once again, an indication of extremely low reducing conditions created by the landfill.

2.3 ISCO PILOT TEST CONCLUSIONS

The 2010 ISCO Pilot Test resulted in decreases in CA concentrations in all wells. Concentrations were reduced by at least 50% in all six wells and CA was not detected in two of the six wells four months after the injections. CA concentration in OW-1, OW-2, OW-4 and MW-98-9D remain over the NYSDEC GWQS of 5 µg/l. The ISCO pilot test concluded that CA can be treated in OU-1 groundwater using activated sodium persulfate. However, a combination of multiple applications, higher oxidant strength and a focused approach is required for effective and timely reduction in concentrations of CA so that CA in the downgradient OU-2 groundwater can attenuate under natural conditions. As requested by NYSDEC, a plan for continued Pilot Test injection of activated sodium persulfate is presented in the next section.

The 2011 ISCO pilot test injections will be conducted in the driveway and the loading dock area using the existing injection and monitoring wells that were installed for the 2010 ISCO pilot test. The 2011 ISCO pilot test will consist of the following steps:

- Mobilization;
- Targeted ISCO Application;
- Post-Injection Sampling.

3.1 GENERAL

The Site Health and Safety Plan will be updated to address the activities to be performed, including sampling, handling and injection of chemical amendments, and use of tools and mechanical devices. In addition, Site work will be conducted under the site-specific Community Air Monitoring Plan (CAMP) approved by the NYSDOH for the 2010 ISCO Pilot Test, and revised for the 2011 ISCO Pilot test. The CAMP includes a program to monitor air for VOCs at the downwind boundary of the exclusion zone during the injections. The revised CAMP is presented as Appendix A.

3.2 BASELINE DATA

Data from groundwater samples collected in March 2011 from the six observation wells will serve as the baseline conditions prior to full-scale injections.

3.3 PROPOSED OXIDANT INJECTION VOLUMES

The post-2010 pilot test injection data indicated that CA concentrations were relatively low in the shallow wells (from non-detect to 33 µg/l) compared to the deep monitoring wells (160 µg/l to 1,600 µg/l). Consequently, injections of activated persulfate will not be conducted in the shallow injection wells. A list of the proposed injection points is presented in Table 3. The oxidant will be injected in the intermediate and deep injection points. During the 2010 pilot test, approximately 600 lb of sodium persulfate was injected in each intermediate and deep point. To expedite treatment during this 2011 application, 1,100 lb of sodium persulfate will be injected in each intermediate and deep point. The volume of the activation agent (hydrogen peroxide) will be increased proportionately to that of sodium persulfate to maintain a hydrogen peroxide to sodium persulfate molar ratio of 7:1 (same as that used in the 2010 pilot test). The concentration of hydrogen peroxide will be maintained at 8% as before. At this application rate, the total volume of oxidant and activation agent represents approximately 45% of the targeted pore volume. Table 5 provides quantities of sodium persulfate and hydrogen peroxide required for each injection point and the total for this 2011 injection.

A total of thirty-four (34) injection points (17 intermediate and 17 deep) will be used to inject the oxidants. Approximately 1,610 gallons of solution will be injected per point. A total of 37,400 lb of sodium persulfate will be injected as a solution with 54,750 gallons of 8% hydrogen peroxide. The pumping rate of 3 to 4 gpm utilized during the 2010 pilot test will be used in this injection program.

Material Safety Data Sheets (MSDSs) for sodium persulfate and hydrogen peroxide are provided in Appendix B.

3.4 INJECTION PROCEDURE

The injection procedure employed during the 2010 ISCO pilot test will be used for this ISCO application. The sodium persulfate and hydrogen peroxide will be stored and mixed inside the Site building in the loading dock area. The oxidant and the activation agent will be mixed in a 1,000-gallon capacity above-ground poly tank. The mixing tank and the pumps will be staged inside a secondary containment area. All tanks, fittings, pumps and piping will be constructed of inert materials. Prior to the start of any injection, the caps on all wells and injection points (except those being injected into) will be secured to prevent daylighting. The oxidant and activation agent will be injected in the test area at targeted vertical depths using injection points and diaphragm pumps. To assure even distribution, the injection location and depth intervals will be alternated. It is estimated that it will take between 15 to 20 days to complete all the injections.

3.5 VAPOR MONITORING PROGRAM

The injection of sodium persulfate and hydrogen peroxide could result in the generation of soil vapor. The oxidation of organic material may produce carbon dioxide that could migrate to the unsaturated zone. Methane associated with the landfill material, hydrogen sulfide primarily associated with the tidal marsh deposits and other VOCs may be liberated with the carbon dioxide. To assess vapor generation, BP will conduct vapor monitoring in selected soil gas points and storm drains during the 2011 ISCO pilot test injections. As was done during the 2010 ISCO injections, soil vapor points SG-05-06, SG-05-07 and SG-09-12 will be utilized for vapor monitoring. Points SG-05-06 and SG-05-07 are located in the driveway east and west of the injection area, respectively. Point SG-09-12 was installed in the driveway in the injection area prior to the combined EAB and ISCO Pilot Test. Vapors will also be monitored in the storm drain located in the loading dock area and in front of the site building. These points will be monitored using a photoionization detector (PID) and a landfill gas meter, capable of detecting oxygen, methane, hydrogen sulfide and carbon dioxide. During the injection program, a reading will be taken at these 4 points at the start of each day prior to injections of the oxidant. Readings will also be made hourly while the injections are occurring. Each day, a final reading will be made at all 4 points at least one

hour after the cessation of injections for that day. The readings will be recorded in a log book.

If elevated readings are detected in the soil gas points or storm drains, the breathing zone at that point will also be monitored. If methane and/or hydrogen sulfide are detected in the storm drains, soil gas points or exclusion zone breathing zone, the compound will be monitored at the downwind CAMP station as noted in the approved Community Air Monitoring Plan. If any action levels, as described in the Health and Safety Plan or the approved Community Air Monitoring Plan (Section 4), are detected in the breathing zone, the work will be halted and the Nassau County Health Department will be notified.

3.6 POST-INJECTION SAMPLING

Post-injection sampling of groundwater will be conducted to monitor the success of the injections. Groundwater samples will be collected from wells MW-97-1S and MW-98-9D and the four monitoring wells installed in the loading dock area. Monitoring wells will be screened for field parameters such as temperature, conductivity, pH, ORP and DO at weekly intervals following injection for the first month to ensure the materials are distributed and the in-situ reactions are proceeding as expected. Groundwater samples will be collected 1 month, 2 months and 3 months after completing the ISCO injections. The groundwater samples will be collected for VOCs, TOC, sulfate, residual persulfate, methane, conductivity, temperature, pH, ORP and DO. A summary of the post-injection monitoring sampling program is presented in Table 5.

3.7 REPORTING

After completion of the injection and sampling program, BP will prepare a Pilot Test Report for submittal to NYSDEC. The report will include a summary of the 2010 and 2011 injection programs, and evaluation of sampling results and recommendations for additional injections, if any. The report will be submitted to NYSDEC 60 days following the last sampling event. Sampling data will be submitted to NYSDEC following each sampling event within three weeks of sampling, so that changes to the subsequent sampling can be evaluated. The sampling data will be submitted in draft form, prior to validation. Upon completion of data validation, the final data will be submitted to NYSDEC.

Site work will be conducted under the revised Community Air Monitoring Plan (CAMP) approved by the NYSDOH. The CAMP includes a program to monitor air for VOCs, methane and hydrogen sulfide during injections. The CAMP is presented as Appendix A.

It is estimated that the scope work presented in this work plan for ISCO injections will be completed within 8 weeks of approval and receipt of applicable permits. Mobilization and completion of the injection program will take approximately 6 to 8 weeks, depending on availability of the chemicals. The performance monitoring will continue for up to 6 months following the completion of the injection.

TABLES

TABLE 1
BASELINE SOIL SAMPLING RESULTS
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
OPERABLE UNIT NO. 1
FREEPORT, NEW YORK

URS SAMPLE ID LAB SAMPLE ID SAMPLE DEPTH (ft) DILUTION SAMPLE DATE UNITS	NYSDEC UNRESTRICTED USE SOIL CLEANUP OBJECTIVES µg/kg	NYSDEC INDUSTRIAL RESTRICTED USE SOIL CLEANUP OBJECTIVES µg/kg	NYSDEC PROTECTION OF GROUNDWATER SOIL CLEANUP OBJECTIVES µg/kg	OW-2 (11-11.5) RTI0996-03 11-11.5 1 9/13/10 µg/kg	OW-2 (30-30.5) RTI0996-04 30-30.5 1 9/13/10 µg/kg
Volatile Organic Compounds					
1,1,1-Trichloroethane	680	1,000,000	680	2.9 U	2.1 U
1,1,2,2-Tetrachloroethane	NE	NE	NE	9.9 J	1.2 U
1,1,2-Trichloroethane	NE	NE	NE	2.9 U	2 U
1,1,2-Trichlorotrifluoroethane	NE	NE	NE	3.6 U	2.6 U
1,1-Dichloroethane	270	480,000	270	4 U	2.9 U
1,1-Dichloroethene	330	1,000,000	330	3.3 U	2.3 U
1,2,4-Trichlorobenzene	NE	NE	NE	1.4 U	0.99 U
1,2-Dibromo-3-chloropropane	NE	NE	NE	3.4 U	2.5 U
1,2-Dibromoethane (EDB)	NE	NE	NE	1.7 U	1.2 U
1,2-Dichlorobenzene	1,100	1,000,000	1,100	2 U	1.4 U
1,2-Dichloroethane	20	60,000	20	3.8 U	2.7 U
1,2-Dichloropropane	NE	NE	NE	1.2 U	0.86 U
1,3-Dichlorobenzene	2,400	560,000	2,400	2 U	1.4 U
1,4-Dichlorobenzene	1,800	250,000	1,800	2.5 J	1.2 U
2-Butanone (MEK)	120	1,000,000	120	7.7 J	2.4 U
2-Hexanone	NE	NE	NE	1.2 U	0.84 U
4-Methyl-2-pentanone (MIBK)	NE	NE	NE	1.7 U	1.2 U
Acetone	50	1,000,000	50	18	3.5 J
Benzene	60	89,000	60	2.7 U	2 U
Bromodichloromethane	NE	NE	NE	2.2 U	1.6 U
Bromoform	NE	NE	NE	2.4 U	1.7 U
Bromomethane	NE	NE	NE	4.5 U	3.2 U
Carbon disulfide	NE	NE	NE	4.5 J	2.1 U
Carbon Tetrachloride	760	44,000	760	2.2 U	1.6 U
Chlorobenzene	1,100	1,000,000	1,100	1.9 U	1.4 U
Chlorodibromomethane	NE	NE	NE	2.1 U	1.5 U
Chloroethane	NE	NE	NE	5.4 J	12
Chloroform	370	700,000	370	4.3 U	3.1 U
Chloromethane	NE	NE	NE	5.7 U	4.1 U
cis-1,2-Dichloroethene	250	1,000,000	250	4.1 U	2.9 U
cis-1,3-Dichloropropene	NE	NE	NE	2.1 U	1.5 U
Cyclohexane	NE	NE	NE	4.1 U	2.9 U
Dichlorodifluoromethane	NE	NE	NE	4.5 U	3.2 U
Ethylbenzene	1,000	780,000	1,000	2.1 U	1.5 U
Isopropylbenzene	NE	NE	NE	2.1 U	1.5 U
Methyl Acetate	NE	NE	NE	4 U	2.9 U
Methyl tert-Butyl Ether	930	1,000,000	930	4.1 U	2.9 U
Methylcyclohexane	NE	NE	NE	2.4 J	1.1 U
Methylene Chloride	50	1,000,000	50	5.1 J	2.3 J
Styrene	NE	NE	NE	0.48 U	0.35 U
Tetrachloroethene	1,300	300,000	1,300	1.7 U	1.2 U
Toluene	700	1,000,000	700	2.5 U	1.8 U
trans-1,2-Dichloroethene	190	1,000,000	190	3.6 U	2.6 U
trans-1,3-Dichloropropene	NE	NE	NE	2.2 U	1.5 U
Trichloroethene	470	400,000	470	2.5 U	1.8 U
Trichlorofluoromethane	NE	NE	NE	3.3 U	2.4 U
Vinyl chloride	20	27,000	20	4.5 U	3.2 U
Xylenes, total	260	1,000,000	1,600	11 U	7.6 U
TOTAL TARGET VOCS	NE	NE	NE	51	17.8
TOTAL TICs	NE	NE	NE	510	61
Miscellaneous					
Soil Oxidant Demand (g/kg)	NE	NE	NE	92.3	48.9

TABLE 1
BASELINE SOIL SAMPLING RESULTS
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
OPERABLE UNIT NO. 1
FREEPORT, NEW YORK

URS SAMPLE ID LAB SAMPLE ID SAMPLE DEPTH (ft) DILUTION SAMPLE DATE UNITS	NYSDEC UNRESTRICTED USE SOIL CLEANUP OBJECTIVES µg/kg	NYSDEC INDUSTRIAL RESTRICTED USE SOIL CLEANUP OBJECTIVES µg/kg	NYSDEC PROTECTION OF GROUNDWATER SOIL CLEANUP OBJECTIVES µg/kg	OW-4 (12-12.5) RTI0996-01 12-12.5 1 9/13/10 µg/kg		OW-4 (30-30.5) RTI0996-02 30-30.5 1 9/13/10 µg/kg	
Volatile Organic Compounds							
1,1,1-Trichloroethane	680	1,000,000	680	2.1	U	2.2	U
1,1,2,2-Tetrachloroethane	NE	NE	NE	1.2	U	1.2	U
1,1,2-Trichloroethane	NE	NE	NE	2	U	2.1	U
1,1,2-Trichlorotrifluoroethane	NE	NE	NE	2.6	U	2.7	U
1,1-Dichloroethane	270	480,000	270	2.9	U	3	U
1,1-Dichloroethene	330	1,000,000	330	2.3	U	2.4	U
1,2,4-Trichlorobenzene	NE	NE	NE	0.99	U	1	U
1,2-Dibromo-3-chloropropane	NE	NE	NE	2.5	U	2.6	U
1,2-Dibromoethane (EDB)	NE	NE	NE	1.2	U	1.3	U
1,2-Dichlorobenzene	1,100	1,000,000	1,100	1.4	U	1.5	U
1,2-Dichloroethane	20	60,000	20	2.7	U	2.8	U
1,2-Dichloropropane	NE	NE	NE	0.86	U	0.89	U
1,3-Dichlorobenzene	2,400	560,000	2,400	1.4	U	1.5	U
1,4-Dichlorobenzene	1,800	250,000	1,800	1.2	U	1.2	U
2-Butanone (MEK)	120	1,000,000	120	4.6	J	2.5	U
2-Hexanone	NE	NE	NE	0.84	U	0.87	U
4-Methyl-2-pentanone (MIBK)	NE	NE	NE	1.2	U	1.2	U
Acetone	50	1,000,000	50	14		4.3	J
Benzene	60	89,000	60	2	U	2	U
Bromodichloromethane	NE	NE	NE	1.6	U	1.6	U
Bromoform	NE	NE	NE	1.7	U	1.8	U
Bromomethane	NE	NE	NE	3.2	U	3.3	U
Carbon disulfide	NE	NE	NE	2.1	U	2.2	U
Carbon Tetrachloride	760	44,000	760	1.6	U	1.7	U
Chlorobenzene	1,100	1,000,000	1,100	1.4	U	1.4	U
Chlorodibromomethane	NE	NE	NE	1.5	U	1.6	U
Chloroethane	NE	NE	NE	3.2	U	37	
Chloroform	370	700,000	370	3.1	U	3.2	U
Chloromethane	NE	NE	NE	4.1	U	4.3	U
cis-1,2-Dichloroethene	250	1,000,000	250	3	U	3.1	U
cis-1,3-Dichloropropene	NE	NE	NE	1.5	U	1.6	U
Cyclohexane	NE	NE	NE	2.9	U	3	U
Dichlorodifluoromethane	NE	NE	NE	3.2	U	3.4	U
Ethylbenzene	1,000	780,000	1,000	1.5	U	1.5	U
Isopropylbenzene	NE	NE	NE	1.5	U	1.6	U
Methyl Acetate	NE	NE	NE	2.9	U	3	U
Methyl tert-Butyl Ether	930	1,000,000	930	2.9	U	3	U
Methylcyclohexane	NE	NE	NE	1.1	U	1.1	U
Methylene Chloride	50	1,000,000	50	3.4	J	2.8	J
Styrene	NE	NE	NE	0.35	U	0.36	U
Tetrachloroethene	1,300	300,000	1,300	1.2	U	1.2	U
Toluene	700	1,000,000	700	1.8	U	1.8	U
trans-1,2-Dichloroethene	190	1,000,000	190	2.6	U	2.7	U
trans-1,3-Dichloropropene	NE	NE	NE	1.5	U	1.6	U
Trichloroethene	470	400,000	470	1.8	U	1.9	U
Trichlorofluoromethane	NE	NE	NE	2.4	U	2.5	U
Vinyl chloride	20	27,000	20	3.2	U	3.3	U
Xylenes, total	260	1,000,000	1,600	7.7	U	8	U
TOTAL TARGET VOCS	NE	NE	NE	22		44.1	
TOTAL TICs	NE	NE	NE	94		30	
Miscellaneous							
Soil Oxidant Demand (g/kg)	NE	NE	NE	95.1		23.7	

