DOE–LM/GJ1230–2006

Pinellas Environmental Restoration Project

Semiannual Progress Report for the Young - Rainey STAR Center's 4.5 Acre Site January through May 2006

June 2006

U.S. Department of Energy

Office of Legacy Management

Work Performed Under DOE Contract No. DE–AC01–02GJ79491
for the U.S. Department of Energy Office of Legacy Management.
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4.5 Acre Site

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Appendix A Laboratory Reports—January 2006 Semiannual Results

Acronyms and Abbreviations

bls	below land surface
COPC	contaminants of potential concern
DCE	dichloroethene
DHC	*Dehalococcoides ethenogenes*
DOE	U.S. Department of Energy
DPE	dual-phase extraction
FDEP	Florida Department of Environmental Protection
ft	feet
IRA	Interim Remedial Action
µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
MCL	maximum contaminant level
mg/L	milligrams per liter
mV	millivolts
NGVD	national geodetic vertical datum
nM	nanomolar
NTU	Nephelometric Turbidity Units
RPD	relative percent difference
STAR Center	Young - Rainey Science, Technology, and Research Center
TCE	trichloroethene
TCOPC	total contaminants of potential concern
VC	vinyl chloride
VOCs	volatile organic compounds

1.0 Introduction

The *Pinellas Environmental Restoration Project Semiannual Progress Report for the 4.5 Acre Site* describes environmental restoration activities for the Pinellas 4.5 Acre Site located in Pinellas County, Largo, Florida. The former U.S. Department of Energy (DOE) Pinellas Plant facility consisted of the 4.5 Acre Site and the Young - Rainey Science, Technology, and Research Center (STAR Center) (Figure 1). The facility was constructed in the mid-1950s as part of a nationwide nuclear weapons research, development, and production complex. Production of weapons-related components ceased in September 1994. However, as a result of these operations, contamination exists in the surficial ground water beneath the Site.

Administration of DOE activities at the 4.5 Acre Site is the responsibility of the DOE Office of Legacy Management in Grand Junction, Colorado. S.M. Stoller Corporation (Stoller), a prime contractor to DOE's Office of Legacy Management in Grand Junction, provides technical support to DOE for remediation and closure of all active solid-waste management units on site and for the 4.5 Acre Site.

The 4.5 Acre Site is located to the northwest of the STAR Center, in the northeast quarter of Section 13, Township 30 South, Range 15 East (Figure 2). This parcel was owned by DOE from 1957 to 1972, at which time it was sold to a private landowner. During the period of DOE ownership, the property was used for disposal of drums of waste resins and solvents. As a result of this practice, the surficial aquifer was impacted by volatile organic compounds (VOCs), primarily vinyl chloride (VC), toluene, trichloroethene (TCE), and 1,2-dichloroethene (DCE). DOE completed a source removal in 1985.

An Interim Remedial Action (IRA) consisting of ground water extraction and treatment via air stripping, and a routine ground water monitoring program were initiated in May 1990. In July 1997, a modification of the IRA involving installation of dual-phase extraction (DPE) wells provided a more aggressive system to remove ground water contamination. In November 1999, the DPE/air-stripping system was replaced with an in-situ biosparge treatment system.

Currently, ground water cleanup is proceeding according to provisions in the document *Remediation Agreement for the Four and One-Half Acre Site in Largo, Pinellas County, Florida* (Remediation Agreement) (DOE 2001b), an agreement between DOE and the Florida Department of Environmental Protection (FDEP); and in accordance with applicable portions of "Corrective Actions for Contamination Site Cases," an appendix to FDEP's *Enforcement Manual* (FDEP 1999).

The *4.5 Acre Site Biosparge System Integration Plan* (DOE 2000) was approved by FDEP on January 17, 2001. This plan states that performance monitoring would be undertaken on a quarterly basis. Therefore, in April 2001, performance monitoring of the remedial system through the use of direct push technology was undertaken. However, the biosparge systems were shut off in May 2003 with no plans to restart them and no performance monitoring data have been collected since April 2003. Subsequent monitoring has been adapted to fit the new remediation scenario and performance monitoring as defined in the *Interim Remedial Action Plan for Ground Water Recovery at the 4.5 Acre Site* (DOE 2003).

The IRA Plan for Ground Water Recovery at the 4.5 Acre Site was submitted to FDEP on August 29, 2003, and approved by FDEP on September 19, 2003. Implementation of the IRA Plan commenced on March 8, 2004, when construction activities began on the IRA treatment system. The treatment system consists of an extraction well field (three recovery wells), pumps and associated piping, transmission water pipeline, utility connection, a low profile tray air stripper unit, and effluent piping. The new IRA system began operations on April 26, 2004.

The IRA system is a temporary measure that was outlined in the *Remedial Action Plan for the Pinellas 4.5 Acre Site* (DOE 2001a) as a contingency option in the event that biosparging resulted in extending the contaminant plume. In April 2005, the *Pinellas Environmental Restoration Project 4.5 Acre Site Remedial Action Plan* (RAP) *Addendum* was submitted to FDEP. This document presented a proposed final action for the 4.5 Acre Site that involves closure of the site using the provisions of the recently adopted State of Florida Global Risk Based Corrective Action regulations.

Technical discussions between FDEP and DOE regarding the proposed final action continue. Part of DOE's proposed final action for the 4.5 Acre Site was to shut down the IRA system and begin a 2-year monitoring period. Approval from FDEP to shut down the IRA system was received on December 20, 2005, thus commencing the DOE's 2-year monitoring period.

This document is the semiannual progress report for the 4.5 Acre Site for January through May 2006, as requested by FDEP. The results of monitoring activities and a summary of ongoing and projected work are provided in this report.

1.1 Site Activities

- Obtained water-level measurements from all monitoring wells on March 7, 2006.
- Conducted the annual sampling event (i.e., collected ground water samples from 41 monitoring wells March 2006.) Forty-one wells were sampled for VOCs and analyzed using U.S. Environmental Protection Agency (EPA) SW-846 Method 8260. Two wells were sampled for arsenic and analyzed using EPA SW-846 Method 6010. Ten wells were sampled for biological remediation parameters.
- Reported the results of this annual sampling event (this document).

2.0 Monitoring Data

2.1 Ground Water Elevations and Flow

Within a 3-hour period on March 7, 2006, depth-to-water measurements were taken in all monitoring wells at the 4.5 Acre Site as part of the sitewide semiannual sampling event. The depth to water in each well was measured with an electronic water-level indicator. The March ground water elevation data for the 4.5 Acre Site are listed in Table 1. The data and information from deep wells were used to construct contours of water levels in the deep surficial aquifer in Figure 3.

The interpretative contours on Figure 3 show ground water flow generally to the west-northwest. These flow patterns are consistent with those observed at the site during the previous 3 years following shutdown of the biosparging system in May 2003. The capture zones that were previously observed around recovery wells PIN20−RW01, −RW02, and −RW03 are no longer evident following shutdown of these three wells in December 2005.

The water table ranged from about 2.5 to 4.0 feet below land surface (ft bls), with ground water elevations that ranged from a high of 15.47 ft at PIN20–TE01 to a low of 13.74 ft at PIN20−M38D. The water table in March 2006 was about 1.5 to 4 ft higher than in October 2005 due to turning off the recovery wells. The average hydraulic gradient across the site was approximately 0.003 feet per foot. This gradient is similar to those observed the past year. Using Darcy's Law, along with approximations of 1 ft/day for hydraulic conductivity and 0.3 for effective porosity, ground water at the site is estimated to move about 4 ft/year. This velocity is consistent with previously observed velocities of 3 to 10 ft/year.

2.2 Ground Water Sampling

Forty-one wells were sampled by Stoller personnel in March 2006. Forty-one wells were sampled for VOCs, two wells were sampled for arsenic, and ten wells were sampled for bioremediation parameters.

All samples were collected in accordance with the *Pinellas Environmental Restoration Project Sampling Procedures for the Young - Rainey STAR Center and 4.5 Acre Site* (DOE 2004) using FDEP procedures. All samples collected were submitted to Accutest Laboratory for analysis. Accutest is accredited by the Florida Department of Health in accordance with the National Environmental Laboratory Accreditation Conference, certification number E83510. VOCs were analyzed using EPA SW-846 Method 8260 and arsenic was analyzed using EPA Method 6010.

All of the monitoring wells were micropurged with dedicated bladder pumps and samples were collected when the field measurements stabilized. Extraction wells were sampled using their associated flowlines with dedicated sampling ports. Table 2 lists measurements of pH, specific conductance, dissolved oxygen, oxidation/reduction potential, turbidity, and temperature recorded at the time each sample was collected. These measurements were collected using a flow cell and multiparameter meter.

