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FORMER MILLER BREWING COMPANY CONTAINER PLANT SITE

TOWN OF VOLNEY, NEW YORK

PILOT STUDY WORK PLAN
For
ENHANCED ANAEROBIC BIODEGRADATION

prepared for:

Miller Brewing Company

submitted by:

URS Corporation

September 2004

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PART I - WORK PLAN

1.0 INTRODUCTION

This work plan presents details of a pilot study that will be conducted at the former Miller Brewing Company (MBCo) Container Plant site located in the Town of Volney, Oswego County, New York (Figure 1). The plan was developed by URS Corporation (URS) in coordination with MBCo and presents a program to evaluate the effectiveness of enhanced anaerobic biodegradation achieved through injections of a suitable food-grade, carbon-based solution as a remedial technology to treat site groundwater contaminated by tetrachloroethylene (a.k.a. perchloroethylene (PCE)) and 1,1,1-trichloroethane (TCA). This work plan includes a monitoring and sampling program to evaluate the effectiveness of the injections. A site-specific Health and Safety Plan (HASP) is being prepared under separate cover. All work at the site will be performed in close coordination with MBCo and the current site owner, Crysteel Manufacturing, Inc. (Crysteel).

Key personnel involved in the project are listed below:

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2.0 SITE BACKGROUND

The former MBCo site is located in the Town of Volney, Oswego County, New York, approximately 1,200 feet southeast of the municipal boundary for the City of Fulton, New York (Figures 1 and 2). The City of Fulton's municipal water supply well field and the Oswego River are located approximately 1,000 feet west of the project site.

Historical manufacturing activities at this site have resulted in groundwater becoming contaminated primarily with the two (2) chlorinated volatile organic compounds (VOCs): PCE and TCA. Leaks were detected in a spill containment tank (Figure 2), constructed at the facility in 1976, during its excavation and removal in the spring of 1986. Relatively high concentrations of chlorinated VOCs were found in soil and groundwater samples collected in the vicinity of this tank. MBCo notified the New York State Department of Environmental Conservation (NYSDEC) and hired an engineering firm to conduct a hydrogeologic investigation of the area.

As a result of several subsurface investigations, which determined that this contamination had impacted the City of Fulton's municipal water supply wells located to the west and downgradient of the site, a groundwater pump and treat system with three (3) recovery wells (RW-1, RW-2, RW-3; Figure 2)) was installed. This system initiated operations on June 27, 1988.

In January 1990, underground storage tanks (USTs) were discovered on the Taylor property, which is located adjacent to the former MBCo site along County Route 57. These tanks were removed in May 1990. Lab analysis of soil samples collected from beneath the tanks detected VOCs. A soil gas survey conducted during 1990 identified additional areas of potential contamination within the southern portion of the former MBCo site (see item #3 below). A site-wide remedial investigation (RI) was then initiated to determine the nature and extent of soil and groundwater contamination at the site. Four (4) sources of contamination were identified coinciding with locations where chlorinated solvents and, to a lesser extent, petroleum hydrocarbons were handled, used, and/or stored based on knowledge of past plant operations. These source areas included:

1. An area to the north of the northern parking lot where spent solvent drums were reportedly washed and stored.

2. The area surrounding, and downgradient of, the former spill containment tank on the north side of the former MBCo container building.
3. An area beneath the container building in the vicinity of the plant's wastewater treatment facility where four (4) leaking USTs were located.
4. An area of contamination extending from the eastern boundary of the Taylor property to the municipal well field.

MBCo initiated an Interim Remedial Measure (IRM) early in 1991 consisting of the construction of a groundwater treatment system designed to remove contaminants from groundwater produced by three (3) municipal production wells adjacent to the site. The system processes water from Municipal Well 2, Keller Well 2, and Keller Well 1 through an air stripper to remove VOCs prior to distribution. The system was constructed on City of Fulton property and began operation on June 10, 1992.

Based on the results of the RI and the original 1995 *Record of Decision (ROD)*, MBCo subsequently expanded the site's pump and treat system to contain the contaminant plume. The system includes a total of 13 groundwater recovery wells and a soil vapor extraction system (SVES) consisting of six (6) vent wells to contain the contaminant plume. The expanded system became operational on February 26, 1997.

Following implementation of the expanded remedial system, concerns were raised regarding its performance. Contaminant concentrations in several recovery wells flat-lined or increased suggesting limited system effectiveness and the probability the system would require many years of operation to provide containment of the on-site contaminants. Additionally, contaminants, primarily PCE and TCA, continued to impact the City of Fulton municipal wells. Also, the City of Fulton was concerned that the continued pumping by the remedial system would reduce the volume of water available to the municipal well field. Given the inherently low water production by the well field, they believed any impact would be significant.

To address these concerns MBCo requested that URS evaluate ways to enhance groundwater remediation at the site. In February 2003, URS prepared (on MBCo's behalf) a *ROD Change Documentation Report* proposing to change the selected remedy from pump and treat to a zero-valent iron permeable reactive barrier (PRB) system. Two PRBs were proposed, one located near the City of Fulton's water supply wells (PRB-1), and a second located just west of the former container plant (PRB-2). PRB-1 was to have been 130 feet long and 60 feet deep, containing a mixture of sand and iron with an effective iron thickness of five inches. PRB-2 was to be a funnel-and-gate type PRB 700 feet long and up to 75 feet deep. Four funnels would have been constructed of a low permeability soil/cement/bentonite (SCB) mixture to direct groundwater to three gates containing a mixture of sand and iron with an effective iron thickness of five inches.

A pilot study conducted at the site confirmed that zero-valent iron could effectively treat PCE and TCA. The pilot study iron was placed to about 80 feet below ground surface using a pressure jetting technique. The actual PRB walls were to be constructed using excavated trenches stabilized by a biopolymer slurry, while the funnel sections used a bentonite slurry.

In July 2003, the NYSDEC prepared an *Explanation of Significant Difference to the ROD* to inform the public of the change in the site remedy.

On October 6, 2003, URS began excavating the funnels for PRB-2 using an excavator with a two-foot-wide bucket capable of excavating to 82 feet below ground surface (ft bgs). In December 2003, after experiencing a number of construction difficulties, PRB construction was suspended due to worsening winter weather conditions and the need to repair stress cracks in the excavator's boom. When construction was halted, less than half of the funnels had been completed, with uncertain integrity at some locations. None of the gates had been completed.

On May 7, 2004, based on a recommendation from URS, MBCo notified the NYSDEC that the post-winter restart of PRB-2 construction had been postponed while URS evaluated the cause of the construction problems encountered the previous season. All equipment was removed from the site and restoration of the disturbed area around PRB-2 was completed on August 2, 2004.

On July 7, 2004, URS informed the NYSDEC that, upon re-evaluation, constructing the PRB was not practical and a revised approach was proposed. Two primary reasons were presented regarding the infeasibility of constructing the PRBs: (1) a limit on trench constructability due to unexpected subsurface conditions including increased depth to the underlying till as well as cobbles and boulders at depth and (2) a re-evaluation of groundwater velocities at depth affecting the effectiveness of the remedy as designed.

A more detailed evaluation of the constructability and effectiveness of the PRBs, as designed, was provided to the NYSDEC in a letter dated August 20, 2004.

3.0 ALTERNATIVE APPROACH AND OBJECTIVES

In light of the infeasibility of continuing PRB construction, URS re-examined various remedial alternatives. For this evaluation, the current extent of groundwater contamination was assumed to be the extent of PCE and TCA contamination as estimated in 2002 (Figure 3).

One technology stood out as being implementable under the difficult subsurface conditions, at a reasonable cost, and also more effective and adaptable than the currently approved remedy. That approach was enhanced anaerobic biodegradation achieved through injection of a suitable food-grade, carbon-based solution.

A version of this technology, utilizing hydrogen release compound (HRC®), was considered as early as 1999 during URS's evaluation of alternatives to the original pump and treat remedy. This was documented in URS's final report entitled, *ROD Change Documentation Report*, dated September 2003. Since 1999, the state of the art for this technology has advanced considerably; various raw food-grade solutions have been successfully injected to treat chlorinated hydrocarbons in groundwater and enriched, engineered food-grade solutions have been developed by several vendors for this application. These products cost significantly less than HRC® and can be injected into the aquifer more easily, making the technology more attractive today than it was in 1999.

3.1 Goal

The overall purpose of the proposed remedy is to create a zone of biological degradation that reduces the mass of contamination in-situ and reduces future impacts to the downgradient municipal water supply. The purpose of this pilot test is to demonstrate the effectiveness of the technology under site-specific conditions and to gather data (e.g., degradation products, duration of favorable conditions, and the size of the treatment zone created) necessary for designing a full-scale implementation plan.

3.2 Theory

Chlorinated compounds in groundwater such as PCE and TCA are known to biodegrade under anaerobic conditions. The proposed remedial solution for this site is to use an injectable carbon-based solution (i.e., molasses, sodium lactate, soybean oil, vegetable oil, or a combination of products) to create conditions in the aquifer that would foster a zone of enhanced anaerobic bacteria activity. The solution would also provide a source for electron donation to allow reductive de-chlorination of the contaminants to occur. This technology has been shown to be effective at a number of sites across the country.

3.3 Advantages

The application of enhanced anaerobic biodegradation has several advantages compared to fixed PRB technology. Because the solution is injected through conventional drilling and Geoprobe methods, its implementation is much easier and more adaptable to changing conditions than PRBs. Once the initial injection is accomplished, subsequent injections can be strategically relocated to attack the contamination as its pattern changes.

The injections can be targeted in the areas of the highest contaminant concentrations (in proximity to the original source areas), or they can be applied as a treatment barrier at the downgradient portion of the contamination. Also, supplements and enhancements (e.g., bioaugmentation with *dehalococcoides*, the only known cultivated organism capable of complete dehalogenation of PCE to ethene) can be added to subsequent injections to address changes in the suite of compounds present as the chlorinated hydrocarbons proceed through their degradation sequences (Figure 4).

Another advantage is that the effect of the enhancement (anaerobic conditions and electron donors) propagates through the aquifer away from the injections points, effectively creating a treatment zone larger than the initial injected area. Thus, it is not necessary to achieve direct contact with the contamination at the injection point to achieve the desired results.

3.4 Approach to Implementation

In order to effectively design the final full-scale plan, this pilot test has been conceived to be of sufficient scope to be representative of site-wide conditions. The actual site-wide injection configuration will be determined after the pilot-scale field test has been completed and evaluated. Additionally, different solutions will be tested to determine an effective mix for producing the optimum conditions for the reductive de-chlorination of PCE and TCA.

As indicated in Figure 4, PCE and TCA will break down and produce a series of degradation products. PCE's degradation sequence produces trichloroethene, then various dichloroethenes, then vinyl chloride, and finally ethylene, which then aerobically degrades to carbon dioxide and water. TCA's degradation sequence produces 1,1 -dichloroethane, then chloroethane, and finally ethane, which also aerobically degrades to carbon dioxide and water. While these degradation products, particularly vinyl chloride, are expected to be created and persist under anaerobic conditions, the pilot test will be conducted immediately adjacent to the plant over 1000 feet upgradient from the municipal water wells. These degradation products should be readily oxidized downgradient from the anaerobic reaction zone. Considering the proposed locations of the pilot test areas there is little risk to the municipal water wells from these compounds. However, if vinyl chloride is shown to persist, it can be addressed during full-scale implementation. Either a patented anaerobic bacteria that degrades vinyl chloride could be injected in the anaerobic treatment zone, or an oxygen releasing compound (ORC®) could be injected to degrade the vinyl chloride downgradient from the anaerobic treatment zone. If necessary, the pilot test can be expanded to evaluate such technologies.

3.5 Schedule

An eight (8) month pilot study will be performed to evaluate the effectiveness of the food-grade, carbon-based solution injection as a method to stimulate biological processes that result in the reductive de-chlorination of PCE and TCA in the saturated zone. URS will initiate the pilot study field work during the week of October 4, 2004 with the installation of new monitoring wells. Injection will be initiated beginning the week of October 18, 2004, with completion by the end of November 2004. Monitoring will continue through May 2005. Interim results will be provided to NYSDEC as they become available, and a draft report will be submitted in June/July 2005.

4.0 SCOPE OF THE PILOT STUDY

The food-grade, carbon-based solution injections will be conducted in two (2) separate areas, "North" and "South" (Figure 5). The North pilot test area will be subdivided into two (2) smaller parts, each measuring approximately 30 feet by 60 feet. The South area will measure approximately 72 feet by 72 feet. These locations were selected because they are situated in areas where measurable, significant results can be obtained. In these areas, the contaminant concentrations are relatively high (thus, contaminant mass reduction can be measured) and the hydraulic gradients are high relative to other locations on site (allowing for an evaluation of the migration of the treatment zone). The test zone will extend from the top of the water table surface, approximately 15 ft bgs, to the total depth of the saturated zone, which is approximately 55 ft bgs in these areas.

The following sequence of activities will be performed for the pilot test:

- Three (3) new monitoring wells will be installed downgradient of the South pilot test area and the MW-37 monitoring well triplet (Figure 5).
- Baseline groundwater sampling and analysis (Table 1) will be performed on 21 wells: MW-1D, MW-1S, MW-2D, MW-3D, MW-6D, MW-6I, MW-6S, MW-11D, MW-1 IS, MW-12D, MW-12S, MW-37D, MW-37I, MW-37S, MW-39D, MW-39S, MW-53D, MW-53S, MW-65D (new well), MW-65S (new well), and MW-66D (new well).
- Recovery wells RW-3 through RW-8 will be temporarily deactivated for the duration of the pilot test to prevent any influence on the migration of the injected solutions.
- A commercially prepared emulsified edible oil solution (EOS™) and/or sodium lactate (WILCLEAR™) will be injected first at 81 locations (at some locations only sodium lactate will be injected; at other locations both solutions will be injected, as is explained later in this document) in the South pilot test area (Figure 5).
- Following completion of the South area injection, a commercially prepared solution of molasses (66 Brix Wes Blend) will be injected at 26 locations in the each part of the North pilot test area (Figure 5). URS is currently researching some patent issues regarding the use and injection of molasses for this purpose. If URS is unable to address these issues satisfactorily, then it may not be possible to use molasses, and the North area pilot test would be abandoned.

- If URS is able to satisfactorily address the aforementioned patent issues, a single permanent injection point will be installed in the North area in which molasses will be re-injected periodically to assess the potential utility of such points during full implementation.
- A six-month performance-monitoring period will follow the injection(s). The 21 onsite wells originally sampled as part of the baseline monitoring will be sampled up to 4 times each (Table 2).
- Pilot study data will be analyzed and reports will be prepared (Section 5.0).

Proposed new monitoring well construction details and groundwater monitoring parameters are described in Section 6.0. Details of the food-grade, carbon-based solution injection process are presented in Section 7.0. Proposed required field operations are described in Section 8.0.

5.0 DATA ANALYSIS AND REPORTING

Five (5) monitoring events will be undertaken, one (1) prior to injection (baseline) and four (4) post-injection. Brief interim data reports will be prepared after the results of the first (30-day), second (60-day), and third (90-day) performance monitoring events are available. The interim reports will present summarized information on the food-grade, carbon-based solution injection and laboratory analytical data. A pilot test summary report will be prepared after results from the last performance monitoring event (180-day) are available. The summary report will present a discussion of the field activities and provide interpretations of the data. Supporting data and information will be included as outlined below.

Pilot Test Summary Report

Work Element	Supporting Data and Information
1. Drilling, Well Installation, and Baseline Monitoring	Subsurface boring logs Well construction diagrams Well development logs Well purging and sampling logs
2. Food-Grade, Carbon-Based Solution Injection	Production information Injection method Injection parameters (interval, amount, and pressure)
3. Performance Monitoring	Well purging and sampling logs Groundwater surface elevations Chemical analytical data Geochemical data (attenuation parameters)
4. Data Evaluation and Results	Temporal contaminant variations Geochemical and biological environments Decay rate constants (if available)
5. Conclusions and Recommendations	Satisfactory/unsatisfactory results Recommendation for monitoring, full-scale treatment

Groundwater analytical data will be evaluated to determine if PCE and TCA are undergoing reductive de-chlorination in the plume. The geochemical data will be evaluated to determine if the food-grade, carbon-based solution injection treatment is successful in creating a reducing environment within the plume.

PART II - FIELD PROGRAM

6.0 WELL INSTALLATION AND GROUNDWATER MONITORING

6.1 Well Installation

Three (3) groundwater-monitoring wells (MW-65D, MW-65S, MW-66D) will be installed at the locations shown on Figure 5. Well MW-65S will be drilled to a depth of approximately 25 ft bgs using a hollow-stem auger drill rig. Wells MW-65D and MW-66D will both be drilled to a depth of approximately 55 ft bgs. These depths were selected to be similar to the depths of other monitoring wells installed in the vicinity as well as to encompass both the top and bottom intervals of the saturated zone. Soil samples will be collected for visual characterization continuously to the completion depth of each borehole. The boreholes will be logged in accordance with Section 8.3.

Each well will be constructed to the following specifications:

- 2-inch inside diameter (ID) x 0.010-inch slotted schedule (sch) 40 polyvinyl chloride (PVC) well screen, installed from 25-10 ft bgs (MW-65S) and 55-45 ft bgs (MW-65D, MW-66D).
- 2-inch ID sch 40 PVC riser, installed with flush-threaded connections from 10 ft bgs to 2.5 feet above ground surface (ft ags) (MW-65S) and 45 ft bgs to 2.5 ft ags (MW-65D, MW-66D).
- Annular backfill consisting of compatible silica sand, installed from 25-8 ft bgs (MW-65S) and 55-43 ft bgs (MW-65D, MW-66D).
- Hydrated bentonite chips, installed from 8-6 ft bgs (MW-65S) and 43-41 ft bgs (MW-65D, MW-66D).
- Cement/bentonite slurry, installed from 6-1 ft bgs (MW-65S) and 41-1 ft bgs (MW-65D, MW-66D).
- Steel stand-pipe monitoring well manhole set in a concrete pad at ground surface extending to 3 ft ags, water tight, with vented lockable cap on the PVC riser pipe.

The new wells will be located and developed in accordance with procedures provided in Sections 8.4 and 8.5, respectively.

6.2 Groundwater Monitoring

One round of groundwater sampling and analysis will be performed to establish baseline conditions prior to injecting the food-grade, carbon-based solutions. Wells MW-1D, MW-1S, MW-2D, MW-3D, MW-6D, MW-6I, MW-6S, MW-11D, MW-11S, MW-12D, MW-12S, MW-37D, MW-37I, MW-37S, MW-39D, MW-39S, MW-53D, MW-53S, MW-65D, MW-65S, and MW-66D will be sampled. Laboratory analysis will be performed for the Target Compound List (TCL) VOCs, inorganic elements, and attenuation parameters listed in Table 1.

After injection of the food-grade, carbon-based solutions, performance monitoring will be performed for six (6) months to document the effectiveness of the technology in reducing the PCE and TCA concentrations. Groundwater samples will be collected at 30 days, 60 days, 90 days, and 180 days after injection of the solution. Analyses will be conducted for the same parameters as the baseline monitoring.

Groundwater sampling procedures are provided in Section 8.6. Quality control, chain-of-custody, and field documentation procedures are provided in Sections 8.7, 8.8, and 8.9, respectively.

6.3 Permanent Injection Point Installation

One (1) permanent injection point (IP-1) will be installed in the North pilot test area at the location shown on Figure 5. The injection point will be advanced to a depth of 55 ft bgs using Geoprobe type direct-push equipment. It will not be necessary to collect soil samples from the borehole.

The injection point will be constructed to the following specifications:

- 1-inch ID x 2.5-inch outside diameter (OD) 0.020-inch pre-packed sch 40 PVC well screen installed from 55 ft to 45 ft bgs.

- 1-inch ID sch 40 PVC riser, installed from 45 ft bgs to 2.5 ft ags, with flush-threaded connections.
- Annular backfill consisting of compatible silica sand, installed from 55-43 ft bgs.
- Hydrated bentonite chips, installed from 43-41 ft bgs.
- Cement/bentonite slurry, installed from 41-1 ft bgs.
- Steel stand-pipe monitoring well manhole set in a concrete pad at ground surface extending to 3 ft ags, water tight, with vented lockable cap on the PVC riser pipe.

The new injection point will be located and developed in accordance with procedures provided in Sections 8.4 and 8.5, respectively.

7.0 FOOD-GRADE, CARBON-BASED SOLUTION INJECTION PILOT TEST

7.1 Quantity and Pattern of Injected Materials

The quantity of injected materials for each of the pilot study areas is based on calculations of aquifer saturation and solution stoichiometry (Appendix A). Food-grade, carbon-based solutions will be injected in a grid pattern within the volume below the treatment areas. The food-grade, carbon-based solutions injections may be followed by the injection of chase water to spread the solutions further from the injection points. However, if too much fluid is injected, the contaminated water could be displaced and migrate from the treatment area. Therefore, a lesser amount typically will be injected - on the order of 10-15 percent of the available pore space in the subject treatment volume. For this study, 12-13 percent will be used. To achieve this level of saturation, the total injected volume of food-grade, carbon-based solution and/or chase water will be 1,000 gallons per injection point in the South area and 962 gallons per injection point in the North area. Stoichiometric analysis was performed to evaluate the quantity of food-grade substance required to satisfy the hydrogen demand needed to insure reductive de-chlorination will proceed to completion (i.e., yield the end products of ethylene and ethane). The analysis included evaluation of other naturally occurring compounds present in the aquifer that will compete with the contaminants and add to the overall hydrogen demand. The total volume of each solution needed to complete reductive de-chlorination in each of the treatment volumes is shown in the table below.

Solution	Raw Volume Needed (gallons)	Dilution Ratio (solution:water)	Injected Volume (gallons)	Safety Factor	Recommended Injected Volume
Molasses*	500	1:9	5,000	5	25,000
Sodium Lactate	1,100	1:1	2,200	1	2,200
EOS™	340	1:4	1,700	1	1,700

* = per grid area

In the North pilot test area, molasses will be injected in a pattern that, if extended, would form a treatment barrier. The area has been subdivided into two (2) smaller parts in order to evaluate the effects of the proposed treatment at different distances from downgradient monitoring wells. Considering the expected disposition of the solution in the aquifer, a safety factor of "5" has been applied to the volume of molasses to be injected in order to insure appropriate coverage. Sodium lactate is expected to be dissolved quickly in the aquifer and to provide a high impact of short duration. The EOS™ is expected to last longer in the aquifer and to provide sustained results. The emulsified oil will have the added benefit of adsorbing contaminants from the soil matrix and releasing the contaminants into the aquifer as the oil is dissolved over time. Based on this expected disposition of solutions, the sodium lactate will be injected throughout the South area pilot test grid. The emulsified oil will be injected only in the upgradient portion of the South area. Thus, degradation will proceed in the short term in the downgradient portion of the grid, unimpeded by the additional effects of the oil, and will continue in the anticipated longer-term portion of the study period as a result of the longer lasting oil.

7.2 Emulsified Oil/Sodium Lactate Products

Commercially prepared emulsified edible oil (EOS™), purchased from EOS Remediation, Inc. (Raleigh, North Carolina), will be used for the South pilot test area. EOS™ is a proprietary mixture of emulsified food-grade oil, lactate, and yeast extract formulated to stimulate anaerobic biological activity for the reductive de-chlorination of chlorinated aliphatic hydrocarbons. The product is prepared at the factory and shipped to the job site in 55-gallon drums.

The EOS™ injection will be followed by the addition of a commercially prepared sodium lactate solution (WILCLEAR™), purchased from JRW Technologies, Inc. (Lenexa, Kansas). WILCLEAR™ is a high-purity sodium lactate concentrate formulated to enhance microbial activity in-situ for biodegradation and reduction of chlorinated solvents. The product is prepared at the factory (Waukegan, Illinois) and shipped to the site in 55-gallon polyethylene drums.

Product information for EOS™ and WILCLEAR™ is provided in Appendix B.

7.3 Emulsified Oil/Sodium Lactate Injection

Emulsified oil/sodium lactate solutions will be applied using 81 injection points situated over a nominal 72-foot-by-72-foot area in the immediate vicinity of the MW-37 well triplet (Figure 5). The program will use equidistant injection points arranged on an approximate 8-foot-grid pattern spacing throughout the interior of the South test area. In order to avoid, and work around, various site features (e.g., trees, shrubbery, fences, subsurface utilities, etc.) it may be necessary to alter the final dimensions of the pilot test area as well as the actual locations of some of the injection points. Such revisions will be decided in the field through consultation with the URS office and properly documented. It is anticipated that 3-4 injection points can be completed (i.e., direct-push drilling and solution injection) by one rig per day. In order to expedite the process URS proposes to utilize two Geoprobe™ type direct-push rigs operating simultaneously within the South pilot test area. Drilling/injection is estimated to be completed within 10-14 days depending on subsurface and weather conditions.

The emulsified oil will be mixed at the site at a ratio of 4 gallons water to 1 gallon EOS™ and injected throughout the entire thickness of the saturated zone using the Geoprobe™ type direct-push equipment as detailed below. Based on previous experience using this product (as discussed in Section 7.1), only about half of the proposed injection points (40/81), the upgradient half, will be utilized. The product will be applied at a rate of approximately 43 gallons of dilute EOS™ per injection point. Calculations are provided documenting the amount of EOS™ required for the pilot test in Section 7.1 and Appendix A.

Following application of the dilute EOS™, WILCLEAR™, mixed onsite at a ratio of 1 gallon water to 1 gallon sodium lactate, will be injected to create a highly reducing environment. All 81 injection points will be utilized for this application. The dilute sodium lactate solution will be applied at a rate of approximately 28 gallons per point. Calculations in Section 7.1 and Appendix A document the amount of sodium lactate that will be used.

The dilute EOS™ and sodium lactate will be followed by approximately 929-972 gallons of chase water (depending on location) per hole to distribute the solutions in the aquifer.

The following procedure is proposed to inject the EOS ™/sodium lactate/chase water solutions at each point. It is anticipated that all the solutions designated for injection at each point (i.e., EOS™/chase water or EOS™/sodium lactate/chase water) will be applied before proceeding to the next injection location. The sequence of injection of these multiple solutions at a given location will be field determined.

- A pressure-activated injection probe and drive rod assembly will be advanced to 55 ft bgs and retracted slightly.

- Clean (potable) water will be poured into the rods to displace air, thus preventing any injection of air into the treatment zone.
- Approximately 43 gallons of dilute EOS™ will be pumped into the treatment zone while withdrawing the drive rods at a uniform rate. The amount of pressure required to effectively distribute the solution into the aquifer while preventing it from upwelling around the injection point and possibly discharging to the surface will be determined in the field.
- The pressure-activated probe will be re-advanced to 55 ft bgs. Dilute WILCLEAR™ sodium lactate will be injected into the treatment zone at a rate of approximately 28 gallons per point.
- The probe will be re-advanced to 55 ft bgs a third time and approximately 929-972 gallons of clean chase water will be pumped into the treatment zone while the rods are withdrawn at a uniform rate.
- The vadose zone will be sealed using hydrated bentonite chips installed through the drive rods or open hole (if possible).
- The ground surface will be finished with asphalt, concrete, or soil to match the existing site conditions.

7.4 Molasses Product

A commercially available molasses solution (66 Brix Wes Blend, fortified with vitamin B^), purchased from Westway Trading (Albany, New York), will be used for the North pilot test area. The product is prepared at the factory and shipped in bulk to the site. Product information is provided in Appendix B.

7.5 Molasses Injection

Following completion of the South pilot test area injection, the molasses will be applied to the North test area, which will be subdivided into two (2) parts (Figure 5). Each part will consist of 26 injection points situated over an area measuring approximately 30 feet by 60 feet. The program in these areas will use equidistant injection points staggered on an approximate 10-foot-grid pattern spacing. In order to avoid, and work around, various site features (e.g., trees, shrubbery, fences, subsurface utilities, etc.) it may be necessary to alter the final dimensions of the pilot test area as well as the actual locations of some of the injection points. Such revisions will be decided in the field through consultation with the URS office and properly documented. It is anticipated that 3-4 injection points can be completed (i.e., direct-push drilling and solution injection) by one rig per day. In order to expedite the process URS proposes to utilize two Geoprobe™ type direct-push rigs operating simultaneously within the North pilot test area. Drilling/injection is estimated to be completed within 7-9 days depending on subsurface and weather conditions.

The molasses, mixed onsite at a ratio of approximately 9 gallons water to 1 gallon molasses, will be injected throughout the entire thickness of the saturated zone using the Geoprobe™ type direct-push equipment. All 52 injection points will be utilized for this application. In addition, dilute molasses will also be applied down the permanent injection point (IP-1). The dilute molasses will be applied at a rate of approximately 962 gallons per point. Calculations in Section 7.1 and Appendix A document the amount of molasses that will be used.