TABLE 1
BASELINE SOIL SAMPLING RESULTS
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
OPERABLE UNIT NO. 1
FREEPORT, NEW YORK

NOTES:

U - Indicates compound was analyzed for but not detected
J - Indicates an estimated value due to limitations identified during the Quality Assurance (QA) review. quantitation limit but greater than zero.
B - This flag is used when the analyte is found in the associated blank as well as in the sample.
E - This flag identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis and therefore, are regarded as estimated values.
D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.
R- Indicates result is unreliable (compound may or not be present)
NS - Not sampled
ND - Not Detected
NE - No existing Groundwater Cleanup Standard
Total VOCs - This row presents the sum total concentration level of target compound list (TCL) volatile organic compounds (VOCs) reported in the sample. When a value is flagged with a "J", the sum total concentration level includes compounds reported at estimated concentration levels below Reporting Limits (RL). When a value is flagged by a "B", it is not included in the sum total concentration level.
100 (Bold) - Concentration exceeds NYSDEC Soil Cleanup Objective, (6 NYCRR 375,October 2010).

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING RESULTS BY WELL
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

		BASELINE SAMPLING	POST-INJECTION MONITORING					
URS SAMPLE ID	**NYSDEC**	**OW-1**	**OW-1**	**OW-1**	**OW-1**	**OW-1**	**OW-1**	**OW-1**
LAB SAMPLE ID	**CLASS GA**	**RTI1578-01**	**SB22093-04**	**RTL1339-04**	**SB23167-01**	**480-1116-1**	**480-1792-1**	**480-2979-4**
DILUTION	**WATER QUALITY**	**5**	**1**	**1**	**1**	**1**	**1**	**1**
SAMPLE DATE	**STANDARD**	**9/24/10**	**12/07/10**	**12/21/2010**	**1/4/11**	**1/20/2011**	**2/17/2011**	**3/24/2011**
UNITS	**µg/l**	**µg/l**	**mg/l**	**µg/l**	**mg/l**	**µg/l**	**µg/l**	**µg/l**
Volatile Organic Compounds								
1,1,1-Trichloroethane	5	10 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
1,1,2,2-Tetrachloroethane	5	7.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.5 U
1,1,2-Trichloroethane	1	9.5 U	NS	1.9 U	NS	1.9 U	1.9 U	1.5 U
1,1,2-Trichlorotrifluoroethane	NE	7.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.9 U
1,1-Dichloroethane	5	8.5 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
1,1-Dichloroethene	5	12 U	NS	2.5 U	NS	2.5 U	2.5 U	2.5 U
1,2,4-Trichlorobenzene	NE	2.9 U	NS	0.57 U	NS	0.57 U	0.57 U	0.57 U
1,2-Dibromo-3-chloropropane	NE	25 U	NS	5 U	NS	5.0 U	5.0 U	5.0 U
1,2-Dibromoethane (EDB)	NE	10 U	NS	2 U	NS	2.0 U	2.0 U	2.0 U
1,2-Dichlorobenzene	NE	6 U	NS	1.2 U	NS	1.2 U	1.2 U	1.2 U
1,2-Dichloroethane	0.6	4.2 U	NS	0.83 U	NS	0.83 U	0.83 U	0.83 U
1,2-Dichloropropane	1	8.5 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
1,3-Dichlorobenzene	NE	6 U	NS	1.2 U	NS	1.2 U	1.2 U	1.2 U
1,4-Dichlorobenzene	NE	5.5 U	NS	1.1 U	NS	1.1 U	1.3 J	1.1 U
2-Butanone (MEK)	50	7.5 U	NS	1.5 U	NS	1.5 UJ	1.5 UJ	1.5 U
2-Hexanone	50	9 U	NS	1.8 U	NS	1.8 UJ	1.8 UJ	1.8 U
4-Methyl-2-pentanone (MIBK)	NE	8.5 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Acetone	50	9.5 U	NS	1.9 U	NS	1.9 R	1.9 UJ	1.9 U
Benzene	1	8 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Bromodichloromethane	5	7.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.5 U
Bromoform	5	25 U	NS	5 U	NS	5.0 U	5.0 U	5 U
Bromomethane	5	22 U	NS	4.3 U	NS	4.3 U	4.3 U	4.3 U
Carbon disulfide	NE	10 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Carbon Tetrachloride	5	10 U	NS	2 U	NS	2.0 U	2.0 U	2 U
Chlorobenzene	5	**13 J**	NS	**5.4 J**	NS	1.6 U	1.6 U	1.6 U
Chlorodibromomethane	5	8.5 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Chloroethane	5	**74**	NS	**120**	NS	**61**	**100 J**	**33.0**
Chloroform	7	9.5 U	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
Chloromethane	5	12 U	NS	2.3 U	NS	2.3 U	2.3 U	2.3 U
cis-1,2-Dichloroethene	NE	9 U	NS	1.8 U	NS	1.8 U	1.8 U	1.8 U
cis-1,3-Dichloropropene	0.4	7 U	NS	1.4 U	NS	1.4 U	1.4 U	1.4 U
Cyclohexane	NE	2.9 U	NS	0.59 U	NS	0.59 U	0.59 U	0.59 U
Dichlorodifluoromethane	NE	10 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Ethylbenzene	5	8 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Isopropylbenzene	NE	1.9 U	NS	0.37 U	NS	0.37 U	0.71 J	0.37 U
Methyl Acetate	NE	3.3 U	NS	0.66 U	NS	0.66 U	0.66 U	0.66 U
Methyl tert-Butyl Ether	NE	2.3 U	NS	0.46 U	NS	0.46 U	0.46 U	0.46 U
Methylcyclohexane	NE	3 U	NS	0.59 U	NS	0.59 U	0.73 J	0.59 U
Methylene Chloride	5	6.5 U	NS	1.3 U	NS	1.3 U	1.3 U	1.3 U
Styrene	5	8.5 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Tetrachloroethene	5	10 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Toluene	5	8 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
trans-1,2-Dichloroethene	NE	9.5 U	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
trans-1,3-Dichloropropene	0.4	8 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Trichloroethene	5	9.5 UJ	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
Trichlorofluoromethane	NE	6.5 U	NS	1.3 U	NS	1.3 U	1.3 U	1.3 U
Vinyl chloride	2	12 U	NS	2.3 U	NS	2.3 U	2.3 U	2.3 U
Xylenes, total	5	4.1 U	NS	0.82 U	NS	0.82 U	0.82 U	0.82 U
TOTAL TARGET VOCS	NE	87	NS	125.4	NS	61	102.74	33
TOTAL VOC TICs	NE	ND	NS	ND	NS	ND	5.3 J	ND
Dissolved Gasses								
Ethane	NE	8.6	NS	1,500 U	NS	0.49 U	300 U	12
Ethene	NE	1.5 U	NS	1,500 U	NS	0.52 U	300 U	1.7
Methane	NE	1400 J	NS	10,000	NS	6,700	16,000 D	13,000 D
General Chemistry								
Sulfate (mg/l)	NE	5 U	NS	1,180	NS	370 B	238 B	191 B
Sulfide (mg/l)	NE	1 U	NS	1 U	NS	0.67 U	0.67 U	0.67 U
Persulfate (mg/l)	NE	NS	3.40 U	5.47	6.11 J	11.2 U	15.4 J	8.01
TOC (mg/l)	NE	10.8	NS	14.1	NS	12.1 J	10.1	8.7
Field parameters								
pH	NE	7.63	6.27	6.49	6.72	6.82	6.53	7.49
Conductivity (mS/cm)	NE	2.20	6.22	12.1	9.4	5.9	5.2	4.26
Dissolved Oxygen (mg/l)	NE	2.09	0.00	0.00	1.07	0.00	1.67	0.00
Redox Potential (mV)	NE	-122	-71	-98	-122	-126	-89	-110

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING RESULTS BY WELL
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

		BASELINE SAMPLING	POST-INJECTION MONITORING					
URS SAMPLE ID	**NYSDEC**	**OW-2**	**OW-2**	**OW-2**	**OW-2**	**OW-2**	**OW-2**	**OW-2**
LAB SAMPLE ID	**CLASS GA**	**RTI1578-02**	**SB22093-07**	**RTL1339-03**	**SB23167-02**	**480-1116-2**	**480-1792-2**	**480-2979-3**
DILUTION	**WATER QUALITY**	**1**	**1**	**40**	**1**	**40**	**20**	**10**
SAMPLE DATE	**STANDARD**	**9/24/10**	**12/07/10**	**12/21/2010**	**1/4/11**	**1/20/2011**	**2/17/2011**	**3/24/2011**
UNITS	**µg/l**	**µg/l**	**mg/l**	**µg/l**	**mg/l**	**µg/l**	**µg/l**	**µg/l**
Volatile Organic Compounds								
1,1,1-Trichloroethane	5	2.1 U	NS	84 U	NS	84 U	42 U	21 U
1,1,2,2-Tetrachloroethane	5	1.5 U	NS	60 U	NS	60 U	30 U	15 U
1,1,2-Trichloroethane	1	1.9 U	NS	76 U	NS	76 U	38 U	15 U
1,1,2-Trichlorotrifluoroethane	NE	1.5 U	NS	60 U	NS	60 U	30 U	19 U
1,1-Dichloroethane	5	4 J	NS	68 U	NS	68 U	34 U	17 U
1,1-Dichloroethene	5	2.5 U	NS	100 U	NS	100 U	50 U	25 U
1,2,4-Trichlorobenzene	NE	0.57 U	NS	23 U	NS	23 U	11 U	6 U
1,2-Dibromo-3-chloropropane	NE	5 U	NS	200 U	NS	200 U	100 U	50 U
1,2-Dibromoethane (EDB)	NE	2 U	NS	80 U	NS	80 U	40 U	20 U
1,2-Dichlorobenzene	NE	1.2 U	NS	48 U	NS	48 U	24 U	12 U
1,2-Dichloroethane	0.6	0.83 U	NS	33 U	NS	33 U	16.6 U	8.3 U
1,2-Dichloropropane	1	1.7 U	NS	68 U	NS	68 U	34 U	17 U
1,3-Dichlorobenzene	NE	1.2 U	NS	48 U	NS	48 U	24 U	12 U
1,4-Dichlorobenzene	NE	1.8 J	NS	44 U	NS	44 U	22 U	11 U
2-Butanone (MEK)	50	1.5 UJ	NS	60 U	NS	60 UJ	30 UJ	15 U
2-Hexanone	50	1.8 UJ	NS	72 U	NS	72 UJ	36 UJ	18 U
4-Methyl-2-pentanone (MIBK)	NE	1.7 U	NS	68 U	NS	68 U	34 U	17 U
Acetone	50	1.9 UJ	NS	76 U	NS	76 R	38 UJ	19 U
Benzene	1	1.6 U	NS	64 U	NS	64 U	32 U	16 U
Bromodichloromethane	5	1.5 U	NS	60 U	NS	60 U	30 U	15 U
Bromoform	5	5 U	NS	200 U	NS	200 U	100 U	50 U
Bromomethane	5	4.3 U	NS	170 U	NS	170 U	86 U	43 U
Carbon disulfide	NE	2.1 UJ	NS	84 U	NS	84 U	154 U	21 U
Carbon Tetrachloride	5	2 UJ	NS	80 U	NS	80 U	40 U	20 U
Chlorobenzene	5	4.5 J	NS	64 U	NS	64 U	32 U	16 U
Chlorodibromomethane	5	1.7 U	NS	68 U	NS	68 U	34 U	17 U
Chloroethane	5	**3,400**	NS	**4,900**	NS	**3,100**	**3,800 J**	**1,600**
Chloroform	7	1.9 U	NS	76 U	NS	76 U	38 U	19 U
Chloromethane	5	2.3 UJ	NS	92 U	NS	92 U	46 U	23 U
cis-1,2-Dichloroethene	NE	1.8 U	NS	72 U	NS	72 U	36 U	18 U
cis-1,3-Dichloropropene	0.4	1.4 U	NS	56 U	NS	56 U	28 U	14 U
Cyclohexane	NE	0.59 U	NS	23 U	NS	23 U	12 U	5.9 U
Dichlorodifluoromethane	NE	2.1 UJ	NS	84 U	NS	84 U	42 U	21 U
Ethylbenzene	5	1.6 U	NS	64 U	NS	64 U	32 U	16 U
Isopropylbenzene	NE	1.2 J	NS	15 U	NS	15 U	7.5 U	3.7 U
Methyl Acetate	NE	0.66 U	NS	27 U	NS	27 U	13 U	6.6 U
Methyl tert-Butyl Ether	NE	0.46 U	NS	18 U	NS	18 U	9.1 U	4.6 U
Methylcyclohexane	NE	0.59 U	NS	24 U	NS	24 U	12 U	5.9 U
Methylene Chloride	5	1.3 U	NS	52 U	NS	52 U	26 U	13 U
Styrene	5	1.7 U	NS	68 U	NS	68 U	34 U	17 U
Tetrachloroethene	5	2.1 U	NS	84 U	NS	84 U	42 U	21 U
Toluene	5	1.6 U	NS	64 U	NS	64 U	32 U	16 U
trans-1,2-Dichloroethene	NE	1.9 U	NS	76 U	NS	76 U	38 U	19 U
trans-1,3-Dichloropropene	0.4	1.6 U	NS	64 U	NS	64 U	32 U	16 U
Trichloroethene	5	1.9 UJ	NS	76 U	NS	76 U	38 U	19 U
Trichlorofluoromethane	NE	1.3 UJ	NS	52 U	NS	52 U	26 U	13 U
Vinyl chloride	2	2.3 UJ	NS	92 U	NS	92 U	46 U	23 U
Xylenes, total	5	1.9 J	NS	33 U	NS	33 U	16 U	8 U
TOTAL TARGET VOCS	NE	3413.4	NS	4,900	NS	3,100	3,800	1,600
TOTAL VOC TICs	NE	103	NS	ND	NS	ND	110 J	86
Dissolved Gasses								
Ethane	NE	95	NS	1,500 U	NS	490 U	300 U	85 D
Ethene	NE	15 U	NS	1,500 U	NS	520 U	300 U	0.52 U
Methane	NE	15,000 J	NS	9,100	NS	4,000	14,000 D	8,700 D
General Chemistry								
Sulfate (mg/l)	NE	29.5 J	NS	373	NS	231 B	287 B	194 B
Sulfide (mg/l)	NE	1 U	NS	1 U	NS	0.67 U	0.67 U	0.67 U
Persulfate (mg/l)	NE	NS	3.40 U	4.0 U	3.40 U	11.2 U	10.0 J	3.40 U
TOC (mg/l)	NE	10.9	NS	13	NS	11.1 J	11.0	8.6
Field parameters								
pH	NE	7.33	5.91	6.29	6.56	6.56	6.23	7.12
Conductivity (mS/cm)	NE	1.23	3.24	1.79	1.93	1.52	1.07	1.58
Dissolved Oxygen (mg/l)	NE	2.11	0.00	0.00	0.54	0.00	0.3	0.00
Redox Potential (mV)	NE	-76	-51	-83	-110	-88	-59.0	-73.0