2.3 Ground Water Analytical Results

Individual contaminants of potential concern (COPC) and total COPCs (TCOPCs) concentrations in samples collected from wells at the 4.5 Acre Site are included in Table 3. Arsenic data are shown on Table 4. The previous four quarters of results are included in Table 3 for comparison. Figure 4 shows the TCOPCs concentrations for March 2006.

No COPCs were detected in samples from the 20 sample locations listed below (results listed in Table 3).

PIN20–M003	PIN20–M012	PIN20–M024	PIN20–M054	PIN20–M40S
PIN20–M005	PIN20–M015	PIN20–M025	PIN20–M22D	PIN20–M41D
PIN20–M007	PIN20–M019	PIN20–M028	PIN20–M38D	PIN20–MWL5
PIN20–M011	PIN20–M023	PIN20–M036	PIN20–M40D	PIN20–MWL6

Samples from 21 sample locations listed below contained COPCs at detectable levels (results listed in Table 3).

PIN20–0502	PIN20–M053	PIN20–M059	PIN20–M064	PIN20–MWL4
PIN20–0503	PIN20–M055	PIN20–M060	PIN20–M18D	
PIN20–M001	PIN20–M056	PIN20–M061	PIN20–MWL1	
PIN20–M035	PIN20–M057	PIN20–M062	PIN20–MWL2	
PIN20–M049	PIN20–M058	PIN20–M063	PIN20–MWL3	

The maximum TCOPCs value detected was 8,564 micrograms per liter (µg/L) at PIN20−M063. The compound detected at the highest concentration in PIN20−M063 was cis-1,2-DCE at a concentration of 4,820 µg/L. Reported "J" values are not considered in the TCOPC analyte concentrations. Arsenic was detected in PIN20−0503 at a concentration of 0.0193 milligrams per liter (mg/L).

Samples were also collected for dissolved gases and microbial activity analyses. The dissolved gases are ethene, ethane, hydrogen, methane, and carbon dioxide. The microbiological analysis is for dehalococcoides ethenogenes. Analytical results for these gases and this microorganism are summarized in Table 5.

Laboratory reports for semiannual samples collected in March 2006 are provided in Appendix A.

2.4 Quality Assurance/Quality Control

Three duplicate samples were compared to their paired sample and the relative percent differences (RPDs) between the results were calculated. Results of analyses for each duplicate sample are listed in Table 6. Three duplicate samples were compared to their paired sample and the relative percent differences (RPDs) between the results were calculated. Results of analyses for each duplicate sample are listed in Table 6. The sample duplicate pair for PIN20−M001 failed to meet the quality control guidance for 1,1-DCE and for benzene. The failure may be due to the fact that the sample and duplicate were analyzed at different dilutions and the analyte concentrations were relatively low. The sample duplicate pair for PIN20−MWL3 failed to meet the quality control guidance for trans-1,2-DCE and for vinyl chloride. The failure may be due to the fact that the sample and duplicate were analyzed a different dilutions.

From the three duplicate samples, 109 individual compounds were analyzed. The failure rate was 3.6 percent. All data are considered Class A level, indicating that the data may be appropriately used for quantitative and qualitative purposes. According to the Stoller Sampling Procedures, duplicate samples should be collected at a frequency of one duplicate for every 20 or less samples. There were 41 VOC samples and three duplicate samples. Because of the low number of arsenic samples, no duplicate for arsenic was collected.

Twenty-four trip blanks were collected during this sampling event and all were nondetect for VOCs.

A data validation software module for identifying and tracking anomalous ground water data points within the SEEPro database was used this period. The software prints a report of analytical results that fall outside of historical minimum or maximum values. No anomalous results were identified from this sampling event. Dissolved oxygen and oxidation reduction

potential values in wells PIN20−0502 and −M059 from the October 2005 sampling event may have been anomalous. These parameters will be tracked in future events before a final evaluation is made.

3.0 Treatment System and Recovery Well Operations

On December 20, operation of the recovery wells and treatment system was discontinued as discussed in Section 1.0.

4.0 Data Interpretation

This data interpretation section is included to aid in evaluating plume stability and remediation progress. This section consists of plots showing contaminant concentrations trends (Section 4.1), plume maps (Section 4.2), and a discussion of site geochemistry (Section 4.3).

4.1 Contaminant Concentration Trends

Figures 5 and 6 show the cis-1,2-DCE and VC concentration trends in wells PIN20−0502 and −M001, respectively. These two wells, located hydraulically downgradient from the area of highest contaminant concentrations, have shown increasing concentration trends over the last few years. This appears to be a result of past operation of a biosparging system. This system injected air into the subsurface with the goal of converting aquifer conditions from anaerobic to aerobic to facilitate contaminant degradation. While this conversion to aerobic conditions never occurred, the disturbance of the subsurface by the air injection apparently caused contaminants to desorb from the soil into the ground water, as evidenced by increasing contaminant concentrations at some biosparge monitoring locations. Additionally, subsurface pressurization that occurred during stopping and starting of the biosparging system may have facilitated contaminant transport by temporarily increasing the hydraulic gradient. The biosparging system operated from fall 1999 until it was permanently shut down in May 2003, but ground water containing elevated contaminant concentrations continues to move downgradient, producing the concentration trends observed in these wells.

Natural attenuation processes, particularly biodegradation, likely are occurring in the area of wells 0502 and M001. The cDCE concentration in well 0502 has decreased over the last 2 years while the VC concentration has continued to increase, potentially indicating biodegradation of cDCE to VC. Other evidence for biodegradation in the area of these wells is the presence of the dechlorinating microorganism *Dehalococcoides ethenogenes* (DHC), daughter products ethane and ethene, and hydrogen concentrations in the optimal range for reductive dechlorination (>1 nanomolar [nM]) (Table 5). While DHC was not detected in well 0502 in March 2006, it was detected at significant concentrations (up to 119,000,000 copy numbers/liter) in three previous sampling events in 2004 and 2005. While the biodegradation rates are obviously not fast enough to degrade all the contaminant mass over the course of a couple of years, biodegradation will continue and the contaminant concentrations in both these wells should decrease over time.

Figures 7 and 8 show TCE, cis-1,2-DCE, and VC concentration trends in wells PIN20−MWL4 and −M063. These two wells are in the area of highest contaminant concentrations on the eastern

side of the site. Concentrations in these wells have decreased significantly over the last few years. The presence of significant numbers of DHC along with the daughter products ethane and ethene, as well as hydrogen concentrations of >1nM indicate that biodegradation is likely the cause of the concentration decreases (Table 5).

Figures 9 and 10 show TCE, cis-1,2-DCE, and VC concentration trends in wells PIN20−M060 and −M061. These wells are in the area of elevated contaminant concentrations near the southwest property boundary, and have shown inconsistent concentration trends since they were first sampled in July 2004. These trends may be due to an effect from the ground water recovery at nearby recovery well RW03. However, operation of this treatment system was discontinued in December 2005, and the first post-operational sampling event was conducted in March 2006. Subsequent sampling events will be necessary to determine the concentration trends in these wells under non-pumping conditions.

4.2 Plume Maps

Plume maps were generated for TCOPCs (Figure 4) and the individual site COPCs: TCE (Figure 11), cis-1,2-DCE (Figure 12), VC (Figure 13), and benzene (Figure 14). The inferred plume boundaries for the individual compounds are the respective maximum contaminant levels (MCLs) of the compounds. Concentrations that are below the MCL are not included in the individual compound plumes. The TCOPCs map is a summary of the individual compound maps. The plume maps also show the plume boundary from the previous year to show any changes over the last year.

The TCE plume for 2006 (Figure 11) is identical in size to the 2005 plume. TCE above the 3 µg/L MCL is located in two small areas, one near the southwest property boundary and one in the east central part of the site. The cDCE plume is located in the same areas as the TCE plume, and also extends downgradient to wells M001 and 0502. The 2006 cDCE plume is identical in size to the 2005 plume. The 2006 VC plume is also identical is size to the 2005 plume, extending across a good portion of the site. VC concentrations along the western and southwestern property boundary are very low; VC was not detected off site. Benzene was detected only at well MWL1 at 2.8 µg/L, just above the 1 µg/L MCL.

In summary, the 2006 contaminant plume at the 4.5 Acre Site is similar in size to the 2005 plume. No COPCs were detected above the MCL in off-site wells. The plume appears stable in terms of area.

4.3 Geochemical Parameters

Geochemical parameters measured in the field in all wells at the 4.5 Acre Site during March 2006 are summarized in Table 2. Conditions across the site generally are reducing as evidenced by the low values of dissolved oxygen and oxygen reduction potential. Hydrogen is another indicator of redox conditions (Table 5), and all concentrations measured in March 2006 were >1 nM, indicating reducing conditions that are conducive to reductive dechlorination (EPA 2000).