Due to the volume of water used to dilute the molasses prior to injection, additional chase water will not be required.

The following procedure is proposed to inject the dilute molasses solution at each point. It is anticipated that all the entire volume of dilute molasses solution designated for injection at each point will be applied before proceeding to the next injection location.

- A pressure-activated injection probe and drive rod assembly will be advanced to 55 ft bgs and retracted slightly.
- Clean (potable) water will be poured into the rods to displace air, thus preventing any injection of air into the treatment zone.
- Dilute molasses will be injected into the treatment zone at a rate of approximately 962 gallons per point while the rods are withdrawn at a uniform rate.
- The vadose zone will be sealed using hydrated bentonite chips installed through the drive rods or open hole (if possible).
- The ground surface will be finished with asphalt, concrete, or soil to match the existing site conditions.

7.6 Testing of IP-1

During the scheduled site visits to sample the monitoring wells (30 days, 60 days, 90 days), additional dilute molasses solution, in the quantities indicated above, will be applied to IP-1 to assess the potential use of such points during full implementation. The solution will need to be applied under pressure using a low-flow pump. Logistics and procedures for these applications are in preparation.

8.0 FIELD OPERATIONS

8.1 Utility Clearance /Work Coordination

Prior to drilling, each proposed monitoring well location and injection point will be cleared to avoid underground utilities and structures. Commercial utility locating services, public utilities, the Town of Volney, MBCo, and Crysteel will be contacted to provide subsurface utility information. In addition, all drilling operations will advance augers or drive rods cautiously from the ground surface through the first five (5) feet of the subsurface.

All field activities, including drilling, well installation, pilot testing, and groundwater monitoring will be coordinated with appropriate personnel from Crysteel, the current property owner.

8.2 Decontamination

All drilling equipment will be steam cleaned both prior to use at the site and prior to demobilization from the site. Downhole equipment, such as augers, split-spoon samplers, drive points, and rods, will also be steam cleaned between well and injection locations.

8.3 Borehole Logging/ Well Installation

A geologist will oversee the drilling process and log information on boreholes MW-65D, MW-65S, and MW-66D using continuous split-spoon soil samples to determine lithology and strata changes. Samples will be described on boring logs according to the Visual-Manual Soil Description Procedure (ASTM D-2488). The geologist will also oversee the well installations and document the as-built well details on well construction log sheets.

8.4 Location of Wells and Injection Points

The horizontal location and vertical elevation of the new monitoring wells will be established by standard survey methods. The horizontal location of the injection points will be established by triangulation and plotted on the base map.

8.5 Well Development

New wells will be developed by pumping until the discharge water is relatively free of sediment and the water quality parameters have stabilized. Measurements of pH, conductivity, and temperature will be taken from the pump discharge at the following frequency:

- Initial discharge
- Every static well water volume

The static water level will be measured in each well prior to and at the conclusion of development.

8.6 Groundwater Sampling

The static groundwater level will be measured at each well prior to purging or sample collection. An electronic water level indicator will be used to measure the depth to the water surface, from the top of the well riser pipe, to the nearest 0.01 foot.

Groundwater samples will be collected using low-flow purging and sampling procedures. Water will be purged from each well using a low-flow peristaltic pump operated at a discharge rate of less than one (1) liter per minute. The purging rate will be maintained at a rate sufficient to prevent drawdown in excess of ten percent of the standing water column. Dedicated new discharge and intake tubing will be used for each well. The tubing inlet will be set at the midpoint of the well screen. Purging will continue until the water quality parameters have stabilized, as determined by the following criteria:

- pH±0.10SU
- Specific conductivity ± 3% of full scale
- Temperature ± 0.2° C

Water quality parameter readings will be recorded on low-flow purging log sheets. Once purging is complete, groundwater samples will be collected using the peristaltic pump. Groundwater samples will be analyzed for the parameters listed in Table 1.

8.7 Quality Control Samples

Duplicate samples will be collected or analyzed in the field at a frequency of > 10 percent. Matrix spike, matrix spike duplicate, rinse blank and trip blank samples will be sampled and analyzed in accordance with the schedule presented on Table 2.

8.8 Chain-of-Custody and Shipping

Chain-of-custody procedures will be used to ensure the custody and integrity of the samples from the time of sampling and continuing through transport, sample receipt, preparation, analysis, storage, reporting, and sample disposal. Records concerning the custody and condition of the samples will be maintained in the field and laboratory records. Information on the custody, transfer, and shipping of samples will be recorded on chain-of-custody (COC) forms that will be initiated in the field by the sampler. Each COC form will include the following information:

- Project number
- Site name
- Name of sampler(s)
- Unique sample identification
- Date and time of sample collection
- Sample type
- Preservative used
- Analytical requirements
- Method of shipment
- Custody transfer signatures and the dates and times of sample transfer from the field to the transporter and to the laboratory

Samples collected in the field will be transported in coolers to the laboratory as expeditiously as possible. The samples will be packed with ice or freezer packs to maintain a temperature of 4° C.

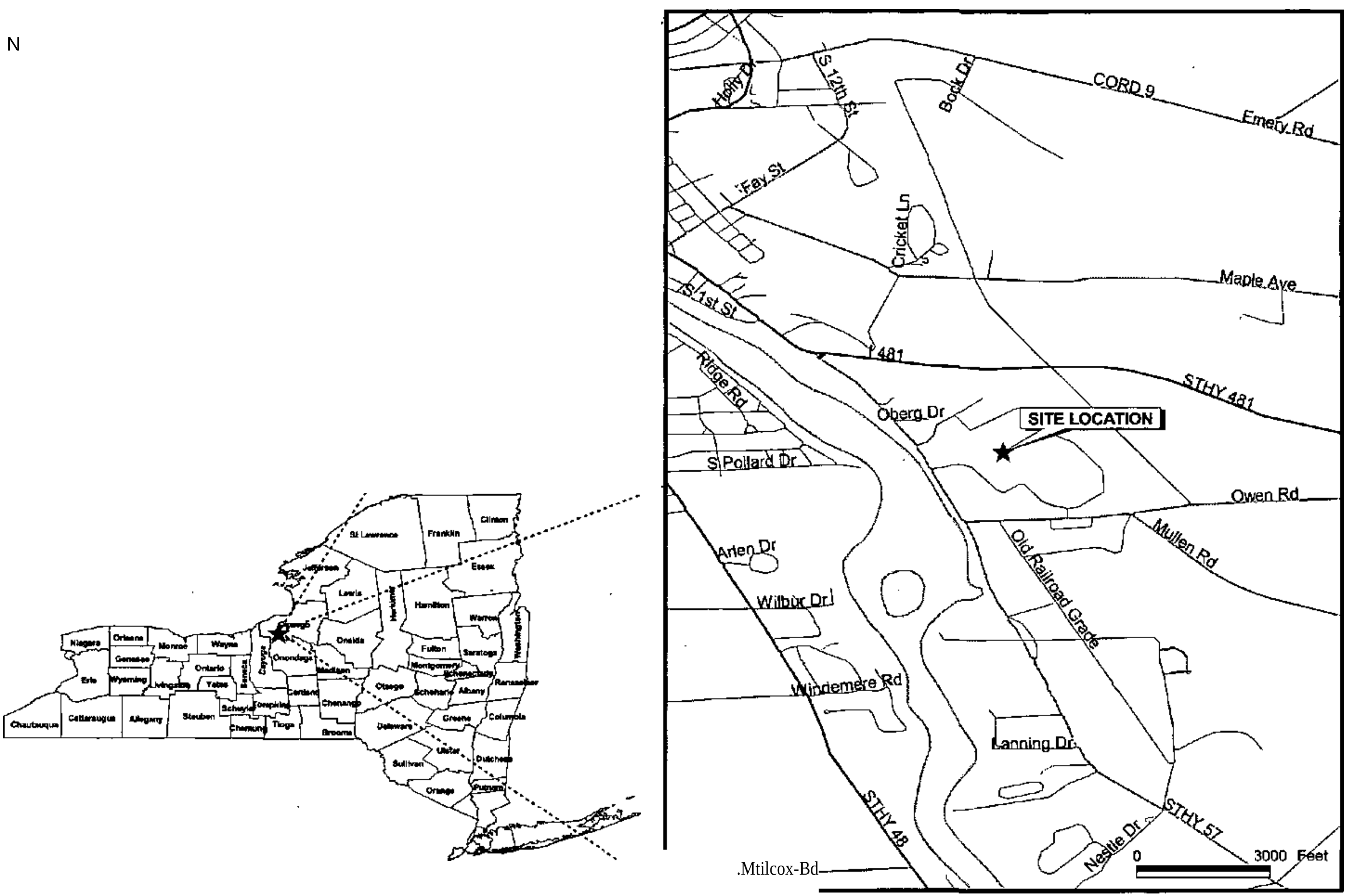
8.9 Field Documentation

Field activities will be documented using field notebooks, photographs, and standard field forms. Field notebooks will serve as the primary record of activities at the site. Field notebooks will be bound with consecutively numbered pages. All entries into the notebook will contain a variety of information including: dates, times, weather, personnel at the site and affiliations, equipment being used, level of personnel protective equipment, instrument calibration, drilling information, sampling/measurement data, and any other relevant information. If an incorrect entry is made, the information will be crossed out with a single strike mark and initialed. Field notebooks will be stored in a project file when not in use.

FIGURES

N:\11173796.0000WDB\GIS\site.apr SITE LOCATION
9/1K2004

N



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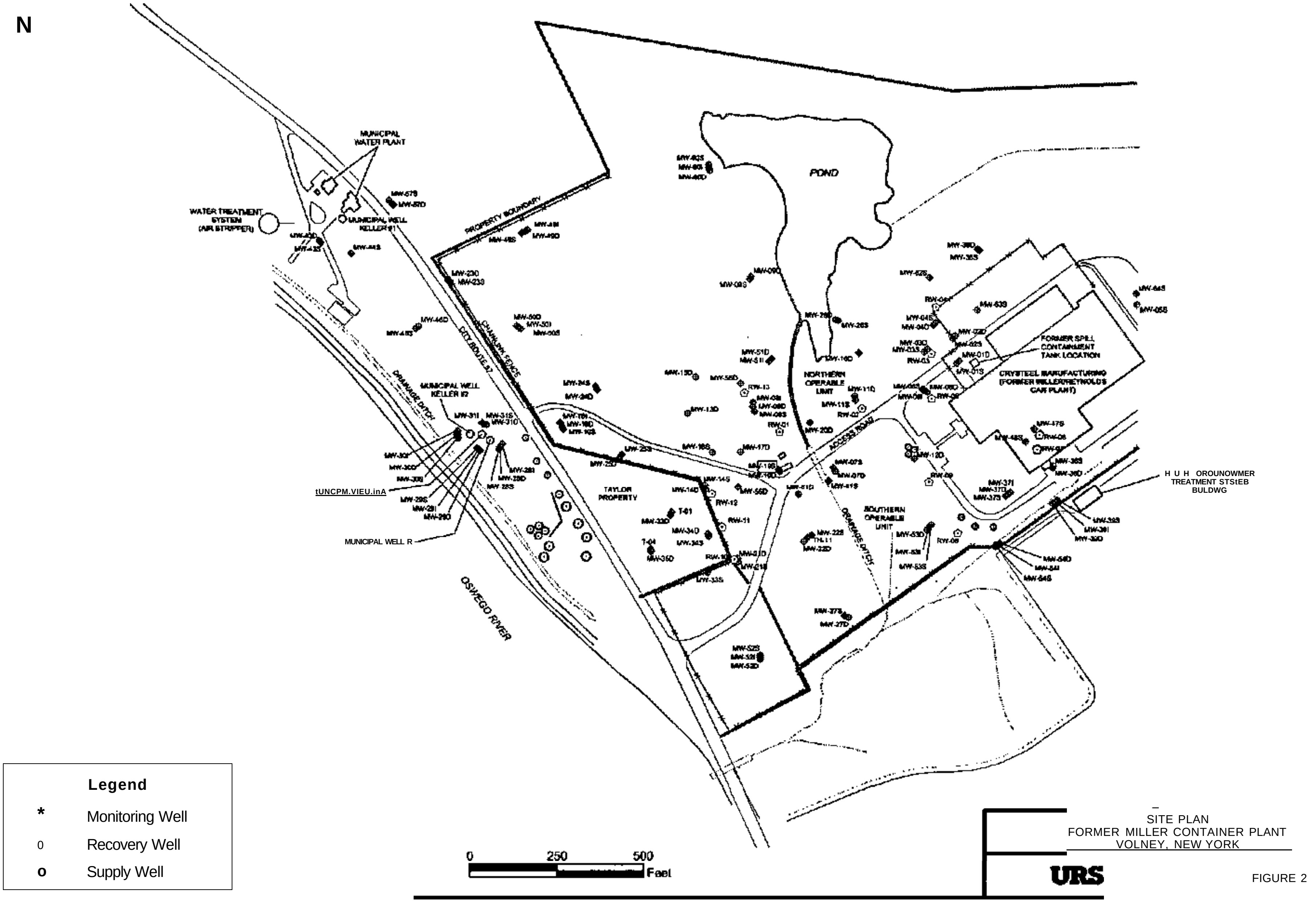
FORMER MILLER CONTAINER PLANT - VOLNEY, NY
SITE LOCATION MAP

FIGURE 1



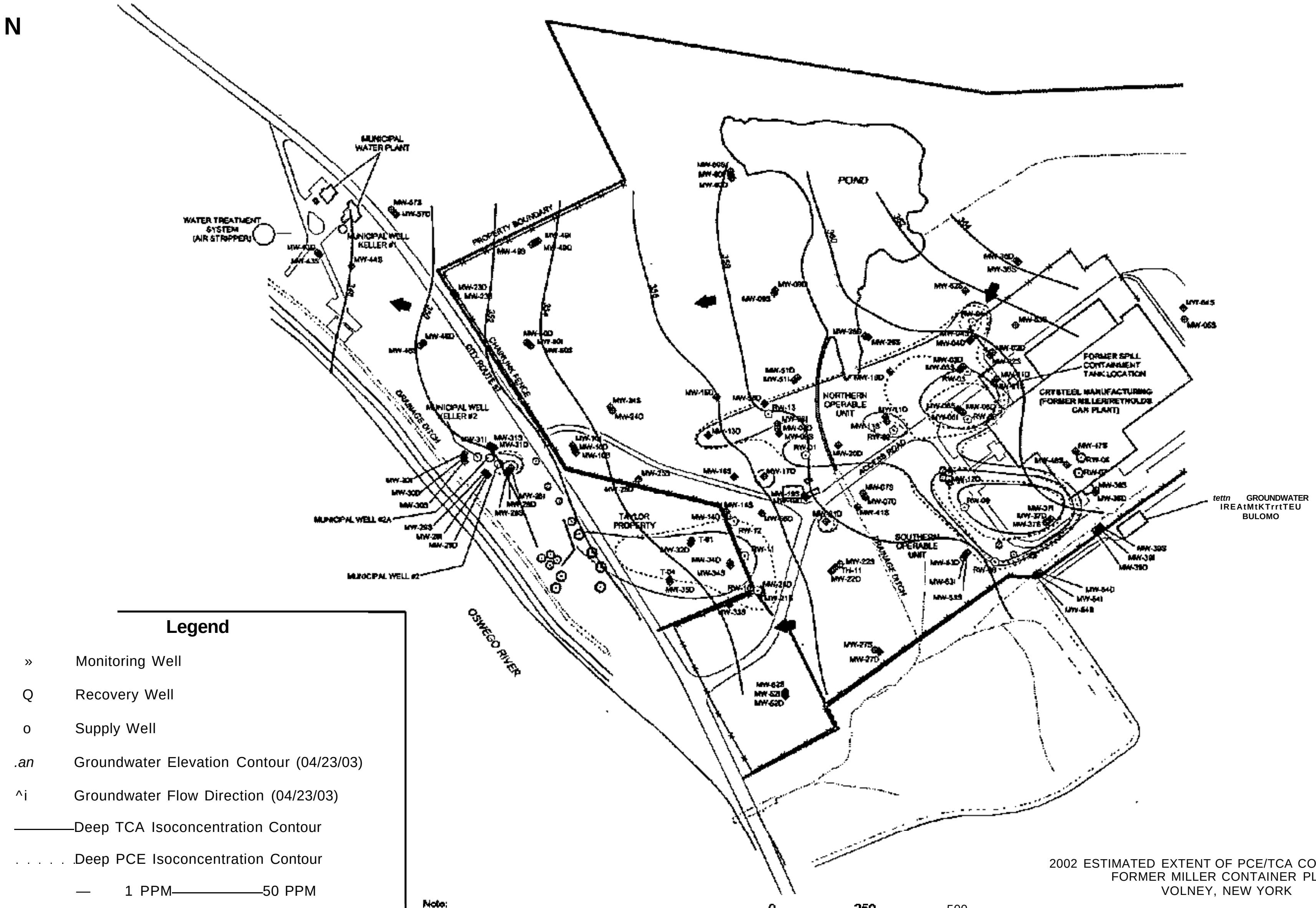
Legend

*	Monitoring Well
0	Recovery Well
o	Supply Well

SITE PLAN
FORMER MILLER CONTAINER PLANT
VOLNEY, NEW YORK

URS

FIGURE 2



Legend

»	Monitoring Well
Q	Recovery Well
o	Supply Well
.an	Groundwater Elevation Contour (04/23/03)
^i	Groundwater Flow Direction (04/23/03)
————	Deep TCA Isoconcentration Contour
. . . . .	Deep PCE Isoconcentration Contour

— 1 PPM ——— 50 PPM

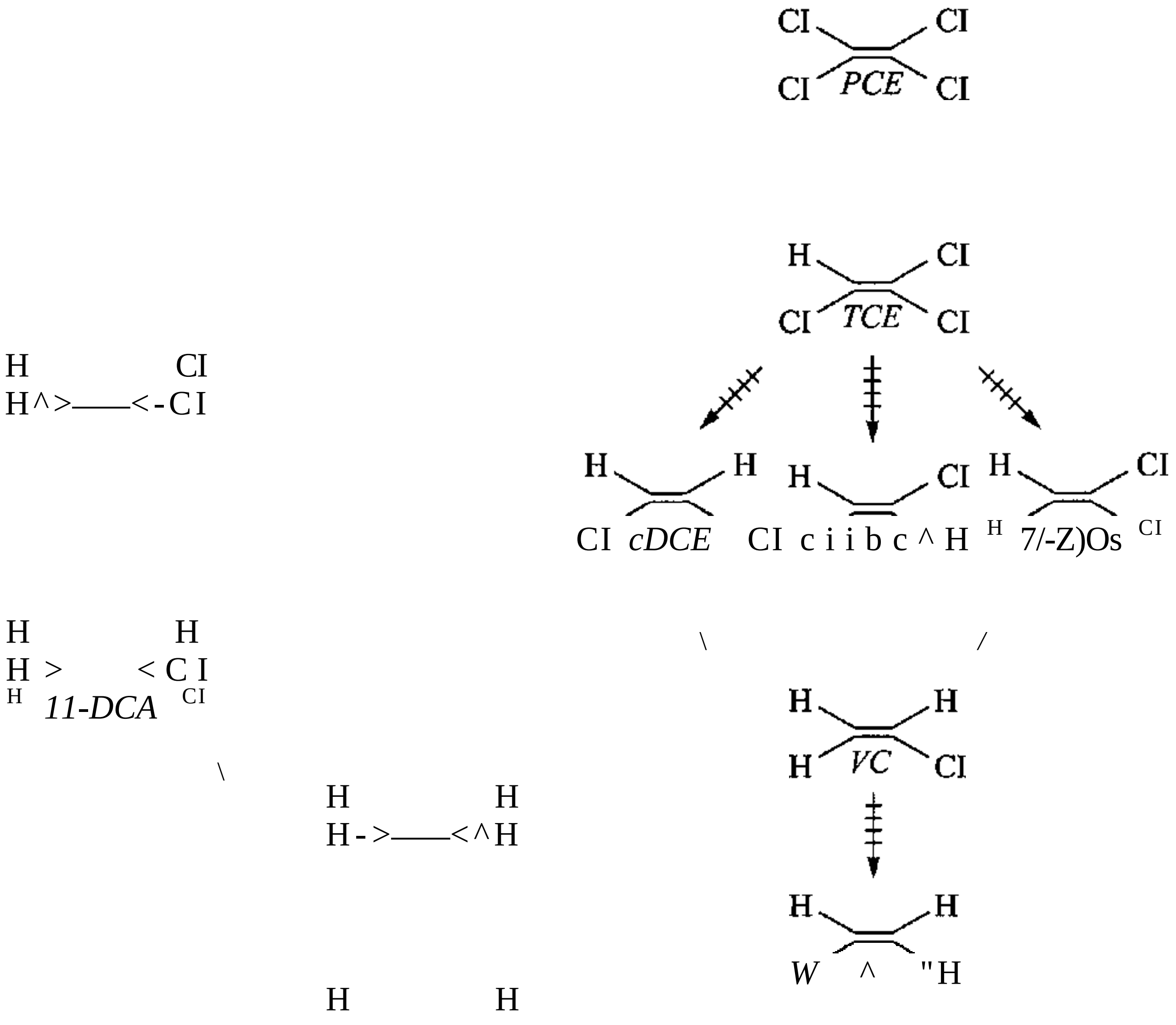
——— 5 PPM ——— 500 PPM

Note:

- MW-61Dwas not used to generate groundwater elevation contours due lo an anomalous reading.

2002 ESTIMATED EXTENT OF PCE/TCA CONTAMINATION
FORMER MILLER CONTAINER PLANT
VOLNEY, NEW YORK

FIGURE 3



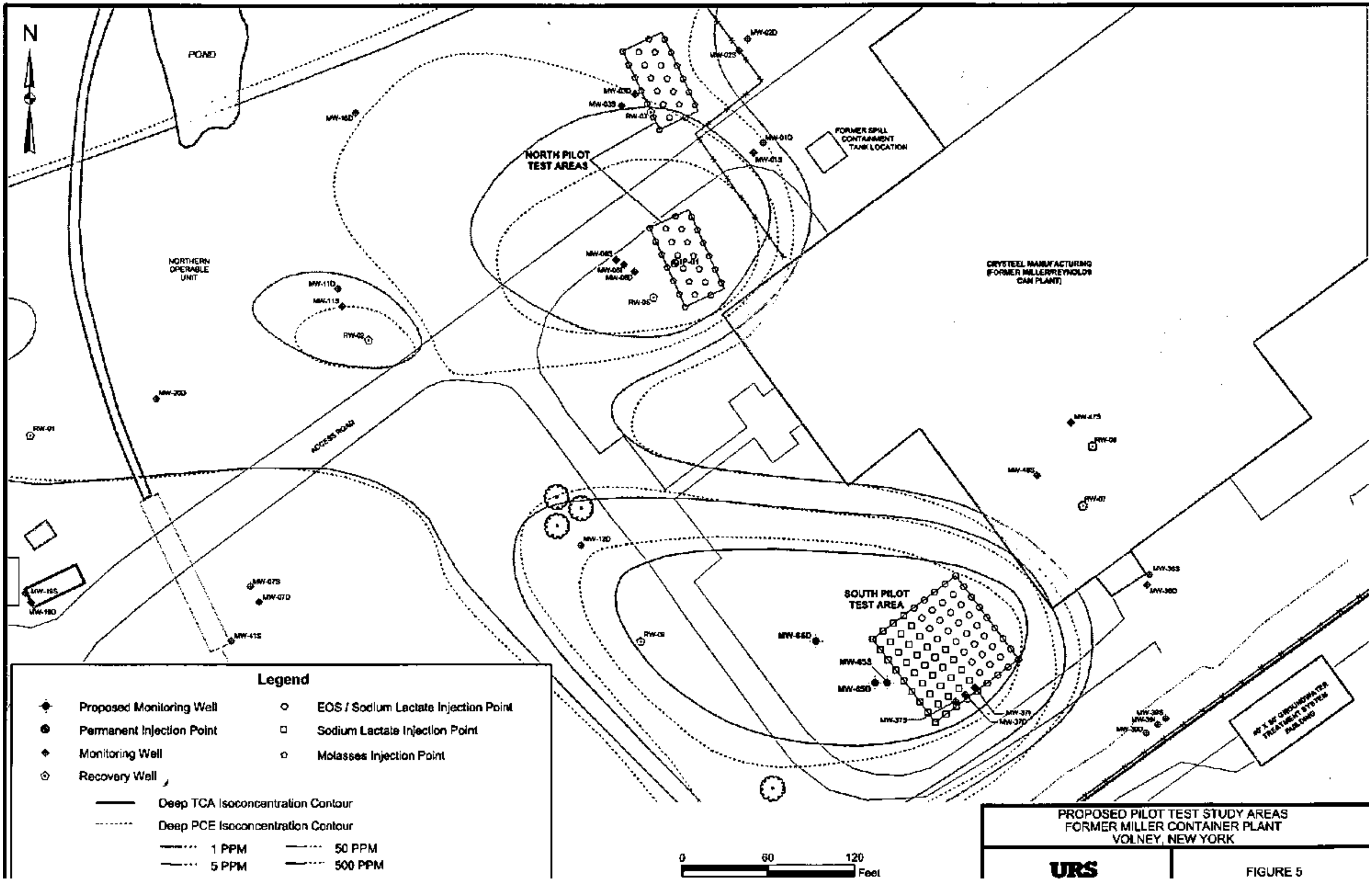
11-DCE = 1,1 -dichloroethene
rc^= trichloroethanc
77-DG4 = 1,1-dichloroethane
G4 = chloroethanc
^ = ethane
PCE = perchloroethene

TCE = trichloroethene
cDCE = cw-dichloroethene
tDCE = frans-dichloroethene
VC = vinyl chloride
E = ethylene

URS

PCE AND TCA DEGRADATION PATHWAYS
FORMER MILLER CONTAINER PLANT
VOLNEY, NEW YORK

FIGURE 4



PROPOSED PILOT TEST STUDY AREAS
FORMER MILLER CONTAINER PLANT
VOLNEY, NEW YORK

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FIGURE 5

TABLES

TABLE 1

FORMER MILLER BREWING COMPANY SITE, TOWN OF VOLNEY, NEW YORK

GROUNDWATER MONITORING PARAMETERS

Parameter	Method Number	Reference	Preservation	Container
Target Compound List (TCL) VOCs, PCE & TCA degradation products	OLM04.2a		HC1 to pH < 2, 4°C	2x40 ml VOA vials w/ Teflon Septa
Total Petroleum Hydrocarbons	1664		HC1 or H2S04 to pH < 2, 4°C	lxl-L Glass
Nitrate/Nitrite	353.2		4°C	250 ml HDPE
Total Kjeldahl Nitrogen	351.1		H2S04 to pH < 2, 4°C	lxl-LHDPE
Nitrogen (as NH3)	350.2		H2S04 to pH < 2, 4°C	500 ml HDPE
Chloride	300.0		None	250 ml HDPE
Fluoride	300.0		None	250 ml HDPE
Sulfate	375.4		4°C	250 ml HDPE
Hardness	130		HNO3 to pH < 2,4°C	500 ml HDPE
Iron (total)	6010B		HNO3 to pH < 2, 4°C	500 ml HDPE
Iron (dissolved)	6010B		Filter, HNO3 to pH < 2, 4°C	500 ml HDPE
Ferric Iron (Fe^{+J})	SM 3500	2	HNO3 to pH < 2, 4°C	500 ml HDPE
Ferrous Iron (Fe^{+Z})	SM3500	2	Field Measurement	500 ml HDPE
Methane, Ethane, Ethene	RSK-175	3	HC1 to pH <2, 4"C	2x40 ml VOA vials w/ Teflon Septa
pH	150<'>	**1**	Field Measurement	HDPE
Temperature	170.1$^{(,}$>	**1**	Field Measurement	HDPE
Dissolved Oxygen	360.1<^{1J}	**1**	Field Measurement	HDPE
Redox Potential	SM 2580B$^{(,)}$	2	Field Measurement	HDPE

References:

1 NYSDEC Analytical Services Protocol, June 2000.

2 Standard Methods for the Examination of Water and Wastewater, 20 Edition.

3 USEPA, R.S. Kerr Environmental Research Laboratory, March 15, 1989.

Notes:

1 Field instrument, low-flow cell

TABLE 2

FORMER MILLER BREWING COMPANY SITE, TOWN OF VOLNEY, NEW YORK
SAMPLING SCHEDULE

Parameter	Estimated Number of Samples	QA/QC Samples				Total Number of Samples
		MS/MSD(1)	Duplicates	Rinse Blanks	Trip Blanks	
Target Compound List (TCL) VOCs, PCE & TCA degradation products	105	5/5	**5**	**5**	**5**	130
Total Petroleum Hydrocarbons	105	5/5	**5**	**5**	**0**	125
Nitrate/Nitrite	105	5/5	**5**	**5**	**0**	125
Total Kjeldahl Nitrogen	105	5/5	**5**	**5**	**0**	125
Nitrogen (as NH_3)	105	5/5	**5**	**5**	**0**	125
Chloride	105	5/5	**5**	**5**	**0**	125
Fluoride	105	5/5	**5**	**5**	**0**	125
Sulfate	105	5/5	**5**	**5**	**0**	125
Hardness	105	5/5	**5**	**5**	**0**	125
Iron (total)	105	5/5	**5**	**5**	**0**	125
Iron (dissolved)	105	5/5	**5**	**5**	**0**	125
Ferric Iron (Fe^{+J})	105	0/0	**5**	**5**	**0**	115
Ferrous Iron (Fe^{+2})$^{(2>}$	105	0/0	**5**	**0**	**0**	110
Methane, Ethane, Ethene	105	**5/5**	**5**	**5**	**5**	130
pH<2>	105	**0/0**	**0**	**0**	**0**	105
Temperature<2>	105	0/0	**0**	**0**	**0**	105
Dissolved Oxygen'2'	105	**0/0**	**0**	**0**	**0**	105
Redox Potential'2'	105	0/0	**0**	**0**	**0**	105

Notes:

(1) Matrix Spike/Matrix Spike Duplicate
(2) Field Measurement

Assumes five sampling events (baseline and 4 performance monitoring) with 21 monitoring wells sampled per event.

