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FINAL

Final
Enhanced Reductive Dechlorination Pilot Test Results Report

Former Unocal Chemical Distribution Facility
2100 East 37th Street North
Wichita, Kansas 67219

Prepared for
Chevron Environmental Management Company (EMC)
6111 Bollinger Canyon Road
San Ramon, California 94583

March 24, 2009

URS Corporation
9400 Amberglen Boulevard
Austin, Texas 78729
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Project Number: 41008814

URS

March 24, 2009

Mr. Christopher C. Carey
Post-Remediation Unit/Remedial Section
Bureau of Environmental Remediation
Kansas Department of Health and Environment
1000 SW Jackson Street, Suite 410
Topeka, KS 66612-1367

Re: **Final Enhanced Reductive Dechlorination Pilot Test Results Report**
Former Unocal Chemical Distribution Facility
2100 East 37th Street North
Wichita, Kansas 67219

Dear Mr. Carey:

URS Corporation (URS) has prepared this report (1 hardcopy and 1 set of replacement pages) on behalf of the Chevron Environmental Management Company (EMC) (formerly Unocal) pursuant to Consent Order 91-E-206 between Chevron EMC and the Kansas Department of Health and Environment (KDHE).

The Enhanced Reductive Dechlorination Pilot Test Results Report includes site background; details about the former extraction system, pilot test objectives; materials and methods used during the pilot test; pilot test monitoring plan; a discussion of the pilot test results; and conclusions and future recommendations.

If you have questions or comments, please feel free to contact me at 512-419-6180.

Respectfully submitted,
URS Corporation

Derek R. Peacock, P.E.
Project Manager

cc: Mr. Michael P. Mailloux, Chevron EMC (1 copy)
File

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Acronyms and Abbreviations

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
Cl	chlorine
CO_2	carbon dioxide
°C	degrees Celsius
DCA	dichloroethane
DCE	dichloroethene
DPT	direct-push technology
DTW	depth to water
EMC	Environmental Management Company
EPA	U.S. Environmental Protection Agency
ft	feet
GS	ground surface
H	hydrogen
HRC®	Hydrogen Release Compound
ID	identification
KDHE	Kansas Department of Health and the Environment
µg/L	micrograms per liter
mL	milliliter
mg/L	milligrams per liter
MIP	membrane interface probe
mV	millivolt
MW	monitoring well
ND	non-detect
nM	nanomolar
NM	not measured
NPDES	National Pollutant Discharge Elimination System
ORP	oxidation-reduction potential
%	percent
PCE	tetrachloroethene
POTW	Publicly Owned Treatment Works
R	recovery well
RI	Remedial Investigation
RSK	Risk-Based Standards for Kansas
SAP	sampling and analysis plan
TCA	trichloroethane
TCE	trichloroethene
TW	test well
Unocal	Unocal Chemical Distribution Facility
URS	URS Corporation
VFA	volatile fatty acid
VOC	volatile organic compound

1.0 Introduction

On behalf of Chevron Environmental Management Company (EMC), URS Corporation (URS) conducted an enhanced reductive dechlorination pilot test (December 2006) at the former Unocal Chemical Distribution Facility (Unocal) located at 2100 East 37th Street in Wichita, Kansas. This pilot test was conducted in accordance with the ***Enhanced Reductive Dechlorination Pilot Test Implementation Workplan, Former Unocal Chemical Distribution Facility, Wichita, Kansas*** (URS, October 2006) that was approved by the Kansas Department of Health and Environment (KDHE) in October 2006. The purpose of this report is to document the results of this pilot test to date (July - August 2008) and propose future monitoring activities based on these results.

1.1 Site Background

The former Unocal site is located in the southeast corner of the southwest quarter of Section 27, Township 26 South, Range 1 East. Figure 1 depicts the location and orientation of the former Unocal site and its geographic relationship to other properties in the immediate area. The facility began operating in the 1950s. Operations generally included receiving bulk shipments of liquid chemicals (primarily industrial solvents), temporarily storing these chemicals in aboveground tanks, and filling orders for both drummed and bulk shipments. Operations at the facility ceased in 1992, and the chemical infrastructure and the structures associated with the facility were razed prior to 2003. Currently, the site has no permanent structures, is relatively flat, and is only partially vegetated with grass. Additional information regarding the site background can be found in the ***Final Revision 0 Remedial Investigation (RI) Report, Former Unocal Chemical Distribution Facility*** (URS, November 2007).

The site has been well characterized spatially by direct push/field laboratory sampling and membrane interface probe (MIP) and spatially and temporally by the monitoring well network. This characterization includes lithologic information, contaminant distribution, and concentration trends over time. The subsurface of the area is comprised of silty clay with interbedded sands and gravel, atop the lower confining unit (Wellington Shale). While the site topography is very flat, the topography of the shale varies significantly across the site. There is a rise in the Wellington formation directly beneath the former tank farm location and a depression on the eastern portion of the site, forming a valley. This valley runs northeast to southwest and is filled with mixed alluvium that exhibits varying hydraulic conductivity. Figure 2 shows a plan view of the site with generalized chlorinated ethane plumes along with a cross section showing the topography of the shale along with the electron capture detector data from the MIP study.

Inadvertent releases of contaminants were likely sourced from three areas on the site (the storage building, tank farm, and warehouse building). The various releases at the site are distinguished by whether benzene, toluene, ethylbenzene and xylene (BTEX) constituents were present to serve as an electron donor. On the eastern portion of the site, a storage building was present at the location where a "tetrachloroethene (PCE) only" plume emanates. Near the north central portion of the site where the former tank farm existed, a mixture of contaminants were released. Along the northwest boundary of the site, there was a warehouse/office building where a floor drain existed and potentially released a mixture of contaminants. While contaminated soil was excavated at these locations, residual source material may be present in the saturated zone. Figure 3 shows the locations where impacted soils were removed at the site.

1.1.1 Contaminant Distribution

Seven different "Plumelets" have been defined on or near the site, as discussed in the RI Report (URS, November 2007). This pilot test focused on the two Plumelets (Plumelet A and B) that have migrated in a southerly direction, as shown in Figure 2. Plumelet A is east of Plumelet B and consists primarily of PCE, but does not contain significant concentrations of BTEX. Plumelet B consists of chlorinated ethenes, ethanes, and BTEX.

Over time, the groundwater zones that contain a mixture of petroleum hydrocarbons and chlorinated solvents have shown significant reduction in both constituent types. This is attributed to the petroleum hydrocarbons providing electron donor material to facilitate reductive dechlorination of chlorinated solvents. Groundwater zones without BTEX have shown a more gradual degradation of chlorinated solvents over time, due to an inadequate amount of natural carbon in the aquifer. Therefore, it was predicted that reductive dechlorination could be enhanced through the injection of an organic compound that would provide a carbon substrate to serve as an electron donor. The economics of using this approach is directly related to the frequency of reintroduction of these organic compounds required to achieve and maintain the plume containment in the subsurface.

1.1.2 Previous Pilot Study

A pilot test using Hydrogen Release Compound (HRC®) was initiated in 1999 downgradient of the source area for Plumelet A on the former Unocal site. The 1999 Pilot Study is detailed in Appendix A. Using direct-push technology (DPT) drilling tools, HRC® was injected in an array to form a reactive barrier perpendicular to the groundwater flow direction. The groundwater concentrations of PCE and trichloroethene (TCE) in the wells downgradient from the injections decreased rapidly following the injection of the organic compound, with PCE concentrations dropping by approximately 95 percent (%) within two months of the injection. A temporary rise

in the concentrations of dechlorination daughter compounds, such as *cis*-1,2-dichloroethene (DCE), vinyl chloride, and ethane, was observed in association with the decrease in concentration of PCE and TCE. Additionally, the organic volatile fatty acid (VFA) levels increased in the downgradient wells during the first six months.

Based on these successful results, monitoring of the test was extended to 18 months. Eventually, the VFA concentrations reached peak levels 1 year to 18 months after injection in most downgradient wells. However, the levels of PCE and all of its daughter compounds continued to decrease after 18 months in all the downgradient wells, eventually dropping below the detection limit after 5 years. The signs of exhaustion of electron donors (i.e., increases in chlorinated solvent concentrations) were detected in the deepest monitoring point, P-02, six years after the original injection. These increases were further noted in P-02 during years seven and eight. On the basis of this pilot test, it was assumed that similar substrate injections would last for at least five years.

1.2 Former Extraction System Details

In 1997, a groundwater extraction system with two interceptor rows (Interceptor A and B) was installed in the downgradient portion of the dissolved plumes to prevent contamination from migrating further downgradient (Figure 3). Interceptor A is a line of six extraction wells oriented north-south, adjacent to the Coleman Company's warehouse. Interceptor B is a line of five extraction wells oriented northwest to southeast. These interceptors were positioned perpendicular to the groundwater flow direction at each location. Figure 3 also shows an additional extraction well (R1) on the former Unocal site. Groundwater extracted from 12 wells was piped underground back to the site, where it was treated with air stripping prior to discharge to the sewer system.

1.2.1 Extraction System Operation and Discharge Permit

Since 1997, the pump and treat system had operated more or less continuously, and, as such, certain components of this system were aging. The system had been effective at preventing chlorinated solvents from migrating beyond the two groundwater interceptors. Concentrations of chlorinated solvents in the extraction system wells and nearby monitoring wells displayed a decreasing trend over time.

In 2005, the City of Wichita indicated by letter that Chevron EMC would no longer be able to discharge process water to the Publicly-Owned Treatment Works (POTW) after their current discharge permit expired on August 30, 2006. The discharge to the POTW had been operating under a "temporary" extension of Permit Number 9291 that was renewed on October 31, 2005.

In 2005, Chevron EMC applied for a National Pollutant Discharge Elimination System (NPDES) permit for the site in order to discharge to surface water ditches. The NPDES permit was denied on the basis of the City's desire not to create a maintenance problem owing to constantly wet ditches. This permit denial left Chevron EMC with no option for discharging treated water.

1.2.2 Extraction System Decommissioning

Prior to the pilot test, the previous groundwater extraction system was turned off, but left in place for potential future use. Extraction wells have been used for performance monitoring for the current pilot test. The extraction pumps remain in the extraction wells, but were not used to collect monitoring well samples.

Currently, the extraction system is being evaluated for partial decommissioning. Factors included in this evaluation are the system's age and configuration, the potential use of the extraction wells as injection wells, and the benefit of potentially removing portions of the system.

1.3 Pilot Test Objectives

While it was apparent that the former extraction system was approaching diminishing returns with regard to the contaminant mass extraction rate, it was still serving its original function as an interceptor device. Therefore, Chevron EMC proposed to "replace" this system with an *in situ* reactive treatment system comprised of two biobarriers that utilize an injected Regenesis product - HRC® and an injected DBI Remediation Product - CAP18-ME™. Figure 4 shows the injection locations in relation to the extraction wells. The basis for this decision was three-fold:

1) The extraction system was approaching the end of its useful life with regard to the mass extraction rate;

2) Enhanced reductive dechlorination had been demonstrated at this site in a previous pilot test; and,

3) The discharge permit had expired.

The goal of this pilot test treatment was to demonstrate that enhanced bioremediation (reductive dechlorination) was as effective in reducing chlorinated solvent concentrations compared to the extraction system.

On August 30, 2006, the existing groundwater extraction system was turned off. The ***Enhanced Reductive Dechlorination Pilot Test Implementation Workplan, Former Unocal Chemical Distribution Facility, Wichita, Kansas*** (URS, October 2006) was approved by KDHE in October 2006. Groundwater samples collected in June 2006 for the 2006 Annual Groundwater

Monitoring Event served as the "baseline" for this pilot test. In December 2006, the *in situ* reactive treatment substrates were injected into the two biobarriers to begin the pilot test.

2.0 Materials and Methods

The purpose of injecting an organic substrate into the subsurface is to provide an electron donor to promote reductive dechlorination of PCE and its daughter compounds (TCE, *cis*-1,2-DCE, and vinyl chloride). A portion of the injected organic substrate should immediately dissolve into groundwater to stimulate dechlorinating bacteria to begin reducing the existing concentration of chlorinated constituents, while the remainder of the substrate should dissolve at a rate similar to the slow dissolution/desorption rate of PCE. This slower dissolving portion can be effective for a long period of time after injection. Two substrates (HRC® and CAP18-ME™) were chosen for injection during this pilot test to allow for a side-by-side comparison of these products. While HRC® had previously been proved at the site during the 1999 Pilot Test, the CAP18-ME™ was evaluated for its slower dissolution and potentially longer effectiveness as a biobarrier.

2.1 Materials

The implementation plan for the barriers involved injecting the substrate HRC® as Interceptor A, referred to as the downstream barrier (and thus, the more important barrier), and injecting the substrate CAP18-ME™ as Interceptor B, referred to as the upstream barrier. HRC® is a proprietary polylactate ester that is manufactured as a viscous gel by Regenesis. CAP18-ME™ is a proprietary vegetable oil product made by DBI Remediation Products, LLC. Both substrates are used to accelerate the *in situ* biodegradation rates of chlorinated solvents, such as PCE and TCE, via anaerobic reductive dechlorination processes. CAP18-ME™ is less mobile than HRC® and thus should remain in the biobarrier injection zone, while HRC® releases lactic acid slowly, which moves away from the injection zone through advection and diffusion. The text in the following sections is paraphrased from vendor supplied information.

2.1.1 HRC® Vendor-Supplied Background

Upon contact with water, HRC® slowly hydrolyzes and is gradually broken down via microbial action as shown in Exhibit 1 from the Regenesis website. During this initial process, lactic acid is released and utilized (fermented) by microbes. The released lactic acid degrades into pyruvic acid and then into acetic acid (shown in Exhibit 2 from the Regenesis website). During this degradation process, hydrogen is produced that aids in the reductive dechlorination of chlorinated solvents. Reductive dechlorination is a term used to describe the mechanism by which chlorinated hydrocarbons are biologically degraded under anaerobic conditions. In this natural process, anaerobic microbes substitute hydrogen (H) for chlorine (Cl) on chlorinated contaminant molecules, thus dechlorinating the compound. Being a natural process, reductive dechlorination usually proceeds at very slow, unsustainable rates. HRC® increases the rate of

dechlorination up to several orders of magnitude, rapidly taking the contaminant through a step-wise dechlorination process that ultimately results in the production of ethene and ethane. The HRC® process also produces butyric and propionic acids. A simplified schematic depicting the relationship between the pyruvate, lactate, propionate, acetate, and butyrate during starch fermentation is shown in Exhibit 3 below. By injecting enough soluble mass of HRC® into the saturated zone, release conditions can occur for a number of years.

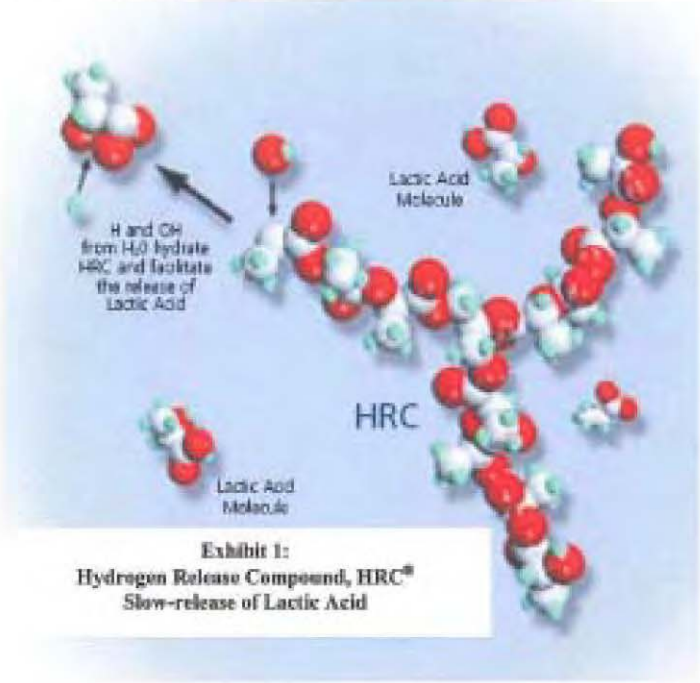
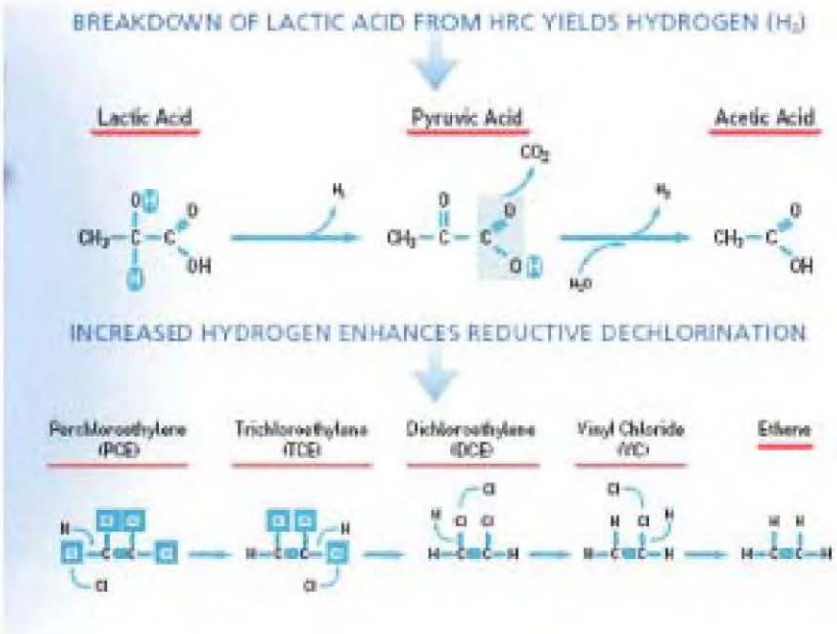


Exhibit 1:
Hydrogen Release Compound, HRC®
Slow-release of Lactic Acid

Exhibit 2:
Breakdown of Lactic Acid and Release of Hydrogen



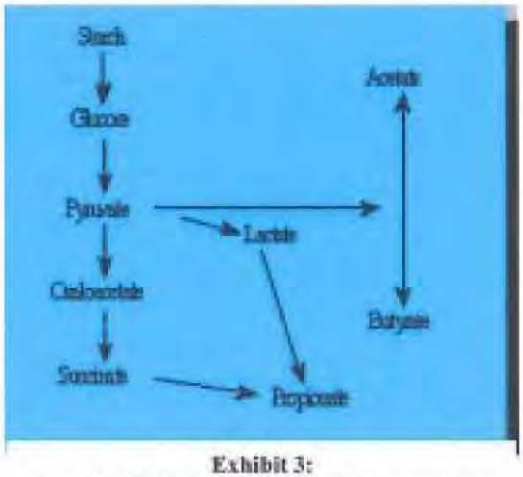


Exhibit 3:
Simplified Scheme for Starch Fermentation in the Rumen.

The hydrogen produced during the fatty acid degradation can by used by different sets of anaerobic microbes for the production of methane (methanogens) or for dechlorination (reductive dechlorinators). Results from university studies suggest that there is competition for hydrogen between the reductive dechlorinators and methanogens. High concentrations of hydrogen favor methanogenic activity, whereas reductive dechlorinators are best supported in conditions of low hydrogen concentrations (2-10 nanomolar [nM]). With HRC®'s time-release feature, a steady, low hydrogen concentration is possible which can optimize reductive dechlorination over competing methanogenic activity.

2.1.2 CAP18™ Vendor-Supplied Background

CAP18™ is a formulation of food-grade, long-chain fatty acids, refined from natural vegetable oils, and has been used to stimulate reductive dechlorination of chlorinated solvents in various field-scale applications since 2001. The long chain fatty acids are consumed via a process known as beta-oxidation, which establishes anaerobic conditions for contaminant degradation and produces hydrogen over a sustained period of time (many months to years). The hydrogen is utilized by microbes to biologically destroy contaminants by stripping chlorine atoms from the molecule.

CAP18-ME™ was developed to stimulate an earlier onset of anaerobic conditions conducive to biodegradation when compared to CAP18™. CAP18-ME™ includes a small amount of methyl esters of fatty acids, which are more rapidly available for microbial utilization and hydrogen production than are the fatty acids from CAP18-ME™. These esters are derived by splitting the backbone of the triacylglycerol compounds that comprise vegetable oils and combining the resulting free fatty acids with an alcohol to form methyl esters. Esters offer an advantage in that

they are completely miscible with CAP18-ME™, and are thus blended with CAP18-ME™ to provide a more rapid onset of reductive dechlorination without sacrificing overall lifetime of the product. Thus CAP18-ME™ can be expected to show results slightly faster than CAP18™, which is an advantage when time is critical (such as in short-duration pilot tests).

For CAP18-ME™, the released triacylglycerols and methyl esters of fatty acids degrade into fatty acids and glycerol and then into acetic acid. During this degradation process, hydrogen is produced. By injecting enough soluble mass of CAP18-ME™ into the saturated zone, release conditions can occur for an extended period of time. Additionally, CAP18-ME™ is designed to reduce methanogenesis, which diverts the hydrogen from dechlorination to methane production.

2.2 Methods

Prior to mobilization, a detailed subsurface utility locating task was performed by Consolidated Utility Services, Inc. Injections near the vicinity of marked areas were offset by approximately two feet (ft) to ensure clearance of the utility. A Coleman representative reviewed and commented on the utility locating task and the final placement of injection locations.

The water levels in the extraction wells near the treatment zones were gauged during implementation of the pilot test to determine the depth to the water table in the various areas. The results of the water level gauging are presented in the table below. The injections were performed from the refusal depth (Wellington Shale) to approximately two ft above the water table.

Water Levels on the Day of Injection

Well ID	GS DTW (ft bgs)
Zone 1	
R-4	8.95
R-5	10.43
R-6	17.98
Zone 2	
R-7	10.52
R-10	10.50
R-11	9.30
R-12	7.82
MW-18	10.01

DTW - Depth to water.
ft bgs - Feet below ground surface.
GS - Ground surface.
ID - Identification.
MW - Monitoring well.
R - Recovery well.

The HRC® and CAP18-ME™ were injected into the subsurface via DPT from the lower confining unit to above the estimated potentiometric surface (bottom-up technique) by PSA Environmental from Lee's Summit, MO. DPT refers to methods used for performing subsurface sample collection, deployment of sensors, or injections by driving, pushing, or vibrating small-diameter hollow steel rods or other tools into the ground. This technology allows for cost-effective, rapid injection at multiple locations, and has been used on both the former Unocal site and Coleman site for soil and groundwater sampling and at the former Unocal site for the HRC® injection during the previous pilot test. Both PSA Environmental and URS staff are experienced in the injection of substrates. Figure 4 shows the locations of the injection points.

The implementation plan was performed in accordance with the Workplan with only one significant deviation: instead of injecting into three discrete zones as originally proposed, only two separate zones were utilized. The original plan, as described in the workplan, was to inject a reduced amount of HRC® in Zone 3 of Interceptor A; however, the same amount of material was injected in both Zones 2 and 3 of Interceptor A. Therefore, those two zones were combined in subsequent discussions.

2.2.1 HRC® Injection (Interceptor A)

As described previously, Zone 2 and 3 were combined into one zone (renamed Interceptor A due to its parallel location to the former groundwater extraction interceptor), and an equivalent amount of substrate was injected throughout this barrier. Interceptor A is 300 ft long and consists of 60 injection points spaced roughly 10 ft apart, forming two rows that are perpendicular to the groundwater flow. The injections were performed to depths ranging from approximately 18 ft below ground surface (bgs) to 32 ft bgs, as presented in Table 1. For each injection, the starting depth of the injection corresponds with the depth of refusal (a bottom-up technique was used). All of the depths were deeper than the initially estimated 15 ft bgs.

For most of the injection points in this interceptor, an HRC® dosing rate of approximately 11 pounds per foot (or 1 gallon per foot) was injected for the first five ft above the refusal depth and then approximately 5.5 pounds per foot (or 0.5 gallons per foot) was injected until above the water table. Owing to the presence of silty clay and clay in the area surrounding recovery well R-11, the HRC® began to surface from the top of the injection holes in that area. In order to maintain production, acetate sleeves were installed in the injection holes from 1 ft bgs to 4 ft above grade. The HRC® that was collected in the sleeves was allowed to settle into the subsurface by gravity as additional injections were performed. The total amount of HRC® injected at the site was approximately 6,120 pounds, which was greater than the initially

estimated amount of approximately 5,400 pounds. This greater amount was needed due to the injection depth being deeper than initially assumed.

Due to the limited amount of HRC® present on-site at the time, injection points D1 and D16 had an HRC® injection rate of 0.5 gallons per foot for the entire length. Once more HRC® arrived on-site, additional offset injection points were performed at D1 and D16. In the offset near injection point D1, HRC® was injected at a rate of 0.5 gallons per foot from 21 ft bgs to 16 ft bgs. In the offset near D16, HRC® was injected at a rate of 0.5 gallons per foot from 20 ft bgs to 15 ft bgs.

2.2.2 CAP18-ME™ Injection (Interceptor B)

Interceptor B (formerly Zone 1) extends 170 ft from R-4 to R-6 and consists of 34 injection points, spaced roughly 10 ft apart, forming two rows that are perpendicular to groundwater flow. The rows are 10 ft apart and offset by 5 ft, producing a diagonal pattern. The injections were performed to depths ranging from approximately 17 ft bgs to 30 ft bgs, as presented in Table 2. For each injection, the starting depth of the injection corresponds with the depth of refusal (a bottom-up technique was used). A CAP18-ME™ dosing rate of approximately 14 pounds per foot (or 1.8 gallons per foot) was used for each injection point.

Since the CAP18ME™ application occurred at the beginning of the field effort, the initial vendor order was conservatively high based on a total treatment depth of 20 ft. Actual treatment thicknesses ranged from 10 to 17.5 ft. Since extra CAP18ME™ was available, two additional injections were performed in the R-4 area, increasing the planned number of injections from 32 to 34. The remainder of the CAP18ME™ was returned to the vendor and a credit was received.

Additional offset injection points were performed for injection points A20 through A25 (located near the northwest end of the interceptor) to ensure that the underlying shale had been reached. For injection points A20 and A21, the initial injection began at 15 ft bgs, where refusal was reached. Subsequent stepout injections, offset by 1 foot, were performed from 24 ft bgs (refusal) to 15 ft bgs. For injection points A22 through A25, the initial injection began at 13 ft bgs. Subsequent stepout injections, offset by 1 foot, were performed from 23 ft bgs (refusal) to 13 ft bgs. In effect, these dual injections are treated as single injection locations. The design CAP18-ME™ dosing rate of approximately 14 pounds per foot (or 1.8 gallons per foot) was followed for each injection point. Approximately 7,010 pounds of CAP18-ME™ was injected at the site, which was less than the conservatively assumed amount of approximately 8,960 pounds. The treatment application is considered to have been performed as designed.

2.2.3 Groundwater Grab Samples

A line of eight groundwater grab samples were collected to determine concentrations of constituents between the two injection rows for the performance evaluation. The results from these samples (GP-01 through GP-08) were presented in the ***Results of Additional Investigation Activities to Complete the RI Delineation Letter*** submitted to KDHE on November 2, 2007. These results were used to configure the various contaminant plumes as presented in the RI Report (URS, November 2007).

3.0 Monitoring Plan

Since December 2006, the pilot test has been monitored on a quarterly basis to determine the progress of enhanced biodegradation in the aquifer. The most current monitoring was conducted as part of the 2008 Annual Groundwater Monitoring Event. Table 3 shows which wells were utilized during each monitoring event; samples were collected from more wells than outlined in the implementation workplan. During the events, samples from each well were analyzed for volatile organic compounds (VOCs), VFAs, dissolved gases, field parameters, and other indicator parameters.

3.1 General Sampling and Analytical Procedures

Field activities during the pilot test monitoring events were performed in accordance with both of the Sampling and Analysis Plans (SAPs) (URS, January 2006 and July 2008) developed for the site. The most recent SAP was submitted by Chevron EMC/URS to the KDHE on July 10, 2008 and was approved by KDHE in a letter dated July 15, 2008 (KDHE, July 2008).

The following location identifier prefixes were used to identify the wells:

- MW - monitoring wells on the Unocal or Coleman properties;
- R - recovery wells; and
- TW - test wells.

The sampling method used was a combination of low-flow sampling via peristaltic pump and controller at the pilot test monitoring locations. If proper drawdown could not be maintained, then the sample was collected via peristaltic pump once the parameters stabilized at the lowest achievable flowrate. Samples from recovery wells were collected via the recovery well piezometer. Purging consisted of a minimum amount of one gallon and continued until purge variable stabilization. Field observations and measurements made during purging and sampling activities were recorded in the URS field logbook, a copy of which is included in Appendix B.

Groundwater samples for VOCs were placed in hydrochloric acid preserved, 40-milliliter (mL) containers provided by the analytical laboratory. Sample containers were filled in accordance with zero-headspace procedures and sealed with Teflon-lined caps. Following sample acquisition, labels were attached to the sample containers, which were then inserted into a protective covering (either bubble wrap or foam padding) and zip-lock bags. The packaged samples were placed into iced coolers to maintain sample temperature below 4 degrees Celsius (°C), and shipped via overnight courier to the analytical laboratory using proper chain-of-custody procedures, in accordance with the SAP.

Groundwater samples were analyzed by Lancaster Laboratories in Lancaster, Pennsylvania, a KDHE-certified laboratory, for 32 VOCs per U.S. Environmental Protection Agency (EPA) Method 8260B, dissolved gases (ethene, ethane, and methane) per SW8015B, and carbon dioxide (CO_2) per laboratory method. Samples were also analyzed by Microseeps Laboratory in Pittsburgh, Pennsylvania and Severn Trent Laboratories in Tallahassee, Florida for VFAs per their laboratory method. The Data Validation Summary and Laboratory Report is provided as Appendix C. A copy of the laboratory analytical report and chain-of-custody forms are included in Appendix D.

Decontamination procedures were performed on non-dedicated sampling equipment (i.e., water level indicator) prior to and after each use. Decontamination consisted of an Alconox®/potable water wash followed by a deionized water rinse. Wastes generated from well sampling activities included purge water and spent decontamination water. Wastewater was stored in 55-gallon drums that were removed by Clean Harbors of Wichita, Kansas.

3.2 Performance Metrics

The objective of the evaluation is to ascertain whether natural attenuation has been enhanced such that contaminant concentrations will be reduced in a reasonable amount of time. It has been shown, through the previous pilot test and in locations of the plume where fuel constituents were detected, that concentrations of chlorinated ethanes and ethenes can be reduced to the tens of micrograms per liter (µg/L) through reductive dechlorination. While it was imprudent to set a target concentration for each constituent, the goal of the pilot test was to reduce the chlorinated ethene concentrations to between non-detect and 50 µg/L. This would represent an overall reduction in the contaminant mass in the downgradient portion of the plume, outperforming the former groundwater extraction system in terms of contaminant mass reduction.

4.0 Results and Discussion

After the injection work was completed, the designated pilot test monitoring wells were monitored approximately every 3 months over an 18 month period. Samples were collected for VOCs, VFAs, dissolved gases, and field parameters (dissolved oxygen, oxidation-reduction potential [ORP], temperature, and pH). Ten wells were monitored for Interceptor A and six for Interceptor B, as shown in Table 3. The latest round of data is from Month 18 (July 2008).

While both chlorinated ethenes and ethanes were present in Plumelet A and B, the common denominator between the plumes is PCE and other ethenes. Additionally, PCE and its daughter products are the only constituents that are consistently exceeding their Tier 2 Risk-Based Standards for Kansas (RSK) residential values. Therefore, this discussion focuses on changes to the chlorinated ethene concentrations, as presented in Tables 4 through 7. Figures 5 through 12 show the concentrations of PCE, TCE, *cis*-1,2-DCE, and vinyl chloride prior to injection (June 2006) and after 18 months (July 2008). The VFAs, dissolved gasses and field parameters data are presented in Table 8 while the VOC data are presented in Table 9. The chlorinated ethane and other VOC concentrations are presented in Appendix E (Unocal Historical Data CD).

4.1 Interceptor A (HRC® Injection)

The sample results from wells monitored for Interceptor A were evaluated based on their location relative to the interceptor (upgradient, sidegradient, and downgradient) and to historical Plumelets A and B. Therefore, the wells were grouped for discussion in the following manner:

- Upgradient/Sidegradient Wells;
- Downgradient Wells within historical Plumelet A (MW-18, MW-20, and R-10); and
- Downgradient Wells within historical Plumelet B (R-11, MW-21 and R-12).

A discussion of the results for each group is provided below.

Upgradient/Sidegradient Wells

For the upgradient well (MW-10) and sidegradient wells (MW-8, R-7, and R-8) of Interceptor A, minimal differences were observed in the concentrations of the VOCs, including the primary constituents (PCE, TCE, *cis*-1,2-DCE, and vinyl chloride), VFAs, and dissolved gases over time. Therefore, it was concluded that:

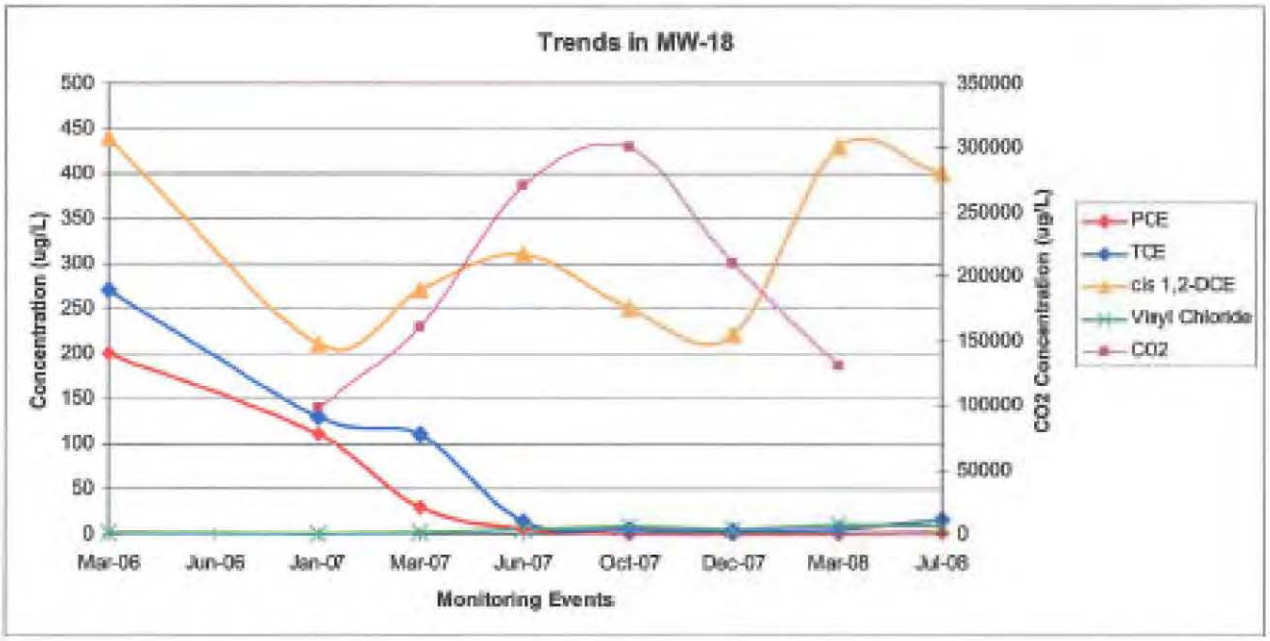
- These wells were not affected by the pilot test injections; and

- The observed changes in constituent concentrations in wells downgradient of this interceptor were a result of reductive dechlorination stimulated by the HRC® injection.

Downgradient Wells within Historical Plumelet A (MW-18, MW-20, and R-10)

Monitoring wells MW-18 and R-10 are located in historical Plumelet A approximately 35 ft downgradient of Interceptor A, while MW-20 is located immediately downgradient of MW-18 approximately 120 ft from the interceptor. Groundwater samples collected in June 2006 for the 2006 Annual Groundwater Monitoring Event served as the "baseline" for this pilot test, including monitor wells R-10 and MW-20. Since a sample was not collected from MW-18 in June 2006, the results from the 2005 Annual Groundwater Monitoring Event (January - March 2006) were used as the baseline values for that well.

For MW-18, PCE and TCE concentrations fell from 200 and 270 µg/L, respectively, in March 2006 to below the Tier 2 residential RSK (5 µg/L) for groundwater by December 2007. Since then, PCE concentrations have remained below the residential standard; however, the TCE concentration rose to 15 µg/L during the July 2008 event. *cis*-1,2-DCE varied significantly, falling from 440 µg/L (March 2006) to 210 µg/L (January 2007), then rising to 400 µg/L (July 2008). Vinyl chloride rose from 0.6 µg/L to 9.1 µg/L. The trends for the chlorinated ethene concentrations in MW-18 are shown in the graph below.



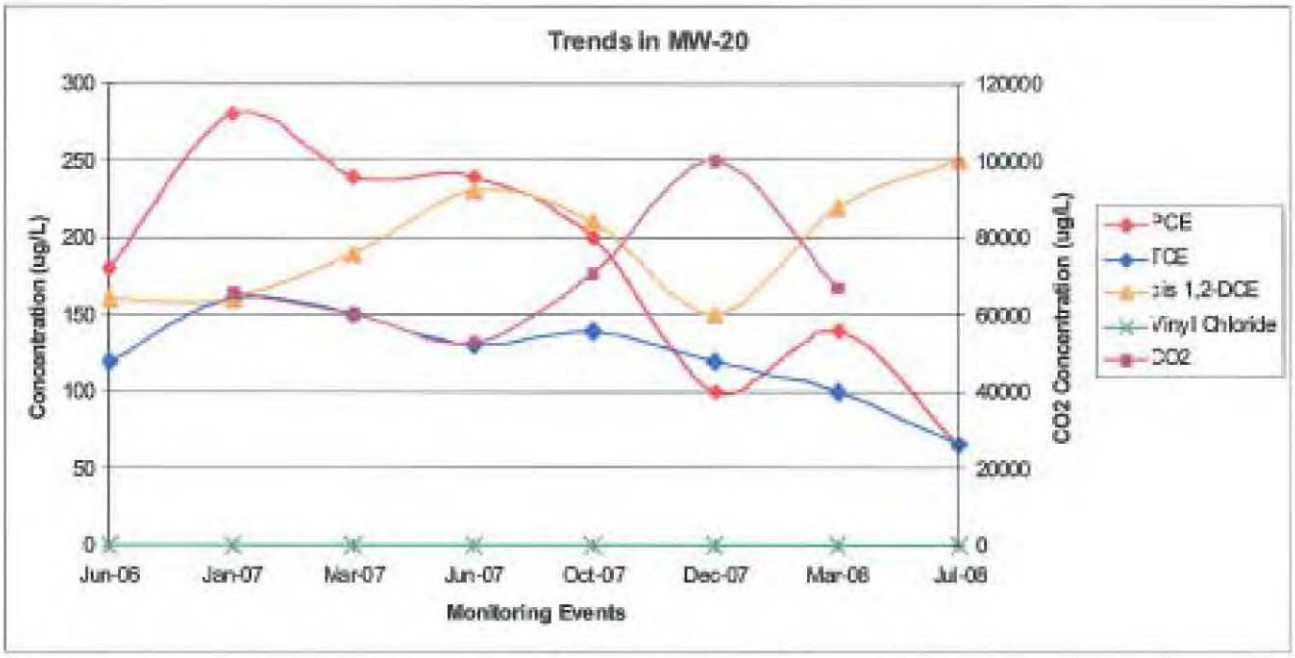
Other VOCs at MW-18 that were affected by the pilot test include: 1,1-dichloroethane (DCA), 1,1-DCE, and chloroethane. 1,1-DCA and 1,1-DCE concentrations decreased from 84 and 7.4 µg/L, respectively, in February 2006 to 28 and 3.2 J µg/L by August 2008. Between these two compounds, only one slight exceedance of the Tier 2 residential RSK value was observed for 1,1-DCE. 1,1-DCE has maintained a concentration below that value (7 µg/L) since January 2007. The concentration of chloroethane was non-detect until June 2007, then increased from 2.4 µg/L (October 2007) to 8.3 µg/L (December 2008), and then decreased to 3.3 µg/L (March 2008). In August 2008, the chloroethane concentration in MW-18 was again non-detect. Since chloroethane is a product of the reduction of 1,1,1-trichloroethane (TCA), 1,1-DCA, and 1,2-DCA, production and then degradation of chloroethane is not surprising.

Acetic, butyric, hexanoic, pentanoic, propionic, and pyruvic acids were all detected at various times and concentrations in MW-18, but all had their highest concentrations in October 2007 (the 9-month sampling event). The CO_2 concentration also increased to its maximum in October 2007 and then declined slightly. Methane rose from below detection to 4,700 µg/L by March 2007, and then dropped to 3,500 µg/L in July 2008. The ORP declined dramatically, from 85 millivolts (mV) initially to the lowest reading of -256 mV in October 2007, and then rose to -58 mV in July 2008. Based on these results, it appears that the effect of the HRC® biobarrier at MW-18 became apparent sometime between six and nine months after injection; this results in a velocity for effective front between 0.19 ft/day and 0.13 ft/day.

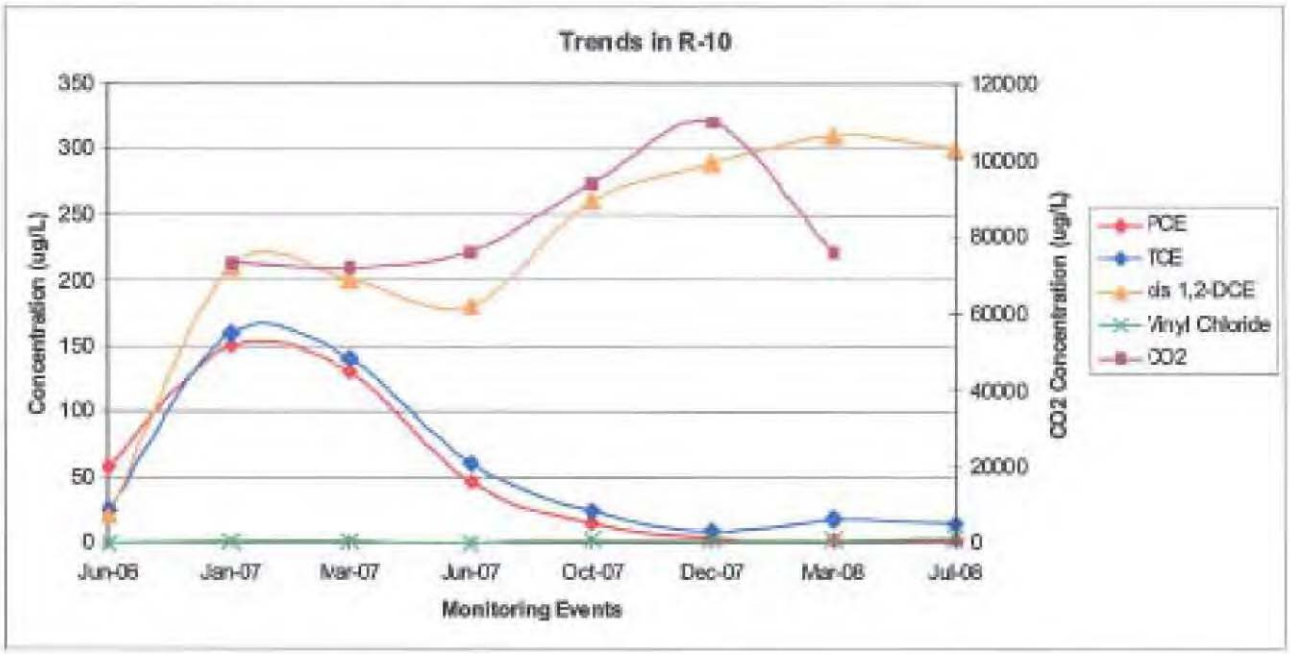
MW-20, 120 ft downgradient from the injections, did not exhibit the same decline as MW-18 for the primary VOCs; however, PCE and TCE declined slightly, while *cis*-1, 2-DCE increased slightly. No production of vinyl chloride has been observed. The trends for the chlorinated ethene concentrations in MW-20 are shown in the graph below. The trends in 1,1-DCA and 1,1-DCE concentrations in MW-18 were also observed in MW-20. 1,1-DCA and 1,1-DCE concentrations decreased from pre-injection highs of 84 and 8.1 µg/L, respectively, in February 2006 to 29 and 2 J µg/L by August 2008. Between these two compounds, only one slight exceedance of the Tier 2 residential RSK value was observed for 1,1-DCE. 1,1-DCE has maintained a concentration below that value (7 µg/L) since May 2006. No trend in concentration was observed for chloroethane.

ORP declined throughout the test, remaining positive until July 2008 (-28 mV). CO_2 concentrations remained relative low throughout the test, with the highest detection at 100 milligrams per liter (mg/L). Methane was only detected during the last round with a concentration of 2.1 µg/L. Considering the faster rate of travel for the effective front calculated from MW-18, the full effect from the injection is expected at MW-20 approximately 21 months

after injection (September 2008). Results from the July 2008 sampling event, such as a slightly lowered ORP value and the detection of methane, suggest that the effective front may be approaching MW-20. Therefore, the effects of the injection on chlorinated solvent concentrations may be evident in this well during the 2009 Annual Groundwater Monitoring Event.



For R-10, PCE concentrations declined from 58 µg/L to below the residential standard (5 µg/L). TCE concentrations declined slightly, while *cis*-1, 2-DCE concentrations increased significantly. Vinyl chloride concentrations increased slightly from non-detect to 3.5 µg/L during the last event (July 2008). The trends for the chlorinated ethene concentrations in R-10 are shown in the graph below. The concentrations for the remaining VOCs, including 1,1-DCA, 1,1-DCE, and chloroethane, did not show significant trends; concentrations, however, throughout the test did not exceed their Tier 2 residential RSK values.