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING RESULTS BY WELL
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

		BASELINE SAMPLING	POST-INJECTION MONITORING					
URS SAMPLE ID	**NYSDEC**	**OW-3**	**OW-3**	**OW-3**	**OW-3**	**OW-3**	**OW-3**	**OW-3**
LAB SAMPLE ID	**CLASS GA**	**RTI1578-09**	**SB22093-02**	**RTL1339-02**	**SB23167-03**	**480-1116-3**	**480-1792-3**	**480-2979-2**
DILUTION	**WATER QUALITY**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
SAMPLE DATE	**STANDARD**	**9/24/10**	**12/07/10**	**12/21/2010**	**1/4/11**	**1/20/2011**	**2/17/2011**	**3/24/2011**
UNITS	**µg/l**	**µg/l**	**mg/l**	**µg/l**	**mg/l**	**µg/l**	**µg/l**	**µg/l**
Volatile Organic Compounds								
1,1,1-Trichloroethane	5	2.1 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
1,1,2,2-Tetrachloroethane	5	1.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.5 U
1,1,2-Trichloroethane	1	1.9 U	NS	1.9 U	NS	1.9 U	1.9 U	1.5 U
1,1,2-Trichlorotrifluoroethane	NE	1.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.9 U
1,1-Dichloroethane	5	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
1,1-Dichloroethene	5	2.5 U	NS	2.5 U	NS	2.5 U	2.5 U	2.5 U
1,2,4-Trichlorobenzene	NE	0.57 U	NS	0.57 U	NS	0.57 U	0.57 U	0.57 U
1,2-Dibromo-3-chloropropane	NE	5 U	NS	5 U	NS	5.0 U	5.0 U	5.0 U
1,2-Dibromoethane (EDB)	NE	2 U	NS	2 U	NS	2.0 U	2.0 U	2.0 U
1,2-Dichlorobenzene	NE	1.2 U	NS	1.2 U	NS	1.2 U	1.2 U	1.2 U
1,2-Dichloroethane	0.6	0.83 U	NS	0.83 U	NS	0.83 U	0.83 U	0.83 U
1,2-Dichloropropane	1	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
1,3-Dichlorobenzene	NE	1.2 U	NS	1.2 U	NS	1.2 U	1.2 U	1.2 U
1,4-Dichlorobenzene	NE	2.6 J	NS	1.7 J	NS	1.5 J	1.8 J	1.3 J
2-Butanone (MEK)	50	1.5 UJ	NS	1.5 U	NS	1.5 UJ	1.5 UJ	1.5 U
2-Hexanone	50	1.8 UJ	NS	1.8 U	NS	1.8 UJ	1.8 UJ	1.8 U
4-Methyl-2-pentanone (MIBK)	NE	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Acetone	50	1.9 UJ	NS	1.9 U	NS	1.9 R	1.9 UJ	1.9 U
Benzene	1	1.6 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Bromodichloromethane	5	1.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.5 U
Bromoform	5	5 U	NS	5 U	NS	5.0 U	5.0 U	5 U
Bromomethane	5	4.3 U	NS	4.3 U	NS	4.3 U	4.3 U	4.3 U
Carbon disulfide	NE	2.1 UJ	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Carbon Tetrachloride	5	2 UJ	NS	2 U	NS	2.0 U	2.0 U	2 U
Chlorobenzene	5	**8 J**	NS	**7 J**	NS	1.6 U	**5.7 J**	**5.6 J**
Chlorodibromomethane	5	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Chloroethane	5	3.8 J	NS	**36**	NS	**16**	**18 J**	2.5 U
Chloroform	7	1.9 U	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
Chloromethane	5	2.3 UJ	NS	2.3 U	NS	2.3 U	2.3 U	2.3 U
cis-1,2-Dichloroethene	NE	1.8 U	NS	1.8 U	NS	1.8 U	1.8 U	1.8 U
cis-1,3-Dichloropropene	0.4	1.4 U	NS	1.4 U	NS	1.4 U	1.4 U	1.4 U
Cyclohexane	NE	0.59 U	NS	0.59 U	NS	0.59 U	0.59 U	0.59 U
Dichlorodifluoromethane	NE	2.1 UJ	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Ethylbenzene	5	1.6 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Isopropylbenzene	NE	0.91 J	NS	0.51 J	NS	0.37 U	0.75 J	0.37 U
Methyl Acetate	NE	0.66 U	NS	0.66 U	NS	0.66 U	0.66 U	0.66 U
Methyl tert-Butyl Ether	NE	0.46 U	NS	0.46 U	NS	0.46 U	0.46 U	0.46 U
Methylcyclohexane	NE	0.59 U	NS	0.59 U	NS	0.59 U	0.73 J	0.59 U
Methylene Chloride	5	1.3 U	NS	1.3 U	NS	1.3 U	1.3 U	1.3 U
Styrene	5	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Tetrachloroethene	5	2.1 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Toluene	5	1.6 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
trans-1,2-Dichloroethene	NE	1.9 U	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
trans-1,3-Dichloropropene	0.4	1.6 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Trichloroethene	5	1.9 UJ	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
Trichlorofluoromethane	NE	1.3 UJ	NS	1.3 U	NS	1.3 U	1.3 U	1.3 U
Vinyl chloride	2	2.3 UJ	NS	2.3 U	NS	2.3 U	2.3 U	2.3 U
Xylenes, total	5	1.8 J	NS	0.82 U	NS	0.82 U	0.82 U	0.82 U
TOTAL TARGET VOCS	NE	17.11	NS	45.21	NS	17.5	26.25	6.9
TOTAL VOC TICs	NE	177.5	NS	79	NS	31 J	16 J	13
Dissolved Gasses								
Ethane	NE	1.5 U	NS	1,500 U	NS	490 U	300 U	9.3
Ethene	NE	1.7	NS	1,500 U	NS	520 U	300 U	8.5
Methane	NE	19,000 j	NS	14,000	NS	9,300	17,000 D	5,800 D
General Chemistry								
Sulfate (mg/l)	NE	5 U	NS	1,390	NS	558 B	201 B	310 B
Sulfide (mg/l)	NE	1 U	NS	1 U	NS	0.67 U	0.67 U	0.67 U
Persulfate (mg/l)	NE	NS	9.97 J	5.47	8.58 J	11.2 U	11.4 J	8.01
TOC (mg/l)	NE	9.8	NS	11.7	NS	9.5 J	10.5	7.7
Field parameters								
pH	NE	7.52	6.38	6.52	6.79	6.87	6.63	7.51
Conductivity (mS/cm)	NE	4.93	6.83	7.21	9.6	6.91	6.32	11.1
Dissolved Oxygen (mg/l)	NE	2.1	0.00	0.00	0.51	0.00	0.28	0.00
Redox Potential (mV)	NE	-105	-91	-157	-116	-138	-72	-112

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING RESULTS BY WELL
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

		BASELINE SAMPLING	POST-INJECTION MONITORING					
URS SAMPLE ID	**NYSDEC**	**OW-4**	**OW-4**	**OW-4**	**OW-4**	**OW-4**	**OW-4**	**OW-4**
LAB SAMPLE ID	**CLASS GA**	**RTI1578-10**	**SB22093-01**	**RTL1339-01**	**SB23167-04**	**480-1116-4**	**480-1792-4**	**480-2979-1**
DILUTION	**WATER QUALITY**	**1**	**1**	**20**	**1**	**20**	**5**	**5**
SAMPLE DATE	**STANDARD**	**9/24/10**	**12/07/10**	**12/21/2010**	**1/4/11**	**1/20/2011**	**2/17/2011**	**3/24/2011**
UNITS	**µg/l**	**µg/l**	**mg/l**	**µg/l**	**mg/l**	**µg/l**	**µg/l**	**µg/l**
Volatile Organic Compounds								
1,1,1-Trichloroethane	5	2.1 U	NS	42 U	NS	11 U	11 U	2.1 U
1,1,2,2-Tetrachloroethane	5	1.5 U	NS	30 U	NS	7.5 U	7.5 U	1.5 U
1,1,2-Trichloroethane	1	1.9 U	NS	38 U	NS	9.5 U	9.5 U	1.5 U
1,1,2-Trichlorotrifluoroethane	NE	1.5 U	NS	30 U	NS	7.5 U	7.5 U	1.9 U
1,1-Dichloroethane	5	1.7 U	NS	34 U	NS	8.5 U	8.5 U	1.7 U
1,1-Dichloroethene	5	**9.7 J**	NS	50 U	NS	13 U	13 U	**6.2 J**
1,2,4-Trichlorobenzene	NE	0.57 U	NS	11 U	NS	2.9 U	2.9 U	0.57 U
1,2-Dibromo-3-chloropropane	NE	5 U	NS	100 U	NS	25 U	25 U	5 U
1,2-Dibromoethane (EDB)	NE	2 U	NS	40 U	NS	10 U	10 U	2 U
1,2-Dichlorobenzene	NE	1.2 U	NS	24 U	NS	6.0 U	6.0 U	1.2 U
1,2-Dichloroethane	0.6	0.83 U	NS	17 U	NS	4.2 U	4.2 U	0.83 U
1,2-Dichloropropane	1	1.7 U	NS	34 U	NS	8.5 U	8.5 U	1.7 U
1,3-Dichlorobenzene	NE	1.2 U	NS	24 U	NS	6.0 U	6.0 U	1.2 U
1,4-Dichlorobenzene	NE	3 J	NS	22 U	NS	5.5 U	5.5 U	3.8 J
2-Butanone (MEK)	50	1.5 UJ	NS	30 U	NS	7.5 UJ	7.5 UJ	1.5 U
2-Hexanone	50	1.8 UJ	NS	36 U	NS	9.0 UJ	9.0 UJ	1.8 U
4-Methyl-2-pentanone (MIBK)	NE	1.7 U	NS	34 U	NS	8.5 U	8.5 U	1.7 U
Acetone	50	1.9 UJ	NS	**120 J**	NS	19 JR	32 J	1.9 U
Benzene	1	1.6 U	NS	32 U	NS	8.0 U	8.0 U	1.6 U
Bromodichloromethane	5	1.5 U	NS	30 U	NS	7.5 U	7.5 U	1.5 U
Bromoform	5	5 U	NS	100 U	NS	25 U	25 U	5.0 U
Bromomethane	5	4.3 U	NS	86 U	NS	22 U	22 U	4.3 U
Carbon disulfide	NE	2.1 UJ	NS	52 J	NS	32 J	58	7.9 J
Carbon Tetrachloride	5	2 UJ	NS	40 U	NS	10 U	10 U	2 U
Chlorobenzene	5	**22**	NS	32 U	NS	8.0 U	8.0 U	**20**
Chlorodibromomethane	5	1.7 U	NS	34 U	NS	8.5 U	8.5 U	1.7 U
Chloroethane	5	**2,500**	NS	**2,800**	NS	**600**	**1000 DJ**	**160**
Chloroform	7	1.9 U	NS	38 U	NS	9.5 U	9.5 U	1.9 U
Chloromethane	5	2.3 UJ	NS	46 U	NS	12 U	12 U	2.3 U
cis-1,2-Dichloroethene	NE	1.8 U	NS	36 U	NS	9.0 U	9.0 U	1.8 U
cis-1,3-Dichloropropene	0.4	1.4 U	NS	28 U	NS	7.0 U	7.0 U	1.4 U
Cyclohexane	NE	0.59 U	NS	12 U	NS	2.9 U	2.9 U	0.59 U
Dichlorodifluoromethane	NE	2.1 UJ	NS	42 U	NS	11 U	11 U	2.1 U
Ethylbenzene	5	1.6 U	NS	32 U	NS	8.0 U	8.0 U	1.6 U
Isopropylbenzene	NE	1 J	NS	7.5 U	NS	1.9 U	1.9 U	0.93 J
Methyl Acetate	NE	0.66 U	NS	13 U	NS	3.3 U	3.3 U	0.7 U
Methyl tert-Butyl Ether	NE	0.46 U	NS	9.1 U	NS	2.3 U	2.3 U	0.46 U
Methylcyclohexane	NE	0.63 J	NS	12 U	NS	3.0 U	3.0 U	0.59 U
Methylene Chloride	5	1.3 U	NS	26 U	NS	6.5 U	6.5 U	1.3 U
Styrene	5	1.7 U	NS	34 U	NS	8.5 U	8.5 U	1.7 U
Tetrachloroethene	5	2.1 U	NS	42 U	NS	11 U	11 U	2.1 U
Toluene	5	3.8 J	NS	32 U	NS	8.0 U	8.0 U	1.6 U
trans-1,2-Dichloroethene	NE	1.9 U	NS	38 U	NS	9.5 U	9.5 U	1.9 U
trans-1,3-Dichloropropene	0.4	1.6 U	NS	32 U	NS	8.0 U	8.0 U	1.6 U
Trichloroethene	5	1.9 UJ	NS	38 U	NS	9.5 U	9.5 U	1.9 U
Trichlorofluoromethane	NE	1.3 UJ	NS	26 U	NS	6.5 U	6.5 U	1.3 U
Vinyl chloride	2	**4.1 J**	NS	46 U	NS	12 U	12 U	2.3 U
Xylenes, total	5	0.82 U	NS	16 U	NS	4.1 U	4.1 U	0.82 U
TOTAL TARGET VOCS	NE	2544.23	NS	2,972	NS	651	1032	198.83
TOTAL VOC TICs	NE	32	NS	ND	NS	ND	29 J	35
Dissolved Gasses								
Ethane	NE	38	NS	1,500 U	NS	490 U	3,000 U	37
Ethene	NE	5 J	NS	1,500 U	NS	520 U	3,000 U	0.52 U
Methane	NE	16,000 DJ	NS	6,800	NS	3,300	8,800	3,600 D
General Chemistry								
Sulfate (mg/l)	NE	6.49	NS	4,790	NS	2,750 B	417 B	521 B
Sulfide (mg/l)	NE	1 U	NS	1 U	NS	0.67 U	0.80 J	0.67 U
Persulfate (mg/l)	NE	NS	3.40 U	4.15	3.40 U	11.2 U	3.40 U	3.98
TOC (mg/l)	NE	10.5	NS	26.6	NS	13.4 J	17.7	10.1
Field parameters								
pH	NE	7.35	4.57	4.56	4.71	4.79	4.94	7.19
Conductivity (mS/cm)	NE	2.98	8.41	16.2	13.9	6.52	7.93	4.09
Dissolved Oxygen (mg/l)	NE	2.26	0.00	0.06	0.49	0.00	3.09	0.00
Redox Potential (mV)	NE	-84	149	99	124	98	94	-96

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING RESULTS BY WELL
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