APPENDIX A
CALCULATIONS

URS EXHIBIT 4.7-2

CALCULATION COVER SHEET

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Project Manager/Date

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PAGE 1 OF 7
JOB NO 111 73 796
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PROJECT **Fulton Container Plant Remediation**
SUBJECT. **Vnliima of Linuid for the Hydrooan Imaetinn Pilot Study South of the plant Building**

1. PURPOSE

The purpose of this calculation is to evaluate the degree of aquifer saturation with the liquid introduced into the subsurface during the proposed hydrogen injection pilot study

2. GENERAL

The aquifer and the injection of substrate have been described in the calculation *Hydrogen Injection Pilot Study South of the Plant Building* (URS, Sep 20, 04) Several substrates were evaluated and the required volumes were determined to be on the order of 1,000 gallons per unit area of aquifer, defined as 72 by 72 feet (a 9 by 9 grid of injection points at 8-ft spacing) In this calculation it is assumed that the substrate is mixed with water and injected into the aquifer The total volume 'of injected liquid (substrate and water) is then evaluated with respect to the degree to which it will fill the aquifer pore space This is to evaluate the degree to which the substrate can be expected to contact the mass of contaminant distributed within the aquifer

3. CALCULATIONS

In the calculation entitled *Hydrogen Injection Pilot Study South of the Plant Building,* the thickness of the saturated zone of the aquifer has been estimated to be 40 feet The soil porosity of 40% was used Based on that, the pore water within the unit area of 72 by 72 feet is $V_{por}e$ = 72*72*40*0 40 = 82,944 ft^3 (620,504 gal)

It is assumed that the treatment area will contain N = 81 injection points Injection will be performed using push technology, utilizing $ti_{n]}$ = 3 hours per point The table presented below shows the total volume of injected liquid (Vm_3) and the average flow required per each injection point (Qpomt) to produce that volume, both as a function of the percent of pore space that will be saturated (p)

$$V_{inD} = P\ V_p\ \bullet$$

$$Qpoint = (V_{in3} / N) / t_{inD}$$

Spreadsheet produces a table of injection rate per point and total injected volume as functions of percentage pore space filled

Data

Area of aqutfer treated A = 72 b 72 ft = 5,184 fr

Saturated thickness of aquifer H_0 = 40 ft

Porosity of aquifer material n = **0.4**

Number of injection points N = 81

Injection time per point 'inj – 3 hrs = 180 mm

Calculate

Pore volume **V_p =** 82,944 ft^J = 620.504 gal

Fraction of pore volume filled		Total volume injected into the aquifer		Volume per point injected into the aquifer		Injection rate per each point	
	3	V,ni = pV$_p$		V,$_{nj}$/N		Qpoln« = <V$_{in]}$/N)/t$_{inj}$	
r%]	**H**	[ft^3]	[gal]	[ft^3]	[flail	[ffVmin]	[gal/mm]
01	0 001	83	621	1 0	6	0 01	0 0
- 1	0 01	829	6,205	10	77	0 06	04
5	0 05	4.147	31,025	51	383	0 26	21
10	01	8,294	62,050	102	766	0 57	43
13	**01306**	**10,832**	**81,038**	**134**	**1,000**	0 74	56
15	015	12.442	93.076	154	1,149	0 85	64
20	02	16,589	124,101	205	1,532	1 14	85
30	03	24,883	186,151	307	2,298	1 71	128
50	05	41.472	310,252	512	3.830	2 84	21 3
75	0 75	62.208	465,378	768	5,745	4 27	31 9
100	1	82,944	620,504	1,024	7,661	5 69	42 6

URS EXHIBIT 4.7-2

CALCULATION COVER SHEET

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Remarks/Conclusions/Results £V«J oirrt/ w'(/<^«> ^tv

Calculation Approved by _______________________

Project Manager/Date

Revision No	Description of Revision	Approved by

Project Manager/Date

JOB NO 111 73 796

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PROJECT **Fulton Container Plant Remediation**

SUBJECT. **Hydrogen Injaction Pilnt Study South of tha Plant Building**

1. PURPOSE

The purpose of this calculation is to estimate quantities of hydrogen-donor products required to conduct a field study of the remediation of chlorinated solvent contamination identified in the aquifer at the Miller Brewing Company Container Division in Fulton, New York The products are sodium lactate and vegetable oil Field study is in the area south of the plant building (see page 21)

2. GENERAL

The aquifer at the site consists of two layers fine sand and silt with some clay lenses, underlain by fine to coarse sand and gravel In some locations the topmost layer is made up by man-made fill, however, the fill is generally located above the water table and does not form an active part of the aquifer The aquifer is underlain by lodgment till, consisting of dense, hard mixture of clayey sand, silt and gravel In some locations the till is absent and the aquifer is in direct contact with the bedrock See Figures B3 through B7 of reference 1

Water is found mostly at unconfined conditions The hydraulic conductivity of the aquifer is highly variable, slug tests results indicate values on the order of 10"^{6} to greater than 10"^{2} cm/s In the area of the plant building and immediately downgradient, values of hydraulic conductivity appear to be mostly on the order of 10 "^{4} to 10"^{3} cm/s See Figures B3 through B7 of reference 1

Hydraulic gradients are difficult to ascertain The flow regime is influenced by several extraction wells (both water supply and remediation wells) as well as the presence of a large pond north of the plant The flow pattern appears to be different at different depths, as well as seasonably variable In most general terms, the ground water flows from east to west, towards the Oswego River A depth-averaged potentiometric surface map is shown on Figure B9 of reference 1 It indicates a gradient of approximately 1 ft over 400 feet (0 0025) immediately downgradient of the plant building

Chlorinated solvent contamination is located mostly around the western part of the building and immediately downgradient See Figures BIO and Bll of reference 1 Results of the latest sampling round (March-April, 2 003) are presented on pages 9 to \± The highest values of total chlorinated hydrocarbons are on the order of 1,000 ug/L

There are no data regarding several aquifer parameters that influence the hydrogen balance during remediation, such as the concentrations of oxygen, nitrate, manganese, iron and sulfate Likewise, the organic carbon content of the aquifer is not known

3. APPROACH

The calculation is based on following assumptions

- The hydrogen yield of the donor compound is determined based on the molecular formula
- It is assumed that all reactions proceed to completion
- Hydrogen demand for reductive dechlorination and for competing electron acceptors is based on stochiometry of reactions

The dissolved mass "Mdisooived" of a chlorinated solvent is calculated as follows

$$M_{dis\ solved} = V_a\ n\ C$$

The same applies to the dissolved mass of competing electron acceptors (oxygen, nitrate, etc) Symbols are V_a - volume of aquifer under remediation, n - aquifer porosity, C' - dissolved-phase concentration of the chlorinated compound (or competing electron acceptor)

The adsorbed mass "Madsorbed" of a chlorinated solvent is calculated based on the assumption of partitioning of contaminants between water and organic carbon present in aquifer soils Competing electron acceptors do not adsorb onto soil Therefore, only the mass of contaminants is taken into account in calculating- the hydrogen demand of the adsorbed compounds

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PROJECT Fulton Container Plant Remediation
SUBJECT. Hydrogen Injactian Pilot Study South of the Plant Building

$S = Kd\ C$

$Kd = Koc\ toe$

$Madeorbed = V_a\ pb\ S$

Symbols are pb - bulk density of aquifer material, S - sorbed-phase concentration of the chlorinated compound, Kd - distribution coefficient of the chlorinated compound, Koc - water/organic carbon partitioning coefficient of the chlorinated compound, f_{oc} - organic carbon fraction of soil

The mass of hydrogen "Mhydrogen" required to treat a given mass "M" of chlorinated solvent or a competing electron acceptor is calculated as follows

$Mhydrogen = M\ /\ f\ atochiometric$

The fstochiometnc is the mass of contaminant or competing electron acceptor neutralized by a unit mass of hydrogen

The microbial demand is treated by using a factor increasing the hydrogen demand calculated for chlorinated solvents and competing electron acceptors

A factor of safety is applied to the total hydrogen demand calculated above

4. DATA

Volume of aquifer treated
The unit volume considered here will encompass the area of 72 by 72 ft Based on Figures B5 and B6, the saturated thickness of the aquifer in the area near the downgradient end of the building is approximately 40 ft

V_a = 72*72*40 = 207,360 ft^3

Aquifer porosity
Unknown Assume 40% (reference 2)

n = 0 40

Hydrogen yield of donor compounds
See page 15

Lactate yield = 22 4 lb lactate / 1 lb hydrogen
Oil yield = 8 lb oil / 1 lb hydrogen

Bulk density of aquifer material
Unknown Use 110 lb/ft^3

p_b = 110 lb/ft^3

Organic carbon fraction of soil
Unknown Use 1%

f_{oc} = 0 01

Water/organic carbon partitioning coefficient
Values of Koc are contaminant-specific See reference 2

Stochiometnc factors
Values of f Btochiometnc are contaminant-specific See pages 16 to 18

Donor product density and content in injected liquid
Degree to which a given product has to be diluted before infection varies, and is generally determined by the product manufacturer Here, based on experience on other project, it is assumed that oil and sodium lactate will form 20% and 60% by weight of the injected liquid, respectively Density of sodium lactate is somewhat higher than those of water The density of injected liquid will be assumed to be 133% of water for lactate The vegetable oil is somewhat lighter, and the density of the injected oil-water mixture will be assumed to be 95% of water density

- Concentrations of competing electron acceptors
  These concentrations are not known Concentrations assumed here are based on values encountered on other projects
- Microbial demand factor
  Value of 4 is assumed
- Dissolved-phase concentrations
  Dissolved-phase concentrations of chlorinated solvents are taken from the March-April, 2003 sampling event Concentrations are from the sample collected in well MW-37I, which displayed the highest total VOC concentration

5. CALCULATIONS

Calculations are presented on pages' 7 to 8 The volumes of reagent required are

- Sodium lactate V = 813 gal
- Vegetable oil V = 1,218 gal

It is also assumed that during the time when the effects of injection are monitored there will be one pore volume natural exchange of ground water within the study area Therefore, the reagent will have to neutralize an additional mass of contaminant and competing electron acceptors in the ground water flowing from upstream

- Lactate Vadditionai = (4 + 76) *4 = 320 gal,
- Oil Vadditionai = (5 + 114)*4 = 476 gal

The total quantities are (to the nearest 100 gal) 1,100 gal of lactate mix (60% by weight), and 1,700 gal of oil mix (20% by weight)

6. REFERENCES

1 ROD Change Documentation Repot
Permeable Reactive Barrier System
Former Miller Containment Plant
URS, September 2003

URS

PAGE _ 6 - OF 31
JOB NO 111 73 796

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PROJECT **Fulton Container Plant Remediation**
SUBJECT. Hydrogen Imactinn Pilot Study South of tha Plant Building

C3!cLfl3+/cm

Sodtum Lactate Design for Plume Area/Grid Treatment

Site Name	Miller Brewing Co Container Division
Location	Fulton, New York

Sodium Lactate (C_3HtNaOj)

Pure Hj Yield	22 4	lb pure Sodium Lactate/lb Hi
Sodium Lactate % (by weight)	60	
Capacity to supply H_z	37 3	tb Sodium Lactate solution/lb M_2
Density of Sodium Lactate	11 05	lb/gal

Site Conceptual Model

Width of Treatment Area	72	ft	
Length of Treatment Area	72	ft	
Depth to Water Table	15	ft	
Thickness of Contaminated Zone	40	ft	
Aquifer Materia!	sand		
Porosity	0 4		
Treatment Zone Pore Volume	82 944	fl^J	620 504 gal

Dissolved Phase Electron Donor Demand

	Contaminant Cone (mg/L)	Mass (lb)	Stoich <wt/wl> contam/Ha	H_aReq (lb)
Telrachloroethene (PCE)	0 8300	4 3	20 7	0 2074
Tnchloroethsne (TCE)	00000	0 0	21 9	0 0000
as 1,2-dichloraelhene (DCE)	2 7000	14 0	24 2	0 5771
Vinyl Chloride (VC)	0 2200	1 1	31 2	0 0365
Carbon tetrachloride	0 0000	0 0	16 2	0 0000
Chloroform	0 0000	0 0	19 9	0 0000
1 1.1-Tnchloroetriane(TCA)	0 8100	4 2	22 2	01887
1 1-Dichlorochloroethane (DCA)	0 2800	.1 5	24 7	0 0607
Additional compound	**00000**	0 0		

Sorbad Phase Electron Donor Demand

Soil bulk density	110	lb/cf
Fraction of organic carbon foe	0 01	range 0 0001 to 0 01

	Koc (LA9)	Contaminant Cone (mg/kg)	Mass (lb)	Stoich (wt/wt) contam/Hj	HjReq (lb)
TetrachtoroBthene (PCE)	263	2 1829	49 79	20 7	2 4019
Tnchloroethene (TCE)	107	0 0000	0 00	21 9	**00000**
cis-1,2-dichloroethene (DCE)	80	2 1600	49 27	24 2	2 0334
Vinyl Chlonde (VC)	2 5	0 0055	013	312	0 0040
Carbon tetrachloride	110	0 0000	0 00	19 2	**00000**
Chloroform	34	**00000**	0 00	19 9	**00000**
1,1,1 Tnchloroethane (TCA)	183	14323	3381	22 2	15209
1 I-Dichloroethane(DCA)	183	0 5307	1211	24 7	0 4895
Additional compound	0	0 00	0 00		

Competing Electron Acceptors	Electron Acceptor Cone (mg/L)	Mass (lb)	Stoich (wt/wl) elec acceptor/H_2	H_2Req (lb)
Oxygen	0 3 0	1 5 5	8 0	0 19
Nitrate	0 80	4 14	1 2 4	0 33
Est Mn reduction demand (potential amt of Mn+2 formed)	1 0 0	5 18	27 5	0 1 9
Est Fe reduction demand (potential amt of Fe+2 farmed)	2 5 0	12 95	65 9	0 23
Estimated sulfate reduction demand	5005	259 22	1 2 0	2160

Microbial Demand Factor	4
Sifoty Factor (SF)	4

Mass Requirements

	(lb)	Sodium Lactate (lb)	(Hal)
Dissolved Phase Contamination	1 1	40 0	3 6
Adsorbed Phase Contamination	6 4	240 8	218
Competing Electron Acceptors	22 6	8419	76 2
Competing Microbial Processes	30 1	1123 0	1016
Subtotal	60 2	2245 6	203 2
Total (with SF)		8982 5	612.9

Oil Design for Plume Area/Grid Treatment

Site Name	Miller Brewing Co Container Division
Location	Fulton, New York

Vegetable Oil **(C,H„0)**

Pure Hj Yield	6	IbpureOilflbHj
Oil % (by weight)	20	
Capacity to supply H_2	40 0	lb Sodium Lactate subslrate/lb H :
Density of Vegetable Oil	7 9	lb/gal

Site Conceptual Model

Width of Treatment Area	72	ft		
Length of Treatment Area	72	ft		
Depth to Water Table	15	ft		
Thickness of Contaminated Zone	40	ft		
Aquifer Material	sand			
Porosity	0 4			
Treatment Zone Pore Volume	82 944	ft*	620504	ga

Dissolved Phase Electron Donor Demand

	Contaminant			
	Cone (mg/L)	Mass (lb)	Stoich (wt/wt) contanVH]	H_2 Req (lb)
Tetrachloroethene (PCE)	0 8300	4 3	207	0 2074
Tnchloroethene (TCE)	0 0000	0 0	21 g	00000
as 1 2-dichloroethene (DCE)	2 7000	14 0	24 2	0 5771
Vinyl ChlondB (VC)	0 2200	1 1	312	00365
Carbon tetrachloride	0 0000	0 0	19 2	0 0000
Chloroform	0 0000	0 0	19 9	0 0000
1 1,1-Tnchloroethane(TCA}	0 8100	4 2	22 2	01887
1 1 Dichlorochloroethane (DCA)	02900	1 5	24 7	0 0607
Additional compound	0 0000	0 0		

Sorbed Phase Electron Donor Demand

Soil bulk density	110	ib/cf
Fraction of organic carbon foe	0 01	range 00001 to 0 01

	Koc	Contaminant		Stoich (wt/wt)	H_a Req
	(LAg)	Concjmg/kg)	Mass (lb)	contam/Hi	(lb)
Tetrachloroethene (PCE)	283	21629	49 79	20 7	24019
Tnchloroethene (TCE)	107	0 0000	0 00	219	0 0000
cis 1 2-dichloroethene (DCE)	80	21600	49 27	24 2	2 0334
Vinyl Chlonde (VC)	2 5	0 0055	0 13	312	0 0040
Carbon tetrachloride	110	00000	0 00	19 2	0 0000
Chloroform	34	00000	0 00	19 9	00000
1,11-Tnchloroethane(TCA)	183	14823	3381	222	15209
1,1-Dichloroelhane (OCA)	183	0 5307	1211	24 7	0 4895
Additional compound	0	000	000		

	Electron Acceptor		Stoich (wt/wt)	HjReq
Competing Electron Acceptors	Cone (mg/L)	Maes (lb)	ilec acceptor/H	(lb)
Oxygen	030	155	80	019
Nitrate	060	414	124	033
Est Mn reduction demand (potential amt of Mn+2 fomied)	100	518	27 5	019
Est Fe reduction demand (potential amt of Fe+2 formed)	250	12 95	55 9	0 23
Estimated sulfate reduction demand	50 05	259 22	120	21 60

Microbial Oemand Factor	(chose 1X-4X)
Safety Factor (SF)	(chose 1X-4X)

Matt Requirements	Hj	Ethyl Lactate	
	(lb)	(lb)	(oal)
Dissolved Phase Contamination	1 1	428	54
Adsorbed Phase Contamination	6 4	258 0	32 7
Competing Electron Acceptors	22 6	902 0	1142
Competing Microbial Processes	301	1203 2	152 3
Subtotal	602	2408 0	304 6
Total (with SF)		9824 2	**121S.2**

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

Location ID			MW-023	MW-03D	MW-08D	MW-081	MW-101
Sample ID			Mwoaa	MW03O	MWOSD	Mwoai	MW10I
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)							
Date Sampled			04/23/03	04/23/03	04/23/03	04/23/03	03/27/03
Parameter	**Units**	**Criteria'**					
Volatile Organic Compounds							
1,1,1 Trichloroethane	UG/L					058	
1,1 Dchloroethane	IXVL						
1,1-Dichloroethene	UG/L				12		
1,2 Dichloroethene (as)	UGrL						
4 Methyl 2 pentanone	UG/L				NA	NA	NA
Acetone	UtVt	50			NA	NA	NA
Benzene	UCVL						
Chloroform	UG/L						
Ethytbenzene	UG/L						
Methyl ethyl ketone (2 Bulanone)	UG/L	50			NA	NA	NA
Methylene chloride	UG1						
retrachloroethene	UG1					1 7	
Toluene	UG/L						
Trichloroethene	UGA			50			
Vinyl chtonde	UG/L						
Xylene (total)	UG/L						

•Crilena NYSOECTOOSd 11) Amblaru Water Quality Standards and Guidance Valusj and Groundwatar EHluant Urrtfatiorii April 2000 OaasGA

FlagB essioned during ehamstry vaidatlon era •hown

Concent ration Exceeds Cntena

TABLE

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GROUNDWATER ANALYTICAL RESULTS

tf$ ~

MILLER BREWING COMPANY - FULTON, NY

&K !L

Location 10			MW-13D	MW-14D	MW-1BD	MW-17D	MW-21S
Sample ID			MW13D	HW14D	• MW-16D	MW17D	MW21S
Matrix			Groundwater	Qroundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			03/27/03	03/27/03	04/23/03	04/23/03	03/27/03
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1 Trichloroethane	UG/L	5	*a* 56 ^	068	C!___21____^	c : ,8 - ^	34
11 Dichloroethane	UG/L	5				064	
1,1-Dichbroethene	UGVL	5	18			CT 5 6 ~=J	0 86
1 2 Dichloroethene (as)	UO/L	5					
4 Methyl 2-pentanone	UGVL		NA	NA		NA	NA
Acetone	UGI	50	NA	NA		NA	NA
Benzene	UG/L	1					
Chloroform	UG/L	7					
EthylbenzenB	UG/L	5					
Methyl ethyl ketone (2 Butanorte)	UGI	50	NA	NA		NA	NA
Methylene chloride	UG/L	5					
Tetrachloroethene	UG/L	5	**CL 9 - U**	44	**C____45 __*Z2***	2 7	C 85 T ^
Toluene	UG1	5					
Tnchloroethene	UG/L	5					
Vinyl chloride	UG/L	2					
Xylene (total)	UGI	5					

•Criteria NYSDEC TOGS (111) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Umrtailons April 2000 Claw GA.

Flags assigned during chemistry validation are shown
C 3 Concantraiion Exceeds Cntena

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

n u

& $ *

Location ID			MW-250	MW-2S8	MW-279	MW-281	MW-28S
Sample ID			MWZED	UW-2SS	MW278	**Mw-sai**	MW2S8
Matrix			Groundwater	Groundwater	Groundwater	Groundwater	Oroundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			03/27/03	03/27/03	03/27/03	04/23/03	03/27/03
Parameter	**Units**	**Criteria***					
Volatile Organic Compounds							
1,1,1 Tnchloroethane	UG/L	5				35	
11 Dlchloroethane	UG/L	5					
1.1-Dichlaroethene	UGfl.	5				0 61	
1 2 Dichtoroethene (els)	UG/I	5					
4 Methyl 2 pentanone	IKVL		NA	NA	NA	NA	NA
Acetone	UG/L	50	NA	NA	NA	NA	NA
Benzene	UG/L	1					
Chloroform	UG1	7					
Ethylbenzene	UG/L	5					
Methyl ethyl ketone (2 Butanone)	UGI	60	NA	NA	NA	NA	NA
Methylene chtonde	UG/L	5					
Tetrachloroethene	UG/L	S				20	0 86
Toluene	UG/L	5					
rrtchtoroethene	UG/L	5					
Vinyl chlonde	UQ1	2					
Xylene (total) ,	UQO.	5					

Cntaria NYSDECTOQ8 0 1 1) A/nblent Watar Quality Standard! and Guidance Values andQroundwatOf EWuofrtLlmitaiion» April 2000 Class QA

Flags assigned dunng chamlstry validation are shown

Concentration Exceeds Cnl ana

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

Location ID			MW-32D	MW33S	MW-34D	MW-35D	MW-36S
Sample ID			MW-32D	MW-33S	MW-34D	MW3SD	MW3B3
Matrix			Groundwater	Qroundwaler	Groundwater	Groundwater	Qroundwater
Depth Interval (ft)			-	*	-	-	-
Date Sampled			03/27/03	03/27/03	03/27/03	03/27/03	04/23/03
Parameter	**Units**	**CrtterlB'**					
Volatile Organic Compound!							
1,1,1 Tnchloroelhane	UGfl.	6	60	CL 62___^	C T 1 4 "^	d 18 ^	
1 1 Dichloroethane	UG/L,	5				0 77	C!___21 .Z^
1,1 Oichloroethens	UQfL	5	14	0 95	42	43	
1,2DichJoroethene{ci3)	(JOT.	5				069	^ ^ _ 190 _^^
4 Methyl 2-pentanone	UGVL		NA	NA	NA	NA	
Acetone	U(VL	50	NA	NA	NA	NA	
Benzene	UGA	1					
Chloroform	UG/I	7					
Ethyl benzene	LOT.	5					
Methyl ethyl ketone (2 Bulanone)	UVL	50	NA	NA	NA	NA	
Methylene chloride	• UGA	5					
Tetrachloroethene	UOfL	5	C_____100_____^	C^____13 0 _ ! ! ^	C ^ 3 _ - ^		
Toluene	UG/L	5					
fnchloroetnene	UG/L	5					
Vinyl chloride	UOI	2					
Xylene (total)	UG/L	5					

Crtlena NYSDECTOGSfl 1 1) Ambient Water Quality Standards and Outdance Values and Groundwater Effluent Limitations April 2000 Class QA

Rons assigned during chsmstry validation are shown

Concentration Exceeds Cntsna

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

Location ID			MW-371	MW-3BS	MW-47S	MW-48S	MW-S1D
Sample ID			MW37I	MW38S	MW47S	MW49S	MW61D
Matrix			**Groundwater**	**Groundwater**	**Groundwater**	**Groundwater**	**Qroundwator**
Depth Interval (ft)							
Date Sampled			**04/23/03**	**04/23/03**	**04/23/03**	**04/23/03**	**04/23/03**
Parameter	**Units**	**Criteria'**					
volatile Organic Compound!							
1 11 Tnchloroethane \y	UG/L						
1 1 Dlchloroethana 1 /	UG/L						054
1,1 Dichloroethene	UG/L					**C** 58 ^	
1,2 Dichloroethene (cis) V	UG/L						
4 Methyl 2 pentanone	UG/L		NA				NA
Acetone	UG/L	50	NA				NA
Benzene	UG/L						
Chloroform *KS*	UG/L						
Ethylbenzene	UG/L						
Methyl ethyl ketone (2 Butanone)	UG/L	50	NA				NA
Methylene chloride	UG/L		•———150				
fetrachloroethene \y	UQ/L						
Toluene	UGH.						
Tnchloroethene \y	UG/L						
Vinyl chloride ^X	UG/L		220 T Z ^				
Xylene (total)	UG/L						

Crllsna NYSDEC TCK3S [11 1) Ambient Water Quality Siandards and Guidance Values and Groundwater Effluent Umtationa Apnl2000 Class GA

Flags assigned during chemstry validation are shown
Concentration Exceeds Criteria

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

Location ID			MW-641	MW-56D	MW-62S	MW-63S
Sample 10			MWS4I	MWS6D	MW-B2S	MW633
Matrix			Groundwater	Groundwater	Groundwater	Oroundwater
Depth Interval (ft)			-	-	-	-
Date Sampled			0423/03	04/23/03	03/27/03	03/27/03
Parameter	**Unite**	**Criteria***				
Volatile Organic Compound!						
1,1 1 Trichloroethane	UG/L	5		**C 80 3**		
1,1 Dichloroethane	UG/L	5				
1,1 Dichtoroethene	UG/L	5		30		
1,2 Dichloroethane (eta)	UG/l	5				
4 Methyl 2-pentanona	UG/L		NA	NA		
Acetone	UO/L	50	NA	NA		
Benzene	UG/L	1				
Chloroform	UG/L	7				
Elhyl benzene	uai	5				
Methyl ethyl ketone (2 Butanone)	UG/L	50	NA	NA		
Methylene chloride	UG/L	5				
Tetrachroroeinene	UG/L	5		**d B3 12**		
Toluene	UG/L	5				
rnchloroethene	UQ/L	5				
Vinyl chloride	UG/L	2				
Xylene (total)	UG/L	6				