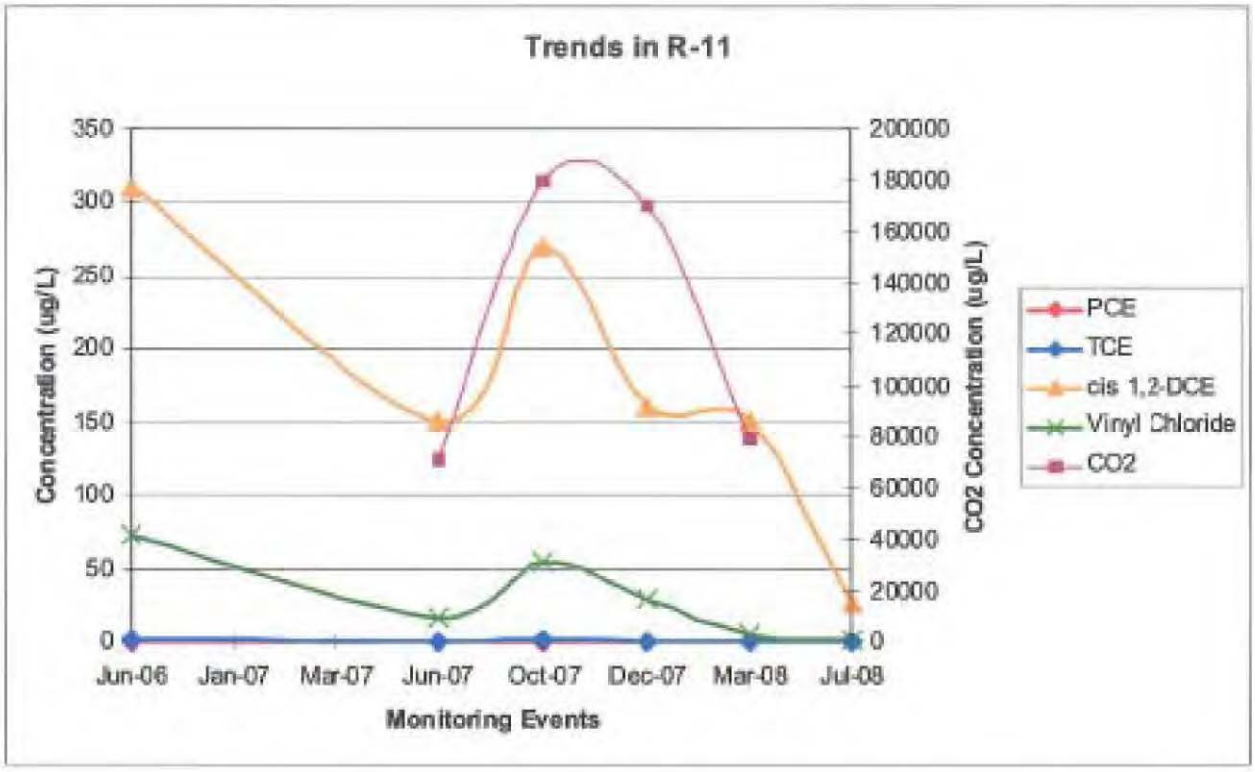
Acetic acid was detected in R-10 during three sampling events (October 2007, December 2007, and July 2008), while hexanoic and lactic acids were only detected during the July 2008 event. Negative ORP values were observed, but fluctuated over time. The concentration of CO_2 peaked in December 2007 at 110 mg/L. The concentration of methane has increased over time with the highest concentration (2 mg/L) occurring in the latest round of data collection (July 2008). Overall, the trends in chlorinated solvent concentration observed in R-10 appear to be similar to those observed in MW-18; however, the concentrations of the other parameters (VFAs, CO_2, and methane) in R-10 did not reflect the drastic changes that were observed in MW-18.

Downgradient Wells within Historical Plumelet B (R-11, MW-21, and R-12)

Monitoring wells R-11 and R-12 are located within historical Plumelet B, approximately 35 ft downgradient of Interceptor A, while MW-21 is located immediately downgradient of R-10, approximately 65 ft from the interceptor. For these three wells, the concentrations of the primary constituents (PCE and TCE) prior to the pilot test injection were relatively low compared to Plumelet A wells; *cis*-1,2-DCE and vinyl chloride concentrations were relatively high. These data exhibit a more degraded condition prior to injection than the area to the south, which is characteristic of historical Plumelet B.

In R-11, PCE and TCE were initially present at less than 1 µg/L. *cis*-1,2-DCE concentrations decreased from 310 µg/L to below the residential RSK (70 µg/L) in July 2008. Vinyl chloride concentrations decreased from 73 µg/L to 0.9 µg/L, which is also below the residential RSK

(2 µg/L). The trends for the chlorinated ethene concentrations in R-11 are shown in the graph below.

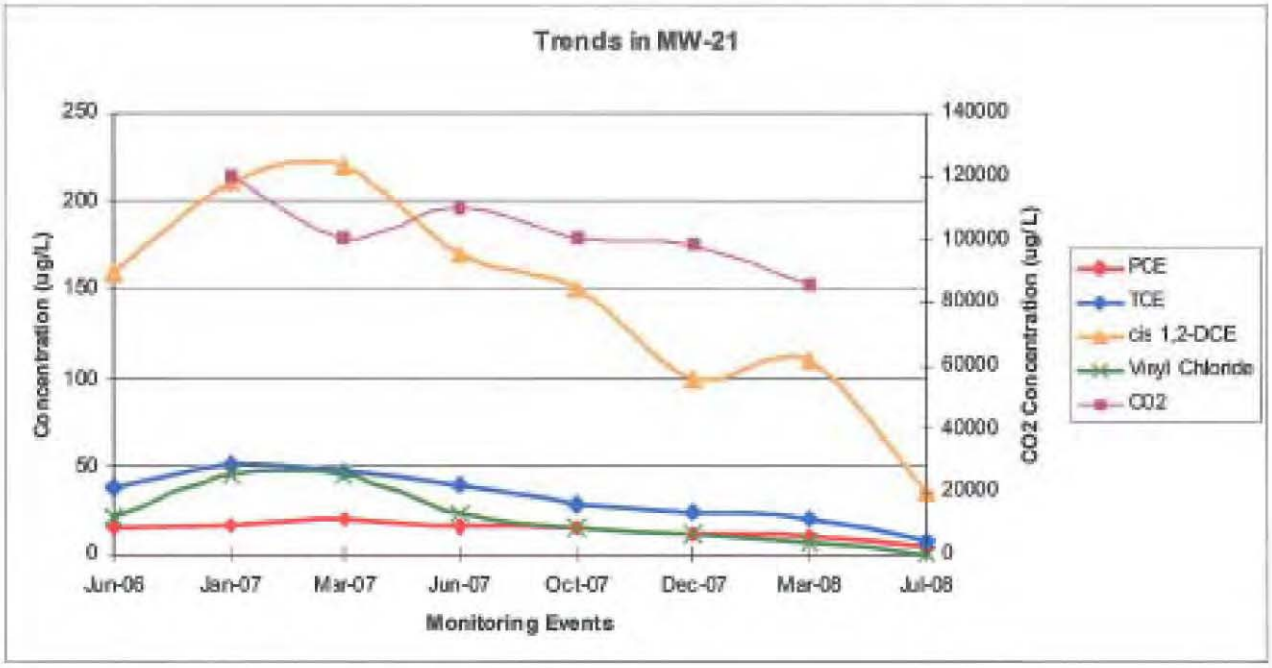


Other VOCs at R-11 that were affected by the pilot test include: 1,1-DCA, 1,2-DCA, and 1,1-DCE. For R-11, 1,1-DCA and 1,2-DCA concentrations decreased from 250 and 4.3 µg/L, respectively, in May 2006 to 24 and 0.4 J µg/L by August 2008. No compound exceeded the Tier 2 residential RSK value during the test. Additionally, the concentration of 1,1-DCE decreased from 2.8 (May 2006) to 0.4 J µg/L (August 2008). Chloroethane concentrations were mostly non-detect during the test. One detection at 0.1 µg/L was observed in October 2007.

Acetic, hexanoic, and lactic acids were all detected at various times and concentrations, with acetic and lactic acids having their highest concentrations in October 2007 (the 9-month sampling event). CO_2 increased to its maximum concentration in October 2007 and then declined slightly. Methane rose from 220 µg/L to 1,000 µg/L by December 2007, before declining to 830 µg/L. During the test, ORP slightly increased from -109 mV to -72 mV (December 2007) before returning to -104 mV (July 2008). Therefore, based on these results, the effect of the HRC® biobarrier at R-11 became apparent between six and nine months after the injection (similar to the result for MW-18).

MW-21 exhibited a steady decline in PCE and TCE concentrations throughout the test. PCE concentrations declined from 17 µg/L to below the residential RSK (5 µg/L), while TCE

concentrations declined from 51 µg/L to 7 µg/L. *cis*-1, 2-DCE concentrations declined from 210 µg/L to 35 µg/L (below Tier 2 residential RSKs) and vinyl chloride concentrations declined from 45 µg/L to <0.01 µg/L (below Tier 2 residential RSKs). The trends for the chlorinated ethene concentrations in MW-21 are shown in the graph below. The results for MW-21 and R-10 are promising, as it appears that complete mineralization of the daughter products has occurred.



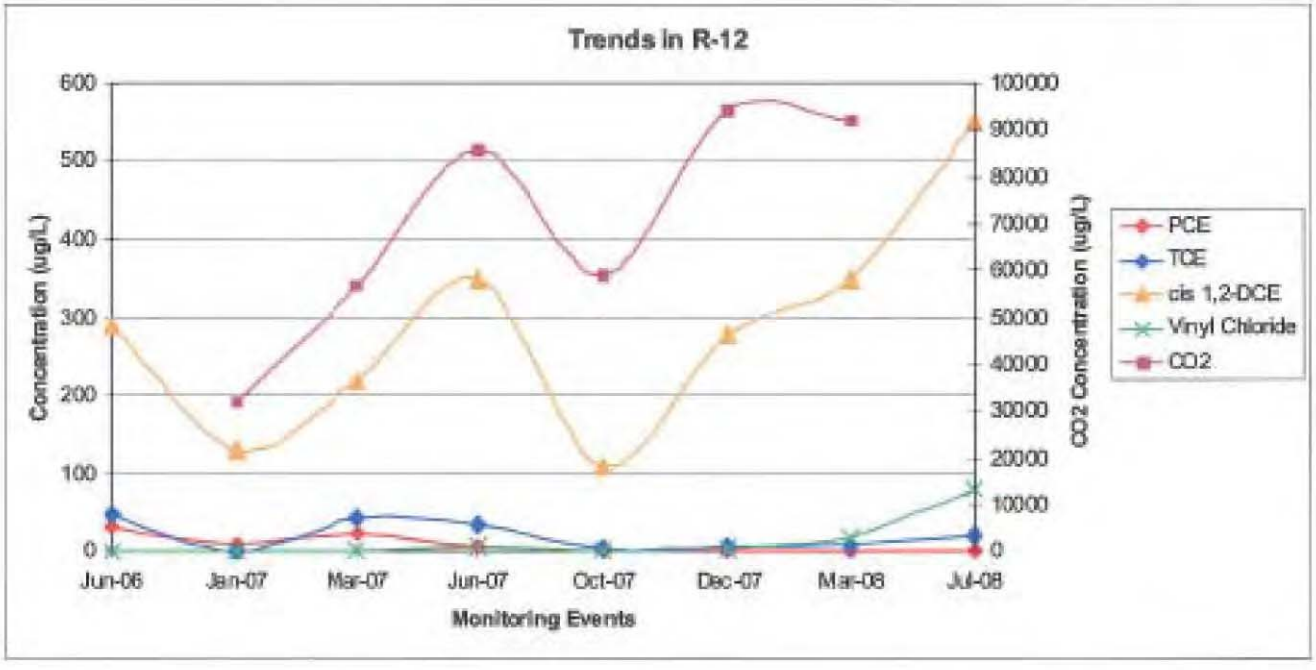
The trends in 1,1-DCA, 1,2-DCA, and 1,1-DCE concentrations in R-11 were also observed in MW-21. 1,1-DCA and 1,2-DCA concentrations decreased from 180 and 2.7 J µg/L, respectively, in February 2006 to 29 and 0.4 J µg/L by August 2008. Additionally, the concentration of 1,1-DCE decreased from 3.5 J (February 2006) to 0.4 J µg/L (August 2008). Chloroethane was not detected during the test.

Since June 2007, the ORP in MW-21 has declined from 77 mV to -4 mV. CO_2 concentrations declined during the test (120 mg/L to 86 mg/L), as did methane (750 µg/L to 180 µg/L). Based on these results, the effect of the HRC® biobarrier at MW-21 also became apparent sometime between the 15- and 18-month sampling events. This results in a velocity for the effective front of between 0.12 ft/day and 0.14 ft/day, which is similar to what was observed at MW-18 and R-11.

R-12 is located near the northern limit of the injections that comprise Interceptor A. In R-12, PCE concentrations declined from 31 µg/L to below the residential standard (5 µg/L). TCE

concentrations declined from 47 µg/L to 20 µg/L, However, *cis*-1,2-DCE concentrations increased from 290 µg/L to 550 µg/L and vinyl chloride concentrations increased from 0.9 J µg/L to 81 µg/L. The concentration increases for *cis*-1,2-DCE and vinyl chloride are greater than one would expect given the relative concentration decreases for PCE and TCE. The trends for the chlorinated ethene concentrations in R-12 are shown in the graph below.

In samples collected from R-12, 1,1-DCA, 1,2-DCA, and 1,1-DCE concentrations fluctuated, but exhibited a discernable increase over time. However, no chlorinated ethane compound exceeded the Tier 2 residential RSK values during the test. 1,1-DCA and 1,2-DCA concentrations increased from 110 and 1.2 µg/L, respectively, in May 2006 to 190 and 3.3 µg/L by August 2008. The chloroethane concentrations remained non-detect until December 2007, increased from 4.9 µg/L (December 2007) to 6.1 µg/L (March 2008), and then decreased to 1.7 J µg/L in August 2008. Additionally, the concentration of 1,1-DCE increased from 0.6 J (May 2006) to 2.2 J µg/L (August 2008).



Acetic acid was detected in R-12 at various times and concentrations with the highest concentration in October 2007 (the 9-month sampling event). Hexanoic and lactic acids were observed in July 2008 only. Negative ORP values were observed but fluctuated over time. The concentration of CO_2 peaked in December 2007 reaching 94 mg/L. The concentration of methane has increased over time with the highest concentration occurring in the last round (July 2008). It is possible that methanogenesis is competing with reductive dechlorination in this area.

4.2 Interceptor B (CAP18-ME™ Injection)

The sample results from wells monitored for Interceptor B were also evaluated based on their location relative to the interceptor (upgradient, sidegradient, and downgradient) and to historical Plumelets A and B. Therefore, the wells were grouped for discussion in the following manner:

- Upgradient/Sidegradient Wells;
- Downgradient Wells within historical Plumelet A (R-5 and R-6); and
- Downgradient Well within historical Plumelet B (R-4).

A discussion of the results for each group is provided below.

Upgradient/Sidegradient Wells

For the slightly upgradient well (TW-4) and sidegradient wells (R-2 and R-3) of Interceptor B, several general statements can be made based on previous and current investigation data:

- This area has historically exhibited very high initial concentrations of both ethanes/ethenes and BTEX constituents during the 1990s (See RI Report [URS, November 2007] for details regarding contaminant trends).
- The area continues to exhibit strongly reducing conditions based on the ORP data and presence of PCE degradation products.
- Being within historical Plumelet B, natural attenuation has greatly reduced concentrations without enhancement in this area because of the presence of BTEX constituents.

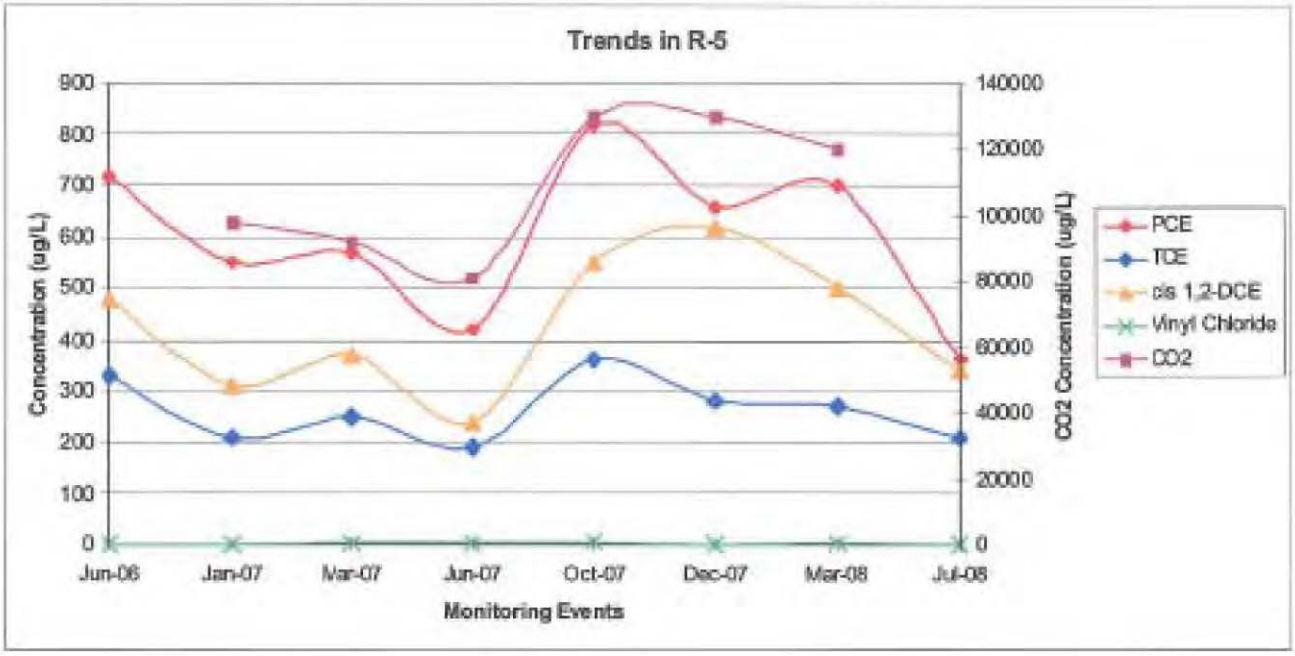
Ideally, the injection of the CAP18-ME™ would create similar groundwater conditions to those in the R-2, R-3, and TW-4 area near Interceptor B by providing the carbon source to encourage enhanced biodegradation.

Downgradient Wells within Historical Plumelet A (R-5 and R-6)

Recovery well R-5 is located approximately 25 ft downgradient from Interceptor B in the zone of highest pre-injection chloroethene concentrations and was the primary well used to evaluate CAP18-ME™. Concentrations of chlorinated ethenes (PCE, TCE, and *cis*-1,2-DCE) in R-5 have fluctuated above and below pre-injection levels, although the final July 2008 event revealed decreasing concentrations relative to the highest concentrations observed during the fall of 2007. The trends for the chlorinated ethene concentrations in R-5 are shown in the graph below. For the first several rounds (January 2007 through October 2007), the ratios of PCE, TCE, and *cis*-1,2-DCE did not change with fluctuations in overall concentrations. During this timeframe, ORP was mainly positive. The last round (July 2008) is somewhat promising, exhibiting the

lowest PCE concentration (approximately half of the pre-injection value), a lower ratio of PCE to its daughter products, and the ORP returning to slightly reducing conditions.

Other VOCs at R-5 that appeared to be affected by the pilot test were 1,1-DCA and 1,1-DCE. 1,1-DCA and 1,1-DCE concentrations decreased from pre-injection highs of 17 and 15 µg/L, respectfully, in February 2006 to lows of 5.2 and 5.1 µg/L in August 2008. During this time frame, no change in the chloroethane concentration was observed. Only 1,1-DCE exceeded the Tier 2 residential RSK value (7 µg/L) during the test.

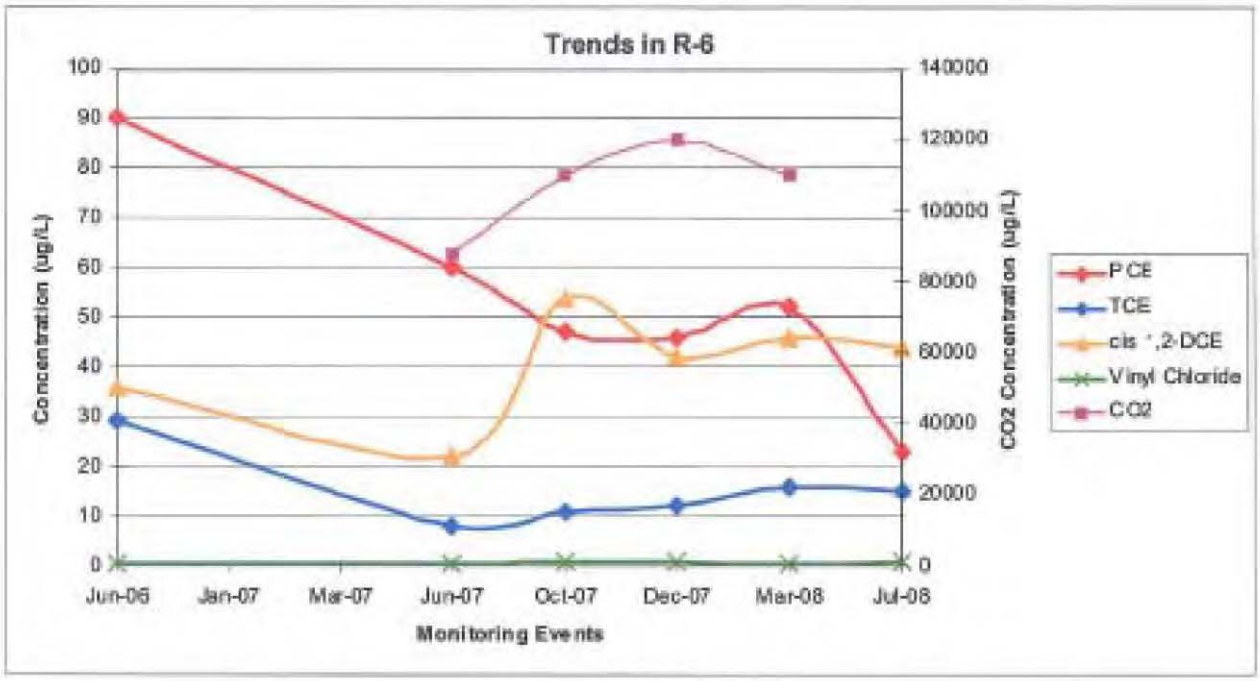


VFAs were not detected at high concentrations (above 1 mg/L) in R-5 during the test. Acetic acid was detected in R-5 in each round of sampling, while lactic acid was detected in July 2007, October 2007 and July 2008. The manufacturer claims that CAP18-ME™ is formulated to inhibit methanogenesis, and while CO_2 rose only slightly (98 mg/L to 130 mg/L) and methane rose slightly until July 2008, no significant reduction in chlorinated ethenes has occurred. With ORP trending between -45 and 163 mV for most of the test, the groundwater conditions near R-5 did not appear amenable to either reductive dechlorination or methanogenesis during the pilot test.

Recovery well R-6 is also located within Plumelet A, approximately 25 ft downgradient from the Interceptor B. This well exhibited lower initial chlorinated ethene concentrations than R-5. For R-6, PCE concentrations declined from 90 µg/L to 23 µg/L during the test, and TCE concentrations for R-6 decreased by approximately 50% . *cis*-1,2-DCE concentrations varied

widely during the test with no discernable trend. Vinyl chloride was not present in R-6 at appreciable concentrations during the test. The trends for the chlorinated ethene concentrations in R-6 are shown in the graph below.

The only other VOC at R-5 that appeared to be affected by the pilot test was 1,1-DCA. 1,1-DCA concentrations increased slightly from 2 µg/L in May 2006 to 5.4 µg/L in August 2008. These concentrations are still far below the Tier 2 RSK value of 340 µg/L. The concentrations for the remaining VOCs, including 1,1-DCE and chloroethane, did not show significant trends and did not exceed their Tier 2 residential RSK values.



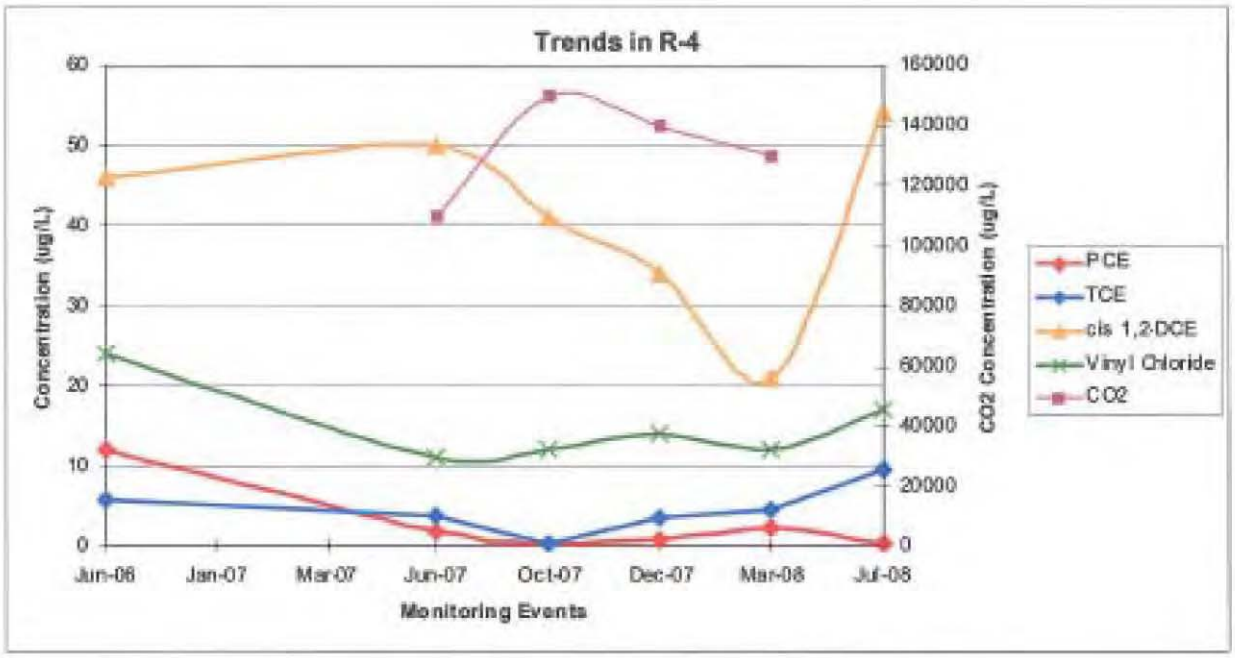
The ORP for R-6 remained positive throughout the test. No significant change in CO_2 concentration was observed; however, the methane concentrations increased by three orders of magnitude from 0.0044 J to 4.5 mg/L. Based on these results, it is unclear whether the concentrations of chlorinated ethenes in R-6 were significantly impacted by the enhanced reductive dechlorination provided by CAP18-ME™ during the pilot test.

It should be noted that, based on the boring logs for R-4, R-5 and R-6, the aquifer does not appear to be as hydraulically conductive as the area around Interceptor A. At MW-18, downgradient of Interceptor A, a sand/gravel lens was noted at around 14 ft bgs, but no such lens was noted in the vicinity of R-5 or R-6.

Downgradient Well within Historical Plumelet B (R-4)

Recovery well R-4 is located within historical Plumelet B, approximately 25 ft downgradient from Interceptor B. This well exhibited mixed results. PCE concentrations declined from 12 µg/L to 0.2 µg/L. TCE concentrations for R-4 also exhibited a decline from the injection until October 2007, but rebounded afterwards. *cis*-1,2-DCE concentrations varied widely during the test with no discernable trend. Vinyl chloride concentrations remained relatively steady during the test. The trends for the chlorinated ethene concentrations in R-4 are shown in the graph below.

The only other VOC at R-4 that appeared to be affected by the pilot test was 1,1-DCA. The concentration of 1,1-DCA decreased from a pre-injection high of 41 µg/L in May 2006 to a low of 8.4 µg/L in August 2008. During this time frame, no change in the chloroethane concentration was observed.



The ORP for R-4 remained negative over time (most likely influenced by the reducing conditions previously mentioned in the area around R-2 and R-3). No significant change in CO_2 concentration was observed; however, the methane concentrations increased three-fold from 1.4 to 4.3 mg/L. R-4 initially contained higher ratios of *cis*-1,2-DCE and vinyl chloride relative to PCE and TCE. Unlike the results from wells within Plumelet B downgradient of Interceptor A, it does not appear that the CAP18-ME™ provided the conditions to allow the concentrations of *cis*-1,2-DCE and vinyl chloride to decrease during the test.

5.0 Conclusions and Future Considerations

The injection of HRC® in the downgradient barrier (Interceptor A) has provided significant reductions in contaminant mass for the primary constituents PCE and TCE. The changes in PCE and TCE concentrations from pre-injection (June 2006) to the latest sampling event (July 2008) are illustrated in Figures 5 through 8. Monitoring wells within 65 ft downgradient of Interceptor A meet the pilot test goal of reducing constituent concentrations to below 50 µg/L for PCE and TCE. This reduction in chlorinated ethene concentrations demonstrates that enhanced bioremediation (reductive dechlorination) is as effective as the former extraction system in reducing contaminant mass and migration. Additionally, if trends continue, it is anticipated that MW-20 (120 ft from the injection area) will meet the pilot test goal for PCE and TCE during the next sampling event (2009 Annual Groundwater Monitoring Event).

It should be noted that samples collected from monitoring wells within historical Plumelet A (R-10, MW-18, and MW-20) had relatively high initial ratios of PCE and TCE relative to *cis*-1,2-DCE and vinyl chloride. Samples collected from these wells showed a significant reduction in the primary constituents (PCE and TCE) with a corresponding increase in *cis*-1,2-DCE (and in one case, vinyl chloride). Samples collected from monitoring wells within historical Plumelet B (R-11, R-12 and MW-21), exhibited lower initial ratios of PCE and TCE relative to *cis*-1,2-DCE and vinyl chloride. In this portion of Plumelet B, *cis*-1,2-DCE and vinyl chloride were reduced in wells R-11 and MW-21 due to limited presence of the primary constituents. The changes in *cis*-1,2-DCE and vinyl chloride concentrations from pre-injection (June 2006) to the latest sampling event (July 2008) are illustrated in Figures 9 through 12.

Based on the results of the 1999 Pilot Test and the pilot test results from the wells within historical Plumelet B (R-11 and MW-21), it is anticipated that the concentration of *cis*-1,2,-DCE and vinyl chloride will eventually decrease in the monitoring wells within historical Plumelet A. The concentrations of *cis*-1,2-DCE and vinyl chloride will be monitored over time in these wells as part of the Site's long-term monitoring program.

Only slight reductions in contaminant mass have been observed with the injection of CAP18-ME™ in the upgradient barrier (Interceptor B). Therefore, this barrier did not meet the pilot test goal of reducing constituent concentrations to below 50 µg/L. While it may have an effect at a later date, CAP18-ME™ is not effective at this site for quickly reducing contaminant concentrations. The CAP18-ME™ vendor was provided results presented in this report and then consulted to explore the reasons for the lack of significant reduction. The vendor agreed that the application was designed and implemented correctly, but a clear reason for the lack of significant degradation was not apparent. The vendor was hopeful that, given time, the CAP18-ME™ would prove effective.

Wells associated with Interceptors A and B will continue to be monitored for chlorinated solvents, select monitored natural attenuation parameters (carbon dioxide, dissolved gases, and total organic carbon), and field parameters (including ORP) during the 2009 Annual Groundwater Monitoring Event (currently scheduled for spring 2009). After 2009, wells that are part of the long-term monitoring (listed in the SAP [URS, July 2008]) will continue to be monitored for chlorinated solvents and field parameters. The goals for continued monitoring are as follows:

1) Ensure that concentrations of primary contaminants PCE and TCE remain below or near KDHE Tier 2 residential standards in wells downgradient from Interceptor A;
2) Monitor chlorinated ethene concentrations in R-4 and R-5 to determine if any effect from Interceptor B is evident;
3) Monitor *cis*-1,2-DCE and vinyl chloride concentrations within Plumelet A downgradient from Interceptor A (MW-18, R-10, and MW-20);
4) Monitor *cis*-1,2-DCE and vinyl chloride concentrations within Plumelet B downgradient from Interceptor A (R-12); and
5) Evaluate ORP, carbon dioxide, and dissolved gases, along with the primary VOCs, for the pilot test wells during the 2009 Annual Groundwater Monitoring Event.

6.0 References

Kansas Department of Health and the Environment (KDHE), July 2008. KDHE letter regarding approval of the Final Revision 2 Sampling and Analysis (SAP) Plan, Former Unocal Chemical Distribution Facility, Wichita, Kansas. July 15.

KDHE, November 2007. KDHE letter regarding Results of Additional Investigation Activities to Complete the RI Delineation, Former Unocal Chemical Distribution Facility, Wichita, Kansas. November 2.

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URS, October 2006. Enhanced Reductive Dechlorination Pilot Test Implementation Workplan, Former Unocal Chemical Distribution Facility, Wichita, Kansas.

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Tables

Table 1. Interceptor A (HRC®) Injection Results

Injection Point	Bottom Depth (ft bgs)	Injection Interval Thickness (ft)	Injection Point	Bottom Depth (ft bgs)	Injection Interval Thickness (ft)
B1	28	20	C23	20	12
B2	27	19	C24	18	10
B3	28	20	C25	18	10
B4	32	24	C26	20	12
B5	32	24	C27	18	10
B6	32	24	C28	20	12
B7	32	24	C29	22	14
B8	32	24	C30	23	15
C1	32	24	C31	23	15
C2	32	24	C32	23	15
C3	32	24	C33	24	16
C4	32	24	C34	23	15
C5	32	24	C35	24	16
C6	32	24	C36	21	13
C7	32	24	D1*	25/21	17
C8	32	24	D2	22	14
C9	30	22	D3	22	14
C10	32	24	D4	23	15
C11	30	22	D5	23	15
C12	27	19	D6	23	15
C13	26	18	D7	24	16
C14	27	19	D8	24	16
C15	27	19	D9	24	16
C16	24	16	D10	20	12
C17	25	17	D11	21	13
C18	22	14	D12	21	13
C19	25	17	D13	18	10
C20	25	17	D14	18	10
C21	25	17	D15	18	10
C22	25	17	D16*	20/20	12

Note: 1) For D1, the initial injection consisted of injecting HRC® at a rate of 0.5 gallons per foot for the entire injection interval. A subsequent injection was then offset by 1 foot, and an additional injection of substrate at a rate of 0.5 gallons per foot was implemented from 21 ft bgs to 16 ft bgs.

Note: 2) For D16, the initial injection consisted of injecting HRC® at a rate of 0.5 gallons per foot for the entire injection interval. A subsequent injection was then offset by 1 foot, and an additional injection of substrate at a rate of 0.5 gallons per foot was implemented from 20 ft bgs to 15 ft bgs.

bgs - Below ground surface.
ft - Feet.
HRC® - Hydrogen release compound.

Table 2. Interceptor B (CAP18-ME™) Injection Results

Injection Point	Bottom Depth (ft bgs)	Injection Interval Thickness (ft)	Injection Point	Bottom Depth (ft bgs)	Injection Interval Thickness (ft)
A1	30	14	A18	17	9
A2	27	11	A19	17	9
A3	27	11	A20*	15/24	16
A4	27	11	A21*	15/24	16
A5	27	11	A22*	13/23	15
A6	28	12	A23*	13/23	15
A7	27	11	A24*	13/23	15
A8	26.5	10.5	A25*	13/23	15
A9	26	10	A26	22	14
A10	26	10	A27	22	14
A11	26	10	A28	22	14
A12	25	17	A29	23	15
A13	25.5	17.5	A30	24	16
A14	23	15	A31	23	15
A15	23	15	A32	23	15
A16	21	13	A33	23	15
A17	21	13	A34	23	15

Note: 1) For A20 and A21, the initial injection began at a depth of 15 ft bgs. The subsequent injections were then offset by 1 foot, and an additional injection from 24 ft bgs (refusal) to 15 ft bgs was implemented.

Note: 2) For A22 through A25, the initial injection began at a depth of 13 ft bgs. The subsequent injections were then offset by 1 foot, and an additional injection from 23 ft bgs (refusal) to 13 ft bgs was implemented.

bgs - Below ground surface.

ft - Feet.

Table 3. Wells Sampled During Each Monitoring Event

Location	Prior to Injection		Post Injection						
	2005 Annual Event	2006 Annual Event			2007 Annual Event				2008 Annual Event
	1/06 - 3/06	5/06 - 6/06	1/07	3/07	6/07	10/07	12/07	3/08	7/08 - 8/08
Upgradient Barrier - CAP18ME									
R-2	X	X	X	X	X	X	X	X	NM
R-3	NM	X	NM	NM	X	X	X	X	X
R-4	X	X	NM	NM	X	X	X	X	X
R-5	X	X	X	X	X	X	X	X	X
R-6	NM	X	NM	NM	X	X	X	X	X
TW-4	X	NM	NM	NM	X	X	X	X	X
Downgradient Barrier - HRC®									
MW-8	X	X	NM	NM	X	NM	NM	X	NM
MW-10	X	NM	NM	NM	X	NM	NM	X	NM
MW-18	X	NM	X	X	X	X	X	X	X
MW-20	X	X	X	X	X	X	X	X	X
MW-21	X	X	X	X	X	X	X	X	X
R-7	X	X	NM	NM	X	NM	NM	X	X
R-8	X	NM	NM	NM	X	NM	NM	X	NM
R-10	NM	X	X	X	X	X	X	X	X
R-11	NM	X	NM	NM	X	X	X	X	X
R-12	NM	X	X	X	X	X	X	X	X

X – Well was sampled during that event.
HRC® - Hydrogen Release Compound.
NM – Not measured.

Table 4 - PCE Results
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

EPA Region 7 MCL or KDHE Action Level for PCE = 5 µg/L

Location	2005 Event 1/06 - 3/06	2006 Event 5/06 - 6/06	1/07	3/07	6/07	10/07	12/07	3/08	7/08 - 8/08
Upgradient Barrier - CAP18ME									
R-2	**1.5 J**	**2**	**0.8**	**1**	**0.5 J**	**0.3 J**	**0.3 J**	**1.7**	NM
R-3	NM	<1	NM	NM	<1	<1	<0.1	<0.1	<0.1
R-4	**6.9**	**12**	NM	NM	**1.8**	**0.2 J**	**0.8**	**2.2**	**0.2**
R-5	**660**	**720**	**550**	**570**	**420**	**820**	**660**	**700**	**360**
R-6	NM	**90**	NM	NM	**60**	**47**	**46**	**52**	**23**
TW-4	<1	NM	NM	NM	<1	<1	<0.5	<0.5	<0.5
Downgradient Barrier - HRC®									
MW-8	<1	<1	NM	NM	<1	NM	NM	<1	<0.1
MW-10	<1	NM	NM	NM	<1	NM	NM	<1	NM
MW-18	**200**	NM	**110**	**29**	**4.4**	**0.6**	**0.8 J**	**0.3**	**1.2**
MW-20	**310**	**180**	**280**	**240**	**240**	**200**	**100**	**140**	**65**
MW-21	**28**	**15**	**17**	**19**	**16**	**15**	**11**	**10**	**3.5**
R-7	**4.0 J**	**17**	NM	NM	**2.3**	NM	NM	**0.2 J**	**0.1**
R-8	<1	NM	NM	NM	<1	NM	NM	**0.2 J**	NM
R-10	NM	**58**	**150**	**130**	**46**	**15**	**3.4**	**2.5**	**2.8 J**
R-11	NM	**0.2 J**	NM	NM	<1	<1	<0.5	<0.5	**0.1**
R-12	NM	**31**	**11**	**22**	**6.5**	**1.2**	**1.6 J**	**1.6**	**3.1**

Volatile organic compounds (VOCs) analyzed using U.S. Environmental Protection Agency (EPA) Method 8260B (Lancaster Laboratories).
Bold indicates detected values.
Shaded value exceeds EPA Region 7 maximum contaminant level (MCL) or Kansas Department of Health and Environment (KDHE) Action Level.
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
µg/L - Micrograms per liter.
HRC® Hydrogen Release Compound.
MW - Monitoring well on Unocal or Coleman properties.
NM - Not measured.
PCE - Tetrachloroethene.
R - Recovery well.
TW - Test well.

Table 5 - TCE Results
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

EPA Region 7 MCL or KDHE Action Level for TCE = 5 µg/L

Location	2005 Event 1/06 - 3/06	2006 Event 5/06 - 6/06	1/07	3/07	6/07	10/07	12/07	3/08	7/08 - 8/08
Upgradient Barrier - CAP18ME									
R-2	**2.2 J**	**7.7**	ND	**2.4**	**2.7**	**0.9**	**1**	**7.2**	NM
R-3	NM	**0.3 J**	NM	NM	<1	<1	**0.4 J**	**0.8**	<0.1
R-4	**13**	**5.8**	NM	NM	**3.9**	**0.3 J**	**3.5**	**4.5**	**9.7**
R-5	**240**	**330**	**210**	**250**	**190**	**360**	**280**	**270**	**210**
R-6	NM	**29**	NM	NM	**7.9**	**11**	**12**	**16**	**15**
TW-4	**0.44 J**	NM	NM	NM	<1	**0.9 J**	<0.5	<0.5	<0.5
Downgradient Barrier - HRC®									
MW-8	<1	<1	NM	NM	<1	NM	NM	<1	<0.1
MW-10	NM	NM	NM	NM	<1	NM	NM	<1	NM
MW-18	**270**	NM	**130**	**110**	**13**	**4.6**	**2.9**	**5.9**	**15**
MW-20	**190**	**120**	**160**	**150**	**130**	**140**	**120**	**100**	**66**
MW-21	**75**	**38**	**51**	**47**	**40**	**29**	**24**	**20**	**7**
R-7	**0.89 J**	**9.5**	NM	NM	**4.6**	NM	NM	**0.7**	**1**
R-8	<1	NM	NM	NM	<1	NM	NM	<1	NM
R-10	NM	**25**	**160**	**140**	**61**	**24**	**8**	**18**	**14**
R-11	NM	**0.7**	NM	NM	**0.5 J**	**0.9**	<0.5	**0.6**	**0.6**
R-12	NM	**47**	ND	**44**	**35**	**4.9**	**5.7**	**8.1**	**20**

Volatile organic compounds (VOCs) analyzed using U.S. Environmental Protection Agency (EPA) Method 8260B (Lancaster Laboratories).
Shaded value exceeds EPA Region 7 maximum contaminant level (MCL) or Kansas Department of Health and Environment (KDHE) Action Level.
Bold indicates detected values.
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
µg/L - Micrograms per liter.
HRC® Hydrogen Release Compound.
MW - Monitoring well on Unocal or Coleman properties.
ND - Not detected.
NM - Not measured.
R - Recovery well.
TCE - Trichloroethene.
TW - Test well.

Table 6 - cis-1,2-DCE Results
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

EPA Region 7 MCL or KDHE Action Level for cis-1,2-DCE = 70 µg/L

Location	2005 Event 1/06 - 3/06	2006 Event 5/06 - 6/06	1/07	3/07	6/07	10/07	12/07	3/08	7/08 - 8/08
Upgradient Barrier - CAP18ME									
R-2	**14**	**68**	**7.7**	**12**	**17**	**6.1**	**5.8**	**25**	NM
R-3	NM	**43**	NM	NM	**46**	**100**	**91**	**80**	**5.2**
R-4	**79**	**46**	NM	NM	**50**	**41**	**34**	**21**	**54**
R-5	**440**	**480**	**310**	**370**	**240**	**550**	**620**	**500**	**340**
R-6	NM	**36**	NM	NM	**22**	**54**	**42**	**46**	**44**
TW-4	**7.9**	NM	NM	NM	**1.6 J**	**5.2**	**1.4 J**	**6.3**	**1.1**
Downgradient Barrier - HRC®									
MW-8	<1	<1	NM	NM	<1	NM	NM	<1	<0.1
MW-10	<1	NM	NM	NM	<1	NM	NM	<1	NM
MW-18	**440**	NM	**210**	**270**	**310**	**250**	**220**	**430**	**400**
MW-20	**260**	**160**	**160**	**190**	**230**	**210**	**150**	**220**	**250**
MW-21	**220**	**160**	**210**	**220**	**170**	**150**	**100**	**110**	**35**
R-7	**0.91 J**	**13**	NM	NM	**8.9**	NM	NM	**13**	**8.5**
R-8	<1	NM	NM	NM	<1	NM	NM	<1	NM
R-10	NM	**20**	**210**	**200**	**180**	**260**	**290**	**310**	**300**
R-11	NM	**310**	NM	NM	**150**	**270**	**160**	**150**	**27**
R-12	NM	**290**	**130**	**220**	**350**	**110**	**280**	**350**	**550**

Volatile organic compounds (VOCs) analyzed using U.S. Environmental Protection Agency (EPA) Method 8260B (Lancaster Laboratories).
Shaded value exceeds EPA Region 7 maximum contaminant level (MCL) or Kansas Department of Health and Environment (KDHE) Action Level.
Bold indicates detected values.
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
µg/L - Micrograms per liter.
DCE - Dichloroethene.
HRC® Hydrogen Release Compound.
MW - Monitoring well on Unocal or Coleman properties.
NM - Not measured.
R - Recovery well.
TW - Test well.

