

FINAL PILOT TEST WORK PLAN 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**



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On behalf of Atlantic Richfield Company, a BP affiliate (BP), URS Corporation (URS) has prepared this Pilot Test Work Plan (PTWP) 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 is to provide planning, implementation and performance monitoring details for pilot testing of in-situ chemical oxidation (ISCO) of site related constituents in groundwater. The pilot test will be conducted using sodium persulfate and hydrogen peroxide. Specifics about the products, the technology and how it will be implemented are discussed in this workplan. In addition, the workplan provides performance monitoring details and schedule for evaluating this technology. This pilot test is being conducted primarily to treat chloroethane in groundwater at the western property boundary of the Site.

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. The purpose of the proposed pilot test is to determine the effectiveness of the ISCO under field conditions and gather design and implementation related data for full-scale application. This technology has already been utilized to successfully address soils in the area of the 1,1,1-trichloroethane (TCA) spill in OU-1.

1.1 BACKGROUND INFORMATION

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.

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 was 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 clay and 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.

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 (ft bgs). 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

1.1.5.1 Soil

The scope of this pilot test is limited to groundwater treatment downgradient of the source area soils. Contaminant assessment in soil is discussed in a separate workplan 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*). The data discussed below is also discussed in the RIR and the OU-1 Supplemental RIR and/or is presented in Tables 1 and 2.

1.1.5.2 Groundwater

During the Delaware Engineering RI, three rounds of groundwater samples were collected from Site monitoring wells: January 1999, April 2000, and May 2003. The groundwater data were compared to the NYSDEC Groundwater Quality Standards (GWQS). URS collected additional rounds of groundwater samples in June 2004, April 2005 and June 2006. Samples were analyzed for VOCs and biofeasibility parameters. Since the completion of the Supplemental Remedial Investigation, numerous rounds of groundwater samples have been collected from wells MW-97-1S and MW-98-9D during the two pilot tests conducted to date

(Section 1.3). CA is the daughter product of TCA degradation and is the only spill-related compound found at the downgradient site boundary at levels exceeding the GWS. A cross-section showing chloroethane concentrations along the east side of Hanse Avenue is presented as Figure 3

Shallow Wells

Shallow well MW-1S, located in the spill area, was sampled four times in 2009 as part of the ISCO program for OU-1 soils. Compounds detected in excess of its GWQS during the most recent sampling event (March 2010) include TCA, 1,1-dichloroethane (DCA), 1,1-dichloroethene (DCE) and CA. During previous sampling events, 1,2-DCA, methylene chloride and vinyl chloride were also detected at levels exceeding the GWQS.

Away from the immediate vicinity of the spill, the number of compounds positively detected in shallow wells and their concentrations have decreased dramatically since investigations started. TCA and its immediate daughter product, DCA were not detected in any shallow wells away from the spill area. CA was detected in shallow wells in the spill area and along the southern Site boundary at concentrations exceeding the GWS. Well MW-97-1S, located at the western site boundary, has been sampled several times since 2008 as a part of previous pilot tests conducted in this area. During five sampling events between September 2009 and March 2010, CA was detected in MW-97-1S at concentrations ranging from 54 µg/l to 250 µg/l. CA was not detected along the northern Site boundary. No VOCs were detected east of the spill area in well MW-98-8S during the most recent sampling event.

Deep Wells

Data is available on-site for five deep wells (base of the gravelly sand) in Operable Unit 1. In the spill area, deep well MW-1D-97 was sampled several times as part of the performance monitoring for the OU-1 Soil ISCO program. Compounds detected in excess of its GWQS during the most recent sampling event include TCA, DCA, DCE, CA and toluene. Prior to the ISCO injections, only TCA and CA were detected at levels exceeding the GWQS.

When last sampled in 2006, east of the spill area, CA was detected over its GWQS at 38 µg/l in well MW-98-8D. In the southeast corner of the Site (MW-00-12D) CA (1,300 µg/l), DCA (11 µg/l) and DCE (5.8 µg/l) were detected at concentrations exceeding their respective GWQS.

In the southwest corners of the Site deep well MW-98-9D has also been sampled several times since 2008 as apart of previous pilot tests conducted in this area. During five sampling events between September 2009 and March 2010, CA was detected in MW-98-9D at concentrations ranging from 330 µg/l to 3,000 µg/l. During the same sampling events, chlorobenzene was detected at concentrations ranging from 4.2 µg/l to 8.5 µg/l.

In the northwest corner of the Site in well MW-97-10D, chlorobenzene has not been detected since May 2003, but chlorobenzene was detected at a concentration of 15 µg/l in 2009. Well MW-00-11A in the spill area is screened in the gray sand underlying the gray clay and silt unit. In samples collected from this well in 2004 and 2006, no VOCs were detected above the laboratory detection limits. These data suggest that the gray sand underlying the gray clay and silt has not been impacted by the TCA spill or other previous site activities.

1.1.5.3 Contaminant Assessment Conclusions

- TCA is currently not present at concentrations exceeding GWS in any Site wells 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.
- Under typical groundwater conditions, TCA will breakdown sequentially to DCA, CA, then to harmless ethane, and eventually carbon dioxide.
- 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 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 in both the shallow and deep wells in the gravelly sand.

1.2 BENCH-SCALE TREATABILITY TESTING

Based upon review of data from soil and groundwater sampling described above, selected technologies were further evaluated by bench scale treatability testing. These technologies include in-situ chemical oxidation (ISCO) to treat residual soil contamination in the source area and enhanced anaerobic bioremediation and enhanced aerobic bioremediation to treat the downgradient groundwater VOC plume. The bench scale test results and other recent site data were utilized in completing the updated FS and allowed for evaluation of updated remedial options including enhanced and natural degradation to address residual contamination associated with the TCA spill. The bench-scale treatability testing for ISCO and enhanced anaerobic bioremediation was performed by Adventus Americas, Inc. (Adventus), under subcontract to URS. A detailed description of the bench-scale testing and the results is presented in URS' report *Supplemental Remedial Investigation, Former*

Columbia Cement Company Facility, Freeport, New York, submitted to NYSDEC on December 21, 2006. The enhanced aerobic bioremediation study was performed by TerraSystems, Inc. to investigate the utility of aerobic enhanced bioremediation to treat the downgradient groundwater VOC plume.

In the Enhanced Anaerobic Bioremediation Treatability Study, the amendments HRC® and EHC® were evaluated for treatment of groundwater by promoting reductive dechlorination of CA. The test concluded that HRC® and EHC® amended columns did not show increased CA removal compared to the sterile and non-sterile control columns after 107 days. Therefore, the organic substrate amendments did not provide significant enhancements over the control columns. Consequently, anaerobic bioremediation using these amendments was rejected as being not feasible.

The In-Situ Bioremediation Treatability Study was conducted to evaluate enhanced anaerobic and aerobic enhanced bioremediation to treat chlorinated ethanes in OU-1. The results of the study indicated that addition of either lactate or SRS yields almost complete conversion of TCA to CA within 4 weeks, but neither substrate yielded significant conversion of CA to ethane. Consequently, anaerobic bioremediation was rejected as not being feasible.

Aerobic bench-scale studies evaluated microcosms amended with oxygen and nutrients. The results of the studies indicate that the combination of aerobic treatment and volatilization yielded 96% removal of all VOCs in the aqueous phase, including CA. It was unclear what fraction of the removal was due to volatilization. The studies suggest aerobic treatment by addition of oxygen should effectively treat the CA produced as a result of anaerobic degradation of TCA observed at the site.

1.3 SUMMARY OF PREVIOUS PILOT TESTS

1.3.1 Enhanced Aerobic Bioremediation Pilot Test

On the basis of bench-test results, a pilot test was conducted to enhance the degradation of CA under aerobic conditions using an oxygen-release product called EHC-O®. EHC-O® is a solid peroxide (calcium peroxide) that is designed to release oxygen over a period of 9 to 12 months. The 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-97-1S and MW-98-9D.

EHC-O® was injected to create a 34-ft wide reactive barrier, approximately 10 ft upgradient of the MW-97-1S / MW-98-9D well couplet. Approximately 800 lb of EHC-O® or 500 gallons of 20% by wt. slurry was injected in 3 points spaced 8 to 10 ft apart over a saturated zone interval of 26 ft (from 10 to 36 ft bgs). The estimated radius of influence of each injection point was 10 feet. The EHC-O® slurry was injected in the test area at targeted

vertical depths using diaphragm pumps and direct push GeoProbe equipment. The injection tip was advanced to the target depth (36 ft bgs) followed by injection of the calculated amount of the EHC-O slurry in 2-ft vertical intervals to 10-ft bgs. The amount of EHC-O® injected was expected to release 116 lbs of oxygen over a period of 9 months to facilitate aerobic biodegradation of chloroethane.

Monitoring wells MW-97-1S and MW-98-9D were sampled for VOCs, pH, dissolved oxygen (DO), redox potential (ORP), and dissolved iron at intervals of 1-month, 3-months and 5-months after injection of EHC-O for performance evaluation. Table 1 summarizes the baseline and performance monitoring data. The results show that some reduction in concentrations of CA was observed after 1 month but the 3-month and 5-month samples show no further reduction of CA in the shallow well, and an increase in CA concentrations in the deep well to pre-injection concentrations. The ORP increased as expected after the first month but decreased back to pre-injection levels in subsequent sampling rounds. The DO levels did not increase significantly as was expected. Even in the first post-injection sampling round, the highest DO level recorded was 1.3 ppm. The following conclusions were drawn from these results:

1. Aerobic biodegradation of CA is possible under site-specific conditions as seen partially in the shallow monitoring well.
2. Due to the highly reduced conditions in the soil and groundwater beneath the site (attributed to the former use of the site as a municipal landfill and the presence of peat); there is a large demand for DO from reduced minerals and other organic matter.
3. These reduced metals and organic matter will preferentially scavenge the DO and limit its availability to enhance the aerobic degradation of CA.
4. A slow-release oxygen delivery system will not be able to maintain DO levels above 2 ppm on a consistent basis in such a highly reduced environment to promote the aerobic degradation of CA.