5.0 Tasks to be Performed Semiannually

The following tasks are scheduled during the next semiannual period (June through November 2006).

- Semiannual sampling and analysis of ground water in September 2006.
- Collect water-level measurements in September 2006.

6.0 References

Florida Department of Environmental Protection (FDEP), 1999. "Corrective Actions for Contamination Site Cases," Appendix to FDEP *Enforcement Manual*, May.

DOE (U.S. Department of Energy), 2000. *4.5 Acre Site Biosparge System Integration Plan*, GJO–2000–182–TAR, MAC–PIN 25.5.1.1, prepared by U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2001a. *Remedial Action Plan for the Pinellas 4.5 Acre Site*, U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado, July.

DOE (U.S. Department of Energy), 2001b. *Remediation Agreement for the Four and One-Half Acre Site in Largo, Pinellas County, Florida*, U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado, January.

DOE (U.S. Department of Energy), 2003. *Pinellas Environmental Restoration Project Interim Remedial Action Plan for Ground Water Recovery at the 4.5 Acre Site*, GJO-2003-480-TAC, prepared by U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado, August.

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EPA (U.S. Environmental Protection Agency), 2000. *Engineered Approaches to In Situ Bioremediation of Chlorinated Solvents: Fundamentals and Field Applications*, EPA Document Number 542-R-00-008, July.

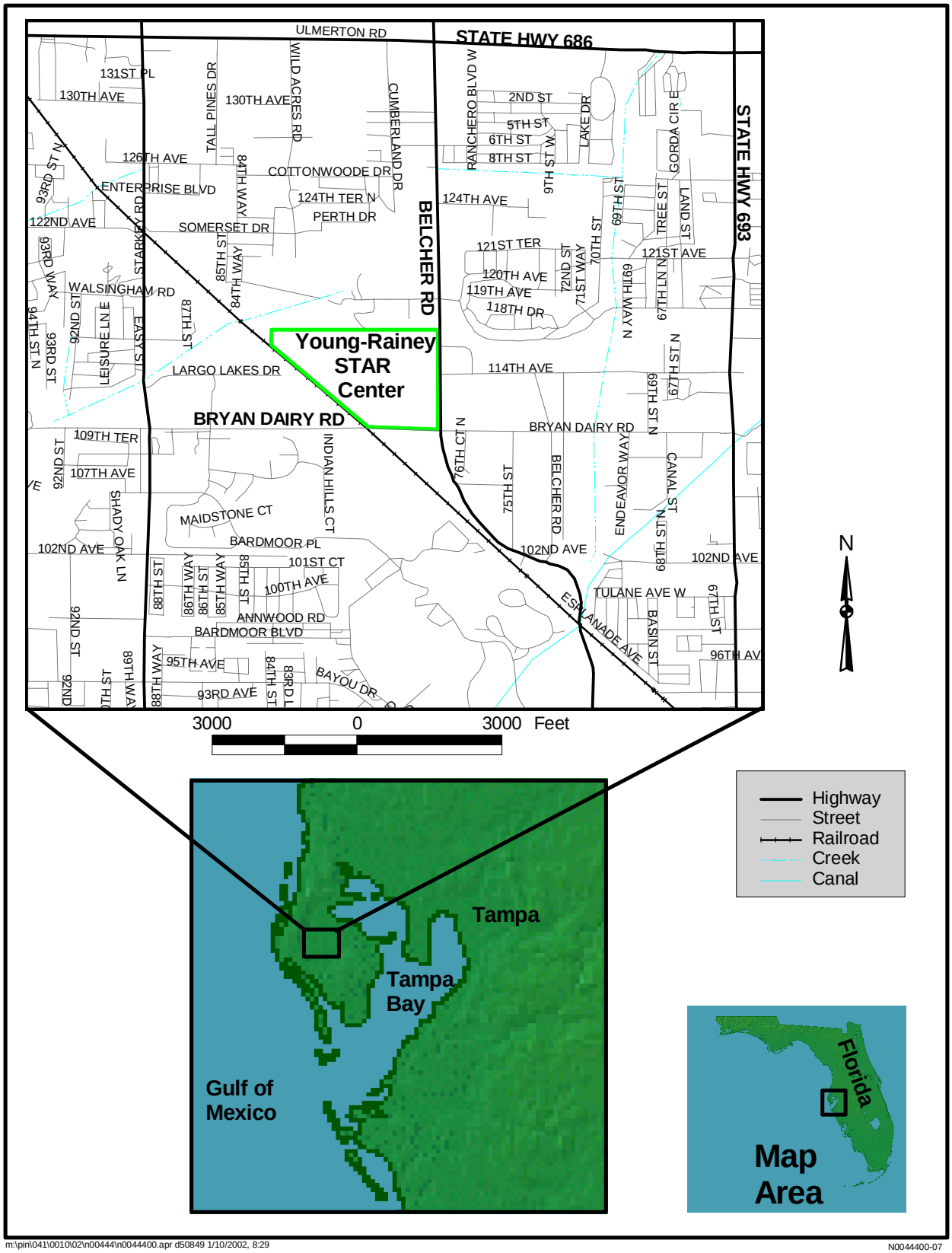

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Figure 1. Young - Rainey STAR Center Location