•Criteria NYSDECTOG3(111) Ambient Watar Quality Standard* and Guidance Values and OrtHindwalar EHlu»nt UmJtB&onB AonJ2000 CIBBBOA

Rao* saalgned during chemsiry validation ara thown

Concentration Eicaada Crttana

n -
<*2£

MILLER STOICHIOMETRIC CALCULATIONS

1 Lactate

8NAC3H5O3 + 8$H_2$0 + 3C_2Cl_4 9C_2H_4 + 4C0_2+ 12H^+ + 12CI" + 8NaHC0_3 A / 3 - 2 3 ^,|€

3*(2*12+4*355)g 8* (1 *23 + 3* 12 + 5*1 + 3*16)g

498g NEEDS 896g
PCE LACTATE

1g NEEOS 1 80g
PCE UCTATE

H - 1

For 60% Na-Lactate

1g NEEDS 30g
PCE 60% Na LACTATE

1/2 **27M**

£ 1 5" \

2 Oil

2C8H-160 + 2H20 + C2CI4 8C_2H_4 + 2C0_2+ 4H^+ + 4CI-

1 *(2*12 + 4*35 5)g 2* (8* 12 + 16* 1 + 1 * 16)g

166g NEEDS 256g
PCE OIL

?-)2-+ tC I + I U **%.o**

1g NEEDS 1 54g
PCE OIL

H a *16*

lolasses/Sugar

8$C_6H_{12}0_6$+B1NflO + 9C2CI4 19C_2H_4 + 28C02+36H;

9* (2* 12 + 4 * ^ 5 ^ 8* (6* 12+ 12

1494g NEEDS 14401]*
PCE PURE SUGAR

NEEDS 0 96g
PCE PURE SUGAR

_ **C \2 + n i-f 6 16**

Assuming 50% sugary Classes (100% solid) **U>**

1fl NEEDS 1^5g
PCE U^TASSES

(¥0

For 662t^olid molasses

NEEDS 2 92g
jT PCE 66S MOLASSES

Job______________________________ Proiect No________________ Sheet______ of _____

Description_______________________ Computed by______________ Date ____________

_________________________________ Checked by_______________ Date ____________

Reference

5-tock(ov£-(n**

PCzf

c - c 4- 4 //a -•> £ — c + 4 a ^

/f

ICC J£, M 2J-(

\€6 /* = **2 ^ ^5"**

R f

c* =-c f. 3 ^ — ^ *£ ~c -t- 3 He/

c;* -/,?- PCfc"

W ***H***

4+±,_ +2 2%,,

<3^ = 2 *f ? £

Job______ Project No______ Sheet______ of ______

Description______ Computed by______.__ Date ______

______ Checked by______ Date ______

Reference

Vo

/

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y / **V**

/r

<$^2 &<*

62 — "?/-?r

-2- "

TCA

* , „ *CJt* *

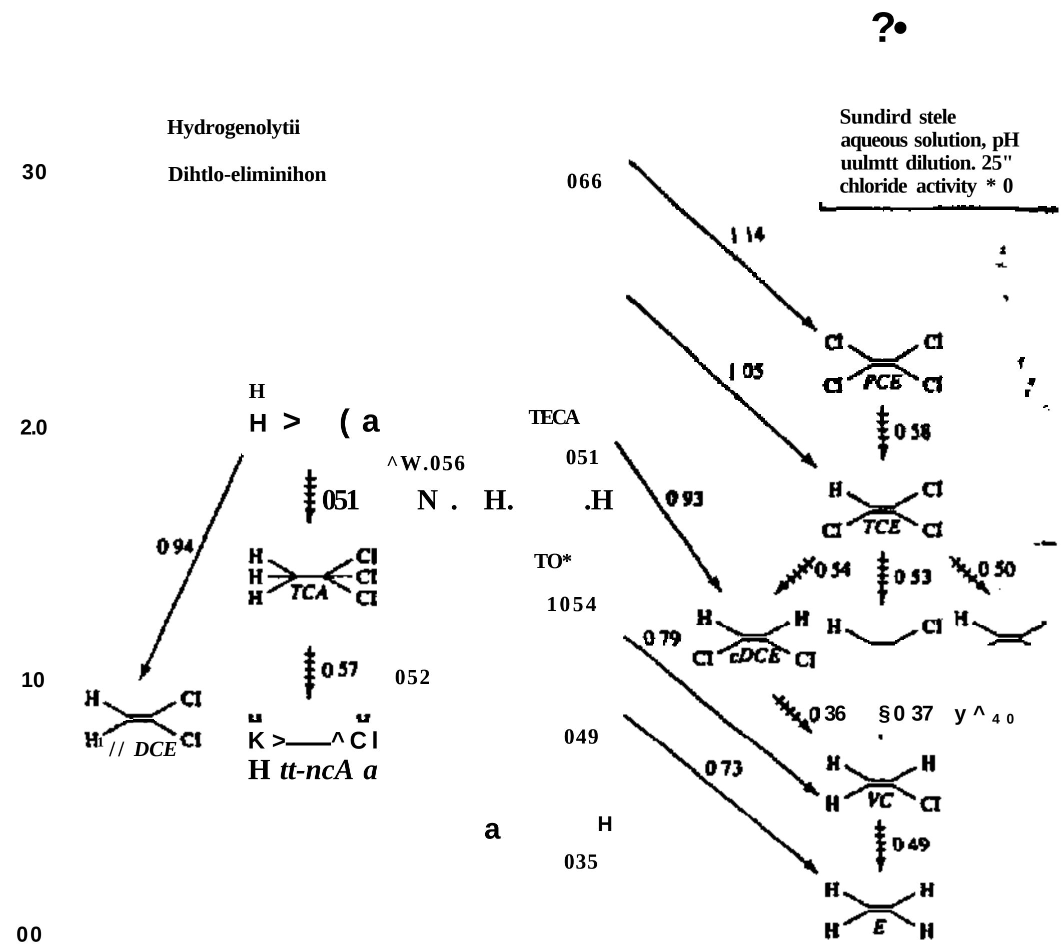
h- »

m s-

—*F*— - *2.7* T-

*, *I-OCA*

$$\frac{—}{T} = 2V*$$



// DCE~ l.l-dlchloroelhene
till TECA - 1.1.1.2-tetrtchloroethano
TCA N tnchloroeihme
// DCA « I l-dtchkwoeihene
HCA • hexschloroeitiane
/*CV* - pentfctiloroeihane
1122 TECA - I.1.2,2,-letrach)o(oethane
IJ2 TCA - I.I 2-tnchlonwihine
12 DCA =» UdxMonKtlune

CI " chloroelhanc
A » ethane
PC£ • perehloroethene
TCE * tnchloroeibene
cDCE » cu-dichlOToethene
iDCE a fronj-dichlotDcti
//-PC£ - t.l-dichtorocthent
VC n vuiyl chlonde
E a ethylene

FIOURE 713 Pothwoyt of chlonnoted alkane and olkene reduction and ettimoted relative half-life reduction potential* in volh *Source* Reprinted with parmmion from T M Vogef, C S Olddle, and P L McCarty, environmental Science *and Technology* 21, no. 8, (1987) 722-36 Copyright 1987 American Chemical Society

I I

URS PAGE **7** OF **31**

JOB NO 111 73 796

MADE BY M O **DATE** 9/20/04

CHKD BY **DATE**

PROJECT Fulton Container Plant Remediation

SUBJECT._____Hydrogen Infection Pilot Study South of the Plant Building______________,___________

^Z^ert^*^

ROD Change Documentation Report
Permeable Reactive Barrier System
Former Miller Container Plant
Town of Volney, NY

FINAL

Reference 1

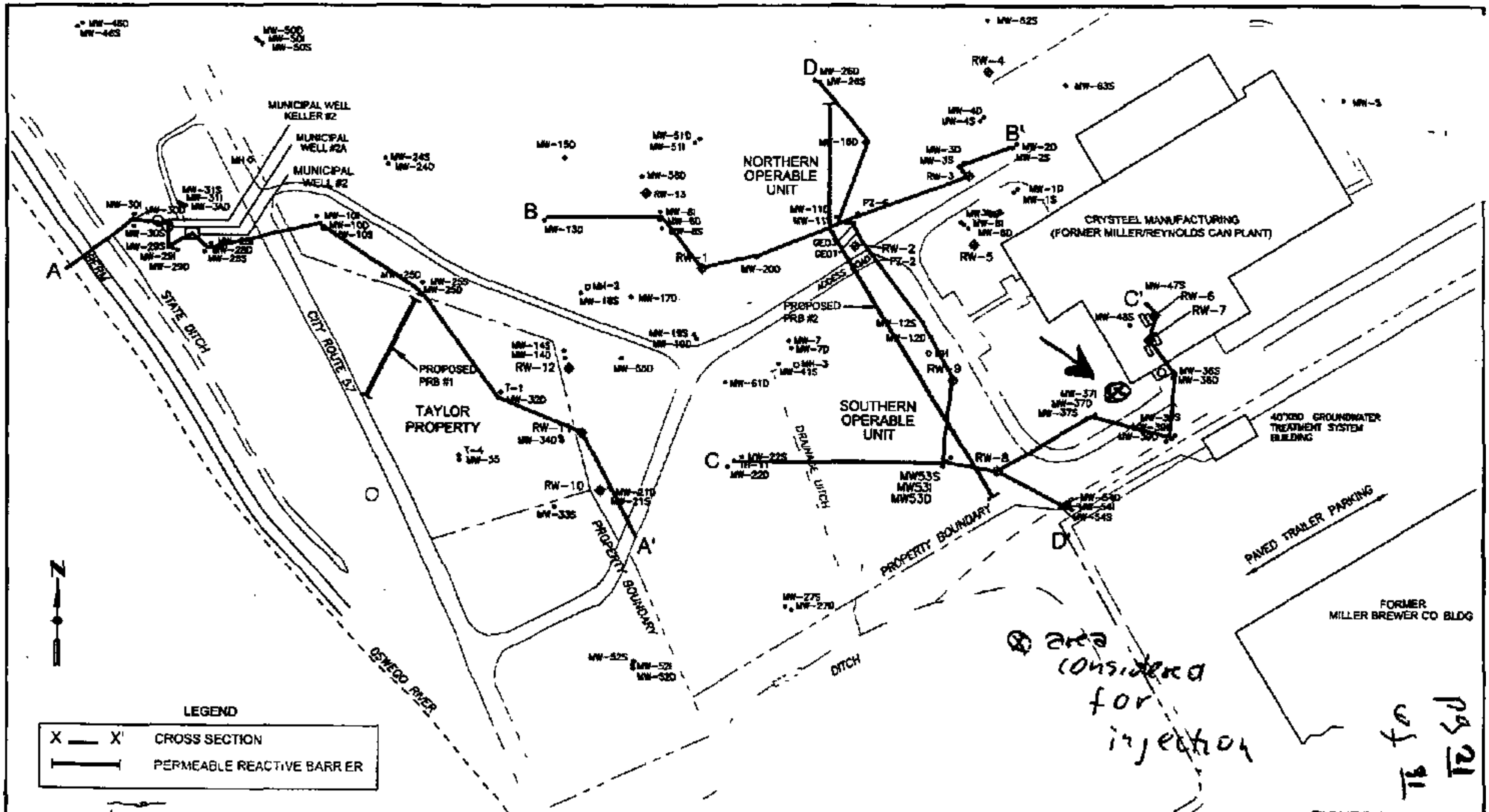
Prepared for:

Miller Brewing Company
3939 W. Highland Boulevard
Milwaukee, WI 53201-8322

Prepared by:

URS Corporation
10200 Innovation Drive, Suite 500
Milwaukee, WI 53227

September 2003

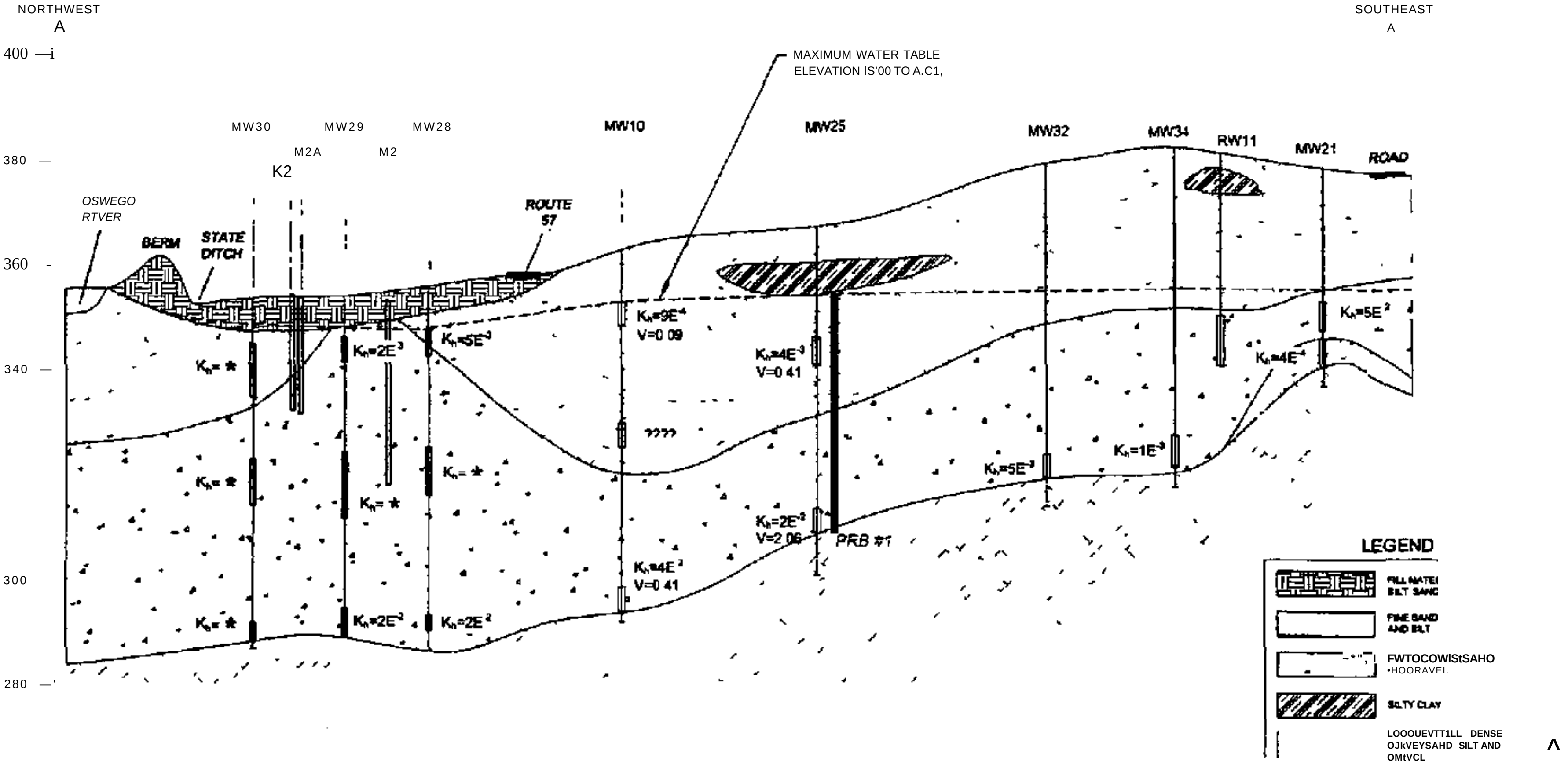


⊗ area considered for injection

pg 21 of 81

FIGURE 3-1

MILLER BREWING COMPANY FORMER MILLER CONTAINER PLANT VOLNEY NEW YORK	AS NOTED		URS	CROSS SECTION LOCATION MAP FORMER MILLER CONTAINER PLANT VOLNEY NEW YORK
	RF	7/22/02		
	JC	7/22/02		81002401
	JI	7/22/02		B3



HORIZONTAL SCALE M FEET
VERTICAL *EXtBGBWnOHSX*

FIGURE 3-2

WEJUEDFOH

MILLER BREWING COMPANY

FORhCR MILLER CONTAINER PLANT
VOLNEY NEWVOAX

AS NOTED	
RF	4M/01
JC	41M31
4	a/i SAB

CON«ie»*T'*t-*Li *WTO « J M F

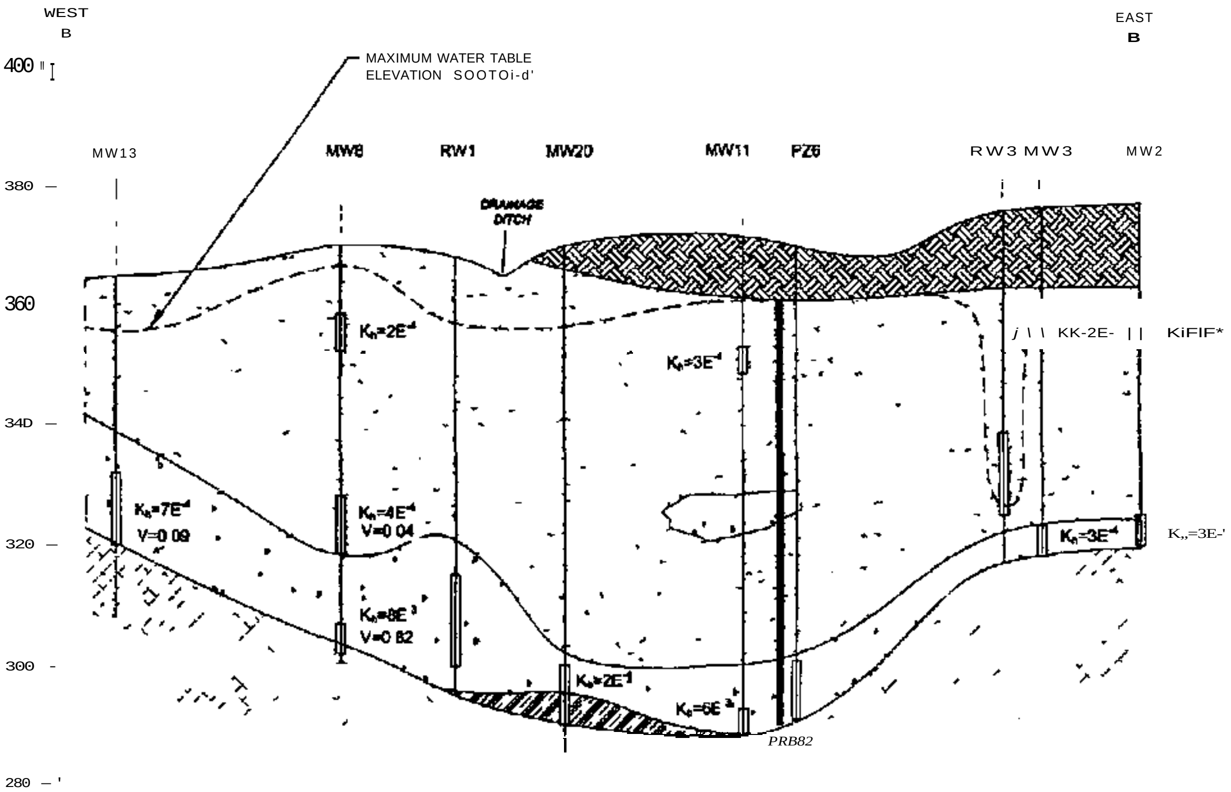
URS

HBSHwrrr

UTWOLOG1C AND HYDROLOGIC PARAMETERS
CROSS SECTION A A THROUGH PRB *1

COtOHHOiU IUIKMO «MW«MUVSU*IES»» BCM

81002401 B4



LEGEND

LOOGMENT T*I DENSE CLAYEY SAND SILT AND GJUVEL

ABBREVIATION KEY

Kh Hydraulic Conductivity (cm/sec)

V GrourKtwater Velooty (ft/day)

* Recharge too raptd for quantitation

^£S

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATJOW-W

FIGURE 3-3

rwumiM

MILLER BREWING COMPANY

FOBtCR UU.ER CONTAINER PLANT
VOLNEV NEW YORK

DUan(V
RF

JC

um——
AM/01

4/4101
tie —

canmmiijmmiinniiitcimniini

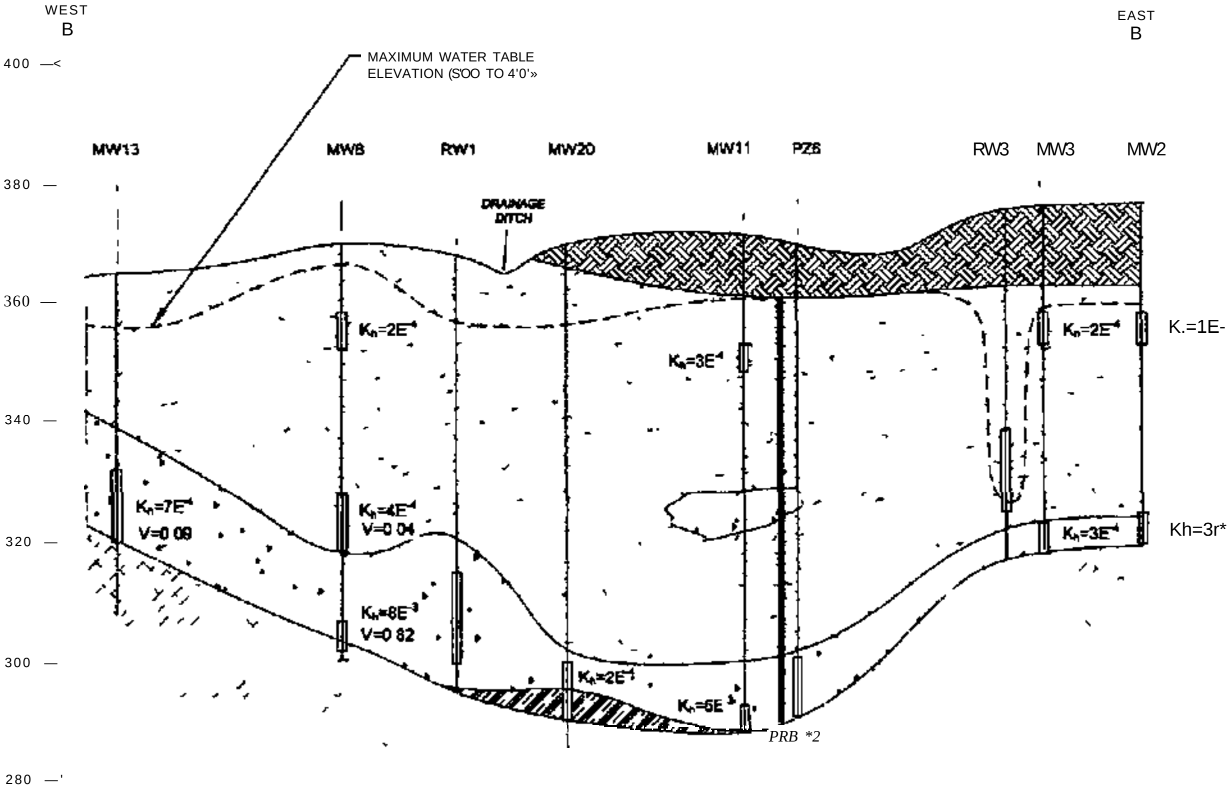
URS

wranjnr

LiTHOLOGIC AND HYOROLOGIC PARAMETERS
CROSS SECTION B B THROUGH PRB «

E w m W C M ft&I f I M G D EXKMCBABbAE:

81002401 B5



LEGEND

^m=8k	FILL MATERIAL CLAY SIT SAND GRAVEL
I	FgNE&tND AFCSLT
I'	FWTOCCWISESMC) Atff) GRAVEL
VWM&	SLTYCLAY
I	10OGUENTT1U 0€NSt CIAYEYSANO SILTAHO GRAVEL

ABBREVIATION KEY

Kr, Hydraulic Conductivity (cm/sec)
V Groundwater Velocity (ft Vday)
* Recnarge too rapid for quantitation

HORIZONTAL SCALE IN FEET
V&mCAL EXAGOERATKIHSX

\>

FIGURE 3-3
BGS3JTET

LITHOLOGIC AND HYDROLOGC PARAMETERS
CROSS SECTION B-B THROUGH PRB #2

MILLER BREWING COMPANY

FORMER UU.ER CONTANER PLANT
VOLNEY WW YORK

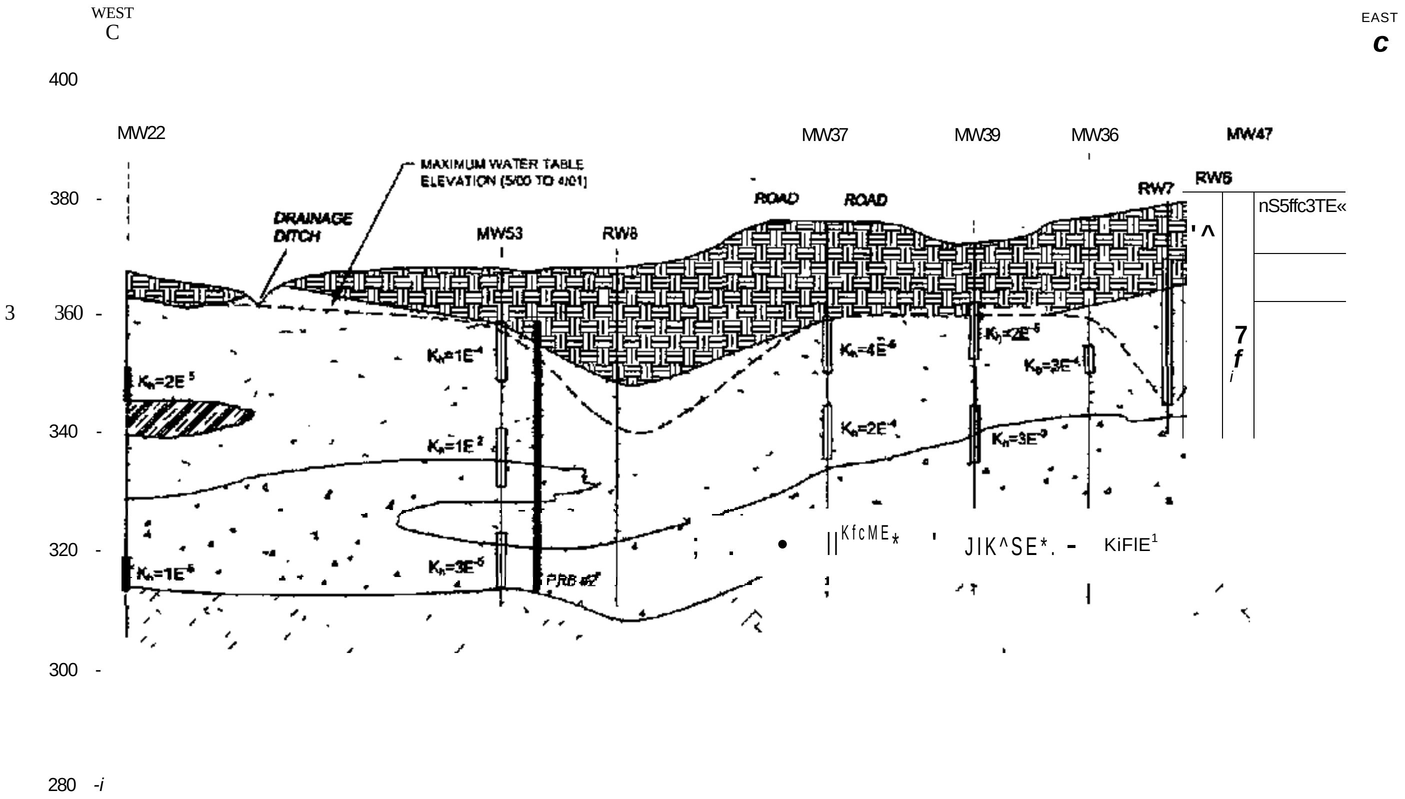
tACJBW
JC

4/4/01
Wit ' '

URS

CIO CMMWHO FU KUIMtOOOIIIOMMIJVfK'ILEMIFKa]