Based on the above results, a combined in-situ chemical oxidation (ISCO) and enhanced bioremediation approach was recommended. The ISCO step was expected to satisfy the chemical oxygen demand and oxidize the reduced matter as well as the chloroethane. The subsequent enhanced aerobic bioremediation will then have a higher probability to degrade chloroethane. This approach is discussed further in the next section.

1.3.2 Combined Enhanced Bioremediation and In-Situ Chemical Oxidation Pilot Test

Based on the results of the EAB Pilot Test, BP proposed a second pilot test utilizing Klozur-CR, a combination of ISCO (with sodium persulfate) and EAB (with calcium peroxide). The ISCO component would oxidize the organic matter and reduced metals, reducing the oxygen demand of the aquifer. More of the oxygen released by the calcium peroxide would then be available for aerobic biodegradation of chloroethane in the groundwater. Klozur-CR has sodium persulfate as the oxidant which was used in the OU-1 soils to treat the contaminants of concern. The sodium persulfate is activated to form the persulfate free radical chemistry at a high pH with calcium peroxide (PermeOx Plus). The PermeOx Plus hydrates and releases molecular oxygen as well as creates a pH of 10 or higher. At this high pH, the sodium persulfate is activated to form persulfate radicals. The molecular oxygen released from PermeOx is then theoretically available to support the aerobic degradation of chloroethane. A bench scale test was not conducted prior to this second pilot test.

The Pilot Test injections were conducted on September 3 and 4, 2009 at the same location as the EAB Pilot Test. Klozur-CR (a powder) was mixed with water to create a 25% solids slurry and injected into 3 borings. The total amount of slurry injected was 600 gallons (200 gallons per location). The Klozur-CR slurry was injected using a diaphragm pump. Two-inch diameter drill rods with an expendable point were then advanced to a depth of 36 ft bgs with a Geoprobe® 6610 DT direct push rig. The injection tip was then raised 2 feet to expose the injection interval. Approximately 15.3 gallons of slurry was injected into the two-foot interval. After completing the injection, the injection tip was retracted another 2 ft and the procedure was repeated until the entire targeted vertical zone (36 ft bgs to 10 ft bgs) was treated.

Caution was used during injections, and injection pressures were monitored to reduce the potential for “daylighting” of the amendments. During all drilling and injection activities, air monitoring was conducted in accordance with the site-specific Community Air Monitoring Plan (CAMP).

The results of the baseline and post-injection laboratory analyses for Klozur-CR are presented in Table 2. In the baseline sample in MW-97-1S, the only compound detected above the GWQS was chloroethane, which was detected at 87 µg/l. Post-injection samples were collected on October 15 and November 17, 2009 and February 16 and March 3, 2010. The CA concentration decreased slightly to 54 µg/l in October 2009, but rebounded to 250 µg/l by February 2010, and was detected at 100 µg/l in March 2010.

In the baseline sample in MW-98-9D, chloroethane (3,000 µg/l) and chlorobenzene (8.5 µg/l) were detected at concentrations exceeding the GWQS. During the October 15, 2009 sampling event, the chloroethane concentration decreased to 330 µg/l. During this sampling event, the chlorobenzene concentration decreased from 8.6 µg/l to 4.2 µg/l. However, the

CA concentration increased to 880 µg/l in November 2009, to 2,900 µg/l in February 2010 and was detected at 970 µg/l in March 2010. During these sampling events, chlorobenzene concentrations ranged from 4.2 µg/l to 7.0 µg/l. Field parameter measurements also showed an initial decrease in DO concentration and ORP, followed by a rebound to pre-injection levels.

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.

The conclusions from the pilot tests are:

- The injection of an oxygen release amendment, consisting of calcium peroxide, produced a short-lived reduction in CA concentrations and ORP. However, CA concentrations and ORP rebounded rapidly. The amendment was not able to yield a DO level above 1.31 mg/l, when a DO level in excess of 5 mg/l is desired for optimum aerobic bioremediation. The injection of a combined slow release oxygen product and ISCO amendment also yielded short-term success, but could not sustain elevated DO levels.
- These results are due to the large oxygen demand of the aquifer materials, including landfill debris and tidal marsh deposits. Because of the highly anaerobic nature of the aquifer, most of the oxygen released was consumed by chemical processes and was not available for biological processes. This excessive oxygen demand makes enhanced aerobic bioremediation not feasible in this setting.
- ISCO was successful at reducing VOC levels in soils in the OU-1 spill area. The ISCO treatment also yielded reduced VOC levels in OU-1 spill area groundwater.

These conclusions suggest the course of action outlined in Section Two, which presents a plan to conduct a pilot test using ISCO to treat OU-1 Groundwater.

A pilot test will be conducted to evaluate the effectiveness of In-Situ Chemical Oxidation (ISCO) to treat Site groundwater along the western Site boundary. If successful, the ISCO treatment may be repeated and/or expanded to reduce or eliminate the CA migrating from the Site. The pilot test will be conducted in the driveway near wells MW-97-1S and MW-98-9D and in the loading dock area at the southwest corner of OU-1. The pilot test area is shown on Figure 2. The pilot test will consist of the following steps:

- Safety evaluation;
- Installation of monitoring wells and injection points;
- Baseline Sampling;
- ISCO Injections;
- Post-Injection Sampling.

2.1 GENERAL

The Site Health and Safety Plan will be updated to address the activities to be performed, including drilling, 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. The CAMP includes a program to monitor air for VOCs and particulates at the downwind boundary of the exclusion zone during all intrusive work. The CAMP is presented as Appendix A.

Prior to the initiation of all ground intrusive work, a utility markout will be conducted by notifying the public one-call system at least 72 hours before the start of work. Also, a private utility locating firm will be retained to confirm utility locations and to clear the areas where intrusive work is to occur. In addition, each boring will be cleared to a depth of 6.5 feet either by hand augering or air knifing.

2.2 SAFETY EVALUATION

Prior to the start of field activities, URS will conduct a thorough evaluation of safety measures to be implemented during the ISCO Pilot Test. The Pilot Test will involve the use of hazardous materials in the front of the property facing Hanse Avenue, near vehicular and pedestrian traffic. URS will employ a robust safety program to protect the public as well as Site workers during the injection program. The safety evaluation will consider traffic control and procedures to establish the exclusion zone, site security, material handling and injection procedures and incident management. No work will be performed if it can not be performed in a way that protects the public and Site workers from hazards related to the ISCO program.

2.3 SITE PREPARATION AND INSTALLATION OF MONITORING WELLS AND INJECTION POINTS

To facilitate potential repeat injections, semi-permanent injection points will be installed for the pilot test in the driveway and in the loading dock. In addition, two monitoring well couplets will be installed in the loading dock area to evaluate the effectiveness of the injections. Prior to installation, an underground utility survey will be conducted to determine if there are any underground structures, utilities, trenches, etc., that can affect the injection. In addition, each monitoring well/injection point will be cleared by air knife to a depth of 6.5 feet below grade. Figure 4 shows the locations of ISCO injection points and monitoring wells. A cross-section of the pilot test area is presented as Figure 5.

2.3.1 Monitoring Wells

To monitor groundwater conditions prior to and after the injections, two monitoring well couplets will be installed in the loading dock area. Wells will be installed using hollow stem auger methods. At each well couplet, continuous soil samples will be collected from the deep boring from 6.5 fbg to the clay unit interface. Soils will be screened with a calibrated photoionization detector (PID) and logged by a URS geologist.

The wells will be constructed of 2-inch ID, Schedule 40 PVC screen and riser pipe with a threaded bottom cap. The screens will be 10 feet in length with No. 10 slot (0.010 inch). The screen intervals in each couplet will generally match that of wells MW-97-1S and MW-98-9D. The shallow wells will be screened from 10 to 20 feet below grade (fbg) and the deep wells will be screened from approximately 25 to 35 fbg. The base of the deeper monitoring wells will be on top of the clay unit. In each well a sand pack will be placed in the annular space from the bottom of the well to 1 foot above the top of the well screen. A bentonite seal will be placed above the sand pack. The seal will be at least 2 feet thick. A cement-bentonite grout will be placed from the top of the bentonite seal to approximately 3 feet below grade. Each well will be finished with a flush-mount steel cover set in concrete, and a water-tight locking cap. After installation, each well will be developed by purging with a submersible pump until visibly clear of sediment. The monitoring wells will be surveyed by a licensed land surveyor.

2.3.2 Injection Points

Five injection point clusters will be installed in the driveway near wells MW-97-1S and MW-98-9D (three clusters upgradient and two clusters downgradient) and twelve clusters will be installed in the loading dock area. As shown on Figure 5, the injection points will be installed in clusters of 3. In each cluster, injection points will be installed with screen intervals at three different depths: 15 fbg to 21 fbg; 23 fbg to 29 fbg; and 30 fbg to 35 fbg.

The injection points will be placed at multiple depths to ensure proper vertical distribution of the ISCO amendments. The screen interval depths are relative to the ground surface in the driveway. As the loading dock ground surface drops below the driveway level, the depths of the injection points in the loading dock area will be adjusted accordingly. The ISCO Pilot Test design proposes a total of 51 injection points. Table 3 provides a list of injection points and the targeted vertical intervals. The injection points will be spaced assuming a 10-foot radius of influence (ROI), similar to the spacing used for the OU-1 Soil ISCO treatment.

The injection points will be constructed of 1-inch PVC with a 5-ft PVC screened interval. A sand pack will be placed around the screened interval and a bentonite seal will be placed above the sand pack. A cement-bentonite grout will be placed from the top of the bentonite seal to approximately 3 feet below grade. The injection points will be capped to prevent any short-circuiting of oxidants during injections. This injection method was used successfully during the OU-1 Soil ISCO program.