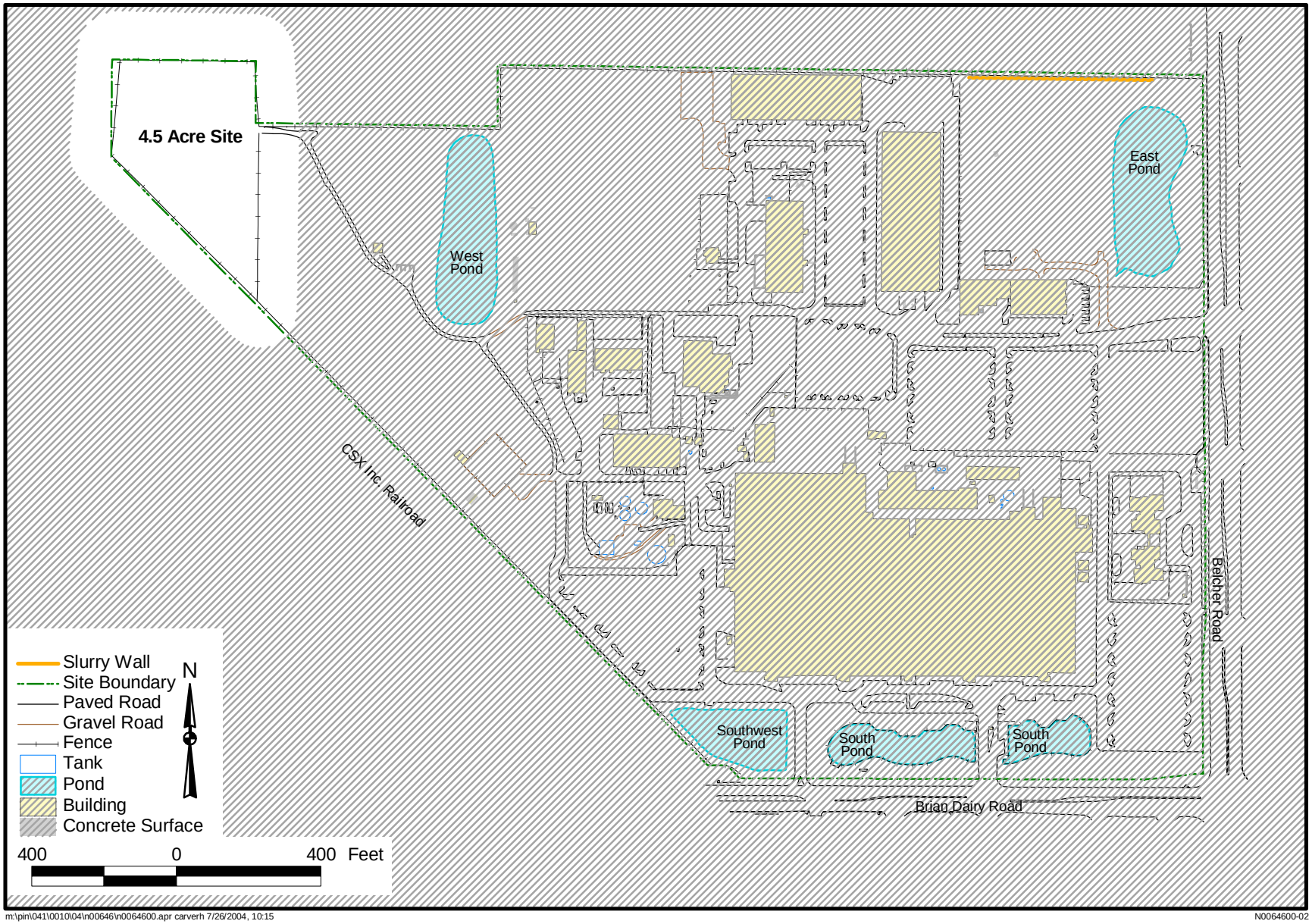

Figure 2. 4.5 Acre Site Location

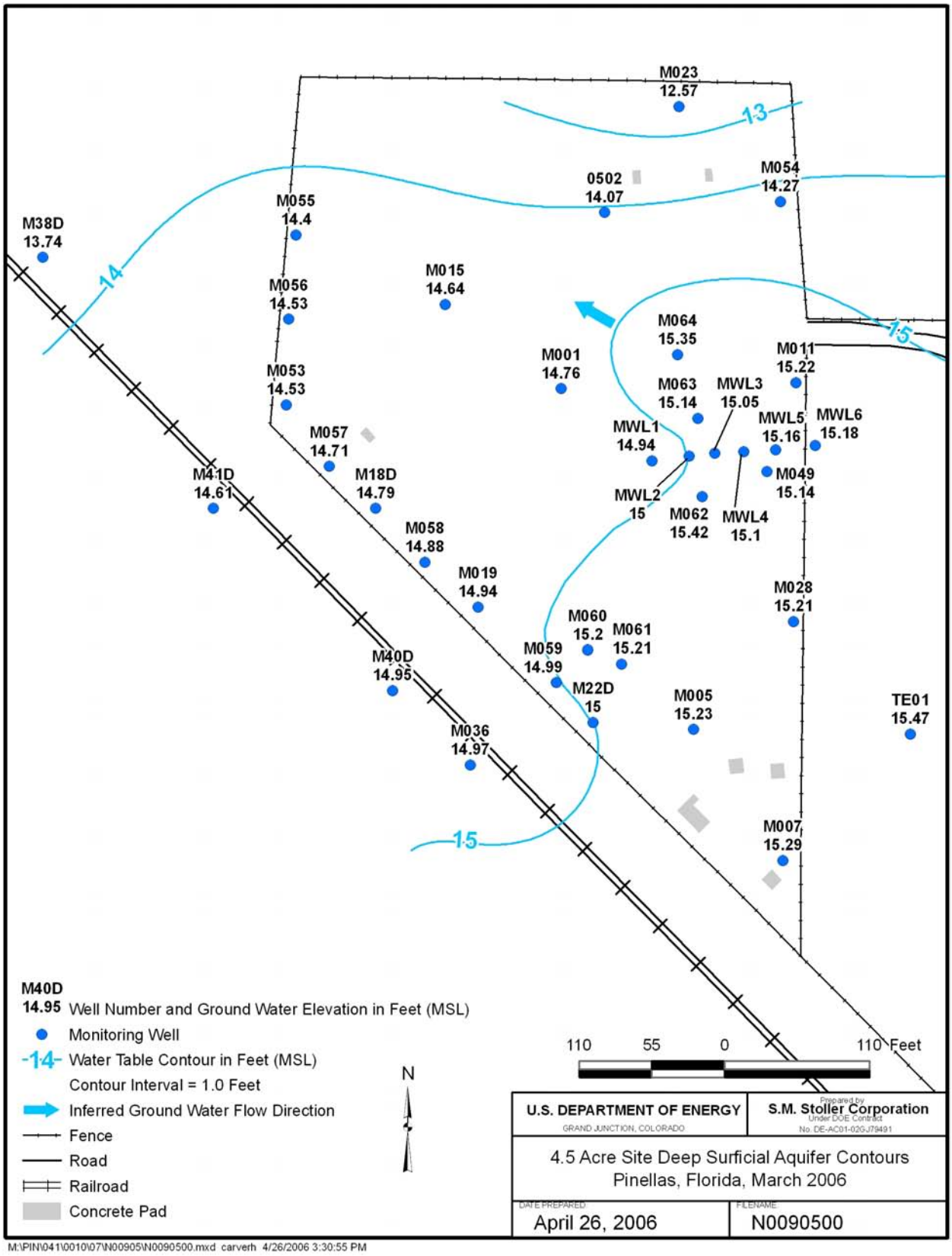

Figure 3. Ground Water Elevations and Deep Surficial Aquifer Flow, 4.5 Acre Site, March 2006