Table 7 - Vinyl Chloride Results
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

EPA Region 7 MCL or KDHE Action Level for Vinyl Chloride = 2 µg/L

Location	2005 Event 1/06 - 3/06	2006 Event 5/06 - 6/06	1/07	3/07	6/07	10/07	12/07	3/08	7/08 - 8/08
Upgradient Barrier - CAP18ME									
R-2	**1.5 J**	**1.1**	**1.2**	**0.6**	**2.6**	**0.8**	**0.9**	**0.6**	NM
R-3	NM	**10**	NM	NM	**11**	**36**	**28**	**51**	**10 JL**
R-4	**30**	**24**	NM	NM	**11**	**12**	**14**	**12**	**17 JL**
R-5	**1.2 J**	**0.7 J**	**1.2 J**	**2.2 J**	**2.2 J**	**4.8 J**	**1.4 J**	**1.7**	<1 UJL
R-6	NM	**0.2 J**	NM	NM	**0.3 J**	**0.7**	**0.7**	**0.5**	**0.8**
TW-4	**36 JL**	NM	NM	NM	**4.6 J**	**9.7**	**3.6**	**21**	**2.3 JL**
Downgradient Barrier - HRC®									
MW-8	<1	<1	NM	NM	<1	NM	NM	<1	<0.1 UJL
MW-10	<1	NM	NM	NM	<1	NM	NM	<1	NM
MW-18	**1.5 J**	NM	**0.6 J**	**2.5**	**4.8**	**8.5**	**5.7**	**11**	**9.1**
MW-20	<1	<1	ND	ND	<1	**0.2 J**	<0.5	**0.2**	<0.5
MW-21	**29 J**	**21**	**45**	**45**	**23**	**15**	**11**	**6.2**	<0.1
R-7	<1	<1	NM	NM	<1	NM	NM	<1	<0.1 UJL
R-8	<1	NM	NM	NM	<1	NM	NM	<1	NM
R-10	NM	<1	**1.2 J**	**1.4**	**0.6 J**	**2.6**	**3**	**2.3**	**3.5 JL**
R-11	NM	**73**	NM	NM	**16**	**55**	**29**	**4.9**	**0.9**
R-12	NM	**0.9 J**	**0.3 J**	**2.3**	**7.0**	**2.8**	**3.4**	**19**	**81**

Volatile organic compounds (VOCs) analyzed using U.S. Environmental Protection Agency (EPA) Method 8260B (Lancaster Laboratories).
Shaded value exceeds EPA Region 7 maximum contaminant level (MCL) or Kansas Department of Health and Environment (KDHE) Action Level.
Bold indicates detected values.
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
L - Result may be biased low.
µg/L - Micrograms per liter.
HRC® Hydrogen Release Compound.
MW - Monitoring well on Unocal or Coleman properties.
ND - Not Detected.
NM - Not measured.
R - Recovery well.
TW - Test well.

Table 8 - Volatile Fatty Acid and Dissolved Gases Results
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

Location	MW-8 Sidegradient								MW-10 Upgradient							
	Jan-07	Mar-07	Jun-07	Jul-07	Oct-07	Dec-07	Mar-08	Jul-08	Jan-07	Mar-07	Jun-07	Jul-07	Oct-07	Dec-07	Mar-08	Jul-08
Volatile Fatty Acids (mg/L)																
Acetic Acid	NM	NM	<0.50	NM	NM	NM	**0.85**	NM	NM	NM	<0.50	NM	NM	NM	<0.07	NM
Butyric Acid	NM	NM	<0.50	NM	NM	NM	<0.07	NM	NM	NM	<0.50	NM	NM	NM	<0.07	NM
Hexanoic Acid	NM	NM	NM	NM	NM	NM	<0.10	NM	NM	NM	NM	NM	NM	NM	<0.10	NM
i-Hexanoic Acid	NM	NM	NM	NM	NM	NM	<0.10	NM	NM	NM	NM	NM	NM	NM	<0.10	NM
i-Pentanoic Acid	NM	NM	NM	NM	NM	NM	<0.07	NM	NM	NM	NM	NM	NM	NM	<0.07	NM
Lactic Acid and HIBA	NM	NM	<10	NM	NM	NM	<0.10	NM	NM	NM	<10	NM	NM	NM	<0.10	NM
Pentanoic Acid	NM	NM	NM	NM	NM	NM	<0.07	NM	NM	NM	NM	NM	NM	NM	<0.07	NM
Propionic Acid	NM	NM	<0.50	NM	NM	NM	<0.07	NM	NM	NM	<0.50	NM	NM	NM	<0.07	NM
Pyruvic Acid	NM	NM	<2.0	NM	NM	NM	<0.07	NM	NM	NM	<2.0	NM	NM	NM	<0.07	NM
Dissolved Gases (mg/L)																
Carbon Dioxide	NM	NM	**33**	NM	NM	NM	**37**	NM	NM	NM	**55**	NM	NM	NM	**53**	NM
Methane	NM	NM	<0.002	NM	NM	NM	<0.002	NM	NM	NM	<0.002	NM	NM	NM	<0.002	NM
Ethane	NM	NM	<0.001	NM	NM	NM	<0.001	NM	NM	NM	<0.001	NM	NM	NM	<0.001	NM
Ethene	NM	NM	<0.001	NM	NM	NM	<0.001	NM	NM	NM	<0.001	NM	NM	NM	<0.001	NM
Field Parameters (mV)																
ORP	NM	NM	-39	NM	NM	NM	-17	-77	NM	NM	131	NM	NM	NM	191	NM

Volatile Fatty Acids were analyzed by Microseeps Laboratory.
Dissolved gases were analyzed by Lancaster Laboratories (SW 8015B and CO_2)
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
mg/L - Milligrams per liter.
mV - Millivolt.
MW - Monitoring well on Unocal or Coleman properties.
ORP - Oxidation-reduction potential.
R - Recovery well.
TW - Test well.

Table 8 - Volatile Fatty Acid and Dissolved Gases Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

	MW-18								MW-20							
	Downgradient								Downgradient							
Location	Jan-07	Mar-07	Jun-07	Jul-07	Oct-07	Dec-07	Mar-08	Jul-08	Jan-07	Mar-07	Jun-07	Jul-07	Oct-07	Dec-07	Mar-08	Jul-08
Volatile Fatty Acids (mg/L)																
Acetic Acid	<2	**0.51**	<0.50	**0.05**	**51**	**0.15**	<0.07	**0.11**	<2	**0.48 J**	<0.50	NM	**0.16**	**1.10**	<0.07	**0.11**
Butyric Acid	<3.5	<0.50	<0.50	<0.07	**0.87**	<0.07	<0.07	<0.07	<3.5	<0.50	<0.50	NM	<0.07	<0.07	<0.07	<0.07
Hexanoic Acid	NM	NM	NM	<0.10	**0.29**	<0.10	<0.10	<0.10	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10
i-Hexanoic Acid	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	<0.10	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10
i-Pentanoic Acid	NM	NM	NM	<0.07	**0.18**	<0.07	<0.07	<0.07	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07
Lactic Acid and HIBA	<1	<10	<10	**0.19**	<1.00	<0.10	<0.10	**0.12**	<1	<10	<10	NM	**0.23**	<0.10	<0.10	**0.13**
Pentanoic Acid	NM	NM	NM	<0.07	**0.26**	<0.07	<0.07	<0.07	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07
Propionic Acid	<5.2	<0.50	<0.50	**0.14**	**37**	<0.07	<0.07	<0.07	<5.2	<0.50	<0.50	NM	<0.07	<0.07	<0.07	<0.07
Pyruvic Acid	<0.15	<2.0	<2.0	<0.07	**0.54**	<0.07	<0.07	<0.07	<0.15	<2.0	<2.0	NM	<0.07	<0.07	<0.07	<0.07
Dissolved Gases (mg/L)																
Carbon Dioxide	**98**	**160**	**270**	NM	**300**	**210**	**130**	NM	**66**	**60**	**53**	NM	**71**	**100**	**67**	NM
Methane	<0.002	**0.026**	**0.19**	NM	**0.58**	**2.3**	**4.7**	**3.5**	<0.002	<0.002	<0.002	NM	<0.002	<0.002	<0.002	**0.0021 J**
Ethane	<0.001	<0.001	**0.003 J**	NM	**0.0027 J**	**0.0032 J**	**0.015**	**0.01**	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001
Ethene	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001
Field Parameters (mV)																
ORP	85	71	67	NM	-256	-53	-20	-58	94	159	162	NM	137	77	44	-28

Volatile Fatty Acids were analyzed by Microseeps Laboratory.
Dissolved gases were analyzed by Lancaster Laboratories (SW 8015B and CO_2)
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
mg/L - Milligrams per liter.
mV - Millivolt.
MW - Monitoring well on Unocal or Coleman properties.
ORP - Oxidation-reduction potential.
R - Recovery well.
TW - Test well.

Table 8 - Volatile Fatty Acid and Dissolved Gases Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

	MW-21								R-2							
	Downgradient								Sidegradient							
Location	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**
Volatile Fatty Acids (mg/L)																
Acetic Acid	<2	<0.50	<0.50	NM	**0.19**	**0.59**	<0.07	**0.12**	<2	<0.50	<0.50	NM	**1.30**	<0.07	**1.00**	**1.10**
Butyric Acid	<3.5	<0.50	<0.50	NM	<0.07	<0.07	<0.07	<0.07	<3.5	<0.50	<0.50	NM	**0.08**	<0.07	<0.07	<0.07
Hexanoic Acid	NM	NM	NM	NM	<0.10	<0.10	<0.10	**0.23**	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10
i-Hexanoic Acid	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.07	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10
i-Pentanoic Acid	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07
Lactic Acid and HIBA	<1	<10	<10	NM	**0.17**	<0.10	<0.10	**0.23**	<1	<10	<10	NM	<0.10	**1.40**	**0.28**	<0.10
Pentanoic Acid	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	NM	<0.70	<0.07	<0.07	<0.07
Propionic Acid	<5.2	<0.50	<0.50	NM	<0.07	<0.07	<0.07	<0.07	<5.2	<0.50	<0.50	NM	<0.70	<0.07	**0.06**	<0.07
Pyruvic Acid	<0.15	<2.0	<2.0	NM	<0.07	**0.13**	<0.07	<0.07	<0.15	<2.0	<2.0	NM	<0.70	<0.07	<0.707	<0.07
Dissolved Gases (mg/L)																
Carbon Dioxide	**120**	**100**	**110**	NM	**100**	**98**	**86**	NM	**11**	**11**	**15**	NM	**19**	**14**	**18**	**23**
Methane	**0.75**	**0.59**	**0.42**	NM	**0.15**	**0.21**	**0.18**	<0.002	<0.002	**0.0026 J**	**0.0032 J**	NM	**0.0031 J**	**0.003 J**	**0.0027 J**	<0.002
Ethane	**0.016**	**0.017**	**0.0069**	NM	**0.0041 J**	**0.0057**	**0.004 J**	<0.001	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001
Ethene	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001
Field Parameters (mV)																
ORP	-9	17	77	NM	57	59	-11	-4	150	86	-12	NM	14	10	35	NM

Volatile Fatty Acids were analyzed by Microseeps Laboratory.
Dissolved gases were analyzed by Lancaster Laboratories (SW 8015B and CO_2)
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
mg/L - Milligrams per liter.
mV - Millivolt.
MW - Monitoring well on Unocal or Coleman properties.
ORP - Oxidation-reduction potential.
R - Recovery well.
TW - Test well.

Table 8 - Volatile Fatty Acid and Dissolved Gases Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

	R-3								R-4							
	Sidegradient								Downgradient							
Location	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**
Volatile Fatty Acids (mg/L)																
Acetic Acid	NM	NM	**0.75**	NM	**0.31**	**0.30**	**0.35**	**0.12**	**0.12**	NM	NM	**1.1**	**6.4**	**0.36**	**0.20**	<0.07
Butyric Acid	NM	NM	<0.50	NM	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	<0.50	<0.07	<0.07	<0.07	<0.07
Hexanoic Acid	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	**0.15**	NM	NM	NM	<0.10	<0.10	<0.10	<0.10
i-Hexanoic Acid	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	<0.10	NM	NM	NM	<0.10	<0.10	<0.10	<0.10
i-Pentanoic Acid	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	<0.07	<0.07	<0.07	<0.07
Lactic Acid and HIBA	NM	NM	<10	NM	**0.78**	**0.49**	**0.80**	<0.10	<0.10	NM	NM	<10	**0.21**	**0.52**	<0.10	<0.10
Pentanoic Acid	NM	NM	NM	NM	<0.07	<0.07	<0.08	<0.07	<0.07	NM	NM	NM	<0.07	<0.07	<0.07	<0.07
Propionic Acid	NM	NM	<0.50	NM	<0.07	**0.09**	<0.07	<0.07	<0.07	NM	NM	<0.50	**4.60**	<0.07	<0.07	<0.07
Pyruvic Acid	NM	NM	<2.0	NM	<0.07	<0.07	<0.08	<0.07	<0.07	NM	NM	<2.0	**0.14**	<0.07	<0.07	<0.07
Dissolved Gases (mg/L)																
Carbon Dioxide	NM	NM	**90**	NM	**120**	**94**	**110**	**98**	NM	NM	NM	**110**	NM	**150**	**140**	**130**
Methane	NM	NM	**1.9**	NM	**0.28**	**0.13**	**0.13**	**0.059**	**1.4**	NM	NM	**1.6**	NM	**2.4**	**2.2**	**4.3**
Ethane	NM	NM	**0.093**	NM	**0.025**	**0.0076**	**0.0077**	**0.0031 J**	**0.018**	NM	NM	**0.011**	NM	**0.0099**	**0.014**	**0.032**
Ethene	NM	NM	**0.0037 J**	NM	**0.011**	**0.012**	**0.011**	**0.019**	**0.01**	NM	NM	**0.0043 J**	NM	**0.0033 J**	**0.0024 J**	**0.0024 J**
Field Parameters (mV)																
ORP	NM	NM	-163	NM	-199	-155	-151	-130	NM	NM	-179	NM	-179	-139	-131	-140

Volatile Fatty Acids were analyzed by Microseeps Laboratory.
Dissolved gases were analyzed by Lancaster Laboratories (SW 8015B and CO_2)
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
mg/L - Milligrams per liter.
mV - Millivolt.
MW - Monitoring well on Unocal or Coleman properties.
ORP - Oxidation-reduction potential.
R - Recovery well.
TW - Test well.

Table 8 - Volatile Fatty Acid and Dissolved Gases Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

	R-5								R-6							
	Downgradient								Downgradient							
Location	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**
Volatile Fatty Acids (mg/L)																
Acetic Acid	<2	**0.57**	**0.43 J**	<0.07	**0.35**	**0.17**	**0.26**	**0.18**	NM	NM	<0.50	<0.07	**0.19**	**0.15**	<0.07	**0.1**
Butyric Acid	<3.5	<0.50	<0.50	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	<0.50	<0.07	<0.07	<0.07	<0.07	<0.07
Hexanoic Acid	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	**0.21**	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	**0.17**
i-Hexanoic Acid	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	<0.10	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	<0.10
i-Pentanoic Acid	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07
Lactic Acid and HIBA	<1	<10	<10	**0.19**	**0.37**	<0.10	<0.10	**0.14**	NM	NM	<10	**0.26**	**0.18**	<0.10	<0.10	**0.12**
Pentanoic Acid	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07
Propionic Acid	<5.2	<0.50	<0.50	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	<0.50	<0.07	<0.07	**0.06**	<0.07	<0.07
Pyruvic Acid	<0.15	<2.0	<2.0	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	<2.0	<0.07	<0.07	<0.07	<0.07	<0.07
Dissolved Gases (mg/L)																
Carbon Dioxide	**98**	**92**	**81**	NM	**130**	**130**	**120**	NM	NM	NM	**88**	NM	**110**	**120**	**110**	NM
Methane	<0.002	<0.002	<0.002	NM	**0.0023 J**	**0.0035 J**	**0.06**	**1.1**	NM	NM	**0.0044 J**	NM	**0.33**	**0.59**	**1**	**4.5**
Ethane	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001	NM	NM	<0.001	NM	<0.001	<0.001	<0.001	<0.001
Ethene	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001	NM	NM	<0.001	NM	<0.001	<0.001	<0.001	<0.001
Field Parameters (mV)																
ORP	-113	45	29	NM	-45	29	163	-19	NM	NM	99	NM	92	68	146	74

Volatile Fatty Acids were analyzed by Microseeps Laboratory.
Dissolved gases were analyzed by Lancaster Laboratories (SW 8015B and CO_2)
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
mg/L - Milligrams per liter.
mV - Millivolt.
MW - Monitoring well on Unocal or Coleman properties.
ORP - Oxidation-reduction potential.
R - Recovery well.
TW - Test well.

Table 8 - Volatile Fatty Acid and Dissolved Gases Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

Location	R-7 Sidegradient								R-8 Sidegradient							
	Jan-07	Mar-07	Jun-07	Jul-07	Oct-07	Dec-07	Mar-08	Jul-08	Jan-07	Mar-07	Jun-07	Jul-07	Oct-07	Dec-07	Mar-08	Jul-08
Volatile Fatty Acids (mg/L)																
Acetic Acid	NM	NM	<0.50	NM	NM	NM	<0.07	**0.11**	NM	NM	<0.50	NM	NM	NM	<0.07	NM
Butyric Acid	NM	NM	<0.50	NM	NM	NM	<0.07	<0.07	NM	NM	<0.50	NM	NM	NM	<0.07	NM
Hexanoic Acid	NM	NM	NM	NM	NM	NM	<0.10	**0.2**	NM	NM	NM	NM	NM	NM	<0.10	NM
i-Hexanoic Acid	NM	NM	NM	NM	NM	NM	<0.10	<0.10	NM	NM	NM	NM	NM	NM	<0.10	NM
i-Pentanoic Acid	NM	NM	NM	NM	NM	NM	<0.07	<0.07	NM	NM	NM	NM	NM	NM	<0.07	NM
Lactic Acid and HIBA	NM	NM	<10	NM	NM	NM	<0.10	**0.15**	NM	NM	<10	NM	NM	NM	<0.10	NM
Pentanoic Acid	NM	NM	NM	NM	NM	NM	<0.07	<0.07	NM	NM	NM	NM	NM	NM	<0.07	NM
Propionic Acid	NM	NM	<0.50	NM	NM	NM	<0.07	<0.07	NM	NM	<0.50	NM	NM	NM	<0.07	NM
Pyruvic Acid	NM	NM	<2.0	NM	NM	NM	<0.07	<0.07	NM	NM	<2.0	NM	NM	NM	<0.07	NM
Dissolved Gases (mg/L)																
Carbon Dioxide	NM	NM	**78**	NM	NM	NM	**50**	NM	NM	NM	**50**	NM	NM	NM	**44**	NM
Methane	NM	NM	**0.02**	NM	NM	NM	**0.45**	**0.54**	NM	NM	<0.002	NM	NM	NM	<0.002	NM
Ethane	NM	NM	<0.001	NM	NM	NM	<0.001	<0.001	NM	NM	<0.001	NM	NM	NM	<0.001	NM
Ethene	NM	NM	<0.001	NM	NM	NM	<0.001	<0.001	NM	NM	<0.001	NM	NM	NM	<0.001	NM
Field Parameters (mV)																
ORP	NM	NM	147	NM	NM	NM	-142	-139	NM	NM	78	NM	NM	NM	181	NM

Volatile Fatty Acids were analyzed by Microseeps Laboratory.
Dissolved gases were analyzed by Lancaster Laboratories (SW 8015B and CO_2)
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
mg/L - Milligrams per liter.
mV - Millivolt.
MW - Monitoring well on Unocal or Coleman properties.
ORP - Oxidation-reduction potential.
R - Recovery well.
TW - Test well.

Table 8 - Volatile Fatty Acid and Dissolved Gases Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

	R-10								R-11							
	Downgradient								Downgradient							
Location	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**
Volatile Fatty Acids (mg/L)																
Acetic Acid	<2	<0.50	<0.50	NM	**0.11**	**0.54**	<0.07	**0.12**	NM	NM	<0.50	<0.07	**0.40**	**0.15**	<0.07	**0.11**
Butyric Acid	<3.5	<0.50	<0.50	NM	<0.07	<0.07	<0.07	<0.07	NM	NM	<0.50	<0.07	<0.07	<0.07	<0.07	<0.07
Hexanoic Acid	NM	NM	NM	NM	<0.10	<0.10	<0.10	**0.21**	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	**0.21**
i-Hexanoic Acid	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	<0.10
i-Pentanoic Acid	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07
Lactic Acid and HIBA	<1	<10	<10	NM	<0.10	<0.10	<0.10	**0.14**	NM	NM	<10	**0.20**	**0.66**	<0.10	<0.10	**0.14**
Pentanoic Acid	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07
Propionic Acid	<5.2	<0.50	<0.50	NM	<0.07	<0.07	<0.07	<0.07	NM	NM	<0.50	<0.07	<0.07	<0.07	<0.07	<0.07
Pyruvic Acid	<0.15	<2.0	<2.0	NM	<0.07	<0.07	<0.07	<0.07	NM	NM	<2.0	<0.07	<0.07	<0.07	<0.07	<0.07
Dissolved Gases (mg/L)																
Carbon Dioxide	**73**	**72**	**76**	NM	**94**	**110**	**76**	NM	NM	NM	**71**	NM	**180**	**170**	**79**	NM
Methane	**0.018**	**0.024**	**0.016**	NM	**0.16**	**0.8**	**0.61**	**2**	NM	NM	**0.22**	NM	**0.91**	**1**	**0.093**	**0.83**
Ethane	<0.001	<0.001	<0.001	NM	**0.0014 J**	**0.0033 J**	**0.0017 J**	**0.0033 J**	NM	NM	**0.0047 J**	NM	**0.022**	**0.025**	**0.0024 J**	**0.015**
Ethene	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001	NM	NM	<0.001	NM	<0.001	<0.001	<0.001	<0.001
Field Parameters (mV)																
ORP	-18	58	29	NM	-45	-20	-14	-71	NM	NM	-109	NM	-93	-72	-93	-104

Volatile Fatty Acids were analyzed by Microseeps Laboratory.
Dissolved gases were analyzed by Lancaster Laboratories (SW 8015B and CO_2)
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
mg/L - Milligrams per liter.
mV - Millivolt.
MW - Monitoring well on Unocal or Coleman properties.
ORP - Oxidation-reduction potential.
R - Recovery well.
TW - Test well.

Table 8 - Volatile Fatty Acid and Dissolved Gases Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
January 2006 through August 2008

	R-12								TW-4							
	Downgradient								Upgradient							
Location	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**	**Jan-07**	**Mar-07**	**Jun-07**	**Jul-07**	**Oct-07**	**Dec-07**	**Mar-08**	**Jul-08**
Volatile Fatty Acids (mg/L)																
Acetic Acid	<2	<0.50	<0.50	**0.17**	**1.30**	**0.10**	<0.07	**0.12**	NM	NM	**0.65**	NM	**0.44**	**0.43**	**0.28**	**0.09**
Butyric Acid	<3.5	<0.50	<0.50	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	<0.50	NM	<0.07	<0.07	<0.07	<0.07
Hexanoic Acid	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	**0.16**	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10
i-Hexanoic Acid	NM	NM	NM	<0.10	<0.10	<0.10	<0.10	<0.10	NM	NM	NM	NM	<0.10	<0.10	<0.10	<0.10
i-Pentanoic Acid	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07
Lactic Acid and HIBA	<1	<10	<10	<0.10	<0.10	<0.10	<0.10	**0.20**	NM	NM	<10	NM	**0.65**	<0.10	<0.10	**0.14**
Pentanoic Acid	NM	NM	NM	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	NM	NM	<0.07	<0.07	<0.07	<0.07
Propionic Acid	<5.2	<0.50	<0.50	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	<0.50	NM	<0.07	**0.07**	<0.07	<0.07
Pyruvic Acid	<0.15	<2.0	<2.0	<0.07	<0.07	<0.07	<0.07	<0.07	NM	NM	<2.0	NM	<0.07	<0.07	<0.07	<0.07
Dissolved Gases (mg/L)																
Carbon Dioxide	**32**	**57**	**86**	NM	**59**	**94**	**92**	NM	NM	NM	**610**	NM	**200**	**220**	**180**	NM
Methane	<0.002	<0.002	<0.002	NM	<0.002	**0.0032 J**	**0.35**	**0.75**	NM	NM	**12**	NM	**9.9**	**12**	**12**	**9.5**
Ethane	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	**0.0015 J**	NM	NM	**0.81 J**	NM	**0.59 J**	**0.68 J**	**0.47**	**0.29**
Ethene	<0.001	<0.001	<0.001	NM	<0.001	<0.001	<0.001	<0.001	NM	NM	**0.024**	NM	**0.025**	**0.027**	**0.036**	**0.012**
Field Parameters (mV)																
ORP	-7	23	-43	NM	-59	-43	-1	-46	NM	NM	-198	NM	-237	-185	-156	-182

Volatile Fatty Acids were analyzed by Microseeps Laboratory.
Dissolved gases were analyzed by Lancaster Laboratories (SW 8015B and CO_2)
< - Less than method detection limit (MDL).
J - The analyte was positively identified; the associated numeric value is the approximate concentration of the analyte in the sample.
mg/L - Milligrams per liter.
mV - Millivolt.
MW - Monitoring well on Unocal or Coleman properties.
ORP - Oxidation-reduction potential.
R - Recovery well.
TW - Test well.

Table 9 - Volatile Organic Compound Results
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	MW-8 Sidegradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,1,2-Trichloroethane	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,1-Dichloroethane	340	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,1-Dichloroethene	7	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,2,4-Trimethylbenzene	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,2-Dichlorobenzene	600	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,2-Dichloroethane	5	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,3,5-Trimethylbenzene	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
2-Butanone	820	<0.2	<1.0	NM	NM	<1.0	NM	NM	<1.0	<1.0
4-Methyl-2-Pentanone	70	<0.2	<1.0	NM	NM	<1.0	NM	NM	<1.0	<1.0
Acetone	260	<0.7	<3.0	NM	NM	<3.0	NM	NM	<3.0	<3.0
Benzene	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Bromoform	80	NM	NM	NM	NM	<0.1	NM	NM	<0.1	<0.1
Carbon Disulfide	9	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.4
Carbon Tetrachloride	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Chlorobenzene	100	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Chloroethane	48	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Chloroform	80	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
cis-1,2-Dichloroethene	70	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Ethylbenzene	700	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Isopropylbenzene	224	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Methyl Tertiary Butyl Ether	20	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Methylene Chloride	5	<0.5	<0.2	NM	NM	<0.2	NM	NM	<0.2	**0.2 BJ**
Naphthalene	3	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
n-Butylbenzene	21	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Styrene	100	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Tetrachloroethene	5	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Toluene	1,000	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	**0.6**
trans-1,2-Dichloroethene	100	<0.1	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Trichloroethene	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Trichlorofluoromethane	25,200	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Vinyl Acetate	N/A	<0.2	<0.2	NM	NM	<0.2	NM	NM	<0.2	<0.2
Vinyl Chloride	2	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Xylenes,Total	10,000	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	**0.1 J**

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	MW-10 Upgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,1,2-Trichloroethane	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,1-Dichloroethane	340	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,1-Dichloroethene	7	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,2,4-Trimethylbenzene	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,2-Dichlorobenzene	600	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,2-Dichloroethane	5	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,3,5-Trimethylbenzene	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
2-Butanone	820	<0.2	NM	NM	NM	<1.0	NM	NM	<1.0	NM
4-Methyl-2-Pentanone	70	<0.2	NM	NM	NM	<1.0	NM	NM	<1.0	NM
Acetone	260	<0.7	NM	NM	NM	<3.0	NM	NM	<3.0	NM
Benzene	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Bromoform	80	NM	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Carbon Disulfide	9	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Carbon Tetrachloride	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Chlorobenzene	100	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Chloroethane	48	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Chloroform	80	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
cis-1,2-Dichloroethene	70	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Ethylbenzene	700	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Isopropylbenzene	224	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Methyl Tertiary Butyl Ether	20	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Methylene Chloride	5	<0.5	NM	NM	NM	<0.2	NM	NM	<0.2	NM
Naphthalene	3	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
n-Butylbenzene	21	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Styrene	100	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Tetrachloroethene	5	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Toluene	1,000	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
trans-1,2-Dichloroethene	100	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Trichloroethene	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Trichlorofluoromethane	25,200	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Vinyl Acetate	N/A	<0.2	NM	NM	NM	<0.2	NM	NM	<0.2	NM
Vinyl Chloride	2	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Xylenes,Total	10,000	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	MW-18 Downgradient								
		Feb-06	May 06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
1,1,2-Trichloroethane	5	**0.39 J**	NM	<0.5	**0.3 J**	<0.5	<0.1	<0.5	<0.2	<1.0
1,1-Dichloroethane	340	**84**	NM	**52**	**45**	**43**	**34**	**16**	**31**	**28**
1,1-Dichloroethene	7	**7.4**	NM	**2.8**	**2.9**	**2.4 J**	**2.3**	**2.2**	**4.2**	**3.2 J**
1,2,4-Trimethylbenzene	5	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
1,2-Dichlorobenzene	600	**0.98 J**	NM	NM	NM	<0.2	**0.5**	<0.5	**0.6**	<1.0
1,2-Dichloroethane	5	**1.7 J**	NM	**0.9 J**	**0.8 J**	**0.7 J**	**0.7**	<0.5	**0.7**	<1.0
1,3,5-Trimethylbenzene	5	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
2-Butanone	820	<0.2	NM	<5.0	<2.0	<5.0	**1400**	<5.0	<2.0	<10
4-Methyl-2-Pentanone	70	<0.2	NM	<5.0	<2.0	<5.0	<1.0	<5.0	<2.0	<10
Acetone	260	**1.1 JB**	NM	<15	<6.0	<15	**220**	<15	<6.0	<30
Benzene	5	**0.27 J**	NM	<0.5	<0.2	<0.5	**0.3**	<0.5	**0.4**	<1.0
Bromoform	80	NM	NM	NM	NM	<0.2	<0.1	<0.5	<0.2	<1.0
Carbon Disulfide	9	<0.2	NM	<0.5	<0.2	<0.5	**0.9**	<0.5	<0.2	<4.0
Carbon Tetrachloride	5	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
Chlorobenzene	100	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
Chloroethane	48	<0.2	NM	<0.5	<0.2	<0.5	**2.4**	**8.3**	**3.3**	<1.0
Chloroform	80	<0.3	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
cis-1,2-Dichloroethene	70	**440**	NM	**210**	**270**	**310**	**250**	**220**	**430**	**400**
Ethylbenzene	700	<0.2	NM	<0.5	<0.2	<0.5	**0.6**	<0.5	<0.2	<1.0
Isopropylbenzene	224	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
Methyl Tertiary Butyl Ether	20	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
Methylene Chloride	5	<0.5	NM	<1.0	<0.4	**1.6 J**	<0.2	<1.0	<0.4	**2.7 BJ**
Naphthalene	3	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
n-Butylbenzene	21	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
Styrene	100	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
Tetrachloroethene	5	**200**	NM	**110**	**29**	**4.4**	**0.6**	**0.8**	**0.3**	**1.2 J**
Toluene	1,000	<0.2	NM	<0.5	0.2 J	<0.5	<0.1	<0.5	<0.2	<1.0
trans-1,2-Dichloroethene	100	**1.3 J**	NM	**0.7 J**	**1.0**	**1.4 J**	**4.0**	**3.6**	**2.9**	**1.8 J**
Trichloroethene	5	**270**	NM	**130**	**110**	**13**	**4.6**	**2.9**	**5.9**	**15**
Trichlorofluoromethane	25,200	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0
Vinyl Acetate	N/A	<0.2	NM	<1.0	<0.4	<1.0	<0.2	<1.0	<0.4	<2.0
Vinyl Chloride	2	**1.5 J**	NM	**0.6 J**	**2.5**	**4.8**	**8.5**	**5.7**	**11**	**9.1**
Xylenes,Total	10,000	<0.2	NM	<0.5	<0.2	<0.5	<0.1	<0.5	<0.2	<1.0

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	MW-20 Downgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	<0.5	<0.5	<0.2	<0.5	**0.2**	<0.5	**0.1**	<0.5
1,1,2-Trichloroethane	5	**0.8 J**	<0.5	**0.8 J**	**0.6 J**	**0.9 J**	**0.7**	**0.6**	**0.5**	<0.5
1,1-Dichloroethane	340	**84**	**49**	**43**	**34**	**46**	**35**	**31**	**28**	**29**
1,1-Dichloroethene	7	**8.1**	**4.7**	**5.1**	**3.9**	**3.8**	**5.5**	**3.4**	**3.5**	**2 J**
1,2,4-Trimethylbenzene	5	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
1,2-Dichlorobenzene	600	<0.2	NM	NM	NM	<0.5	**0.3**	<0.5	**0.2**	<0.5
1,2-Dichloroethane	5	**2.1 J**	**1.5 J**	**1.1 J**	**0.9 J**	**1.2 J**	**1**	**0.6**	**0.7**	**0.9 J**
1,3,5-Trimethylbenzene	5	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
2-Butanone	820	<0.2	<5.0	<5.0	<2.0	<5.0	<1.0	<5.0	<1.0	<5.0
4-Methyl-2-Pentanone	70	<0.2	<5.0	<5.0	<2.0	<5.0	<1.0	<5.0	<1.0	<5.0
Acetone	260	<0.7	<15	<15	<6.0	<15	<3.0	<15	<3.0	<15
Benzene	5	<0.2	<0.5	<0.5	<0.2	<0.5	**0.1**	<0.5	**0.1**	<0.5
Bromoform	80	NM	NM	NM	NM	<0.5	<0.1	<0.5	<0.1	<0.5
Carbon Disulfide	9	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<2.0
Carbon Tetrachloride	5	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Chlorobenzene	100	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Chloroethane	48	**0.89 J**	**0.5 J**	**0.6 J**	**0.3 J**	<0.5	**0.1**	<0.5	<0.1	<0.5
Chloroform	80	<0.3	<0.5	<0.5	<0.2	<0.5	**0.1**	<0.5	<0.1	<0.5
cis-1,2-Dichloroethene	70	**260**	**160**	**160**	**190**	**230**	**210**	**150**	**220**	**250**
Ethylbenzene	700	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Isopropylbenzene	224	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Methyl Tertiary Butyl Ether	20	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Methylene Chloride	5	<0.5	**1.2 J**	<1.0	<0.4	<1.0	<0.2	<1.0	<0.2	**1.5 BJ**
Naphthalene	3	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
n-Butylbenzene	21	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Styrene	100	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Tetrachloroethene	5	**310**	**180**	**280**	**240**	**240**	**200**	**100**	**140**	**65**
Toluene	1,000	<0.2	<0.5	<0.5	<0.2	**0.7 J**	<0.1	<0.5	<0.1	<0.5
trans-1,2-Dichloroethene	100	**5.6**	**1.3 J**	**3.8**	**8.5**	**1.4 J**	**0.6**	**0.6**	**2.5**	**5.7**
Trichloroethene	5	**190**	**120**	**160**	**150**	**130**	**140**	**120**	**100**	**66**
Trichlorofluoromethane	25,200	<0.2	<0.5	<0.5	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Vinyl Acetate	N/A	<0.2	<1.0	<1.0	<0.4	<1.0	<0.2	<1.0	<0.2	<1.0
Vinyl Chloride	2	<0.3	<0.5	<0.5	<0.2	<0.5	**0.2**	<0.5	**0.2**	<0.5
Xylenes,Total	10,000	<0.2	<0.5	<0.5	<0.2	**0.5 J**	<0.1	<0.5	<0.1	<0.5

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	MW-21 Downgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
1,1,2-Trichloroethane	5	**0.27 J**	<0.5	**0.8 J**	<0.2	<0.2	**0.1**	<0.5	<0.1	<0.1
1,1-Dichloroethane	340	**180**	**130**	**210**	**160**	**140**	**120**	**100**	**78**	**29**
1,1-Dichloroethene	7	**3.5 J**	**1.8 J**	**2.5 J**	**2.5**	**1.9**	**2.0**	**1.6**	**1.2**	**0.4 J**
1,2,4-Trimethylbenzene	5	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
1,2-Dichlorobenzene	600	**1.2 J**	NM	NM	NM	**1.4**	**1.0**	**0.8**	**0.8**	**0.1 J**
1,2-Dichloroethane	5	**2.7 J**	**2 J**	**3.0**	**2.5**	**2.0**	**1.5**	**1.1**	**1.1**	**0.4 J**
1,3,5-Trimethylbenzene	5	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
2-Butanone	820	<0.2	<5.0	<5.0	<2.0	**2.4 J**	**1.1**	<5.0	<1.0	<1.0
4-Methyl-2-Pentanone	70	<0.2	<5.0	<5.0	<2.0	<2.0	<1.0	<5.0	<1.0	<1.0
Acetone	260	**1.3 JB**	<15	<15	<6.0	<6.0	<3.0	<15	<3.0	<3.0
Benzene	5	**0.5 J**	<0.5	**0.6 J**	**0.6 J**	**0.4 J**	**0.3**	<0.5	**0.2**	<0.1
Bromoform	80	NM	NM	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Carbon Disulfide	9	<0.2	<0.5	<0.5	<0.2	<0.2	**0.1**	<0.5	<0.1	<0.4
Carbon Tetrachloride	5	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Chlorobenzene	100	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Chloroethane	48	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Chloroform	80	<0.3	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	**0.2 J**
cis-1,2-Dichloroethene	70	**220**	**160**	**210**	**220**	**170**	**150**	**100**	**110**	**35**
Ethylbenzene	700	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Isopropylbenzene	224	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Methyl Tertiary Butyl Ether	20	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Methylene Chloride	5	<0.5	**1.1 J**	**1.1 J**	<0.4	**0.5 J**	<0.2	<1.0	<0.2	**0.2 BJ**
Naphthalene	3	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
n-Butylbenzene	21	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Styrene	100	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Tetrachloroethene	5	**28**	**15**	**17**	**19**	**16**	**15**	**11**	**10**	**3.5**
Toluene	1,000	<0.2	<0.5	<0.5	**0.2 J**	<0.2	<0.1	<0.5	<0.1	**0.2 J**
trans-1,2-Dichloroethene	100	**5.3**	**0.6 J**	**1.7 J**	**2.3**	**0.7 J**	**0.8**	**0.9**	**1.4**	**1.8**
Trichloroethene	5	**75**	**38**	**51**	**47**	**40**	**29**	**24**	**20**	**7**
Trichlorofluoromethane	25,200	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1
Vinyl Acetate	N/A	<0.2	<1	<1.0	<0.4	<0.4	<0.2	<1.0	<0.2	<0.2
Vinyl Chloride	2	**29 J**	**21**	**45**	**45**	**23**	**15**	**11**	**6.2**	<0.1
Xylenes,Total	10,000	<0.2	<0.5	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.1

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-2 Sidegradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
1,1,2-Trichloroethane	5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
1,1-Dichloroethane	340	**1.5 J**	**4.7**	**1**	**1.1**	**1.7**	**0.7**	**0.6**	**3.6**	NM
1,1-Dichloroethene	7	<0.3	**0.2 J**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
1,2,4-Trimethylbenzene	5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
1,2-Dichlorobenzene	600	<0.2	NM	NM	NM	<0.1	<0.1	<0.1	<0.1	NM
1,2-Dichloroethane	5	<0.3	**0.2 J**	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1**	NM
1,3,5-Trimethylbenzene	5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
2-Butanone	820	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	NM
4-Methyl-2-Pentanone	70	<0.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	NM
Acetone	260	**1.6 JB**	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	NM
Benzene	5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Bromoform	80	NM	NM	NM	NM	<0.1	<0.1	<0.1	<0.1	NM
Carbon Disulfide	9	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	**0.1 B**	<0.1	NM
Carbon Tetrachloride	5	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Chlorobenzene	100	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Chloroethane	48	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Chloroform	80	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
cis-1,2-Dichloroethene	70	**14**	**68**	**7.7**	**12**	**17**	**6.1**	**5.8**	**25**	NM
Ethylbenzene	700	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Isopropylbenzene	224	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Methyl Tertiary Butyl Ether	20	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Methylene Chloride	5	<0.5	**0.4 JB**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NM
Naphthalene	3	**0.35 JB**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
n-Butylbenzene	21	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Styrene	100	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Tetrachloroethene	5	**1.5 J**	**2**	**0.8**	**1.0**	**0.5 J**	**0.3**	**0.3**	**1.7**	NM
Toluene	1,000	<0.2	<0.1	<0.1	**0.2 J**	<0.1	<0.1	<0.1	<0.1	NM
trans-1,2-Dichloroethene	100	**0.17 J**	**1.1**	<0.1	<0.1	**0.4 J**	**0.1 JL**	<0.1	**0.2**	NM
Trichloroethene	5	**2.2 J**	**7.7**	<0.1	**2.4**	**2.7**	**0.9**	**1**	**7.2**	NM
Trichlorofluoromethane	25,200	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM
Vinyl Acetate	N/A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	NM
Vinyl Chloride	2	**1.5 J**	**1.1**	**1.2**	**0.6**	**2.6**	**0.8**	**0.9**	**0.6**	NM
Xylenes,Total	10,000	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NM

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.

mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-3 Sidegradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	NM	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
1,1,2-Trichloroethane	5	NM	<0.1	NM	NM	<0.2	**8.7**	<0.1	<0.1	<0.1
1,1-Dichloroethane	340	NM	**24**	NM	NM	**17**	**26**	**25**	**38**	**25**
1,1-Dichloroethene	7	NM	**0.2 J**	NM	NM	<0.2	**0.6**	**0.3**	**0.2**	<0.1
1,2,4-Trimethylbenzene	5	NM	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
1,2-Dichlorobenzene	600	NM	NM	NM	NM	**1.2**	**1**	**0.4**	**1.0**	**2**
1,2-Dichloroethane	5	NM	**0.7**	NM	NM	<0.2	**0.6**	**0.4**	**0.8**	**0.7**
1,3,5-Trimethylbenzene	5	NM	<0.1	NM	NM	<0.2	**4.6**	<0.1	<0.1	<0.1
2-Butanone	820	NM	<1.0	NM	NM	**2.7 J**	**1.3**	**1**	<1.0	<1.0
4-Methyl-2-Pentanone	70	NM	<1.0	NM	NM	<2.0	<1.0	<1.0	<1.0	<1.0
Acetone	260	NM	**3.6 J**	NM	NM	<6.0	<3.0	<3.0	<3.0	<3.0
Benzene	5	NM	**4**	NM	NM	**3.8**	**1.6**	**0.6**	**0.4**	**2.2**
Bromoform	80	NM	NM	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Carbon Disulfide	9	NM	**0.1 J**	NM	NM	<0.2	**0.2**	**0.2 B**	<0.1	<0.4
Carbon Tetrachloride	5	NM	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Chlorobenzene	100	NM	<0.1	NM	NM	<0.2	**5.6**	<0.1	<0.1	**0.1 J**
Chloroethane	48	NM	**4.5**	NM	NM	**7.0**	**2.5**	**0.8**	**0.5**	**0.9**
Chloroform	80	NM	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
cis-1,2-Dichloroethene	70	NM	**43**	NM	NM	**46**	**100**	**91**	**80**	**5.2**
Ethylbenzene	700	NM	**0.1 J**	NM	NM	<0.2	**5.6**	<0.1	<0.1	<0.1
Isopropylbenzene	224	NM	**1.4**	NM	NM	**0.7 J**	**0.1**	<0.1	<0.1	**0.2 J**
Methyl Tertiary Butyl Ether	20	NM	<0.1	NM	NM	<0.2	**5.0**	<0.1	<0.1	<0.1
Methylene Chloride	5	NM	**0.6 B**	NM	NM	**1.0 B**	**5.7**	<0.2	**0.2**	**0.3 BJ**
Naphthalene	3	NM	<0.1	NM	NM	**0.3 J**	**0.2 JH**	**0.3**	<0.1	<0.1
n-Butylbenzene	21	NM	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Styrene	100	NM	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Tetrachloroethene	5	NM	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Toluene	1,000	NM	<0.1	NM	NM	<0.2	**0.1**	<0.1	<0.1	**0.2 J**
trans-1,2-Dichloroethene	100	NM	**1.4**	NM	NM	**1.5**	**4.3 JL**	**2.4**	**2.0**	**0.8**
Trichloroethene	5	NM	**0.3 J**	NM	NM	<0.2	<0.1	**0.4**	**0.8**	<0.1
Trichlorofluoromethane	25,200	NM	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Vinyl Acetate	N/A	NM	<0.2	NM	NM	<0.4	<0.2	<0.2	<0.2	<0.2
Vinyl Chloride	2	NM	**10**	NM	NM	**11**	**36**	**28**	**51**	**10 JL**
Xylenes,Total	10,000	NM	<0.1	NM	NM	<0.2	**0.1**	<0.1	<0.1	<0.1