2.4 BASELINE SAMPLING

During monitoring well installation, soil samples will be collected from the deeper boring in each well couplet. Two soil samples will be collected from each boring. One sample will be collected from the shallow (10 fbg to 20 fbg) and deep (25 fbg to 35 fbg) interval in each boring. Sample depths will be biased toward the interval exhibiting the greatest evidence of contamination (PID readings, staining, odors, etc.). If no evidence of impact is observed, the sample will be collected from the approximate midpoint of the interval. Soil samples will be analyzed for VOCs and soil oxidant demand which will be used to calculate the proper dosage of ISCO amendments that should be applied to address the soil oxidant demand, as well as the groundwater VOCs treatment.

During injection point installation, one grab groundwater sample will be collected in the loading dock area from the upper 5 feet of the saturated zone. The sample will be analyzed for VOCs. If significant VOC impacts are detected, a shallow monitoring well may be installed screened across the water table to a depth of 5 feet below the water table. If installed, the monitoring well will be incorporated into the post-injection monitoring program.

Prior to injections, baseline groundwater samples will be collected from monitoring wells MW-97-1S, MW-98-9D and the four newly installed monitoring wells in the loading dock area. Groundwater samples will be collected using low-flow methods. Samples will be analyzed for VOCs, total organic carbon (TOC), sulfate, sulfide, methane, ethane and ethene. Field parameters, including temperature, pH, DO, ORP, specific conductance and turbidity will be monitored during purging and sampling.

2.5 PROPOSED OXIDANT INJECTION VOLUMES

Table 4 shows the amount of activated sodium persulfate (ASP) oxidant and the activation agent (hydrogen peroxide) that will be injected during the ISCO Pilot Test. Material Safety Data Sheets (MSDSs) for sodium persulfate and hydrogen peroxide are provided in Appendix B. Based on the distribution of groundwater total VOCs in samples collected in the pilot test area, two application rates of the oxidant are proposed. A higher application rate is proposed for deeper intervals where CA concentrations greater than 500 µg/l have been observed. A lower application rate is proposed for the shallower interval where CA concentrations are generally less than 500 µg/l. These application rates are the same as those used for the OU-1 Soil ISCO treatment in the TCA spill area. Similar to the spill area, it is assumed that most of the oxidant demand will come from the soils (landfill debris and peat), and not the VOCs. The effective ASP concentration will be 29 g/L and 59 g/L in groundwater at the low and high application rates, respectively. The application rates may be adjusted based on the results of the baseline sampling

A total of fifty-one (51) injection points (17 shallow, 17 intermediate and 17 deep) will be used to inject the oxidants. Approximately 300 gallons of solution will be injected per point for the low ASP application rate and 400 gallons per point for the high ASP application rate. A total of 24,466 lb of ASP will be injected as a solution with 18,597 gallons of 8% hydrogen peroxide.

2.6 INJECTION PROCEDURE

Upon receipt of workplan approval from NYSDEC and NYSDOH, BP will submit to USEPA Region 2 an application for an Underground Injection Control Permit. The application will be a revision to the permit granted for the pilot test (UICID: 08NY05903011). Injections will not proceed until authorization from USEPA is granted.

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.

2.7 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 and other VOCs may be liberated with the carbon dioxide. In addition to the CAMP monitoring, to assess vapor generation, BP will conduct vapor monitoring in selected soil gas points during the 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 Enhanced Bioremediation and ISCO Pilot Test. Vapors will also be monitored in the storm drain located in the loading dock area and any other storm drains located along Hanse Avenue 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 and carbon dioxide. During the injection program, a reading will be taken at these 4 points at the start of each day prior to the start of injections. 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 any action levels, as described in the Health and Safety Plan, are detected in the breathing zone, the work will be halted and the Nassau County Health Department will be notified.

2.8 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 at weekly intervals following injection for the first month to ensure the materials are distributed and the in-situ reactions are proceeding as expected. The field parameters will include pH, temperature, specific conductance, turbidity, ORP and DO. Samples for persulfate will be collected at the second weekly monitoring event and submitted for laboratory analysis. After one month, samples will be collected for VOCs, TOC, methane, ethane, ethene, sulfate, sulfide and persulfate. At six weeks following injections, field parameters will be monitored and samples will be collected and submitted to the laboratory for persulfate analysis. At two months following injections, samples will be collected for the same suite of parameters as the one-month sampling event.

After data from the two month samples is received, all of the data collected to date will be evaluated with NYSDEC to assess the effectiveness of the ISCO treatment and the potential need for additional injections. If VOC concentrations have decreased and persulfate is still present, monitoring will continue on a monthly basis. If VOC concentrations have decreased and little or no residual persulfate is present in groundwater, the data will be evaluated with respect to additional injections. If little or no persulfate is present in groundwater, and VOC concentrations have not decreased, BP and NYSDEC will evaluate whether the ISCO treatment is effective.

Confirmation soil samples will be collected after six months. A summary of the post-injection monitoring sampling program is presented in Table 5.

2.9 REPORTING

After completion of the post-injection sampling program, BP will prepare a Pilot Test Report for submittal to NYSDEC. The report will include a summary of the injection program, an 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. Status reports will be submitted after the injection and following each sampling event. Post-injection sampling data which may be raw, non-validated, draft results will be submitted to NYSDEC within 3 weeks of submittal of samples to the laboratory. If the data has not been validated at that point, the data will be marked as “Draft/Non-Validated Data” and may be subject to change after validation.

Site work will be conducted under a Community Air Monitoring Plan (CAMP) approved by NYSDOH. The CAMP includes a program to monitor air for VOCs and particulates during all intrusive work. The CAMP is presented as Appendix A. In addition to the pilot test drilling and injection program, the CAMP also addresses drilling and injections in the former UST area and sub-slab vapor testing and mitigation work inside the Site building. These activities will not be performed as part of this pilot test.

Because of known subsurface conditions and NYSDOH requirements, measures will be implemented during all Site intrusive activities to protect the health and safety of Site workers and the community. A site-specific Health and Safety Plan (HASP) has been prepared to address ongoing site activities. The HASP will be updated as necessary following the safety evaluation (Section 2.2) and will be submitted under separate cover. The updated HASP, will address the activities to be performed, including drilling, sampling, handling and injection of chemical amendments, and use of tools and mechanical devices.

Prior to the initiation of all ground intrusive work, a utility markout will be conducted by notifying the public one-call system at least 72 hours before the start of work. In addition, a private utility locating firm will be retained to confirm utility locations and to clear the areas where intrusive work is to occur. In addition, each boring will be cleared to a depth of 6.5 feet either by hand augering or air knifing.

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. The safety evaluation will take approximately one week. Following a utility markout, installation of the injection points will take 2 to 3 weeks. Mobilization and completion of the injection program will take approximately 4 to 5 weeks. The performance monitoring will continue for up to 6 months following the completion of the injection.

TABLES

TABLE 1
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
ENHANCED BIOREMEDIATION BASELINE / CONFIRMATION SAMPLING
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

URS SAMPLE ID LAB SAMPLE ID SAMPLE DEPTH (ft) DILUTION SAMPLE DATE UNITS	NYSDEC CLASS GA GROUNDWATER QUALITY STANDARD µg/l	MW-97-1S 5437591 10 - 20 1 8/7/08 µg/l	MW-97-1S 5485655 10 - 20 1 9/29/08 µg/l	MW-97-1S A8D99302 10 - 20 4 11/4/08 µg/l
VOLATILE ORGANIC COMPOUNDS				
Acetone	NE	6.0 U	6.0 U	40 U
Benzene	1	0.5 U	0.5 U	40 U
Bromodichloromethane	NE	1.0 U	1.0 U	40 U
Bromoform	NE	1.0 U	1.0 U	40 U
Bromomethane	NE	1.0 U	1.0 U	40 U
2-Butanone	NE	3.0 U	3.0 U	40 U
Carbon Disulfide	60	1.0 U	1.0 U	40 U
Carbon Tetrachloride	5	1.0 U	1.0 U	40 U
Chlorobenzene	5	2.9 J	2.6 J	3 J
Chloroethane	5	93	55	56 J
Chloroform	7	0.8 U	0.8 U	40 U
Chloromethane	5	1.0 U	1.0 U	40 U
Dibromochloromethane	NE	1.0 U	1.0 U	40 U
1,4-Dichlorobenzene	3	NR	NR	2 J
1,1-Dichloroethane	5	1.0 U	1.0 U	40 U
1,2-Dichloroethane	0.6	1.0 U	1.0 U	40 U
1,1-Dichloroethene	5	0.8 U	0.8 U	40 U
cis-1,2-Dichloroethene	5	0.8 U	0.8 U	40 U
trans-1,2-Dichloroethene	5	0.8 U	0.8 U	40 U
1,2-Dichloropropane	1	1.0 U	1.0 U	40 U
cis-1,3-Dichloropropene	0.4	1.0 U	1.0 U	40 U
trans-1,3-Dichloropropene	0.4	1.0 U	1.0 U	40 U
Ethylbenzene	5	0.8 U	0.8 U	40 U
2-Hexanone	NE	3.0 U	3.0 U	40 U
Isopropylbenzene	5	NR	NR	40 U
Methylene Chloride	5	2.0 U	2.0 U	3 BJ
4-Methyl-2-pentanone	NE	3.0 U	3.0 U	40 U
Styrene	5	1.0 U	1.0 U	40 U
1,1,2,2-Tetrachloroethane	5	1.0 U	1.0 U	40 U
Tetrachloroethene	5	0.8 U	0.8 U	40 U
Toluene	5	0.7 U	0.7 U	40 U
1,1,1-Trichloroethane	5	0.8 U	0.8 U	40 U
1,1,2-Trichloroethane	1	0.8 U	0.8 U	40 U
Trichloroethene	5	1.0 U	1.0 U	40 U
Vinyl Chloride	2	1.0 U	1.0 U	40 U
Xylene (Total)	5	0.8 U	0.8 U	40 U
TOTAL TARGET VOCS	NE	95.9 J	57.6 J	58 J
Dissolved Gasses				
Methane	NE	21,000	24,000	NR
Ethane	NE	75	40	NR
Ethene	NE	1.0 U	1.0 U	NR
General Chemistry				
Iron (mg/l)	300	3.16	1.82	NR
Sulfate (mg/l)	250000	9.9	NS	NR
Sulfide (mg/l)	NE	0.53 U	NS	NR
Total Organic Carbon (mg/l)	NE	11.8	NS	NR
FIELD PARAMETERS				
pH	NE	6.36	6.91	6.39
Dissolved Oxygen	NE	0.00	1.31	0.05
Redox Potential	NE	-100	96	-174