		BASELINE SAMPLING	POST-INJECTION MONITORING					
URS SAMPLE ID	**NYSDEC**	**MW-97-1S**	**MW-97-1S**	**MW-97-1S**	**MW-97-1S**	**MW-97-1S**	**MW-97-1S**	**MW-97-1S**
LAB SAMPLE ID	**CLASS GA**	**RTI1578-06**	**SB22093-05**	**RTL1339-05**	**SB23167-05**	**480-1116-5**	**480-1792-5**	**480-2979-5**
DILUTION	**WATER QUALITY**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
SAMPLE DATE	**STANDARD**	**9/24/10**	**12/07/10**	**12/21/2010**	**1/4/11**	**1/20/2011**	**2/17/2011**	**3/24/2011**
UNITS	**µg/l**	**µg/l**	**mg/l**	**µg/l**	**mg/l**	**µg/l**	**µg/l**	**µg/l**
Volatile Organic Compounds								
1,1,1-Trichloroethane	5	2.1 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
1,1,2,2-Tetrachloroethane	5	1.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.5 U
1,1,2-Trichloroethane	1	1.9 U	NS	1.9 U	NS	1.9 U	1.9 U	1.5 U
1,1,2-Trichlorotrifluoroethane	NE	1.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.9 U
1,1-Dichloroethane	5	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
1,1-Dichloroethene	5	2.5 U	NS	2.5 U	NS	2.5 U	2.5 U	2.5 U
1,2,4-Trichlorobenzene	NE	0.57 U	NS	0.57 U	NS	0.57 U	0.57 U	0.57 U
1,2-Dibromo-3-chloropropane	NE	5 U	NS	5 U	NS	5.0 U	5.0 U	5.0 U
1,2-Dibromoethane (EDB)	NE	2 U	NS	2 U	NS	2.0 U	2.0 U	2.0 U
1,2-Dichlorobenzene	NE	1.2 U	NS	1.2 U	NS	1.2 U	1.2 U	1.2 U
1,2-Dichloroethane	0.6	0.83 U	NS	0.83 U	NS	0.83 U	0.83 U	0.83 U
1,2-Dichloropropane	1	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
1,3-Dichlorobenzene	NE	1.2 U	NS	1.2 U	NS	1.2 U	1.2 U	1.2 U
1,4-Dichlorobenzene	NE	1.1 U	NS	1.1 U	NS	1.1 U	1.3 J	1.1 J
2-Butanone (MEK)	50	1.5 U	NS	1.5 U	NS	1.5 UJ	1.5 UJ	1.5 U
2-Hexanone	50	1.8 U	NS	1.8 U	NS	1.8 UJ	1.8 UJ	1.8 U
4-Methyl-2-pentanone (MIBK)	NE	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Acetone	50	1.9 U	NS	1.9 U	NS	1.9 R	1.9 UJ	1.9 U
Benzene	1	1.6 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Bromodichloromethane	5	1.5 U	NS	1.5 U	NS	1.5 U	1.5 U	1.5 U
Bromoform	5	5 U	NS	5 U	NS	5.0 U	5.0 U	5 U
Bromomethane	5	4.3 U	NS	4.3 U	NS	4.3 U	4.3 U	4.3 U
Carbon disulfide	NE	2.1 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Carbon Tetrachloride	5	2 U	NS	2 U	NS	2.0 U	2.0 U	2 U
Chlorobenzene	5	3.5 J	NS	2.2 J	NS	1.6 U	1.6 U	1.6 U
Chlorodibromomethane	5	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Chloroethane	5	**73**	NS	**260 D**	NS	**10**	2.5 UJ	2.5 U
Chloroform	7	1.9 U	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
Chloromethane	5	2.3 U	NS	2.3 U	NS	2.3 U	2.3 U	2.3 U
cis-1,2-Dichloroethene	NE	1.8 U	NS	1.8 U	NS	1.8 U	1.8 U	1.8 U
cis-1,3-Dichloropropene	0.4	1.4 U	NS	1.4 U	NS	1.4 U	1.4 U	1.4 U
Cyclohexane	NE	0.59 U	NS	0.59 U	NS	0.59 U	0.59 U	0.59 U
Dichlorodifluoromethane	NE	2.1 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Ethylbenzene	5	1.6 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Isopropylbenzene	NE	0.37 U	NS	0.37 U	NS	0.37 U	0.37 U	0.37 U
Methyl Acetate	NE	0.66 U	NS	0.66 U	NS	0.66 U	0.66 U	0.66 U
Methyl tert-Butyl Ether	NE	0.46 U	NS	0.46 U	NS	0.46 U	0.46 U	0.46 U
Methylcyclohexane	NE	0.59 U	NS	0.59 U	NS	0.59 U	0.59 U	0.59 U
Methylene Chloride	5	1.3 U	NS	1.3 U	NS	1.3 U	1.3 U	1.3 U
Styrene	5	1.7 U	NS	1.7 U	NS	1.7 U	1.7 U	1.7 U
Tetrachloroethene	5	2.1 U	NS	2.1 U	NS	2.1 U	2.1 U	2.1 U
Toluene	5	1.6 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
trans-1,2-Dichloroethene	NE	1.9 U	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
trans-1,3-Dichloropropene	0.4	1.6 U	NS	1.6 U	NS	1.6 U	1.6 U	1.6 U
Trichloroethene	5	1.9 UJ	NS	1.9 U	NS	1.9 U	1.9 U	1.9 U
Trichlorofluoromethane	NE	1.3 U	NS	1.3 U	NS	1.3 U	1.3 U	1.3 U
Vinyl chloride	2	2.3 U	NS	2.3 U	NS	2.3 U	2.3 U	2.3 U
Xylenes, total	5	0.82 U	NS	0.82 U	NS	0.82 U	0.82 U	0.82 U
TOTAL TARGET VOCS	NE	76.5	NS	262.2	NS	10	1.3	1.1 J
TOTAL VOC TICs	NE	26	NS	11	NS	ND	ND	12
Dissolved Gasses								
Ethane	NE	3,000 U	NS	150 U	NS	49 U	3,000 U	14
Ethene	NE	3,000 U	NS	150 U	NS	52 U	3,000 U	0.52 U
Methane	NE	28,000 J	NS	470	NS	530	5,200	7,200 D
General Chemistry								
Sulfate (mg/l)	NE	25.6 J	NS	391	NS	733 B	650 B	440 B
Sulfide (mg/l)	NE	1 U	NS	1 U	NS	0.67 U	0.67 U	0.67 U
Persulfate (mg/l)	NE	NS	3.40 U	4.0 U	3.40 U	11.2 U	7.34 J	3.40 U
TOC (mg/l)	NE	9.9	NS	10.9	NS	12.0 J	15.2	15.0
Field parameters								
pH	NE	7.34	5.61	5.98	6.23	6.23	5.84	6.69
Conductivity (mS/cm)	NE	0.993	1.36	1.38	1.6	1.6	1.61	1.61
Dissolved Oxygen (mg/l)	NE	2.07	5.23	0.00	0.34	0.34	2.20	0.00
Redox Potential (mV)	NE	-85	129	22	-29	-29.0	17.0	-26.0

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING RESULTS BY WELL
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

		BASELINE SAMPLING	POST-INJECTION MONITORING					
URS SAMPLE ID	**NYSDEC**	**MW-98-9D**	**MW-98-9D**	**MW-98-9D**	**MW-98-9D**	**MW-98-9D**	**MW-98-9D**	**MW-98-9D**
LAB SAMPLE ID	**CLASS GA**	**RTI1578-05**	**SB22093-06**	**RTL1339-06**	**SB23167-06**	**480-1116-6**	**480-1792-6**	**480-2979-6**
DILUTION	**WATER QUALITY**	**10**	**1**	**10**	**1**	**10**	**10**	**2**
SAMPLE DATE	**STANDARD**	**9/24/10**	**12/07/10**	**12/21/2010**	**1/4/11**	**1/20/2011**	**2/17/2011**	**3/24/2011**
UNITS	**µg/l**	**µg/l**	**mg/l**	**µg/l**	**mg/l**	**µg/l**	**µg/l**	**µg/l**
Volatile Organic Compounds								
1,1,1-Trichloroethane	5	21 U	NS	21 U	NS	21 U	21 U	4.2 U
1,1,2,2-Tetrachloroethane	5	15 U	NS	15 U	NS	15 U	15 U	3 U
1,1,2-Trichloroethane	1	19 U	NS	19 U	NS	19 U	19 U	3 U
1,1,2-Trichlorotrifluoroethane	NE	15 U	NS	15 U	NS	15 U	15 U	3.8 U
1,1-Dichloroethane	5	17 U	NS	17 U	NS	17 U	17 U	3.4 U
1,1-Dichloroethene	5	25 U	NS	25 U	NS	25 U	25 U	5 U
1,2,4-Trichlorobenzene	NE	5.7 U	NS	5.7 U	NS	5.7 U	5.7 U	1.1 U
1,2-Dibromo-3-chloropropane	NE	50 U	NS	50 U	NS	50 U	50 U	10 U
1,2-Dibromoethane (EDB)	NE	20 U	NS	20 U	NS	20 U	20 U	4 U
1,2-Dichlorobenzene	NE	12 U	NS	12 U	NS	12 U	12 U	2.4 U
1,2-Dichloroethane	0.6	8.3 U	NS	8.3 U	NS	8.3 U	8.3 U	1.7 U
1,2-Dichloropropane	1	17 U	NS	17 U	NS	17 U	17 U	3.4 U
1,3-Dichlorobenzene	NE	12 U	NS	12 U	NS	12 U	12 U	2.4 U
1,4-Dichlorobenzene	NE	11 U	NS	11 U	NS	11 U	11 U	2.2 U
2-Butanone (MEK)	50	15 U	NS	15 U	NS	15 UJ	15 UJ	3 U
2-Hexanone	50	18 U	NS	18 U	NS	18 UJ	18 UJ	3.6 U
4-Methyl-2-pentanone (MIBK)	NE	17 U	NS	17 U	NS	17 U	17 U	3.4 U
Acetone	50	19 U	NS	**370**	NS	**160 R**	**140 J**	7.8 J
Benzene	1	16 U	NS	16 U	NS	16 U	16 U	3.2 U
Bromodichloromethane	5	15 U	NS	15 U	NS	15 U	15 U	3 U
Bromoform	5	50 U	NS	50 U	NS	50 U	50 U	10 U
Bromomethane	5	43 U	NS	43 U	NS	43 U	43 U	8.6 U
Carbon disulfide	NE	21 U	NS	64 J	NS	77 J	43 J	13 J
Carbon Tetrachloride	5	20 U	NS	20 U	NS	20 U	20 U	4 U
Chlorobenzene	5	16 U	NS	16 U	NS	16 U	16 U	3.2 U
Chlorodibromomethane	5	17 U	NS	17 U	NS	17 U	17 U	3.4 U
Chloroethane	5	**790**	NS	**470**	NS	**250**	**350 J**	**300**
Chloroform	7	19 U	NS	19 U	NS	19 U	19 U	3.8 U
Chloromethane	5	23 U	NS	23 U	NS	23 U	23 U	4.6 U
cis-1,2-Dichloroethene	NE	18 U	NS	18 U	NS	18 U	18 U	3.6 U
cis-1,3-Dichloropropene	0.4	14 U	NS	14 U	NS	14 U	14 U	2.8 U
Cyclohexane	NE	5.9 U	NS	5.9 U	NS	5.9 U	5.9 U	1.2 U
Dichlorodifluoromethane	NE	21 U	NS	21 U	NS	21 U	21 U	4.2 U
Ethylbenzene	5	16 U	NS	16 U	NS	16 U	16 U	3.2 U
Isopropylbenzene	NE	3.7 U	NS	3.7 U	NS	3.7 U	3.7 U	0.75 U
Methyl Acetate	NE	6.6 U	NS	6.6 U	NS	6.6 U	6.6 U	1.3 U
Methyl tert-Butyl Ether	NE	4.6 U	NS	4.6 U	NS	4.6 U	4.6 U	0.91 U
Methylcyclohexane	NE	5.9 U	NS	5.9 U	NS	5.9 U	5.9 U	1.2 U
Methylene Chloride	5	13 U	NS	13 U	NS	13 U	13 U	2.6 U
Styrene	5	17 U	NS	17 U	NS	17 U	17 U	3.4 U
Tetrachloroethene	5	21 U	NS	21 U	NS	21 U	21 U	4.2 U
Toluene	5	16 U	NS	16 U	NS	16 U	16 U	3.2 U
trans-1,2-Dichloroethene	NE	19 U	NS	19 U	NS	19 U	19 U	3.8 U
trans-1,3-Dichloropropene	0.4	16 U	NS	16 U	NS	16 U	16 U	3.2 U
Trichloroethene	5	19 UJ	NS	19 U	NS	19 U	19 U	3.8 U
Trichlorofluoromethane	NE	13 U	NS	13 U	NS	13 U	13 U	2.6 U
Vinyl chloride	2	23 U	NS	23 U	NS	23 U	23 U	4.6 U
Xylenes, total	5	8.2 U	NS	8.2 U	NS	8.2 U	8.2 U	1.6 U
TOTAL TARGET VOCS	NE	790	NS	840	NS	487	533	320.8
TOTAL VOC TICs	NE	61	NS	ND	NS	ND	ND	49
Dissolved Gasses								
Ethane	NE	1,500 U	NS	1,500 U	NS	490 U	3,000 U	36 D
Ethene	NE	1,500 U	NS	1,500 U	NS	520 U	3,000 U	0.52 U
Methane	NE	12,000 J	NS	1,800	NS	2,100	5,600	5,100 D
General Chemistry								
Sulfate (mg/l)	NE	106	NS	16,200	NS	28,700 B	1,910 B	5,960 B
Sulfide (mg/l)	NE	1 U	NS	1 U	NS	0.67 U	0.67 U	0.67 U
Persulfate (mg/l)	NE	NS	3.40 U	13.4	3.40 U	7.51 J	8.68 J	3.40 U
TOC (mg/l)	NE	10.6	NS	60.6	NS	64.1 J	43.8	11.6
Field parameters								
pH	NE	7.45	3.22	3.20	3.48	3.36	3.60	4.94
Conductivity (mS/cm)	NE	1.17	10	55.3	35.1	39.9	26.3	11.7
Dissolved Oxygen (mg/l)	NE	2.11	0.00	0.00	0.32	0.00	0.35	0.00
Redox Potential (mV)	NE	-102	272	223	206	197	214	96

TABLE 2
SUMMARY OF GROUNDWATER SAMPLING RESULTS BY WELL
OU-1 GW ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

NOTES:

U - Indicates compound was analyzed for but not detected
J - Indicates an estimated value due to limitations identified during the Quality Assurance (QA) review. quantitation limit but greater than zero.
B - This flag is used when the analyte is found in the associated blank as well as in the sample.
E - This flag identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis and therefore, are regarded as estimated values.
D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.
R - Indicates result is unreliable (compound may or not be present)
NS - Not sampled
ND - Not Detected
NE - No existing Groundwater Cleanup Standard
Total VOCs - This row presents the sum total concentration level of target compound list (TCL) volatile organic compounds (VOCs) reported in the sample. When a value is flagged with a "J", the sum total concentration level includes compounds reported at estimated concentration levels below Reporting Limits (RL). When a value is flagged by a "B", it is not included in the sum total concentration level.
100 (Bold) - Concentration exceeds NYSDEC Class GA Groundwater Quality Standard.