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-4 Downgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
1,1,2-Trichloroethane	5	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
1,1-Dichloroethane	340	**30**	**41**	NM	NM	**24**	**21**	**23**	**30**	**8.4**
1,1-Dichloroethene	7	**0.46 J**	**0.3 J**	NM	NM	**0.2 J**	**0.1**	**0.2**	**0.3**	**0.3 J**
1,2,4-Trimethylbenzene	5	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
1,2-Dichlorobenzene	600	<0.2	NM	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
1,2-Dichloroethane	5	<0.3	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	**0.2 J**
1,3,5-Trimethylbenzene	5	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
2-Butanone	820	<0.2	<1.0	NM	NM	**21**	**1.9**	**3.1**	<1.0	<1.0
4-Methyl-2-Pentanone	70	<0.2	<1.0	NM	NM	<2.0	<1.0	<1.0	<1.0	<1.0
Acetone	260	**2.3 JB**	**6.9**	NM	NM	<6.0	<3.0	<3.0	<3.0	<3.0
Benzene	5	**1.1 J**	**1.7**	NM	NM	**0.6 J**	**0.4**	**0.6**	**1.5**	**0.4 J**
Bromoform	80	NM	NM	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Carbon Disulfide	9	**0.5 J**	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.4
Carbon Tetrachloride	5	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Chlorobenzene	100	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Chloroethane	48	<0.2	**0.2 J**	NM	NM	<0.2	<0.1	<0.1	**0.3**	**0.3 J**
Chloroform	80	<0.3	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
cis-1,2-Dichloroethene	70	**79**	**46**	NM	NM	**50**	**41**	**34**	**21**	**54**
Ethylbenzene	700	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Isopropylbenzene	224	**0.19 J**	**0.6**	NM	NM	<0.2	<0.1	**0.2**	**1.1**	<0.1
Methyl Tertiary Butyl Ether	20	<0.2	**0.2 J**	NM	NM	**0.2 J**	**0.3**	**0.2**	**0.2**	**0.5 J**
Methylene Chloride	5	<0.5	**0.6 B**	NM	NM	**1.1 B**	<0.2	<0.2	**0.7**	**0.2 BJ**
Naphthalene	3	**0.37 JB**	<0.1	NM	NM	<0.2	<0.1	**0.4**	**0.5**	<0.1
n-Butylbenzene	21	**0.23 J**	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Styrene	100	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Tetrachloroethene	5	**6.9**	**12**	NM	NM	**1.8**	**0.2**	**0.8**	**2.2**	**0.2 J**
Toluene	1,000	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	**0.2 J**
trans-1,2-Dichloroethene	100	**0.63 J**	**2.7**	NM	NM	**1.6**	**0.5 J**	**0.6**	**0.5**	**0.5 J**
Trichloroethene	5	**13**	**5.8**	NM	NM	**3.9**	**0.3**	**3.5**	**4.5**	**9.7**
Trichlorofluoromethane	25,200	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1
Vinyl Acetate	N/A	<0.2	<0.2	NM	NM	<0.4	<0.2	<0.2	<0.2	<0.2
Vinyl Chloride	2	**30**	**24**	NM	NM	**11**	**12**	**14**	**12**	**17 JL**
Xylenes,Total	10,000	<0.2	<0.1	NM	NM	<0.2	<0.1	<0.1	<0.1	<0.1

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-5 Downgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	**3.1 J**	**3.9**	**2.7**	**2.3 J**	**1.9 J**	**3.9**	**3.3**	**3**	**2 J**
1,1,2-Trichloroethane	5	**0.49 J**	<0.5	**0.5 J**	**0.6 J**	<0.5	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	340	**17**	**13**	**18**	**14**	**7.0**	**9.3**	**6.9**	**7.0**	**5.2**
1,1-Dichloroethene	7	**15**	**11**	**10**	**11**	**6.8**	**12**	**12**	**9.7**	**5.1**
1,2,4-Trimethylbenzene	5	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	600	**0.68 J**	NM	NM	NM	<0.5	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	5	**0.77 J**	**0.7 J**	**0.8 J**	**0.7 J**	<0.5	<1.0	<1.0	<1.0	<1.0
1,3,5-Trimethylbenzene	5	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
2-Butanone	820	<0.2	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	<10
4-Methyl-2-Pentanone	70	<0.2	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	<10
Acetone	260	<0.7	<15	<15	<15	<15	<30	<30	<30	<30
Benzene	5	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Bromoform	80	NM	NM	NM	NM	<0.5	<1.0	<1.0	<1.0	<1.0
Carbon Disulfide	9	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<4.0
Carbon Tetrachloride	5	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	100	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Chloroethane	48	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Chloroform	80	<0.3	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene	70	**440**	**480**	**310**	**370**	**240**	**550**	**620**	**500**	**340**
Ethylbenzene	700	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene	224	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Methyl Tertiary Butyl Ether	20	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	5	<0.5	<1.0	<1.0	<1.0	**2.0 BJ**	<2.0	<2.0	<2.0	**2.8 BJ**
Naphthalene	3	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	**5.1**	<1.0
n-Butylbenzene	21	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Styrene	100	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	5	**660**	**720**	**550**	**570**	**420**	**820**	**660**	**700**	**360**
Toluene	1,000	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene	100	**2 J**	**2.3 J**	**1.9 J**	**2.5 J**	**2.2 J**	**3.2 J**	**3.8**	**2.1**	**1.5 J**
Trichloroethene	5	**240**	**330**	**210**	**250**	**190**	**360**	**280**	**270**	**210**
Trichlorofluoromethane	25,200	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0
Vinyl Acetate	N/A	<0.2	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0
Vinyl Chloride	2	**1.2 J**	**0.7 J**	**1.2 J**	**2.2 J**	**2.2 J**	**4.8**	**1.4**	**1.7**	<1.0
Xylenes,Total	10,000	<0.2	<0.5	<0.5	<0.5	<0.5	<1.0	<1.0	<1.0	<1.0

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-6 Downgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	NM	**0.8**	NM	NM	<0.1	**0.2**	**0.3**	**0.4**	**0.2 J**
1,1,2-Trichloroethane	5	NM	**0.2 J**	NM	NM	**0.2 J**	**0.1**	**0.2**	**0.1**	<0.1
1,1-Dichloroethane	340	NM	**2**	NM	NM	**3.7**	**6.3**	**5.9**	**5.7**	**5.4**
1,1-Dichloroethene	7	NM	**1.1**	NM	NM	**0.5**	**1.4**	**1.3**	**1.3**	**0.9**
1,2,4-Trimethylbenzene	5	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-Dichlorobenzene	600	NM	NM	NM	NM	<0.1	**0.1**	**0.1**	**0.1**	**0.1 J**
1,2-Dichloroethane	5	NM	**0.1 J**	NM	NM	**0.1 J**	**0.3**	**0.2**	**0.2**	**0.2 J**
1,3,5-Trimethylbenzene	5	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
2-Butanone	820	NM	<1.0	NM	NM	<1.0	<1.0	<1.0	<1.0	<1.0
4-Methyl-2-Pentanone	70	NM	<1.0	NM	NM	<1.0	<1.0	<1.0	<1.0	<1.0
Acetone	260	NM	<3.0	NM	NM	<3.0	<3.0	<3.0	<3.0	**4.6 J**
Benzene	5	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Bromoform	80	NM	NM	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Carbon Disulfide	9	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.4
Carbon Tetrachloride	5	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorobenzene	100	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Chloroethane	48	NM	<0.1	NM	NM	<0.1	0.1	<0.1	<0.1	<0.1
Chloroform	80	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
cis-1,2-Dichloroethene	70	NM	**36**	NM	NM	**22**	**54**	**42**	**46**	**44**
Ethylbenzene	700	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Isopropylbenzene	224	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Methyl Tertiary Butyl Ether	20	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Methylene Chloride	5	NM	**0.4 JB**	NM	NM	<0.2	<0.2	<0.2	<0.2	**0.2 BJ**
Naphthalene	3	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
n-Butylbenzene	21	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Styrene	100	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Tetrachloroethene	5	NM	**90**	NM	NM	**60**	**47**	**46**	**52**	**23**
Toluene	1,000	NM	<0.1	NM	NM	<0.1	<0.1	**0.4**	<0.1	**0.3 J**
trans-1,2-Dichloroethene	100	NM	**0.2 J**	NM	NM	**0.2 J**	**0.2**	**0.4**	**0.1**	**0.2 J**
Trichloroethene	5	NM	**29**	NM	NM	**7.9**	**11**	**12**	**16**	**15**
Trichlorofluoromethane	25,200	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1
Vinyl Acetate	N/A	NM	<0.2	NM	NM	<0.2	<0.2	<0.2	<0.2	<0.2
Vinyl Chloride	2	NM	**0.2 J**	NM	NM	**0.3 J**	**0.7**	**0.7**	**0.5**	**0.8**
Xylenes,Total	10,000	NM	<0.1	NM	NM	<0.1	<0.1	<0.1	<0.1	<0.1

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-7 Sidegradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,1,2-Trichloroethane	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,1-Dichloroethane	340	<0.3	**1.5**	NM	NM	**0.9**	NM	NM	**0.8**	**0.5**
1,1-Dichloroethene	7	<0.3	**0.3 J**	NM	NM	**0.2 J**	NM	NM	**0.2**	**0.1 J**
1,2,4-Trimethylbenzene	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,2-Dichlorobenzene	600	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,2-Dichloroethane	5	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
1,3,5-Trimethylbenzene	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
2-Butanone	820	<0.2	<1.0	NM	NM	<1.0	NM	NM	<1.0	<1.0
4-Methyl-2-Pentanone	70	<0.2	<1.0	NM	NM	<1.0	NM	NM	<1.0	<1.0
Acetone	260	<0.7	<3.0	NM	NM	<3.0	NM	NM	<3.0	<3.0
Benzene	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Bromoform	80	NM	NM	NM	NM	<0.1	NM	NM	<0.1	<0.1
Carbon Disulfide	9	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.4
Carbon Tetrachloride	5	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Chlorobenzene	100	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Chloroethane	48	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Chloroform	80	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
cis-1,2-Dichloroethene	70	**0.91 J**	**13**	NM	NM	**8.9**	NM	NM	**13**	**8.5**
Ethylbenzene	700	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Isopropylbenzene	224	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Methyl Tertiary Butyl Ether	20	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Methylene Chloride	5	<0.5	**0.4 JB**	NM	NM	<0.2	NM	NM	<0.2	**0.2 BJ**
Naphthalene	3	**0.35 JB**	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
n-Butylbenzene	21	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Styrene	100	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Tetrachloroethene	5	**4 J**	**17**	NM	NM	**2.3**	NM	NM	**0.2**	**0.1 J**
Toluene	1,000	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
trans-1,2-Dichloroethene	100	<0.2	**0.2 J**	NM	NM	**0.2 J**	NM	NM	**0.1**	**0.1 J**
Trichloroethene	5	**0.89 J**	**9.5**	NM	NM	**4.6**	NM	NM	**0.7**	**1**
Trichlorofluoromethane	25,200	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Vinyl Acetate	N/A	<0.2	<0.2	NM	NM	<0.2	NM	NM	<0.2	<0.2
Vinyl Chloride	2	<0.3	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1
Xylenes,Total	10,000	<0.2	<0.1	NM	NM	<0.1	NM	NM	<0.1	<0.1

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.

mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-8 Sidegradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,1,2-Trichloroethane	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,1-Dichloroethane	340	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,1-Dichloroethene	7	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,2,4-Trimethylbenzene	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,2-Dichlorobenzene	600	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,2-Dichloroethane	5	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
1,3,5-Trimethylbenzene	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
2-Butanone	820	<0.2	NM	NM	NM	<1.0	NM	NM	<1.0	NM
4-Methyl-2-Pentanone	70	<0.2	NM	NM	NM	<1.0	NM	NM	<1.0	NM
Acetone	260	<0.7	NM	NM	NM	<3.0	NM	NM	<3.0	NM
Benzene	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Bromoform	80	NM	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Carbon Disulfide	9	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Carbon Tetrachloride	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Chlorobenzene	100	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Chloroethane	48	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Chloroform	80	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
cis-1,2-Dichloroethene	70	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Ethylbenzene	700	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Isopropylbenzene	224	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Methyl Tertiary Butyl Ether	20	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Methylene Chloride	5	<0.5	NM	NM	NM	<0.2	NM	NM	<0.2	NM
Naphthalene	3	**0.38 JB**	NM	NM	NM	<0.1	NM	NM	<0.1	NM
n-Butylbenzene	21	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Styrene	100	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Tetrachloroethene	5	<0.3	NM	NM	NM	<0.1	NM	NM	**0.2**	NM
Toluene	1,000	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
trans-1,2-Dichloroethene	100	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Trichloroethene	5	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Trichlorofluoromethane	25,200	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Vinyl Acetate	N/A	<0.2	NM	NM	NM	<0.2	NM	NM	<0.2	NM
Vinyl Chloride	2	<0.3	NM	NM	NM	<0.1	NM	NM	<0.1	NM
Xylenes,Total	10,000	<0.2	NM	NM	NM	<0.1	NM	NM	<0.1	NM

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-10 Downgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	NM	**0.2 J**	<0.5	**0.2 J**	<0.2	<0.1	<0.5	**0.1**	<0.5
1,1,2-Trichloroethane	5	NM	<0.1	<0.5	**0.3 J**	**0.2 J**	**0.2**	<0.5	<0.1	<0.5
1,1-Dichloroethane	340	NM	**2.8**	**34**	**29**	**20**	**23**	**19**	**14**	**10**
1,1-Dichloroethene	7	NM	**0.4 J**	**3.4**	**3.3**	**2.0**	**2.8**	**3.0**	**3.2**	**2.3 J**
1,2,4-Trimethylbenzene	5	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
1,2-Dichlorobenzene	600	NM	NM	NM	NM	<0.2	**0.2**	<0.5	**0.2**	<0.5
1,2-Dichloroethane	5	NM	<0.1	**0.6 J**	**0.5 J**	**0.3 J**	**0.4**	<0.5	**0.3**	<0.5
1,3,5-Trimethylbenzene	5	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
2-Butanone	820	NM	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<1.0	<5.0
4-Methyl-2-Pentanone	70	NM	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<1.0	<5.0
Acetone	260	NM	<3.0	<15	<6.0	<6.0	<3.0	<15	<3.0	<15
Benzene	5	NM	<0.1	<0.5	<0.2	<0.2	**0.1**	<0.5	**0.2**	<0.5
Bromoform	80	NM	NM	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.5
Carbon Disulfide	9	NM	<0.1	<0.5	**0.3 J**	<0.2	0.3	<0.5	<0.1	<2.0
Carbon Tetrachloride	5	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
Chlorobenzene	100	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
Chloroethane	48	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	**0.7**	<0.5
Chloroform	80	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	**0.1**	<0.5
cis-1,2-Dichloroethene	70	NM	**20**	**210**	**200**	**180**	**260**	**290**	**310**	**300**
Ethylbenzene	700	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
Isopropylbenzene	224	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
Methyl Tertiary Butyl Ether	20	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
Methylene Chloride	5	NM	**0.4 JB**	<1.0	<0.4	**0.5 J**	<0.2	<1.0	<0.2	**1.4 BJ**
Naphthalene	3	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
n-Butylbenzene	21	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
Styrene	100	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
Tetrachloroethene	5	NM	**58**	**150**	**130**	**46**	**15**	**3.4**	**2.5**	**2.8 J**
Toluene	1,000	NM	<0.1	<0.5	**0.2 J**	<0.2	<0.1	<0.5	<0.1	<0.5
trans-1,2-Dichloroethene	100	NM	**0.2 J**	**1.7 J**	**2.4**	**0.7 J**	**1.1**	**1.6**	**1.2**	**1.2 J**
Trichloroethene	5	NM	**25**	**160**	**140**	**61**	**24**	**8**	**18**	**14**
Trichlorofluoromethane	25,200	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5
Vinyl Acetate	N/A	NM	<0.2	<1.0	<0.4	<0.4	<0.2	<1.0	<0.2	<1.0
Vinyl Chloride	2	NM	<0.1	**1.2 J**	**1.4**	**0.6 J**	**2.6**	**3.0**	**2.3**	**3.5 JL**
Xylenes,Total	10,000	NM	<0.1	<0.5	<0.2	<0.2	<0.1	<0.5	<0.1	<0.5

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-11 Downgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
1,1,2-Trichloroethane	5	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
1,1-Dichloroethane	340	NM	**250**	NM	NM	**110**	**210**	**110**	**110**	**24**
1,1-Dichloroethene	7	NM	**2.8**	NM	NM	**1.2**	**3.7**	**2**	**1.2**	**0.4 J**
1,2,4-Trimethylbenzene	5	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
1,2-Dichlorobenzene	600	NM	NM	NM	NM	**1.5**	**3.6**	**2.6**	**2.1**	**0.6**
1,2-Dichloroethane	5	NM	**4.3**	NM	NM	**1.7**	**3.9**	**2.2**	**1.6**	**0.4 J**
1,3,5-Trimethylbenzene	5	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
2-Butanone	820	NM	<1.0	NM	NM	<2.0	**4.7**	<5.0	<1.0	<1.0
4-Methyl-2-Pentanone	70	NM	<1.0	NM	NM	<2.0	<1.0	<5.0	<1.0	<1.0
Acetone	260	NM	**5.1**	NM	NM	<6.0	**4.1**	<15.	<3.0	<3.0
Benzene	5	NM	**1.2**	NM	NM	**0.4 J**	**1.0**	**0.7**	**0.5**	**0.1 J**
Bromoform	80	NM	NM	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Carbon Disulfide	9	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.4
Carbon Tetrachloride	5	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Chlorobenzene	100	NM	**0.2 J**	NM	NM	<0.2	**0.2**	<0.5	**0.1**	<0.1
Chloroethane	48	NM	<0.1	NM	NM	<0.2	**0.1**	<0.5	<0.1	<0.1
Chloroform	80	NM	0.3 J	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
cis-1,2-Dichloroethene	70	NM	**310**	NM	NM	**150**	**270**	**160**	**150**	**27**
Ethylbenzene	700	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Isopropylbenzene	224	NM	**0.1 J**	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Methyl Tertiary Butyl Ether	20	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Methylene Chloride	5	NM	<0.2	NM	NM	**0.4 J**	**0.2 B**	<1.0	<0.2	**0.2 BJ**
Naphthalene	3	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
n-Butylbenzene	21	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Styrene	100	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Tetrachloroethene	5	NM	**0.2 J**	NM	NM	<0.2	<0.1	<0.5	<0.1	**0.1 J**
Toluene	1,000	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
trans-1,2-Dichloroethene	100	NM	**4.6**	NM	NM	**2.0**	**5.2**	**3.0**	**0.8**	**0.6**
Trichloroethene	5	NM	**0.7**	NM	NM	**0.5 J**	**0.9**	<0.5	**0.6**	**0.6**
Trichlorofluoromethane	25,200	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1
Vinyl Acetate	N/A	NM	<0.2	NM	NM	<0.4	<0.2	<1.0	<0.2	<0.2
Vinyl Chloride	2	NM	**73**	NM	NM	**16**	**55**	**29**	**4.9**	**0.9**
Xylenes,Total	10,000	NM	<0.1	NM	NM	<0.2	<0.1	<0.5	<0.1	<0.1

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	R-12 Downgradient								
		Feb-06	May-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
1,1,2-Trichloroethane	5	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
1,1-Dichloroethane	340	NM	**110**	**43**	**59**	**100**	**30**	**75**	**88**	**190**
1,1-Dichloroethene	7	NM	**0.6 J**	**0.3 J**	**0.6 J**	**0.8 J**	**0.4**	**1**	**1.5**	**2.2 J**
1,2,4-Trimethylbenzene	5	NM	<0.2	**0.1 J**	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
1,2-Dichlorobenzene	600	NM	NM	NM	NM	<0.5	<0.1	<0.5	**0.6**	**1.2 J**
1,2-Dichloroethane	5	NM	**1.2**	**0.5 J**	**1 J**	**1.3 J**	**0.4**	**1.1**	**1.6**	**3.3**
1,3,5-Trimethylbenzene	5	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
2-Butanone	820	NM	<2.0	<1.0	<2.0	<5.0	<1.0	<5.0	<1.0	<5.0
4-Methyl-2-Pentanone	70	NM	<2.0	<1.0	<2.0	<5.0	<1.0	<5.0	<1.0	<5.0
Acetone	260	NM	<6.0	<3.0	<6.0	<15	<3.0	<15	<3.0	<15
Benzene	5	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	**0.5**	**1.1 J**
Bromoform	80	NM	NM	NM	NM	<0.5	<0.1	<0.5	<0.1	<0.5
Carbon Disulfide	9	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<2.0
Carbon Tetrachloride	5	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Chlorobenzene	100	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Chloroethane	48	NM	<0.2	<0.1	<0.2	<0.5	<0.1	**4.9**	**6.1**	**1.7 J**
Chloroform	80	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
cis-1,2-Dichloroethene	70	NM	**290**	**130**	**220**	**350**	**110**	**280**	**350**	**550**
Ethylbenzene	700	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Isopropylbenzene	224	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Methyl Tertiary Butyl Ether	20	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Methylene Chloride	5	NM	**0.5 JB**	**0.6 B**	<0.4	**1.1 BJ**	<0.2	<1.0	<0.2	**1.9 BJ**
Naphthalene	3	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
n-Butylbenzene	21	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Styrene	100	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Tetrachloroethene	5	NM	**31**	**11**	**22**	**6.5**	**1.2**	**1.6**	**1.6**	**3.1**
Toluene	1,000	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
trans-1,2-Dichloroethene	100	NM	**2**	**0.7**	**1.4**	**3.1**	**2.5**	**2.6**	**1.8**	**3.8**
Trichloroethene	5	NM	**47**	<0.1	**44**	**35**	**4.9**	**5.7**	**8.1**	**20**
Trichlorofluoromethane	25,200	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5
Vinyl Acetate	N/A	NM	<0.4	<0.2	<0.4	<1.0	<0.2	<1.0	<0.2	<1.0
Vinyl Chloride	2	NM	**0.9 J**	**0.3 J**	**2.3**	**7.0**	**2.8**	**3.4**	**19**	**81**
Xylenes,Total	10,000	NM	<0.2	<0.1	<0.2	<0.5	<0.1	<0.5	<0.1	<0.5

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.
mg/L - Milligrams per liter.
NM - Not measured.

Table 9 - Volatile Organic Compound Results (Continued)
Former Unocal Chemical Distribution Facility, Wichita, Kansas
February 2006 through August 2008

Location	Residential KDHE Screening Value	TW-4 Upgradient								
		Feb-06	Jan-07	Mar-07	Jun-07	Oct-07	Dec-07	Mar-08	Jul-08	Aug-08
Volatile Organic Compounds (mg/L)										
1,1,1-Trichloroethane	200	<0.2	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
1,1,2-Trichloroethane	5	<0.2	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
1,1-Dichloroethane	340	**130**	NM	NM	**31**	**23**	**15**	**23**	**4.4**	**9.4**
1,1-Dichloroethene	7	<0.3	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
1,2,4-Trimethylbenzene	5	**770**	NM	NM	**69**	**8.3**	**2.7**	**1.1**	**0.6**	**1 J**
1,2-Dichlorobenzene	600	**10**	NM	NM	**12**	**11**	**10**	**11**	**5.6**	**12**
1,2-Dichloroethane	5	**5.6**	NM	NM	**5.4**	**5.3**	**3.9**	**4.3**	**1.2 JH**	**2.9**
1,3,5-Trimethylbenzene	5	**190**	NM	NM	**130**	**73**	**31**	**6.3**	**2.6**	**4.2**
2-Butanone	820	<0.2	NM	NM	<10	**7.0**	**8.9**	<5.0	**3.4 J**	<5.0
4-Methyl-2-Pentanone	70	**0.72 J**	NM	NM	<10	<5.0	<5.0	<5.0	<1.0	<5.0
Acetone	260	<0.7	NM	NM	<30	<15	<15	<15	**6**	<15
Benzene	5	**76 JL**	NM	NM	**69**	**62**	**52**	**40**	**7.4**	**22**
Bromoform	80	NM	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
Carbon Disulfide	9	<0.2	NM	NM	<1.0	<0.5	0.7	<0.5	<0.4	<2.0
Carbon Tetrachloride	5	<0.2	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
Chlorobenzene	100	**0.21 J**	NM	NM	<1.0	<0.5	<0.5	<0.5	**0.2 J**	<0.5
Chloroethane	48	**95**	NM	NM	**69**	**64**	**52**	**55**	**9.7**	**26**
Chloroform	80	<0.3	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
cis-1,2-Dichloroethene	70	**7.9**	NM	NM	**1.6 J**	**5.2**	**1.4**	**6.3**	**1.1**	**1.1 J**
Ethylbenzene	700	**170**	NM	NM	**51**	**47**	**38**	**34**	**4.5**	**20**
Isopropylbenzene	224	**65 JL**	NM	NM	**67**	**75**	**72**	**57**	**7.5**	**64**
Methyl Tertiary Butyl Ether	20	<0.2	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
Methylene Chloride	5	<0.5	NM	NM	**6.6**	**1.3 B**	**1.4 B**	**4.3**	**0.3 BJ**	**2.4 BJ**
Naphthalene	3	**310**	NM	NM	**430**	**350**	**310**	**240**	**15**	**83**
n-Butylbenzene	21	**20 JH**	NM	NM	**18**	**19**	**18**	**17**	<0.1	**18**
Styrene	100	<0.2	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
Tetrachloroethene	5	<0.3	NM	NM	<1.0	<0.5	<0.5	<0.5	**0.1 J**	<0.5
Toluene	1,000	**7.2**	NM	NM	**2.6 J**	**2.0**	**1.4**	**1.1**	**0.2 J**	**0.8 J**
trans-1,2-Dichloroethene	100	**2 J**	NM	NM	<1.0	**0.9 JL**	**0.6**	**0.8**	**0.2 J**	<0.5
Trichloroethene	5	**0.44 J**	NM	NM	<1.0	**0.9**	<0.5	<0.5	**0.2 J**	<0.5
Trichlorofluoromethane	25,200	<0.2	NM	NM	<1.0	<0.5	<0.5	<0.5	<0.1	<0.5
Vinyl Acetate	N/A	<0.2	NM	NM	<2.0	<1.0	<1.0	<1.0	<0.2	<1.0
Vinyl Chloride	2	**36 JL**	NM	NM	**4.6 J**	**9.7**	**3.6**	**21**	**1.6**	**2.3 JL**
Xylenes,Total	10,000	**102**	NM	NM	**13**	**2.5**	**0.8**	**0.6**	**0.1 J**	**0.5 J**

Bold indicated detected values.
Shaded values are above the KDHE screening values.
< - Less than method detection limit (MDL).
B - Analyte detected in a blank at a concentration within five times the sample result (ten times for common laboratory contaminants).
J - The analyte was positively identified, the quantitation is an estimation.
L - Result may be biased low.

mg/L - Milligrams per liter.
NM - Not measured.

Figures

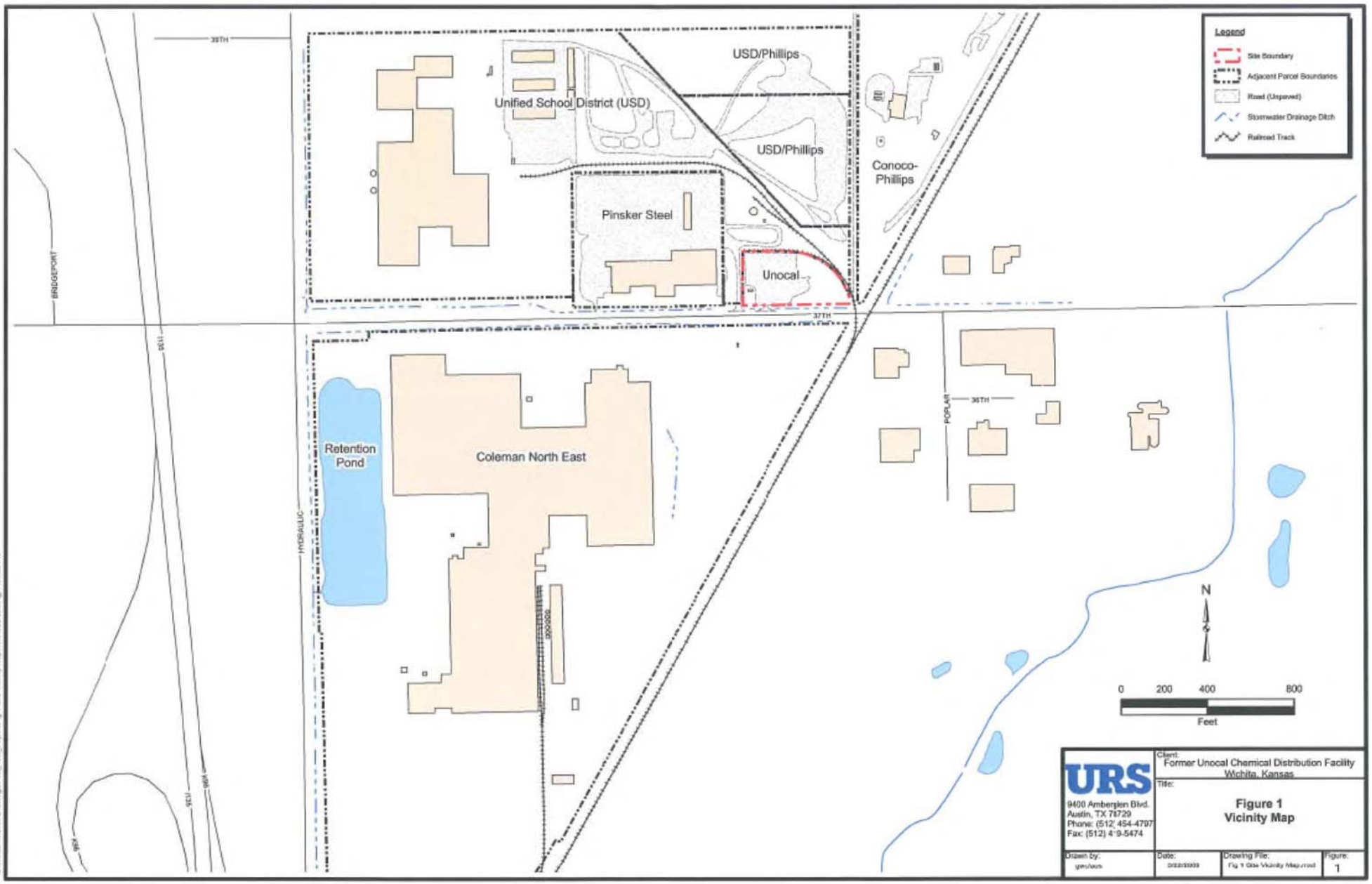
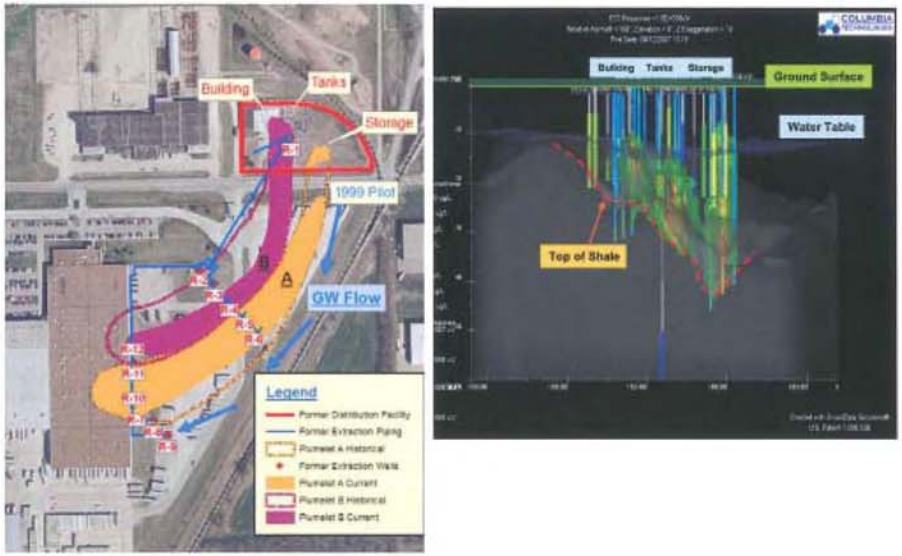
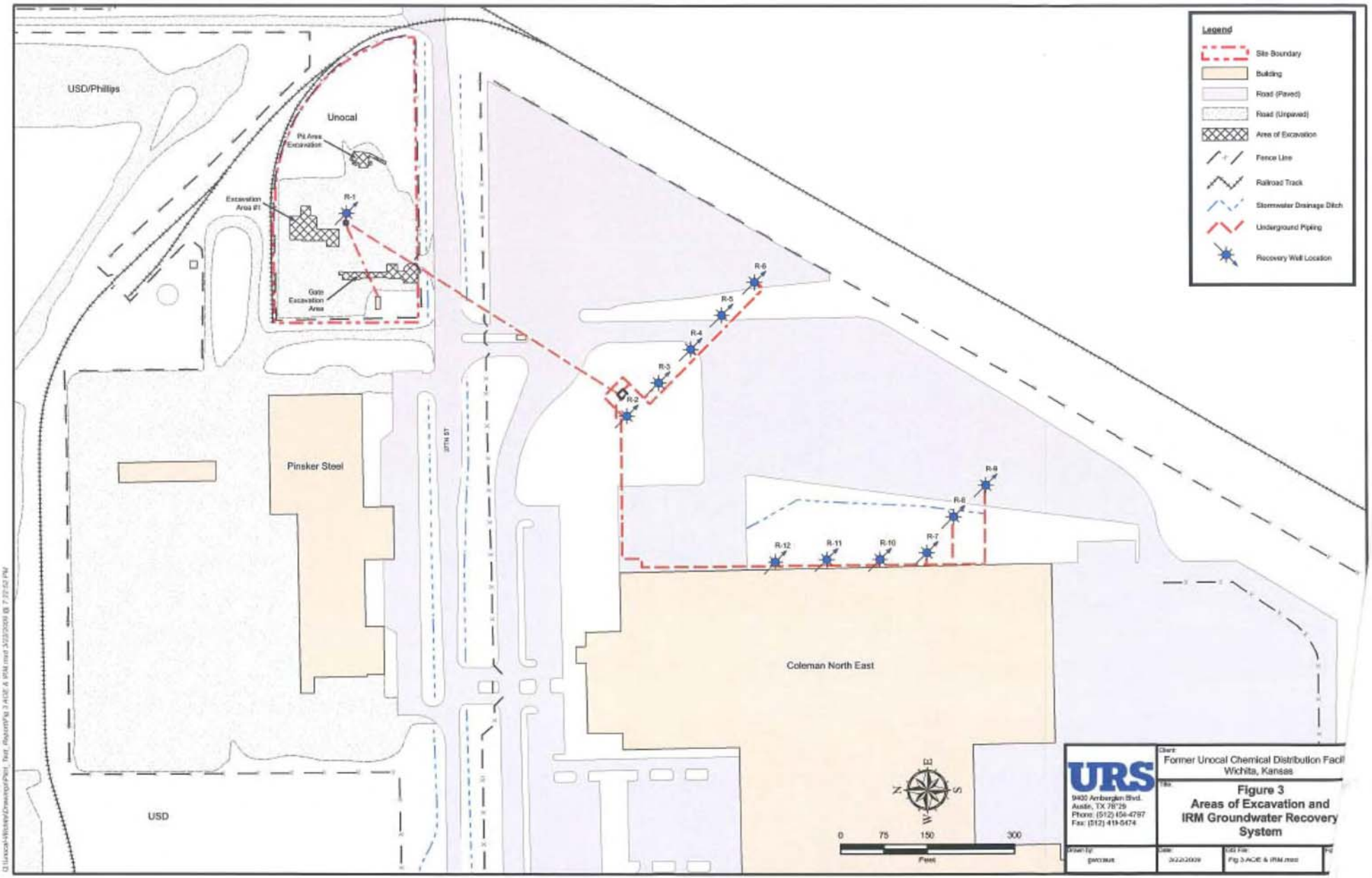
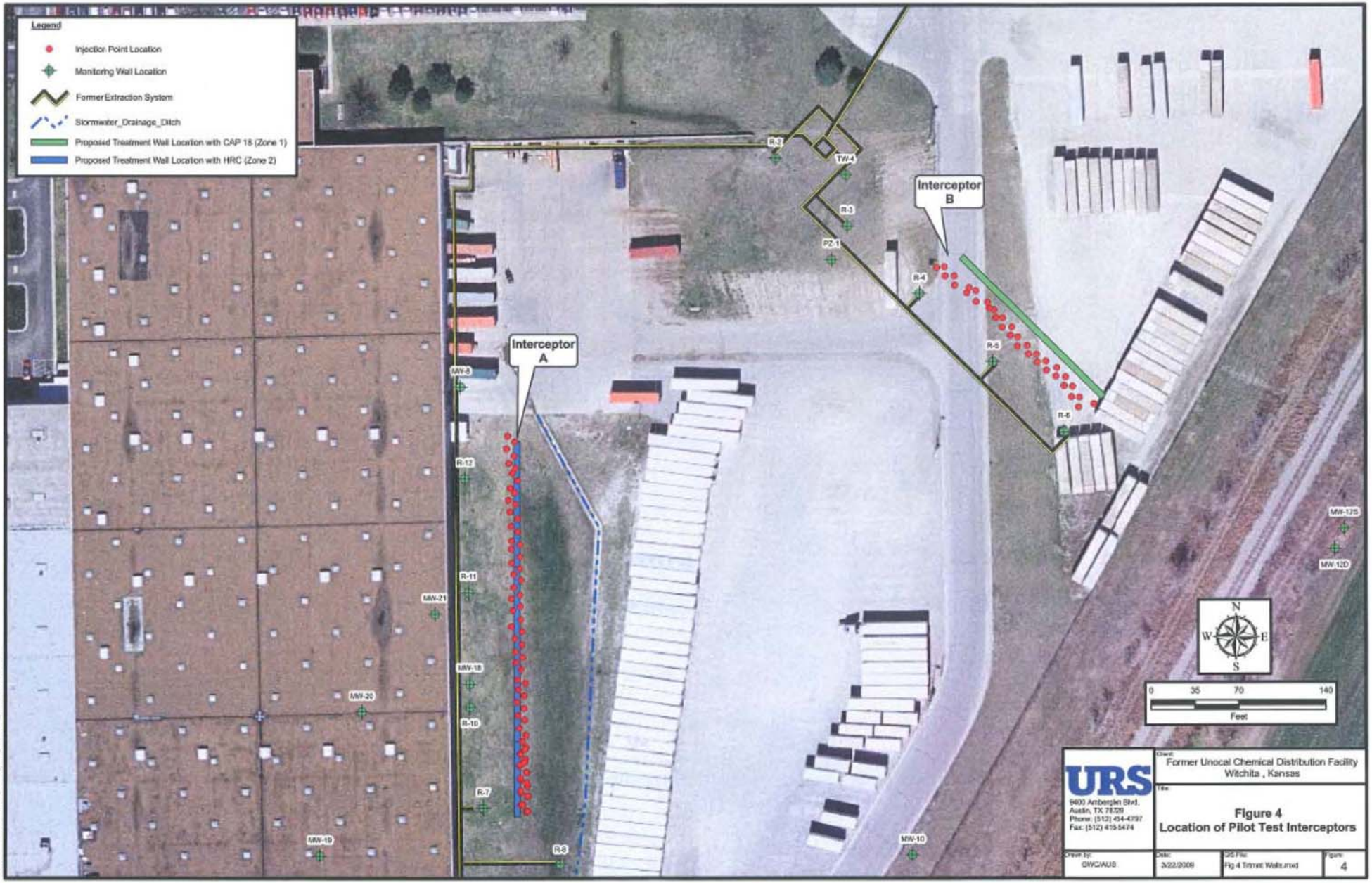

Legend
Site Boundary
Adjacent Parcel Boundaries
Road (Unpaved)
Stormwater Drainage Ditch
Railroad Track
USD/Phillips
Unified School District (USD)
USD/Phillips
Conoco-
Phillips
Pinsker Steel
Unocal
Retention
Pond
Coleman North East
BRIDGEPORT
HYDRAULIC
POPLAR
36TH
37TH
N
0
200
400
800
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 419-5474
Client:
Former Unocal Chemical Distribution Facility
Wichita, Kansas
Title:
Figure 1
Vicinity Map
Drawn by:
Date:
Drawing File:
Figure:
1

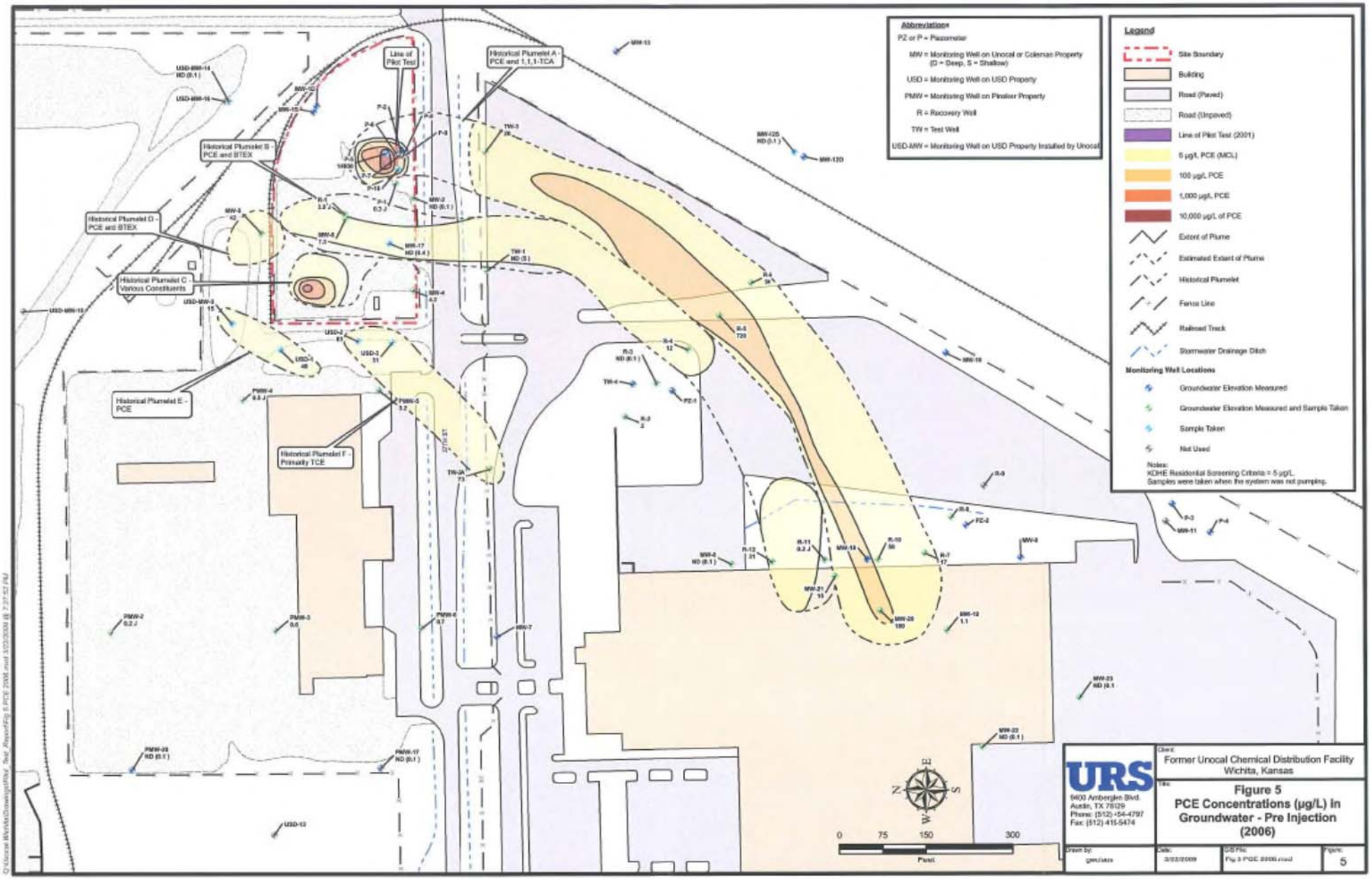
Figure 2. Plan View and Cross Section of the Former Unocal Chemical Distribution Facility