TABLE 1
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
ENHANCED BIOREMEDIATION BASELINE / CONFIRMATION SAMPLING
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

URS SAMPLE ID LAB SAMPLE ID SAMPLE DEPTH (ft) DILUTION SAMPLE DATE UNITS	NYSDEC CLASS GA GROUNDWATER QUALITY STANDARD µg/l	MW-98-9D 5437589 25 - 35 1/5 8/7/08 µg/l	DUP08070 5437593 25 - 35 1/5 8/7/08 µg/l	MW-98-9D 5485654 25 - 35 1/5 9/29/08 µg/l	DUP09290 5485656 25 - 35 1/5 9/29/08 µg/l	MW-98-9D A8D99301 25 - 35 4 11/4/08 µg/l
VOLATILE ORGANIC COMPOUNDS						
Acetone	NE	6.0 U	6.0 U	9.5 J	10 J	40 U
Benzene	1	0.62 J	0.63 J	0.5 U	0.5 U	40 U
Bromodichloromethane	NE	1.0 U	1.0 U	1.0 U	1.0 U	40 U
Bromoform	NE	1.0 U	1.0 U	1.0 U	1.0 U	40 U
Bromomethane	NE	1.0 U	1.0 U	1.0 U	1.0 U	40 U
2-Butanone	NE	3.0 U	3.0 U	3.0 U	3.0 U	40 U
Carbon Disulfide	60	1.0 U	1.0 U	1.0 U	1.0 U	40 U
Carbon Tetrachloride	5	1.0 U	1.0 U	1.0 U	1.0 U	40 U
Chlorobenzene	5	7.5	7.6	5.3	4.8 J	8.0 J
Chloroethane	5	620 D	620 D	360 D	350 D	880 D
Chloroform	7	0.8 U	0.8 U	0.8 U	0.8 U	40 U
Chloromethane	5	1.0 U	1.0 U	1.0 U	1.0 U	40 U
Dibromochloromethane	NE	1.0 U	1.0 U	1.0 U	1.0 U	40 U
1,4-Dichlorobenzene	3	NR	NR	NR	NR	4.0 J
1,1-Dichloroethane	5	1.0 U	1.0 U	1.0 U	1.0 U	40 U
1,2-Dichloroethane	0.6	1.0 U	1.0 U	1.0 U	1.0 U	40 U
1,1-Dichloroethene	5	0.8 U	0.8 U	0.8 U	0.8 U	40 U
cis-1,2-Dichloroethene	5	0.8 U	0.8 U	0.8 U	0.8 U	1 J
trans-1,2-Dichloroethene	5	0.8 U	0.8 U	0.8 U	0.8 U	40 U
1,2-Dichloropropane	1	1.0 U	1.0 U	1.0 U	1.0 U	40 U
cis-1,3-Dichloropropene	0.4	1.0 U	1.0 U	1.0 U	1.0 U	40 U
trans-1,3-Dichloropropene	0.4	1.0 U	1.0 U	1.0 U	1.0 U	40 U
Ethylbenzene	5	0.8 U	0.8 U	0.8 U	0.8 U	40 U
2-Hexanone	NE	3.0 U	3.0 U	3.0 U	3.0 U	40 U
Isopropylbenzene	5	NR	NR	NR	NR	1.0 J
Methylene Chloride	5	2.0 U	2.0 U	2.0 U	2.0 U	5.0 BJ
4-Methyl-2-pentanone	NE	3.0 U	3.0 U	3.0 U	3.0 U	40 U
Styrene	5	1.0 U	1.0 U	1.0 U	1.0 U	40 U
1,1,2,2-Tetrachloroethane	5	1.0 U	1.0 U	1.0 U	1.0 U	40 U
Tetrachloroethene	5	0.8 U	0.8 U	0.8 U	0.8 U	40 U
Toluene	5	0.7 U	0.7 U	0.7 U	0.7 U	40 U
1,1,1-Trichloroethane	5	0.8 U	0.8 U	0.8 U	0.8 U	40 U
1,1,2-Trichloroethane	1	0.8 U	0.8 U	0.8 U	0.8 U	40 U
Trichloroethene	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 J
Vinyl Chloride	2	1.0 U	1.0 U	1.0 U	1.0 U	40 U
Xylene (Total)	5	3.6 J	3.5 J	1.6 J	1.4 J	4.0 J
TOTAL TARGET VOCS	NE	631.72 J	631.73 J	376.4 J	366.2 J	899
Displved Gasses						
Methane	NE	6,300	7,600	9,900	16,000	NR
Ethane	NE	120	240	220	210 J	NR
Ethene	NE	1.0 U	1.0 U	1.0 U	1.0 U	NR
General Chemistry						
Iron (mg/l)	300	7.06	8.63	0.0839 J	0.0826 J	NR
Sulfate (mg/l)	250000	3.5 J	1.5 U	NS	NS	NR
Sulfide (mg/l)	NE	0.53 U	0.53 U	NS	NS	NR
Total Organic Carbon (mg/l)	NE	11.2	11.5	NS	NS	NR
FIELD PARAMETERS						
pH	NE	6.30	NA	7.23	NA	6.51
Dissolved Oxygen	NE	1.29	NA	0.26	NA	0.00
Redox Potential	NE	-112	NA	92	NA	-210

TABLE 2
LABORATORY ANALYTICAL RESULTS
KLOZUR-CR GROUNDWATER 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 CLASS GA GROUNDWATER QUALITY STANDARD µg/l	MW-97-1S RSI0098-04 10 - 20 1 9/1/09 µg/l	MW-97-1S RSJ1036-02 10 - 20 5 10/15/09 µg/l	MW-97-1S RSK0905-02 10 - 20 1 11/17/09 µg/l	MW-97-1S RTB0715-01 10 - 20 1 / 2 2/16/10 µg/l	MW-97-1S RTC0511-01 10 - 20 1 3/3/10 µg/l	MW-97-1S RTC0511-02 10 - 20 1 3/3/10 µg/l
Volatile Organic Compounds							
1,1,1-Trichloroethane	5	0.66 U	3.2 U	0.66 U	0.66 U	0.66 U	0.66 U
1,1,2,2-Tetrachloroethane	5	0.64 U	3.2 U	0.64 U	0.64 U	0.64 U	0.64 U
1,1,2-Trichloroethane	1	0.53 U	2.7 U	0.53 U	0.53 U	0.53 U	0.53 U
1,1,2-Trichlorotrifluoroethane	NE	0.65 U	3.2 U	0.65 U	0.65 U	0.65 U	0.65 U
1,1-Dichloroethane	5	0.31 U	1.6 U	0.31 U	0.31 U	0.31 U	0.31 U
1,1-Dichloroethene	5	0.44 U	2.2 U	0.44 U	0.44 U	0.44 U	0.44 U
1,2,4-Trichlorobenzene	NE	0.57 U	2.9 U	0.57 U	0.57 U	0.57 U	0.57 U
1,2-Dibromo-3-chloropropane	NE	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dibromoethane (EDB)	NE	0.25 U	1.2 U	0.25 U	0.25 U	0.25 U	0.25 U
1,2-Dichlorobenzene	NE	0.38 U	1.9 U	0.38 U	0.38 U	0.38 U	0.38 U
1,2-Dichloroethane	0.6	0.83 U	4.2 U	0.83 U	0.83 U	0.83 U	0.83 U
1,2-Dichloropropane	1	0.33 U	1.6 U	0.33 U	0.33 U	0.33 U	0.33 U
1,3-Dichlorobenzene	NE	0.29 U	1.5 U	0.29 U	0.29 U	0.29 U	0.29 U
1,4-Dichlorobenzene	NE	1.4 J	1.3 U	0.86 J	1.20 J	1.50 J	1.50 J
2-Butanone (MEK)	50	0.31 U	1.6 U	0.31 U	2.5 U	2.5 U	2.5 U
2-Hexanone	50	0.14 U	0.70 U	0.14 U	0.14 U	0.14 U	0.14 U
4-Methyl-2-pentanone (MIBK)	NE	0.45 U	2.3 U	0.45 U	0.45 U	0.45 U	0.45 U
Acetone	50	0.64 U	3.2 U	0.64 U	0.64 U	0.64 U	0.64 U
Benzene	1	0.54 U	2.7 U	0.54 U	0.54 U	0.54 U	0.54 U
Bromodichloromethane	5	0.64 U	3.2 U	0.64 U	0.64 U	0.64 U	0.64 U
Bromoform	5	0.30 U	1.5 U	0.30 U	0.30 U	0.30 U	0.30 U
Bromomethane	5	0.61 U	3.1 U	0.61 U	0.61 U	0.61 U	0.61 U
Carbon disulfide	NE	0.33 U	2.6 U	1.10 J	0.33 U	0.33 U	0.33 U
Carbon Tetrachloride	5	0.30 U	1.5 U	0.30 U	0.30 U	0.30 U	0.30 U
Chlorobenzene	5	2.9 J	3.4 U	3.5 J	3.3 J	3.1 J	3.2 J
Chlorodibromomethane	5	0.29 U	1.4 U	0.29 U	0.29 U	0.29 U	0.29 U
Chloroethane	5	87	54	68	250 D	98	100
Chloroform	7	0.79 U	4.0 U	0.79 U	0.79 U	0.79 U	0.79 U
Chloromethane	5	0.72 U	3.6 U	0.72 U	0.72 U	0.72 U	0.72 U
cis-1,2-Dichloroethene	NE	0.34 U	1.7 U	0.34 U	0.34 U	0.34 U	0.34 U
cis-1,3-Dichloropropene	0.4	0.21 U	1.1 U	0.21 U	0.21 U	0.21 U	0.21 U
Cyclohexane	NE	1.1 J	2.9 U	0.59 U	0.59 U	0.59 U	0.59 U
Dichlorodifluoromethane	NE	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U
Ethylbenzene	5	0.32 U	1.6 U	0.32 U	0.32 U	0.32 U	0.32 U
Isopropylbenzene	NE	1.2 J	1.9 U	0.37 U	0.37 U	0.37 U	0.37 U
Methyl Acetate	NE	0.66 U	3.3 U	0.66 U	0.66 U	0.66 U	0.66 U
Methyl tert-Butyl Ether	NE	0.46 U	2.3 U	0.46 U	0.46 U	0.46 U	0.46 U
Methylcyclohexane	NE	0.71 J	3.0 U	0.59 U	0.59 U	0.76 U	0.75 U
Methylene Chloride	5	0.46 U	2.3 U	0.46 U	0.46 U	0.46 U	0.46 U
Styrene	5	0.28 U	1.4 U	0.28 U	0.28 U	0.28 U	0.28 U
Tetrachloroethene	5	0.35 U	1.7 U	0.35 U	0.35 U	0.35 U	0.35 U
Toluene	5	0.31 U	1.5 U	0.31 U	0.31 U	0.31 U	0.31 U
trans-1,2-Dichloroethene	NE	0.43 U	2.1 U	0.43 U	0.43 U	0.43 U	0.43 U
trans-1,3-Dichloropropene	0.4	0.29 U	1.5 U	0.29 U	0.29 U	0.29 U	0.29 U
Trichloroethene	5	0.62 U	3.1 U	0.62 U	0.62 U	0.62 U	0.62 U
Trichlorofluoromethane	NE	0.39 U	2.0 U	0.39 U	0.39 U	0.39 U	0.39 U
Vinyl chloride	2	0.76 U	3.8 U	0.76 U	0.76 U	0.76 U	0.76 U
Xylenes, total	5	0.82 U	4.1 U	0.82 U	0.82 U	0.82 U	0.82 U
TOTAL TARGET VOCs	NE	94.31	60	73.46	254.5 D	103.36	105.45 D
Dissolved Gasses							
Ethane	NE	180 U	360 U	NA	NA	NA	NA
Ethene	NE	150 U	300 U	NA	NA	NA	NA
Methane	NE	12000	9800	NA	NA	NA	NA
General Chemistry							
TOC (mg/l)	NE	9.9	NA	NA	NA	NA	NA
Iron (Dissolved)	NE	37.1	NA	NA	NA	NA	NA
Sulfate (mg/l)	NE	1.49 U	102	274	79.6	125	132
Sulfide (mg/l)	NE	0.7 U	0.1	0.7 U	1.0 U	1.0 U	1.0 U