TABLE 3
PROPOSED INJECTION POINTS
2011 IN-SITU CHEMICAL OXIDATION
OPERABLE UNIT No. 1 GROUNDWATER
FORMER COLUMBIA CEMENT COMPANY SITE
FREEPORT, NEW YORK

ISCO Injection Points			
Intermediate Screened Interval		Deep Screened Interval	
IP #	(ft bgs)	IP #	(ft bgs)
IP-1I	23 to 29	IP-1D	30 to 36
IP-2I	23 to 29	IP-2D	30 to 36
IP-3I	23 to 29	IP-3D	30 to 36
IP-4I	23 to 29	IP-4D	30 to 36
IP-5I	23 to 29	IP-5D	30 to 36
IP-6I	23 to 29	IP-6D	30 to 36
IP-7I	23 to 29	IP-7D	30 to 36
IP-8I	23 to 29	IP-8D	30 to 36
IP-9I	23 to 29	IP-9D	30 to 36
IP-10I	23 to 29	IP-10D	30 to 36
IP-11I	23 to 29	IP-11D	30 to 36
IP-12I	23 to 29	IP-12D	30 to 36
IP-13I	23 to 29	IP-13D	30 to 36
IP-14I	23 to 29	IP-14D	30 to 36
IP-15I	23 to 29	IP-15D	30 to 36
IP-16I	23 to 29	IP-16D	30 to 36
IP-17I	23 to 29	IP-17D	30 to 36

TABLE 4
PROPOSED INJECTION MASS OF OXIDANT AND ACTIVATION AGENT
2011 IN-SITU CHEMICAL OXIDATION
OPERABLE UNIT No. 1 GROUNDWATER
FORMER COLUMBIA CEMENT COMPANY SITE
FREEPORT, NEW YORK

	IP #	Screened Interval, ft bgs	Number of Points	lb of sodium persulfate per point	lb of 100% hydrogen peroxide per point	lb of 8% hydrogen peroxide per point	gal of 8% hydrogen peroxide per point	**Total sodium persulfate, lb**	**Total 8% hydrogen peroxide, gal**
Intermediate Points	IP-1I to IP-17I	23 to 29	17	1,100	1,100	13,750	1,610	**18,700**	**27,371**
Deep Points	IP-1D to IP-17D	30 to 36	17	1,100	1,100	13,750	1,610	**18,700**	**27,371**
Total	**34**		**34**	**2,200**	**2,200**	**27,500**	**3,220**	**37,400**	**54,742**

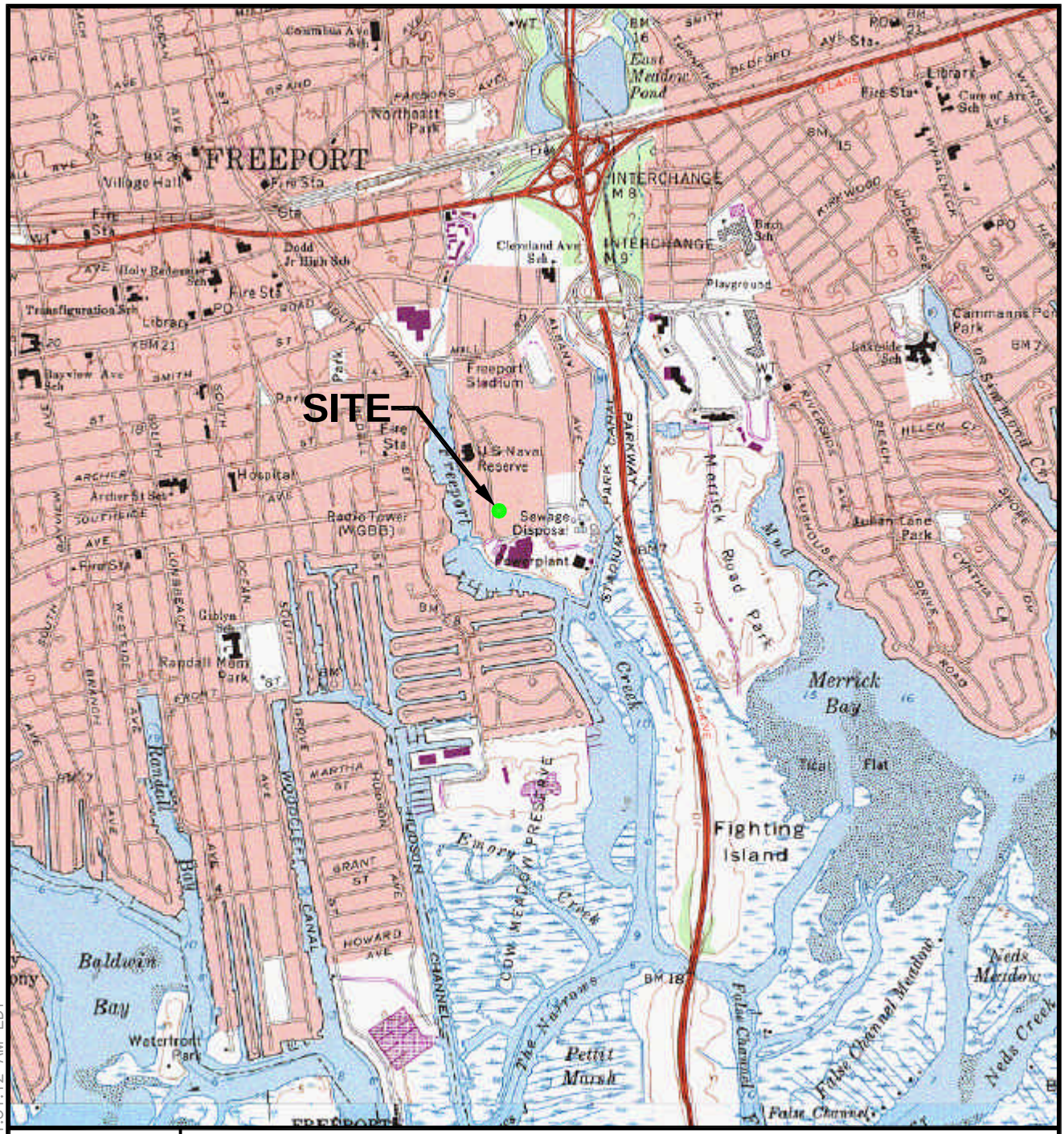
TABLE 5
SUMMARY OF PERFORMANCE MONITORING PROGRAM
2011 IN-SITU CHEMICAL OXIDATION
OPERABLE UNIT No. 1 GROUNDWATER
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

MATRIX	SAMPLE SCHEDULE	SAMPLE LOCATION(S)	SAMPLE METHOD	ANALYTICAL PARAMETERS
GROUNDWATER	1 Week After Injections	MW-97-1S	Low flow	Field Parameters
		MW-98-9D	Low flow	Field Parameters
		OW-1	Low flow	Field Parameters
		OW-2	Low flow	Field Parameters
		OW-3	Low flow	Field Parameters
		OW-4	Low flow	Field Parameters
	2 Weeks After Injections	MW-97-1S	Low flow	Field Parameters, Persulfate
		MW-98-9D	Low flow	Field Parameters, Persulfate
		OW-1	Low flow	Field Parameters, Persulfate
		OW-2	Low flow	Field Parameters, Persulfate
		OW-3	Low flow	Field Parameters, Persulfate
		OW-4	Low flow	Field Parameters, Persulfate
	3 Weeks After Injections	MW-97-1S	Low flow	Field Parameters
		MW-98-9D	Low flow	Field Parameters
		OW-1	Low flow	Field Parameters
		OW-2	Low flow	Field Parameters
		OW-3	Low flow	Field Parameters
		OW-4	Low flow	Field Parameters
	1 Month After Injections	MW-97-1S	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		MW-98-9D	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-1	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-2	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-3	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-4	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
	6 Weeks After Injections	MW-97-1S	Low flow	Field Parameters, Persulfate
		MW-98-9D	Low flow	Field Parameters, Persulfate
		OW-1	Low flow	Field Parameters, Persulfate
		OW-2	Low flow	Field Parameters, Persulfate
		OW-3	Low flow	Field Parameters, Persulfate
		OW-4	Low flow	Field Parameters, Persulfate
	2 Months After Injections	MW-97-1S	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		MW-98-9D	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-1	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-2	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-3	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-4	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
	3 Months After Injections	MW-97-1S	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		MW-98-9D	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-1	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-2	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-3	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters
		OW-4	Low flow	VOCs, TOC, Sulfate, Persulfate, MEE, Field Parameters

Note:
Field Parameters : pH, conductivity, dissolved oxygen and redox potential
VOCs : Volatile organic compounds
TOC : Total Organic carbon
MEE : Methane, ethane, ethene

Monthly monitoring will continue until data indicates additional injections are required or no further action is necessar

FIGURES



NEW YORK

QUADRANGLE LOCATION

0 2000 4000

SCALE IN FEET

N

REFERENCE:
U.S.G.S. 7.5 MINUTE QUADRANGLE:
FREEPORT, N.Y., 1994

FORMER COLUMBIA CEMENT COMPANY, INC.

159 HANSE AVENUE
FREEPORT, NEW YORK

SITE LOCATION MAP

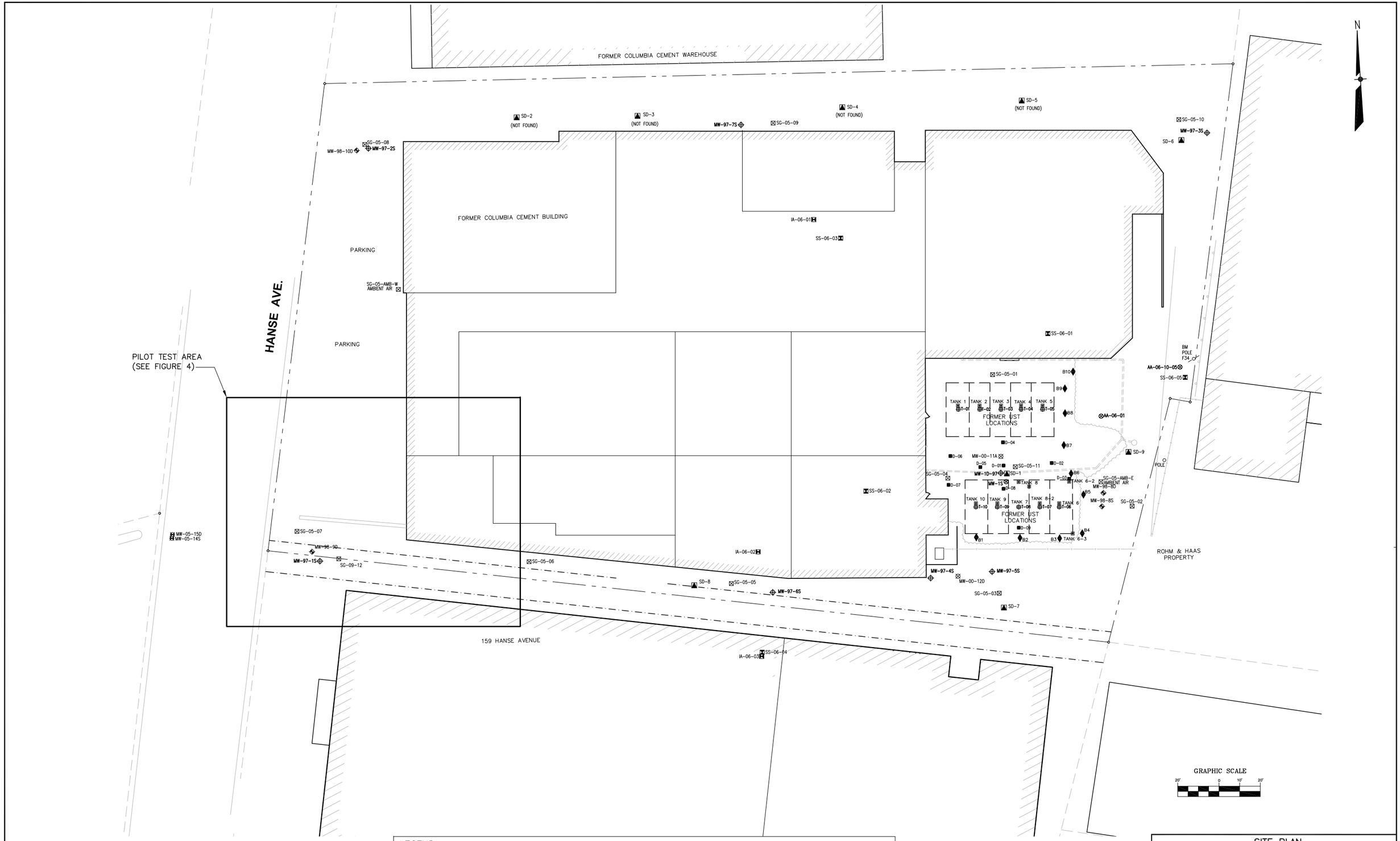
URS
12 COMMERCE DRIVE
CRANFORD, NJ, 07016
PHONE: (908) 272-8300
FAX: (908) 272-3940

DATE: 11/08/03

JOB: 18564-060-175

FIGURE 1

S:\18564\060\PLOT\060-001.dwg 04/05/2004 11:31:12 AM EDT



LEGEND:

MW-1S	⊗ 1988 MONITORING WELL LOCATION	SD-1	▲ STORM DRAIN LOCATION
MW-97-5S	⊕ 1997 MONITORING WELL LOCATION	SG-05-01	⊠ SOIL GAS SAMPLING LOCATIONS
MW-98-9D	⊕ 1998 MONITORING WELL LOCATION		
MW-00-11A	⊠ 2000 MONITORING WELL LOCATION		
MW-05-15D	⊠ 2005 OFFSITE MONITORING WELL LOCATION		

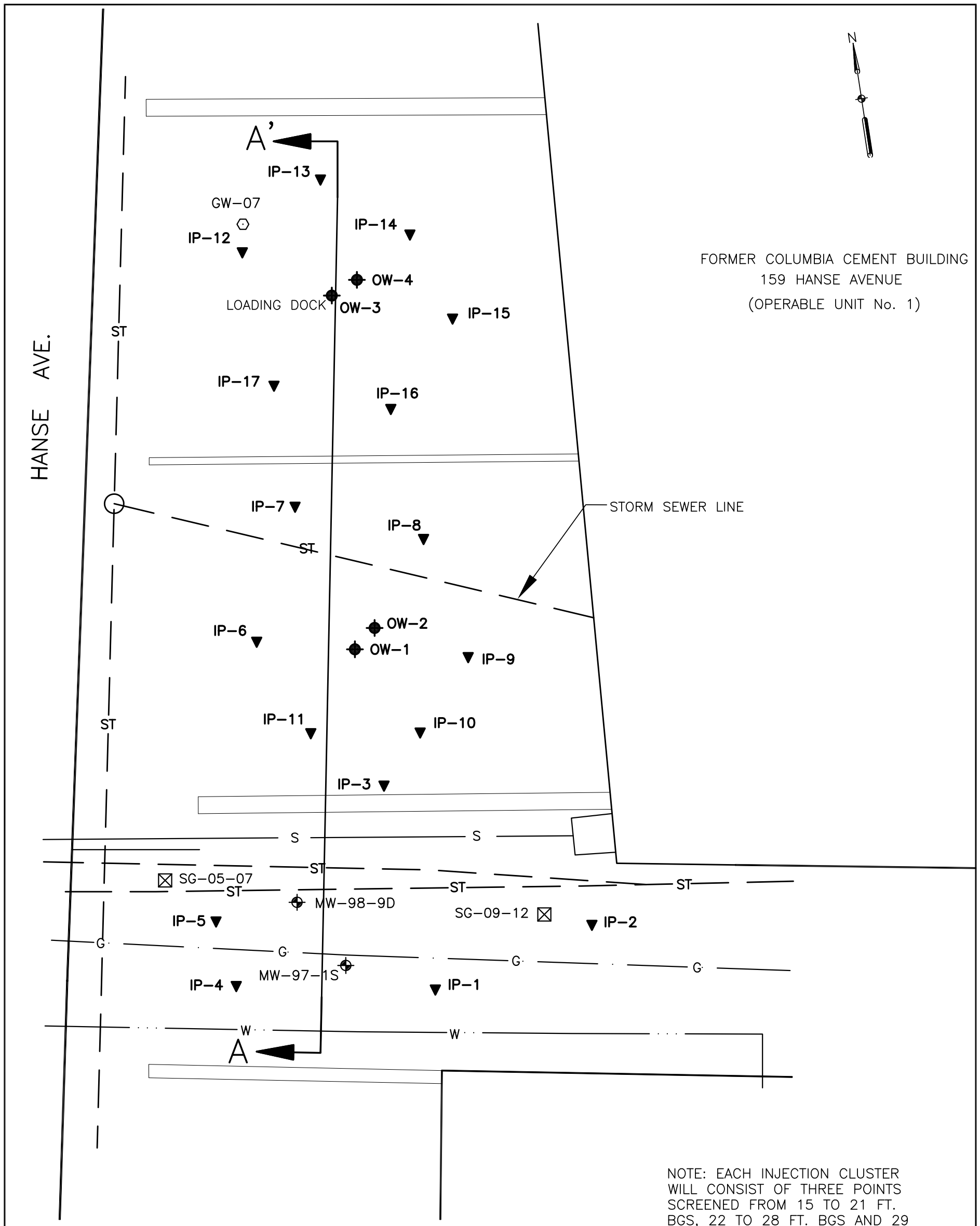
NOTE:
BASE MAP PROVIDED BY DELAWARE ENGINEERING, P.C.