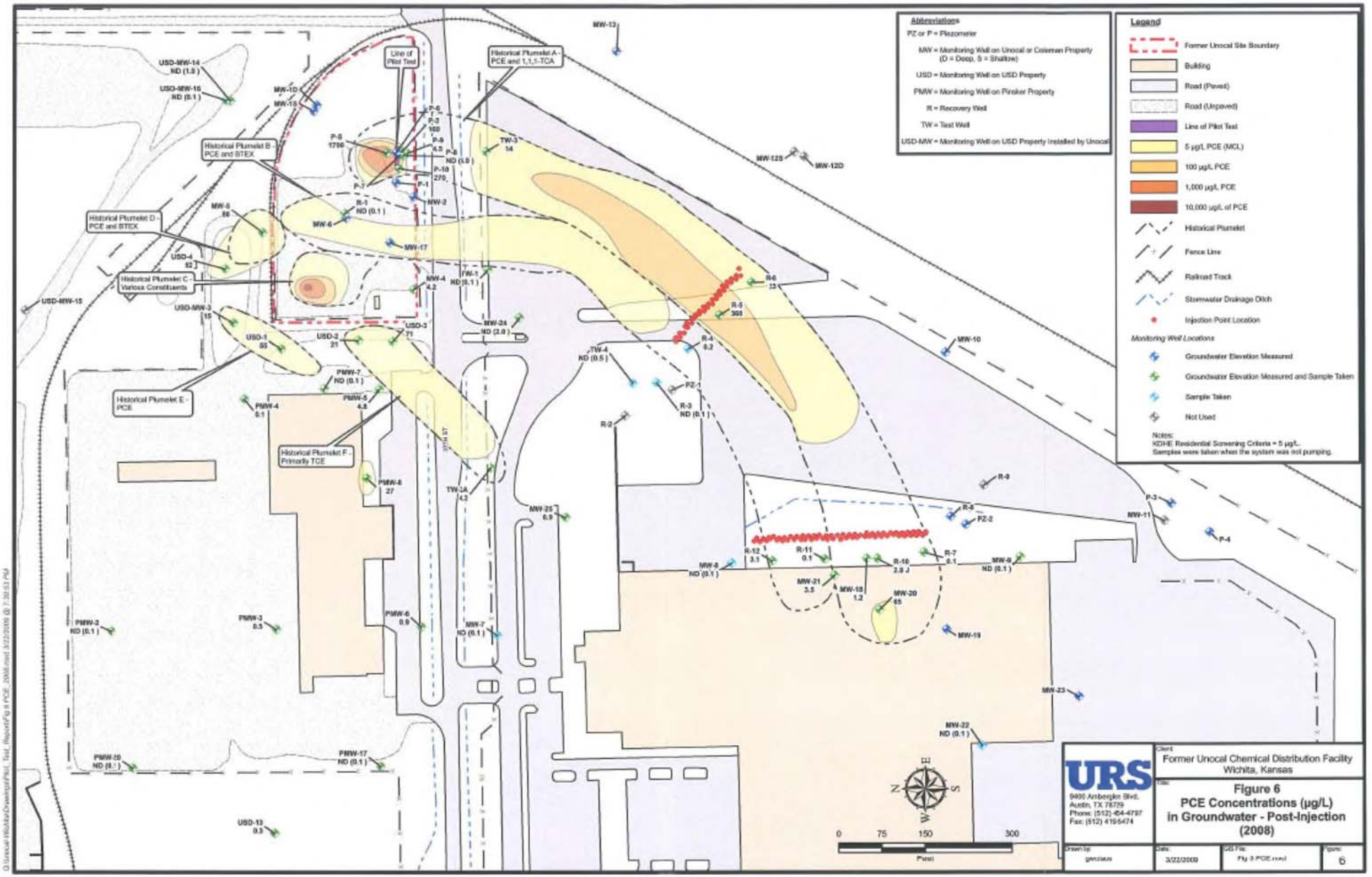


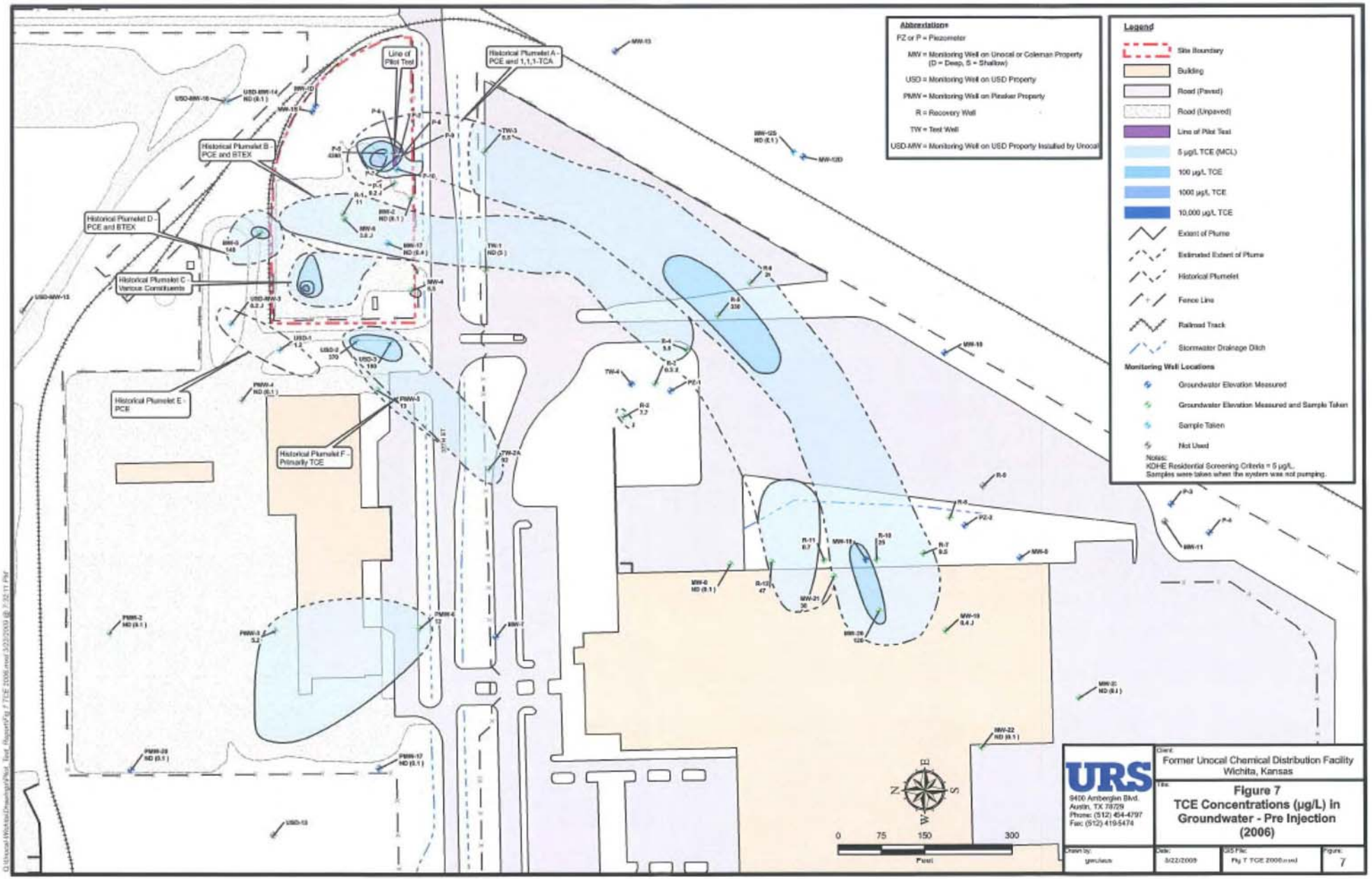

Legend
Site Boundary
Building
Road (Paved)
Road (Unpaved)
Area of Excavation
Fence Line
Railroad Track
Stormwater Drainage Ditch
Underground Piping
Recovery Well Location
USD/Phillips
Unocal
Pit Area Excavation
Excavation Area #1
Gate Excavation Area
R-1
R-2
R-3
R-4
R-5
R-6
R-7
R-8
R-9
R-10
R-11
R-12
Pinsker Steel
25TH ST
Coleman North East
USD
0
75
150
300
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 419-5474
Client:
Former Unocal Chemical Distribution Facil
Wichita, Kansas
Title:
Figure 3
Areas of Excavation and
IRM Groundwater Recovery
System
Drawn by:
gwcaus
Date:
3/22/2009
CAD File:
Fig 3 ACE & IRM.mxd

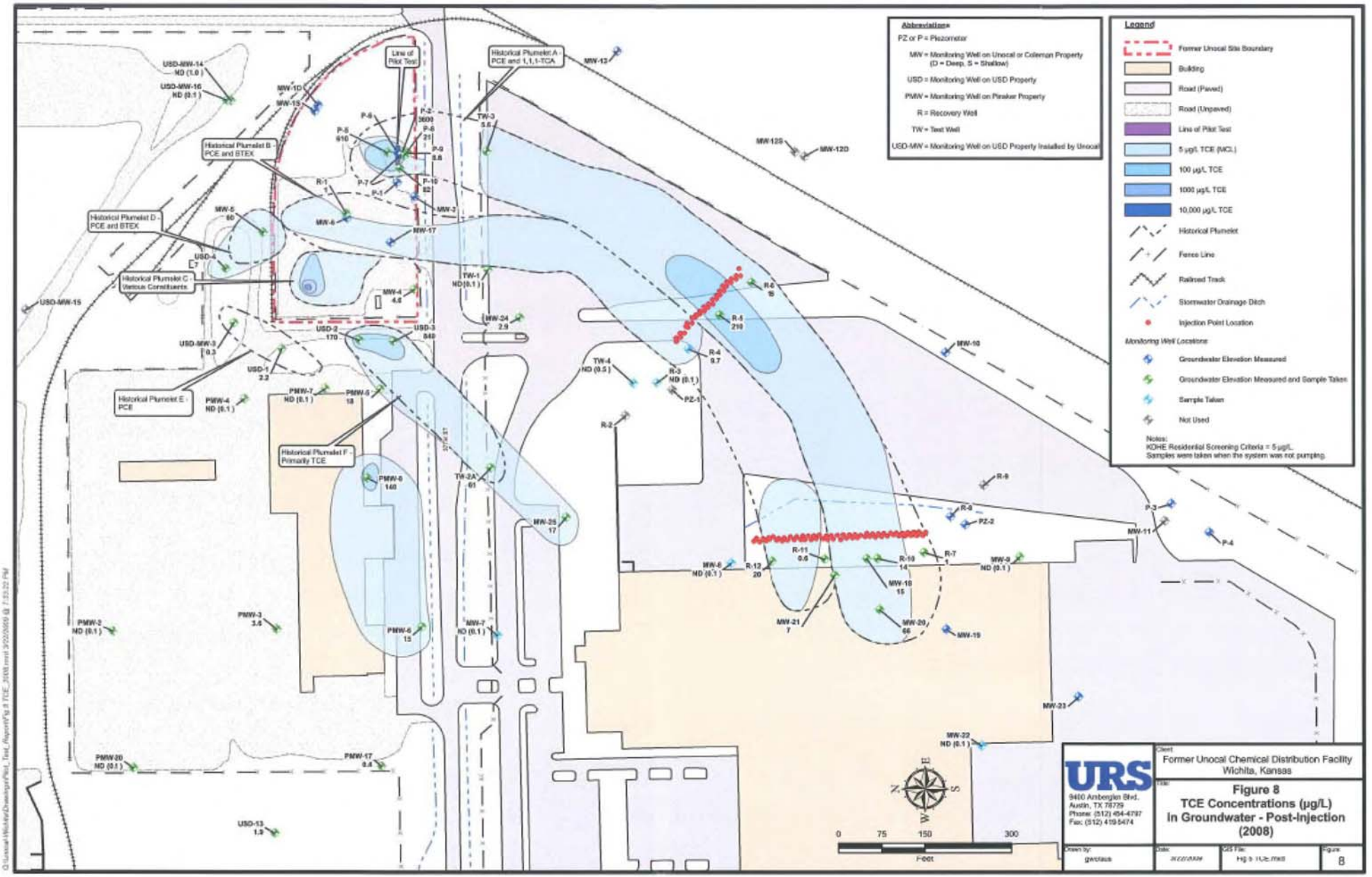


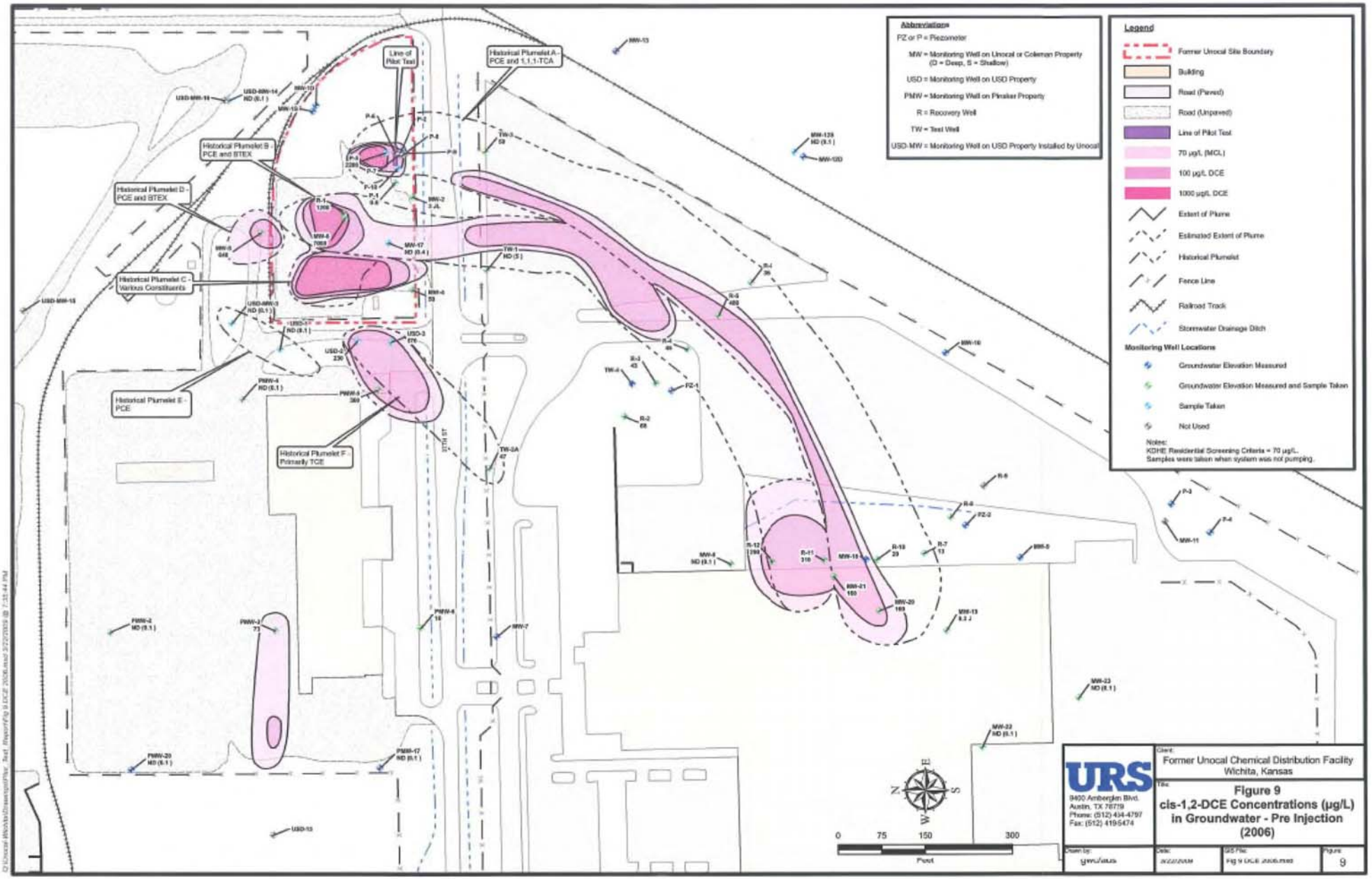
G:\Unocal-Wichita\Drawings\Pilot_Test_Report\Fig 4 Trimmt Walls.mxd

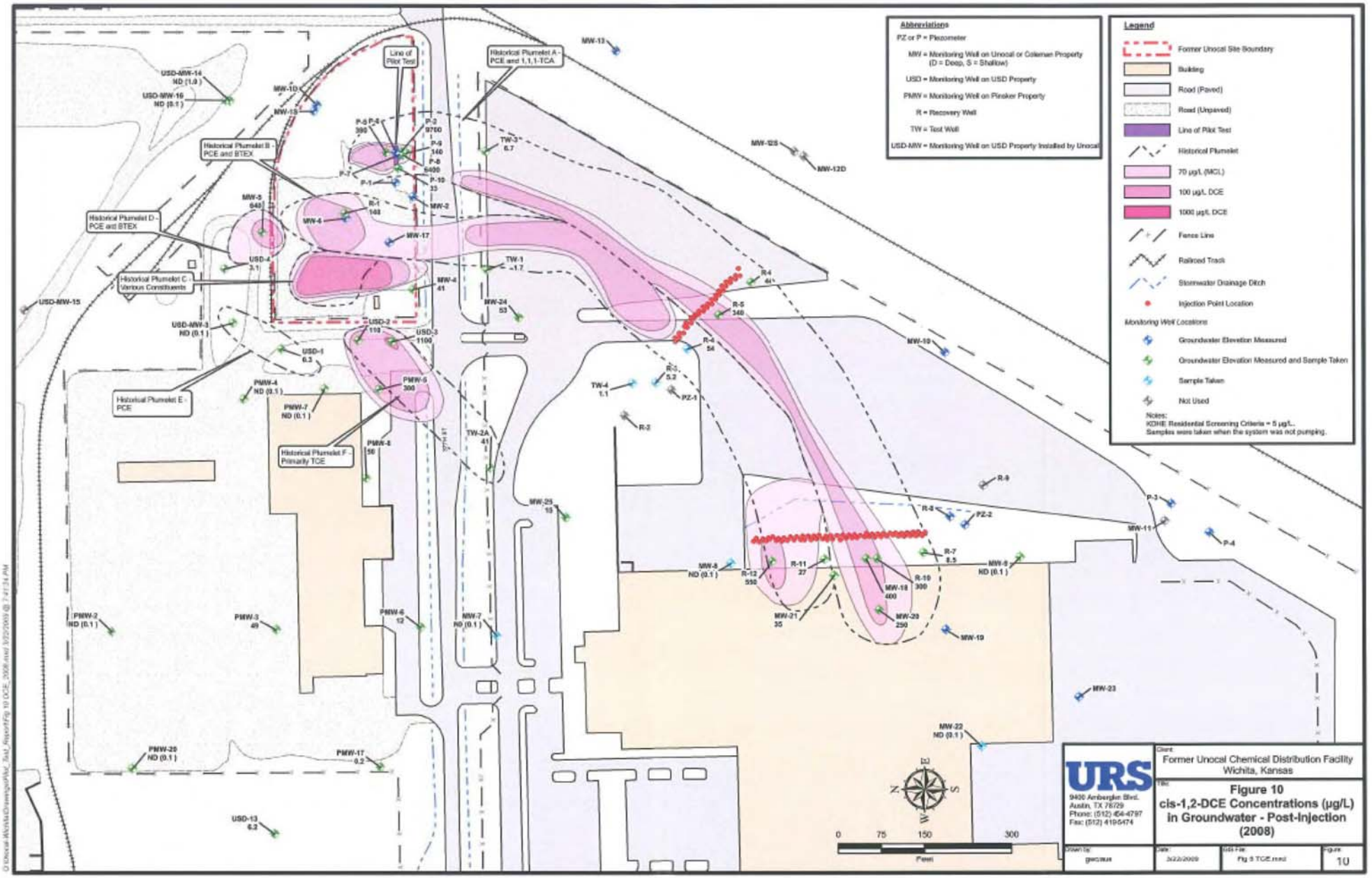

Abbreviations
PZ or P = Piezometer
MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)
USD = Monitoring Well on USD Property
PMW = Monitoring Well on Pinaker Property
R = Recovery Well
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Site Boundary
Building
Road (Paved)
Road (Unpaved)
Line of Pilot Test (2001)
5 µg/L PCE (MCL)
100 µg/L PCE
1,000 µg/L PCE
10,000 µg/L of PCE
Extent of Plume
Estimated Extent of Plume
Historical Plumelet
Fence Line
Railroad Track
Stormwater Drainage Ditch
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
KDHE Residential Screening Criteria = 5 µg/L.
Samples were taken when the system was not pumping.
Line of Pilot Test
Historical Plumelet A - PCE and 1,1,1-TCA
Historical Plumelet B - PCE and BTEX
Historical Plumelet D - PCE and BTEX
Historical Plumelet C - Various Constituents
Historical Plumelet E - PCE
Historical Plumelet F - Primarily TCE
0 75 150 300
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 415-5474
Client:
Former Unocal Chemical Distribution Facility
Wichita, Kansas
Title:
Figure 5
PCE Concentrations (µg/L) in Groundwater - Pre Injection (2006)
Drawn by:
Date:
GIS File:
Figure:
5


Abbreviations
PZ or P = Piezometer
MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)
USD = Monitoring Well on USD Property
PMW = Monitoring Well on Pinsker Property
R = Recovery Well
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Former Unocal Site Boundary
Building
Road (Paved)
Road (Unpaved)
Line of Pilot Test
5 µg/L PCE (MCL)
100 µg/L PCE
1,000 µg/L PCE
10,000 µg/L of PCE
Historical Plumelet
Fence Line
Railroad Track
Stormwater Drainage Ditch
Injection Point Location
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
KDHE Residential Screening Criteria = 5 µg/L.
Samples were taken when the system was not pumping.
Line of Pilot Test
Historical Plumelet A - PCE and 1,1,1-TCA
Historical Plumelet B - PCE and BTEX
Historical Plumelet C - Various Constituents
Historical Plumelet D - PCE and BTEX
Historical Plumelet E - PCE
Historical Plumelet F - Primarily TCE
0 75 150 300
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 419-5474
Client
Former Unocal Chemical Distribution Facility
Wichita, Kansas
Title
Figure 6
PCE Concentrations (µg/L)
in Groundwater - Post-Injection
(2008)
Drawn by
gwcleus
Date
3/22/2009
GIS File
Fig 3 PCE.mxd
Figure
6


Abbreviations
PZ or P = Piezometer
MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)
USD = Monitoring Well on USD Property
PMW = Monitoring Well on Pinaker Property
R = Recovery Well
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Site Boundary
Building
Road (Paved)
Road (Unpaved)
Line of Pilot Test
5 µg/L TCE (MCL)
100 µg/L TCE
1000 µg/L TCE
10,000 µg/L TCE
Extent of Plume
Estimated Extent of Plume
Historical Plumelet
Fence Line
Railroad Track
Stormwater Drainage Ditch
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
KDHE Residential Screening Criteria = 5 µg/L.
Samples were taken when the system was not pumping.
Line of Pilot Test
Historical Plumelet A - PCE and 1,1,1-TCA
Historical Plumelet B - PCE and BTEX
Historical Plumelet C - Various Constituents
Historical Plumelet D - PCE and BTEX
Historical Plumelet E - PCE
Historical Plumelet F - Primarily TCE
0 75 150 300
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 419-5474
Client:
Former Unocal Chemical Distribution Facility
Wichita, Kansas
Title:
Figure 7
TCE Concentrations (µg/L) in Groundwater - Pre Injection (2006)
Drawn by:
Date:
3/22/2009
GIS File:
Fig 7 TCE 2006.mxd
Figure:
7


Abbreviations
PZ or P = Piezometer
MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)
USD = Monitoring Well on USD Property
PMW = Monitoring Well on Pinaker Property
R = Recovery Well
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Former Unocal Site Boundary
Building
Road (Paved)
Road (Unpaved)
Line of Pilot Test
5 µg/L TCE (MCL)
100 µg/L TCE
1000 µg/L TCE
10,000 µg/L TCE
Historical Plumelet
Fence Line
Railroad Track
Stormwater Drainage Ditch
Injection Point Location
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
KDHE Residential Screening Criteria = 5 µg/L.
Samples were taken when the system was not pumping.
Line of Pilot Test
Historical Plumelet A - PCE and 1,1,1-TCA
Historical Plumelet B - PCE and BTEX
Historical Plumelet C - Various Constituents
Historical Plumelet D - PCE and BTEX
Historical Plumelet E - PCE
Historical Plumelet F - Primarily TCE
USD-MW-14 ND (1.0)
USD-MW-16 ND (0.1)
USD-MW-15
USD-MW-3 0.3
MW-1D
MW-1S
P-8
P-2 3600
P-5 610
P-6 21
P-9 0.8
P-10 82
P-7
P-1
R-1 1
MW-2
MW-5 60
MW-6
MW-17
USD-4 7
MW-4 4.8
TW-1 ND (0.1)
USD-2 170
USD-3 840
USD-1 2.2
MW-24 2.9
TW-3 5.6
MW-12
MW-12S
MW-12D
R-6 15
R-5 210
R-4 9.7
TW-4 ND (0.5)
R-3 ND (0.1)
PZ-1
MW-10
R-2
PMW-7 ND (0.1)
PMW-5 18
PMW-4 ND (0.1)
PMW-6 140
TW-2A 61
MW-25 17
R-8
R-9
PZ-2
P-3
MW-11
P-4
R-11 0.6
R-12 20
MW-8 ND (0.1)
R-10 14
R-7 1
MW-9 ND (0.1)
MW-18 15
MW-21 7
MW-20 66
MW-19
MW-7 ND (0.1)
PMW-2 ND (0.1)
PMW-3 3.6
PMW-1 15
MW-23
MW-22 ND (0.1)
PMW-20 ND (0.1)
PMW-17 0.4
USD-13 1.9
N
E
S
W
0
75
150
300
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 419-5474
Client
Former Unocal Chemical Distribution Facility
Wichita, Kansas
Title
Figure 8
TCE Concentrations (µg/L)
In Groundwater - Post-Injection
(2008)
Drawn by: gwolaus
Date: 8/22/2008
GIS File: Fig 8 TCE.mxd
Figure 8


Abbreviations
PZ or P = Piezometer
MW = Monitoring Well on Unocal or Coleman Property (D = Deep, S = Shallow)
USD = Monitoring Well on USD Property
PMW = Monitoring Well on Pinaker Property
R = Recovery Well
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Former Unocal Site Boundary
Building
Road (Paved)
Road (Unpaved)
Line of Pilot Test
70 µg/L (MCL)
100 µg/L DCE
1000 µg/L DCE
Extent of Plume
Estimated Extent of Plume
Historical Plumelet
Fence Line
Railroad Track
Stormwater Drainage Ditch
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
KDHE Residential Screening Criteria = 70 µg/L.
Samples were taken when system was not pumping.
Line of Pilot Test
Historical Plumelet A - PCE and 1,1,1-TCA
Historical Plumelet B - PCE and BTEX
Historical Plumelet D - PCE and BTEX
Historical Plumelet C - Various Constituents
Historical Plumelet E - PCE
Historical Plumelet F - Primarily TCE
37TH ST
0 75 150 300
Feet
URS
8400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 434-4797
Fax: (512) 419-5474
Client:
Former Unocal Chemical Distribution Facility
Wichita, Kansas
Title:
Figure 9
cis-1,2-DCE Concentrations (µg/L) in Groundwater - Pre Injection (2006)
Drawn by:
gwc/aus
Date:
Figure:
9


Abbreviations
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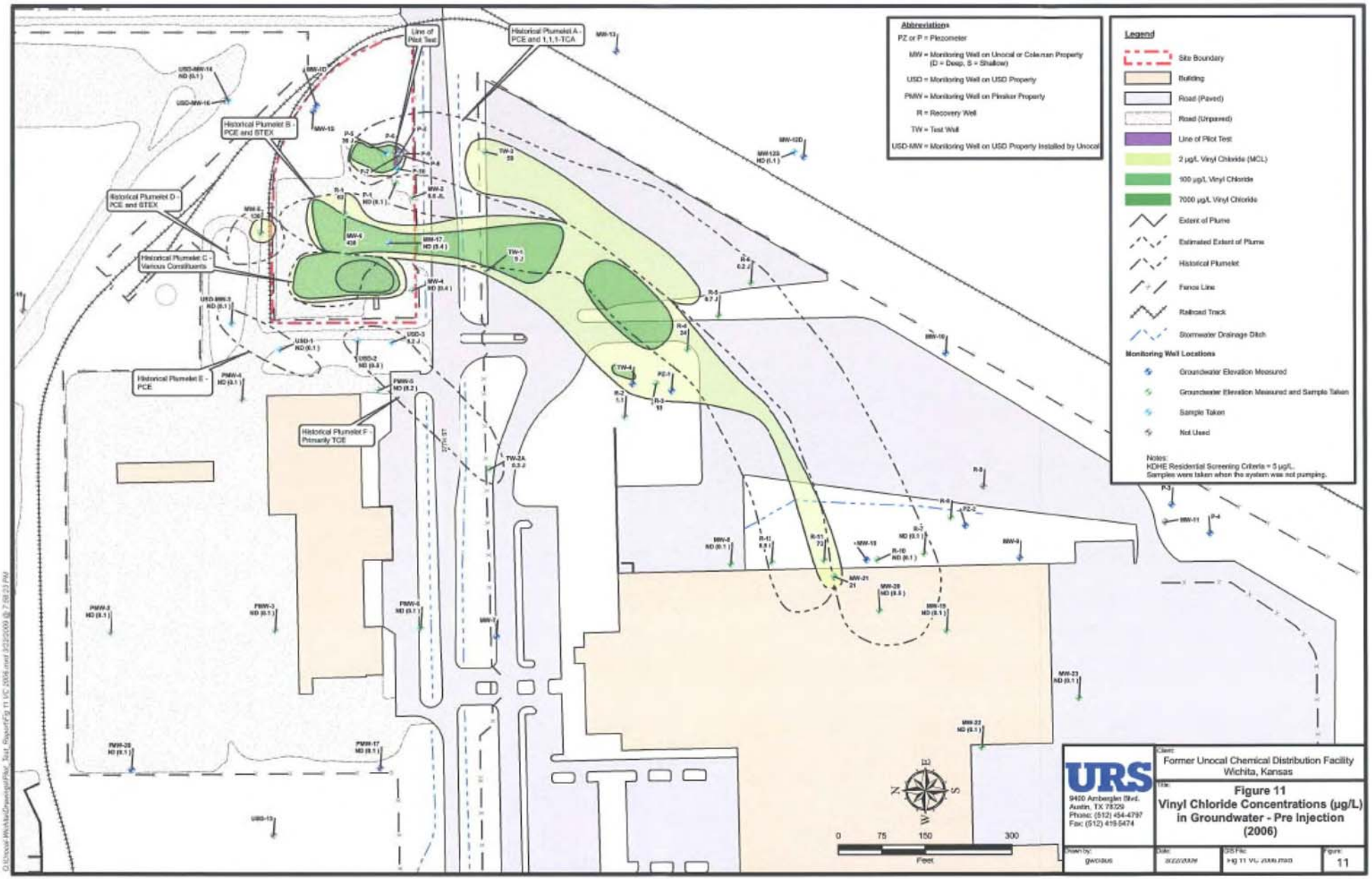
USD = Monitoring Well on USD Property
PMW = Monitoring Well on Plinker Property
R = Recovery Well
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Former Unocal Site Boundary
Building
Road (Paved)
Road (Unpaved)
Line of Pilot Test
Historical Plumelet
70 µg/L (MCL)
100 µg/L DCE
1000 µg/L DCE
Fence Line
Railroad Track
Stormwater Drainage Ditch
Injection Point Location
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
KDHE Residential Screening Criteria = 5 µg/L.
Samples were taken when the system was not pumping.
Line of Pilot Test
Historical Plumelet A - PCE and 1,1,1-TCA
Historical Plumelet B - PCE and BTEX
Historical Plumelet C - Various Constituents
Historical Plumelet D - PCE and BTEX
Historical Plumelet E - PCE
Historical Plumelet F - Primarily TCE
MW-13
MW-10
MW-11
MW-12S
MW-12D
MW-19
MW-23
MW-25
MW-24
MW-17
MW-18
MW-20
MW-21
MW-22
USD-MW-14 ND (1.0)
USD-MW-16 ND (0.1)
USD-MW-15
USD-MW-3 ND (0.1)
USD-1 6.3
USD-2 110
USD-3 1100
USD-4 3.1
USD-13 6.2
PMW-2 ND (0.1)
PMW-3 49
PMW-4 ND (0.1)
PMW-5 300
PMW-6 12
PMW-7 ND (0.1)
PMW-8 50
PMW-17 0.2
PMW-20 ND (0.1)
MW-1D
MW-1S
MW-2
MW-3 640
MW-4 41
MW-5 ND (0.1)
MW-6 ND (0.1)
MW-7 ND (0.1)
MW-8 ND (0.1)
MW-9 ND (0.1)
P-1
P-2 9750
P-3 390
P-4
P-5
P-6 5400
P-7
P-8 140
P-9 33
P-10
R-1 168
R-2
R-3 5.2
R-4 54
R-5 140
R-7 8.5
R-8
R-9
R-10 300
R-11 27
R-12 550
PZ-1
PZ-2
TW-1 1.7
TW-2A 41
TW-3 6.7
TW-4 1.1
0 75 150 300
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 419-5474
Client: Former Unocal Chemical Distribution Facility Wichita, Kansas
Title: Figure 10 cis-1,2-DCE Concentrations (µg/L) in Groundwater - Post-Injection (2008)
Drawn by: gwc/aux
Date: 3/22/2009
Sub File: Fig 9 TCE.mxd
Figure: 10


Abbreviations
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USD = Monitoring Well on USD Property
PMW = Monitoring Well on Pinaker Property
R = Recovery Well
TW = Test Well
USD-MW = Monitoring Well on USD Property Installed by Unocal
Legend
Site Boundary
Building
Road (Paved)
Road (Unpaved)
Line of Pilot Test
2 µg/L Vinyl Chloride (MCL)
100 µg/L Vinyl Chloride
7000 µg/L Vinyl Chloride
Extent of Plume
Estimated Extent of Plume
Historical Plumelet
Fence Line
Railroad Track
Stormwater Drainage Ditch
Monitoring Well Locations
Groundwater Elevation Measured
Groundwater Elevation Measured and Sample Taken
Sample Taken
Not Used
Notes:
KDHE Residential Screening Criteria = 5 µg/L.
Samples were taken when the system was not pumping.
Line of Pilot Test
Historical Plumelet A - PCE and 1,1,1-TCA
Historical Plumelet B - PCE and BTEX
Historical Plumelet C - Various Constituents
Historical Plumelet D - PCE and BTEX
Historical Plumelet E - PCE
Historical Plumelet F - Primarily TCE
MW-13
MW-12D
MW-12S
MW-10
MW-11
MW-9
MW-8
MW-7
MW-6
MW-5
MW-4
MW-3
MW-2
MW-1D
MW-1S
MW-14
MW-15
MW-16
MW-17
MW-18
MW-19
MW-20
MW-21
MW-22
MW-23
TW-1
TW-2
TW-2A
TW-3
TW-4
R-1
R-2
R-3
R-4
R-5
R-6
R-7
R-8
R-9
R-10
R-11
R-12
PZ-1
PZ-2
P-1
P-2
P-3
P-4
P-5
P-6
P-7
P-8
P-10
USD-MW-14
USD-MW-15
USD-MW-16
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USD-1
USD-2
USD-3
USD-13
PMW-1
PMW-2
PMW-3
PMW-4
PMW-5
PMW-6
PMW-17
PMW-20
MW-2D
MW-123
MW-5
MW-17
MW-4
MW-18
MW-20
MW-19
MW-21
MW-22
MW-23
N
S
W
0
75
150
300
Feet
URS
9400 Amberglen Blvd.
Austin, TX 78729
Phone: (512) 454-4797
Fax: (512) 419-5474
Client:
Former Unocal Chemical Distribution Facility
Wichita, Kansas
Title:
Figure 11
Vinyl Chloride Concentrations (µg/L) in Groundwater - Pre Injection (2006)
Drawn by:
gwobus
Date:
Figure:
11

Appendix A

1999 Pilot Test Report

Examination of Long Term Effectiveness of a Reductive Dechlorination Barrier in Groundwater

Dong X. Li (dxli@chevron.com) (Chevron, Richmond, California)
Michael P. Mailloux (Chevron, San Ramon, California)

ABSTRACT: To accelerate the natural reductive dechlorination process of chlorinated hydrocarbons such as tetrachloroethene (PCE) and trichloroethene (TCE) in groundwater, an organic compound (hydrogen releasing compound or HRC) was injected into an aquifer six years ago in a pilot test. Using a direct-push technique, the organic compound was injected in an array to form a reactive barrier across the groundwater flow gradient. The concentrations of PCE and TCE in groundwater from the downgradient wells decreased rapidly following the injection of the organic compound. The PCE concentrations down-gradient from the reactive barrier dropped by approximately 95 percent within 2 months of the injection and continued to decrease over time. A temporary rise in the concentrations of dechlorination daughter compounds such as cis-1,2-dichloroethene (cis-1,2-DCE), vinyl chloride, and ethene was observed in association with the decrease in concentration of PCE and TCE in these downgradient wells. The down-gradient PCE concentrations eventually dropped below the analytical detection limit, even as the PCE concentration up-gradient of the reactive barrier remained relatively stable after five years. The concentrations of PCE and all its dechlorination daughter compounds remain low after six years in all the down-gradient wells. This approach has a much lower cost to implement and maintain compared to a pump and treat system. It is a preferred remedial alternative for the site.

INTRODUCTION

Reductive dechlorination is an effective and well understood process to degrade chlorinated hydrocarbons in a subsurface environment (Vogel *et al.*, 1987). There are various engineered approaches to promote reductive dechlorination by creating a reducing environment in the subsurface through injection/infiltration of an organic carbon compound (South *et al.*, 2001) or construction of zero-valence barriers. Direct injection and/or infiltration of an organic carbon compound is often the low cost alternative comparing to the construction of a zero-valence wall to form a reductive dechlorination barrier for containment and remediation of a chlorinated hydrocarbon plume. However, the overall economics of using one of these approaches is directly related to the frequency of reintroduction of these organic compounds required to achieve and maintain the plume containment in the subsurface. Because this is a fairly recent development, there are limited data available in the literature as to the long term effectiveness of this injected compound.

The long term effectiveness of a commercially available organic compound (HRC by Regenesis) on a chlorinated hydrocarbon plume (mainly PCE) is examined here by revisiting a location where a pilot study was performed over 6 years ago (South *et al.*,

2001). The pilot test was conducted at a former chemical distribution facility, which was closed down after 40 years of operation. Previous investigations had identified areas with individual petroleum and chlorinated hydrocarbons sources contributing to co-mingled groundwater plumes (Li *et al.*, 2000). The contaminant sources included ones containing strictly chlorinated hydrocarbons and the others containing a mixture of petroleum/chlorinated hydrocarbons. Over time in the areas with a mixture of petroleum/chlorinated hydrocarbons, significant reduction in both petroleum and chlorinated hydrocarbons was observed. Petroleum hydrocarbons have appearently become the electron donors to facilitate reductive dechlorination of chlorinated hydrocarbons. In areas with only chlorinated hydrocarbons, the degradation of chlorinated hydrocarbons occurred only gradually over time. Examples from selected monitoring wells at the site are shown in Figure 1 in a semilog plot.

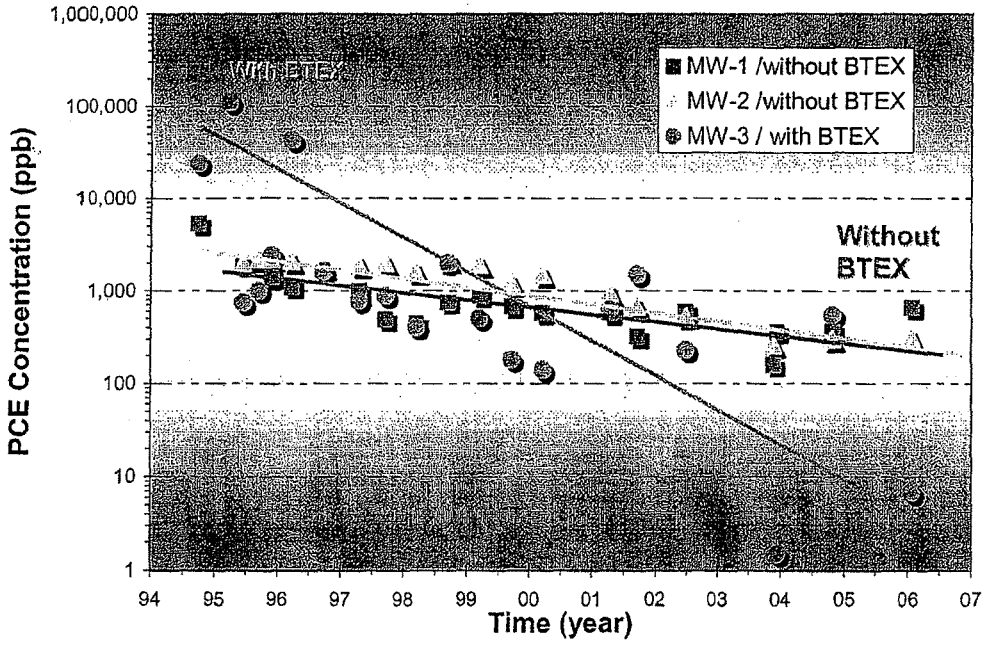

FIGURE 1. A semilog plot of PCE concentrations over time at three locations at the site, showing the effect of BTEX (benzene, toluene, ethylbenzene, and xylenes) on the PCE concentrations.

The original pilot test area is downgradient of a localized source that contains mostly tetrachloroethene (PCE). Prior to the pilot test only PCE and its dechlorinated daughter compounds were found. The geologic condition at the test plot area consists of 25 feet of silty clay with effective porosity of roughly 10% overlaying a weathered claystone. Groundwater flows south with a gradient of 0.01 and a seepage velocity of 0.5 feet per day. Because of the low solubility of PCE, the trapped and absorbed PCE in the clayey soil matrix dissolves only gradually into groundwater over time, feeding a PCE plume

that can persist for a long period of time. The persistent nature of this PCE plume makes a pump-and-treat approach ineffective as a clean-up method and very costly in the long run. Reductive dechlorination through injection of an organic compound can be an attractive alternative to the pump-and-treat approach. The shallow groundwater, which has fluctuated between 7 feet and 10 feet below ground surface, also is suitable for injection using a direct-push method.

MATERIALS AND METHODS

The goal of injecting an organic compound into the subsurface is to provide a carbon substrate or an electron donor to promote reductive dechlorination of PCE and its daughter compounds (TCE, DCE, and vinyl chloride). The amount of the injected organic compound and its dissolution in the groundwater should be sufficient to react with the existing level of chlorinated hydrocarbons, while the rate of dissolution of the organic compound into the groundwater should be similar to the slow dissolution rate of PCE, so that it can be effective for a long period of time after the injection. At the time of the initial pilot test, HRC (hydrogen release compound) was one of the few commercially available organic compounds that were tailored for reductive dechlorination in the subsurface environment. HRC is a glycerol polylactate ester that will dissolve and degrade in groundwater slowly over time (Koenigsberg and Farone 1999).

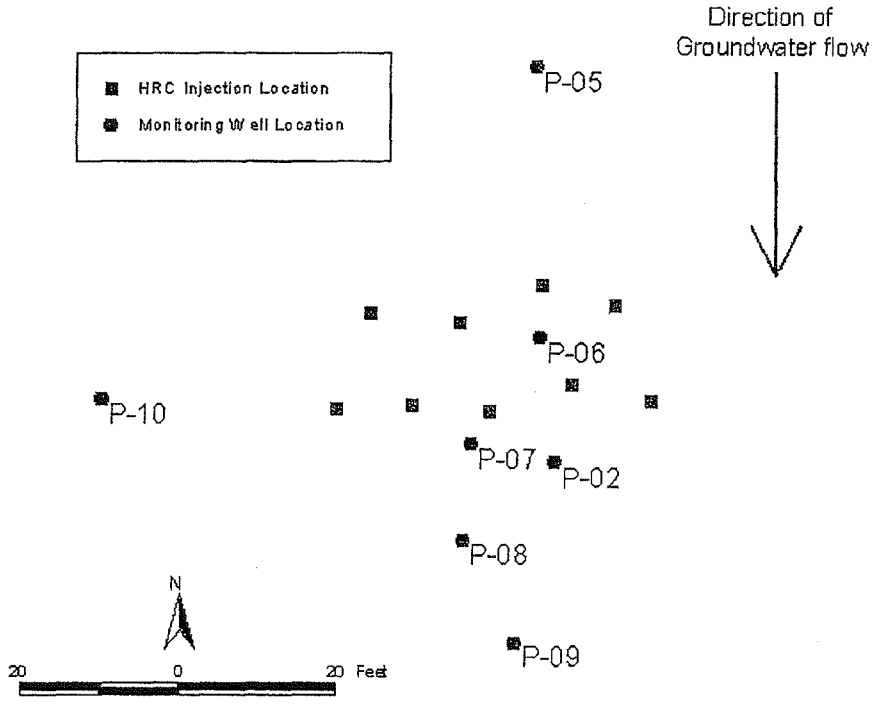

FIGURE 2. A plan view of the pilot test layout. The red circles show the monitoring well locations. The blue squares show the HRC injection locations.

The injection was carried out by using a direct-push rig (Strataprobe). There were nine injection points spaced at roughly 15 ft apart, forming two rows that were perpendicular to the direction of the groundwater flow (Figure 2). The thick organic liquid of polylactate ester was thinned with glycerol and pumped through the push rod in 1-foot intervals from 30 feet to 5 feet depth as the rod was withdrawn. Approximately 0.5 gallon of the organic mixture was injected in each 1 foot interval.

Total 7 groundwater sampling wells were used to monitor the change in trace chemical composition in the groundwater for the pilot test. The monitoring well locations relative to the injection locations are shown in Figures 2 and 3. The six wells (P-05 through P-10) were screened between 5 ft and 15 ft depth, which were installed for the pilot test prior to the injection. Well P-05 was set as the up-gradient well. Well P-06 was set in the center of the injection array, and Wells P-07, P-08, and P-09 were set down-gradient of the injection array to monitor effect with distance. Well P-10 was set laterally to the array to assess the cross-gradient effect of the injected organic barrier. An existing well (P-02), which was screened between 8 ft and 23 ft depth, was used to monitor the effects on the deeper zones of the site.

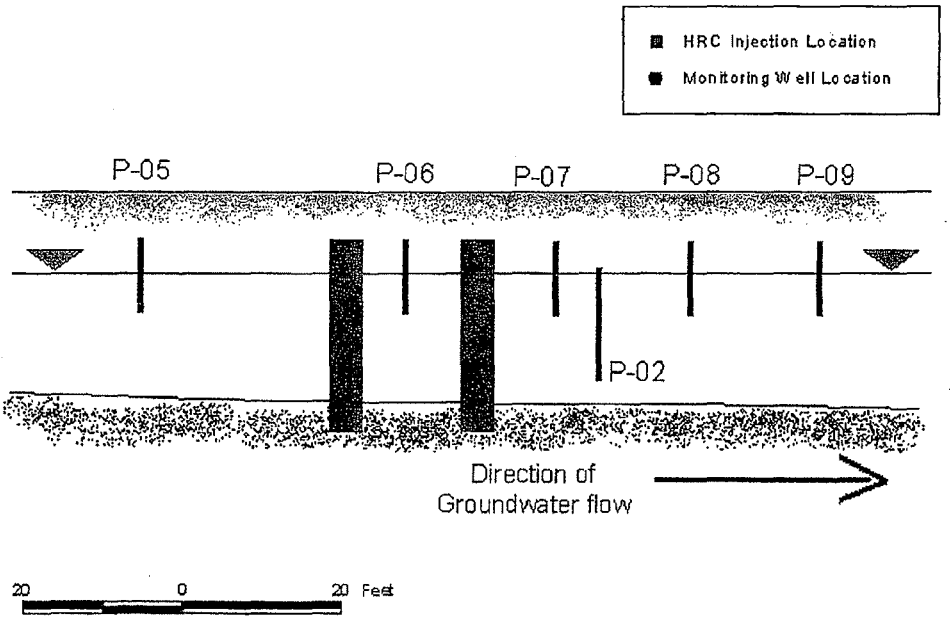

FIGURE 3. A cross-section view of the pilot test layout. The red bars show the screened interval of the monitoring wells. The blue bars show the injection column.