TABLE 2
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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 CLASS GA GROUNDWATER QUALITY STANDARD µg/l	MW-98-9D RSI0098-03 25 - 35 1 9/1/09 µg/l	MW-98-9D RSJ1036-01 25 - 35 5 10/15/09 µg/l	MW-98-9D RSK0905-01 25 - 35 1 11/17/09 µg/l	DUP111709 RSK0905-03 25 - 35 1 11/17/09 µg/l	MW-98-9D RTB0715-02 25 - 35 1 / 25 2/16/10 µg/l	DUP021610 RTB0715-03 25 - 35 1 / 25 2/16/10 µg/l	MW-98-9D RTC-0511-03 25 - 35 5 / 10 3/3/10 µg/l
Volatile Organic Compounds								
1,1,1-Trichloroethane	5	0.66 U	3.2 U	0.66 U	0.66 U	0.66 U	0.66 U	3.3 U
1,1,2,2-Tetrachloroethane	5	0.64 U	3.2 U	0.64 U	0.64 U	0.64 U	0.64 U	3.2 U
1,1,2-Trichloroethane	1	0.53 U	2.7 U	0.53 U	0.53 U	0.53 U	0.53 U	2.7 U
1,1,2-Trichlorotrifluoroethane	NE	0.65 U	3.2 U	0.65 U	0.65 U	0.65 U	0.65 U	3.2 U
1,1-Dichloroethane	5	0.31 U	1.6 U	0.31 U	0.31 U	0.31 U	0.31 U	1.6 U
1,1-Dichloroethene	5	0.44 U	2.2 U	0.44 U	0.44 U	0.44 U	0.44 U	2.2 U
1,2,4-Trichlorobenzene	NE	0.57 U	2.9 U	0.57 U	0.57 U	0.57 U	0.57 U	2.9 U
1,2-Dibromo-3-chloropropane	NE	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U
1,2-Dibromoethane (EDB)	NE	0.25 U	1.2 U	0.25 U	0.25 U	0.25 U	0.25 U	1.2 U
1,2-Dichlorobenzene	NE	0.38 U	1.9 U	0.38 U	0.38 U	0.38 U	0.38 U	1.9 U
1,2-Dichloroethane	0.6	0.83 U	4.2 U	0.83 U	0.83 U	0.83 U	0.83 U	4.2 U
1,2-Dichloropropane	1	0.33 U	1.6 U	0.33 U	0.33 U	0.33 U	0.33 U	1.6 U
1,3-Dichlorobenzene	NE	0.29 U	1.5 U	0.29 U	0.29 U	0.29 U	0.29 U	1.5 U
1,4-Dichlorobenzene	NE	4.8 J	1.3 U	1.90 J	2.10 J	3.5 J	3.7 J	3.6 J
2-Butanone (MEK)	50	0.31 U	1.6 U	0.31 U	0.31 U	2.5 U	0.31 U	12 U
2-Hexanone	50	0.14 U	0.70 U	0.14 U	0.14 U	0.14 U	0.14 U	0.70 U
4-Methyl-2-pentanone (MIBK)	NE	0.45 U	2.3 U	0.45 U	0.45 U	0.45 U	0.45 U	2.3 U
Acetone	50	1.0 J	3.2 U	0.64 U	0.64 U	0.64 U	0.64 U	3.2 U
Benzene	1	0.61 J	2.7 U	0.54 U	0.54 U	0.58 J	0.57 J	2.7 J
Bromodichloromethane	5	0.64 U	3.2 U	0.64 U	0.64 U	0.64 U	0.64 U	3.2 U
Bromoform	5	0.30 U	1.5 U	0.30 U	0.30 U	0.30 U	0.30 U	1.5 U
Bromomethane	5	0.61 U	3.1 U	0.61 U	0.61 U	0.61 U	0.61 U	3.1 U
Carbon disulfide	NE	0.33 U	2.6	1.5 J	1.5 J	1.5 U	1.5 U	1.6 U
Carbon Tetrachloride	5	0.30 U	1.5 U	0.30 U	0.30 U	0.30 U	0.30 U	1.5 U
Chlorobenzene	5	8.5 J	4.2	6.0 J	6.7 J	7.0 J	7.0 J	6.3 J
Chlorodibromomethane	5	0.29 U	1.4 U	0.29 U	0.29 U	0.29 U	0.29 U	1.4 U
Chloroethane	5	3000 D	330	880 D	850 D	2900 D	2600 D	970 D
Chloroform	7	0.79 U	4.0 U	0.79 U	0.79 U	0.79 U	0.79 U	4.0 U
Chloromethane	5	0.72 U	3.6 U	0.72 U	0.72 U	0.72 U	0.72 U	3.6 U
cis-1,2-Dichloroethene	NE	0.34 U	1.7 U	0.34 U	0.34 U	0.34 U	0.34 U	1.7 U
cis-1,3-Dichloropropene	0.4	0.21 U	1.1 U	0.21 U	0.21 U	0.21 U	0.21 U	1.1 U
Cyclohexane	NE	1.1 J	2.9 U	0.59 U	0.59 U	0.76 J	0.77 J	2.9 J
Dichlorodifluoromethane	NE	0.50 U	2.5 U	0.50 U	0.50 U	0.50 U	0.50 U	2.5 U
Ethylbenzene	5	0.32 U	1.6 U	0.32 U	0.32 U	0.32 U	0.32 U	1.6 U
Isopropylbenzene	NE	1.2 J	1.9 U	0.37 U	0.37 U	0.78 J	0.84 J	1.9 U
Methyl Acetate	NE	0.66 U	3.3 U	0.66 U	0.66 U	0.66 U	0.66 U	3.3 U
Methyl tert-Butyl Ether	NE	0.46 U	2.3 U	0.46 U	0.46 U	0.46 U	0.46 U	2.3 U
Methylcyclohexane	NE	0.83 J	3.0 U	0.59 U	0.59 U	0.59 U	0.59 U	3.0 U
Methylene Chloride	5	0.46 U	2.3 U	0.46 U	0.46 U	0.46 U	0.46 U	2.3 U
Styrene	5	0.28 U	1.4 U	0.28 U	0.28 U	0.28 U	0.28 U	1.4 U
Tetrachloroethene	5	0.35 U	1.7 U	0.35 U	0.35 U	0.35 U	0.35 U	1.7 U
Toluene	5	0.31 U	1.5 U	0.31 U	0.31 U	0.31 U	0.31 U	1.5 U
trans-1,2-Dichloroethene	NE	0.43 U	2.1 U	0.43 U	0.43 U	0.43 U	0.43 U	2.1 U
trans-1,3-Dichloropropene	0.4	0.29 U	1.5 U	0.29 U	0.29 U	0.29 U	0.29 U	1.5 U
Trichloroethene	5	0.62 U	3.1 U	0.62 U	0.62 U	0.62 U	0.62 U	3.1 U
Trichlorofluoromethane	NE	0.39 U	2.0 U	0.39 U	0.39 U	0.39 U	0.39 U	2.0 U
Vinyl chloride	2	0.76 U	3.8 U	0.76 U	0.76 U	0.76 U	0.76 U	3.8 U
Xylenes, total	5	4.8 J	4.1 U	3.3 U	3.4 U	3.0 J	3.0 J	4.1 U
TOTAL TARGET VOCS	NE	3022.84	336.8	892.7	863.7	2915.62 D	2615.88 D	979.9
Dissolved Gasses								
Ethane	NE	180 U	180 U	NA	NA	NA	NA	NA
Ethene	NE	150 U	150 U	NA	NA	NA	NA	NA
Methane	NE	11000	8300	NA	NA	NA	NA	NA
General Chemistry								
TOC (mg/l)	NE	10.0	NA	NA	NA	NA	NA	NA
Iron (Dissolved)	NE	34.6	NA	NA	NA	NA	NA	NA
Sulfate (mg/l)	NE	1.49 U	433	443	449	160	197	1.0
Sulfide (mg/l)	NE	0.7 U	0.02	0.7 U	0.7 U	1.0 U	1.0 U	1.0 U