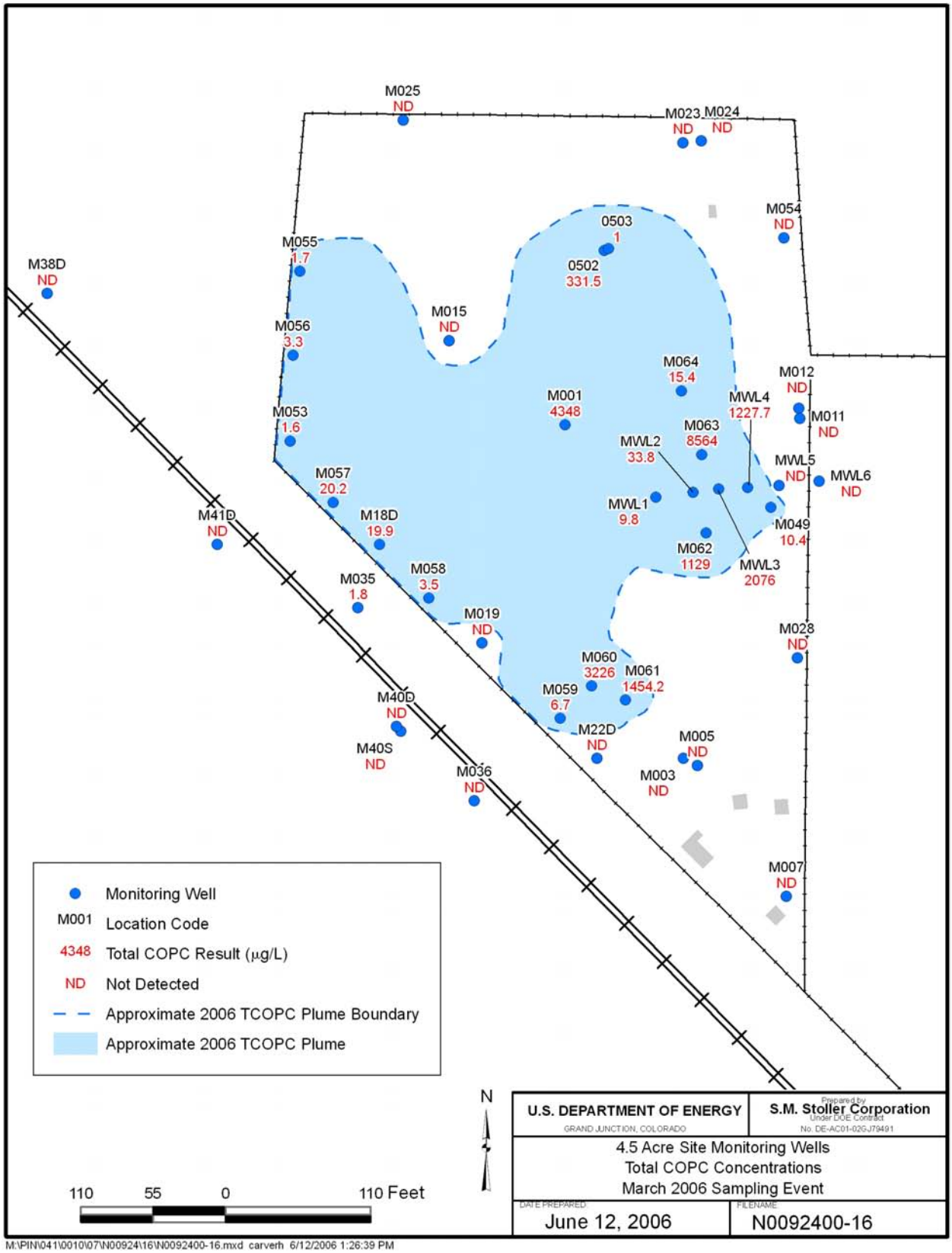

Figure 4. 4.5 Acre Site TCOPC Concentrations March 2006 Sampling Event

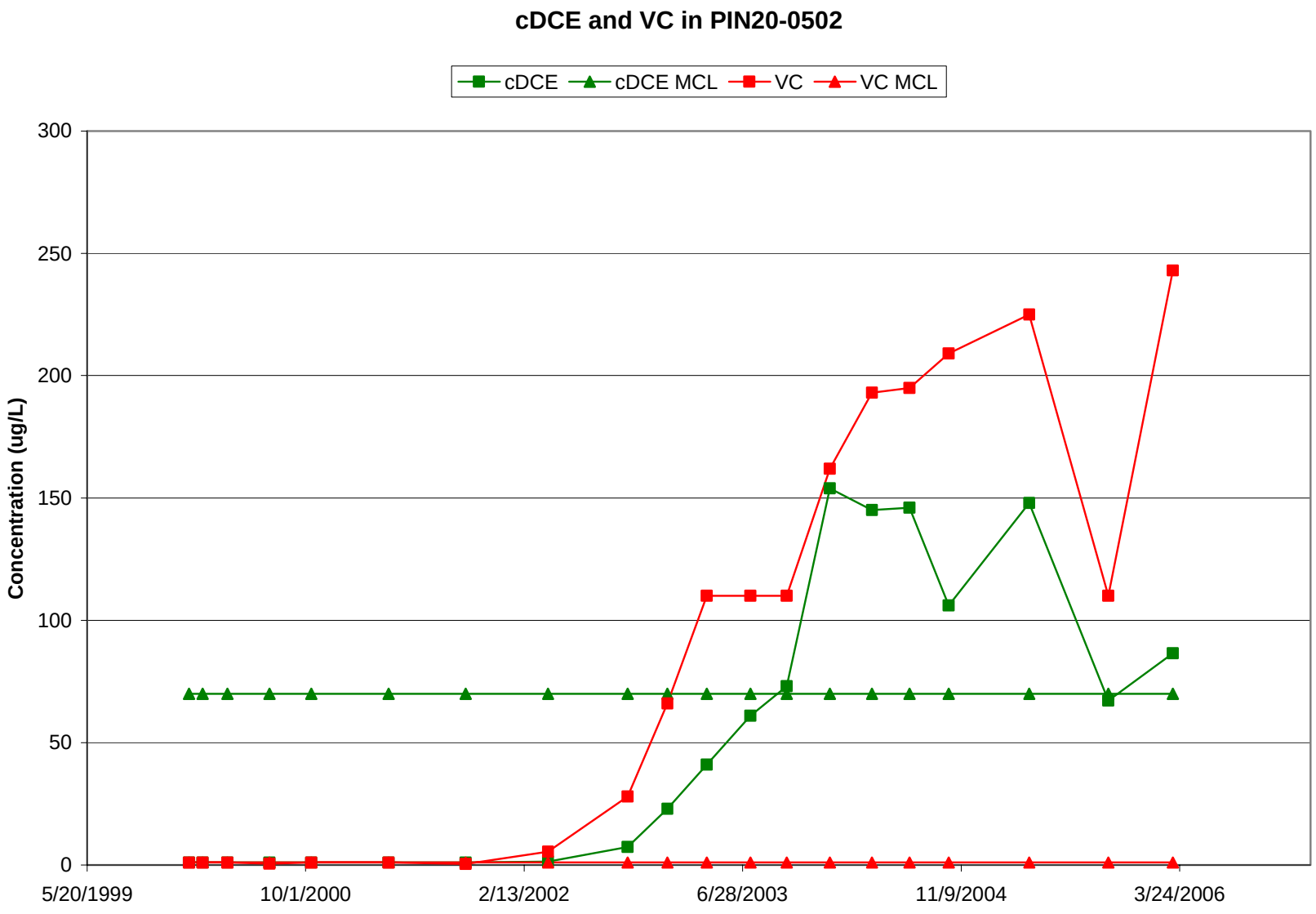

Figure 5. cDCE and VC in PIN20−0502

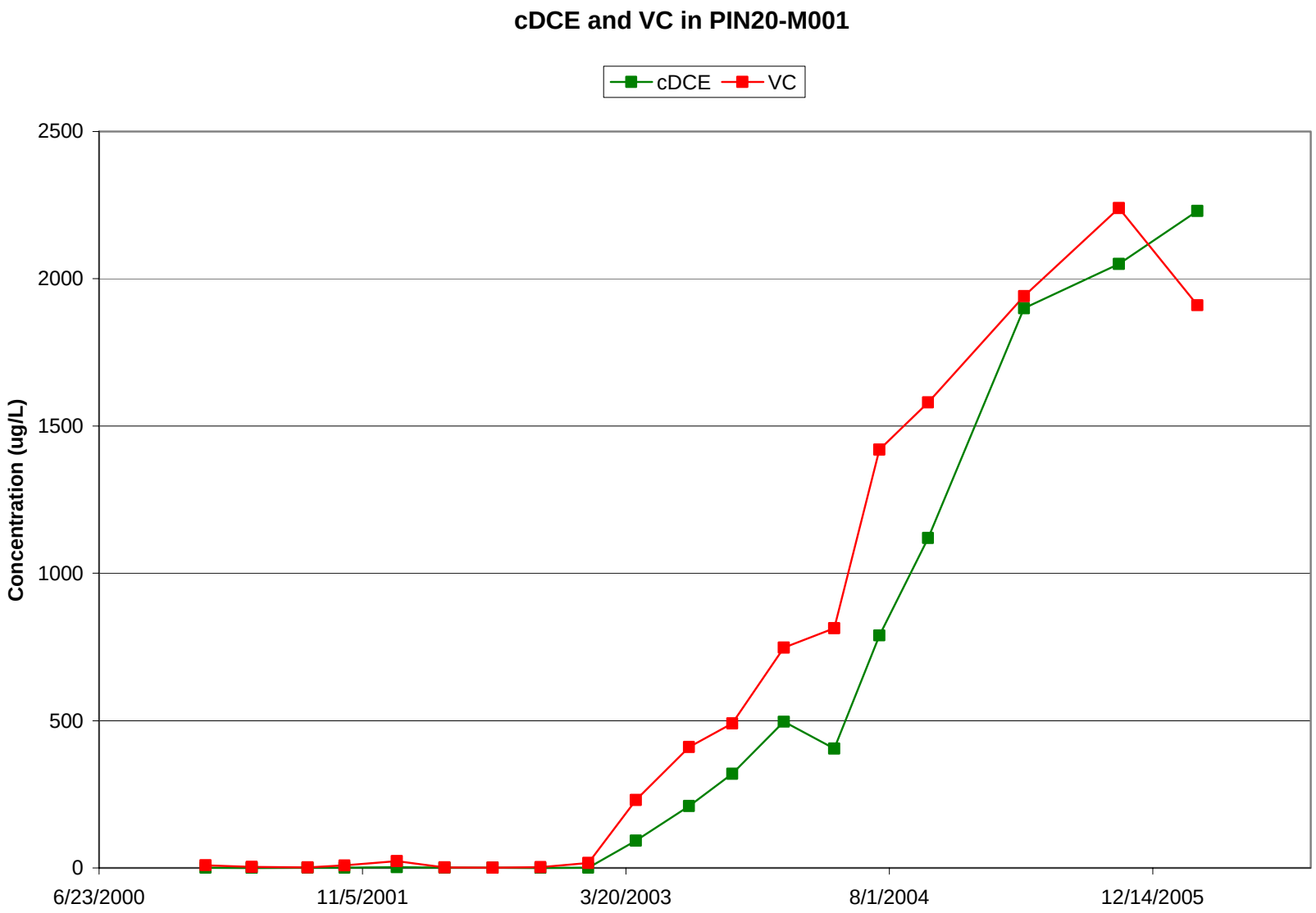