SITE PLAN
OPERABLE UNIT NO. 1
FORMER COLUMBIA CEMENT COMPANY, INC.
FREEPORT, NEW YORK

URS
WAYNE, NEW JERSEY

DR. BY	ET	SCALE AS SHOWN	DWG. NO. 3027001-FIG2	PROJ. NO. 11130279	
CK'D. BY	MB	DATE	MAY 10, 2011	FIG. NO.	2

K:\Cadd\Columbia Cement\11130279(Columbia Cement)\30279001-FIG2.dwg, 5/10/2011 12:23:59 PM



ISCO
INJECTION LAYOUT
FORMER COLUMBIA CEMENT COMPANY, INC.
159 HANSE AVENUE
FREEPORT, NEW YORK

URS
WAYNE, NEW JERSEY

DR. BY	LH	SCALE	1"=20'	DWG. NO. 30279002-FIG.3		PROJ. NO.	11130274
CK'D. BY	MB	DATE	MAY 10, 2011	FIG. NO.	3		

K:\Cadd\Columbia Cement\11130279(Columbia Cement)\30279002-FIG3.dwg, 5/10/2011 12:22:38 PM

A

A'

MW-97-1S MW-98-9D

IP-1 IP-5 IP-3 IP-11 OW-2 OW-1 IP-6 IP-7 IP-16 OW-3 OW-4 IP-14 IP-13

0
5
10
15
20
25
30
35
40

(DEPTH FT.)

APPROXIMATE LOCATION OF STORM DRAIN LINE

GRAY CLAY

LEGEND:

MONITORING WELL SCREEN INTERVAL.

INJECTION POINT SCREEN INTERVAL

0 3 6 12
VERT. SCALE (FEET)

0 3 6 12
HORIZ. SCALE (FEET)

ISCO INJECTION LAYOUT
ALONG CROSS-SECTION A-A'
OPERABLE UNIT NO. 1
FORMER COLUMBIA CEMENT COMPANY, INC.
FREEPORT, NEW YORK

URS
WAYNE, NEW JERSEY

DR. BY	KM	SCALE	AS SHOWN	DWG. NO. 30279003-FIG4	PROJ. NO. 11130279
CK'D. BY	MB	DATE	MAY 10, 2011	FIG. NO.	4

K:\Cadd\Columbia Cement\11130279(Columbia Cement)\30279003-FIG4.dwg, Layout1, 5/10/2011 12:21:56 PM

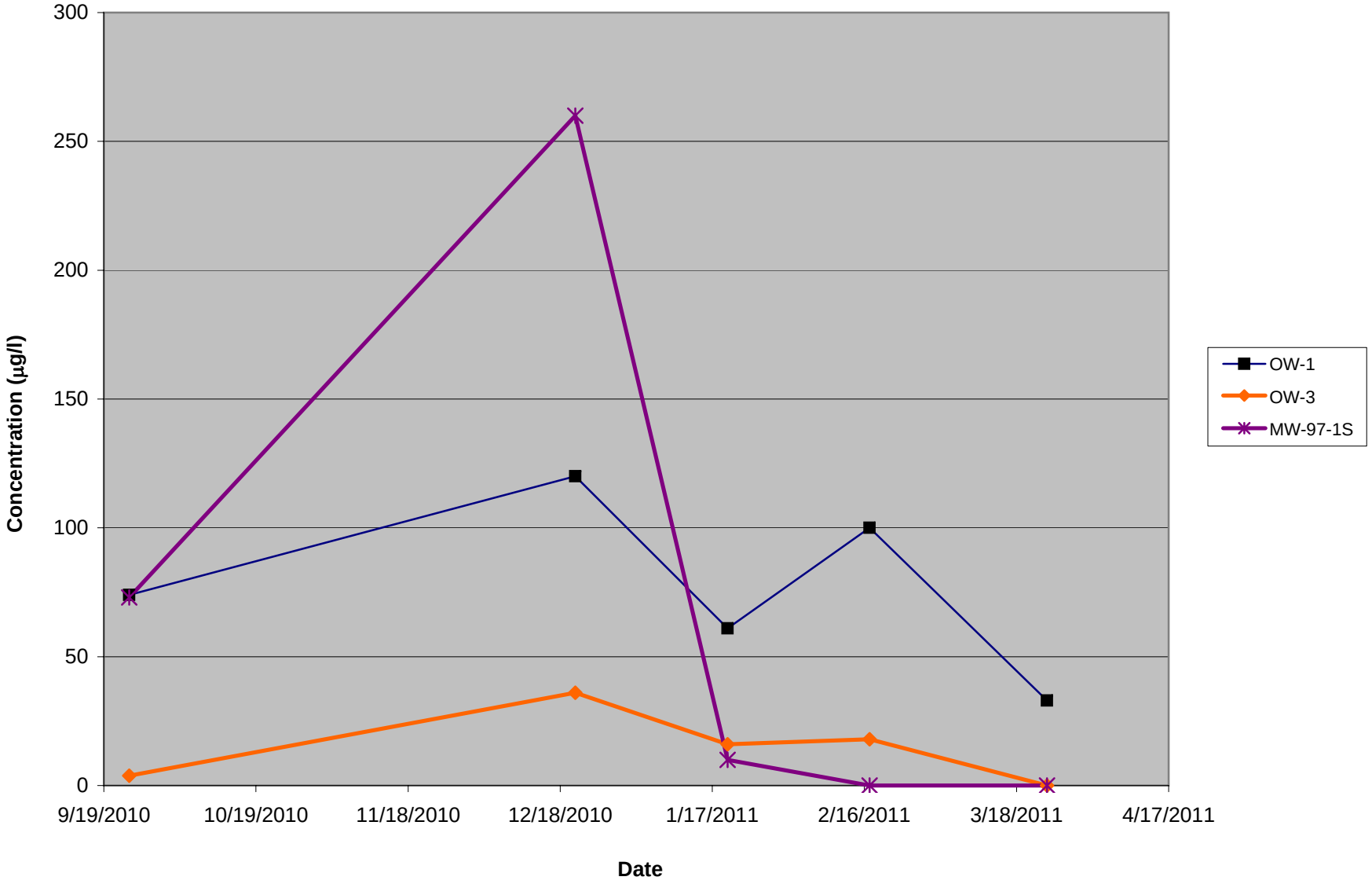


FIGURE 5
CHLOROETHANE CONCENTRATIONS IN SHALLOW WELLS
ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY SITE
FREEPORT, NEW YORK

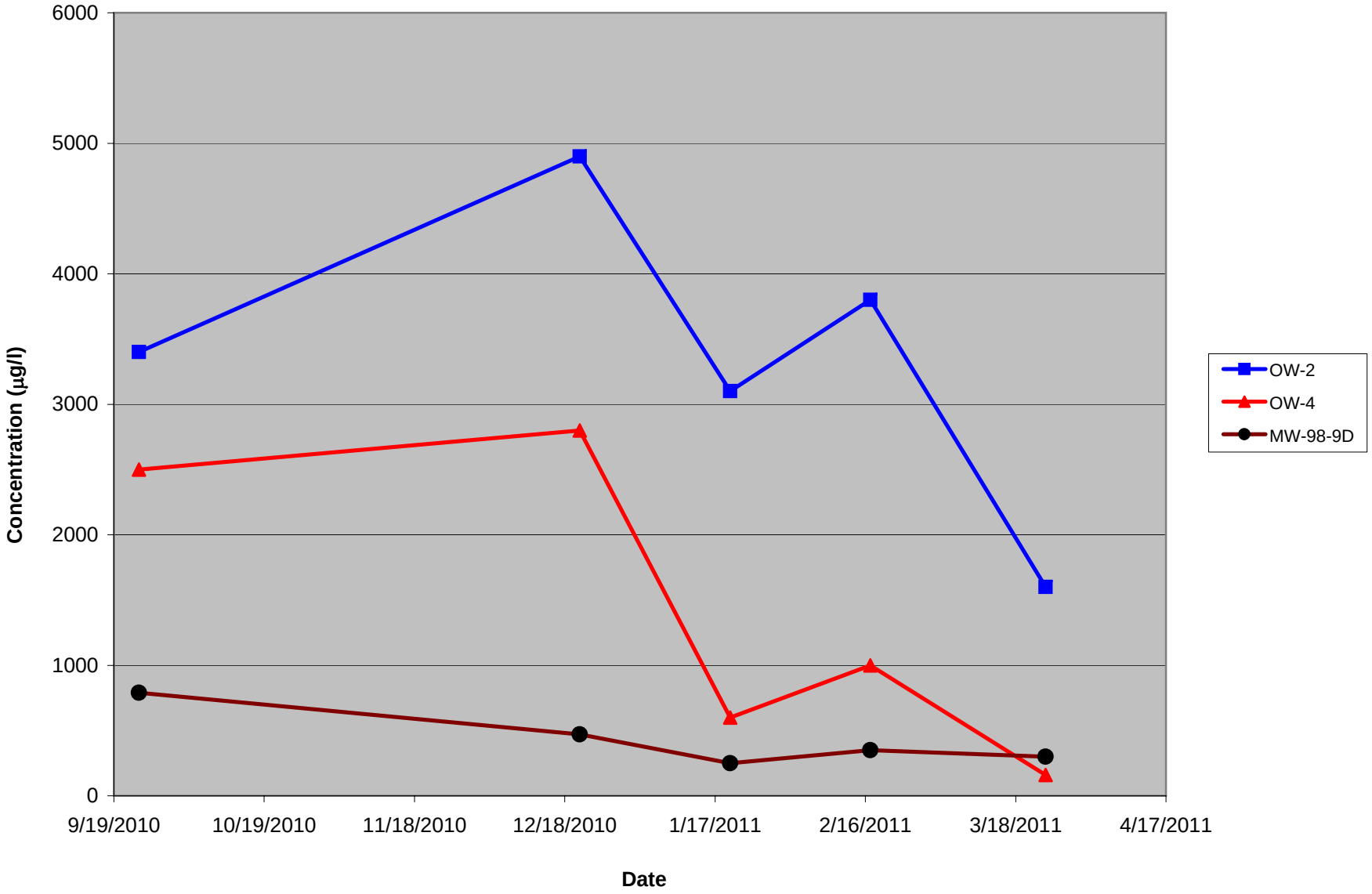


FIGURE 6
CHLOROETHANE CONCENTRATIONS IN DEEP WELLS
ISCO PILOT TEST
FORMER COLUMBIA CEMENT COMPANY SITE
FREEPORT, NEW YORK

A

A'

MW-97-1S MW-98-9D

OW-2 OW-1

OW-3

IP-1 IP-5 IP-3 IP-11 IP-6 IP-7 IP-16 OW-4 IP-14 IP-13

0
5
10
15
20
25
30
35
40

(DEPTH FT.)

APPROXIMATE LOCATION OF STORM DRAIN LINE

9/24/10
73

3/24/11
ND

9/24/10
790

3/24/11
300

9/24/10
74

3/24/11
33

9/24/10
3,400

3/24/10
1,600

9/24/10
3.8

3/24/11
ND

9/24/10
2,500

3/24/11
160

GRAY CLAY

LEGEND:

SAMPLING DATE

9/24/10
250

CHLOROETHANE CONCENTRATION (ug/L)

MONITORING WELL SCREEN INTERVAL.

INJECTION POINT SCREEN INTERVAL

0 3 6 12
VERT. SCALE (FEET)

0 3 6 12
HORIZ. SCALE (FEET)

CHLOROETHANE CONCENTRATIONS
ALONG CROSS-SECTION A-A'
OPERABLE UNIT NO. 1
FORMER COLUMBIA CEMENT COMPANY, INC.
FREEPORT, NEW YORK

URS
WAYNE, NEW JERSEY

DR. BY	KM	SCALE	AS SHOWN	DWG. NO. 30279004-FIG7	PROJ. NO. 11130279
CK'D. BY	MB	DATE	MAY 10, 2011	FIG. NO.	7

K:\Cadd\Columbia Cement\11130279(Columbia Cement)\30279004-FIG7.dwg, Layout1, 5/10/2011 12:20:22 PM

APPENDIX A

COMMUNITY AIR MONITORING PLAN

COMMUNITY AIR MONITORING PLAN

IN-SITU CHEMICAL OXIDATION FOR GROUNDWATER

OPERABLE UNIT NO. 1

FORMER COLUMBIA CEMENT COMPANY SITE

FREEPORT, NEW YORK

SITE NUMBER 1-30-052

Prepared for:
Atlantic Richfield Company
4850 East 49th Street
Cuyahoga Heights, Ohio, 44125

Prepared by:
URS Corporation
201 Willowbrook Boulevard
Wayne, New Jersey 07470

1.0 INTRODUCTION

The Former Columbia Cement Company (CCC) Site located at 159 Hanse Avenue (Site) has undergone extensive environmental investigation in response to a 1988 release of 1,1,1-trichloroethane (TCA). A supplementary Remedial Investigation Report was submitted to NYSDEC in December 2006 and a Feasibilty Study Report was submitted in February 2008. A Record of Decision was prepared by NYSDEC in March 2008, indicating selected remediation/mitigation measures for impacted soil, groundwater and soil vapor. The remediation/mitigation measures will commence in 2008. This Community Air Monitoring Plan (CAMP) was prepared to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air. Protection of Site workers will be addressed through a site-specific Health and Safety Plan (HASP).

2.0 BACKGROUND

The site building was constructed in 1969 on the location of a former municipal landfill. From 1969 to 1996, Columbia Cement produced adhesives in the Site building, including solvent-base adhesives. Multiple above-ground and underground storage tanks were present at the Site containing solvents, raw materials and other materials. On April 28, 1988, Quadrell Brothers of Rahway, New Jersey was delivering 3,500 gallons of 1,1,1-TCA to CCC. While pumping into one of the 6,000-gallon USTs, the tanker truck became pressurized and ruptured. Approximately 1,760 gallons of 1,1,1-TCA was spilled to the ground surface and flowed to a storm drain in the UST area. Since then the Site has undergone numerous investigations, documented in other submittals. In December 2003 Delaware Engineering submitted a Remedial Investigation Report. URS Corporation submitted a Supplemental Remedial Investigation Report in December 2006. The remedial investigation activities revealed that the soil and groundwater at the Site are impacted with 1,1,1-TCA, its degradation daughter products, other solvents utilized in adhesive manufacturing and stored on Site, as well as other constituents likely related to the former municipal landfill. These soil and groundwater impacts have also created soil vapor contamination.