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

Injection Points					
Shallow Screened Interval		Intermediate Screened Interval		Deep Screened Interval	
IP #	(ft bgs)	IP #	(ft bgs)	IP #	(ft bgs)
IP-1S	15 to 21	IP-1I	22 to 28	IP-1D	29 to 35
IP-2S	15 to 21	IP-2I	22 to 28	IP-2D	29 to 35
IP-3S	15 to 21	IP-3I	22 to 28	IP-3D	29 to 35
IP-4S	15 to 21	IP-4I	22 to 28	IP-4D	29 to 35
IP-5S	15 to 21	IP-5I	22 to 28	IP-5D	29 to 35
IP-6S	15 to 21	IP-6I	22 to 28	IP-6D	29 to 35
IP-7S	15 to 21	IP-7I	22 to 28	IP-7D	29 to 35
IP-8S	15 to 21	IP-8I	22 to 28	IP-8D	29 to 35
IP-9S	15 to 21	IP-9I	22 to 28	IP-9D	29 to 35
IP-10S	15 to 21	IP-10I	22 to 28	IP-10D	29 to 35
IP-11S	15 to 21	IP-11I	22 to 28	IP-11D	29 to 35
IP-12S	15 to 21	IP-12I	22 to 28	IP-12D	29 to 35
IP-13S	15 to 21	IP-13I	22 to 28	IP-13D	29 to 35
IP-14S	15 to 21	IP-14I	22 to 28	IP-14D	29 to 35
IP-15S	15 to 21	IP-15I	22 to 28	IP-15D	29 to 35
IP-16S	15 to 21	IP-16I	22 to 28	IP-16D	29 to 35
IP-17S	15 to 21	IP-17I	22 to 28	IP-17D	29 to 35

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

For 8% Hydrogen Peroxide, 5:1 molar ratio of peroxide to persulfate, and SOD of 10 g persulfate per kg of soil									
	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
Shallow Points	IP-1S to IP-17S	15 to 21	17	288	206	2,570	301	4,893	5,116
Total			17	288	206	2,570	301	4,893	5,116

For 8% Hydrogen Peroxide and 7:1 molar ratio of peroxide to persulfate, and SOD of 20 g persulfate per kg of soil									
	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	22 to 28	17	576	576	3,386	397	9,786	6,741
Deep Points	IP-1D to IP-17D	29 to 35	17	576	576	3,386	397	9,786	6,741
Total			34	1,151	1,151	6,773	793	19,573	13,482

Grand Total								24,466	18,597
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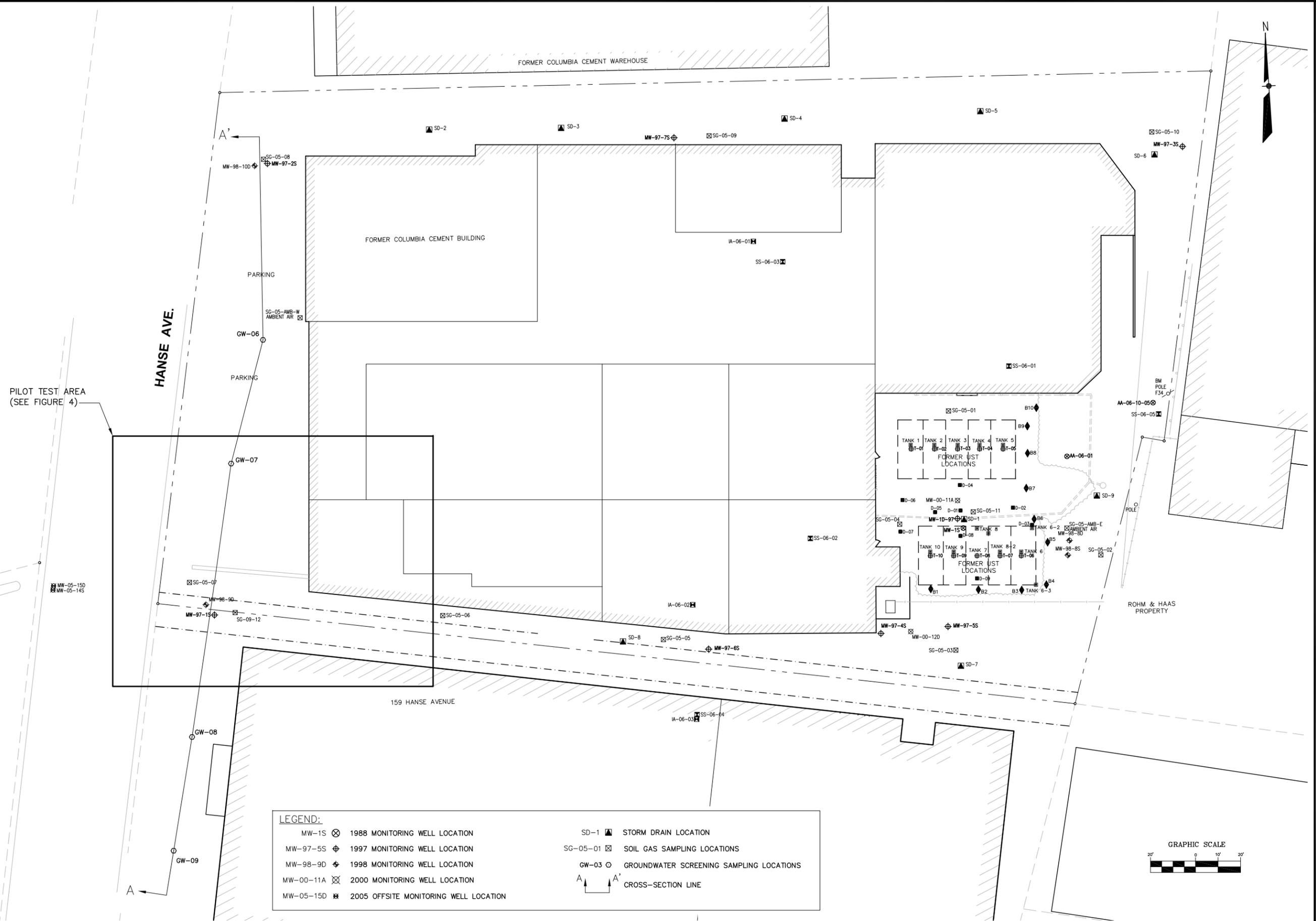
TABLE 5
SUMMARY OF PERFORMANCE MONITORING PROGRAM
IN-SITU CHEMICAL OXIDATION PILOT TEST
OPERABLE UNIT No. 1 GROUNDWATER
FORMER COLUMBIA CEMENT COMPANY FACILITY
FREEPORT, NEW YORK

MATRIX	SAMPLE SCHEDULE	SAMPLE LOCATION(S)	SAMPLE METHOD	ANALYTICAL PARAMETERS
SOIL	Before Injections	OW-2 (shallow)	Split Spoon / Macro-core	VOCs, Soil oxidant demand
		OW-2 (deep)	Split Spoon / Macro-core	VOCs, Soil oxidant demand
		OW-4 (shallow)	Split Spoon / Macro-core	VOCs, Soil oxidant demand
		OW-4 (deep)	Split Spoon / Macro-core	VOCs, Soil oxidant demand
	6 Month After Injections	OW-2 (shallow)	Split Spoon / Macro-core	VOCs
		OW-2 (deep)	Split Spoon / Macro-core	VOCs
		OW-4 (shallow)	Split Spoon / Macro-core	VOCs
		OW-4 (deep)	Split Spoon / Macro-core	VOCs
GROUNDWATER	Before Injections	MW-97-1S	Low flow	VOCs, TOC, Sulfate, Sulfide, MEE, Field Parameters
		MW-98-9D	Low flow	VOCs, TOC, Sulfate, Sulfide, MEE, Field Parameters
		OW-1	Low flow	VOCs, TOC, Sulfate, Sulfide, MEE, Field Parameters
		OW-2	Low flow	VOCs, TOC, Sulfate, Sulfide, MEE, Field Parameters
		OW-3	Low flow	VOCs, TOC, Sulfate, Sulfide, MEE, Field Parameters
	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
	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
	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
	1 Month After Injections	MW-97-1S	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		MW-98-9D	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-1	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-2	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-3	Low flow	VOCs, TOC, Sulfate, Sulfide, 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
	2 Months After Injections	MW-97-1S	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		MW-98-9D	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-1	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-2	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-3	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
	3 Months After Injections	MW-97-1S	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		MW-98-9D	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-1	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-2	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-3	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
	4 Month After Injections*	MW-97-1S	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		MW-98-9D	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-1	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-2	Low flow	VOCs, TOC, Sulfate, Sulfide, Persulfate, MEE, Field Parameters
		OW-3	Low flow	VOCs, TOC, Sulfate, Sulfide, 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 necessary.