The groundwater was sampled through the 7 monitoring wells prior to the injection and then monthly for the initial 4 months following the injection. Additional sampling and analysis were performed at various frequencies as shown in Tables 1 and 2. The groundwater samples were analyzed for chlorinated hydrocarbons, dissolved gases, as well as organic acids.

RESULTS AND DISCUSSION

The effort of HRC injection on the chlorinated hydrocarbons in the groundwater was rapid. Concentration reduction of highly chlorinated compounds (PCE and TCE) as well as the concentration increase of dechlorinated daughter compounds (DCE, and vinyl chloride) was observed in all down-gradient wells within the first month (Table 1). Even for the most distant monitoring point P-09, the impact was significant: over 50% drop in PCE level and 10-fold increase in cis-1,2-DCE concentration. Detection of small molecule fatty acids (acetic and propionic acids) within the first month also indicates that injected organic compounds have reached P-09 (Table 2). Since P-09 is 30 ft down-gradient from the closest injection point, much beyond the estimated groundwater travel distance based on the average seepage velocity of 0.5 ft per day, the injection process of push liquid into the pore space may have played a role in the rapid transport process. However, no significant change of terms of PCE dechlorination was observed in the up-gradient well P-05 or in the cross-gradient well P-10. No fatty acids were detected in P-05 or P-10 during the six year period.

TABLE 1. Concentrations (in microgram/liter) of PCE and its dechlorinated daughter products from the 7 monitoring wells over time. HRC was injected in September 1999.

Sampling Date		9/99	10/99	11/99	12/99	1/00	3/00	5/00	9/00	11/04	1/06
P-10 cross-gradient well	PCE	5300	2600	610	2200	2000	940	1200	500	2500	630
	TCE	200	120	72	110	120	42	84	67	880	220
	cis-1,2-DCE	140	98	95	100	97	24	62	47	460	150
	VC	<100	<10	3.5	<1.0	1.2	<1.0	<1.0	<1	5	3.2
P-05 up-gradient well	PCE	35000	49000	55000	45000	45000	10000	8300	47000	15000	37000
	TCE	2600	4000	4400	3900	3100	990	560	3200	4200	9900
	cis-1,2-DCE	1400	2500	3800	3700	4100	710	370	3000	1600	5000
	VC	250	240	120	110	290	170	160	130	42	170
	Ethene	<10	<20	<20	<20	<20	<10	<20	<30		
P-06 between injection points	PCE	6000	150	360	700	960	1700	940	230	<1	3.1
	TCE	1100	120	370	960	2100	5200	1300	680	9	2.4
	cis-1,2-DCE	550	5200	11000	12000	24000	21000	12000	5300	280	9.6
	VC	290	380	1500	1200	2800	2100	4100	1500	50	4.4
	Ethene	<10	<30	<20	<20	21	44	203	880		
P-07 down-gradient well	PCE	6500	210	160	180	250	270	430	310	<1	<1
	TCE	840	68	210	200	540	1300	2200	410	<1	<1
	cis-1,2-DCE	560	3900	8000	10000	15000	12000	14000	8900	140	510
	VC	160	140	390	360	1100	540	2200	770	37	<1
	Ethene	<10	<20	<20	<20	<10	89	180	240		
P-02 deep down-gradient well	PCE	6400	4800	510	2700	1700	2600	1800	41	<1	20
	TCE	1400	890	960	2300	3300	1800	8200	240	31	1600
	cis-1,2-DCE	490	1800	6100	6500	10000	7800	7000	17000	310	8800
	VC	180	510	280	390	880	3600	1300	2400	80	710
	Ethene	<10	<10	<30	<20	25	373	243	140		
P-08 down-gradient well	PCE	9000	950	140	56	31	35	46	47	<1	<1
	TCE	1300	140	220	40	80	60	370	350	<1	<1
	cis-1,2-DCE	860	4000	5300	4900	9200	5600	5900	5600	4	11
	VC	170	250	930	920	2000	2400	2300	1000	2	20
	Ethene	<10	<20	<30	<20	130	876	1150	580		
P-09 down-gradient well	PCE	3900	1700	140	1600	170	110	49	<5.0	<1	<1
	TCE	640	390	64	310	220	120	210	<5.0	<1	<1
	cis-1,2-DCE	160	1700	1600	1000	1100	1100	1900	430	8	1.4
	VC	<100	120	440	290	530	570	1200	190	5	<1
	Ethene	<10	<20	<30	87	447	580	1200	1310		

Over time, the reductive dechlorination steps propagated down along the groundwater gradient, with the concentrations of intermediate products (cis-1,2-DCE, vinyl chloride, and ethene) reaching a peak level at various down-gradient wells (Table 1). The most surprising result of this pilot test is the long term effectiveness of HRC. The six-month pilot test had to be extended because the organic acids levels continued to increase in the down-gradient wells. Eventually, the organic acid concentrations reached peak levels one year to 18 months after the injection in most of the down gradient wells (Table 2). However, the levels of PCE and all of its daughter compounds continued to decrease after 18 months in all the wells, except the up-gradient well, P-05, and the cross-gradient well, P-10. The concentrations level of PCE eventually dropped below detection limit for all the down-gradient wells after 5 years (Figure 4). The signs of exhaustion of electron donors were first detected in the deep monitoring point, P-02, 6 years after the original injection.

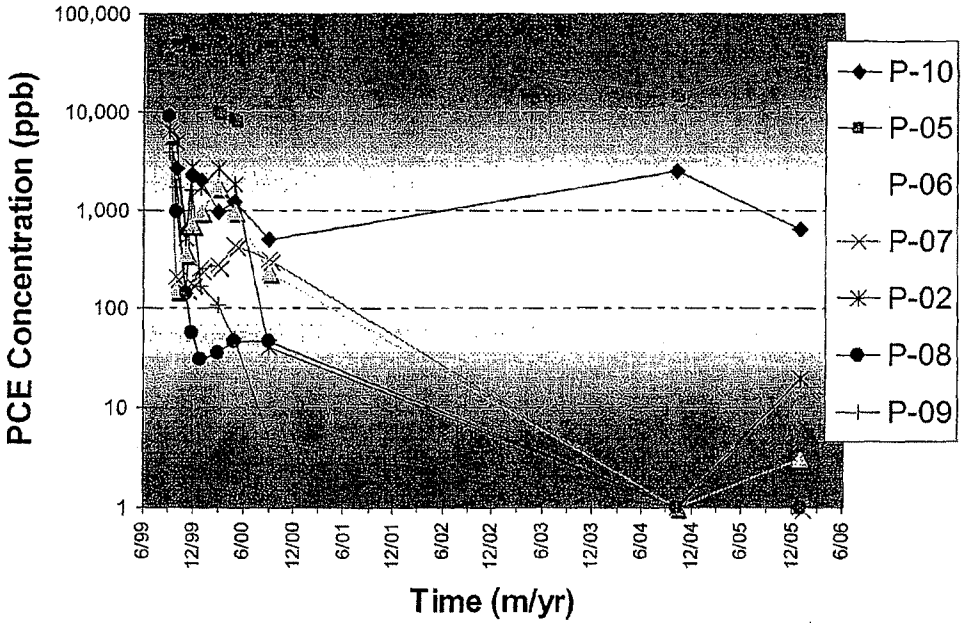

Figure 4. Change of PCE concentrations over time. P-10 is a cross-gradient well; P-05 is up-gradient; P-06 is between injection points; P-02 is a deep down-gradient well; P-07, P-08, and P-09 are down-gradient wells.

The fact that the rebound of chlorinated hydrocarbon levels was first observed in the deep monitoring point can be explained by the difference in the density between chlorinated hydrocarbons and the injected organic compounds. PCE and TCE in their liquid forms are denser than liquid water, whereas lactate ester and glycerol are less dense than water. Therefore any mobile separate phase liquid of HRC will tend to rise in

the water table. As a result, depletion of electron donors is more likely to occur in the deeper zone. This is consistent with the observation that the organic acid concentrations reached the peak levels in the deep down-gradient well, P-02, 6 months after the injection, much earlier than that in the other wells (Table 2). One way to overcome this tendency is to inject more HRC in the deeper zone at this site.

TABLE 2. Concentrations (in microgram/liter) of organic acids from the 5 down-gradient monitoring wells over time following the HRC injection in September 1999.

Collection Date		9/99	10/99	11/99	12/99	1/00	3/00	5/00	9/00	5/01	1/06
P-06	Acetic	<1	125	238	275	258	177	129	384	447	<1
	Butyric	<1	<1	77	86	86	64	72	107	391	<1
	Lactic	<1	48	47	104	162	221	174	112	791	<1
	Propionic	<1	337	623	872	1100	520	569	1190	1060	<1
	Pyruvic	<0.1	0.4	0.3	0.7	<0.1	0.4	<0.1	0.6	2.5	<1
P-07	Acetic	<1	838	379	413	397	354	<1	724	386	<1
	Butyric	<1	557	651	452	381	212	411	1050	517	<1
	Lactic	<1	1620	1120	970	1070	1220	2557	4590	300	<1
	Propionic	<1	375	824	1140	1050	708	1220	1810	785	<1
	Pyruvic	<0.1	3.5	0.6	1.1	<0.1	1.3	<0.1	8.7	2	<1
P-08	Acetic	<1	76	119	297	339	352	189	403	528	0.18
	Butyric	<1	<1	24	99	125	85	103	225	426	<1
	Lactic	<1	<1	<1	<1	<1	54	43	<1	<1	<1
	Propionic	<1	129	263	837	1060	1080	1060	1370	1380	<1
	Pyruvic	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	0.4	0.34
P-09	Acetic	<1	29	50	28	114	70	59	430	606	<1
	Butyric	<1	<1	<1	<1	<1	<1	<1	21	94.2	<1
	Lactic	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Propionic	<1	14	96	31	160	82	156	648	644	<1
	Pyruvic	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	0.3	<1
P-02	Acetic	<1	81	53	83	102	330	43	94		4.3
	Butyric	<1	<1	<1	7	18	130	32	11		<1
	Lactic	<1	20	<1	<1	<1	58	4	<1		<1
	Propionic	<1	199	36	125	249	1200	345	358		<1
	Pyruvic	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4		<1

CONCLUSIONS

The results of this pilot test show that injected HRC is an effective reactive barrier for the PCE plume. The barrier remains active 6 years after the injection. The long term effectiveness of this reactive barrier makes it an attractive remedial alternative for the site.

ACKNOWLEDGMENT

We thank Derek Peacock of URS Corporation for coordinating the field sampling effort.

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Appendix B

Field Notes

Location Wichita, KS Date 12/12/06

Project / Client 4100 8222.07

URS (LB) Geo (ZD)

Purpose: Injection JOB

Personnel: John P. O'Neal, Anna Kunkel, Heather Tittiung, Derek Peacock, PSA Bill Aaron Butler, Sean Corson Robert Tieman Mike Mailloux

Equipment Geoprobe -

OIL/Water Interface

Weather CIR / COOL UPPER 30's.

645 Arrive @ SITE

710 Conduct H&S Meeting

800 Filling out JSAs Vehicle Inspection Forms

900 Mike Mailloux URS on site

915 Gauge wells & Mark out Locations

1000 Prep for Injection Points

1015 Filing up Buckets with CAP18

Begin Injections START

AREA 1 East Side

1045 Begin Injections SECORNER AREA 1

Depth to 30 ft BGS Begin Injection of CAP 18 - Line is leaking - Must go to Auto store for ORing

1130 Repair ORing in Valve for Line

1215 End Drilling

John P. O'Neal

Location Wichita, KS Date 12/12/06

Project / Client 41008222.07

URS (4) PSI (4) Chevron 1

1135 Heather Tittiung off site
NOTE Equipment used
Geoprobe RIG - 54 DT Geoprobe
GS-1000 for CAP 18 Pump
(GS - 2000 for HRC Pump)
1230 On Going Injections In Zone 1
East → West ZIGZAG A1- ...
1330 Mark location for Supplemental
GW Sampling with Derek Peacock
Derek Peacock will contact KATY Gearing
(Coleman) and Inform of Supplemental
GW Sampling Activities
1730 End injecting Mat (CAP)
1715 Leave the site

JPO 12/13/06

John P. O'Neal

Location Wichita, KS Date 12/13/06

Project / Client 41008222.07

URS (2) PSA (3)

Purpose: Injection JOB
Personnel: John P. O'Neal, Anna Kunkel
(URS) Aaron Butler, Sean Corson & Robert Tieman
Equipment - Geoprobe 54 DT Geoprobe, OFC/Wire
Interface
Weather: 42 - Cool Mid 40s
700 Arrive @ site
740 Conduct H&S Meet
800 Resume Probing @ AREA 1 location
1100 Remain Drums of CAP Delivered
1130 Quick Break for Lunch time
1200 Resume Probing @ AREA 1
1330 Robert (PSA) calls - Informs
URS that CAP 18 Material look
different (White) Anna Kunkel
and John O'Neal (URS) go over
to look @ material. ~~decide~~
~~not to~~ JPO 12/13/06 Anna calls
Dan Bryant (DBI) Dan States
water Probably accumulated in
mixture (CAP 18). Gives white appearance
Anna & John Decide not to use
this Drum mixture. Move CAP 18
Storage / transfer area - Drums

John P. O'Neal

Location Wichita, KS Date 12/13/06

Project / Client 41008222.07

URS(2) PSA(3)

were placed in different location close to injection points -

1445 Resume Geoprobing / Injection activities.

1630 End Geoprobe activities

1645 Cleaning up area

1715 End of Day

JPO 12/13/06

John P. O'Neal

Location Wichita, KS Date 12/14/06

Project / Client 41008222.07

URS(2) PSA(3)

Purpose: Injection JOB

Personnel: John P. O'Neal & Anna Kunkelcur

Aaron Butler, Robert Tieman & Sean Corson (PSA)

Equipment: S4DT Geoprobe, OIL/Water Interface, los 1,000 & 2,000 Pump

Weather: PC Mid - high 50s

715 Meet @ site

730 H&S Meeting (Tailgate)

800 Continue Geoprobing & Inj Zone A

Gauge Area 2 & 3 Wells

Well ID	TOC DTW	GS DTW	TD
MW-9	10.32	10.75	32.68
PZ-2	7.02	7.50	24.38
R-8	5.61	6.50	—
R-7	9.86	10.52	—
R-10	10.51	10.50	—
R-11	9.90	9.30	-
R-12	8.18	7.82	20.72
MW-18	9.63	10.01	2 PZ
R-4	7.68	8.95	

JPO 12/14/06

HRC injection scheme -

Zone 2 & 3 - same injection scheme

1 gal/ft for 1st 5 ft

.5 gal/ft until 8 ft bgs

At Yellow Lab Steel Rec

John P. O'Neal

Location Wichita, KS Date 12/14/06

Project / Client 41008222.07

URS(2) PSA (3)

*Zones 2 & 3 Inject 8' to Apox 22.0 ft BGS

1355 Probing In Zones 2 & 3

1410 Some Trouble with the GS 2000 I

1600 Figure will need to add 4-6 Rechill @ Shallow Points in Areas

1730 End Geo Probing

1800 Leave the site

JPO 12/14/06

John P. O'Neal

Location Wichita, KS Date 12/15/06

Project / Client 41008222.07

URS(2) PSA (3)

Purpose: Injection JOB

Personnel: Jon Formeal + Anna Kunkle (URS) Aaron Butler, Robert Tiemann, Sean Corson (PSA)

Equipment: SUDP Geo Probe, Oil/Water interface, GS 1,000 & 2,000 Pump

Weather PC - high 60s

700 Mob to site

715 Arrive @ site

730 HES Meeting

845 Resume Probing AREA 2 & 3

1100 Get Sample Containers Lunch

1230 Resume Drilling AREA D yellow dot line

Want to see depth to shale

Mtg & 24.0 ft BGS

1750 Leave the site

JPO 12/15/06

John P. O'Neal

Location Wichita, KS Date 12/16/06

Project / Client 41008222.07

URS (2) PSA (3)

Purpose: Injection Job

Personnel: John P. O'Neal (URS) Aaron Butler, Robert Tieman, Sean Corson (PSA)

Equipment 54 DP GeoProbe, 2000 GS Pump

Weather PC / Cool

700 Mob. to Site

715 Arrive @ Site

720 JPO 12/16/06 Begin H&S Meeting

755 Begin Geoprobing

1530 Double Checked with Drillers On Amount of Product used in each hole

1700 Hydraulic Line to Hammer Breaks

1710 Talk to Anna Kunkel URS

1730 PSA will bring new Probe to job Will Arrive before work Sun AM

1800 Talk to Dick Peacock UPDATE on job

1845 Leave the Site

Completed 14 Point

JPO 12/16/06

John P. O'Neal

Location Wichita, KS Date 12/17/06

Project / Client 41008222.07

URS (2) PSA (3)

Purpose: Injection Job

Personnel: John P. O'Neal (URS) Aaron Butler, Robert Tieman, Sean Corson (PSA)

Equipment: New GeoProbe, 1000 GS Pump

Weather: Cloudy / Cool mid 40s

700 Mob. to Site

735 arrive @ Site

750 PSA on site - Had to get New Probe in Kansas City

810 H&S Meeting

1000 on Probe A-27 - CAP 18 not Injecting - @ 12-14 gallons comming out of hole

1030 Contact Anna Kunkel - Instructs to get as much CAP In as possible (eg. 12-14 gals out of 28 ft)

1040 Dick Peacock returns phone call Agrees that we need to get as much as possible - But not speed great deal of time waiting

1115 Injecting Proper Amount of Actual

1530 Begin Re injections

90 from 15 & 13 to TD

Approx 23-24 feet

Below the Ground Surface

John P. O'Neal

Location Wichita, KS Date 12/17/06

Project / Client 41008222.07

URS (1) PSA (3)

1800 End Drilling
1805 Cleaning up area -
Steam Cleaning Road
1845 Cleaning up area & Equipment
Talk to Anna Kunkel (URS)
1) Talk about Drum Delivery
2) Injection Ration (D)
3) If agequate depth on Slope (A)
1900 Leave Site - End of Day

JPO 12/17/06

John P. O'Neal

Location Wichita, KS Date 12/17/06

Project / Client 41008222.07

URS (2) PSA (3)

Purpose: Injection Job
Personnel: John P. O'Neal (URS) Aaron Butler, Robert Tieman & Sean Corson (PSA)
Equipment: 54 DT Geoprobe. GS 2000 Pro
Weather PC / Cool Mid 40s
700 Mob to Site
715 Arrive @ Site / Contact Steve Irwin (DEP) about Drum Pickup - other info discussed (Packaged)
730 PSA onsite
740 Conduct H&S meeting
800 Mob to Home Depot get strapping for Drums PSA setting up in zone C
830 Talk to Mr Frost (Coleman) OK to use concrete for 130 rings in Road - will look @ Road to see if continued cleaning
900 Begin Probing
1100 Count Amount Est vs Amount Injected Approx 129 Bucket Estimated Approx 109 Buckets Used.
* Notify Austin office Anna Kunkel of Shortage *
Driller states holes will not except more HRC - using max amount

John P. O'Neal

Location Wichita, KS Date 12/17/06

Project / Client 41008222.07

URS (1) PSA (3)

C-22

Of Material for Each Hole

* Anna will Inform Derek Peacock of Mt Anna Kunkel Instructs to Continue with 1st 5 feet 1 gallon per foot 1/2 gallon per foot to in Zone D area Section

* Anna Informs Derek Peacock of Extra ITRC - Derek states OK - Use as much ITRC in hole as possible

Awaiting of Problem

1645 Cleaning up area

1700 Demob from site

John P. O'Neal

Location Wichita, KS Date 12/17/06

Project / Client 41008222.07

URS (1) PSA (3)

Purpose: Injection JOB

Personnel: John P. O'Neal (URS) Anna Butler, Robert Tieman & Sean Corson (PSA)

Equipment: new geoprobe, 2000 GS Pump

Weather - Cloudy / cool mid 40s

700 Mob to site

715 Arrive @ site, PSA on site

730 Conduct HES meeting

800 Resume Geoprobing

* D-8, D-9, & D-10 Adjusted Due to Utilities - moved less than 2 feet

1600 End

1650 Pick up Drums

1800 Leave the site

JPO 12/17/06

John P. O'Neal

Location Wichita, KS Date 12/20/06

Project / Client 41008222.07

URS (1) PSA (3)

Purpose: Injection / Grab Groundwater

Personnel: John P. O'Neal (URS) Anson Butler, Robert Tieman, Sean Corson (PSA)

Equipment GeoProbe 5400, Sample Supplies

Weather Rain / Cool, Low 50's

700 Mob to site

730 Pick up supplies

740 Arrive @ site

750 PSA Onsite

800 Prep for GW Sampling

			Drillers Cleaning up DTW	TD
900	Sample GP-1	6	25.30	29.00
955	Sample GP-2	Had to Bail	16.70	29.50
1050	Sample GP-3	B	19.80	29.50
1135	Sample GP-4	B	7.30	31.00
1210	Sample GP-5	B	17.30 ~~5.10~~	30.00
1235	Sample GP-6	B	9.35	26.00
1310	Sample GP-7	B	16.60	26.00
1330	Sample GP-8	14-18 Sheen	14.0	26.00

1400 Cleaning up area

1500 Meet w/ Kat & Georg & Mr. Trust Inspect area

1545 Talk w/ Anna Kunkel (URS) Coordinate Pick up of HRC Pallet @ Coleman

John P. O'Neal

Location Wichita, KS

Project / Client 41008222.07

URS (1) PSA (3)

1600 Mob to Ship GW Samples

1630 Ship GW Samples via FEDEX

1700 Arrive @ Hotel - Do Paperwork

JPO 12/20/06

John P. O'Neal

Location Wichita, KS Date 12/20/06

Project / Client 41008222.07

URS(1) PSA(3)

Purpose: Measure / Ship Coleman

Personnel: John P. O'Neal (URS)

Equipment: —

Weather PC Cloudy / cool

730 Arrive @ site - check with Return Dept - Coleman will ship (HRC 00)

830 Talk to Greg Callihan (URS - Austin) on Directions for GPS

900 GPS locations in zone A, B, C & D

1100 Make site maps

1200 Call FED EX samples have not made it to CAB → Instruct U. Imp. Package - FEDEX will prioritize

1230 Let Anna Kunkel know of problems WAIT ON TRUCK to pick up HRC

1300 FEDEX picks up

1330 Demob from site.

JPO 12/20/06

John P. O'Neal

Location Date

Project / Client

Jan 2007

Location Wichita, KS Date 12/20/06

Project / Client 41008222.07

URS(1) PSA(3)

Purpose: Measure / Ship Coleman

Personnel: John P. O'Neal (URS)

Equipment: —

Weather PC Cloudy / cool

730 Arrive @ site - check with Rotary Dept - Coleman will ship HRC 00)

830 Talk to Guy Callihan (URS-Austin) on Directions for GPS

900 GPS locations in zone A, B, C & D

1100 Make site maps

1200 Call FED EX samples have not made it to LAB -> Instruct U. Imp. Package - FEDEX will prioritize

1230 Let Anna Kunkel know of Problems WAIT ON TRUCK to Pick up HRC

1300 FEDEX Picks up

1330 Demob from site.

JDO 12/20/06

John P. O'Neal

Location Wichita, KS Date 1/23/07

Project / Client 41008222.08

URS(2)

Purpose: Groundwater sample

Personnel: John P. O'Neal / John Mettam

Equipment: Water Level Indicator, Horiba U-22, Geoprobe Pump, Sample Containers & Supplies

Weather: Clr / Low 40's Snow on Ground Sinclair

730 Mob. to site

1130 Arrive @ site

1200 Pick up supplies

1245 Go over Safety - Safety Meeting JSA, Safety Plan, Vehicle Inspection Rep.

1400 Set up on R-2 D.T.W. 6.29

1425 Call LAB on Ph / HNO3 bottle TEST

JDO 1/23/07

Location WICHITA KS Date 1/23/07

Project / Client 410082207

John MEITAUER / John O'Neal

DTW Before Pumping 6.29'

TIME	DTW	PH	Cond	TURB	DO	TEMP	ORP	FR
1500	6.34	6.97	3.34	-5.0	8.00	14.1	57	170
1507	6.41	~~6.99~~ 7.42	3.40	406	2.56	14.3	54	170
1615	6.49	7.36	3.39	242.0	1.31	14.3	56	170
1620	6.58	7.48	3.27	-50	1.02	14.9	69	190
1535	6.67	7.52	3.32	179.0	0.95	14.0	70	190
1540	6.75	7.55	3.32	82.8	.70	14.3	68	190
1545	6.82	7.54	3.31	105.0	.65	14.1	71	180
1550	6.94	7.52	3.31	179.0	.61	14.4	74	180
1555	6.94	7.51	3.30	176.0	.61	14.3	77	180
1600	6.99	7.51	3.30	112.0	.63	14.3	80	180
1610	7.01	7.50	3.28	65.9	.66	14.5	84	180
1615	7.05	7.50	3.27	47.2	.67	14.2	86	180
1620	7.10	7.50	3.29	49.7	.68	14.3	90	180
1630	7.09	7.50	3.24	49.6	.69	14.9	94	180
PR		7.63	3.40	24.0	2.21	13.0	150	

1649 POST READINGS

Checked PH VOA - 2

Checked PH 500M - 2

1650 END SAMPLING R-2

FE = 0

1720 Leave Site JPO 1/23/07

John P. O'Neal

Location WICHITA, KS Date 1/24/07

Project / Client 410082222.08

JOBS (2)

PURPOSE: Groundwater Sampling

PERSONNEL: John P. O'Neal / John Meitauer

EQUIPMENT: Water Level Indicator, Peristaltic Pump, YSI Probe, Flow Cell, Sample containers & Supplies

WEATHER: CLR/Cold Snow Melting

715 Mob to Site

740 Pick up Supplies / Ice

800 Arrive @ Site

805 Conduct HES Meeting

810 Setup on R-5

JPO 1/24/07

John P. O'Neal

Location Wichita, KS Date 1/24/07

Project / Client 41008222.07

URS (2)

Well ID R-~~4~~ 5

STAR WL 10.87

DTIME	DTW	PH	COND	TURB	DO	TEMP	ORP	FE
0830	10.92	7.08	1.19	27.0	3.93	13.0	123	180
840	10.97	7.06	1.21	27.8	4.11	13.0	122	180
0845	10.58	7.06	1.23	26.0	3.55	13.5	119	180
0855	10.99	7.07	1.23	23.6	3.15	14.1	116	180
0900	10.99	7.06	1.23	37.7	2.51	14.6	36	180
910	11.01	7.04	1.23	47.0	2.10	14.4	-91	180
920	10.99	7.04	1.23	27.7	1.74	14.9	-109	180
930	11.02	7.03	1.23	36.0	1.33	14.8	-119	180
935	11.02	7.05	1.23	22.0	1.13	15.2	-116	180
940	11.02	7.04	1.22	33.8	0.92	15.6	-116	180
945	11.02	7.03	1.22	33.6	0.50	15.8	-114	180
950	11.02	7.02	1.22	20.8	.40	15.7	-113	180
1000	11.02	7.03	1.22	19.3	.35	15.7	-113	180
1005	11.02	7.02	1.23	20.3	.20	15.8	-113	180
1010	11.02	7.02	1.22	20.4	.21	15.8	-113	180
1020		7.09	1.23	9.4	5.00	14.1	53	180

1015 Sample Time

PH of VOA -2.

PH of 500mL -2. Note: Tubing 2' off BT of well

FE Ø

1020 Post Reading

John R O'Neal

Location Wichita, KS Date 1/24/07

Project / Client 41008222.07

URS (2)

R-10

DTW 1045

Set up on R-10 1030

Time	DTW	PH	COND	TURB	DO	TEMP	ORP	FE
1055	10.52	7.19	1.32	99.2	3.15	15.0	8.0	150
11:00	10.52	7.17	1.32	68.0	.99	14.8	40.0	160
11:05	10.52	7.16	1.31	73.1	.63	14.9	18.0	160
11:10	10.53	7.15	1.31	40.0	.25	15.2	-5	160
11:15	10.52	7.15	1.28	-5.0	.38	15.7	-83	160
11:20	10.58	7.14	1.30	-5.0	.14	15.5	-67	160
11:25	10.57	7.14	1.29	485.0	0.0	15.7	-45	160
11:30	10.58	7.13	1.29	49.1	0.0	15.7	-12	160
11:35	10.58	7.12	1.29	24.4	0.0	15.7	-6	160
11:40	10.57	7.12	1.30	21.4	0	15.7	-1	160
11:45	10.57	7.12	1.29	28.8	0	15.8	-1	160
11:50	10.58	7.12	1.29	48.8	0	15.9	-12	160
11:55	10.59	7.12	1.30	79.0	0	15.8	-18	160
12:10 Sample								
12:15	10.60	7.25	1.29	55.9	1.60	15.5	38	

PH VOA -2

PH 500 mL -2

FE 0

Note: Tubing 2' of BT of well

John R. O'Neal

Location 9.56 wichita, KS Date 1/24/07

Project / Client 41008222.03

URSC7)

MW-18 DTW. 9.56

TIME	DTW	PH	CON	TURB	DO	Temp	ORP	FE
1240	9.70	7.09	1.37	30.4	1.87	16.5	57	150
1245	9.78	7.09	1.37	12.5	1.09	16.5	83	160
1250	9.78	7.09	1.37	2/05.	.67	16.7	80	160
1255	9.78	7.08	1.37	385.0	.66	16.6	48	160
1300	9.78	7.08	1.37	357.0	.65	16.7	56	160
1305	9.80	7.08	1.38	21.0	.48	16.4	82	160
1310	9.80	7.08	1.37	12.1	.03	16.7	80	160
1315	9.80	7.06	1.38	8.0	0	16.0	83	160
1320	9.80	7.06	1.38	7.3	0	15.9	83	160
1325	9.80	7.07	1.39	7.0	0	15.9	83	160
1330	9.80	7.07	1.39	9.9	0	15.8	82	160
1335	9.80	7.06	1.39	5.0	0	15.6	84	170
1340	9.80	7.07	1.38	4.1	0	15.4	85	170
~~1345~~	9.80	7.13	1.38	39.2	6.08	14.0	129	—

1400 POST READING

1355 Sample Time

P/H VOA - 2

PH 500 mL - 2

FE

1410 MOVE TO R-12 Location

Note: Pumping Well & Tubing off 2' off BT of well.

JOHN P. O'NEAL

Location Wichita, KS Date 1/24/07

Project / Client 41008222.03

URSC2)

DTW 8.12

R-12

Time	DTW	PH	Cond	Turb	DO	Temp	ORP	FE
1415	8.15	7.21	3.01	418.0	7.14	13.5	70	160
1420	8.20	7.23	3.07	180.0	7.91	13.8	41	160
1425	8.23	7.25	3.06	120.0	7.73	14.0	21	180
1430	8.31	7.28	3.08	83.4	4.73	14.0	5	180
1435	8.31	7.30	3.03	268.0	5.97	14.1	0	170
1440	8.31	7.30	3.03	183.0	3.87	14.0	1	120
1445	8.32	7.30	3.02	222.0	3.77	14.1	0	170
1450	8.32	7.31	2.99	123.0	3.56	14.0	-4	170
1455	8.33	7.32	2.92	125.0	3.12	13.9	-6	170
1500	8.33	7.33	2.92	171.0	2.87	13.9	-5	170
1505	8.34	7.33	2.87	175.0	2.27	14.2	-5	170
1510	8.36	7.34	2.82	165.0	2.09	14.1	-5	120
1515	8.37	7.36	2.75	166.0	1.75	14.2	-7	170
1520	8.37	7.37	2.72	168.0	1.64	14.2	-7	170
1555	~~7.48~~	7.48	2.50	632.0	9.64	13.4	28	170

Sample Time 1540

PH VOA

PH 500 mL

FE = 0.0

Note: Well Tubing set 2' off BT of well

1615 MOVE TO NEXT SITE

JOHN P. O'NEAL

Location Wichita, KS Date 1/24/07

Project / Client 41008222.08

URS(2)

1630 Dump Purge water into 55 gallon Drums

John Mettava takes Drum Inventory

1645 Work on COC and Samples

1715 Demob from SiR

JPO 1/24/07

John P. O'Neal

Location Wichita, KS Date 1/25/07

Project / Client 41008222.08

URS(2)

Purpose: Groundwater Sample

Personnel: John O'Neal / John Mettava

Equipment: water level Indicator

U-22 Horiba Meter, Geo Pump, Pres Pump, Sample Containers & Supplies

Weather Cir Cold high 30's

730 Mob to site / Pick up Supplies

815 Arrive @ site Call Derek Peacock / Anna Kunkel Drive site to look at snowy conditions

830 Disscuss Health & Safety Meeting & Observations

845 Calibrate U-22 Horiba Meter

900 Talk to Derek Peacock about Sampling Progress (314) 603-0921

915 Talk to Richard with Golder Will not Gauge - Cir. Horiba

930 11.83 DTW MW-20 Set up on MW-20

JPO 1/25/07

John P. O'Neal

Location WITCHITA KS. Date 1/25/07

Project / Client 41003222.08

CRS(2)

MW-20 DTW 10.83 2" well

Time	DTW	Ph	Cond	Turb	DO	Temp	ORP	FR
1010	12.06	7.13	1.22	95.0	4.93	20.0	111	180
1015	12.12	7.16	1.25	58.8	2.23	21.2	99	180
1020	12.13	7.15	1.25	38.9	2.11	21.3	90	170
1025	12.12	7.15	1.25	27.0	1.88	21.3	85	170
1030	12.12	7.15	1.25	19.9	1.75	21.4	86	170
1035	12.12	7.15	1.25	29.7	1.62	21.4	87	170
1040	12.12	7.14	1.25	30.6	1.49	21.4	89	170
1045	12.12	7.14	1.25	29.9	1.40	21.4	91	170
1050	12.13	7.14	1.25	33.2	1.30	21.4	92	170
1055	12.13	7.14	1.25	32.8	1.27	21.4	92	170
1100	12.13	7.14	1.25	29.0	1.22	21.4	93	170
1105	12.13	7.14	1.25	22.9	1.18	21.4	94	170
1110								

JMA

Sample 11:15

Ph 500 mL - 2 pH 40 mL vom - 2

FE 0

Note: Tubing set 2' off BT of well

Slow P.O'ed

Location WITCHITA KS Date 1/25/07

Project / Client 41003222.08

C125(2)

MW-21 DTW - 11.12

Time	DTW	Ph	Cond	Turb	DO	Temp	ORP	FR
1240	11.29	6.35	1.92	-5	2.30	20.3	-84	170
1245	11.31	6.45	1.74	-5.0	1.96	20.3	-88	180
1250	11.39	6.86	1.50	-5.0	1.13	20.1	-75	180
1255	11.43	6.90	1.49	280.0	.50	20.1	-61	180
1300	11.46	6.90	1.48	96.0	.33	20.1	-42	180
1305	11.50	6.92	1.45	75.9	.25	20.2	-31	180
1310	11.52	6.93	1.43	62.7	.20	20.2	-27	180
1315	11.58	6.94	1.40	59.6	.12	20.2	-18	180
1320	11.58	6.94	1.40	63.9	.09	20.2	-16	180
1325	11.59	6.96	1.40	58.2	.07	20.2	-14	180
1330	11.59	6.96	1.40	73.8	.06	20.2	-13	180
1335	11.59	6.96	1.40	23.8	.12	20.2	-10	180
1340	11.59	6.96	1.41	33.6	.12	20.2	-9	180

JMA 11/25/07

Sample Time 1305

Ph 500 mL Ph 40 mL vom

FE = 0.5

Note Tubing 2' off BT of well

Slow P.O'ed

URS (7)

1345	Prep samples for FEDEX
1430	Pick up truck
1440	Disch. waste Into Portable Tank
1455	Leave the site
1600	Pack Samples & Ship via FEDEX
1630	End of Day

TPO 11/25/07

John P. O'Neil

Location Wichita, KS Date 3/12/07

Project / Client 4100 8222.08

URS(2)

Purpose: Pilot Test Sampling

Personnel: John P. O'Neal, John Mettam

Equip: oil/water Interface, Sample Supplies

Weather: Fog / Cool High Sos

730 Mob to site

800 Meet Golder (Richard) to gauge USD wells

930 End Gauging USD wells

Well ID	DTW
MW-14	13.06
MW-16	14.50
MW-13 (USD)	10.96
MW-5	13.29
MW-3	10.73
USD-1	10.31
USD-2	11.00
USD-3	11.06

950 Meet with David Ryan Access to Hillman

1030 At Clean Harbors Signing Profiles

1050 John Mettam on site Start gauging wells @ Hillman

John P. O'Neal

Location Wichita, KS Date 3/12/07

Project / Client 4100.8222.08

URS(2)

1100 Continue Gauging

Well ID	DTW
PMW-4	9.58
PMW-3	15.40
PMW-2	20.50
MW-20 (USD)	20.75
PMW-5	11.06
PMW-6	10.20
MW-17 (USD)	18.00
MW-22	10.72
MW-23	10.80
P-04	5.20
P-03	5.02
MW-10	12.83
MW-12D	19.60
MW-13	15.88
MW-20	11.70
MW-21	10.92
MW-9	9.72
MW-18	10.01
PZ-2	6.50
R-8	Blocked
MW-19	Blocked
MW-20	11.70

John P. O'Neal

Location Wichita, KS Date 3/12/07

Project / Client 41008222.08

URS (2)

WELL ID	DTW
MW-21	10.92
R-8	5.08
R-7	9.38
R-10	10.01
R-11	9.48
R-12	7.78
MW-8	3.38
R-2	5.73
TW-4	5.76
PZ-1	6.45
R-3	4.65
R-4	7.10
R-5	10.30
R-6	17.00
TW-3	14.31
TW-1	13.96
TW-2R	8.82
MW-7	7.42
MW-15	10.85
MW-1d	11.25
P-1	13.25
P-2	13.38
P-6	14.55

John P. O'Neill

Location Wichita, KS Date 3/12/07

Project / Client 41008222.08

URS (2)

12.38 13.25 14.70

P-7	14.70
P-8	14.70
P-9	14.95
P-5	14.65
P-10	14.75
MW-2	14.30
R-1	15.32
MW-5	14.20
MW-17	15.45
MW-4	15.35

1625 End Gauging Wells

1645 @ Clean Manhole

JOIN P. O'NEILL 3/12/07

John P. O'Neill

14.

Location Wichita, KS Date 3/13/07

Project / Client 41008222.08

URS(2)

Purpose: Pilot Test Sampling (3 mon)

Personnel: John P. O'Neal & John Mettauer (URS)

Equip: Pres Pump, U-22 Horiba, water level Indicator, sample supplies & containers

Weather FOG / Cool Low 60's

730 Mob. to site

800 Arrive @ site organize for sampling

815 H&S Meeting Note: Adhere to following JSA Gauging, Groundwater sampling

JPO 3/13/07

R-2 DTW: 5.72

TIME	DTW	PH	COND	TURB	DO	TEMP	ORP	FR
0920	5.82	7.30	99.9	67.5	3.40	14.24	72	200
0925	6.00	7.29	99.9	58.5	3.42	14.20	72	200
0930	6.10	7.29	99.9	65.9	3.30	14.08	72	160
0935	6.20	7.29	99.9	70.5	2.84	14.18	72	160
0940	6.28	7.29	99.9	72.9	2.89	14.23	66	180
0945	6.31	7.28	99.9	77.2	2.85	14.20	69	180
0950	6.38	7.28	99.9	74.5	2.86	14.17	70	180
0955	6.40	7.28	99.9	88.7	2.87	14.15	71	180
1000	6.42	7.27	99.9	90.0	2.85	14.11	73	180
1005	6.43	7.28	99.9	105.0	2.80	14.16	75	180
1010	6.45	7.28	99.9	105.0	2.80	14.12	77	180

Location Wichita KS VFA/VFA water prep Date 3/13/07 143

Project / Client 41008222.08

URS(2)

R-2

TIME	DTW	PH	COND	TURB	DO	TEMP	ORP	FR
1015	6.46	7.27	99.9	109.0	2.78	14.13	77	180
1020	6.48	7.28	99.9	126.0	2.80	14.16	80	180
1025	6.49	7.27	78.8	129.0	2.79	14.18	80	180
1030	6.50	7.27	66.7	138.0	2.76	14.26	81	180
1035	6.51	7.27	39.4	145.0	2.73	14.36	81	180
1040	6.52	7.27	22.9	152.0	2.70	14.50	84	180
1045	6.54	7.26	23.4	158.0	2.70	14.55	85	180
1050	6.56	7.26	24.5	160.0	2.70	14.57	86	180
1055								

SAMPLE R-2

PH VOA - 2.0

PH 500 M - 2.0

FE Ø HCL 2.0

R-5 DTW 10.30

TIME	DTW	PH	COND	TURB	DO	TEMP	ORP	FR
1030	10.41	6.83	99.9	190.0	3.24	17.33	80	170
1035	10.43	6.82	99.9	125.0	3.23	17.25	66	170
1040	10.45	6.81	99.9	51.1	3.15	17.16	52	170
1145	10.46	6.81	99.9	53.3	3.08	17.23	49	170
1150	10.45	6.81	99.9	46.7	2.85	17.18	49	170
1155	10.46	6.80	99.9	45.0	2.81	17.24	49	170
1200	10.46	6.80	99.9	29.0	2.71	17.20	49	170
1205		6.80	99.9	31.0	2.35	17.30	48	170

Location WICHITA KS Date 3/13/07

Project / Client 41008222.08

URS (2) John Mettauer / John O'Neal
MASTER SLAVE

CONT: R5

TIME	DTW	Ph	Cond	TURB	DO	TEMP	ORP	FR
1210	10.47	6.80	99.9	28.7	2.37	17.26	49	180
1215	10.47	6.80	99.9	23.5	2.71	17.26	49	180
1220	10.48	6.80	99.9	19.3	2.34	17.22	48	180
1225	10.48	6.81	99.9	21.8	2.57	17.32	48	180
1230	10.49	6.81	99.9	42.2	2.55	17.27	45	180
1235	10.50	6.82	99.9	42.5	2.54	17.25	45	180
1240	10.50	6.83	99.9	42.6	2.52	17.37	45	160

PH VOA - 2.0 PH-500 - 2.0

FE - Ø

1245 SAMPLE TIME R-5

R-10 DTW 9.98

TIME	DTW	Ph	Cond	TURB	DO	TEMP	ORP	FR
1330	10.09	6.90	2.06	-5.0	3.17	17.14	12	190
1335	10.10	6.88	99.9	215.0	2.61	16.25	33	190
1340	10.12	6.88	99.9	161.0	2.64	16.25	34	190
1345	10.15	6.87	99.9	69.5	2.58	16.33	39	190
1350	10.19	6.86	85.5	149.0	2.88	16.28	44	190
1355	10.16	6.84	61.2	90.3	2.79	16.29	35	190
1400	10.16	6.83	23.3	92.2	2.78	16.50	49	200
1405	10.15	6.82	18.7	102.0	2.67	16.53	52	200
1410	10.15	6.81	21.0	102.0	2.61	16.54	54	200
1415	10.15	6.81	20.3	101.0	2.64	16.56	55	200

Location WICHITA, KS. Date 3/13/07

Project / Client 41008222.08

URS (2)

R-10 CONT:

TIME	DTW	Ph	Cond	TURB	DO	TEMP	ORP	FR
1420	10.20	6.79	14.0	102.0	2.60	16.62	56	200
1425	10.20	6.78	18.2	104.0	2.58	16.63	57	200
1430	10.20	6.77	13.2	92.9	2.48	16.66	58	200

1440 SAMPLED R-10

PH - VOA 2.0 PH-500 mL 2.0

FE - Ø

MW-18 DTW - 9.12

TIME	DTW	Ph	Cond	TURB	DO	TEMP	ORP	FR
1510	9.29	6.57	99.9	-5.0	2.57	18.60	-7	160
1515	9.30	6.58	61.1	800.0	2.63	18.32	22	160
1520	9.30	6.57	25.9	318.0	2.67	18.05	40	160
1525	9.30	6.57	41.0	240.0	2.53	18.01	51	160
1530	9.30	6.53	16.5	76.8	2.34	17.65	63	160
1535	9.30	6.53	20.9	88.3	2.35	17.65	66	160
1540	9.30	6.51	15.8	78.8	2.36	17.62	66	160
1545	9.30	6.50	14.7	65.9	3.36	17.66	67	160
1550	9.30	6.49	17.8	75.0	2.41	17.76	70	160
1555	9.30	6.48	12.1	87.0	2.51	17.54	71	160
1600	9.30	6.47	5.18	163.0	2.58	17.34	71	160

Location Wichita KS Date 3/13/07

Project / Client 4100822.08

Cont: MW-18

Time	DTW	PH	Cond	Turb	DO	Temp	ORP	FR
1605	9.31	6.46	6.09	207.0	2.56	17.33	71	160
1610	9.31	6.45	5.98	236.0	2.59	17.18	71	160
1615	9.31	6.46	5.90	253.0	2.55	17.33	71	160
1620								
1625								

Sample Time MW-18 1625

PH - VOA PH 500 mL

FE

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Common Field Data Error Codes

Error Codes Are Used to Explain Common Mistakes and Are Written Above or Close to the Mistake

Commonly Used Error Codes Include:

- RE Recording Error
- CE Calculation Error
- TE Transcription Error
- SE Spelling Error
- CL Changed for Clarity
- DC Original Sample Description Changed After Further Evalutaion
- WO Write Over
- NI Not Initialled and Dated at Time of Entry
- OB Not Recorded at the Time of Initial Observation

Note: Error Code Should Be Circled, Dated And Initialed When Recorded.