81002401 B5



LEGEND

LOCXa©JTTIU. DENSE
WArEYSAMO SU.I WD
OUAVEL

ABBREVIATION KEY

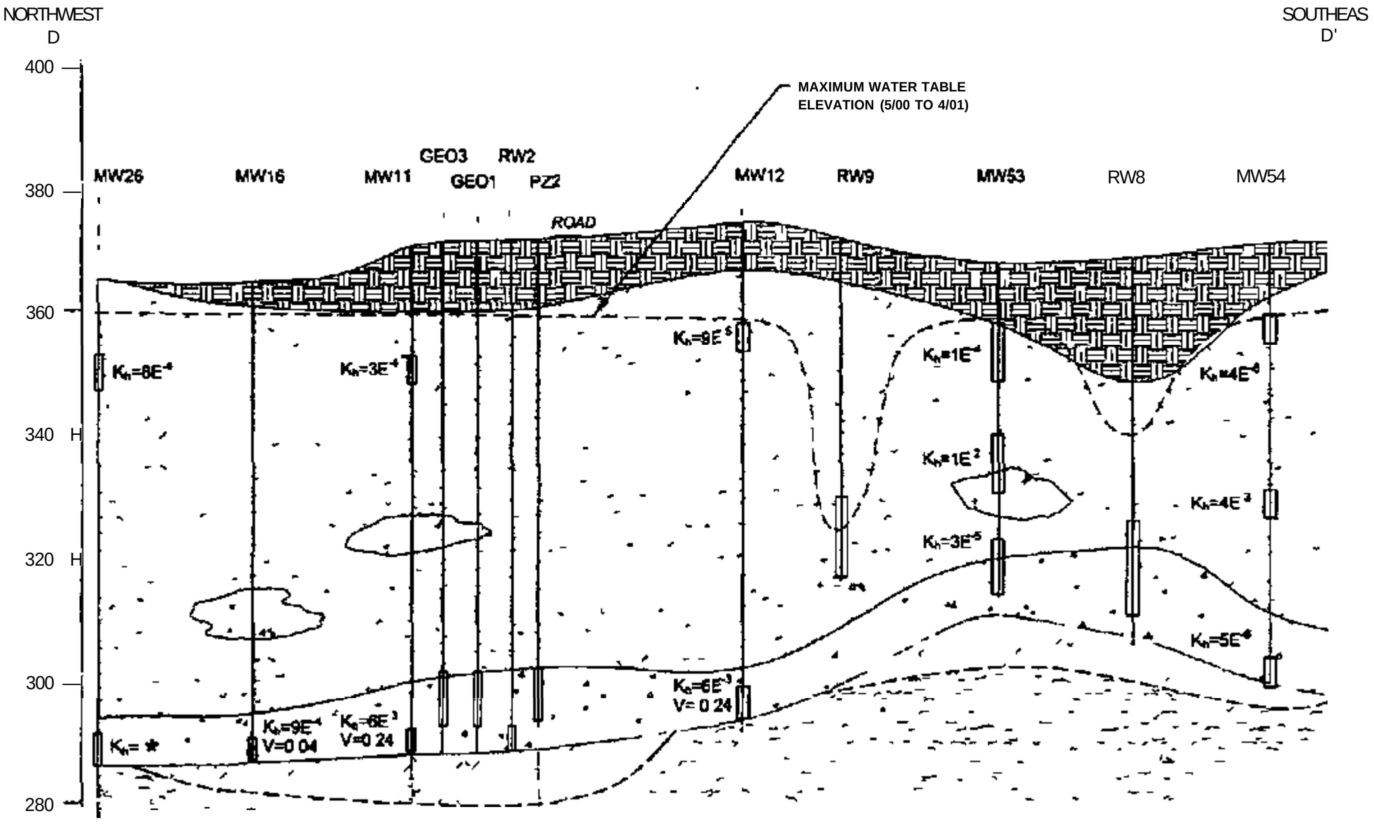
Kh Hydraulic Conductivity (cm/sec)
V Groundwater Velocity (ft /day)
* Recharge too rapid far quantitation

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGERATIONS

S

FIGURE 3-4

MILLER BREWING COMPANY FORMER MILLER CONTAINER PLANT VOLNEY NEW YORK	AS NOTED *Wt*——— 4/4/01 JC 4M/C1	CCMBCBTIMJiu. H o n ; REWWBI—KWtTYC* **URS** •HMUQEC WACtMHEVB	UTHOLOGIC AND HYDROLOGIC PARAMETERS CROSS SECTION C-C THROUGH PRB *2 C W D ^ M M i F U HBLLBW!OO0gaiO**OfeJWtll*fc.fSM f fi3-* 81002401	B6



LEGEND

i | | g T f a | a FU.IHATCT1AI CXAY

LOOGMNTTIU OEWtt CLAYEY «ANO M.T AMD GRAVEL

ABBREVIATION KEY

Kft Hydraulic Conductivity (cm/sec)

V Groundwater Velocity {ft/day)

* Recharge too rapid for quantrtaton

HORIZONTAL SCALE IN FEET

PJ.OTPR3

FIGURE 3-5

•SWBDXJI

MILLER BREWING COMPANY
FOftkCR MILLER CONTAINER PLWI-
vomer1 NEWYOAX

wrr
HKBRS
Rf
JC

me——
4f4fl1
un

can»mH#uAwniDorjDj«»iiiTTv

URS

MJ1ULSW
LrTHOLOGIC AND HYDROLOGIC PARAMETERS
CROSS SECTION 0 D THRDUGKPRB*2

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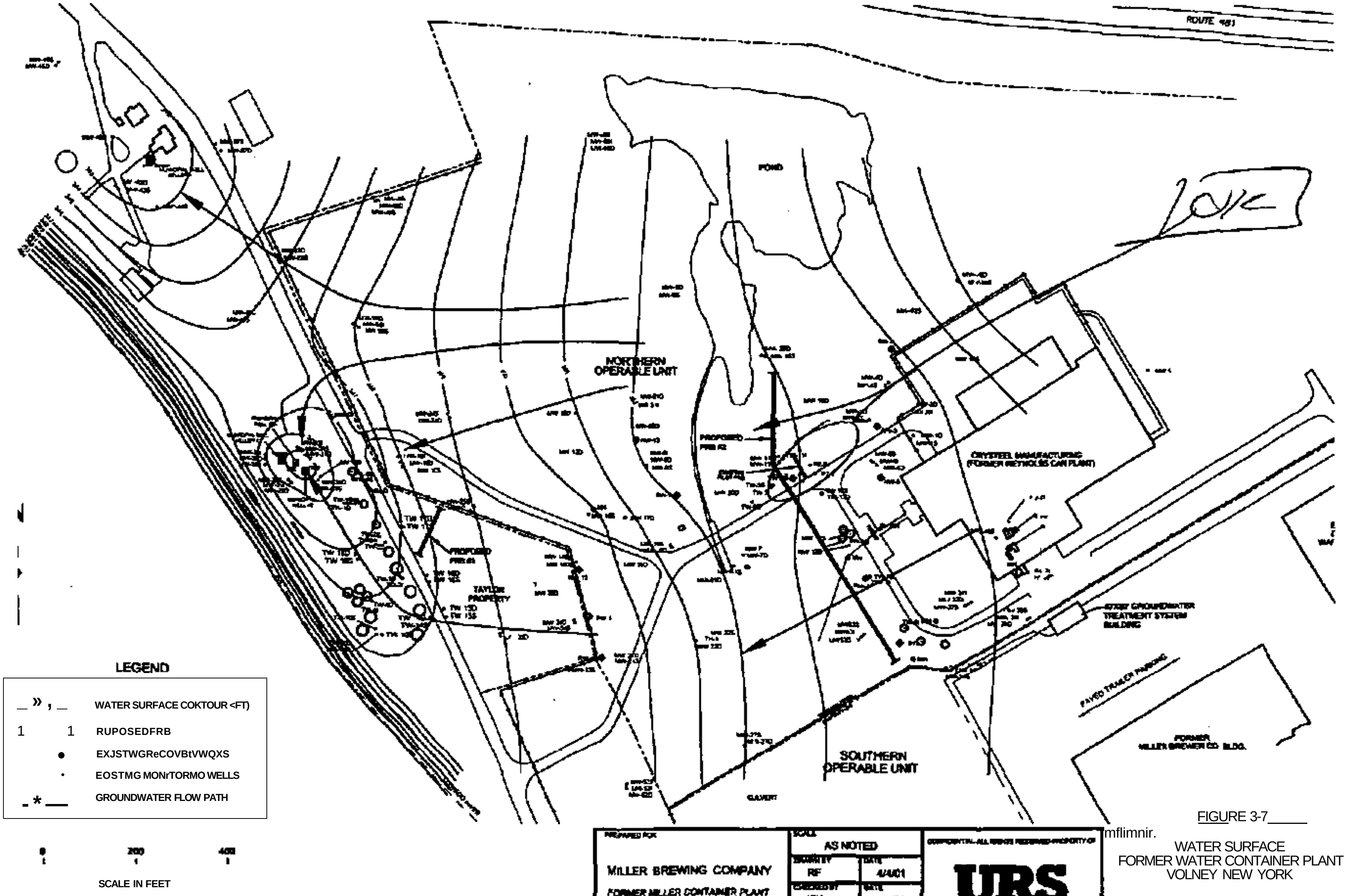

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_ » , _ WATER SURFACE COKTOUR <FT)

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● EXJSTWGReCOVBtVWQXS

• EOSTMG MONrTORMO WELLS

_ * ___ GROUNDWATER FLOW PATH

PREPARED FOR MILLER BREWING COMPANY *FORMER MILLER CONTAINER PLANT* *VOLNEY NEW YORK*	SCALE AS NOTED	CONFIDENTIAL-ALL RIGHTS RESERVED-PROPERTY OF **URS** MILWAUKEE, WISCONSIN
	DRAWN BY RF · DATE 4/4/01	
	CHECKED BY JSK · DATE 4/4/01	
	APPROVED BY JI · DATE 8/15/02	

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FIGURE 3-7

WATER SURFACE
FORMER WATER CONTAINER PLANT
VOLNEY NEW YORK

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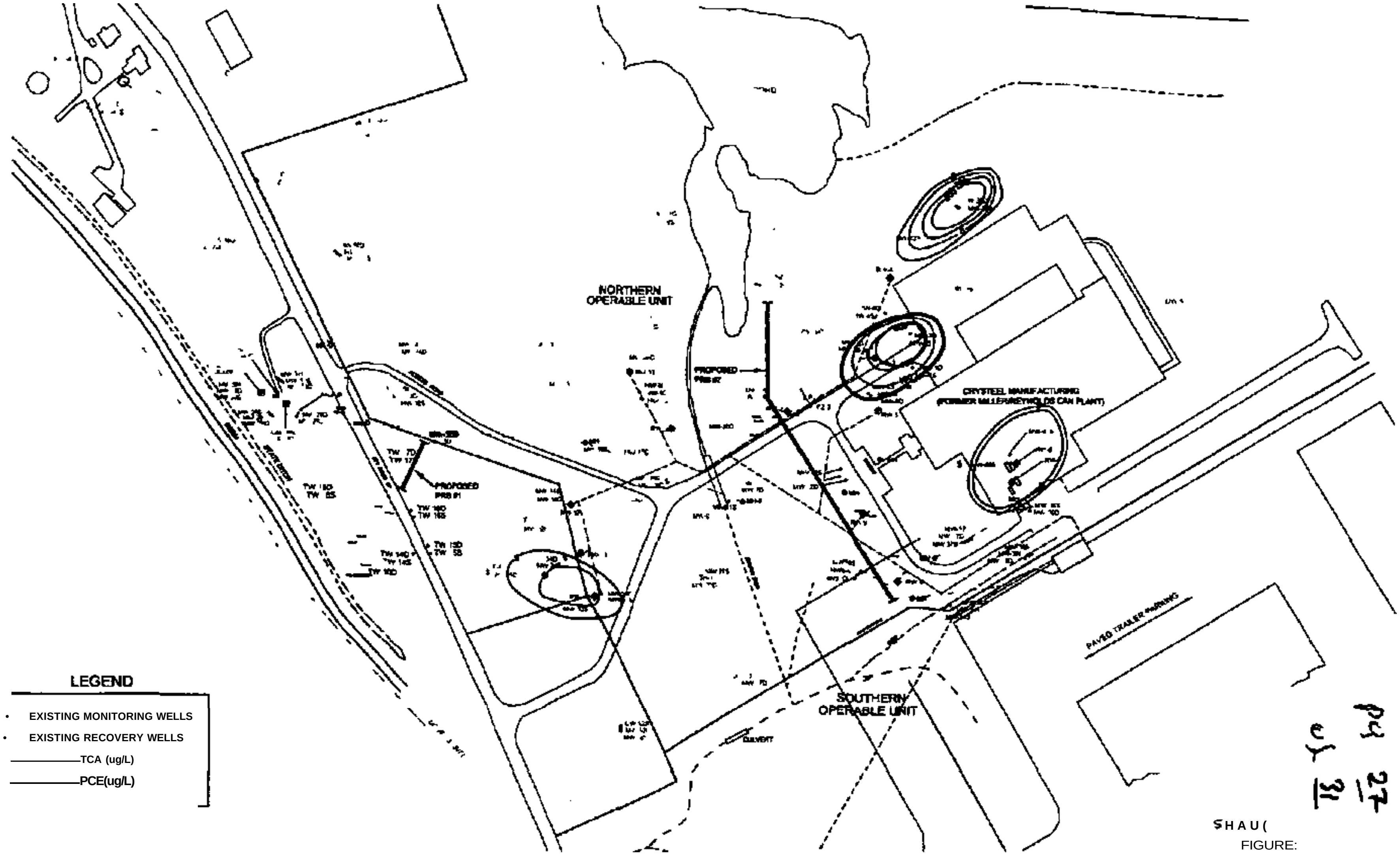

pg 27
of 31

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FIGURE:

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MILLER BREWING COMPANY

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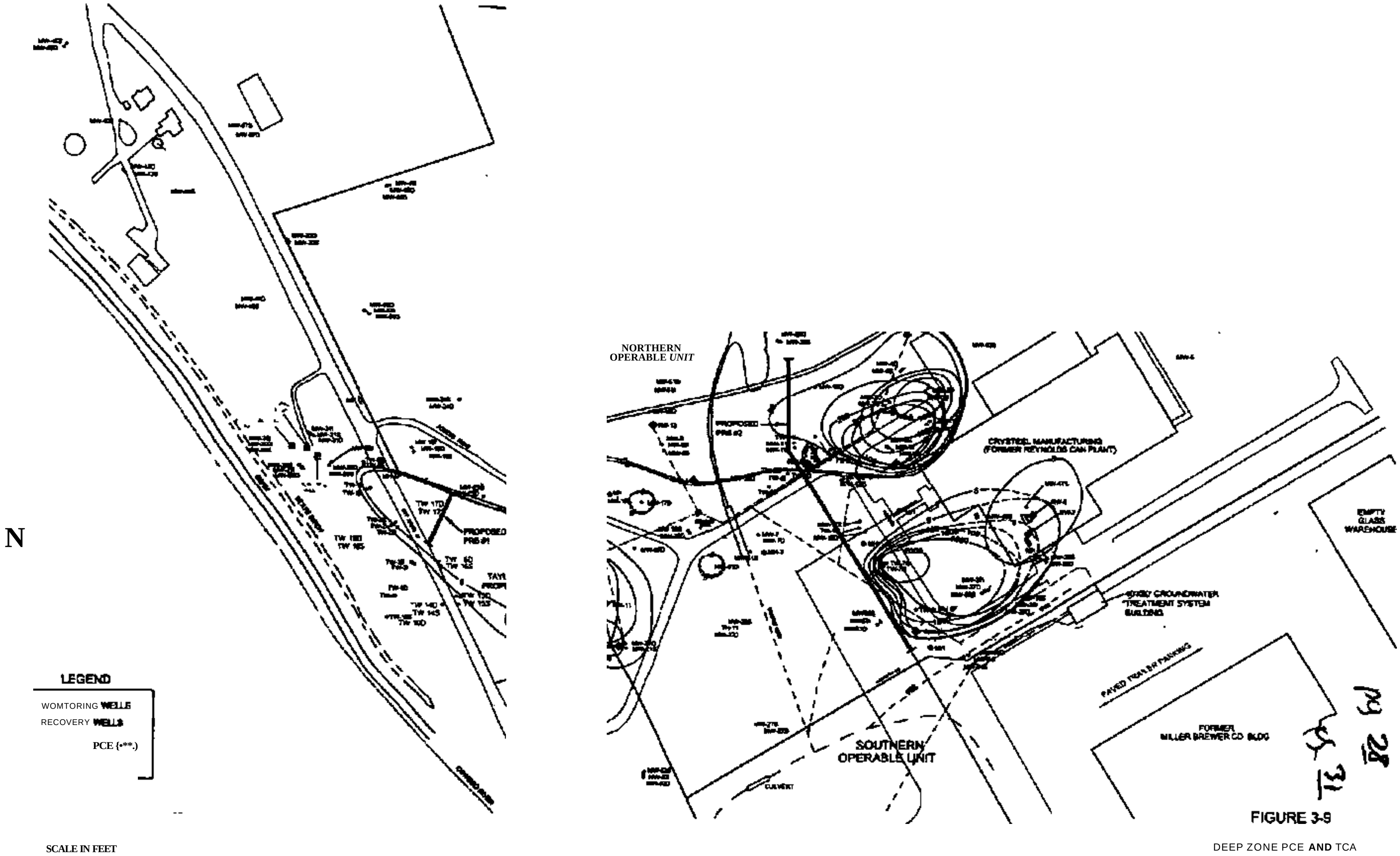

pg 28 of 31

FIGURE 3-9

MILLER BREWING COMPANY

FORMER MILLER CONTAINER PLANT
VOLNEY NEW YORK

URS

DEEP ZONE PCE **AND** TCA
FORMER MILLER CONTAINER PLANT
VOLNEY NEW YORK

TECHNICAL PROTOCOL FOR EVALUATING NATURAL ATTENUATION OF CHLORINATED SOLVENTS IN GROUND WATER

by

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NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
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CINCINNATI, OHIO 45268

Table B.2.1 *Values of Aqueous Solubility and $K_x$for Selected Chlorinated Compounds*

Compound	Solubility (mg/L)	(L/Kp)
Tetrachloroethene	150'	263'
Tetrachloroethene		359[b]
Tetrachloroethene	1,503°	209-238[L]
Tnchloroethene	1,100'	107'
Tnchloroethene		n7[b]
Tnchloroethene	l,100[c]	87-150=
1,1-Dichloroethene	2,250*	64 6*
1,1-Dichloroethene		80 2[b]
1.1-Dichloroethene	2,500°	150[d]
as-1,2-Dichloroethene		80 7*
or-l,2-Dichloroethene	3,500[c]	40[c]
trans-1,2-Dichloroethene	6,300'	58 9*
trans-1,2-Dichloroethcne		80 2[D]
/r<8u-l,2-Dichloroethene	6,300[e]	36°
Vinyl Chlonde	1,100*	2 45'
Vmyl Chlonde	2,763[fl]	04-56°
1,1,1 -Tnchloroethane	1,495°	183°
1,1,2-Tnchloroethane	4,420[e]	70°
1,1 -Dichloroethane	5,060"	40[d]
1,2-DichIoroethane	8,520°	33 to 152"
Chloroethane	5.710"	33 to 143°
Hexachlorobenzene	0 006'	..
1,2-Dichlorobenzene	156°	272 - 1480"
1 ,3-Dichlorobenzene	111"	203 to 31,600"
1,4-Dichlorobenzene	74 to 87°	273tol833[J]
Chlorobenzene	472[a]	83tn389[J]
Carbon Tetrachlonde	805«	nr>«
Chloroform	7,950°	<34[e]
Methylene Chlonde	13.000°	48[c]

[0] *From Knox et al, J 993*

[b] *From Jeng et al, 1992, Temperature - 20°C*

[e] *From Howard. 1990, Temperature - 25'C*

[d] *From Howard. 1989, Temperature = 2S°C*

' *From Howard. 1989. Temperature = 20'C*

[/] *ATSDR. 1990. Temperature - 20"C*

* *From Howard, 1990. Temperature = 20^{B}C*

accepted literature values until the modeled and observed contaminant distribution patterns match Because aquifer materials can have a range of effective porosity, sensitivity analyses should be performed to determine the effect of varying the effective porosity on numerical model results Values of effective porosity chosen for the sensitivity analyses should vary over the accepted range for the aquifer matrix matenal Table C 3 2 presents accepted literature values for total porosity and effective porosity

***Table** C.3,2 Representative Values of Dry Bulk Density, Total Porosity, and Effective Porosity for Common Aquifer Matrix Materials (After Walton, 1988 and Domemco and Schwartz, 1990)*

Aquifer Matrix	Dry **Bulk Density (gnVcnr)**	**Total Porosity**	Effective Porosity
Clay	1 00-240	034-060	001-02
Peat	—	—	03-05
Glacial Sediments	115-2 10	—	005-02
Sandy Clay	—	—	003-02
Silt	—	034-061	001-03
Loess	075-160	—	015-035
Fine Sand	1 37-1 81	026-053	01-03
Medium Sand	1 37-1 81	—	015-03
Coarse Sand	1 37-1 81	031-046	02-035
Gravely Sand	1 37-1 81	—	02-035
Fine Gravel	136-219	025-038	02-0 35
Medium Gravel	136-219	—	015-025
Coarse Gravel	136-219	024-036	01-025
Sandstone	160-268	005-030	01-04
Sihstone	—	021-041	001-035
Shale	154-3 17	00-010	—
Limestone	174-279	00-50	001-024
Granite	224-246	—	—
Basalt	200-2 70	003-035	—
Volcanic Tuff	—	—	002-035

C.3.1.5 Linear Ground-water Flow Velocity (Seepage or Advective Velocity)

The average linear ground-water flow velocity (seepage velocity) in one dimension in the direction parallel to ground-water flow in a saturated porous medium is given by

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CALCULATION COVER SHEET

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Project Manager/Date

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PAGE 1 OF 2
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PROJECT **Fulton Container Plant Remediation**
SUBJECT. **Vnlumft of Liquid for the Hydrognn Iniaction Pilot Study North of the plant Building**

1. PURPOSE

The purpose of this calculation is to evaluate the degree of aquifer saturation with the liquid introduced into the subsurface during the proposed hydrogen injection pilot study

2. GENERAL

The aquifer and the injection of substrate have been described in calculation *Hydrogen Injection Pilot* Study *North of the Plant Building* (URS, Sep 20, 04) The substrate evaluated was 60%-molasses/40%-water mix It was determined that approximately 500 gallons per test area of aquifer (60 by 30 ft) needs to be injected Using four rows of injection points, staggered, it was determined that the total number of points is 26 In this calculation it is assumed that the substrate is mixed with water and injected into the aquifer The total volume of injected liquid (substrate and water) is then evaluated with respect to the degree to which it will fill the aquifer pore space This is to evaluate the degree to which the substrate will contact the mass of contaminant distributed within the aquifer

3. CALCULATIONS

In the calculation entitled *Hydrogen Injection Pilot Study North of the Plant Building,* the thickness of the saturated zone of the aquifer has been estimated to be 40 feet The soil porosity of 40% was used Based on that, the pore water within the test area of 60 by 30 feet is V_{p0}re ~ 60*30*40*0 40 = 28,800 ft^3 (215,424 gal)

It is assumed that the treatment area will contain N = 26 injection points Injection will be performed using push technology, utilizing $t_{in]}$ = 3 hours per point The table presented below shows the total volume of injected liquid (Vin_3) and the average flow required per each injection point (Qpomt) to produce that volume, both as a function of the percent of pore space that will be saturated (p)

$$V_{in3} = P\ V_p$$

$$Qpomt = (V_{in]} / N) / t_{inj}$$

Spreadsheet produces a table of injection rate per point and total injected volume as functions of percentage pore space filled

Data

Area of aquifer treated	A	60	by	30 ft =	1,800 ft^2
Saturated thickness of aquifer	H_0	40 ft			
Porosity of aquifer material	n	04			
Number of injection points	N	26			
Injection time per point		3hrs =		180 mm	

Calculate

Pore volume V_D = 28,800 ft^J = 215,453 gal

Fraction of pore volume filled		Total volume injected into the aquifer		Volume per point injected into the aquifer		Injection rate per each point	
P		$V_{,nj} = pV_p$		$V_{,n)}/N$		Qpo«^{s}(V_{IN}/N)/tfc,	
[%1	E]	[ft^3]	[gall	[ft^3]	fgaii	[ft^3/min]	[gal/min]
01	0 001	29	215	1 1	8	0 01	00
1	0 01	288	2,155	11	83	0 06	05
5	0 05	1,440	10,773	55	414	0 31	23
10	01	2,880	21,545	111	829	0 62	46
13	**013**	**3,761**	**28,138**	**145**	**1,082**	0 80	60
15	0 15	4,320	32,318	166	1,243	0 92	69
20	02	5,760	43,091	222	1,657	123	92
30	03	8,640	64,636	332	2,486	185	138
50	05	14,400	107.726	554	4,143	3 08	23 0
75	0 75	21,600	161,590	831	6,215	4 62	34 5
100	1	28.800	215.453	1.108	8,287	6 15	46 0

Note The pilot study includes two areas, each 60 by 30 ft

URS EXHIBIT 4.7-2

CALCULATION COVER SHEET

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Calculation Approved by

Project Manager/Date

Revision No	Description of Revision	Approved by

Project Manager/Date

PROJECT **Fulton Container Plant Remediation**
SUBJECT. **Hydrogen Infection Pilot Study North of the Plant Building**

1. PURPOSE

The purpose of this calculation is to estimate quantities of hydrogen-donor product (molasses) required to conduct a field study of the remediation of chlorinated solvent contamination identified in the aquifer at the Miller Brewing Company Container Division in Fulton, New York The study area is north of the plant building (see page 21)

2. GENERAL

The aquifer at the site consists of two layers fine sand and silt with some clay lenses, underlain by fine to coarse sand and gravel In some locations the topmost layer is made up by man-made fill, however, the fill is generally located above the water table and does not form an active part of the aquifer The aquifer is underlain by lodgment till, consisting of dense, hard mixture of clayey sand, silt and gravel In some locations the till is absent and the aquifer is in direct contact with the bedrock See Figures 3-2 through 3-5 of reference 1

Water is found mostly at unconfmed conditions The hydraulic conductivity of the aquifer is highly variable, slug tests results indicate values on the order of 10"^{e} to greater than 10"^{2} cm/s In the area of the plant building and immediately downgradient, values of hydraulic conductivity appear to be mostly on the order of 10"^{4} to 10"^{3} cm/s See Figures 3-1 through 3-5 of reference 1

Hydraulic gradients are difficult to ascertain The flow regime is influenced by several extraction wells (both water supply and remediation wells) as well as the presence of a large pond north of the plant The flow pattern appears to be different at different depths, as well as seasonably variable In most general terms, the ground water flows from east to west, towards the Oswego River A depth-averaged potentiometric surface map is shown on Figure 3-7 of reference 1 It indicates a gradient of approximately 1 ft over 400 feet (0 0025) immediately downgradient of the plant building

Chlorinated solvent contamination is located mostly around the western part of the building and immediately downgradient See Figures 3-8 and 3-9 of reference 1 Results of the latest sampling round (March-April, 2003) are presented on pages 8 to 13 The highest values of total chlorinated hydrocarbons are on the order of 1,000 ug/L

There are no data regarding several aquifer parameters that influence the hydrogen balance during remediation, such as the concentrations of oxygen, nitrate, manganese, iron and sulfate Likewise, the organic carbon content of the aquifer is not known

3. APPROACH

The calculation is based on following assumptions

- The hydrogen yield of the donor compound is determined based on the molecular formula
- It is assumed that all reactions proceed to completion
- Hydrogen demand for reductive dechlorination and for competing electron acceptors is based on stochiometry of reactions

The dissolved mass "Mdissoived" of a chlorinated solvent is calculated as follows

$$MdisBolved = V_a \; n \; C$$

The same applies to the dissolved mass of competing electron acceptors (oxygen, nitrate, etc) Symbols are V_a - volume of aquifer under remediation, n - aquifer porosity, C dissolved-phase concentration of the chlorinated compound (or competing electron acceptor)

The adsorbed mass "Mactaorbed" of a chlorinated solvent is. calculated based on the assumption of partitioning of contaminants between water and organic carbon present m aquifer soils Competing electron acceptors do not adsorb onto soil Therefore, only the mass of contaminants is taken into account in calculating the hydrogen demand of the adsorbed compounds

$$S = Kd\ C$$

$$Kd = Koc\ foe$$

$$Madaorbed = V_a\ pb\ S$$

Symbols are pb - bulk density of aquifer material, S - sorbed-phase concentration of the chlorinated compound, Kd - distribution coefficient of the chlorinated compound, Koc - water/organic carbon partitioning coefficient of the chlorinated compound, f_{OC} - organic carbon fraction of soil

The mass of hydrogen "Mhydrogen" required to treat a given mass ^{W}M" of chlorinated solvent or a competing electron acceptor is calculated as follows

$$Mhydrogen = M\ /\ fstochiometric$$

The f stochiometric is the mass of contaminant or competing electron acceptor neutralized by a unit mass of hydrogen