FIGURES

K:\Cadd\Columbia Cement\11130272(Columbia Cement)\UNIT No2(2008)\30272022-FIGURE2.dwg, 4/29/2010 9:41:06 AM



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	GW-03 ○	GROUNDWATER SCREENING SAMPLING LOCATIONS
MW-00-11A ⊗	2000 MONITORING WELL LOCATION	A-A'	CROSS-SECTION LINE
MW-05-15D ⊗	2005 OFFSITE MONITORING WELL LOCATION		

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

Atlantic Richfield Company
(A BP Affiliated Company)



Issue Date: 04/20/05

Revisions		
No.	Date	Description

Project Description

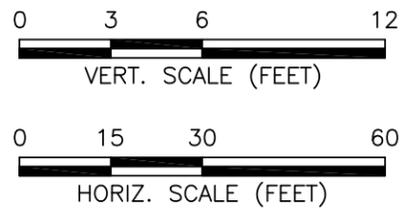
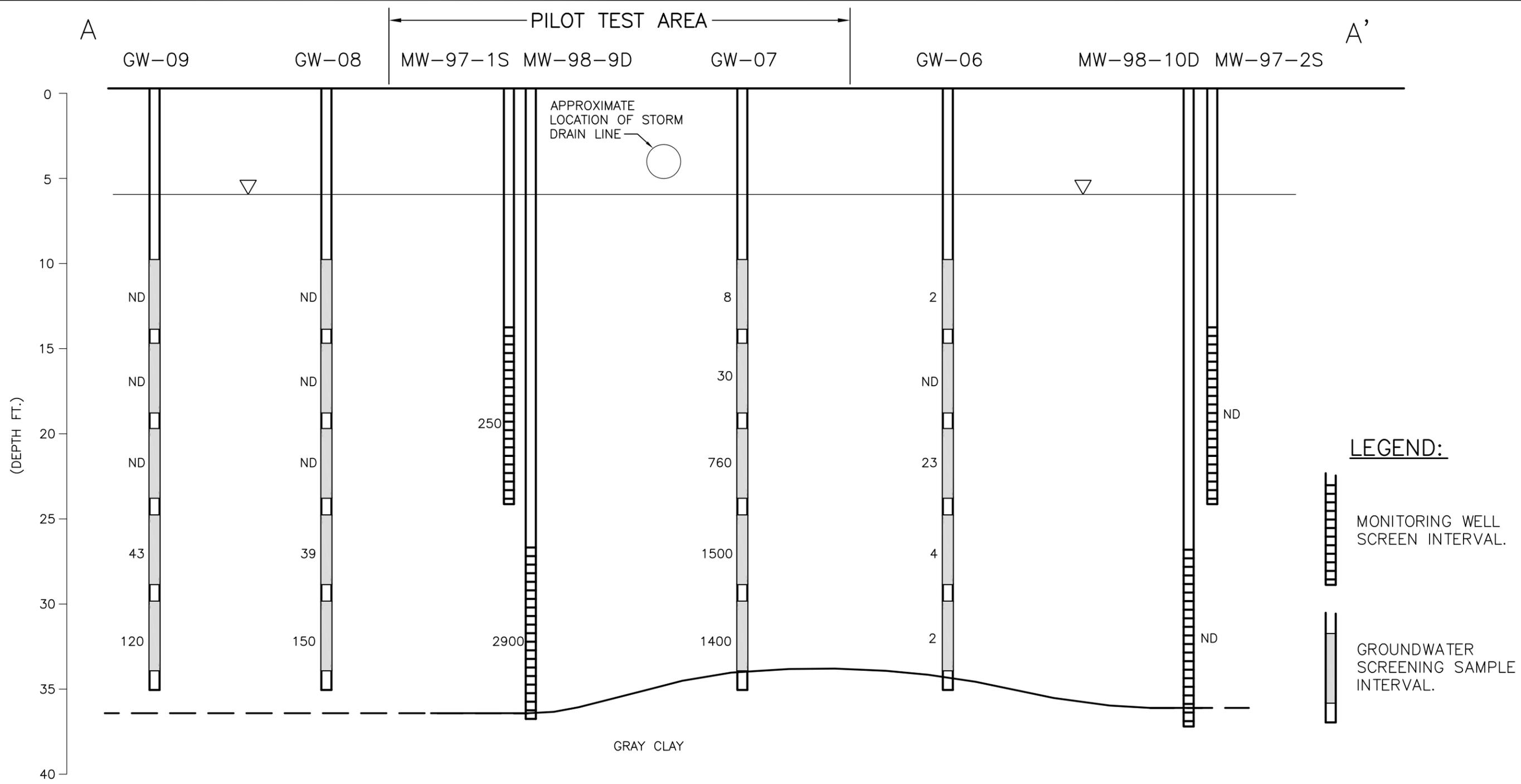
Former Columbia Cement Company, Inc.
159 Hanse Avenue
Freeport, New York

Sheet Title:

SITE PLAN

Drawn By:	E.T.	04/16/10
Checked By:	M.B.	04/16/10
Scale:	AS SHOWN	
Project Number:	11130274	
Sheet Number:	FIGURE 2	

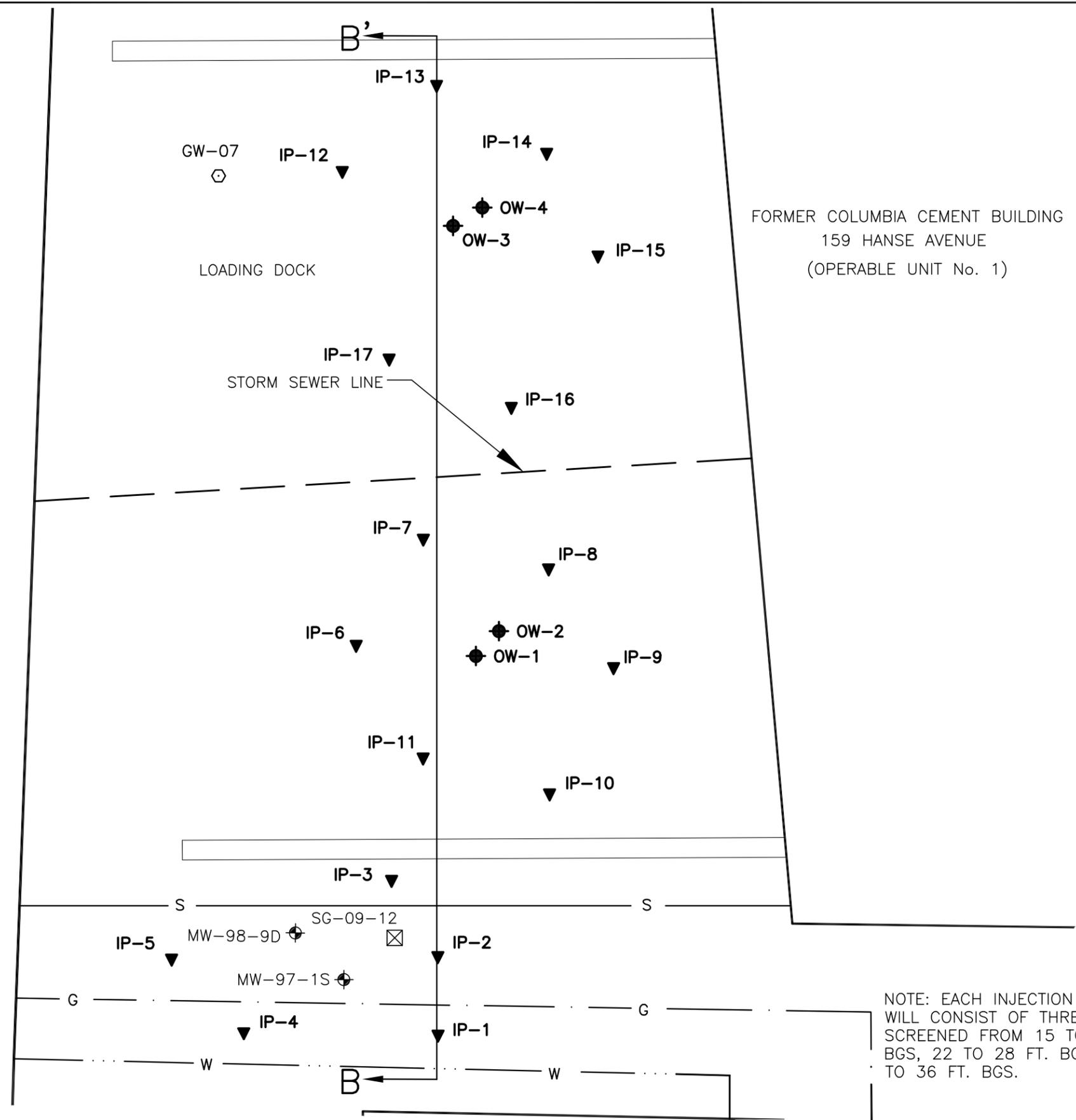
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CHLOROETHANE ALONG CROSS-SECTION A-A'					
OPERABLE UNIT NO. 2					
FORMER COLUMBIA CEMENT COMPANY, INC.					
FREEPORT, NEW YORK					
URS					
WAYNE, NEW JERSEY					
DR. BY	KM	SCALE	AS SHOWN	DWG. NO.	30272023
CK'D. BY	MB	DATE	APRIL 28, 2010	FIG. NO.	3
PROJ. NO.			11130274		

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HANSE AVE.