Hazard Classifications

Class 1 Explosives
Class 2 Gas
Class 3 Flammable Liquid
Class 4 Flammable Solids (Potential spontaneous combustion, or emission of flammable gases when in contact with water)
Class 5 Oxidizing Substances and Organic Peroxides
Class 6 Toxic (poisonous) and Infectious substances
Class 7 Radioactive material
Class 8 Corrosives
Class 9 Miscellaneous dangerous goods

Container type abbreviations (for sampling guidelines):

BR - Boston Round
ABR - Amber Boston Round
AJ - Amber Jug
CWM - Clear Wide Mouth
AWM - Amber Wide Mouth
Poly - Polyethylene Bottles
BOD Bottle

CURVE FORMULAS

$T = R \tan \frac{1}{2} I$

$T = \frac{50 \tan \frac{1}{2} I}{\text{Sin. } \frac{1}{2} D}$

$\text{Sin. } \frac{1}{2} D = \frac{50}{R}$

$\text{Sin. } \frac{1}{2} D = \frac{50 \tan \frac{1}{2} I}{T}$

$R = T \text{ cot. } \frac{1}{2} I$

$R = \frac{50}{\text{Sin. } \frac{1}{2} D}$

$E = R \text{ ex. sec } \frac{1}{2} I$

$E = T \tan \frac{1}{4} I$

$\text{Chord def.} = \frac{\text{chord}^2}{R}$

$\text{No. chords} = \frac{I}{D}$

$\text{Tan. def.} = \frac{1}{2} \text{ chord def.}$

The square of any distance, divided by twice the radius, will equal the distance from tangent to curve, very nearly.

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft.) and divide given deflection by the product.

Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance.

To find deflection for a given angle and distance. Multiply the angle by .01745, and the product by the distance.

GENERAL DATA

Right Angle Triangles. Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt. $10.10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. $25.25^2 \div 200 = 3.125$: $100 - 3.125 = 96.875 =$ Base.

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

Leveling. The correction for curvature and refraction, in feet and decimals of feet is equal to $0.574\,d^2$, where d is the distance in miles. The correction for curvature alone is closely, $\frac{2}{3}d^2$. The combined correction is negative.

Probable Error. If d_1, d_2, d_3, etc. are the discrepancies of various results from the mean, and if Σd^2 = the sum of the squares of these differences and n = the number of observations, then the probable error of the mean $= \pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n-1)}}$

MINUTES IN DECIMALS OF A DEGREE

1′	.0167	11′	.1833	21′	.3500	31′	.5167	41′	.6833	51′	.8500
2	.0333	12	.2000	22	.3667	32	.5333	42	.7000	52	.8667
3	.0500	13	.2167	23	.3833	33	.5500	43	.7167	53	.8833
4	.0667	14	.2333	24	.4000	34	.5667	44	.7333	54	.9000
5	.0833	15	.2500	25	.4167	35	.5833	45	.7500	55	.9167
6	.1000	16	.2667	26	.4333	36	.6000	46	.7667	56	.9333
7	.1167	17	.2833	27	.4500	37	.6167	47	.7833	57	.9500
8	.1333	18	.3000	28	.4667	38	.6333	48	.8000	58	.9667
9	.1500	19	.3167	29	.4833	39	.6500	49	.8167	59	.9833
10	.1667	20	.3333	30	.5000	40	.6667	50	.8333	60	1.0000

INCHES IN DECIMALS OF A FOOT

1-16	3-32	1/8	3-16	1/4	5-16	3/8	7/16	1/2	9/16	5/8	11/16
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729	
1	2	3	4	5	6	7	8	9	10	11	
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167	

3/14/07

MW-20	DTW	11.65						
Time	DTW	PH	Cond	Turb	DO	Temp °C	ft	
900	11.78	6.93	99.9	191.0	5.17	21.21	163	200
905	11.79	6.90	99.9	198.0	3.41	21.25	160	200
910	11.80	6.91	99.9	220.0	3.07	21.26	168	200
915	11.80	6.93	99.9	247.0	2.98	21.26	158	200
920	11.80	6.93	99.9	270.0	2.86	21.26	159	200
925	11.80	6.93	99.9	297.0	2.95	21.26	159	200
930	11.80	6.93	99.9	320.0	2.93	21.24	159	200
935	11.80	6.94	79.0	370.0	2.91	21.27	158	200
940	11.80	6.94	63.4	396.0	2.90	21.27	159	200
945	11.80	6.93	52.9	400.0	2.91	21.27	159	200
950								

0950 Sample Time

PH Volt 2.0 PH 500 mL 2.0

FE = Ø

Note: With no Clear Tubes at Head

3/14/07

JCM & JL

MW-21 10.82 DTW

Time	DTW	Ph	Cond	Turb	DO	Temp	ORP	FR
1030	11.00	6.71	3.84	129.0	2.88	19.68	-26	200
1035	11.10	6.70	99.9	109.0	2.42	19.64	-4	200
1040	11.18	6.71	26.6	109.0	2.13	19.63	2	200
1045	11.22	6.71	21.0	116.0	2.06	19.62	6	200
1050	11.23	6.72	12.5	106.0	2.02	19.61	9	170
1055	11.27	6.72	9.6	106.0	2.01	19.60	8	170
1100	11.28	6.71	5.26	106.0	2.01	19.60	11	170
1105	11.28	6.71	4.90	112.0	2.00	19.60	12	170
1110	11.32	6.71	4.48	116.0	2.00	19.59	13	170
1115	11.32	6.71	4.40	118.0	2.00	19.59	16	170
1120	11.34	6.71	4.42	115.0	2.00	19.59	17	170
1125	11.34	6.71	4.42	115.0	2.00	19.59	17	170
1130	11.34							

Sample Time 1130

PH VOA 3 PH 500 mL

FR 1.0

R-12 DTW 7.65

Time	DTW	Ph	Cond	Turb	DO	Temp	ORP	FR
1200	7.86	6.95	99.9	472.0	2.32	15.86	16	210
1205	7.90	6.93	99.9	461.0	2.26	15.77	10	210
1210	7.95	6.91	99.9	357.6	2.16	16.16	10	210
1215	7.96	6.87	41.0	385.0	2.20	16.37	11	210
1220	7.96	6.84	27.3	456.6	2.21	16.27	13	210
1225	7.97	6.82	21.1	348.0	2.16	16.44	13	210
1230	7.98	6.80	17.8	367.0	2.17	16.52	16	210
1235	8.00	6.78	17.0	376.0	2.19	16.33	17	210
1240	8.00	6.77	16.0	407.0	2.18	16.53	18	210
1245	8.01	6.76	15.9	422.0	2.20	16.30	20	210
1250	8.02	6.75	16.5	430.0	2.19	16.42	21	210
1255	8.03	6.75	15.3	467.0	2.19	16.37	22	210
1300		6.74	13.8	452.0	2.17	16.57	23	210

Sample Time 1310

Ph VOA 2.0 Ph 500 mL 2.0

FR 0

Field Equip Blank 1445

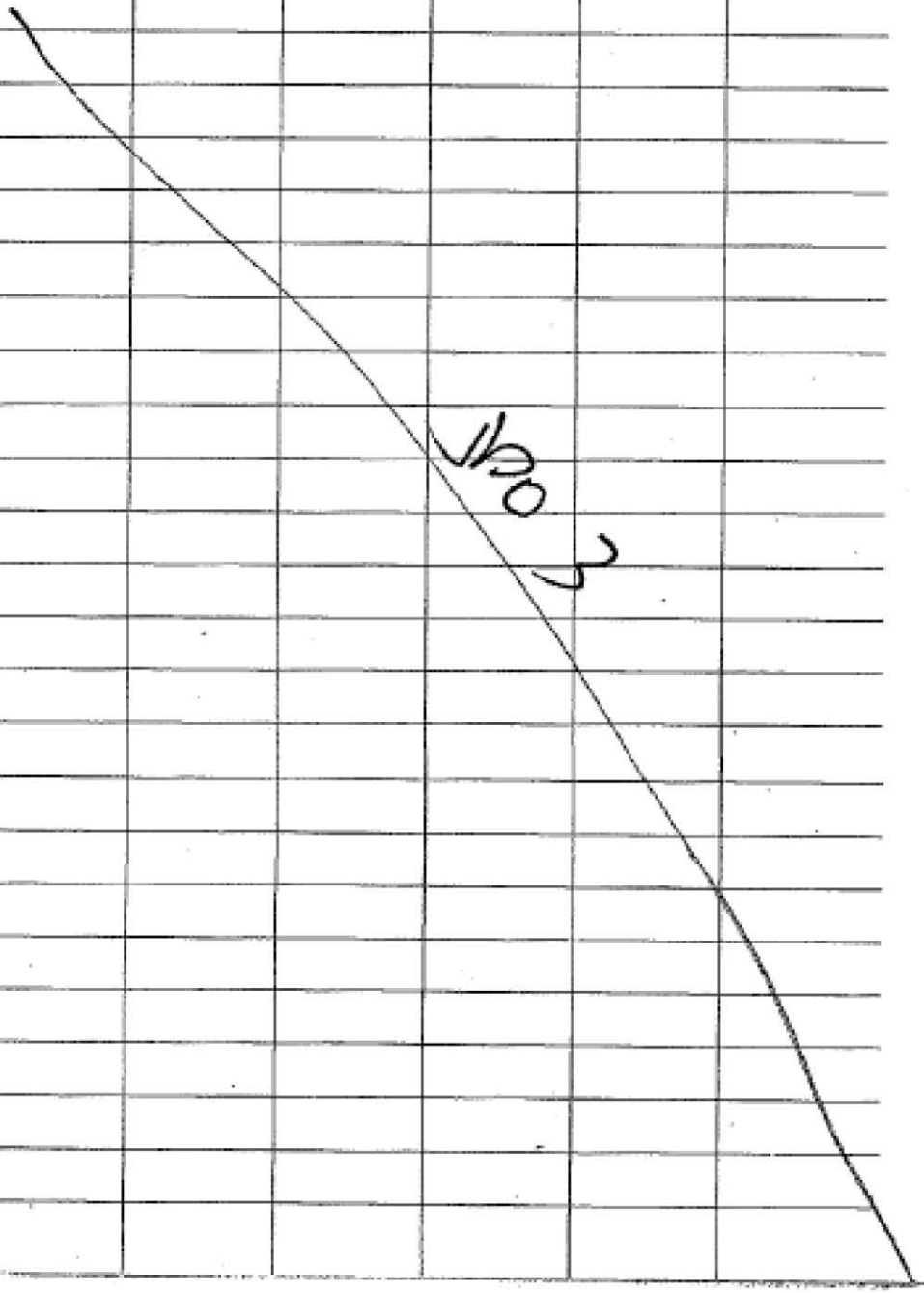
Note: High Turb Reading Water is Clear

Note: Pumping Slower As well

3/14/07

1545 Pack samples

1635 Ship samples FEDEX



Chevron Generic Analysis Request/Chain of Custody

Lancaster Laboratories
Where quality is a science.

For Lancaster Laboratories use only
Acct. #: _____ Sample #: _____ SCR#: 007928

Facility #: _____
Site Address: _____
Chevron PM: _____ Lead Consultant: _____
Consultant/Office: _____
Consultant Prj. Mgr.: _____
Consultant Phone #: _____ Fax #: _____
Sampler: _____
Service Order #: _____ ☐ Non SAR: _____

Sample Identification	Date Collected	Time Collected	Grab	Composite	Matrix: Soil	Matrix: Water	Matrix: Oil ☐ Air ☐	Total Number of Containers	Analyses Requested / Preservation Codes: BTEX + MTBE 8021 ☐ 8260 ☐ Naphth ☐	8260 full scan	Oxygenates	TPH G	TPH D ☐ Extended Rng. ☐ Silica Gel Cleanup	Lead Total ☐ Diss. ☐ Method	VPH/EPH	NWTPH HCID ☐ quantification			

Preservative Codes
H = HCl T = Thiosulfate
N = HNO_3 B = NaOH
S = H_2SO_4 O = Other

☐ J value reporting needed
☐ Must meet lowest detection limits possible for 8260 compounds

8021 MTBE Confirmation
☐ Confirm MTBE + Naphthalene
☐ Confirm highest hit by 8260
☐ Confirm all hits by 8260
☐ Run ____ oxy's on highest hit
☐ Run ____ oxy's on all hits

Comments / Remarks

Turnaround Time Requested (TAT) (please circle)
STD. TAT 72 hour 48 hour
24 hour 4 day 5 day

Data Package Options (please circle if required)
QC Summary Type I - Full
Type VI (Raw Data) Disk / EDD
WIP (RWQCB) Standard Format
Disk _____ Other

	Date	Time		Date	Time
Relinquished by:			Received by:		
Relinquished by:			Received by:		
Relinquished by:			Received by:		
Relinquished by Commercial Carrier: UPS FedEx Other			Received by:		
Temperature Upon Receipt _____ C°			Custody Seals Intact? Yes No		

Serial Number 31724

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SEVERN TRENT **STL**

STL Tallahassee
2846 Industrial Plaza Drive
Tallahassee, FL 32301
Website: www.stl-inc.com
Phone: (850) 878-3994
Fax: (850) 878-9504

Alternate Laboratory Name/Location
Phone:
Fax:

PROJECT REFERENCE: Cherokee Wilson	PROJECT NO.: 41003722	PROJECT LOCATION (STATE): KS	PAGE ___ OF ___
SAMPLER'S SIGNATURE: [signature]	P.O. NUMBER:	CONTRACT NO.:	STANDARD REPORT DELIVERY ○ DATE DUE ___
CLIENT (STE) PM: Dean Peacock	CLIENT PHONE: (512) 419-1170	CLIENT FAX:	EXPEDITED REPORT DELIVERY (SURCHARGE) ○ DATE DUE ___
CLIENT NAME:	CLIENT E-MAIL: John_[illegible]@[illegible].com		
CLIENT ADDRESS: 1437 South Boulder STE 1020 Tulsa, OK 74119			
COMPANY CONTRACTING THIS WORK (if applicable):			NUMBER OF COOLERS SUBMITTED PER SHIPMENT:

MATRIX TYPE: COMPOSITE (C) OR GRAB (G) INDICATE; AQUEOUS (WATER); SOLID OR SEMISOLID; AIR; NONAQUEOUS LIQUID (OIL, SOLVENT,...)

REQUIRED ANALYSIS: VFA/VFA [illegible]

PRESERVATIVE: 1

SAMPLE DATE	SAMPLE TIME	SAMPLE IDENTIFICATION	COMPOSITE (C) OR GRAB (G) INDICATE	AQUEOUS (WATER)	SOLID OR SEMISOLID	AIR	NONAQUEOUS LIQUID (OIL, SOLVENT,...)	NUMBER OF CONTAINERS SUBMITTED	REMARKS
3/13/07	1055	R-2		✓				3	
3/13/07	1245	R-5		✓				3	
3/13/07	[illegible]	R-10		✓				3	
3/13/07	1525	MW-18		✓				3	
3/14/07	920	MW-20		✓				3	
3/14/07	1130	MW-21		✓				3	
3/14/07	1310	R-12		✓				3	

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME
[signature] EMPTY CONTAINERS	3/7/07	1400	[signature]	3/17/07	1700			
RECEIVED BY: (SIGNATURE) EMPTY CONTAINERS	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

LABORATORY USE ONLY

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT YES ○ NO ○	CUSTODY SEAL NO.	STL TALLAHASSEE LOG NO.	LABORATORY REMARKS

IF FOUND PLEASE RETURN TO:

NAME _____

COMPANY _____

STREET _____

CITY _____ STATE ____ ZIP ____

PHONE ____ _____

JOB BOOK

FROM BEN MEADOWS COMPANY

PROJECT NAME Usical Wichita KS

PROJECT NUMBER Pilot Test Smplg

CREW John Mettauer/Kim High

DATE Oct/02 BOOK # 01 OF ____

WEATHER _____

FIELD BOOK
16 PAGE
8 LEAVES
50% RAG

Reorder part # 101650
Phone # 800-241-6401

UNICAL WIT.

10/2/07

John METTAUER, ANNA KUNKEL
Held Safety Meeting. Marked
Location for New Drilling.
United Rental Picked up Mower.

Equipment
Horiba U-22, Water Level, Peristaltic
Pump.
Sampling for: VOC, CO_2, Volatile Head
Space Hydrocarbon, Fatty Acid, Total
& Disolved Iron

Field Parameters with Horiba U-22

Weather Overcast High mid 80°
Rain

2

UNICAL WIT 10/2/07

Mob. Equip

1030 Set up on R-2

DTW: 3.35'

DTB:

Time	DTW	PH	Cond	Turb	DO	Temp	ORP	FR
1045	3.50	7.01	364	354	2.32	19.30	32	200
1050	3.75	6.99	360	350	1.57	19.19	18	200
1055	3.80	6.95	357	376	1.35	19.07	15	200
1100	3.80	6.99	355	537	1.28	19.03	14	200
1105	4.00	7.00	352	468	1.18	19.03	14	200
1110	4.01	7.00	3.51	598	1.14	19.11	14	200
1115	4.01	7.00	3.55	357	1.15	19.14	14	200
1120	4.05	7.00	3.48	399	1.11	19.05	15	200
1125	4.10	7.00	3.45	722.0	1.05	18.90	16	200
1130	4.10	7.00	3.48	768	1.07	18.95	14	200
1135	4.10	7.00	3.47	898	1.07	19.02	14	200
1140	4.10	7.00	3.47	787	1.05	19.06	14	200

1145 Sampled R-2

FT: 0.0

Sample ID R-2 / R-2 Dup.

VOC, CO_2, VHSH, Fatty Acid, Total & Dissolved Iron

2

UNICAL WIT

1330 10/2/07

TW-4 SET UP Note: Well Cover Bolts Broken

DTW: 3.45.

Time	DTW	PH	COND	TURB	DO	TEMP. ORP	FE
1340	3.90	6.34	1.69	416	2.24	20.00	-161	220
1345	3.95	6.43	1.63	161	1.65	19.90	-167	220
1350	4.00	6.46	1.60	357	1.38	19.91	-184	220
1355	4.05	6.45	1.58	384	1.27	19.68	-197	220
1400	4.05	6.46	1.57	473	1.18	19.81	-207	220
1405	4.03	6.47	1.57	503	1.14	19.87	-216	220
1410	4.04	6.47	1.55	606	1.12	19.87	-221	220
1415	4.05	6.45	1.54	340	1.07	19.67	-227	220
1420	4.06	6.48	1.53	401	1.06	19.82	-230	220
1425	4.08	6.48	1.53	550	1.03	19.74	-233	220
1430	4.10	6.48	1.54	559	1.03	19.79	-235	220
1435	4.10	6.49	1.53	751	1.01	19.84	-237	220
1440	4.10	6.49	1.54	568	1.01	19.88	-237	220

1445 Sampled TW-4

FE: 3.0

10/2/07

1500 SET UP ON R-3

DTW: 4.00

Time	DTW	PH	COND	TURB	DO	TEMP ORP	FE
1510	4.80	6.48	2.18	164	1.91	22.6	-179	230
1515	4.90	6.52	2.20	97.6	1.48	22.0	-184	230
1520	5.00	6.54	2.20	288.0	1.17	21.74	-192	230
1525	5.10	6.54	2.20	265.0	1.09	21.82	-193	230
1530	5.15	6.54	2.20	269	1.03	21.88	-194	230
1535	5.15	6.54	2.19	265	.99	21.79	-195	230
1540	5.20	6.54	2.19	204	.98	21.79	-199	230
1545	5.33	6.53	2.18	300	.92	21.75	-199	230
1550	5.40	6.54	2.19	418	.91	21.78	-195	230
1555	5.50	6.54	2.19	320	.90	21.64	-199	230
1600	5.60	6.54	2.19	152	.87	21.65	-199	230
1605	5.65	6.54	2.19	212	.89	21.65	-199	230

1610 SAMPLED R-3

1700 DEPARTED SITE

UNICAL WIT

1330 10/2/07

TW-4 SET UP Note: Well Cover Bolts Broken

DTW: 3.45.

Time	DTW	PH	Cond	Turb	DO	Temp.	ORP	Fe
1340	3.90	6.34	1.69	416	2.24	20.00	-161	220
1345	3.95	6.43	1.63	161	1.65	19.90	-167	220
1350	4.00	6.46	1.60	357	1.58	19.91	-184	220
1355	4.05	6.45	1.58	384	1.27	19.68	-197	220
1400	4.05	6.46	1.57	473	1.18	19.81	-207	220
1405	4.03	6.47	1.57	503	1.14	19.87	-216	220
1410	4.04	6.47	1.55	606	1.12	19.87	-221	220
1415	4.05	6.45	1.54	340	1.07	19.67	-227	220
1420	4.06	6.48	1.53	401	1.06	19.82	-230	220
1425	4.08	6.48	1.53	550	1.03	19.74	-233	220
1430	4.10	6.48	1.54	559	1.03	19.79	-235	220
1435	4.10	6.49	1.53	751	1.01	19.84	-237	220
1440	4.10	6.49	1.54	568	1.01	19.88	-237	220

1445 Sampled TW-4

FE: 3.0

10/2/07

1500 SET UP ON R-3

DTW: 4.00

Time	DTW	PH	Cond	Turb	DO	Temp	ORP	Fe
1510	4.80	6.48	2.18	164	1.91	22.6	-179	230
1515	4.90	6.52	2.20	97.6	1.48	22.0	-184	230
1520	5.00	6.54	2.20	288.0	1.17	21.74	-192	230
1525	5.10	6.54	2.20	265.0	1.09	21.82	-193	230
1530	5.15	6.54	2.20	269	1.03	21.88	-194	230
1535	5.15	6.54	2.19	265	.99	21.79	-195	230
1540	5.20	6.54	2.19	204	.98	21.79	-199	230
1545	5.33	6.53	2.18	300	.92	21.75	-199	230
1550	5.40	6.54	2.19	418	.91	21.78	-195	230
1555	5.50	6.54	2.19	320	.90	21.64	-199	230
1600	5.60	6.54	2.19	152	.87	21.65	-199	230
1605	5.65	6.54	2.19	262	.89	21.65	-199	230

1610 Sampled R-3

1700 DEPARTED SITE

UNICAL WIT

10/3/07

0700 ARRIVED ON SITE
0730 Held H & S meeting
CAL HURIBA U-22
0740 Set up on R-4
DTW 4.75

Time	DTW	PH	Cond	Turb	DO	Temp	ORP	T
800	4.85	6.72	1.50	-5	2.19	19.38	-177	160
805	4.90	6.72	1.49	-5	2.06	19.41	-180	
810	4.95	6.72	1.48	494	1.45	19.49	-184	
815	4.95	6.78	1.48	422	1.29	19.59	-183	165
820	4.95	6.77	1.48	509	1.19	19.67	-183	165
825	4.95	6.78	1.48	510	1.19	19.61	-183	165
830	4.95	6.77	1.47	494	1.14	19.75	-182	165
835	4.95	6.77	1.47	528	1.12	19.81	-181	165
840	4.95	6.77	1.46	548	1.11	19.87	-181	165
845	4.95	6.76	1.47	568	1.08	19.88	-180	165
850	4.95	6.76	1.46	603	1.07	19.96	-179	165
855	4.95	6.75	1.46	607	1.07	20.02	-179	165

900 Sampled R-4
FE: 4.0

10/3/07

0930 Set up on MW-R-5
DTW 8.15

Time	DTW	PH	Cond	Turb	DO	Temp	ORP	FR
0940	8.20	6.67	1.40	310	1.95	19.48	08	200
0945	8.20	6.69	1.35	192	1.40	19.50	0.9	200
0950	8.25	6.69	1.39	277	1.33	19.44	0.8	200
0955	8.25	6.70	1.38	337	1.24	19.55	0.0	200
1000	8.25	6.70	1.38	352	1.21	19.67	0.0	200
1005	8.25	6.70	1.39	245	1.17	19.62	-20	200
1010	8.25	6.70	1.38	296	1.15	19.54	-28	200
1015	8.25	6.71	1.38	154	1.13	19.64	-34	200
1020	8.25	6.70	1.38	295	1.09	19.72	-38	200
1025	8.25	6.70	1.38	183	1.09	19.70	-41	200
1030	8.25	6.70	1.38	366	1.06	19.53	-46	200
1035	8.25	6.70	1.38	313	1.05	19.60	-45	200
1040	8.25	6.70	1.37	209	1.04	19.56	-45	200

1045 Sampled R-5
FE: 0.0

Unifrac Wichita

10/3/07

1230 SET UP ON R-6

DTW: 15.00

Time	DTW	pH	Cond	Turb	DO	Temp	ORP	FC
1300	15.00	6.56	1.38	215	1.85	18.49	123	200
1305	15.00	6.60	1.38	113	1.44	18.43	114	200
1310	15.00	6.64	1.37	90.1	1.33	18.39	109	200
1315	15.00	6.65	1.37	94.0	1.25	18.38	106	200
1320	15.00	6.66	1.37	96.0	1.25	18.46	103	200
1325	15.05	6.67	1.37	94.2	1.21	18.42	101	200
1330	15.05	6.68	1.37	93.2	1.15	18.65	98	200
1335	15.05	6.68	1.37	102	1.17	18.47	97	200
1340	15.05	6.67	1.37	99.7	1.15	18.52	95	200
1345	15.05	6.69	1.36	90.9	1.14	18.92	93	200
1350	15.05	6.68	1.36	102.0	1.12	19.06	92	200
1355	15.05	6.69	1.37	102.0	1.13	18.93	92	200

1400 SAMPLED R-6 / R-6 DUP.

FE: 0.0

JSA Review

Amb Observation Done.

8

1415 SET UP ON R-12 Jan. H (12)

DTW: 6.26

Time	DTW	pH	Cond	Turb	DO	Temp	ORP	FC
1420	6.40	6.69	3.56	187	1.32	20.35	+53	200
1425	6.42	6.69	3.55	117	1.27	20.35	-53	200
1430	6.44	6.69	3.55	143	1.22	20.40	-55	200
1435	6.45	6.69	3.54	113	1.14	20.32	-56	200
1440	6.45	6.69	3.54	122	1.14	20.31	-56	200
1445	6.45	6.69	3.53	152	1.10	20.33	-58	200
1450	6.45	6.69	3.53	168	1.08	20.41	-58	200
1455	6.45	6.69	3.52	139	1.08	20.31	-60	200
1500	6.45	6.70	3.52	126	1.07	20.36	-58	200
1505	6.45	6.70	3.51	79	1.07	20.32	-58	200
1510	6.46	6.69	3.50	82	1.06	20.30	-59	200
1515	6.46	6.69	3.51	78.1	1.05	20.32	-59	200

1520 SAMPLED R-12 H (12)

FE: 2.0

Kim Hall Assisted on Site To Take Over for Amanda

9

UNICAL WICHITA

10/3/07

1600 SET UP ON R-12.11

DTW 7.90

TIME	DTW	PH	COND	TURB	DO	TEMP	ORP	FR
1610	8.30	6.56	1.76	109	1.75	20.09	-87	200
1615	8.57	6.57	1.75	92.3	1.30	19.96	-89	200
1620	8.72	6.58	1.75	90.6	1.29	19.92	-91	200
1625	8.80	6.57	1.74	90.3	1.19	19.92	-91	200
1630	8.88	6.58	1.73	89.3	1.14	19.92	-92	200
1635	8.90	6.59	1.72	77.2	1.12	19.92	-92	200
1640	8.90	6.59	1.71	85.1	1.08	20.02	-92	200
1645	8.70	6.60	1.71	77.9	1.07	19.93	-93	200
1650	8.90	6.60	1.71	78.4	1.05	19.98	-93	200
1655	8.90	6.61	1.69	46.2	1.03	19.87	-93	200
1700	8.90	6.61	1.70	53.8	1.04	19.95	-93	200
1705	8.90	6.61	1.69	48.4	1.02	19.94	-93	200

1710 SAMPLED

FE: 3.5

SAMPLES SHIPPED OFF TODAY TO 2 LAB'S

10/3/07

1720 SET UP ON MW-18

1715 DTW 7.50

TIME	DTW	PH	COND	TURB	DO	TEMP	ORP	FR
1730	7.80	6.30	1.72	224	2.03	19.57	-148	180
1735	7.82	6.26	1.66	302	1.43	19.48	-197	180
1740	7.86	6.25	1.62	240	1.20	19.28	-242	180
1745	7.79	.28	1.55	190	1.02	19.37	-271	180
1750	7.80	6.28	1.55	182	.99	19.37	-270	180
1755	7.80	6.28	1.55	175	.99	17.90	-268	180
1800	6.28	1.55	161.0	.98	19.39	-265	180	
1805	7.80	6.28	1.55	131.0	.97	19.37	-263	180
1810	7.80	6.26	1.54	127.0	.95	19.36	-260	180
1815	7.82	6.25	1.54	118.0	.95	19.41	-258	180
1820	7.82	6.25	1.55	217	.93	19.40	-256	180
1825	7.84	6.25	1.55	181	.93	19.38	-256	180

1830 SAMPLE MW-18

FE: 4.0

1900 DEPARTED SITE

Unical W1

10/4/07

0730 Arrived on site
Held H&S meeting
Slip trip fall traffic in side
Bldg.
Cal Auriba U-22 to 4.00 PH
Load Equipment to Kim High
to Sample R-10 MW-20, 21

Stoped @ QT for ICE, Gas, Coffee
Weather Clear Light Breeze from
S.E. No Clouds. High to 85

Unical Witchia

10/4/07

0745 Set up on R-10

DTW: 8.41

Time	DTW	PH	Cond.	Turb	DO	Temp	ORP	FR
0800	8.65	6.69	1.42	344	2.04	19.37	-39	180
0805	8.65	6.73	1.41	297	1.79	19.37	-44	180
0810	8.65	6.74	1.41	281	1.77	19.36	-44	180
0815	8.65	6.75	1.41	302	1.72	19.36	-45	180
0820	8.65	6.79	1.40	400	1.53	19.35	-48	180
0825	8.65	6.80	1.40	301	1.49	19.34	-48	180
0830	8.65	6.81	1.39	314	1.40	19.42	-47	180
0835	8.65	6.82	1.39	332	1.39	19.38	-47	180
0840	8.65	6.82	1.39	379	1.39	19.39	-46	180
0845	8.65	6.83	1.39	223	1.33	19.40	-45	180
0850	8.65	6.83	1.39	253	1.31	19.41	-45	180
0855	8.65	6.82	1.39	327	1.31	19.42	-45	180

0900 Sampled R-10
FE: 0.0

UNICAL WICHITA

10/4/07

0930 Set up on MW-21

DTW - 9.02

Time	DTW.	PH	Cond	Turb	DO	Temp	ORP	FR
0940	9.30	6.65	1.26	230	2.83	20.71	93	220
0945	9.40	6.66	1.23	258	1.88	20.68	84	220
0950	9.42	6.66	1.23	452	1.65	20.67	78	220
0955	9.50	6.67	1.23	456	1.52	20.65	77	220
1000	9.50	6.68	1.24	372	1.45	20.67	79	220
1005	9.50	6.68	1.24	377	1.39	20.67	79	220
1015	9.50	6.68	1.25	448	1.34	20.63	67	220
1020	9.50	6.68	1.26	323	1.29	20.63	62	220
1025	9.50	6.67	1.27	309	1.27	20.62	55	220
1030	9.50	6.67	1.27	358	1.23	20.55	56	220
1035	9.50	6.67	1.27	388	1.22	20.56	57	220

1040 Sample MW-21

FE 0.0

Sampled inside Column

Note: Well head BLDS Bruised

UNICAL WICHITA

10/4/07

0850 Set upon MW-20

DTW: 10.00'

Time	DTW	PH	Cond	Turb	DO	Temp	ORP	FR
1100	10.15	6.82	1.38	106	4.06	23.05	130	180
1105	10.15	6.81	1.38	149	3.04	22.92	130	180
1110	10.15	6.81	1.37	177	2.73	22.81	129	180
1115	10.15	6.82	1.37	224	2.56	22.77	130	180
1120	10.15	6.82	1.37	229	2.49	22.69	131	180
1125	10.15	6.82	1.37	298	2.42	22.63	133	180
1130	10.15	6.82	1.37	266	2.39	22.61	134	180
1135	10.16	6.82	1.37	257	2.37	22.69	135	180
1140	10.15	6.81	1.36	341	2.31	22.57	136	180
1145	10.15	6.81	1.36	336	2.25	22.49	137	180
1150	10.15	6.81	1.36	386	2.17	22.47	137	180
1155	10.15	6.80	1.36	347	2.15	22.47	137	180

1200 Sample MW-20

IF FOUND PLEASE RETURN TO:

NAME _____

COMPANY _____

STREET _____

CITY _____ STATE ____ ZIP ____

PHONE _____ _____

Reorder part # 101650
Phone # 800-241-6401

JOB BOOK

FROM BEN MEADOWS COMPANY

PROJECT NAME Unical Wichtaks

PROJECT NUMBER Delineation Smplg

CREW Kim High / John Nettauer

DATE Oct/08 BOOK # 02 OF ____

WEATHER _____

FIELD BOOK
16 PAGE
8 LEAVES
50% RAG

CURVE FORMULAS

$T = R \tan \frac{1}{2} I$

$T = \frac{50 \tan \frac{1}{2} I}{\text{Sin. } \frac{1}{2} D}$

$\text{Sin. } \frac{1}{2} D = \frac{50}{R}$

$\text{Sin. } \frac{1}{2} D = \frac{50 \tan \frac{1}{2} I}{T}$

$R = T \text{ cot. } \frac{1}{2} I$

$R = \frac{50}{\text{Sin. } \frac{1}{2} D}$

$E = R \text{ ex. sec } \frac{1}{2} I$

$E = T \tan \frac{1}{4} I$

$\text{Chord def.} = \frac{\text{chord}^2}{R}$

$\text{No. chords} = \frac{I}{D}$

$\text{Tan. def.} = \frac{1}{2} \text{ chord def.}$

The square of any distance, divided by twice the radius, will equal the distance from tangent to curve, very nearly.

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft.) and divide given deflection by the product.

Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance.

To find deflection for a given angle and distance. Multiply the angle by .01745, and the product by the distance.

GENERAL DATA

Right Angle Triangles. Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt. $10.10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. $25.25^2 \div 200 = 3.125$: $100 - 3.125 = 96.875$ = Base.

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

Leveling. The correction for curvature and refraction, in feet and decimals of feet is equal to $0.574 d^2$, where d is the distance in miles. The correction for curvature alone is closely, $\frac{2}{3} d^2$. The combined correction is negative.

Probable Error. If d_1, d_2, d_3, etc. are the discrepancies of various results from the mean, and if Σd^2 = the sum of the squares of these differences and n = the number of observations, then the probable error of the mean = $\pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n-1)}}$

MINUTES IN DECIMALS OF A DEGREE

1'	.0167	11'	.1833	21'	.3500	31'	.5167	41'	.6833	51'	.8500
2	.0333	12	.2000	22	.3667	32	.5333	42	.7000	52	.8667
3	.0500	13	.2167	23	.3833	33	.5500	43	.7167	53	.8833
4	.0667	14	.2333	24	.4000	34	.5667	44	.7333	54	.9000
5	.0833	15	.2500	25	.4167	35	.5833	45	.7500	55	.9167
6	.1000	16	.2667	26	.4333	36	.6000	46	.7667	56	.9333
7	.1167	17	.2833	27	.4500	37	.6167	47	.7833	57	.9500
8	.1333	18	.3000	28	.4667	38	.6333	48	.8000	58	.9667
9	.1500	19	.3167	29	.4833	39	.6500	49	.8167	59	.9833
10	.1667	20	.3333	30	.5000	40	.6667	50	.8333	60	1.0000

INCHES IN DECIMALS OF A FOOT

1-16	3-32	1/8	5-16	1/4	5-16	3/8	7/16	1/2	9/16	5/8	3/4
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729

1	2	3	4	5	6	7	8	9	10	11
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

10-8-07

Delineation Sampling - Unocal

WKS Personnel: Kim Higby, John Matthews

0930 Onsite - Temp = 60 - 70 F
Breezy, Clear

1115 Chris Carey (KDHE) onsite
PSA onsite
Conduct H+S Briefing, Review
JSA's

1150 Set up on GP-16(a) + (b)
Start GP-16
with zone ~25' bgs

[1240 Anna Kunkel onsite]

Set 5' screen 30-35' bgs for grab sample
Offset ~1 to 2 feet, ~~set 10' screen (15-25)~~
Leave drop out screen 20-25

1315 Anna conducts more H+S
Emphasis on hand safety
Set up on GP-18a
TD = 25', 15-25' screen
1" PVC

1345 Set up on GP-12

1355 Start GP-12(b)

1415 Stop work for vehicle traffic.
Hit water @ ~25' bgs.
Total depth 35' bgs
Set 5' screen 30-35' bgs

10-8-07

1435 Check WL at GP-16
shallow GP-16a WL = 12.7' bgs
deep GP-16b WL = 13.3' bgs
WL at GP-18b = DRY.
1510 Set up on GP-21 (deep only)
1535 Total depth @ 20' bgs
weathered shale at 13' bgs
Ground water at ~ 10.5' bgs
Screen 10-20' bgs (Temp)
* John Mettauer to Collect grab Samples at GP-16.
1620 Waiting for wrecker to pull probe out. - Sunk in soft soil.
WL at GP-21 = 14.1' bgs
WL at GP-12b = 12.5' bgs
* Left msg for Catherine Loering w/ Coleman regarding situation.
1600 Sampled GP-16A
1610 " GP-16B
1630 " GP-12B
1725 " GP-21
1725 " GP-21 DUP
1720 PSA Pulled pipe + plugged GP 16A, 16B, 12B w/ bentonite chip.
1815 URS Offsite.

10-9-07

0700 URS and PSA Onsite
Meet with Mike (Golder)
Sign in on USD property
Conduct Tailgate Safety
Weather: 58°F AM to 86°F (PM)
Clear, mild.
0745 Set up at GP-24 (USD property)
* JM to sample USD-13 with Golder.
GP-24 Total depth @ 15'
Encountered weathered shale ~ 10' bgs all the way.
Left hole open, no pipe in hole.
0810 Start GP-25 (USD property)
0820 Refusal at 15'
Weathered shale at ~ 14.7'
Dry hole.
0830 Set up on GP-26 (USD) (Si 17)
Hit water at ~7' bgs* and ~17' bgs (Sand)
Total depth at 30'
Hole producing large amounts of water
Screen 20-30' bgs GP-26 (b)
0930 Offset ~1' and probe GP-26(a)

Cont. 10-9-07

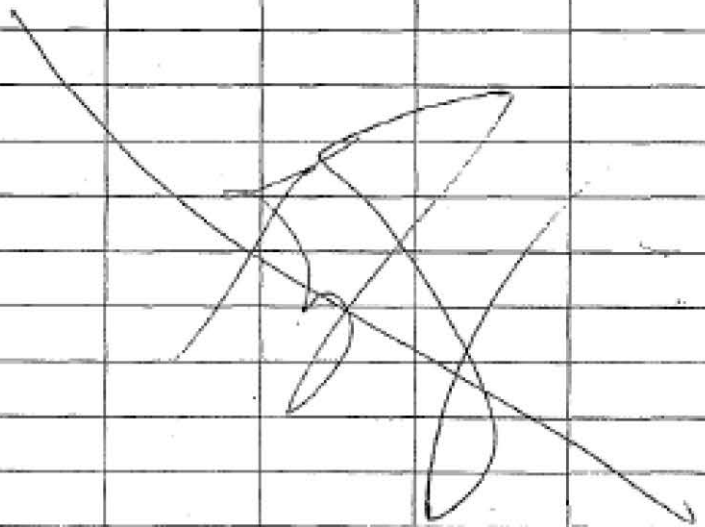
Probe hole @ 3'4 no soil samples
drop pipe in hole
Screen 5-15' bgs.
0900 Sampled USD-13 for VOC
USD-13 DUP
USD-13 MS/MSD
* Shared Samples w/ Golder
0940 Set up on GP-27 (USD)
Moist and strong odor (13')
PID = 658 ppm. (13')
>1000 (20')
1000 Stop work for H+S -
elevated PID + odor.
Evaluate PPE.
1015 Total depth @ 25' bgs
Weathered Shale. (black)
Set PVC 15-25' Screen (GP-27B)
Offset 1' w 5-15' Screen (GP-27A)
~~* GP-26~~ KH
* Lots of water.
1040 Spoke w/ Sandi (Hillman) to
request starting today on
locations. She did not see
a problem w/ that.
1050 Set up on GP-28 (Chevron/Unocal)

Cont. 10-9-07

1120 Total depth @ 20'
Encountered weathered Shale
at 18.5' bgs.
Groundwater at ~15' (Set 17)
Set 5' Screen (15-20')
1250 Setup at GP-29 (East Side Hillman)
1310 Total Depth @ 15' DRY
10-15' Stuck in Sampler.
Leave hole open.
Shale at 10' bgs. TD
1340 Set up on GP-30 (Hillman N.)
* 1345 Spoke w/ Harold Frost (Coleman)
Mr. Frost will fix nuts. Easier
for him to take care of it than
for us to call in someone.
1400 Confirm location on grass
w/ David Ryan (Hillman).
No known utilities.
* Move location GP-31 from
Concrete to Grass. (North side Hillman)
1410 Start GP-31
1420 Total depth 10' - DRY
Shale at 9.5 (weathered)
Leave hole open
1500 Met w/ Harold Frost (Coleman)

Cont. 10-9-07

Harold Cleared GP-22 + 23
of site utilities.
1500 Set up on GP-22
1525 Total depth at 15' (shale)
Set 5' screen 1" PVC
10-15' Screen
Shale at 14.5'
Water at ~ 8' bgs (sand)
1535 Set up at GP-23
1600 Total depth @ 15' DRY
Set 5' Screen (10-15')
1630 PSA Offsite
1730 Relinquish Samples - Fed Ex.



Delineation Smplg. 10-10-07

0700 URS Onsite (JM, KH)
JM to meet Golder for GW Samplg.
Weather: Clear 55-85°F
breezy, mild
0730 PSA Onsite
0740 Conduct Tailgate H&S
0800 Set up at GP-32 (Hillman North)
Groundwater ~13' (
Shale at 22.5' weathered
Sand at ~ 17'. (SP Sand at 20)
0830 TD at 25'
Set 5' screen 19-24'
0840 Set up on GP-33 (Hillman)
0905 TD = 30', Set ~~15-25~~ Screen (KH)
Shale at 24.5'
Water at ~~17' bgs~~ 15' bgs (KH)
0930 Start GP-34 (Hillman)
0950 TD = 15' DRY *
Shale at 14.5'
Very soft clay 5-11' Moist
5' Screen (10-15')
1010 Plugged GP-32 Bentonite HP
" GP31 DRY
" GP30 DRY

Cont. 10-10-07

Plugged GP-27 Buttmith HP
↳ DRY.
GP-24 DRY
GP-25 DRY
GP-26 A/B
GP-27 A/B
GP-28 ~~DRY~~ HP
GP-18a
GP-21, 22, 23
GP-33

1050 Provided feedback from LPO - Sat boring install.
1100 PSA Offsite - O
1200 Plugged GP-34 Dry
1230 Relinquish Samples Fedex
JM to take drum inventory.

IF FOUND PLEASE RETURN TO:

NAME _____

COMPANY _____

STREET _____

CITY _____ STATE ____ ZIP ____

PHONE _____ _____

Reorder part # 101650
Phone # 800-241-6401

JOB BOOK

FROM BEN MEADOWS COMPANY

PROJECT NAME Universal Wichita

PROJECT NUMBER Delineation Study

CREW John Hettmer / Kim Hyla

DATE 10/9/07 BOOK # ____ OF ____

WEATHER _____

FIELD BOOK
16 PAGE
8 LEAVES
50% RAG

CURVE FORMULAS

$T = R \tan \frac{1}{2} I$

$T = \frac{50 \tan \frac{1}{2} I}{\text{Sin. } \frac{1}{2} D}$

$\text{Sin. } \frac{1}{2} D = \frac{50}{R}$

$\text{Sin. } \frac{1}{2} D = \frac{50 \tan \frac{1}{2} I}{T}$

$R = T \cot. \frac{1}{2} I$

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$E = R \text{ ex. sec } \frac{1}{2} I$

$E = T \tan \frac{1}{4} I$

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Right Angle Triangles. Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt. $10.10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. $25.25^2 \div 200 = 3.125$. $100 - 3.125 = 96.875$ = Base.