Figure 6. cDCE and VC in PIN20−M001

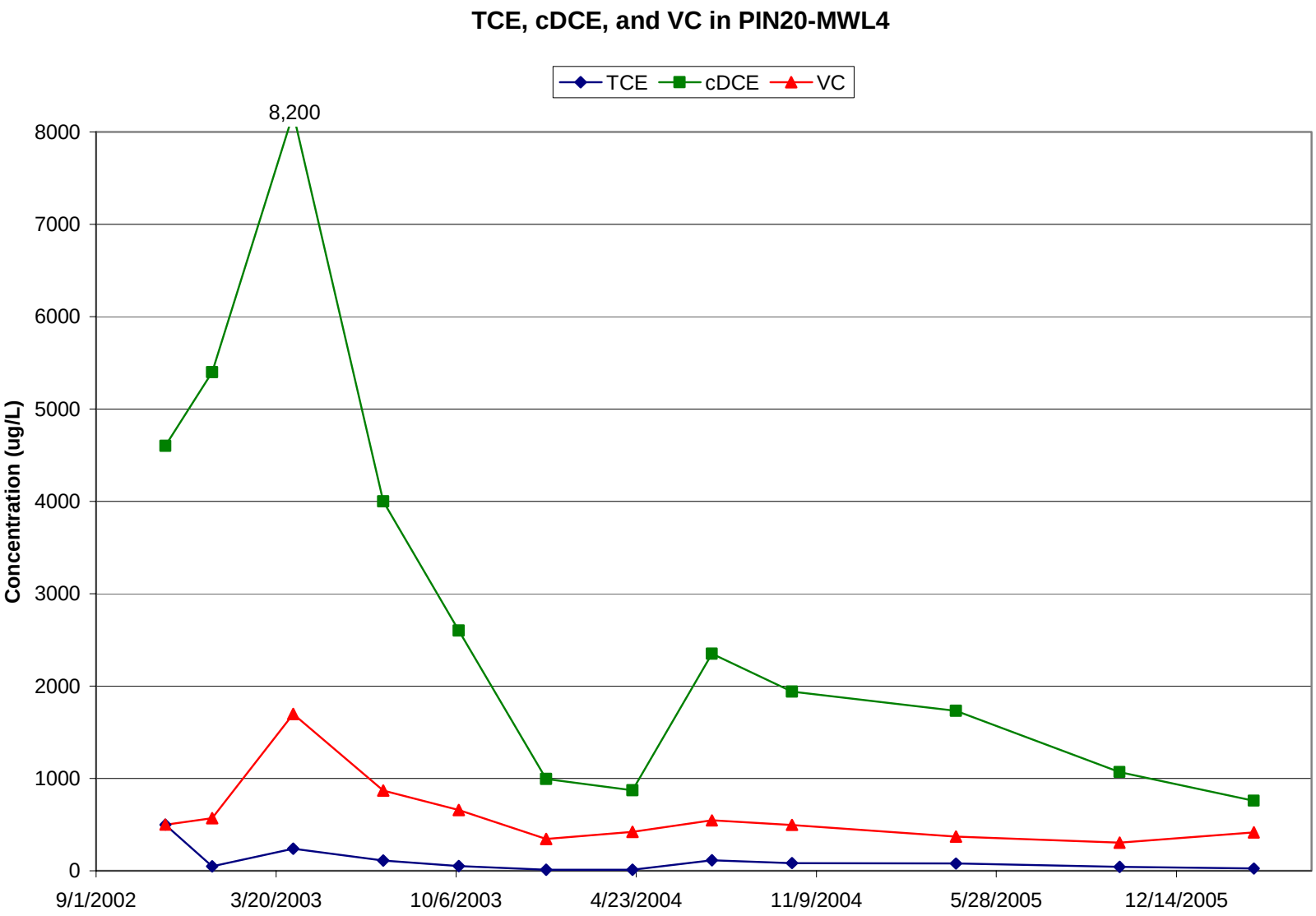

Figure 7. TCE, cDCE, and VC in PIN20−MWL4

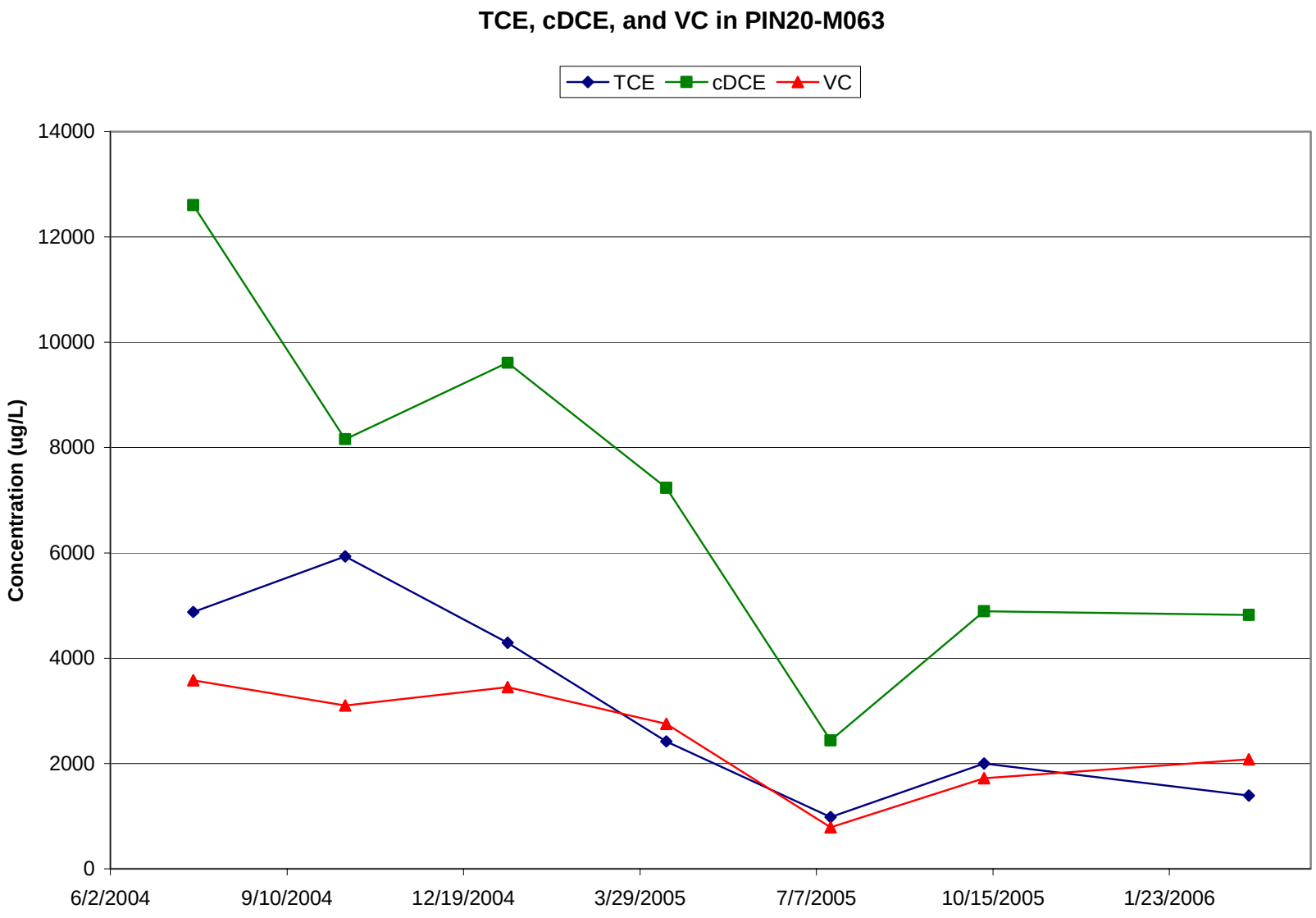

Figure 8. TCE, cDCE, and VC in PIN20−M063

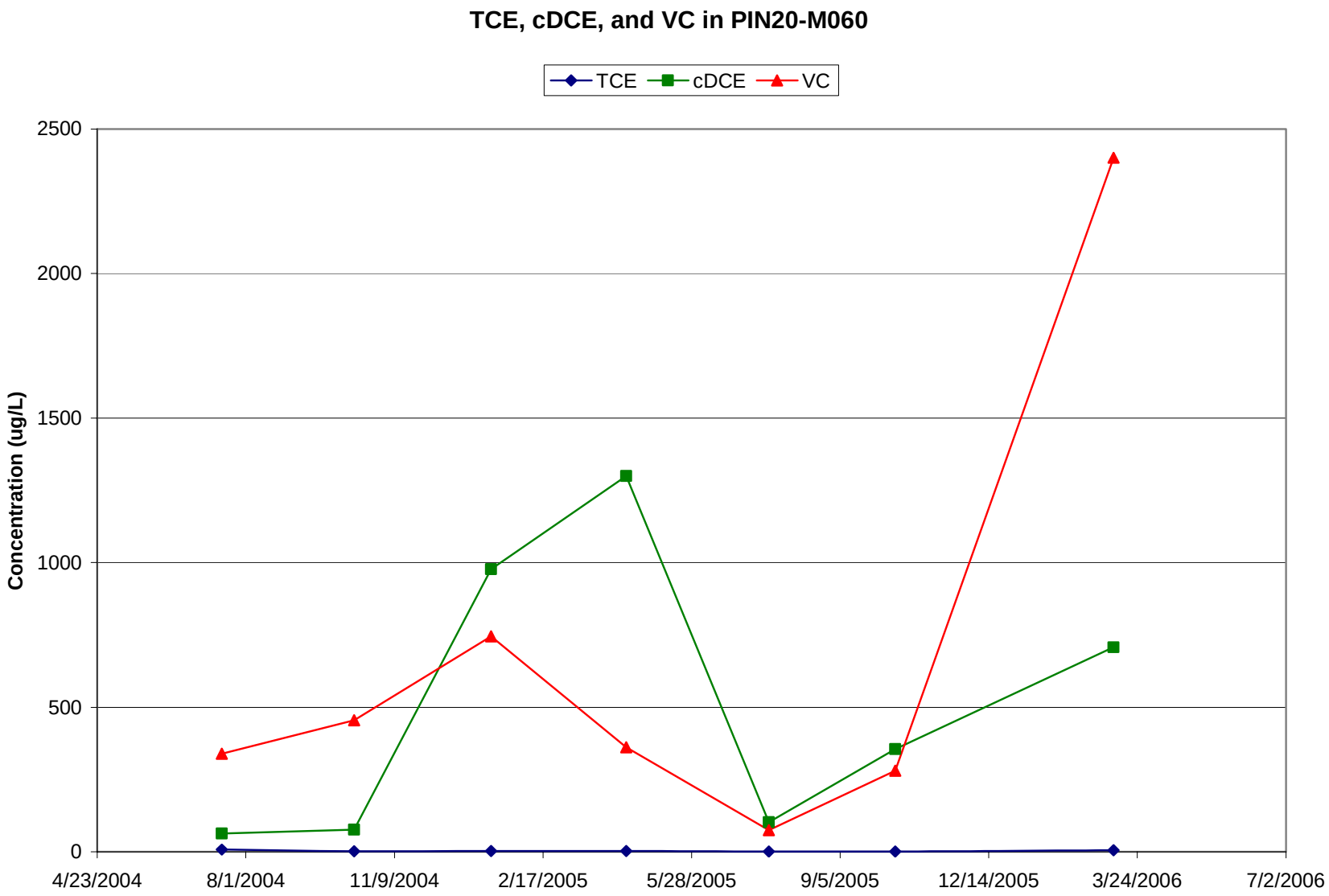