The microbial demand is treated by using a factor increasing the hydrogen demand calculated for chlorinated solvents and competing electron acceptors

A factor of safety is applied to the total hydrogen demand calculated above

4. DATA

Volume of aquifer treated
The unit volume considered here will encompass the area of 60 by 30 ft Based on Figures 3-3 and 3-4, the saturated thickness of the aquifer in the area near the downgradient end of the building is approximately 4 0 ft

$V_a = 60*30*40 = 72,000\ ft^3$

Aquifer porosity
Unknown Assume 40% (reference 2)

n = 0 40

Hydrogen yield of molasses
See page 15 Hydrogen yield of sugar contained within molasses is

Hydrogen yield = 15 lb molasses / 1 lb hydrogen

Bulk density of aquifer material
Unknown Use 110 lb/ft^3

$p_b = 110\ lb/ft^3$

Organic carbon fraction of soil
Unknown Use 1%

foe « 0 01

Water/organic carbon partitioning coefficient
Values of Koc are contaminant-specific See reference 2

Stochiometric factors
Values of fotochicmetric are contaminant-specific See pages 16 to 18

Donor product density and content in injected liquid
The hydrogen donor product in molasses is sugar Sugar makes up approximately 60% by weight of molasses {page 14) Therefore, the capacity of molasses to supply hydrogen is as follows

H2 capacity of sugar = 0 067 lb Ha/ lb sugar {see page 15)

Fraction of sugar in molasses = 0 60 (page 14)

H_2 capacity of molasses = 0 067*0 60 = 0 040 lb Ha/ lb molasses, or 25 lb molasses/ 1 lb H_2

It is assumed that, molasses will form 60% by weight of the injected liquid Specific gravity of molasses is 1 41 (page 14.) Therefore, specific gravity of 60%-molasses/40%-water mixture is (1 41*0 6 + 1 00*0 4)/l 0 = 1 25 Density of injected liquid is 1 25 kg/L = 10 4 lb/gal

- Concentrations of competing electron acceptors
  These concentrations are not known Concentrations assumed here are based on values encountered on other projects
- Microbial demand factor
  Value of 4 is assumed
- Dissolved-phase concentrations
  Dissolved-phase concentrations of chlorinated solvents are taken from the March-April, 2003 sampling event Concentrations are from the sample collected in well MW-37I, which displayed the highest total VOC concentration

5. CALCULATIONS

Calculations are presented on page 7 The volume of molasses/water mixture (60% molasses by weight) required is

V = 335 gal

It is also assumed that during the time when the effects of injection are monitored there will be one pore volume natural exchange of ground water within the study area Therefore, the reagent will have to neutralize an additional mass of contaminant and competing electron acceptors in the ground water flowing from upstream

Vaddxtxonai = (1 5+31 4)*4 = 132 gal

The total quantity (to the nearest 100 gal) is 335 + 132 « 500 gal of molasses mix (60% of molasses by weight)

6. REFERENCES

1 ROD Change Documentation Repot
Permeable reactive Barrier System
Former Miller Containment Plant
URS, September 2003

f'a/ivte^^{1}^ $*^{s}$

Molasses Design for Plume Area/Grid Treatment

Site Namo	Miller Brewing Co Container Division
Local i on	Fulton New York

Molasses (C|H„0»)

Pure Hj Yield	25 lb Molasses (at 80% sugar 40% other ingredientsVib H_2
Molasses % (by weight) in solution	60
Capacity of solution to supply H_2	41 7 lb Molasses solution/lb H_2
Density of Molasses/Water solution	10 4 lb/gal

SiU Conceptual Model

Width of Treatment Area	60 0 ft	
Length of Treatment Area	300ft	
Depth to Water Table	15 ft	
Thickness of Contaminated Zone	40 ft	
Aquifer Matenal	sand	
Porosity	0 4	
Treatment Zone Pore Volume	28 800 ft^1	215 453 gal

Dissolved Phase Electron Donor Demand

	Contaminant Cone (mg/L)	Mass (lb)	StoiCh (wt/wl) contam/H2	H_zReq (lb)
TetrachloroBlhene (PCE)	0 8300	1 5	20 7	0 0720
Tnchloroethene (TCE)	0 0000	0 0	21 9	0 0000
as-1 2 dichloroethene (DCE)	2 7000	4 9	24 2	0 2004
Vinyl CNonde (VC)	0 2200	0 4	31 2	0 0127
Carbon tetrachloride	0 0000	0 0	19 2	0 0000
Chloroform	0 0000	0 0	19 9	0 0000
1 1 1 Tnchloroethane (TCA)	0 8100	1 5	22 2	0 0855
1 1 Dichloroethane (OCA)	0 2900	0 5	24 7	0 0211
Additional compound	0 0000	0 0		

Sorbed Phase Electron Donor Demand

Soil bulk density	110	lb/cf
Fraction of organic carbon foe	0 01	range 0 0001 to 0 01

	Koc (L/kg)	Contaminant Cone (mo/kg)	Mass (lb)	Stoich (wt/wt) contanVH,	HjReq (lb)
Tetrachloroethene (PCE)	263	21829	17 29	20 7	0 8340
Tnchloroelheno (TCE)	107	OOOOO	000	21 0	0 0000
cis-1 2 dichloroethone (DCE)	80	21800	1711	24 2	0 7080
Vinyl Chlonde (VC)	25	0 0055	004	31 2	0 0014
Carbon tetrachloride	110	OOOOO	000	10 2	0 0000
Chloroform	34	0 0000	000	19 9	0 0000
1 1 1 Tnchloroethane (TCA)	183	14823	1174	22 2	0 5281
1 l-Dichloroethane(DCA)	183	0 5307	4 20	24 7	01700
Additional compound	0	000	0 00		

Competing Electron Acceptors	Electron Acceptor Cone (mg/L)	Mass (lb)	Stoich (wt/wt) elec acceptor/Hi	H_2Req (lb)
Oxygen	030	054	80	0 07
Nitrate	080	144	124	012
Est Mn reduction demand (potential amt of Mn*2 formed)	100	180	27 5	0 07
Est Fe reduction demand (potential amt of FB+2 formed)	250	4 50	559	0 08
Estimated sulfate reduction demand	5005	90 01	120	7 50

Microbial Demand Factor	(chose 1X-4X)
Safety Factor <SF)	(chose 1X-4X)

Mass Requirements	H2 (lb)	Molasses (lb)	(flail
Dissolved Phase Contamination	04	155	1 5
Adsorbed Phase Contamination	22	93 3	90
Competing Electron Acceptors	78	3262	314
Competing Microbial Processes	10 4	435 2	418
Subtotal	209	870 2	83 7
Total (with SF)		34810	334.7

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

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^>C 51

Location ID			MW-029 ,	MW-03D	MW-08D	MW-0BI	MW-101
Sample ID			MW02S	MWWD	MW08D	MW-OBJ	MW-101
Matrix			Groundwater	Groundwater	Qrourtdwaler	Qroundwatar	Qroundwatar
Depth Interval (ft)			-	-	-	-	•
Date Sampled			04/23/03	04/23/03	04/23/03	04/23/03	03/27/03
Parameter	Unite	Criteria*					
Volatile Organic Compounds							
1,1,1 Tnchroroethane	tm	S	•— B2 ^	C 68 T5	C si ^	068	
1,1-Dichloroothane	mL	5	C^ 79 " ^	CT"^ is ^			
1,1 DlcNoroothene	uon.	6	C 55 _^	C L i 2 j ^	12		
1,2Dlehloroeihene(cta)	UG/L	5	^T_280__^	C ! 6B ^			
4-Methy) 2 pentanone	UGfl.	•			NA	NA	NA
Acetone	uon.	50			NA	NA	NA
Benzena	UOfL	1					
Chloroform	U&L	7					
Elhylbenzene	UG/L	6					
Methyl ethyl ketone (2 Butanone)	UGA	50			NA	NA	NA
Methylene chloride	IKVL	5					
Tetrcchloroethene	UG/I	S	C 170 ^	C 1 8 0 ^	^ _ 1 3 _ _ - ^	17	
Toluene	UGA	5					
Trlchbroetrtene	UQfl.	5	CT 15 " ^	50			
Vinyl chloride	UG/I	2					
Xylene (total)	UG/L	5					

Crttofia NYSOECTOGSO 11), AmHerrt WatgrQuaHty Standards and GuWanca Valuat and Groundwatar Effluont Umlutlons ApnlKMO ClatsQA.

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TABLE 3
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

f"3 -"
0 C %

Location ID			MW-130	MW-14D	MW-16D	MW-17D	MW-21S
Sample ID			MW13D	MW14D	MW-1BD	MW-17D	MW-21S
Matrix			Groundwater	Qroundwater	Qroundwater	Qroundwater	Groundwater
Depth Interval (ft)			-	-	-	-	-
Dale Sampled			03/27/03	03/27/03	04/23/03	04/23/03	03/27/03
Parameter	Units	Criteria*					
Volatile Organic Compounds							
1,1,1'Tnchloit»tharw	UG/L	5	C ! S B ! ^	068	a 2i ^	C ia ""5	34
11 Dichloroelhane	UG1	5				054	
1,1 DlcWoroethene	UCW.	G	18			C ^ ^	086
1,2Dlchloroemana(clB)	UOt	S					
•-Methyl 2-pentanone	uai	•	NA	NA		NA	NA
Acetone	UOA	50	NA	NA		NA	NA
Benzene	UC¥L	1					
Chloroform	UG/L	7					
Ethyl benzene	UQ1	5					
Methyl ethyl ketone (2 Butanone)	UG/L	60	NA	NA		NA	NA
Methylene chloride	UQ1	5					
Tetrachloroethane	UG/L	5	d a ^	44	C7 45 " ^	27	CT" 85 ""^
Toluene	UG/L	5					
rrichloroethene	UG/L	S					
i/lnyt chloride	UG/L	2					
Xylene (total)	UG/L	5					

Criteria NYSDECTOGSO 1 1), Ambient WaterQuallty Standards and Guidance Values and Groundwater Effluent Limitations April 2000 Class GA

Rags assigned dunng chemistry validation are shown

CT J> Concentration Exceeds Criteria

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

Location ID			MW-25D	MW-25S	MW-279	MW-281	MW-28S
Sample) 10			UW2B0	MW2BS	MW278	MW2H	MW-248
Matrix			Groundwater	groundwater	Qroundwater	Qroundwater	Qroundwater
Depth Interval (ft)			-	-	-	-	-
Data Sampled			03/27/03	03/27/03	03/27/03	04/23/03	03/27/03
Parameter	**Units**	**Criteria***					
Votatlla Organic Compounds							
1,1,1-Tnchloroettiane	UG/L	5				35	
1,1-Dfctiloroethane	UG/L	6					
1,1 Dlchtoroettiena	UG/L	5				0 81	
1^-Oichk>roelhsn0 (da)	UGA	6					
4 Methyl 2 pentanone	UGH	-	NA	NA	NA	NA	NA
Acetone	UG/L	SO	NA	NA	NA	NA	NA
Benzene	UG/L	1					
Chlorotonn	UGH	7					
Ethyl benzene	UG/l	S					
Methyl ethyl ketone (2 Butanone)	UCVL	50	NA	NA	NA	NA	NA
Methylene cWorlde	UG/L	5					
Tetrachloroelhene	UQ/L	5				20	086
Toluene	UQ/L	5					
Trictikjroethene	UGVL	S					
Vinyl chloride	UG/L	2					
Xylene (total)	UGVL	5					

•Criteria NYSOEC TOOS(11 1) Ambient Watar Quality SttndiitlitntfGuklanoi Value* BndQroundwaW Effluent Umltatlorn April 2000, ClenGA.

Flags assigned (bring chemrrtry validation are shown

Concentration Exceeds Criteria

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

Location ID			MW-32D	MW-338	MW-34D	MW-3SO	MW-38S
Sample ID			MW-WO	MW-3I8	MWMD	MW-35D	MW-»8
Matrix			Qroundwater	Groundwater	Qroundwater	Qroundwater	Qroundwater
Depth Interval (ft)			-	-	-	-	-
Date Sampled			03/27/03	03/27/03	03/27/03	03/27/03	04723/03
Parameter	Unite	Criteria*					
Volatile Organic Compound!							
1,1,1-Trichloroethane	IKVL	5	SO	Cl 62 " ^	C ! 1 4 ^	CT IB ^	
1,1 Dwhtoroethane	UOI	5				077	cr » - ^
1,1 Dichtoroetherte	UGA	5	14	095	42	43	
1,2-D|chloroethene (CIB)	UCVL	6				0 69	C 100 ^
4-Methy1-2 pentanone	UGA	-	NA	NA	NA	NA	
Acetone	UOA	SO	NA	NA	NA	NA	
Benzene	uw.	1					
Chloroform	U»L	7					
Ethylbertzene	UO/L	5					
Methyl ethyl ketone (2-Butanone)	UG1	SO	NA	NA	NA	NA	
Methylene chtortde	IKVL	5					
retrachloroethene	U0A	S	C___10 0 " ^	^ _ _ 1 3 0 _ _ ^	r 37 ^)		
Toluene	UG/l	5					
rrichloroe thane	UG/L	5					
Vinyl ohtoride	UG/L	2					
Xytene (total)	UG/L	5					

CritMla NV30ECTOQ3(111),AmbientWatsrOuslItySandonisandGuWane*ValuesarKlGrtMWlwMef Effluent Uirttattons April2000 ClassGA

Flags assigned during chemistry validation are shown

Concentration Exceeds Criteria

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

		Location ID	MW-371	MW-38S	MW-478	MW-468	MW-51D
		Sample ID	MW37I	MW-ses	MW-478	MW4B3	MW-S1D
		Matrix	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
		Depth Interval (ft)					
		Date Sampled	04/23/03	04/23/03	04/23/03	04/23/03	04/23/03
Parameter	**Unite**	**Criteria'**					
Volatile Organic Compounda							
1,1,1-Trichtoroethane \S	UCfL						
1,1 Dichlotoelhane *i f*	UG/L						054
1.1 Dtehloroethene	UG1						
1,2-Olchloroetnene (da) V	UOI					450 1 ^	
4 Methyl 2 perrtanone	UCVL		NA				NA
Acetone	UG/L	SO	NA				NA
Benzene	UOL						
Chlorolotm ^	UQ1						
Ethylberaene	UGI						
Methyl eltiyl ketone (2 Butanone)	IXVL	50	NA				NA
Methylene chloride	UCW.		150				
retrachtOfoethofw V	UG/I						
Toluene	UG/L						
rrichtoroethene \J	UG/L					130 r>	
Vinyl chloride *TZ*	UG/L		———220 ^				
Xylene (total)	UGTL						

Ciltarla NYSDECTOGS(111) Ambient Waiar Quality Standards and Guidance Values and Groundwatar Effluant Limitations April 2000 Class GA

Flags ettlonad durlno chamstiy validation are shown

Conctntratlon Excasda Crltsrta

TABLE
GROUNDWATER ANALYTICAL RESULTS
MILLER BREWING COMPANY - FULTON, NY

Location ID			MW-641	MW-66D	MW-62S	MW-63S
Sample ID			MWS4I	MWS6D	MWB2S	Mw-eas
Matrix			Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)			-	•	-	-
Date Sampled			04/23/03	0423/03	03/27/03	03/27/03
Parameter	**Unite**	Criteria*				
Volatile Organic Compounds						
1,1,1 Trichtaroethane	\JGIL	6		C 80 ^		
1,1-Dlchloroethane	UG/L	5				
1,1-Dtehbroethene	**UOI**	5		30		
1,2-OtehloraethBne(cJa}	UG/L	5				
4 Methyl 2-pentanone	UG/L		NA	NA		
Acetone	**UG/L**	60	NA	NA		
Benzene	UG/L	1				
Chloroform	UG/L	7				
Elhylbenzene	UG'L	S				
Methyl ethyl ketone (2 Butanone)	UG/L	50	NA	NA		
Methylene chloride	UG/L	5				
Telrachloroethene	UG'L	5		d 83 ^		
Toluene	UG'L	5				
Tnchloroelhene	UG/L	5				
Vinyl chloride	UG/L	2				
Xylene (total)	**UG/L**	6				

'CriWrta NYSDECTOQSfI 1 1) Ambf&nt Watar Quality Standards and Qutdanco Values and Groundwater Effluant limitation* April 2000 CtaaaOA

Flags assigned during chamstry validation ara shown

Concentration Excseda Cntena

Blackstrap Molasses

Blackstrap molasses is the residual liquid food obtained in the manufacturing of raw sugar Then cane juice, or mother liquor, after having been purified, is concentrated in to thick mass As the sugar crystallizes, this mass is passed through a centrifuge which allows the mother liquor to pass through but retains the crystallized sugar The resulting molasses is very dark and has a robust somewhat bitter-tart flavor

Specification for Blackstrap Molasses:

Physico-Chemical		
1	Total solids as Brix (%)	78-80 5
2	Moisture (%)	20-25
3	Total Sugar (%)	55-65 ^——
4	Invert Sugar (%)	9-22 (glucose and fructo
5	Sucrose (%)	37-50
6	Ash (sulfated) (%)	6-11
7	Nitrogen Free Extract (%)	63 0
8	Crude Protein (%)	3 0 (0 nutritional protein
9	Ca (%)	0 8
10	P(%)	0 08
11	K(%)	2 4/0 0175 lb/lb (8 g/lb)
12	Na(%)	0 2/0 0044 lb/lb (2 g/lb)
13	Chlorine (%)	1 4
14	Sulfur (%)	0 5
15	Carbohydrates	0 7 lb/lb
16	pH (1 1 dilution)	4 5-6 0
17	Fat	0 lb/lb
18	Dietary Fiber	0 lb/lb
19	Specific Gravity	1 41 - ^ —
20	Energy	1270Cal/lb 5300 KJ/lb
21	Odor	Slightly acrid
22	Clarity	Opaque
23	Color	Dark brown to black
24	Flavor	Characteristic bitter sweet No Mustiness
Microbiological		
25	Plate Count	Less than 5000/gram
26	Yeast	Less than 500/gram
27	Mold	Less than 500/gram
28	Salmonella	Negative/100 gram
Storage		
29	Temperature	50-70°F
30	Shelf Life	3 months

n –
«*3i

MILLER STOICHIOMETRIC CALCULATIONS

1 Lactate

8NAC3H5O3 + $8H_20$ + 3C2Cl4 $9C_2H_4$ +.4$C0_2$+ $12H^+$ + 12Cl- + 8NaHC03 ***a- 23^,|e**

3*(2*12 + 4*355)g 8«(1 '23 + 3*12 + 5*1 +3*16)g

4g8g NEEDS 896g
PCE **LACTATE**

1g NEEDS ! $_8$0g ***c - 11***

H<r **H - 1**

For 60% Na-Lactate

1g NEEDS 3 0g **. I23+M2 *+5 1+3 K>*** **22.*+**

S 1 **1**

2 Oil

2C8H-160 + 2H2O + C2Cl4 8C2H4 + $2C0_2$+ $4H^+$ + 4Cl-

1 *(2* 12 + 4*35 5)g 2 * (8*12+ 16* 1 +1 * 16)g

166g NEEDS 256g
PCE OIL

ff-12.+ It f + I IC

1g NEEDS 1 54g
PCE OIL

H_{It}

Molasses/Sugar

$8C_6H_{12}0_6$ + 8H2O + $9C_2Cl_4$ $19C_2H_4$ + $28C0_2$+ $36H^+$ + 36Cl"

9*(2*12 + 4*355)g 8* (6* 12+ 12*1 +6+16)g

1494g NEEDS i440g
PCE PURE SUGAR

c_ch_{l7}.o_c

1g NEEDS 0 96g **f-i2* 12 \ + *& a***
PCE PURE SUGAR

Assuming 50% sugar in molasses (100% solid) ***u_{k7}_*** *n-i*

1g NEEDS 1 93g
PCE MOLASSES

is *-o*

For 66% solid molasses **T"**

1g NEEDS 2 92g
PCE 66% MOLASSES

Or

*0 061 *£'*

Job	**Project No**	**Sheet** **of**
Description	**Computed by**	**Date**
	Checked by	**Date**

Reference

\ / \ S^H

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rcr

c;* -/,2- PC£"

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Job	Project No	Sheet of
Descnption	Computed by	Date
	Checked by	Date

Reference

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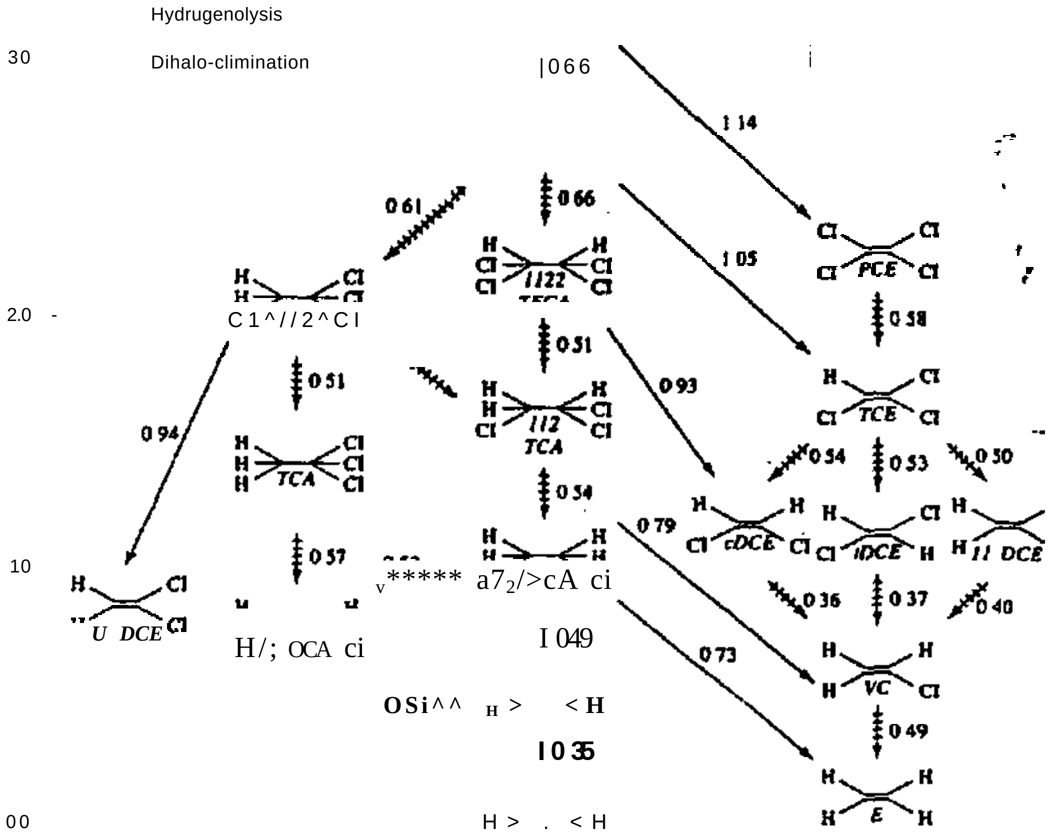


;/ DCE <* I l-dichtoroethene
;//2 TECA * 1,1,1 2-terrachloroethane
TCV4 * tnchloroethane
U DCA * t 1-dichloroethane
//C/4 •* hexachlonscihaiK
PCA a pentKhloroethane
1122 TECA * I 1 2.2,-tetrachlonjethane
112 TCA = I.I 2-tnchloroethane
/2 DCA => l.2dtchIoroethane

CV* * clilorocihane
4 » ethane
PCE « peichlorortftene
TC£ » tnchloroeihene
cDCE * eu-cichloroetherw
/CC£ <* *trans* dichlotoet
UDCE » 1,1-dichloroethene
VC » vmyl chlonde
E * ethylene

FIOURI 7 13 Pathways of cHonnoted alkans and allcene reduction and estimated relative half Itfe reduction potentials >*n* volts Source Repnnted with parmission from T M Voget, C S Giddle, ond P L MeCorty, E/iwonmenfoJ Sc;»nce *and Tmcknology* 21, no fl, {1987J 722-34 Copyright 1987 American Chemical Society

flpfar Uf&3*

ROD Change Documentation Report
Permeable Reactive Barrier System
Former Miller Container Plant
Town of Volney, NY

FINAL

Reference 1

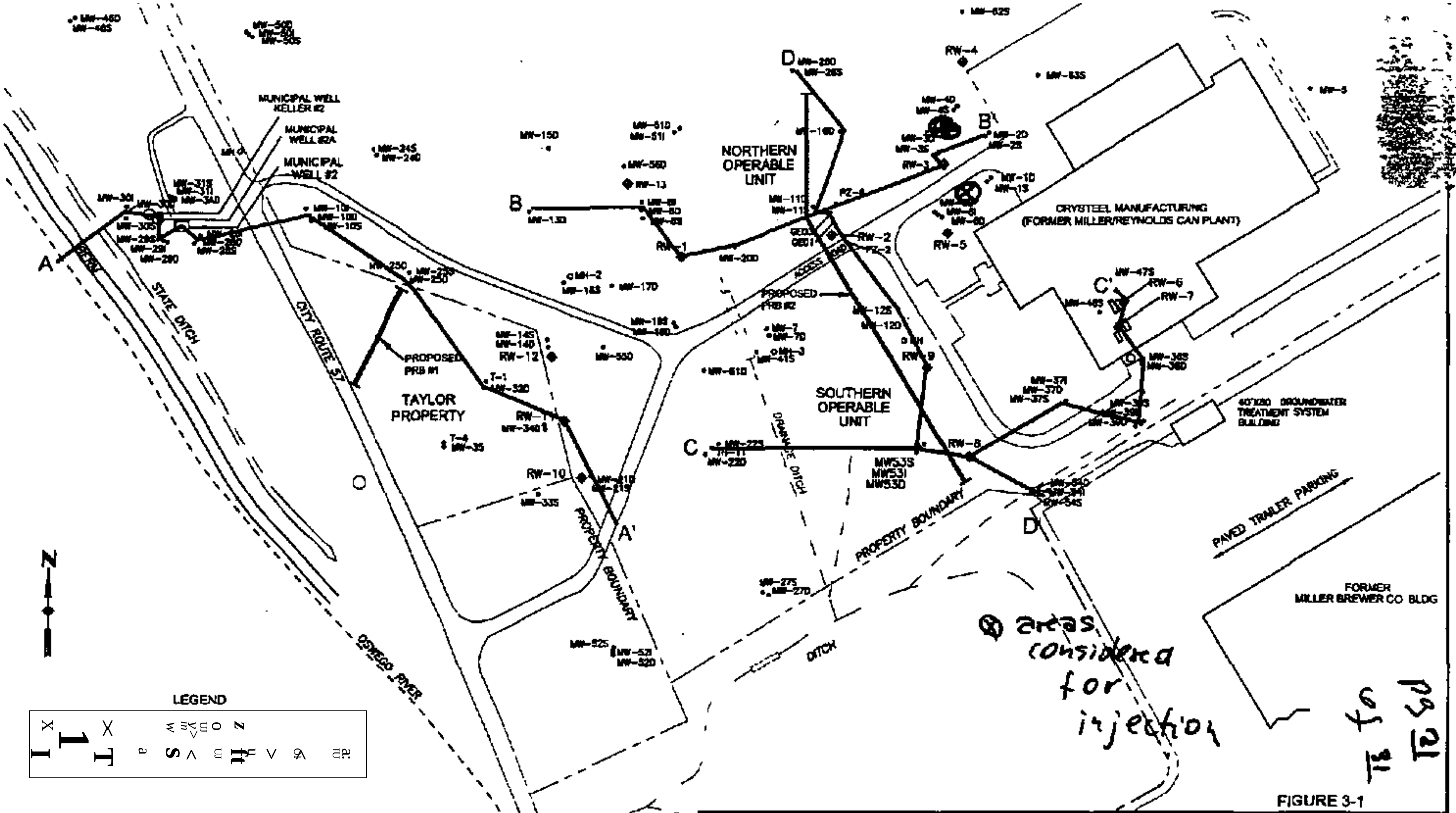
Prepared for:

Miller Brewing Company
3939 W. Highland Boulevard
Milwaukee, WI 53201-8322

Prepared by:

URS Corporation
10200 Innovation Drive, Suite 500
Milwaukee, WI 53227

September 2003



⊗ areas considered for injection

pg 21 of 81

FIGURE 3-1

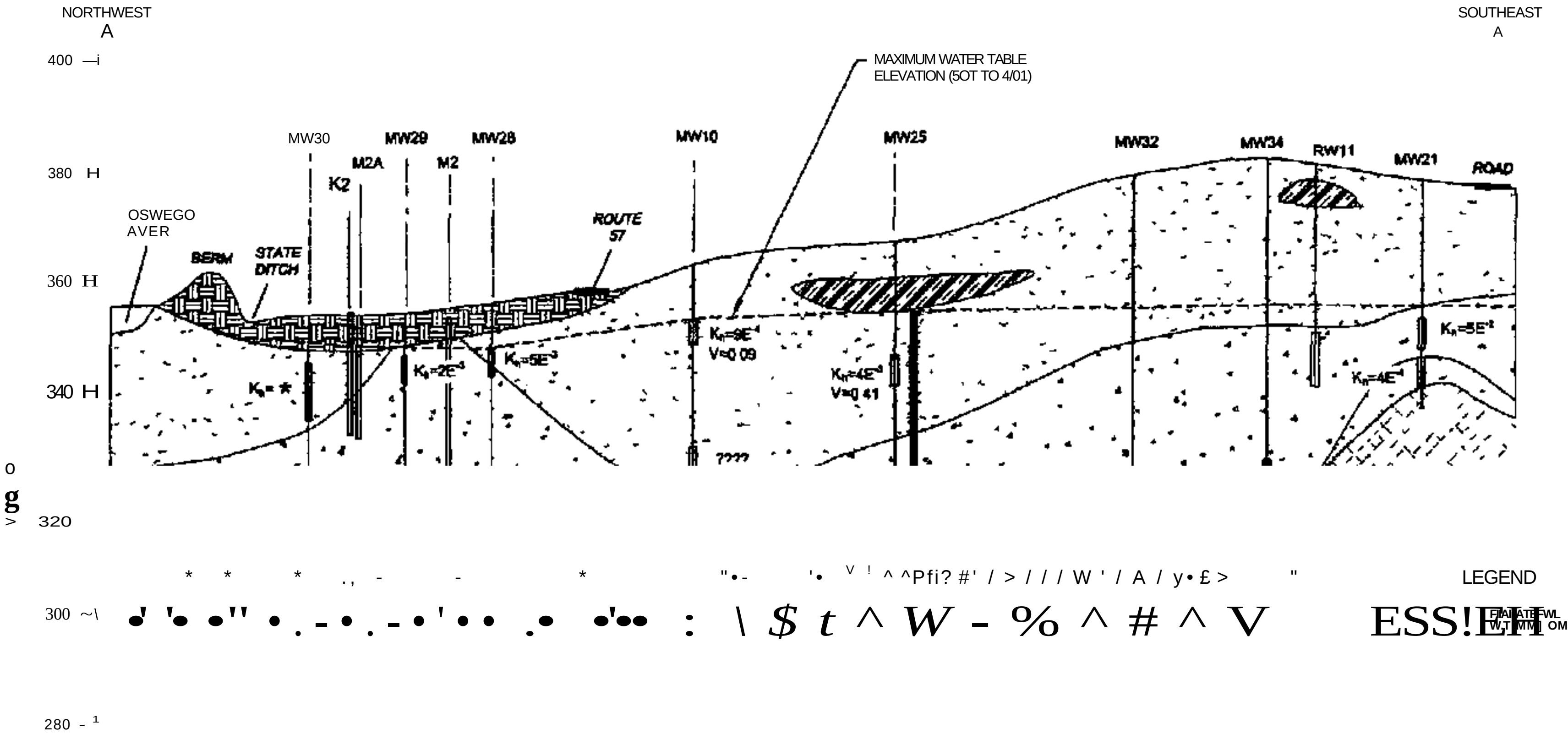
MILLER BREWING COMPANY
FORMER MILLER CONTAINER PLANT
VOLNEY NEW YORK

AS NOTED

RF	7/22/02
JC	7/22/02

URS

CROSS SECTION LOCATION MAP
FORMER MILLER CONTAINER PLANT
VOLNEY NEW YORK



LEGEND

ESS!EH FIANATE FWL OAY W,T.MM.] OMVB.