In January 2007, URS submitted a draft Feasibility Study Report, evaluating potential remedial alternatives. NYSDEC and NYSDOH requested further off-site investigation. When groundwater contamination of spill-related compounds was detected near Freeport Creek, NYSDEC divided the Site into two Operable Units. Operable Unit 1 (OU-1) is the onsite project area and includes the former CCC property, currently owned by ITW. OU-2 is the offsite area including downgradient properties located between Hanse Avenue and Freeport Creek and areas immediately surrounding OU-1. The Final Revised FS addressing OU-1 was submitted to NYSDEC on February 18, 2008. NYSDEC prepared the Proposed Remedial Action Plan (PRAP) in February 2008 based on this FS and selected ISCO, in-situ bioremediation and sub-slab depressurization alternatives to address soil, groundwater and soil vapor impacts, respectively, at the Site within OU-1. All of these measures involve ground-intrusive activities

that could result in the release of subsurface contaminants to the atmosphere. The Record of Decision (ROD) for the OU-1 selecting the above remedies was issued by NYSDEC in March 2008.

3.0 COMMUNITY AIR MONITORING PLAN

This Community Air Monitoring Plan was prepared to present a description of air monitoring activities to be performed during In-Situ Chemical Oxidation (ISCO) injection and related activities at the Site. Other Site activities will be addressed under separate CAMPs.

3.1 ISCO INJECTIONS

Groundwater pilot testing and treatment will consist of a series of injections near the southeast corner of the Site. During these activities, the work area/exclusion zone will be delineated by barricades, traffic cones and caution tape. Continuous monitoring for VOCs, methane, hydrogen sulfide and oxygen will be performed in the work area near the injection equipment. In addition, continuous VOC monitoring will be performed at the downwind perimeter of the work area, as described in Sections 3.3 and 3.4. Readings will be recorded in a CAMP Log Book.

Additional monitoring will be conducted in selected storm drains and soil gas sampling points in and around the ISCO pilot test area. If hydrogen sulfide is detected in these readings, or in the work area breathing zone, hydrogen sulfide monitoring will be added to the downwind monitoring station.

3.2 NON-INJECTION ACTIVITIES

Periodic monitoring for VOCs will be required during non-injection activities such as the collection of groundwater samples from existing monitoring wells or management of drums of waste. "Periodic" monitoring during sample collection will consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or drum, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location.

3.3 GROUND-INTRUSIVE ACTIVITIES

Ground-intrusive activities (drilling, excavation) will be conducted during confirmatory soils sampling at the conclusion of the pilot test. During ground intrusive activities, real-time air monitoring for volatile organic compounds (VOCs) and particulate levels at the perimeter of the exclusion zone or work area will be necessary. Continuous monitoring will be required for all ground intrusive activities. Ground intrusive activities include, but are not limited to, the installation of soil borings or monitoring wells, advancement of soil borings for the purpose of injection of amendments and drilling or cutting the building slab to install sub-slab vapor testing or extraction points.

3.4 VOC MONITORING, RESPONSE LEVELS, AND ACTIONS

Volatile organic compounds (VOCs) will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a **continuous** basis or as otherwise specified. Wind direction will be determined by observing a wind direction indicator suspended near the work zone. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions, and/or if the work location changes. Wind direction and the location of upwind and downwind monitoring locations will be recorded on a map during each day of ISCO injections. The monitoring work will be performed using equipment appropriate to measure the contaminants known or suspected to be present (a PID with an 11.7 eV lamp). The equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below. Calibration information will be recorded in a CAMP Log Book.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shut down.

All 15-minute readings will be recorded in a CAMP Log Book and be available for State (DEC and DOH) personnel and local (county or municipal) health departments to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

3.5 METHANE, HYDROGEN SULFIDE AND OXYGEN MONITORING, RESPONSE LEVELS, AND ACTIONS

Methane, hydrogen sulfide and oxygen concentrations will be monitored continuously near the injection equipment or drill rig and hourly during injections in selected storm drains and soil gas points. The monitoring work will be performed using a landfill gas meter, or other appropriate

equipment. The equipment will be calibrated at least daily following the manufacturer's instructions. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below. Calibration information will be recorded in a CAMP Log Book.

- If the methane concentration in the work area breathing zone or the storm drains exceeds 2.5%, work will be stopped and a re-evaluation of activities initiated. Work may continue only after the methane concentration falls below 2.5%.

- If the hydrogen sulfide concentration in the work zone breathing zone or storm drains exceeds 5 ppm, work will be stopped and a re-evaluation of activities initiated. Work may continue only after the hydrogen sulfide concentration falls below 5 ppm.

- If the oxygen concentration in the work area breathing zone or storm drains exceeds 23%, work will be stopped and a re-evaluation of activities initiated. Work may continue only after the oxygen concentration falls below 23%.

If methane and/or hydrogen sulfide are detected above background levels in the work zone or in storm drains or soil gas points, they will be added to the downwind monitoring station. The monitoring equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below. Calibration information will be recorded in a CAMP Log Book.

- If the ambient air concentration of methane at the downwind perimeter of the work area or exclusion zone exceeds 2.5% for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the methane level readily decreases (per instantaneous readings) below 2.5%, work activities will resume with continued monitoring.

- If the ambient air concentration of hydrogen sulfide at the downwind perimeter of the work area or exclusion zone exceeds 5 ppm for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the hydrogen sulfide level readily decreases (per instantaneous readings) below 5 ppm, work activities will resume with continued monitoring.

All readings will be recorded in a CAMP Log Book and be available for State (DEC and DOH) personnel and local (county or municipal) health departments to review.

3.6 PARTICULATE MONITORING, RESPONSE LEVELS, AND ACTIONS

Particulate monitoring will be performed if any ground-intrusive activities are conducted. Particulate concentrations will be monitored at the start of the day and periodically at the upwind perimeter of the exclusion zone. Particulate concentrations will be monitored continuously at the

downwind perimeters of the exclusion zone at a temporary particulate monitoring station. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

All readings will be recorded in a CAMP Log Book and be available for State (DEC and DOH) personnel and local (county or municipal) health departments to review.

3.7 NUISANCE ODOR MONITORING, RESPONSE LEVELS, AND ACTIONS

Periodic monitoring of nuisance odors will be conducted at the downwind perimeter of the exclusion zone by smelling the ambient air. If nuisance odors are detected the work area will be checked to evaluate whether the odors are emanating from the source area. Other businesses in the area may produce nuisance odors. If the origin of the nuisance odors is determined to be the work area, work will be stopped and a re-evaluation of activities initiated.

APPENDIX B

MATERIAL SAFETY DATA SHEETS

MATERIAL SAFETY DATA SHEET

Sodium Persulfate

MSDS Ref. No.: 7775-27-1
Date Approved: 04/30/2006
Revision No.: 12

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazardous Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	Sodium Persulfate
SYNONYMS:	Sodium Peroxydisulfate; Disodium Peroxydisulfate
GENERAL USE:	Polymerization initiator. Etchant and cleaner in manufacture of printed circuit boards. Booster in hair bleaching formulations in cosmetics. Secondary oil recovery systems as a polymerization initiator and a gel breaker.

MANUFACTURER

FMC CORPORATION
FMC Peroxygens
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)

EMERGENCY TELEPHONE NUMBERS

(303) 595-9048 (Medical - U.S. - Call Collect)

For leak, fire, spill, or accident emergencies, call:
(800) 424-9300 (CHEMTREC - U.S.A. & Canada)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- White, odorless, crystals
- Oxidizer.
- Decomposes in storage under conditions of moisture (water/water vapor) and/or excessive heat causing release of oxides of sulfur and oxygen that supports combustion. Decomposition could form a high temperature melt. See Section 10 ("Stability and Reactivity").

POTENTIAL HEALTH EFFECTS: Airborne persulfate dust may be irritating to eyes, nose, lungs, throat and skin upon contact. Exposure to high levels of persulfate dust may cause difficulty in breathing in sensitive persons.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Sodium Persulfate	7775-27-1	>99	231-892-1	Not classified

4. FIRST AID MEASURES

EYES: Flush with plenty of water. Get medical attention if irritation occurs and persists.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: This product has low oral toxicity and is not irritating to the eyes and skin. Flooding of exposed areas with water is suggested, but gastric lavage or emesis induction for ingestions must consider possible aggravation of esophageal injury and the expected absence of system effects. Treatment is controlled removal of exposure followed by symptomatic and supportive care.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Deluge with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire. Presence of water accelerates decomposition.

FIRE FIGHTING PROCEDURES: Do not use carbon dioxide or other gas filled fire extinguishers; they will have no effect on decomposing persulfates. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

SENSITIVITY TO STATIC DISCHARGE: Not available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Spilled material should be collected and put in approved DOT container and isolated for disposal. Isolated material should be monitored for signs of decomposition (fuming/smoking). If spilled material is wet, dissolve with large quantity of water and dispose as a hazardous waste. All disposals should be carried out according to regulatory agencies procedures.

7. HANDLING AND STORAGE

HANDLING: Use adequate ventilation when transferring product from bags or drums. Wear respiratory protection if ventilation is inadequate or not available. Use eye and skin protection. Use clean plastic or stainless steel scoops only.

STORAGE: Store (unopened) in a cool, clean, dry place away from point sources of heat, e.g. radiant heaters or steam pipes. Use first in, first out storage system. Avoid contamination of opened product. In case of fire or decomposition (fuming/smoking) deluge with plenty of water to control decomposition. For storage, refer to NFPA Bulletin 430 on storage of liquid and solid oxidizing materials.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of dust into work environment. Spills should be collected into suitable containers to prevent dispersion into the air.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Sodium Persulfate	0.1 mg/m^3 (TWA)		

ENGINEERING CONTROLS: Provide mechanical local general room ventilation to prevent release of dust into the work environment. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use cup type chemical goggles. Full face shield may be used.

RESPIRATORY: Use approved dust respirator when airborne dust is expected.

PROTECTIVE CLOTHING: Normal work clothes. Rubber or neoprene footwear.

GLOVES: Rubber or neoprene gloves. Thoroughly wash the outside of gloves with soap and water prior to removal. Inspect regularly for leaks.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	None
APPEARANCE:	White crystals
AUTOIGNITION TEMPERATURE:	Not applicable. No evidence of combustion up to 800°C. Decomposition will occur upon heating.
BOILING POINT:	Not applicable
COEFFICIENT OF OIL / WATER:	Not applicable
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	Not applicable (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
MELTING POINT:	Decomposes
ODOR THRESHOLD:	Not applicable
OXIDIZING PROPERTIES:	Oxidizer
PERCENT VOLATILE:	Not applicable
pH:	typically 5.0 - 7.0 @ 25 °C (1% solution)
SOLUBILITY IN WATER:	73 % @ 25 °C (by wt.)
SPECIFIC GRAVITY:	2.6 (H_2O=1)
VAPOR DENSITY:	Not applicable (Air = 1)
VAPOR PRESSURE:	Not applicable

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Heat, moisture and contamination.
STABILITY:	Stable (becomes unstable in presence of heat, moisture and/or contamination).
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Acids, alkalis, halides (fluorides, chlorides, bromides and iodides), combustible materials, most metals and heavy metals, oxidizable materials, other oxidizers, reducing agents, cleaners, and organic or carbon containing compounds. Contact

with incompatible materials can result in a material decomposition or other uncontrolled reactions.

HAZARDOUS DECOMPOSITION PRODUCTS: Oxygen that supports combustion and oxides of sulfur.

COMMENTS: PRECAUTIONARY STATEMENT: Use of persulfates in chemical reactions requires appropriate precautions and design considerations for pressure and thermal relief.

Decomposing persulfates will evolve large volumes of gas and/or vapor, can accelerate exponentially with heat generation, and create significant and hazardous pressures if contained and not properly controlled or mitigated.

Use with alcohols in the presence of water has been demonstrated to generate conditions that require rigorous adherence to process safety methods and standards to prevent escalation to an uncontrolled reaction.

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11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

SKIN EFFECTS: Non-irritating (rabbit) [FMC Study Number: ICG/T-79.029]

DERMAL LD_{50}: > 10 g/kg [FMC Study Number: ICG/T-79.029]

ORAL LD_{50}: 895 mg/kg (rat) [FMC Study Number: ICG/T-79.029]

INHALATION LC_{50}: 5.1 mg/l (rat) [FMC I95-2017]

SENSITIZATION: May be sensitizing to allergic persons. [FMC Study Number: ICG/T-79.029]

TARGET ORGANS: Eyes, skin, respiratory passages

ACUTE EFFECTS FROM OVEREXPOSURE: Dust may be harmful and irritating. May be harmful if swallowed.

CHRONIC EFFECTS FROM OVEREXPOSURE: Sensitive persons may develop dermatitis and asthma [Respiration 38:144, 1979]. Groups of male and female rats were fed 0, 300 or 3000 ppm sodium persulfate in the diet for 13 weeks, followed by 5000 ppm for 5 weeks. Microscopic examination of tissues revealed some injury to the gastrointestinal tract at the high dose (3000 ppm) only. This effect is not unexpected for an oxidizer at high concentrations. [Ref. FMC I90-1151, Toxicologist 1:149, 1981].

CARCINOGENICITY:

NTP:	Not listed
IARC:	Not listed
OSHA:	Not listed
OTHER:	ACGIH: Not listed

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION:

Bluegill sunfish, 96-hour LC_{50} = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC_{50} = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC_{50} = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC_{50} = 519 mg/L [FMC Study I92-1253]

CHEMICAL FATE INFORMATION: Biodegradability does not apply to inorganic substances.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: Dispose as a hazardous waste in accordance with local, state and federal regulatory agencies.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME:	Sodium Persulfate
PRIMARY HAZARD CLASS / DIVISION:	5.1 (Oxidizer)
UN/NA NUMBER:	UN 1505
PACKING GROUP:	III
LABEL(S):	5.1 (Oxidizer)
PLACARD(S):	5.1 (Oxidizer)
MARKING(S):	Sodium Persulfate, UN 1505
ADDITIONAL INFORMATION:	Hazardous Substance/RQ: Not applicable

49 STCC Number: 4918733

This material is shipped in 225 lb. fiber drums, 55 lb. poly bags and 1000 - 2200 lb. IBC's (supersacks).

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME: Sodium Persulfate

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME: Sodium Persulfate

OTHER INFORMATION:

Protect from physical damage. Do not store near acids, moisture or heat.

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15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):
Not applicable

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):
The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.:
None

SECTION 313 REPORTABLE INGREDIENTS (40 CFR 372):
Not listed

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):
Unlisted, RQ = 100 lbs., Ignitability

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):

Listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):
Waste Number: D001

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

Product Identification Number: 1505
Hazard Classification / Division: Class C (Oxidizer), Class D, Div. 2, Subdiv. B. (Toxic)
Ingredient Disclosure List: Listed

INTERNATIONAL LISTINGS

Sodium persulfate:
Australia (AICS): Listed
China: Listed
Japan (ENCS): (1)-1131
Korea: KE-12369
Philippines (PICCS): Listed

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS:

EC Symbols: (Not classified as hazardous)

EC Risk Phrases: (Not classified as hazardous)

EC Safety Phrases: (Not classified as hazardous)

16. OTHER INFORMATION

HMIS

Health	1
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	J

Protection = J (Safety goggles, gloves, apron & combination dust & vapor respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe

3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	1
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA = National Fire Protection Association

Degree of Hazard Code:
4 = Extreme
3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:
This MSDS replaces Revision #11, dated February 22, 2005.
Changes in information are as follows:
Section 1 (Product and Company Identification)
Section 3 (Composition / Information on Ingredients)
Section 16 (Other Information)

FMC Logo - FMC Corporation Trademark

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MATERIAL SAFETY DATA SHEET

Hydrogen Peroxide (8 to 20%)

MSDS Ref. No.: 7722-84-1-2
Date Approved: 04/05/2005
Revision No.: 6

This document has been prepared to meet the requirements of the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200; the Canada's Workplace Hazardous Materials Information System (WHMIS) and, the EC Directive, 2001/58/EC.