Figure 9. TCE, cDCE, and VC in PIN20−M060

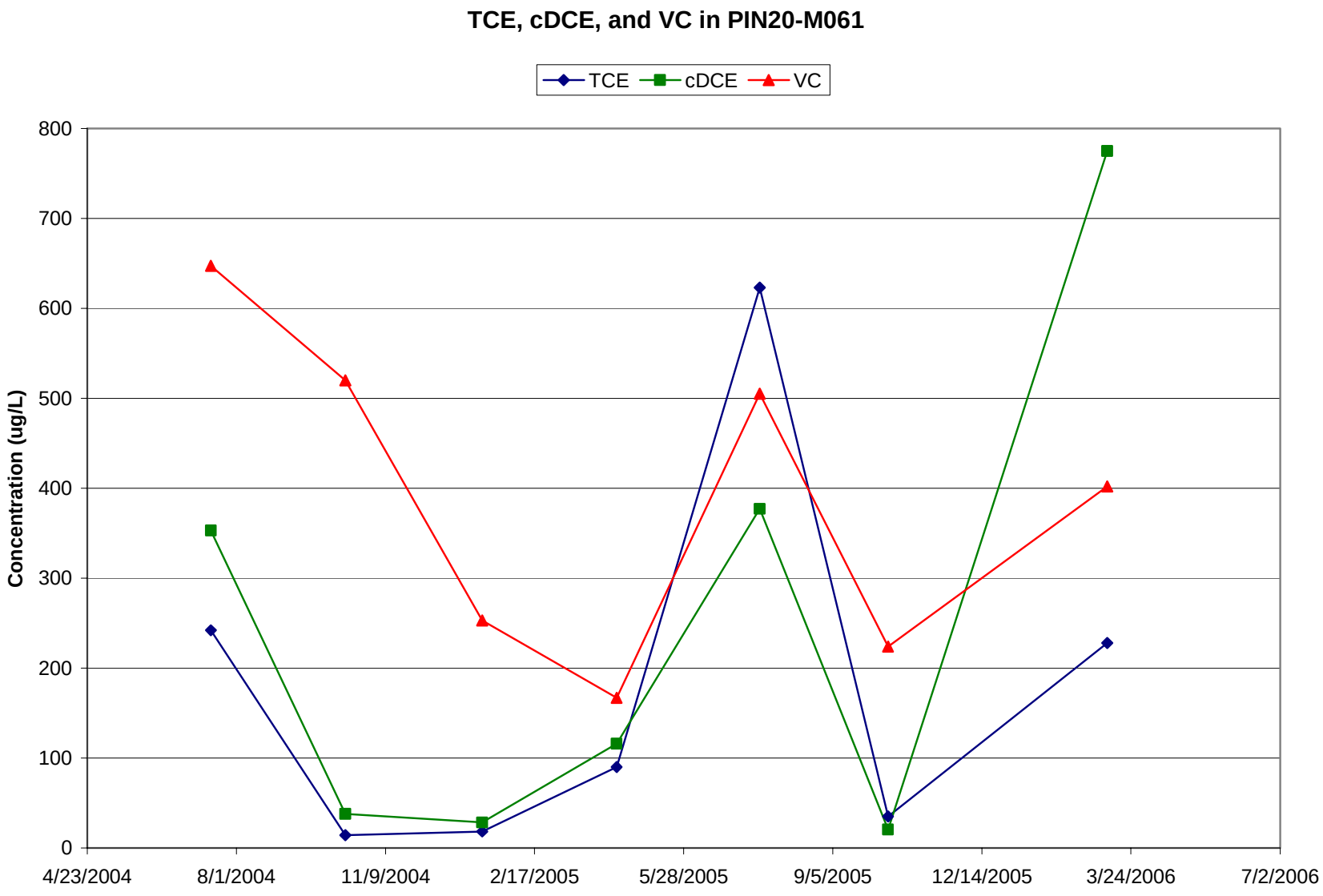

Figure 10. TCE, cDCE, and VC in PIN20−M061

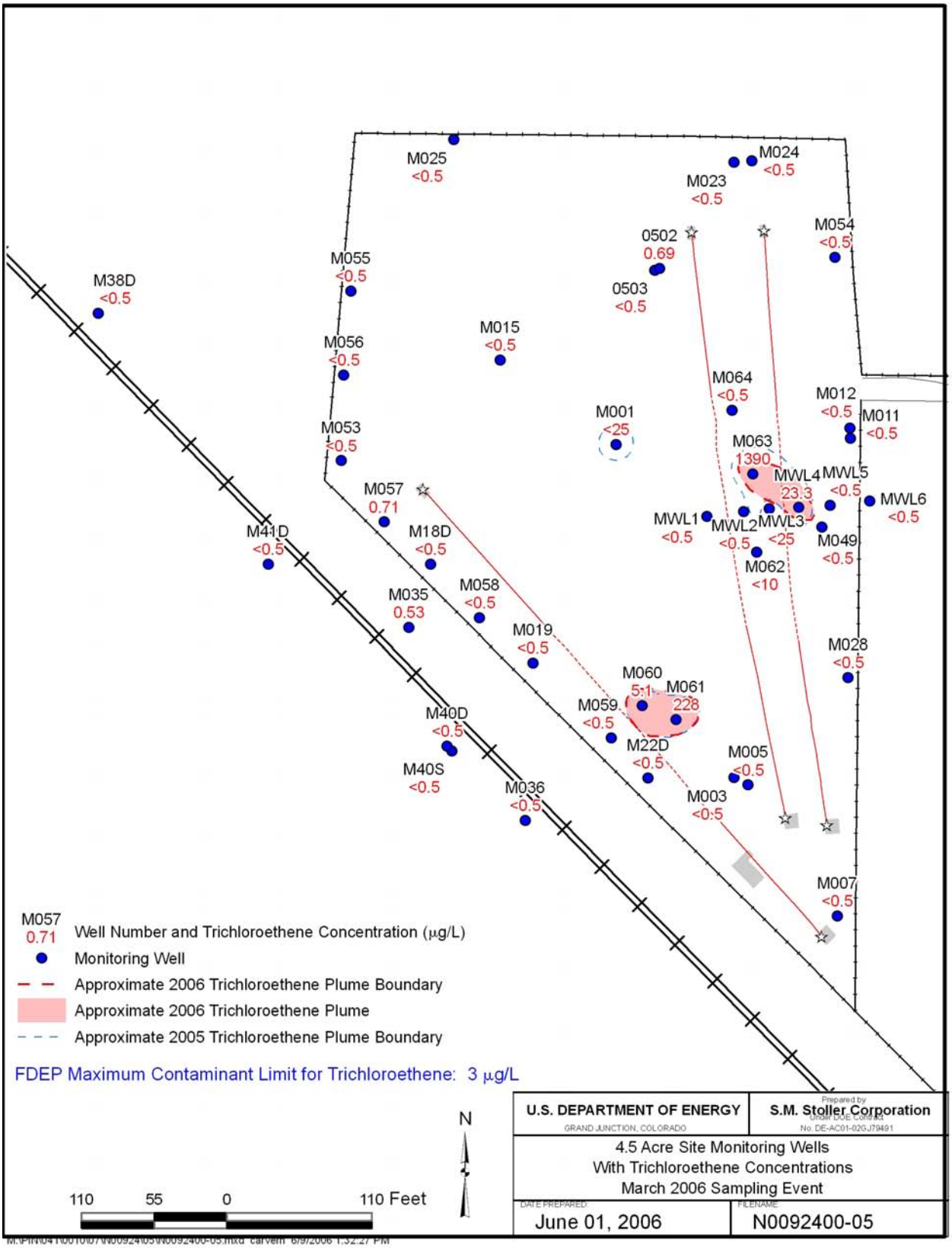

Figure 11. 4.5 Acre Site Monitoring Wells with TCE Concentrations March 2006 Sampling Event