(UDDHCNTlia DENS &AYEYSM* H.T0M) vb

HORgONTALSCM£ IN FEET
VERTICAL EOOGSOTWUMST

FIGURE 3-2

IBUWHLl

LrTHOLOGC AND KYDROLOGIC PARAMETERS
CROSS SECTION A* THROUGH PRB #1

OUDHUUSIUtm 11 HH 111 <••«-<! rTH'HWiomt

04(VV1dA4

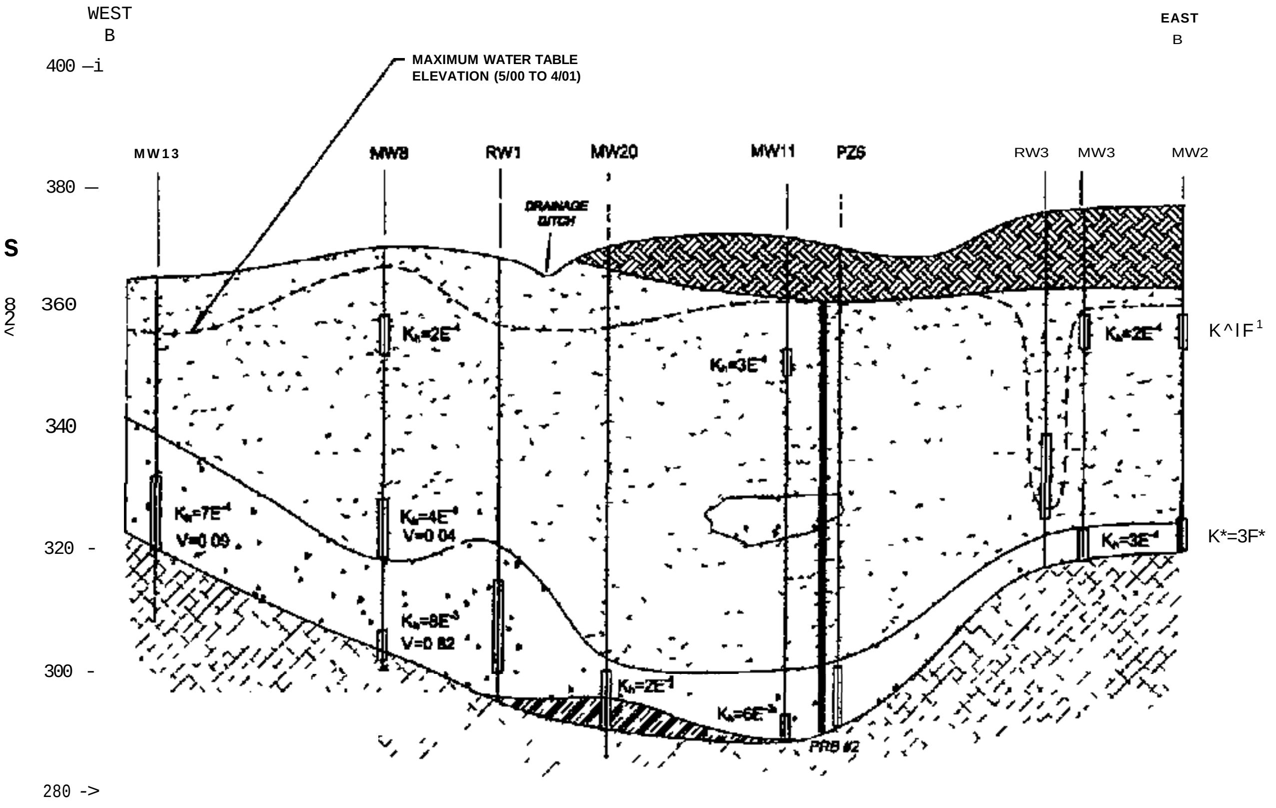
AS NOTED

MILLER BREWING COMPANY

fOUCR WXBt C0NTA)N6t PLANT
VOLNEY NEW YORK

4W01

URS



LEGEND

FILL MATERIAL SILT SAND

FINE SAND AND SILT

FICTOCOM3E5AND ANOOUva

uooOMBrrnu. DENSE. OAVEVUW SH1AHO GRAVEL

ABBREVIATION KEY

10, Hydraulc Conductivity (cm/sec)

V Groundwater Velocity (fL/dsy)

* Recharge too rapid for quantrtaton

HORIZONTAL SCALE IN FEET
VERTICAL EXAGGSMnOWJX

FIGURE 3-3

MILLER BREWING COMPANY

RIRIO MLLER CONTAINER PLANT
VOLNEV NEWVCHK

AS NOTED
agmr pan
RE I 4W01
UtUUUlf IWU
JC I 4M/01
r-JWHLgir"fBar—"•

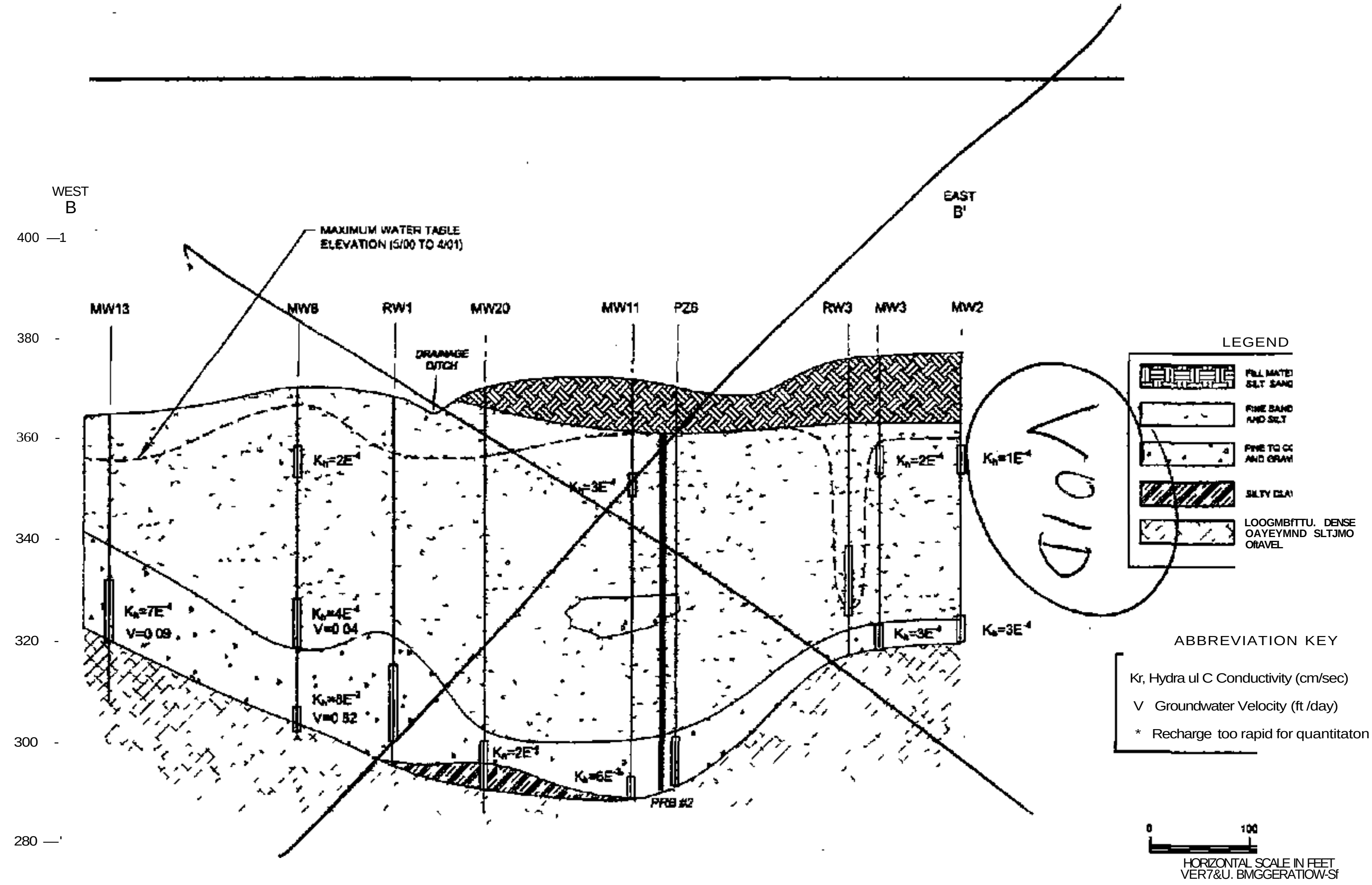
campiwuu wam ^gww*nawi O*

URS

HBSBSW

UTHOLOGIC AND HYDROLOOIC PARAMETERS
CROSS SECTION B-B THROUGH PRB*2

CWOWIH'U IKICMOOMMNICejVeUKBBinOJ



ABBREVIATION KEY

Kr, Hydra ul C Conductivity (cm/sec)
V Groundwater Velocity (ft /day)
* Recharge too rapid for quantitaton

\S>
I

FIGURE 3-3

•WPMTDKH

MILLER BREWING COMPANY

FORMER MLLER CONTAINER PLANT
VOLNEY NEWVORX

VBS-

suiuin
RF
teasmr
JC
MtbJBIV

vac——
4rt»1

ca*onnnmmcnii ipmBtmjmm g

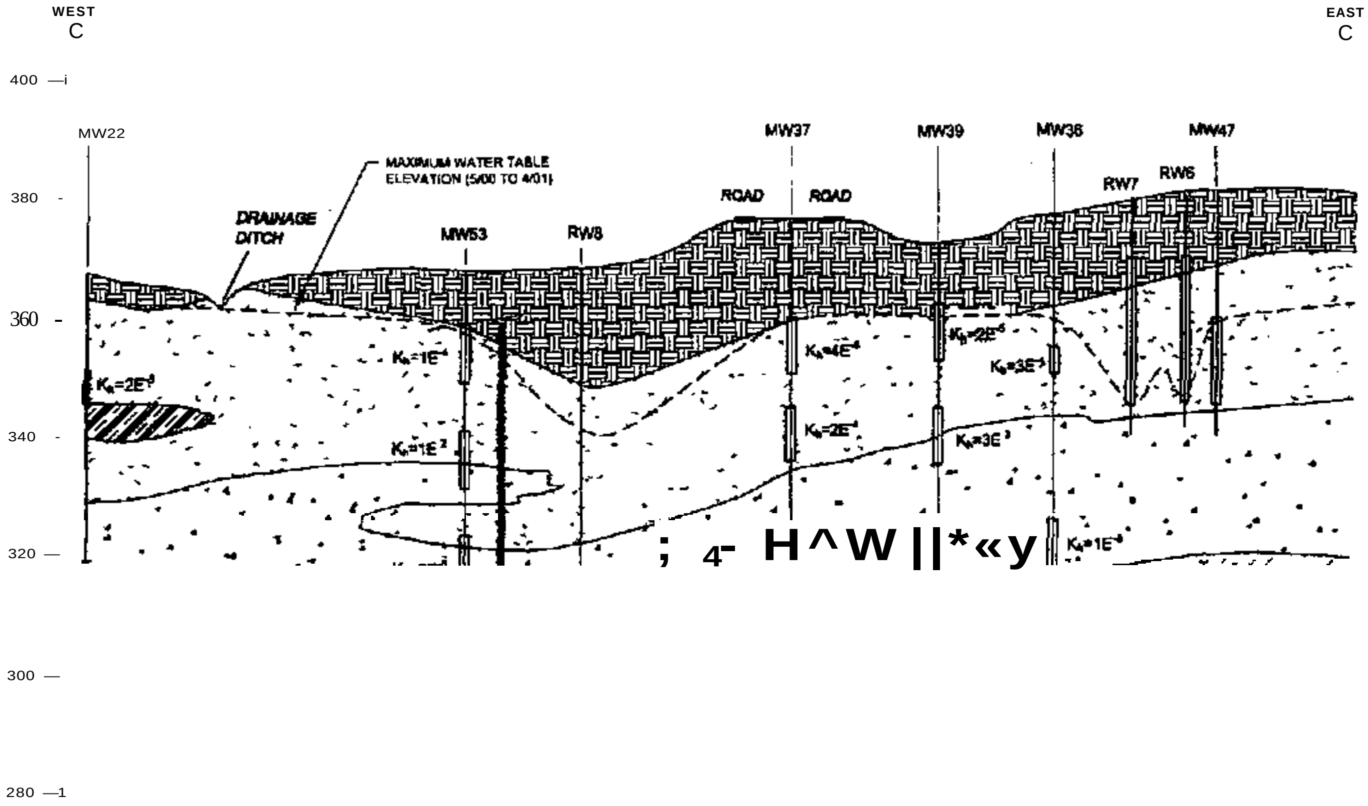
URS

WGSBBTH"

UTHOLOGC AND HVDROLOGK; PARAMETERS
CROSS SECTION 6-6 THROUGH PRS #Z

CM) BMMNG FL£ mLSWO0«3IB*re,IVPU«LCTIW"(a-i

£



LEGEND

Fill MA1EHML CLAY
•m^rpmri SIT MMD GRMB.

—i ' • '—1 LDtxaiEKT-nj. DENSE
' "/ 1 CmVEYSAND SITHM)
——. . i I BJUU¥L

ABBREVIATION KEY

K. Hydraulic Conductivity (cm/sec)

V Groundwater Velocity (fUday)

* Recharge too rapid for quantitation

HORIZONTAL SCALE IN FE£T
VCRDOU. ECAGGOMTJOftLfflt

"5

FIGURE 3-4

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cowcomM^uiaWB HtMhOWlOtWTt 0

LTTHOLOGIC AND HYDROLOGIC PARAMETERS
CROSS SECTION C-C THROUGH PUS #2

MILLER BREWING COMPANY

FORMER MILBtCONTAMER PLANT
VOLNEY NEW VOW

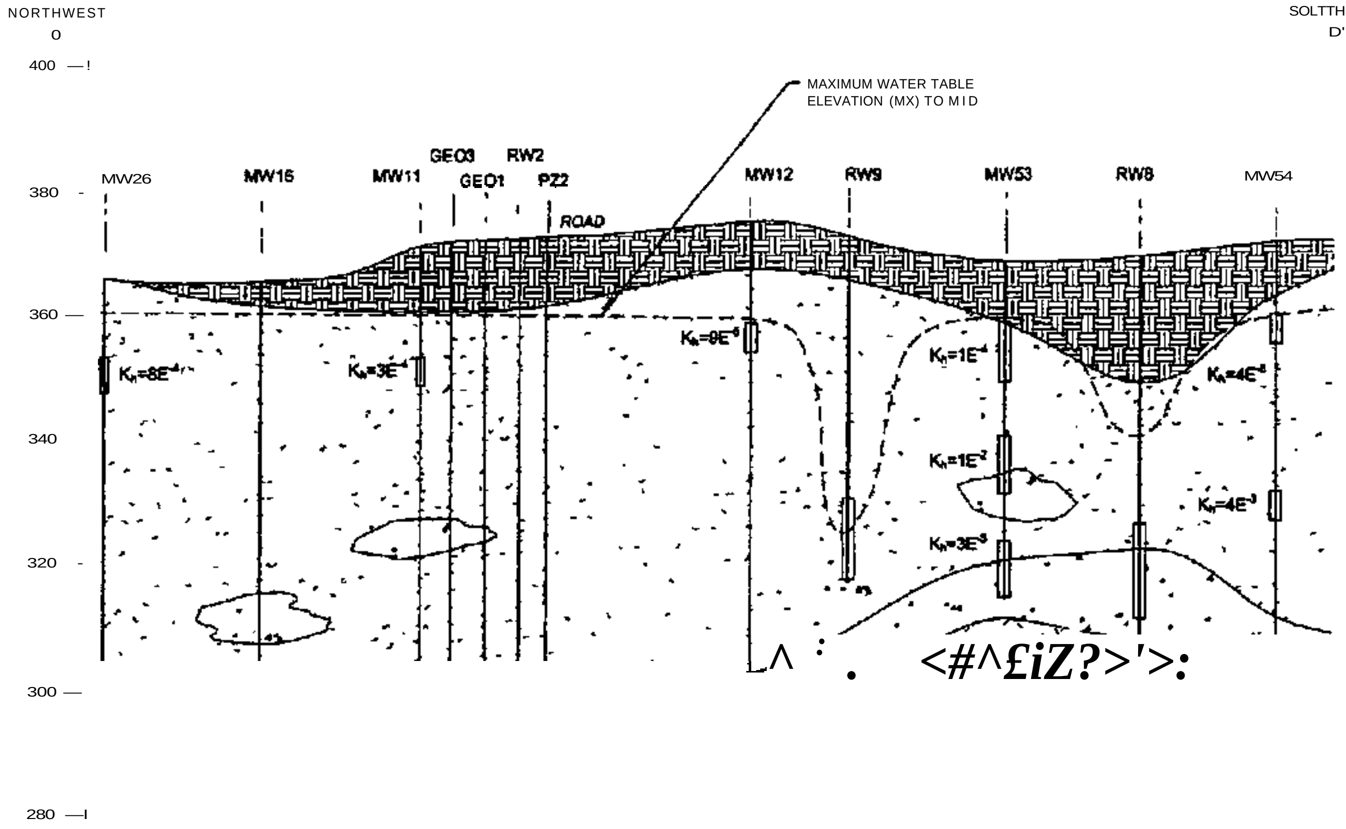
nam*"
JC

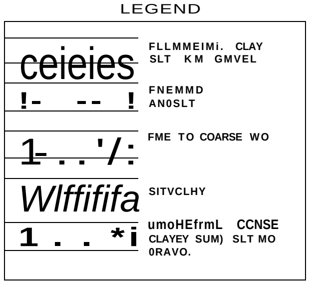
V M 1

4WD1

UBS

CMMUMSPU. WIIIMHII«W,Mf»|H|«HII IHIHill





ABBREVIATION KEY

Ki, Hydraulic Conductivity (an/sec)

V Groundwater Velocity (ft May)

* Recharge too rapid for quantitation

HORIZONTAL SCALE IN FEET
VERTICAL EX*GGEHAT)c*LOf

FIGURE 3-5

MIUER BREWING COMPANY

FORMER MILLER CONTAINER PLANT
VOLNEY NEWVDRK

AS NOTED
RF
mooir
JC
1PRMS1T

mr "
TOT-
4W01
4WJ1

eawa«wrfmwili>M»BWiiaBiiiig

URS

wssoia

LITH0LOG1C AND HYOROLOGIC PARAMETERS
CROSS SECTION D-D THROUGH PRB «

UODRUHM3FU. WLLOMODOCSSHOBMEIMIZSaTnGW

iW

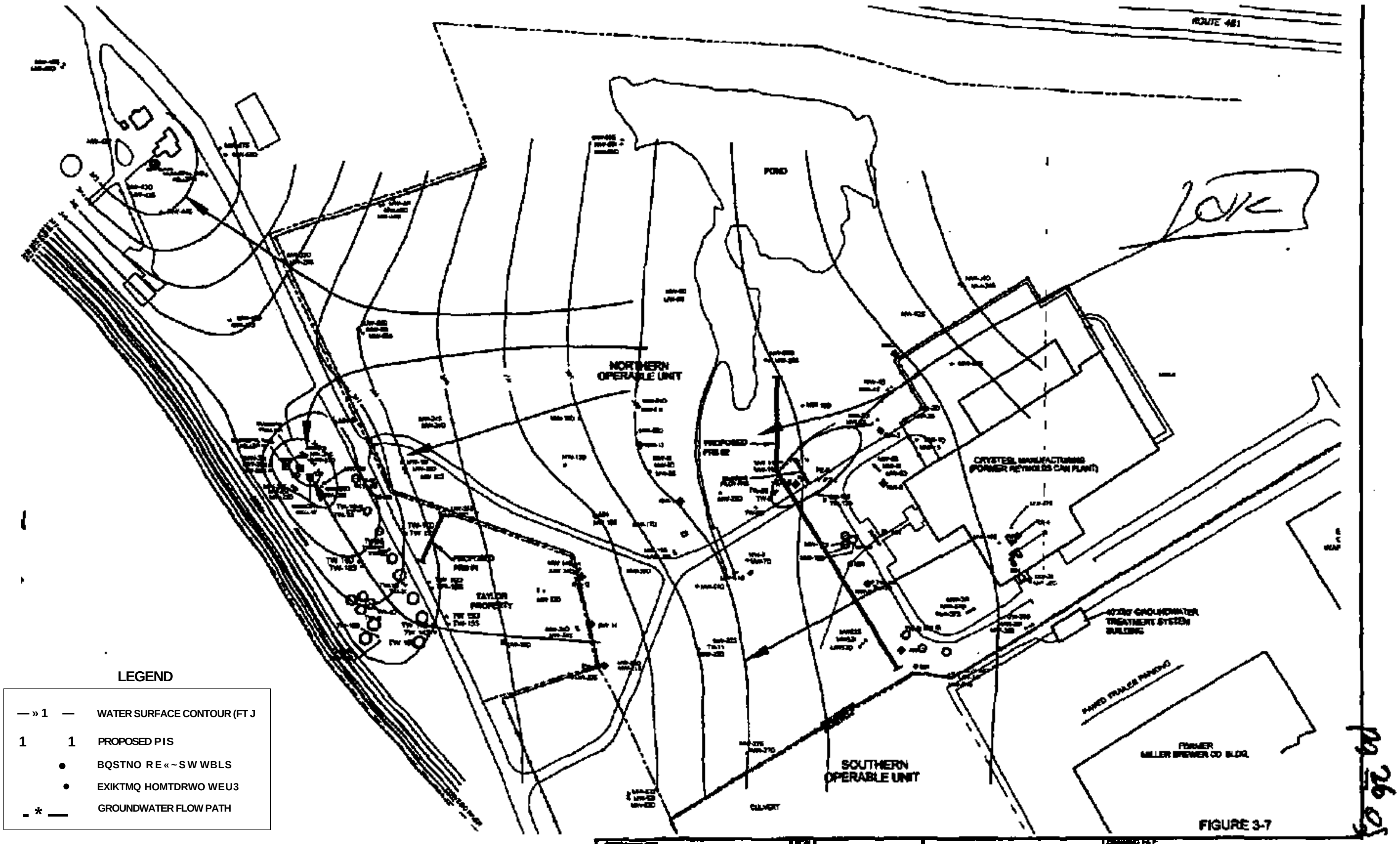


FIGURE 3-7

pg 26 of

LEGEND

—» 1 —	WATER SURFACE CONTOUR (FT J
1 1	PROPOSED PIS
●	BQSTNO RE«~SW WBLS
●	EXIKTMQ HOMTDRWO WEU3
- * —	GROUNDWATER FLOW PATH

SCA1EMFEET

HU£R BREWING COWAWf

FORMBIWIBIDOMTANEft PLANT

voueviEvnonc

AS MOTH)