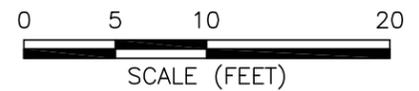


FORMER COLUMBIA CEMENT BUILDING
159 HANSE AVENUE
(OPERABLE UNIT No. 1)



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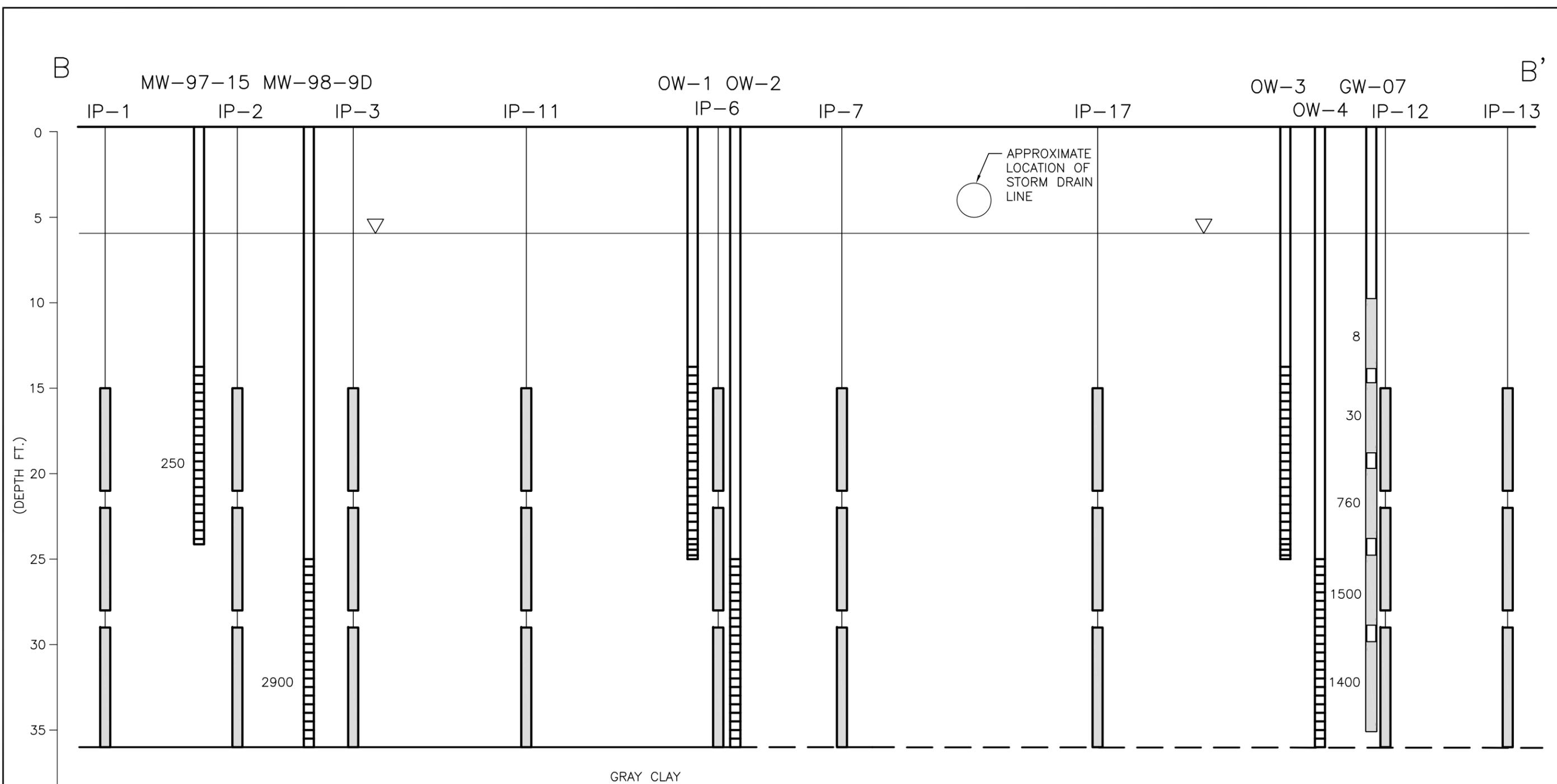
- PROPOSED MONITORING WELL
- ▼ PROPOSED INJECTION CLUSTER
- MW-05-14S ● MONITORING WELL
- GW-03 ⊕ GROUNDWATER SCREENING LOCATION
- SG-09-12 ⊠ SOIL GAS SAMPLING LOCATION
- B B' CROSS-SECTION LINE



NOTE: EACH INJECTION CLUSTER WILL CONSIST OF THREE POINTS SCREENED FROM 15 TO 21 FT. BGS, 22 TO 28 FT. BGS AND 29 TO 36 FT. BGS.

PROPOSED ISCO INJECTION LAYOUT FORMER COLUMBIA CEMENT COMPANY, INC. 159 HANSE AVENUE FREEPORT, NEW YORK			
URS WAYNE, NEW JERSEY			
DR. BY	LH	SCALE	1"=20'
CK'D. BY	MB	DATE	APRIL 12, 2010
DWG. NO.		30272020	
PROJ. NO.		11130274	
FIG. NO.		4	

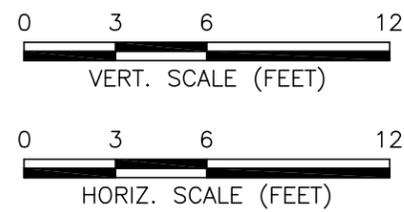
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LEGEND:

- 
 MONITORING WELL SCREEN INTERVAL.
- 
 GROUNDWATER SCREENING SAMPLE INTERVAL.
- 
 INJECTION POINT SCREEN INTERVAL.

MOST RECENT CHLOROETHANE CONCENTRATION (ug/L) 



PROPOSED ISCO INJECTION LAYOUT
 ALONG CROSS-SECTION B-B'
 OPERABLE UNIT NO. 2
 FORMER COLUMBIA CEMENT COMPANY, INC.
 FREEPORT, NEW YORK

URS
 WAYNE, NEW JERSEY

DR. BY	KM	SCALE	AS SHOWN	DWG. NO. 30272021	PROJ. NO. 11130274
CK'D. BY	MB	DATE	FEBRUARY 26, 2010	FIG. NO.	5

APPENDIX A

COMMUNITY AIR MONITORING PLAN

COMMUNITY AIR MONITORING PLAN

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 Feasibility 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 do 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

3.1 GROUND INTRUSIVE ACTIVITIES

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, injection of amendments and drilling or cutting the building slab to install sub-slab vapor testing or extraction points. Specifically, anticipated situations where continuous monitoring will be required are described below:

- All anticipated soil treatment activities will take place in the southeast portion of the Site, in and around the former UST area. These activities will include pilot testing and full-scale implementation of in-situ chemical oxidation, as well as baseline and confirmatory soil sampling. During these activities, the work area/exclusion zone will be delineated by barricades, traffic cones and caution tape. Continuous monitoring for VOCs and methane will be performed in the work area near the drill rig and injection equipment. During ISCO injections, oxygen will also be monitored in the work area. Oxygen levels will also be monitored periodically at the storm drain basins to check for short-circuiting. In addition, continuous VOC and particulate 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.
- Groundwater pilot testing and treatment will consist of a series of injections near the southwest corner of the Site. The injections will occur in the driveway on the south side of the Site building and in the loading dock area. During these activities, the work area/exclusion zone will be delineated by barricades, traffic cones and caution tape. Continuous monitoring for VOCs, methane and oxygen will be performed in the work area near the drill rig and injection equipment. In addition, continuous VOC and particulate 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.
- The sub-slab vapor testing and mitigation work will take place inside the Site building. The building is currently vacant. During ground intrusive work, continuous monitoring for VOCs will be performed in the work area near the drilling equipment. In addition, periodic VOC and particulate monitoring will be performed at the nearest open exterior doorway. Readings will be recorded in a CAMP Log Book.

3.2 NON-INTRUSIVE WORK

Periodic monitoring for VOCs will be required during non-intrusive 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 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 the windsock in the rear of the adjacent Rohm & Haas facility. 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. 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 shutdown.

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.

3.4 PARTICULATE MONITORING, RESPONSE LEVELS, AND ACTIONS

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 $150 \text{ mcg}/\text{m}^3$ 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 $150 \text{ mcg}/\text{m}^3$ 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 $150 \text{ mcg}/\text{m}^3$ 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.

3.5 METHANE AND OXYGEN MONITORING, RESPONSE LEVELS, AND ACTIONS

Methane concentrations will be monitored **continuously** near the drill rig and injection equipment. The monitoring work will be performed using a landfill gas meter, or other appropriate equipment. Oxygen levels will be monitored in the work zone during the ISCO injection with the same 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 exceeds 5%, work will be stopped and a re-evaluation of activities initiated. Work may continue only after the methane concentration falls below 5%.

- If the oxygen concentration in the work area breathing zone exceeds 25%, work will be stopped and a re-evaluation of activities initiated. Work may continue only after the oxygen concentration falls below 25%.

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 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 ₂ O=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.

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 LD₅₀: > 10 g/kg [FMC Study Number: ICG/T-79.029]

ORAL LD₅₀: 895 mg/kg (rat) [FMC Study Number: ICG/T-79.029]

INHALATION LC₅₀: 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 LC₅₀ = 771 mg/L [FMC Study I92-1250]
Rainbow trout, 96-hour LC₅₀ = 163 mg/L [FMC Study I92-1251]
Daphnia, 48-hour LC₅₀ = 133 mg/L [FMC Study I92-1252]
Grass shrimp, 96-hour LC₅₀ = 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.

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)

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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.

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 ₂ O % by wt) Above 1

SPECIFIC GRAVITY:	(H ₂ O=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 LD₅₀: 35% hydrogen peroxide: > 2,000 mg/kg (rabbit) [FMC Study Number: I83-746]

ORAL LD₅₀: 10% hydrogen peroxide: > 5,000 mg/kg (rat) [FMC Study Number: I89-1077]

INHALATION LC₅₀: 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 H₂O₂ 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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