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Hydrogen Peroxide (8 to 20%)

GENERAL USE: Standard 8% is formulated with an inorganic tin-based stabilizer for high stability and long term storage. Suitable for industrial bleaching, processing, pollution abatement and general oxidation reactions. Technical grade contains an organic based stabilizer. It is particularly useful in chemical synthesis where the presence of inorganic residues is objectionable.

MANUFACTURER

FMC CORPORATION
Hydrogen Peroxide Division
1735 Market Street
Philadelphia, PA 19103
(215) 299-6000 (General Information)

FMC of Canada Ltd.
Hydrogen Peroxide Division
PG Pulp Mill Road
Prince George, BC V2N2S6
(250) 561-4200 (General Information)

EMERGENCY TELEPHONE NUMBERS

(800) 424-9300 (CHEMTREC - U.S.)
(613) 996-6666 (CANUTEC)
(303) 595-9048 (Medical - U.S. - Call Collect)

(281) 474-8750 (Plant: Pasadena, TX, US - Call Collect)
(250) 561-4221 (Plant: Prince George, BC, Canada - Call Collect)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

- Clear, colorless, odorless liquid
- Oxidizer.
- Contact with combustibles may cause fire.
- Decomposes yielding oxygen that supports combustion of organic matters and can cause overpressure if confined.
- Extremely irritating to eyes, nose, throat and lungs.

POTENTIAL HEALTH EFFECTS: Extremely irritating to eyes, nose, throat and lungs. May cause skin irritation.

3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS#	Wt.%	EC No.	EC Class
Hydrogen Peroxide	7722-84-1	8 - 20	231-765-0	Xn, R22-41
Water	7732-18-5	80 - 92	231-791-2	Not classified

4. FIRST AID MEASURES

EYES: Immediately flush with water for at least 15 minutes, lifting the upper and lower eyelids intermittently. See a medical doctor or ophthalmologist immediately.

SKIN: Wash with plenty of soap and water. Get medical attention if irritation occurs and persists.

INGESTION: Rinse mouth with water. Dilute by giving 1 or 2 glasses of water. Do not induce vomiting. Never give anything by mouth to an unconscious person. See a medical doctor immediately.

INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs and persists, contact a medical doctor.

NOTES TO MEDICAL DOCTOR: Hydrogen peroxide at 8 to 20% concentration is an oxidant. Skin contact may be irritating; eye contact may be severely irritating. Treatment is by dilution and is symptomatic and supportive.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Flood with water.

FIRE / EXPLOSION HAZARDS: Product is non-combustible. On decomposition releases oxygen which may intensify fire.

FIRE FIGHTING PROCEDURES: Any tank or container surrounded by fire should be flooded with water for cooling. Wear full protective clothing and self-contained breathing apparatus.

FLAMMABLE LIMITS: Non-combustible

SENSITIVITY TO IMPACT: No data available

SENSITIVITY TO STATIC DISCHARGE: No data available

6. ACCIDENTAL RELEASE MEASURES

RELEASE NOTES: Dilute with a large volume of water and hold in a pond or diked area until hydrogen peroxide decomposes. Dispose according to methods outlined for waste disposal.

Combustible materials exposed to hydrogen peroxide should be immediately submerged in or rinsed with large amounts of water to ensure that all hydrogen peroxide is removed. Residual hydrogen peroxide that is allowed to dry (upon evaporation hydrogen peroxide can concentrate) on organic materials such as paper, fabrics, cotton, leather, wood or other combustibles can cause the material to ignite and result in a fire.

7. HANDLING AND STORAGE

HANDLING: Wear chemical splash-type monogoggles and full-face shield, impervious clothing, such as rubber, PVC, etc., and rubber or neoprene gloves and shoes. Avoid cotton, wool and leather. Avoid excessive heat and contamination. Contamination may cause decomposition and generation of oxygen gas which could result in high pressures and possible container rupture. Hydrogen peroxide should be stored only in vented containers and transferred only in a prescribed manner (see FMC Technical Bulletins). Never return unused hydrogen peroxide to original container, empty drums should be triple rinsed with water before discarding. Utensils used for handling hydrogen peroxide should only be made of glass, stainless steel, aluminum or plastic.

STORAGE: Store drums in cool areas out of direct sunlight and away from combustibles. For bulk storage refer to FMC Technical Bulletins.

COMMENTS: VENTILATION: Provide mechanical general and/or local exhaust ventilation to prevent release of vapor or mist into the work environment.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE LIMITS

Chemical Name	ACGIH	OSHA	Supplier
Hydrogen Peroxide	1 ppm (TWA)	1 ppm (PEL)	

ENGINEERING CONTROLS: Ventilation should be provided to minimize the release of hydrogen peroxide vapors and mists into the work environment. Spills should be minimized or confined immediately to prevent release into the work area. Remove contaminated clothing immediately and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT

EYES AND FACE: Use chemical splash-type monogoggles and a full-face shield made of polycarbonate, acetate, polycarbonate/acetate, PETG or thermoplastic.

RESPIRATORY: If concentrations in excess of 10 ppm are expected, use NIOSH/DHHS approved self-contained breathing apparatus (SCBA), or other approved atmospheric-supplied respirator (ASR) equipment (e.g., a full-face airline respirator (ALR)). DO NOT use any form of air-purifying respirator (APR) or filtering facepiece (AKA dust mask), especially those containing oxidizable sorbants such as activated carbon.

PROTECTIVE CLOTHING: Rubber or neoprene footwear (avoid leather). Impervious clothing materials such as rubber, neoprene, nitrile or polyvinyl chloride (avoid cotton, wool and leather). Completely submerge hydrogen peroxide contaminated clothing or other materials in water prior to drying. Residual hydrogen peroxide, if allowed to dry on materials such as paper, fabrics, cotton, leather, wood or other combustibles can cause the material to ignite and result in a fire.

GLOVES: Liquid proof rubber or neoprene gloves. Thoroughly rinse the outside of gloves with water prior to removal. Inspect regularly for leaks.

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9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR:	Odorless
APPEARANCE:	Clear, colorless liquid
AUTOIGNITION TEMPERATURE:	Non-combustible
BOILING POINT:	102°C (216°F) (8% and 10%)
COEFFICIENT OF OIL / WATER:	Not available
DENSITY / WEIGHT PER VOLUME:	Not available
EVAPORATION RATE:	Above 1 (Butyl Acetate = 1)
FLASH POINT:	Non-combustible
FREEZING POINT:	-5°C (23°F) (8%); -6°C (21°F) (10%)
ODOR THRESHOLD:	Not available
OXIDIZING PROPERTIES:	Oxidizer
PERCENT VOLATILE:	100%
pH:	(as is) approx. 2.5 to 3.5
SOLUBILITY IN WATER:	(in H_20 % by wt) Above 1

SPECIFIC GRAVITY:	(H_2O=1) 1.06 @ 20°C/4°C (8%); 1.03 @ 20°C/4°C (10%)
VAPOR DENSITY:	(Air = 1): Not available
VAPOR PRESSURE:	31 mmHg @ 30°C (8%); 30 mmHg @ 30°C (10%)

COMMENTS:
pH (1% solution): 5.0 - 6.0

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID:	Excessive heat or contamination could cause product to become unstable.
STABILITY:	Stable (heat and contamination could cause decomposition)
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Reducing agents, wood, paper and other combustibles, iron and other heavy metals, copper alloys and caustic.
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxygen which supports combustion.

COMMENTS: Materials to Avoid : Dirt, organics, cyanides and combustibles such as wood, paper, oils, etc.

11. TOXICOLOGICAL INFORMATION

EYE EFFECTS: 8% hydrogen peroxide: Extremely irritating (washed) (rabbit)
8% hydrogen peroxide: Moderately irritating (unwashed) (rabbit)
10% hydrogen peroxide: Extremely irritating (rabbit)
[FMC Study Number: I84-851]

SKIN EFFECTS: 10% hydrogen peroxide: Slightly irritating after 4 hr. exposure (rabbit) [FMC Study Number: I89-1078]

DERMAL LD_{50}: 35% hydrogen peroxide: > 2,000 mg/kg (rabbit) [FMC Study Number: I83-746]

ORAL LD_{50}: 10% hydrogen peroxide: > 5,000 mg/kg (rat) [FMC Study Number: I89-1077]

INHALATION LC_{50}: 50% hydrogen peroxide: > 0.17 mg/l (rat) [FMC Study Number: I89-1080]

TARGET ORGANS: Eyes, nose, throat and lungs

ACUTE EFFECTS FROM OVEREXPOSURE: Extremely irritating to eyes, nose, throat and lungs. May cause skin irritation.

CHRONIC EFFECTS FROM OVEREXPOSURE: The International Agency for Research on Cancer (IARC) has concluded that there is inadequate evidence for carcinogenicity of hydrogen peroxide in humans, but limited evidence in experimental animals (Group 3 - not classifiable as to its carcinogenicity to humans). The American Conference of Governmental Industrial Hygienists (ACGIH) has concluded that hydrogen peroxide is a 'Confirmed Animal Carcinogen with Unknown Relevance to Humans' (A3).

CARCINOGENICITY:

Chemical Name	IARC	NTP	OSHA	Other
Hydrogen Peroxide	Listed	Not listed	Not listed	(ACGIH) Listed (A3, Animal Carcinogen)

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION: Channel catfish 96-hour LC_{50} = 37.4 mg/L
Fathead minnow 96-hour LC_{50} = 16.4 mg/L
Daphnia magna 24-hour EC_{50} = 7.7 mg/L
Daphnia pulex 48-hour LC_{50} = 2.4 mg/L
Freshwater snail 96-hour LC_{50} = 17.7 mg/L
For more information refer to ECETOC "Joint Assessment of Commodity Chemicals No. 22, Hydrogen Peroxide." ISSN-0773-6339, January 1993

CHEMICAL FATE INFORMATION: Hydrogen peroxide in the aquatic environment is subject to various reduction or oxidation processes and decomposes into water and oxygen. Hydrogen peroxide half-life in freshwater ranged from 8 hours to 20 days, in air from 10-20 hrs. and in soils from minutes to hours depending upon microbiological activity and metal contaminants.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHOD: An acceptable method of disposal is to dilute with a large amount of water and allow the hydrogen peroxide to decompose followed by discharge into a suitable treatment system in accordance with all regulatory agencies. The appropriate regulatory agencies should be contacted prior to disposal.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

PROPER SHIPPING NAME: Hydrogen Peroxide, aqueous solutions with

	not less than 8%, but less than 20% hydrogen peroxide
UN/NA NUMBER:	UN 2984
PACKING GROUP:	III
LABEL(S):	Oxidizer
PLACARD(S):	5.1 (Oxidizer)
ADDITIONAL INFORMATION:	DOT Marking: Hydrogen Peroxide, aqueous solution with not less than 8%, but less than 20% Hydrogen Peroxide, UN 2984 Hazardous Substance/RQ: Not applicable 49 STCC Number: 4918689 DOT Spec: stainless steel/high purity aluminum cargo tanks and rail cars. UN Spec: HDPE drums. Contact FMC for specific details.

INTERNATIONAL MARITIME DANGEROUS GOODS (IMDG)

PROPER SHIPPING NAME:	Hydrogen peroxide, aqueous solution with not less than 8%, but less than 20% peroxide.

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) / INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

PROPER SHIPPING NAME:	Hydrogen peroxide, aqueous solution with not less than 8%, but less than 20% peroxide(*).

OTHER INFORMATION:

(*) Air regulations permit shipment of Hydrogen Peroxide (8 - 20%) in non-vented containers for Air Cargo Only aircraft, as well as for Passenger and Cargo aircraft. HOWEVER, all FMC Hydrogen Peroxide containers are vented and therefore, air shipments of FMC H_20_2 is not permitted. IATA air regulations state that venting of packages containing oxidizing substances is not permitted for air transport.

Protect from physical damage. Keep drums in upright position. Drums should not be stacked in transit. Do not store drum on wooden pallets.

15. REGULATORY INFORMATION

UNITED STATES

SARA TITLE III (SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT)

SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355, APPENDIX A):
Not listed

SECTION 311 HAZARD CATEGORIES (40 CFR 370):
Fire Hazard, Immediate (Acute) Health Hazard

SECTION 312 THRESHOLD PLANNING QUANTITY (40 CFR 370):
The Threshold Planning Quantity (TPQ) for this product, if treated as a mixture, is 10,000 lbs; however, this product contains the following ingredients with a TPQ of less than 10,000 lbs.: None, (conc. <52%)

CERCLA (COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT)

CERCLA DESIGNATION & REPORTABLE QUANTITIES (RQ) (40 CFR 302.4):
Unlisted (Hydrogen Peroxide 8-20%); RQ = 100 lbs.; Ignitability

TSCA (TOXIC SUBSTANCE CONTROL ACT)

TSCA INVENTORY STATUS (40 CFR 710):
Listed

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)
RCRA IDENTIFICATION OF HAZARDOUS WASTE (40 CFR 261):
Waste Number: D001

CANADA

WHMIS (WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM):

Chemical Name:	Hydrogen peroxide
Hazard Classification / Division:	Class C (Oxidizer), Class D, Div. 2, Subdiv. B
Ingredient Disclosure List:	Listed

INTERNATIONAL LISTINGS

Hydrogen peroxide:
China: Listed
Japan (ENCS): (1)-419
Korea: KE-20204
Philippines (PICCS): Listed

HAZARD, RISK AND SAFETY PHRASE DESCRIPTIONS:

Hydrogen Peroxide, (Index #008-003-00-9):

EC Symbols: Xn (Harmful)

EC Risk Phrases:	R22	(Harmful if swallowed.)
	R41	(Risk of serious damage to eyes.)
EC Safety Phrases:	S1/2	(Keep locked up and out of reach of children.)
	S3	(Keep in a cool place.)
	S17	(Keep away from combustible material.)
	S26	(In case of contact with eyes, rinse immediately with plenty of water and seek medical advice)
	S28	(After contact with skin, wash immediately with plenty of water and soap.)
	S36/37/39	(Wear suitable protective clothing, gloves and eye/face protection.)
	S45	(In case of accident or if you feel unwell, seek medical advice immediately - show the label where possible.)

16. OTHER INFORMATION

HMIS

Health	1
Flammability	0
Physical Hazard	1
Personal Protection (PPE)	H

Protection = H (Safety goggles, gloves, apron, the use of a supplied air or SCBA respirator is required in lieu of a vapor cartridge respirator)

HMIS = Hazardous Materials Identification System

Degree of Hazard Code:
4 = Severe
3 = Serious
2 = Moderate
1 = Slight
0 = Minimal

NFPA

Health	1
Flammability	0
Reactivity	1
Special	OX

SPECIAL = OX (Oxidizer)

NFPA = National Fire Protection Association

Degree of Hazard Code:
4 = Extreme

3 = High
2 = Moderate
1 = Slight
0 = Insignificant

REVISION SUMMARY:
This MSDS replaces Revision #5, dated February 02, 2004.
Changes in information are as follows:
Section 3 (Composition / Information on Ingredients)
Section 15 (Regulatory Information)
Section 16 (Other Information)

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APPENDIX C

HEALTH AND SAFETY PLAN