WR

RF

JSK

nwumiir

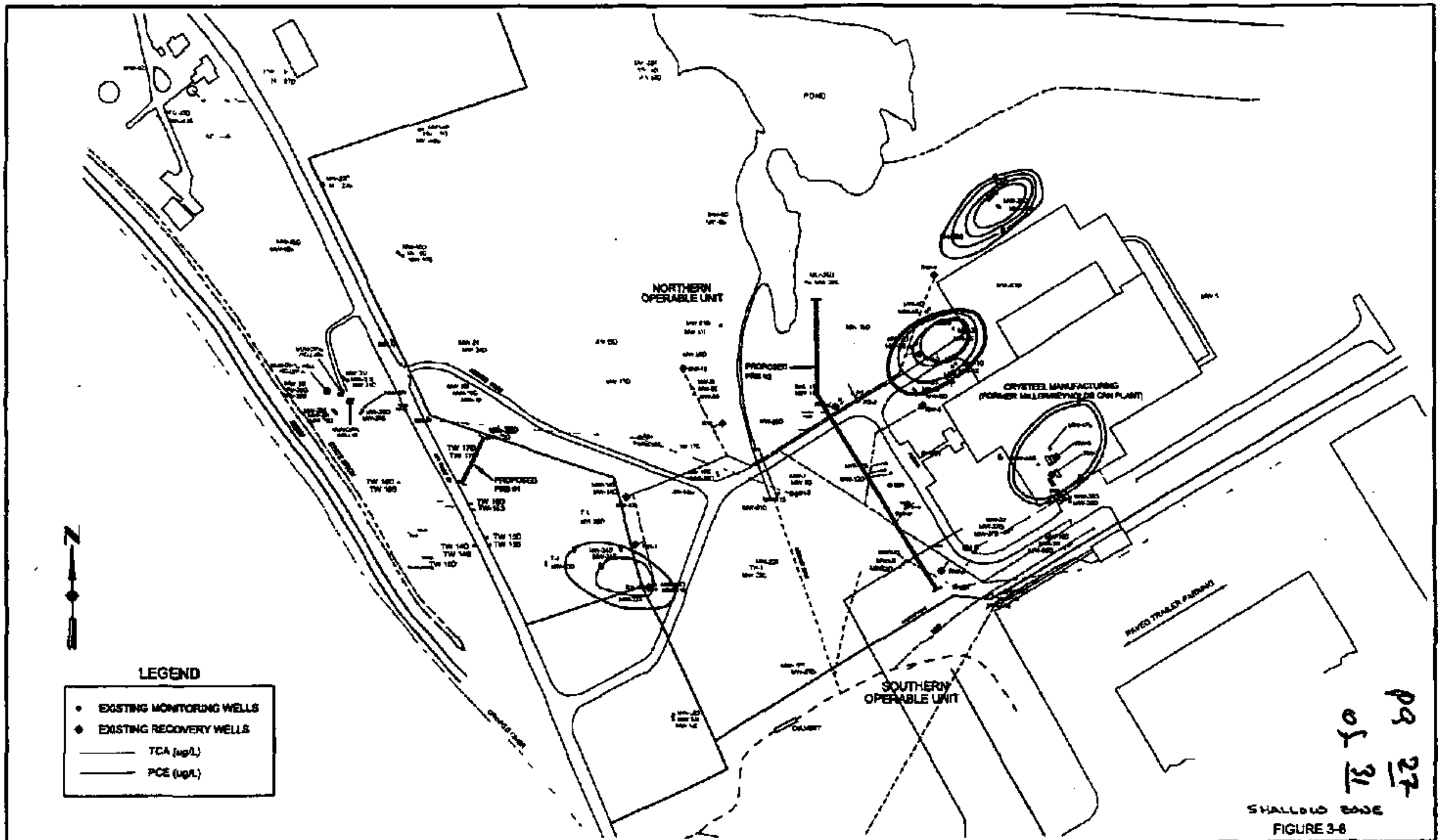
V1MB

URS

WATB? SURFACE
FORfcER WATER CONTAINER PLANT
VOLNEY NEW YORK

Boamant mi HIIHII-IIIIIII

61002401 B3



pg 27 of 31

SHALLOW ZONE

FIGURE 3-8

PREPARED FOR

MILLER BREWING COMPANY

FORMER MILLER CONTAINER PLANT
VOLNEY NEW YORK

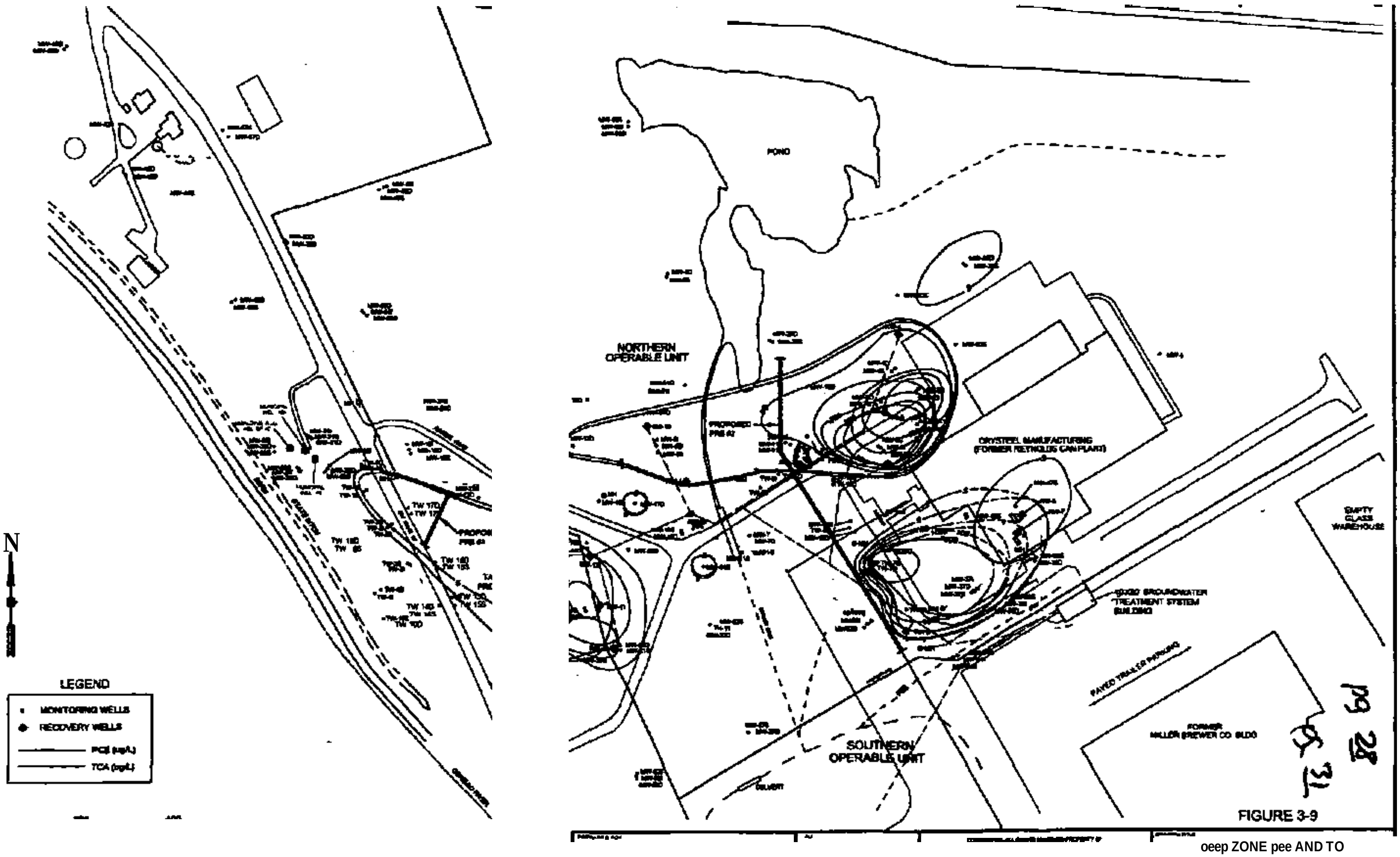
SCALE	
AS NOTED	
DRAWN BY	DATE
RF	4/4/01
CHECKED BY	DATE
JC	4/4/01
APPROVED BY	DATE

URS

LITHOLOGIC AND HYDROLOGIC PARAMETERS
CROSS SECTION B-B THROUGH PRB #2

81002401

B1D



pg 28 of 31

FIGURE 3-9

MILLER BREWING COMPANY
FORMER MILLER CONTAINER PLANT
VOLNEY NEW YORK

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oeep ZONE pee AND TO
FORMER MILLER CONTAINER PLANT
VOLNEY MEWYORK

81CC2401 B11

TECHNICAL PROTOCOL FOR EVALUATING NATURAL ATTENUATION OF CHLORINATED SOLVENTS IN GROUND WATER

by

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NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U S ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

Table B.2.1 *Values of Aqueous Solubility and$K_K$for Selected Chlorinated Compounds*

Compound	Solubility (mg/L)	Koc fL/Kc)
Tetrachloroethene	150*	763'
Tetrachloroethene		359°
Tetrachloroethene	1,503°	7.09-238*
Tnchloroethene	1.100*	107'
Tnchloroethene		137^{D}
Tnchloroethene	1,100°	$87\text{-}l50^{v}$
1,1-Dichloroethene	2^50*	64 6'
1,1-DichJoroetbene		$80\ 2^{D}$
1,1-Dichloroethene	2^00"	150°
cis-l,2-Dichloroethene		80 2°
cts-I,2-Dichloroethene	3,500°	49*
trans-l,2-Dichloroethene	$6{,}300^{i}$	« 9 *
tran$-,2-Dichloroethene		$80\ 2^{D}$
transA,2-Dichloroethene	6300°	3tf
Vinyl Chloride	1,100'	245'
Vinyl Chloride	2,763°	$f>4\text{-}56^{u}$
1,1,1 -Tnchloroethane	1,495°	183°
1,1,2-Tnchloroethane	4,420"	70°
1,1 -Dtchloroethane	5,060*	40-
1 ,2-Dichloroethane	8.520°	33 to 152"
Chloroethane	5,710°	33 to 143"
Hexachlorobenzene	0 006'	—
1 ^-Dichlorobenzene	156°	*7.71* - 148CT
13-Dichlorobenzene	111*	293 to 31,600*
1,4-Dichlorobenzene	74 to 87°	$273tol833^{a}$
Chlorobenzene	472°	$83to389^{J}$
Carbon Tetrachloride	805*	110»
Chloroform	7,950°	<34°
Methylene Chloride	13.000°	48°

* *Fmm Knox et al, 1993*

[0] *From Jeng et al, 1992, Temperature = 20'C*

[e] *From Howard, 1990. Temperature - 25"C*

[4] *From Howard, 1989, Temperature = 2S°C*

* *From Howard, 1989, Temperature = 20'C*

* *ATSDR, 1990, Temperature - 20'C*

* *From Howard, 1990, Temperature = 20'C*

n

accepted literature values until the modeled and observed contaminant distnbution patterns match Because aquifer materials can have a range of effective porosity, sensitivity analyses should be performed to determine the effect of varying the effective porosity on numerical model results. Values of effective porosity chosen for the sensitivity analyses should vary over the accepted range for the aquifer matrix material Table C 3 2 presents accepted literature values for total porosity and effective porosity

n

Table C.3.2 Representative Values of Dry Bulk Density, Total Porosity, and Effective Porosity for Common Aquifer Matrix Materials (After Walton, 1988 and Domemco and Schwartz, 1990)

ft

1

Aquifer Matrix	Dry Bulk Density (jtnVcnT)	Total Porosity	Effective Porosity
day	100-240	034-060	001-02
Peat	—	—	03-05
Olaaal Sediments	1 15-210	—	005-02
Sandy Clay	—	_	003-02
Silt	—	034-061	001-03
Loess	075-160	—	015-035
FraeSand	137-1 81	026-053	01-03
Medium Sand	1 37-1 81	—	015-03
CoaiseSand	137-1 81	031-046	02435
Gravely Sand	1 37-1 81	—	02-035
Fine Gravel	136-219	025-038	02-035
Medium Gravel	136-219	—	015-025
Coarse Gravel	136-219	024-036	01-025
Sandstone	160-268	005-030	01-04
Sihstone	.—	021-041	001-035
Shale	154-317	00410	—
Limestone	174-279	00-50	001-024
Granite	224-246	—	—
Basalt	200-270	003-035	—
Volcanic Tuff	—	—	002-035

C.3.1.5 Linear Ground-water Flow Velocity (Seepage or Advective Velocity)

The average linear ground-water flow velocity (seepage velocity) in one dimension in the direction parallel to ground-water flow in a saturated porous medium is given by

APPENDIX B

PRODUCT INFORMATION

EOS?®

EOS® Concentrate 1.1
Emulsified Edible Oil Substrate

(Licensed under US Patent # 6,398,960)

Benefits

•" EOS® provides simplified product handling and improved subsurface distribution characteristics compared to other *in situ* products
v' EOS® provides a long-lasting, natural time-release, organic substrate
S EOS® does not require continuous substrate additions
S EOS® is supplied as a microemulsion concentrate, making it easier to prepare and inject in the field compared to most other *in situ* products
•" EOS® is easily diluted and mixed in the field and pumped into the aquifer, affording immediate impact to greater areas of concern beneath the site
/ EOS® applications incur no continuing operating and maintenance cost
- EOS® is a low cost-effective alternative for aquifer restoration

Product Uses

Aquifer Remediation
EOS® accelerates anaerobic biodegradation in aquifers impacted with chlorinated solvents, perch I orate, and nitrate and promotes biotransformations of chromium, radionuclides, and acid mine drainage to less toxic forms

General Description

EOS* Concentrate is a white liquid, food-grade emulsion with a milky appearance and a vegetable oil odor It is a stable emulsion that is miscible in water

Packaging

EOS Concentrate is packaged in 55-gallon drums The product can also be packaged in totes or shipped in bulk tankers Contact your EOS Remediation representative for special packaging requests

Storage Conditions

EOS*Concentrate is stable under normal conditions Storage in a dry place above freezing is recommended

Preparation

EOS Concentrate is mixed with 4 parts water prior to injection to achieve the final working concentration Therefore, each 55-gallon drum of concentrate provides a final mix volume of 275 gallons Injection can be accomplished with a suitable pump and hoses attached either to wells or direct push points Contact your EOS Remediation representative for suggestions on injection design

EOS Remediation, Inc
3722 Benson Drive, Suite 101
Raleigh, NC 27609
(919) 873-2204 • Fax (919) 873-1074
www eos remediation com

EOS Remediation Inc wairants the information presented in this bulletin to be accurate and reliable No other representation or warranties are given or made in relation to the information or the product, and EOS Remediation assumes no responsibility for advice or recommendation* made herein or any other information disseminated concerning this product EOS Remediation shall not be liable for consequential damages, including, but not limited to, last profits and loss of use, or for damages In the nature of penalties

EOS™ Storage, Material Handling and Injection

EOS™ Concentrate

EOS™ is prepared from a food-grade, concentrated, emulsified oil (but not intended for human consumption) that should be stored at temperatures between 40 degrees and 90 degrees Fahrenheit Colder temperatures may slightly increase viscosity of the concentrate and require increased pumping effort to transfer the matenal from the container EOS™ should be protected from freezing temperatures wherever possible, since freezing can potentially result in product separation

Containers

EOS™ can be furnished and shipped in DOT-approved 55-gallon drums (weighing approximately 420 lbs), 290-gallon totes (~ 2,220lbs), or 350-gallon (-2990 lbs) IBC tanks DOT-approved 55-gallon drums with opening in the lid are the most commonly used containers Totes have a bottom discharge valve that can be used to gravity drain or can be emptied with a small transfer pump Totes are supported by heavy cardboard that requires inside storage and protection from puncture IBC tanks consist of a polyethylene tank within a wire cage IBC tanks can be stored outside and have both top and bottom discharge ports

Water

The EOS™ concentrate is diluted with water pnor to injection A diluted mixture of 20% concentrate to 80% water is a typical injection blend Once the blend ts injected into the subsurface, it is chased with water to spread the emulsion into the aquifer A suitable quantity of water must be identified at your project site Natural site groundwater is usually the best source because it is available and recirculated in the aquifer However, the aquifer must yield a sufficient volume to be extracted in a relatively short period and regulatory approval may be required for re-injecting potentially contaminated groundwater Potable water can be used to prepare and chase the emulsion, however, pretreatment of the water with granular activated carbon (GAC) or air sparging to remove residual chlorinated disinfection byproducts and other contaminants may be required

Handling, Mixing and Blending EOS™ Concentrate

To overcome minor settling that may occur due to prolonged storage or cold weather, remixing of the EOS™ concentrate is recommended before dilution If drums or IBCs are used, a drum mixer can be inserted through the bung or top port to easily redistribute the concentrate If totes are used, resuspension can be facilitated in a second mixing tank or series of drums

EOS™ concentrate should be blended with water on site in the recommended ratio immediately pnor to use A drum pump, gravity or other centrifugal pump can be used to transfer the concentrate from the container to a final injectable-emulsion mixing vessel such as another drum, polyethylene tanks and stock watenng tanks Using a dilution proportion of 1 4, each 55-gallon drum of EOS™ concentrate provides a final mix volume of 275 gallons When the EOS™ concentrate is supplied in totes or IBC tanks, a water meter can be used to measure the volume of EOS™ concentrate added to the tank

Direct Push Points vs Wells

The diluted emulsion is injected into the aquifer with a pump and hoses attached either to a well, senes of wells or direct push points Each project site must be evaluated to determine the most cost-effective injection method EOS™ has been successfully injected through both wells and direct push borings

Injection wells can be installed using conventional drilling equipment or direct push equipment The top of the well screen should not extend into the unsaturated portion of the aquifer In situations where the water table is close to the ground surface, the top of the well screen should be maintained at least 5 feet below grade Extremely long screen lengths are not recommended, since there would be an uneven application of emulsion throughout the aquifer thickness In situations where the emulsion is to be applied over a significant vertical distance, a senes of shallow and deep injection wells should be considered An adequate seal between the well casing and the borehole is absolutely necessary

EOS™ can also be injected directly via direct push equipment The emulsion can be injected through the drilling rods as the drill string is withdrawn The process continues until the end of the bottom rod is at the top of the injection zone The rods should then be left at this position while the chase water is injected to move the emulsion outward in the formation The rods should be removed at the end of the water chase

Equipment Setup for Injection

EOS™ emulsion is typically injected using low pressure pumping equipment Either connect a single hose from the supply pump to a manifold connecting all of the injection wells or supply the injection points in a daisy chain manner with a discharge hose extending from the pump to the first injection well first back to the dilution tank Valves on each manifold serve to balance out flow rates

Water Chase

After the required amount of EOS™ has been injected into the aquifer, additional chase water will disperse the emulsion into the aquifer The chase water can be added to the dilution tank after the emulsion has been pumped out with no changes in the equipment setup In some cases, the water chase can be applied using water line pressure and no pump Water should be applied until the calculated volume has been injected and then the valve on the wellhead or manifold is closed

MATERIAL SAFETY DATA SHEET

EMULSIFIED EDIBLE OIL SUBSTRATE

-HMIS--

HEALTH **1**

FLAMMABIUTY

REACTIVITY

PERSONAL PROTECTION

DOT HAZARD CLASSIFICATION NONE
0

MANUFACTURER'S NAME

EOS Remediation, Inc
3722 Benson Drive, Suite 101
Ralelgh.NC 27609

DATE OF PREPARATION
01-24-03, Rev 02-16-04

INFORMATION TELEPHONE NO
919-873-2204

SECTION! - PRODUCT IDENTIFICATION

PRODUCT NAME	**EOS*CONCENTRATE 1 1**
PRODUCT CLASS	**VEGETABLE OIL BASED EMULSION**
CAS NUMBER	**MIXTURE**

SECTION II - HAZARDOUS INGREDIENTS

COMPONENTS	EXPOSURE LIMIT

THIS PRODUCT IS A MIXTURE OF EDIBLE FOOD GRADE ADDITIVES AND CONTAINS NO HAZARDOUS INGREDIENTS

SECTION III - PHYSICAL DATA

BOILING POINT	**212°F**
SPECIFIC GRAVITY	**92**
VAPOR PRESSURE	**NOT ESTABLISHED**
PERCENT VOLATILE BY VOLUME (%)	**24 (AS WATER)**
VAPOR DENSITY	**HEAVIER THAN AIR**
EVAPORATION RATE	**NOT ESTABLISHED**
SOLUBILITY IN WATER	**SOLUBLE**
APPEARANCE AND ODOR	**OFF WHITE LIQUID WITH VEGETABLE OIL ODOR**

EMULSIFIED EDIBLE OIL SUBSTRATE

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT	**>300°F**
FLAMMABLE LIMITS	**NOT ESTABLISHED**
EXTINGUISHING MEDIA	**CO_2, FOAM, DRY CHEMICAL** **NOTE WATER, FOG, AND FOAM MAY CAUSE FROTHING AND SPATTERING**
UNUSUAL FIRE AND EXPLOSION HAZARDS	**BURNING WILL CAUSE OXIDES OF CARBON**
SPECIAL FIRE FIGHTING PROCEDURES	**WEAR SELF CONTAINED BREATHING APPARATUS AND CHEMICAL RESISTANT CLOTHING USE WATER SPRAY TO COOL FIRE EXPOSED CONTAINERS**

SECTION V - PHYSICAL HAZARDS

STABILITY	**STABLE**
CONDITIONS TO AVOID	**NONE**
INCOMPATIBILITY	**STRONG ACIDS AND OXIDIZERS**
HAZARDOUS DECOMPOSITION PRODUCTS	**THERMAL DECOMPOSITION MAY PRODUCT OXIDES OF CARBON**
HAZARDOUS POLYMERIZATION	**WILL NOT OCCUR**

SECTION VI - HEALTH HAZARDS

SIGNS AND SYMPTOMS OF EXPOSURE
1 Acute Overexposure - **NONE**
2 Chronic Overexposure - NONE

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE **NONE KNOWN**

CHEMICAL LISTED AS CARCINOGEN OR POTENTIAL CARCINOGEN
NTP-NO IARC-N2 OSHA - **NO**

EMERGENCY AND FIRST AID PROCEDURES

1) Inhalation-	**REMOVE TO FRESH AIR**
2) Eyes-	**FLUSH WITH WATER FOR 15 MINUTES, IF IRRITATION PERSISTS SEE PHYSICIAN**
3) Skin-	**WASH WITH MILD SOAP AND WATER**
4) Ingestion-	**PRODUCT IS NON-TOXIC IF NAUSEA OCCURS, INDUCE VOMITING AND SEEK MEDICAL ATTENTION**

SECTION VII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION	**NOT NORMALLY REQUIRED**
VENTILATION	**LOCAL EXHAUST**
PROTECTIVE GLOVES	**NOT NORMALLY REQUIRED**
EYE PROTECTION	**NOT NORMALLY REQUIRED**
OTHER PROTECTIVE CLOTHING OR EQUIPMENT	**NONE**

SECTION VIII - SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE	**DO NOT STORE NEAR EXCESSIVE HEAT OR OXIDIZERS**
OTHER PRECAUTIONS	**NONE**
STEPS TO BE TAKEN IN CASE MATERIAL IS SPILLED	**SOAK UP WITH DRY ABSORBENT AND FLUSH AREA WITH LARGE AMOUNTS OF WATER**
WASTE DISPOSAL METHODS	**DISPOSE OF ACCORDING TO FEDERAL, STATE, AND LOCAL REGULATIONS**

SECTION IX - ADDITIONAL REGULATORY INFORMATION

SARA TITLE III

UNDER THE PROVISIONS OF TITLE 111, SECTION 311/312 OF THE SUPERFUND AMENDMENTS AND REAUTHORIZATIONS ACT, THIS PRODUCT IS CLASSIFIED INTO THE FOLLOWING HAZARD CATEGORIES **NONE**

THIS PRODUCT DOES **NOT** CONTAIN SECTION 313 REPORTABLE INGREDIENTS

THE INFORMATION CONTAINED HEREIN IS BASED ON AVAILABLE DATA AND IS BELIEVED TO BE CORRECT HOWEVER, EOS REMEDIATION, INC MAKES.NO WARRANTY, EXPRESSED OR IMPLIED, REGARDING THE ACCURACY OF THIS DATA OR THE RESULTS TO BE OBTAINED THEREOF THIS INFORMATION AND PRODUCT ARE FURNISHED ON THE CONDITION THAT THE PERSON RECEIVING THEM SHALL MAKE HIS/HER OWN DETERMINATION AS TO THE SUITABILITY OF THE PRODUCT FOR HIS/HER PARTICULAR PURPOSE

\N\LCLEAR .TM

Sodium Lactate

For Bioremediation Applications

Description

JRW Technologies' WILCLEAR™ Sodium Lactate for bioremedmtion is a clear, slightly viscous liquid that is 60% solids by weight in USP purified water WILCLEAR™ Sodium Lactate provides the lowest metals content, as measured by a nationally recognized analytical laboratory, of any sodium lactate available and exceeds US Pharmacopoeia standards It is the only sodium lactate that meets all primary MCL's (maximum contaminant levels) for drinking water in a 60% form, thus minimizing concern for underground injection

Specifications

	SDecifi cation	Typical
Sodium Lactate, % by wt	60+12	60±0 5
H_20	40+12	40 + 0 5
pH	70 + 05	68-72
Color, APHA	25 max	. 10
Iron, ppm	2 max	<5
Specific Gravity	13100-13400	
Citrate, Oxalate, Phosphate, Tartrate	none detected	
Sulfate	none detected	
Sugars	none detected	
Sodium, %	123 + 02	
Odor	Practically odorless	

Applications

WILCLEAR™ Sodium Lactate is used to enhance the microbia activity 1 biodegradation and reduction of chlorinated solvents Technical support for bioremediation applications is provided through an exclusive agreement with SRP Technologies, developers of Bioavailability Enhancement Technology (B ET™), patent pending)

Packaging

55 gallon (600 lbs Net) Polyethylene Drums, 2 850 lb IBC's

Storage

Store unopened under dry conditions at ambient temperatures

5/01

MATERIAL SAFETY DATA SHEET

ALDON
H n · n n M · K · _ · * * · * •
A L DOM ® CORPORATION

221 Rochester Street
Avon New York 14414-9409
(S8s,22Mi77

MSDSNo MM0602
Effective Date ApnM 2002

SECTION I NAME

Product	Molasses
Chenucel Synonyms	N/A
Formula	N/A
Unit Size	up to 3 785 LL
CAS No	None assigned

24 HOUR EMERGENCY ASSISTANCE

CHEMTREC
8D0-424-9300
Day 585-2264177

NFPA
HUARO RATING

MWHAL	**SUGMT**	**MODERATE**	**SEVERE**	**EXTREME**
0	1 2		3	4

Health	0
FPV	0
Reactnrtty	0

HM1S

SECTION II INGREDIENTS OF MIXTURES

Principal Component(s)	%	TLV Units
Molasses	100%	None listed
USE M KEEPING WtTH GOOD LABORATORY PRACTICES		

SECTION III PHYSICAL DATA

Melting Point (°F)	N/A	**Sparfc Grant* (H,0 = 1)**	142
Boiling Point (°F)	230°C	**PercaniVotaai* byVofcm* (%]**	20
Vapor Pressure (mm Hg)	70	**npotiW* Ran**	N/A
Vapor Density (AJT=1)	Data not tested		
Solubility in Water	Infinite		
Appearance & Odor	Slight amber to brown colored Ulick bqtad no odor		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used)	Non-flammable	Fbmmable Umrts m Alf %byVol«rw N/A	Lower	Upper
ExtUtflOKhar • M b	None required Product B non-cornbustibte			

SPECIAL FIREFIGHTING PROCEDURES

Non-flammable

UNUSUAL FIRE AND EXPLOSION HAZARDS

Non-explosrve

DOT NON-REGULATED

Approved by U S Department of Labor essenbaNy timfer" to tarm OSHA 20

HEALTH HAZARD DATA

Threshold Limited Value I

None established (ACGIH2001)

Effects of Overexposure,

No ril effects are expected May cause transient irritation to the eyes
Target organs Norte known

Emergency and First Aid Procedures

INGESTION Call physician or Poison Control Center mmedtatery Induce vomrbng only if advised by appropriate medical personnel Never give anything by mouth to an unconscious person EYES Check for and remove contact lenses Flush thoroughly with water for at least 15 minutes Mbng upper and lower eyelids occasunafty Get immediate medical attention SKIN Remove Contaminated dotrung Rush thoroughly with mdd soap and water If rotation occurs get medical attention INHALATION Remove to fresh air If not breathing give artificial respiration It breathing is difficult, give oxygen Get medical attention

SECTION V REACTIVITY DATA

Stability Unstable Stable

Conditions to Avoidf

Not applicable

Incompatibility (Materials to Avoid) Not applicable

Hazardous Decomposition Products Not applicable

Hazardous Polymerization Hay Occur Will Not Occur

Conditions to AvoidJ

Not applicable

SECTION VII SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled

Absorb with an inert dry material and mop up with soap and water
Solid disposal dump or flush to sanrtary sower

Waste Disposal Method

Discharge treatment or disposal may be subject to Federal Stats or Local laws
These disposal gudebnes are intended tor the dtsposal of catalog-size quantities only

Solid disposal dump or sanitary tandffill

SECTION VIII SPECIAL PROTECTION INFORMATION

Rsspestnn Protection (SpecrryType) None required m normal handling at room temperatures

Ventilation	**Local Exhaust**	None needed	Special	No
	HachaMcal (Gerwral]	None needed	Other	No
Protective Gloves	None needed	Eye Protection	Chemical safety glasses	

Other Protactn* QfllipilMiit Smock apron splash goggles eye wash station

SECTION IX SPECIAL PRECAUTIONS

Precautions to be Taken in Handling A Storing

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Store in venalated tanks equipped with filtered air vents at 105*F -110°F

Avoid storage temperatures above 115*F tor prolonged periods or discoloration and/or carmeltzatjon may occur

Revision No \ |Date 03/01/02 |Approved Michael Raszeja **ChwMeWSMV CoQuinHur** MR

TTm*™««B«vtt*ttiiwHi—i«*Mtntfnam4iiM»«i nlfytJd Dmjfn« wwuM IM *Vm* ift^umi p « y• —•—'—^-^•-•••n—!»• ' ' — ”>»| —" "m|mi' i aajl'ilmjinmiliini i *form* UM o(d a * mMnfc MM tMrtr and MdhBlamptoyMa HttHdnuiIIHHIII WttatWS1»«JJ» Pn*Monmctcttdgw

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