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

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Probable Error. If d_1, d_2, d_3, etc. are the discrepancies of various results from the mean, and if Σd^2 = the sum of the squares of these differences and n = the number of observations, then the probable error of the mean $= \pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n-1)}}$

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4	.0667	14	.2333	24	.4000	34	.5667	44	.7333	54	.9000
5	.0833	15	.2500	25	.4167	35	.5833	45	.7500	55	.9167
6	.1000	16	.2667	26	.4333	36	.6000	46	.7667	56	.9333
7	.1167	17	.2833	27	.4500	37	.6167	47	.7833	57	.9500
8	.1333	18	.3000	28	.4667	38	.6333	48	.8000	58	.9667
9	.1500	19	.3167	29	.4833	39	.6500	49	.8167	59	.9833
10	.1667	20	.3333	30	.5000	40	.6667	50	.8333	60	1.0000

INCHES IN DECIMALS OF A FOOT

1-16	3-32	1/8	5-16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729

1	2	3	4	5	6	7	8	9	10	11
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

10/9/07

07 00 Arrived on Site
Held Safety Meeting
0730 went to 4150 for Bridge Plate
with Mike Gas in with
Gabe

10/9/07

0800 Set up on USD-13

DTW: 9.10 Meter: No. Well Casing

Time	DTW	pH	Cond	Turb	Do	Temp	ORP	FR
0815	9.10	6.85	2.20	50	2.15	12.75	4	200
0820	9.10	6.85	2.36	405	1.69	18.14	18	200
08259.10		6.90	2.36	412	1.65	18.18	20	200
830	9.10	6.90	2.34	362	1.62	18.29	27	200
0835	9.10	6.92	2.27	226	1.54	18.44	39	200
0840	9.10	6.92	2.26	148	1.46	18.59	55	200
0845	9.10	6.92	2.26	133	1.43	18.67	59	200
0850	9.10	6.92	2.24	112	1.39	18.73	63	200
0855	9.10	6.92	2.25	86.2	1.37	18.78	62	200
0900	9.10	6.91	2.25	92.2	1.38	18.78	59	200

0900 Sampled USD-13, USD-13DUP

Split Sample USD-13MS/MSD

with Golder FE: 0.0

1015 GP 26A DTW: DRY

TD: 15.01

1020 GP 26B DTW: 9.00

TD: 30.00'

1030 Start Pumping very silty

1045 Sampled GP-26B-VOC

GP-26B-DUP split Sampled Golder

8

10/9/07

1100 GP-27A DTW 10.65

GP-27B DTW 12.50

1115 Start Pump: GP-27A

1130 Sampled GP-27A

1135 Start Pumping GP-27B 1½ GAL

1140 Sampled GP-27B

1300 Set up on GP-28

DTW: 10.40

1305 Start Pumping 1½ GAL

1315 Sampled GP-28, GP-28MS/MSD

1330 DTW-23.50 TD 24.00 GP18A

1540 Set up on GP-22

DTW: 8.85

1600 Sample GP-22 GP-22DUP

Purged 1½ GAL

1630 GP-18A 24.40

10/10/07

0710 GP-24 open hole no PVC
DTW 8.85 TD 9.10

GP-25 open hole no PVC
DTW: 12.20 TD 12.70

0730 GP-26A dry no water
GPS Location unit

Location	LAT. N	Lon. W
GP28	37.752876 N	97.309196 W
GP30 dry	37.752590 N	97.311450 W
GP31 dry	37.752335 N	97.311478 W
GP29	37.752724 N	97.310600 W
GP24	37.753120 N	97.309860 W
GP25	37.753258 N	97.309700 W
GP26	37.753242 N	97.309540 W
GP27	37.753113 N	97.309341 W
GP18	37.752576 N	97.309258 W
GP16	37.751583 N	97.309471 W
GP12	37.751572 N	97.309996 W
GP21	37.751633 N	97.311050 W
GP22	37.751648 N	97.311409 W
GP23	37.751640 N	97.311653 W

GP-23 DTW 12.60 TD 15.00
GP 18 DTW - 21.10 T

0830 GP-23 DTW 12.60 TD 15
Sampled GP-23
0845 Set up on GP-18
DTW: 21.16 TD 24.00
0900 Sampled GP-18

0910 GP-32
37.753025 N 97.312744 W
DTW: 18.85 TD 23.30
0930 Sampled GP-32
0940 GP-33
97.753338 N 97.312416 W
TD 23.5 DTW 18.20
1000 Sampled GP-33

DRUM INV.

Soil	1	Full	
"	1	Empty	
Purge WATE	5 1/2	OLD	DRUM
This Sampling	1	Drum	
Empty STEAL	Fluid	Drum	4
Empty POLY	Fluid	Drum	1

Dec 2017

Location Wichita, KS Date 12-18-07

Project / Client Chevron / Pilot test

41008451.03

Team - R. Krebs and J. Mettauer (URS)
Purpose - groundwater sampling
Weather - 30° F, clear, calm
Equipment - peristaltic pump, disposable tubing, coolers, ice, sample jars.
700 - Meet at hotel, leave for site after getting ice.
Perform daily safety tailgate meeting. JSAs reviewed in detail last night.
730 - Set up over R-2 on Coleman Site. Perform SPSA.
See Groundwater Purge Forms
900 - Sample R-2. Setup over R3.
Called J. Youngerman (URS Project Chemist) for questions on Chain-of-Custody procedures and Microseeps. Left message.
1030 - Sample R-3
J. Youngerman called - instructed me to write "Voas may not be preserved" on Lancaster COC. Informed her that we did not receive a sample kit from Microseeps and that the fatty acid samples

Rota Krebs 12-18-07

Location Wichita, KS Date 12-18-07

Project / Client Chevron / Pilot Test

41008451.03

would not be preserved.
1045 - Setup over TW-4. Perform SPSA.
1145 - Collect sample TW-4
1200 - Set up over R-4
1215 - R. Krebs leaves site to dispose of purge water at former Unocal site, get ice for samples, and to get lunch
1310 - R. Krebs returns to site. R-4 sample collected. Setup over R-5. Eat Lunch
1445 - Collect sample R-5.
Ask Coleman to move trailer because it is directly over R-6. Trailer is moved.
530 - Anna Kunkel and Derek Peacock (URS) call and inform us that we will have to resample all 6 wells for VFA after we obtain jars with correct preservative from Microseeps. J. Mettauer to drive to Oklahoma tonight to get Microseeps package
10 - Collect Sample R6. J. Mettauer leaves.
1630 - R. Krebs leaves site, drops off supplies at trailer
730 - Drop off Lancaster Samples at FedEx - End of day

Rota Krebs 12-18-07

Location Wichita, KS Date 12-19-07

Project / Client Chevron / Pilot Test

4100845103

0700 - Leave hotel, pick up supplies at Unocal trailer

0730 - Arrive at Coleman site. Daily Safety Tailgate meeting.
Team - R. Krebs and J. Mettauer
Purpose - Pilot test groundwater sampling
Weather - 32°F, clear skies, calm
Equipment - Peristaltic pump, disposable tubing, coolers, ice, sample jars.

845 - Sample R-12. Set up over R-11

- At 820 - performed feedback with Anna Kunkel on Loss Prevention Observations conducted by me on J. Mettauer.

945 - Sample R-11. Set up over MW-18
Called to confirm Lancaster received sample cooler this morning.

1105 - Sample MW-18. Set up over R-10
Perform SPSA.

1230 - Sample R-10. Leave site to dispose of purge water and to take lunch break.

1345 - Set up at MW-21 inside Colem building. Perform SPSA.

Rita Krebs 12-19-07

Location Wichita, KS Date 12-19-07

Project / Client Chevron / Pilot Test

4100845103

1445 - Collect sample MW-21. Set up over MW-20. Perform SPSA.

1600 - Collect sample MW-20. Leave Coleman, drop off sample supplies and purge water at trailer.

1640 - Drop off samples at FedEx

1700 - End of Day

RK 12-19-07

Rita Krebs

Location Wichita, KS Date 12-20-0

Project / Client Chevron / Pilot Test

4100845.03

700- Leave hotel, go to trailer and load equipment.

0725- Arrive at site.

Objective- re-sample 6 wells for VFA. (R-2, TW-4, R-3, R-4, R-5, R-6)

Team- R. Krebs and J. Mettauer

Weather- 30°F, light wind, clear skies

Equipment- peristaltic pump and Horiba. Sample cooler with ice, sample jars.

Daily Safety Tailgate meeting

800- Collect sample R-2. All parameters stabilized except ORP, which shows error message. Re-calibrate horiba

845- Collected sample R-3. pH and ORP still reading error messages. Change batt

930- Collected sample TW-4.

Rita Krebs leaves site, disposes of purge water at Unocal site, gets more tubing from Home Depot. Returns to site.

1000- collect sample R-4. one of six bottles broke. I call Jean Youngerman and she says 5 are okay.

Re-calibrate Horiba.

Rita Krebs 12-20-07

Location Wichita, KS Date 12-20-07

Project / Client Chevron / Pilot Test

4100845.03

1130- Collect sample R-5. Set up over R-6.

1215- Collect sample R-6. Pack up coolers. Leave Coleman stand go to Unocal trailer to drop off equipment and purge water

1315- leave Unocal site. Demob.

RK 12-20-07

Rita Krebs

Chevron - former UNOCAL site 3-24-08

Activity: Pilot List Sampling
Weather: Ptly cloudy to clear, 65F, windy.
Personnell: Kim High, Kim Nguyen

1230 Visit site and check available equipment and materials in storage trailer

1300 Check rental equipment and sample kits. Address equipment/sample container issues.

1430 Perform ~~Safe~~ KH Safe ~~Permac~~ KW Performance Self Assessment (SPSA). Conduct H&S Tailgate Meeting. Review JSAs: GW Sampling and and Sampling: Well Vault. Review routes to hospital and occupational health clinics. Review routes to Store, safety store, etc.

* SPSA - review vehicle safety and journey management plan.

1510 Called Katy Goering to set up meeting at Coleman property (for safety paths) at ~~5:1~~ KW 1715.

1545 Purchase safety equipment at safety store and Walmart Complete "vehicle inspection form."

1700 Unload purchases at site trailer.

1715 Meet with Katy to walk "tornado" path.

1730 Offsite. Conduct LPO (driving) on K. High on drive back to hotel.

-Kim Nguyen 3/24/08

Clear Skies, High 68°F

Purpose: GW Sample at former Rhodeal (Pilot Test Smplg)
Feedback Session for LPO conducted on 3/24/08.

~~Hoss~~

Equipment: Peristaltic Pump, Horiba Water Quality Meter w/ Flow Thru Cell, Water Level meter, Dedicated tubing

Crew: Kim Nguyen, Kim High

0730 Load truck with supplies and equipment. Call Anna Kunkel to conduct feedback session for LPO (driving) completed on 3/24/08.
* Waiting for water level meter to arrive at hotel via Fedex. Complete "vehicle inspection form."

0800 Pick up supplies from site trailer. Calibrate Horiba.

Calibration Standard	Final Reading
pH = 4.00	pH = 3.98
Sp. Conductivity = 4.49 $\frac{mS}{cm}$	S.C = 4.48 $\frac{mS}{cm}$
Turbidity = 0.0 NTU	Turbidity = 0.0 NTU

0900 Setup at R-5

0925 Start pumping w/ peristaltic.

0940 SP SA - STE at edge of grass where meets curb. Discuss hazards.

1005 Collect PT-R5-020 and -021 *Added HCl to VOAs as needed

Final parameters:

R5 parameters continued.
WL = 5.74 'btoc
purge rate = 275 mL/min
vol purged =
Temp = 16.86 °C
Sp. Cond = 1.44 mS/cm
DO = 0.37 mg/L
pH = 7.04
ORP = 163 mV
TURBITY = 0.3 NTU

1030 Set up at R-3
1045 Pump on at R-3.
1135 Collect PT-R3-020 sample. Added HCl to VOA
1140 Dump purge water into drums. Conduct SPSA - instead of having to back truck into oncoming traffic, pull thru fence and turn around before lock gate.
1210 Break for lunch. Purchase ice.
1320 Setup on TW-4
Conduct LPO - Sampling Setup
1340 Start purge
SPSA (Kim Hogh) - Locate MW-8, travel path.
*Observe soft saturated ground - discuss w/ Kim Nguyen to avoid driving in those areas
1430 Collect PT-TW4-020 sample. Decon WL meter
1450 Set up on R-2.

3/25/08

1455 Pump on at R-2.

1535 Collect PT-R2-020 sample. VOA preservative added to get pH < 2. Decon WL meter

1600 Set up on MW-8. Well is hidden in concrete, covered by sand and fine gravel material.

1605 Pump on at MW-8. Problems with specific conductivity reading. Need to recalibrate Horiba.

1740 Collect PT-MW8-010 sample. Decon WL meter.

1830 Ship 2 coolers via Fedex to Lancaster Labs.

3/25/08

Clear skies, Chance of rain storms.

Purpose: GW sampling at R-8, R-7, R-10, MW-18, R-11, R-12, and R-4; Feedback session on LPO

Equipment: Horiba U-22 Water Quality meter, Solinst WL meter, Peristaltic Pump, dedicated tubing

Crew: Kim Nguyen and Kim High

0715 Load equipment from site trailer. Purchase ice. Conduct H&S Tailgate meeting Calibrate Horiba.

Solution Standard	Final Reading
pH = 4.00	3.98
Sp. Cond = 4.49 $\frac{mS}{cm}$	4.58 $\frac{mS}{cm}$
Turbidity = 0.0 NTU	0.0 NTU

0808 Set up on R-8. Conduct SPSA - search for spiders in vault using a long metal tool.

0813 Pump on at R-8.

0855 Collect PT-R8-010 Sample. Decon WL meter.

0910 Set up on R-7.

0917 Pump on at R-7.

0955 Collect PT-R7-013 Sample (MS/MSD). Decon WL meter.

1010 Set up on R-10.

1028 Pump on at R-10.

1105 Collect PT-R10-020 Sample. Decon WL meter.

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1125 Set up on MW-18.

1130 Pump on at MW-18.

1210 Collect PT-MW18-020. sample. Decon WL meter.

1220 Dump water into drums. Leave site for Home Depot to purchase a long crowbar. Break for lunch. Conduct SPSA - determine/plan journey to store.

1400 Set up on R-11. Recalibrate Horiba. Conduct SPSA - position truck to block the wind - wind can potentially cause hazards

1407 Pump on at R-11.

1500 Collect PT-R11-020. Decon WL meter.

1510 Set up on R-12.

1523 Pump on at R-12.

1600 Collect PT-R12-020. Decon WL meter. Conduct SPSA - think about purging another well. Because of high chance for rain tomorrow (many potential hazards), try to get as much done today.

1610 Set up on R-4. Conduct SPSA; set up cones due to high traffic, move truck bed further away from road, lifting technique with crowbar, thinking about which direction to move the heavy manhole to avoid foot injuries, thought of hazards and remedies regarding the garter snake found (looked at SMS) inside manhole.

3/26/08

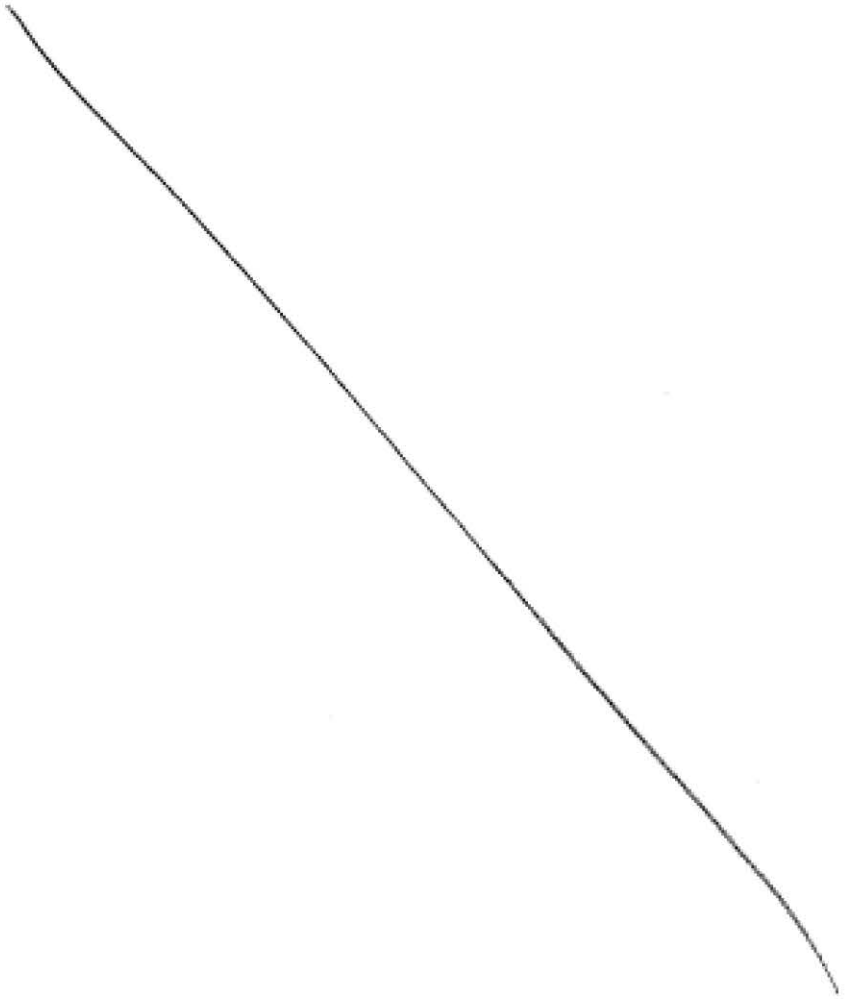
1629 Pump on at R-4.

1705 Collect PT-R4-020 sample. Decon WL meter.

1720 Unload equipment. Dump water. Pack samples

1800 Ship samples via Fedex to Lancaster Laboratory and Microseeps Laboratory.

1815 Offsite



3/26/08

(Foggy, light wind, High 63° F)

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Purpose: GW Sampling at R-6, MW-10, MW-21 and MW-20
Conduct LPO and feedback session.

Equipment: Horiba U-22 Water Quality Meter w/ flow thru cell, Solinst WL meter, Peristaltic Pump, Dedicated tubing

Crew: Kim Nguyen and Kim High

0730 Load equipment. Fax sample logs to Jean Youngerman. Conduct tailgate H&S meeting.
& Review and update JSA - opening well vaults.
0810 Calibrate Horiba.

Standard Solution	Final Reading
pH = 4.00	pH = 3.99
Sp. Cond = 4.49 $\frac{mS}{cm}$	Sp. Cond = 4.51 $\frac{mS}{cm}$
Turbidity = 0.0 NTU	Turbidity = 0.0 NTU

0830 Set up on R-6.
0844 Pump on at R-6
0930 Collect PT-R6-020 sample. Decon WL meter. Conduct SPSA - to avoid potential injuries with lifting sampling equipment to wells inside Coleman building, attempt to get a cart to carry equipment.
1000 Set up on MW-21.
1009 Pump on at MW-21
1100 Collect PT-MW21-020 sample. Decon WL

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meter.

1120 Set up on MW-20. Conduct LPO. KN observes KH

1125 Pump on at MW-20

1210 Collect PT-MW20-020 and -021 (DUP)

1230 Near loss incident occurred. Truck ran into protective casing of well at R-10. Call PjM - Derek Peacock to inform of incident. Fill out NLI. Break for lunch. Decon WL meter. Dump purge water into drums.

1400 Set up on MW-10.

1424 Pump on at MW-10. Call Derek Peacock to conduct feedback session on LPO done earlier in day.

1500 Collect PT-MW10-010 Sample.

1520 Assess situation at R-10. Well cover has been dislodged, but no damage has occurred in the interior. The well cover (protective casing) still is able to fulfill its purpose.

1600 Conduct housekeeping Purchase ice. Pack coolers.

1700 Ship coolers via Fedex. Scan → pdf forms and send to PjM.

3/27/08

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/25/08
Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High
Well Identification: MW-8
Initial Water Level (feet BTOC): 1.35
Well Diameter (inches): 2
Well Depth (feet): 18.88' btoc
Screen Interval (feet ~~BTOC~~ bgs): 7.6-17.6
Well Volume: 10.7 L
Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): 12.6
Sample Time: 1740
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~3%~~ 10%	Dissolved Oxygen (mg/L) +/- ~~10%~~ 0.5	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- ~~10~~ 20 mV	Turbidity (NTU) < ~~10~~ 50 NTU, or ~~+/-~~ ~~10%~~	Comments
1605	1.40	Pump on	-	-	KH -	-	-	-	-	
1610	2.02	125	0.63	16.88	>99.9	2.65	7.15	130	91.4	Flow rate as low as possible to minimize drawdown
1615	2.17	125	1.25	16.76	>99.9 KH	3.06	7.15	73	47.7	Problems w/ Specific Conductivity probe
1620	2.30	350	3.0	16.76	583	3.28	7.13	36	33.9	
1625	2.20	200	4.0	16.64	92.4	3.45	7.13	19	23.9	
1630	2.20	175	4.88	16.73	35.6	2.68	7.13	14	25.5	
1635	2.25	200	5.88	16.75	18.4	2.66	7.14	8	19.9	
1640	2.27	200	6.88	16.75	40.2	1.94	7.13	2	18.1	
1645	2.23	150	7.63	16.69	55.8	2.54	7.13	1	14.1	
1650	2.25	150	8.38	16.71	>99.9	2.48	7.12	2	21.2	
1655	2.31	150	9.13	16.79	>99.9	1.33	7.13	-4	20.4	
1700 KH	2.36	175	10.01	16.73	>99.9	2.84	7.13	-7	10.1	
1705 KH	2.37	175	10.88	16.75	99.4	2.89 KH	7.13	-8	12.0	
1710 KH	2.38	150	11.63	16.73	99.2	3.13	7.13	-9	10.4	
1715 KH	2.40	150	12.38	16.75	>99.9	2.58	7.12	-12 KH	8.1	
1720 KH	2.44	150	13.13	16.72	70.4	1.65	7.13	-13	2.5	
1725	2.48	150	13.88	16.71	>99.9	1.11	7.12	-16	4.3	
1728	2.52	150	14.63	16.71	>99.9	3.33	7.12	-16	10.6	
1731	2.45	150	15.38	16.68	>99.9	2.89	7.12	-15	11.1	
1734	2.46	150	16.13	16.64	>99.9	2.98	7.12	-17	4.6	

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.16	0.61	1.49	2.46	5.56	9.88	15.44

1740 Collect PT-MW8-010

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling

Date: 3/27/08

Location: Wichita, Kansas (Coleman Property)

Field Personnel: Kim Nguyen, Kim High

Well Identification: MW-10

Initial Water Level (feet BTOC): 8.94

Well Diameter (inches): 2

Well Depth (feet): ~~~40 bgs~~ ~35.5 btoc

Screen Interval (feet ~~BTOC~~ bgs): 14.6-34.6

Well Volume: 16.2 L

Pump/Purging Device: Peristaltic Pump

Pump Intake Depth (feet BTOC): ~24.6

Sample Time: 1500

Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~5%~~ 10%	Dissolved Oxygen (mg/L) 0.5 +/- ~~10%~~ mg/L	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) < ~~10~~ NTU, ~~or~~ 50 ~~10%~~	Comments
KH 1424 ~~1419~~	8.94	Pump on	-	-	-	-	-	-	-	very soft bottom
1429	8.99	175	0.88	14.91	7.31	3.71	7.17	200	70.8	
1434	8.99	175	1.75	14.62	1.75	3.65	7.15	194	50.8	
1439	8.99	175	2.63	14.62	3.85	3.62	7.15	192	53.3	
1444	8.99	175	3.50	14.64	3.25	4.15	7.15	191	47.9	
1449	9.00	175	4.38	14.68	5.79	4.16	7.16	191	40.9	
1454	9.00	175	5.25	14.63	5.46	4.17	7.16	191	38.4	
1459	9.00	175	6.13	14.58	5.55	4.15	7.16	191	40.0	
1500	Collect PT-MW10-010									

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.46	5.56	9.88	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling

Date: 3/26/08

Location: Wichita, Kansas (Coleman Property)

Field Personnel: Kim Nguyen, Kim High

Well Identification: MW-18

Initial Water Level (feet BTOC): 6.13

Well Diameter (inches): 2

Well Depth (feet): ~ 21.4' bgs

Screen Interval (feet ~~BTOC~~ bgs): 4.1-18.6

Well Volume: 9.3 L

Pump/Purging Device: Peristaltic Pump

Pump Intake Depth (feet BTOC): ~ 11

Sample Time: 1210

Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~6%~~ 10%	Dissolved Oxygen (mg/L) < 5 +/- ~~10%~~ mg/L	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) < ~~10~~ NTU, ~~or <5~~ SD ~~10%~~	Comments
1130	6.13	Pump on	-	-	-	-	-	-	-	
1135	6.25	175	0.88	14.85	26.0	0.80	6.63	-13	52.5	
1140	6.27	175	1.75	14.85	25.5	0.82	6.63	-15	22.3	
1145	6.27	175	2.63	14.79	9.0	0.87	6.63	-18	2.9	
1150	6.29	175	3.50	14.49	3.58	0.87	6.64	-20	11.2	
1155	6.30	175	4.38	14.58	3.19	0.85	6.64	-21	26.0	
1200	6.31	175	5.26	14.58	2.69	0.83	6.65	-20	41.1	
1205	6.31	175	6.13	14.43	2.53	0.83	6.65	-20	45.2	
1210	Collect PT-MW18-020									* Added acid to VOAs

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.16	0.61	1.40	2.49	5.59	9.88	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/27/08
Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High
Well Identification: MW 20
Initial Water Level (feet BTOC): 8.44
Well Diameter (inches): 2"
Well Depth (feet): ~~6-21~~ 24
Screen Interval (feet BTOC): 6-21 bgs
Well Volume: 9.5 L
Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): ~13.5
Sample Time: 1210
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (liter gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~3%~~ 10%	Dissolved Oxygen (mg/L) 0.5 mg/L +/- ~~10%~~ 2	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- ~~10~~ 20 mV	Turbidity (NTU) <~~10~~ NTU, ~~same~~ OR ~~10%~~	Comments
1125	8.44	Pump on	-	-	-	-	-	-	-	
1130	8.87	200	1.0	21.55	>99.9	4.75	6.95	23	210	
1136	8.89	250	2.25	21.57	>99.9	4.77	6.97	32	212	
1140	8.85	150	3.0	21.56	>99.9	4.49	7.03	33	256	
1145	8.86	160	3.8	21.57	>99.9	1.99	7.03	36	51.6	
1150	8.86	175	3.68	21.60	>99.9	2.40	7.02	45	56.1	
1155	8.86	175	5.55	21.59	>99.9	2.29	7.02	44	43	
1200	8.87	160	6.35	21.62	>99.9	2.23	7.02	40	16.5	
1205	8.87	150	7.10	21.62	>99.9	2.18	7.02	44	15.6	
1210	Collect Sample PT-MW20-020 and -021									* Added acid to VOAs

Well Diameter (in)	1	2	3	4	5	6	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.68
Volume (L/ft)	0.15	0.61	1.40	2.46	5.56	9.88	15.88

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling

Date: 3/27/08

Location: Wichita, Kansas (Coleman Property)

Field Personnel: Kim Nguyen, Kim High

Well Identification: MW-21

Initial Water Level (feet BTOC): 7.68

Well Diameter (inches): 2

Well Depth (feet): ~22.1' bgs

Screen Interval (feet ~~BTOC~~ bgs): 10.3 - 20.3

Well Volume: 8.8 L

Pump/Purging Device: Peristaltic Pump

Pump Intake Depth (feet BTOC):

Sample Time: 1100 (DUP)

Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~3%~~	Dissolved Oxygen (mg/L) +/- 0.5 ~~mg/L~~	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) < ~~10~~ NTU, ~~+/- 10%~~ > 50 ~~10%~~	Comments
1009	7.68	Pump on	-	-	-	-	-	-	-	
1014	7.89	175	0.88	19.38	>99.9	0.99	7.03	49	162.0	Water is orangish color
1019	7.94	150	1.63	19.43	>99.9	0.84	7.00	37	183.0	Flow rate as low as possible to minimize drawdown
1024	7.97	200	2.63	19.50	>99.9	0.77	6.96	-37	112.0	
1029	8.02	200	3.63	19.56	>99.9	0.70	6.97	-33	101.0	
1034	8.03	200	4.63	19.55	>99.9	0.66	6.97	-27	95.1	
1039	8.08	225	5.76	19.61	73.4	0.62	6.96	-20	44.9	
1044	8.08	200	6.76	19.60	54.0	0.60	6.96	-12	27.2	
1049	8.10	200	7.76	19.59	46.2	0.58	6.95	-13	1.3	
1054	8.10	200	8.76	19.59	41.5	0.56	6.95	-11	26.5	
~~1059~~										
1100	Collect PT-MW21-020									

Well Diameter (in)	1	2	3	4	5	6	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.46	5.55	9.89	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling

Date: 3/25/08

Location: Wichita, Kansas (Coleman Property)

Field Personnel: Kim Nguyen, Kim High

Well Identification: R-2

Initial Water Level (feet BTOC): 1.77

Well Diameter (inches): 1

Well Depth (feet): 23.42' btoc

Screen Interval (feet ~~BTOC~~ bgs): 7.7-22.7

Well Volume: 13.2L

Pump/Purging Device: Peristaltic Pump

Pump Intake Depth (feet BTOC): ~ 15.2

Sample Time: 1535

Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~3%~~ 10%	*Dissolved Oxygen (mg/L) & S +/- ~~10%~~ 2"	pH (SU) +/- 0.2	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) <~~10~~ 20 NTU, or ~~+10%~~ 5%	Comments
~~1454~~	1.77	Pump on	-	-	-	-	-	-	-	
1500	2.08	200	1.2	15.97	17.7	1.02	7.44	58	188	
1505	2.15	200	2.2	15.87	25.6	0.77	7.49	43	141	
1510	2.20	200	3.2	15.72	24.1	0.65	7.50	36	107	
1515	2.25	200	4.2	15.89	18.1	0.56	7.51	34	96.3	
1520	2.28	200	5.2	15.76	15.9	0.50	7.51	31	115	
1525	2.32	225	6.33	15.90	12.4	0.46	7.54	31	145	
1530	2.34	200	7.33	15.96	12.7	0.45	7.55	30	162	
1535	2.37	200	8.33	15.90	11.8	0.58	7.55	35	121	
1535		Collect Sample [RT-R2-020]								* Added HCl acid to sample (VOAs)

Well Diameter (in)	1	2	3	4	5	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.46	5.56	9.89	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/25/08

Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High

Well Identification: R-3
Initial Water Level (feet BTOC): 1.94

Well Diameter (inches): 1
Well Depth (feet): 18.97' btoc (soft bottom)

Screen Interval (feet ~~btoc~~ bgs): 8.6-18.6
Well Volume: 10.4 L

Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): ~15' btoc

Sample Time: 1135
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~4%~~ 10%	Dissolved Oxygen (mg/L) +/- ~~10%~~ 0.5	pH (SU) +/- 0.2	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) < ~~10~~ NTU, or ~~50~~	Comments
1045	2.02	Pump on	-	-	-	-	-	Kit	-	
1055	2.75	250	1.25	14.20	4.60	0.57	7.12	-126	29.4	clear w/ black grains
1100	2.86	250	2.5	14.37	3.08	0.52	7.10	-135	26.4	
1105	2.92	200	3.5	14.45	3.06	0.42	7.13	-140	22.0	
1110	2.94	175	4.38	14.01	2.50	0.34	7.15	-146	21.9	
1115	3.01	150	5.13	13.95	2.45	0.34	7.12	-148	22.5	
1120	2.75	150	5.88	14.34	2.42	0.34	7.09	-149	19.8	
1125	2.77	150	6.63	14.29	2.50	0.36	7.10	-150	18.5	
1130	2.77	150	7.38	14.41	2.55	0.35	7.10	-151	16.3	
Collect		PT-R3-020								* Added HCl acid to sample (VOAs)

Well Diameter (in)	1	2	3	4	5	6	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.09
Volume (L/ft)	0.16	0.61	1.40	2.46	5.56	9.88	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/26/08

Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High

Well Identification: R-4 (piezometer-drawdown tube)
Initial Water Level (feet BTOC): 2.22

Well Diameter (inches): 1
Well Depth (feet): ~23.3' bgs

Screen Interval (feet ~~BTOC~~ bgs): 8.3-23.3
Well Volume: 12.9 L

Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): ~15.8

Sample Time: 1705
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~5%~~	Dissolved Oxygen (mg/L) +/- ~~10%~~ 5%	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- ~~10~~ 5% mV	Turbidity (NTU) < ~~10~~ 50 NTU, ~~+/- 10%~~	Comments
1629	2.23	Pump on	-	-	-	-	-	-	-	
1634	2.37	200	1.0	16.65	>99.9	0.62	7.11	-135	160.0	
1639	2.38	225	2.13	16.62	>99.9	2.21	7.09	-129	44.8	Clear w/ clumps of Fe oxide
1644	2.38	225	3.25	16.64	>99.9	0.48	7.09	-135	20.8	
1649	2.38	225	4.38	16.64	>99.9	0.40	7.09	-134	60.0	Water is clear discharging from tube, clumps beneath inflow thru cell.
1654	2.38	225	5.5	16.60	>99.9	0.73	7.10	-127	1.9	Clear outflow thru cell
1659	2.38	225	6.63	16.66	>99.9	0.37	7.09	-131	0.0	
1705	Collect PT-R4-020									*Added acid to VOAs

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.46	5.56	9.88	15.44

Monitoring Well Purging Form

* Cap missing off of drawdown tube

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/25/08
Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High
Well Identification: R-5 (Piezometer & drawdown tube)
Initial Water Level (feet BTOC): 5.57'
Well Diameter (inches): 1
Well Depth (feet): ~23.5' bgs, 24.01' btoc (soft bottom)
Screen Interval (feet ~~BTOC~~ bgs): 8.5-23.5
Well Volume: 2.8 L
Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): ~16
Sample Time: 1005 (KN) (DUP)
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~10~~%	Dissolved Oxygen (mg/L) +/- ~~10%~~ 0.5	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) < ~~10~~ NTU, or ~~+/- 10%~~	Comments
927	5.57	Pump on	-	-	-	-	-	-	-	
932	5.71	300	1.5	16.99	2.20	0.51	6.88	230	25.7	Clear
937	5.72	300	3.0	16.73	2.24	0.45	6.93	210	2.5	Clear
942	5.71	250	4.25	16.53	1.63	0.43	6.95	196	0.0	Clear
947	5.72	250	5.5	16.84	1.72	0.39	6.98	184	5.8	Clear
952	5.71	260	6.8	17.04	1.54	0.37	6.99	175	0.0	Clear
957	5.73	260	8.1	16.92	1.46	0.38	6.99	164	0.0	Clear
1002	5.74	275	9.48	16.86	1.44	0.37	7.04	163	0.3	Clear
1005		collect	PT-R5-020							* Added HCl to sample (VOAs)
			PT-R5-021							

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.15	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.46	5.56	9.88	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3-27-08
Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High
Well Identification: R-6
Initial Water Level (feet BTOC): 12.26
Well Diameter (inches): 1"
Well Depth (feet): ~29' bgs
Screen Interval (feet ~~BTOC~~ bgs): 9-20
Well Volume: 10.2 L
Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): 17.5
Sample Time: 0930
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~3%~~ 10%	Dissolved Oxygen (mg/L) 0.5 +/- ~~10%~~ 5%	pH (SU) +/- 0.2	Oxidation-Reduction Potential (mV) +/- ~~10~~ 50 mV	Turbidity (NTU) < ~~10~~ 50 NTU, ~~<5 NTU~~	Comments
844	12.28	Pump on	-	-	-	-	-	-	-	
849	12.34	250	1.25	18.29	1.32	0.55	6.87	196	0.0	* Flushing turbidity
854	12.32	200	2.25	16.40	32.4	0.53	6.94	187	0.0	*
859	12.32	225	3.38	16.04	28.6	0.49	6.96	179	12.8	
904	12.31	225	4.50	15.93	19.4	0.46	6.97	166	7.7	
909	12.32	225	5.63	15.80	14.8	0.44	6.98	161	15.0	
914	12.33	225	6.75	15.98	13.7	0.43	6.99	155	12.2	
919	12.32	225	7.88	15.92	12.0	0.42	6.99	151	14.8	
924	12.32	225	9.0	15.93	11.3	0.42	6.99	148	28.1	
0929	12.32	225	10.13	15.94	6.04	0.46	6.98	146	49.4	
0930		Collect	Sample	PT-R6-020						* Added acid to VOAs

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.16	0.61	1.40	2.48	5.56	9.88	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling

Date: 3/26/08

Location: Wichita, Kansas (Coleman Property)

Field Personnel: Kim Nguyen, Kim High

Well Identification: R-7 (Piezometer-drawdown tube)

Initial Water Level (feet BTOC): 6.34

Well Diameter (inches): 1

Well Depth (feet): ~25' bgs

Screen Interval (feet ~~BTOC~~ bgs): 10-25

Well Volume: 11.4 L

Pump/Purging Device: Peristaltic Pump

Pump Intake Depth (feet BTOC): ~17.5

Sample Time: 955 (MS/MSD)

Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~5%~~ 10%	Dissolved Oxygen (mg/L) 0.5 +/- ~~10%~~ mg/L	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- 10% mV	Turbidity (NTU) < ~~10~~ 50 NTU, ~~or +/- 10%~~	Comments
917	6.34	Pump on	-	-	-	-	-	-	-	
922	6.39	275	1.38	14.57	17.6	0.60	7.05	-120	0.0	Clear
927	6.39	275	2.75	14.64	9.8	0.48	7.06	-127	47.2	Clear
932	6.39	300	4.25	14.66	3.57	0.43	7.07	-131	0.7	Clear
937	6.39	300	5.75	14.69	2.43	0.43	7.07	-135	0.0	Clear
942	6.39	300	7.25	14.66	1.88	0.40	7.08	-138	22.4	Clear
947	6.39	300	8.75	14.72	1.62	0.41	7.08	-140	23.8	Clear
952	6.39	300	10.25	14.71	1.50	0.39	7.09	-142	28.3	Clear
										* Added acid to VOAs
955	Collect PT-R7-013 (MS/MSD)									

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.45	5.55	9.88	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/26/08
Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High
Well Identification: R-8 (Piezometer - drawdown tube)
Initial Water Level (feet BTOC): 1.98
Well Diameter (inches): 1
Well Depth (feet): ~ 25.5' bgs
Screen Interval (feet ~~BTOC~~ bgs): 10.5-25.5
Well Volume: 14.3 L
Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): ~ 18
Sample Time: 855
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) ~~+/- 3% or 0.1~~	Dissolved Oxygen (mg/L) ~~+/- 10% or 0.5~~	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) ~~+/- 10 mV~~	Turbidity (NTU) ~~< 10 NTU, or +/- 10%~~	Comments
813	1.94	Pump on	-	-	-	-	-	-	-	
818	2.06	250	1.25	13.34	8.72	1.19	6.91	202	0.0	clear
823	2.06	250	2.5	13.34	33.1	1.00	7.05	195	0.0	Clear
828	2.07	300	4.0	13.38	51.1	0.85	7.09	191	0.0	Clear
833	2.07	300	5.5	13.41	63.2	0.81	7.10	187	0.0	Clear
838	2.07	300	7.0	13.43	56.6	0.77	7.10	185	0.0	Clear
843	2.09	275	8.38	13.43	>99.9	0.77	7.10	184	0.0	clear
848	2.08	300	9.88	13.46	44.0	0.82	7.11	181	0.0	Clear
855	Collect PT-R8-010									* Call Derek about issues w/ Sp. Cond. stabilizing
										Derek P. says that Sp. Cond is not as important.
										* Added acid to VOAs.

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.16	0.61	1.40	2.46	5.55	9.89	15.44

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling

Date: 3/26/08

Location: Wichita, Kansas (Coleman Property)

Field Personnel: Kim Nguyen, Kim High

Well Identification: R-10 (Piezometer - drawdown tube)

Initial Water Level (feet BTOC): 6.95 btoc

Well Diameter (inches): 1

Well Depth (feet): ~21.5' bgs

Screen Interval (feet ~~BTOC~~ bgs): 6.5-21.5

Well Volume: 8.9L

Pump/Purging Device: Peristaltic Pump

Pump Intake Depth (feet BTOC): ~14

Sample Time: 1105

Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~5%~~ 10%	Dissolved Oxygen (mg/L) +/- ~~10%~~ 0.5 ~~5%~~	pH (SU) +/- 0.1	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) < ~~10~~ 50 NTU, ~~or +/- 10%~~	Comments
1028	6.96	Pump on	-	-	-	-	-	-	-	
1033	6.99	150	0.75	18.12	1.67	0.98	6.97	-5	43.1	
1038	7.01	175	1.63	14.65	23.6	0.82	7.00	0	1.8	
1043	7.02	200	2.63	14.49	24.6	0.66	6.99	-6	~~-6~~ 0.0	
1048	7.04	150	3.38	14.51	19.8	0.56	6.99	-12	0.0	
1053	7.03	150	4.13	14.49	18.4	0.60	6.99	-15	9.1	
1058	7.03	160	4.93	14.50	18.3	0.60	6.99	-15	12.1	
1103	7.03	175	5.8	14.56	18.4	0.54	6.99	-14	21.9	
1105	Collect Sample PT-R10-020									

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.44	2.46	5.56	9.86	15.44

* No cap on drawdown tube

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/26/08
Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High
Well Identification: R-11 (piezometer-drawdown tube)
Initial Water Level (feet BTOC): 6.49
Well Diameter (inches): 1
Well Depth (feet): ~19.1' bgs
Screen Interval (feet ~~BTOC~~ bgs): 9.1-19.1
Well Volume: 7.7L
Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): 14.1
Sample Time: 1500
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~5%~~ 10%	Dissolved Oxygen (mg/L) ±0.5 +/- ~~10%~~ 5%	pH (SU) +/- 0.2	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) < ~~10~~ 10 NTU, or ~~+/-~~ 5% ~~10%~~	Comments
1407	6.49	Pump on	-	-	-	-	-	-	-	
1412	6.72	0.75	150	15.01	92.3	1.35	7.12	-68	0.0	
1417	6.87	1.45	140	15.10	94.1	0.84	7.18	-79	0.0	
1422	6.93	2.25	160	15.07	34.6	0.60	7.22	-84	0.0	
1427	7.05	3.0	150	15.11	22.7	0.55	7.23	-87	0.0	
1432	7.13	3.75	150	15.16	20.2	0.55	7.25	-88	0.0	
1437	7.21	4.45	140	15.19	15.2	0.56	7.25	-89	0.0	
1442	7.25	5.20	150	15.18	9.9	0.51	7.25	-91	0.0	
1447	7.30	5.95	150	15.20	4.66 ##9.72	0.48	7.25	-92	0.0	
1452	7.37	6.7	150	15.20	9.72	0.45	7.25	-94	0.0	
1457	7.42	7.45	150	15.15	4.49	0.53	7.25	-93	0.0	
1500		Collect Sample PT-R11-020								

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.46	5.55	9.85	15.44

* No cap on drawdown tube

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/26/08
Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High
Well Identification: R-12 (piezometer - drawdown tube)
Initial Water Level (feet BTOC): 4.98
Well Diameter (inches): 1
Well Depth (feet): ~16.9' bgs
Screen Interval (feet ~~BTOC~~ bgs): 6.9-16.9
Well Volume: 7.3 L
Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): 11.9
Sample Time: 1600
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~5%~~ 10%	Dissolved Oxygen (mg/L) +/- ~~10%~~ 0.5	pH (SU) +/- ~~0.1~~	Oxidation-Reduction Potential (mV) +/- 10 mV	Turbidity (NTU) <~~40~~ NTU, or +/- ~~10%~~ 5%	Comments
1523	4.97	Pump on	-	-	-	-	-	-	-	
1528	5.12	250	1.25	14.43	>99.9	0.82	7.11	20	71.9	
1533	5.13	200	2.25	14.27	58.2	0.58	7.09	6	39.4	
1538	5.19	200	3.25	14.18	16.4	0.49	7.08	2	4.4	Clear
1543	5.18	200	4.25	14.24	11.0	0.44	7.09	1	14.0	Clear
1548	5.20	200	5.25	14.15	5.50	0.42	7.08	0	18.8	Clear
1553	5.20	200	6.25	14.20	5.50	0.40	7.08	-1	15.1	
1558	5.21	200	7.25	14.15	5.50	0.39	7.08	-1	25.0	* Add acid to VOAs
1600	Collect PT-R12-020.									

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.48	5.56	9.88	15.44

* Interface probe is detecting a thin sheen / LNAPL.

Monitoring Well Purging Form

Project: Unocal Wichita - Pilot Test Sampling
Date: 3/25/08
Location: Wichita, Kansas (Coleman Property)
Field Personnel: Kim Nguyen, Kim High
Well Identification: TW-4
Initial Water Level (feet BTOC): 1.54
Well Diameter (inches): 2
Well Depth (feet): 16.91' btoc
Screen Interval (feet ~~BTOC~~ bgs): 12.3-16.5
Well Volume: 9.4 L
Pump/Purging Device: Peristaltic Pump
Pump Intake Depth (feet BTOC): 14.4
Sample Time: 1430
Analyses/Notes: VOCs, Total Fe & Mn, Dissolved Fe & Mn, Dissolved Gases, Fatty Acids

Time	Water Level (ft BTOC)	Purge Rate (mL/min)	Volume Purged (L or gal)	Temperature (°C) +/- 1°C	Specific Conductivity (mS/cm) +/- ~~3%~~ 10%	Dissolved Oxygen (mg/L) +/- ~~10%~~ 5%	pH (SU) +/- 0.~~2~~	Oxidation-Reduction Potential (mV) +/- ~~10~~ 10 mV	Turbidity (NTU) < ~~10~~ 10 NTU, ~~<5~~	Comments
1342	1.61	Pump on	-	-	-	-	-	-	-	
1347	1.96	275	1.38	19.84	2.35	0.59	6.62	-82	509.0	Strong hydrocarbon odor
1352	1.96	200	2.38	16.98	4.06	0.55	6.84	-88	206.0	flow rate as low as possible to minimize drawdown
1357	1.98	200	3.38	16.27	2.03	0.55	6.79	-107	210.0	
1402	2.00	175	4.25	16.14	1.54	0.59	6.80	-119	160.0	
1407	2.01	200	5.25	16.08	1.47	0.65	6.81	-129	339.0	
1412	2.02	250	6.5	16.22	1.45	0.70	6.84	-137	135.0	
1417	2.05	250	7.75	16.56	1.45	0.76	6.88	-145	105.0	
1422	2.04	225	8.88	16.52	1.46	0.79	6.90	-150	99.5	
1427	2.04	225	10.00	16.56	1.46	0.81	6.92	-156	96.1	Turbidity stabilized to 10%.
										will not lower.
		Collect PT-TW4-020								

Well Diameter (in)	1	2	3	4	6	8	10
Volume (gal/ft)	0.04	0.16	0.37	0.65	1.47	2.61	4.08
Volume (L/ft)	0.15	0.61	1.40	2.46	5.56	9.88	15.44