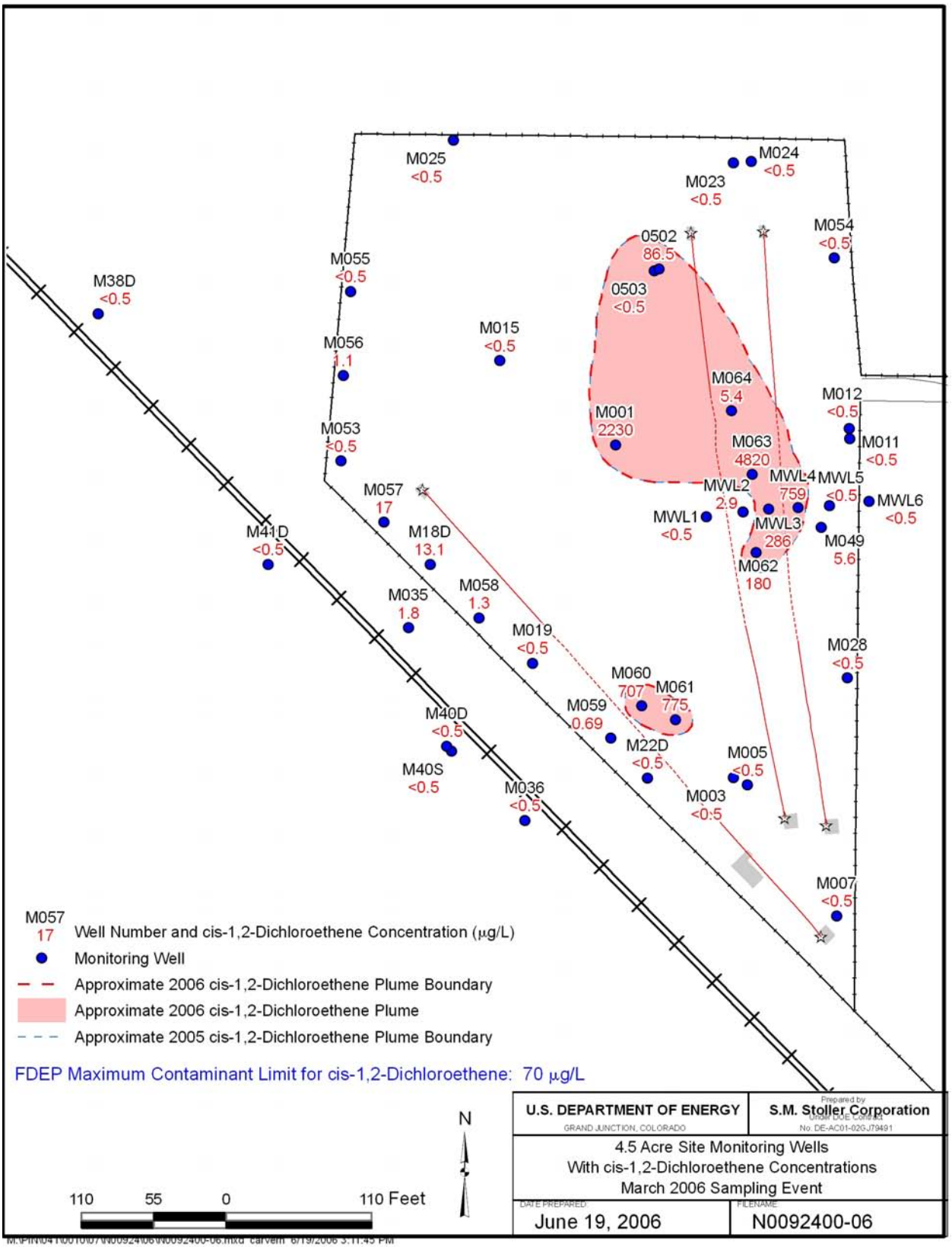

Figure 12. 4.5 Acre Site Monitoring Wells with cis-1,2-DCE Concentrations March 2006 Sampling Event

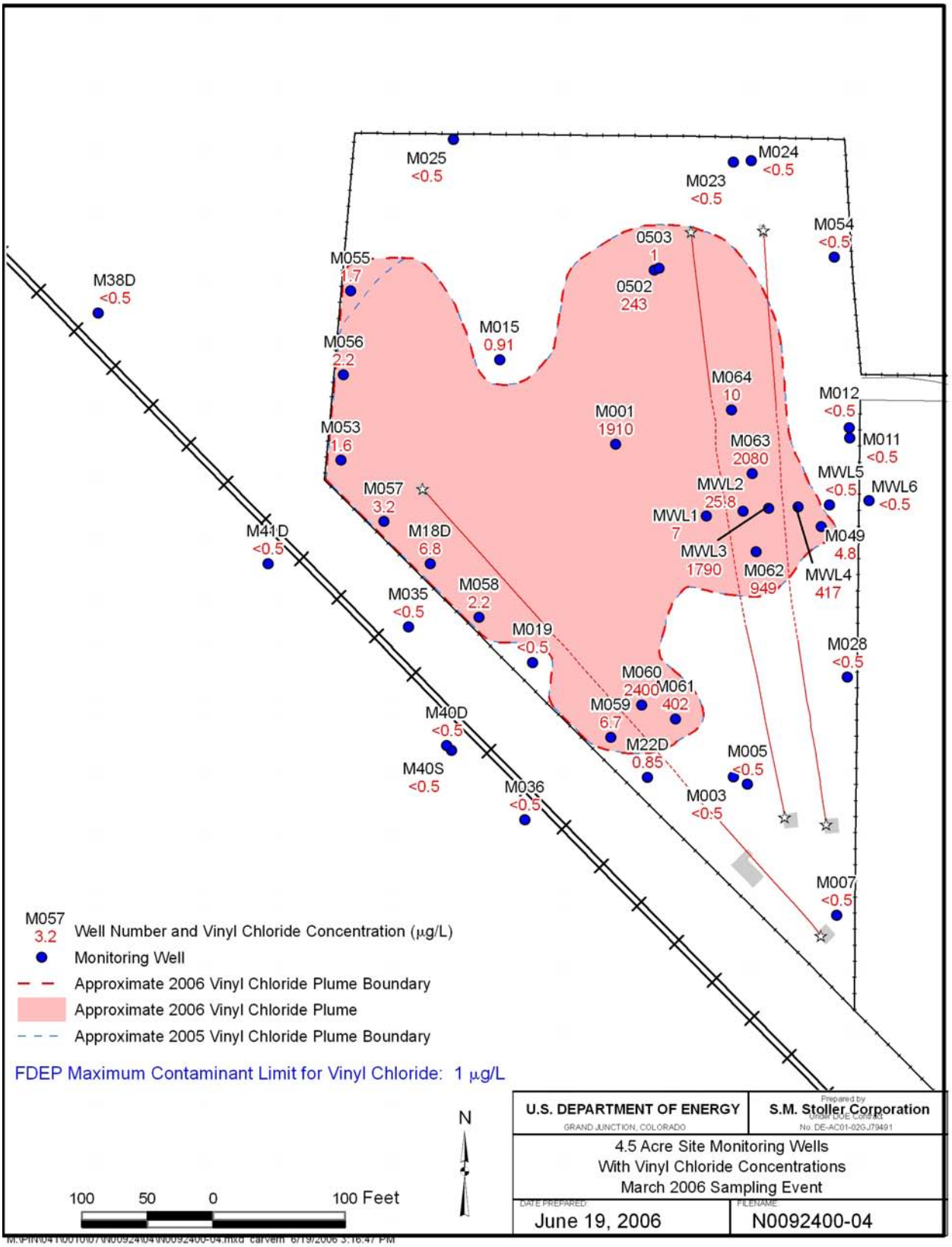

Figure 13. 4.5 Acre Site Monitoring Wells with VC Concentrations March 2006 Sampling Event

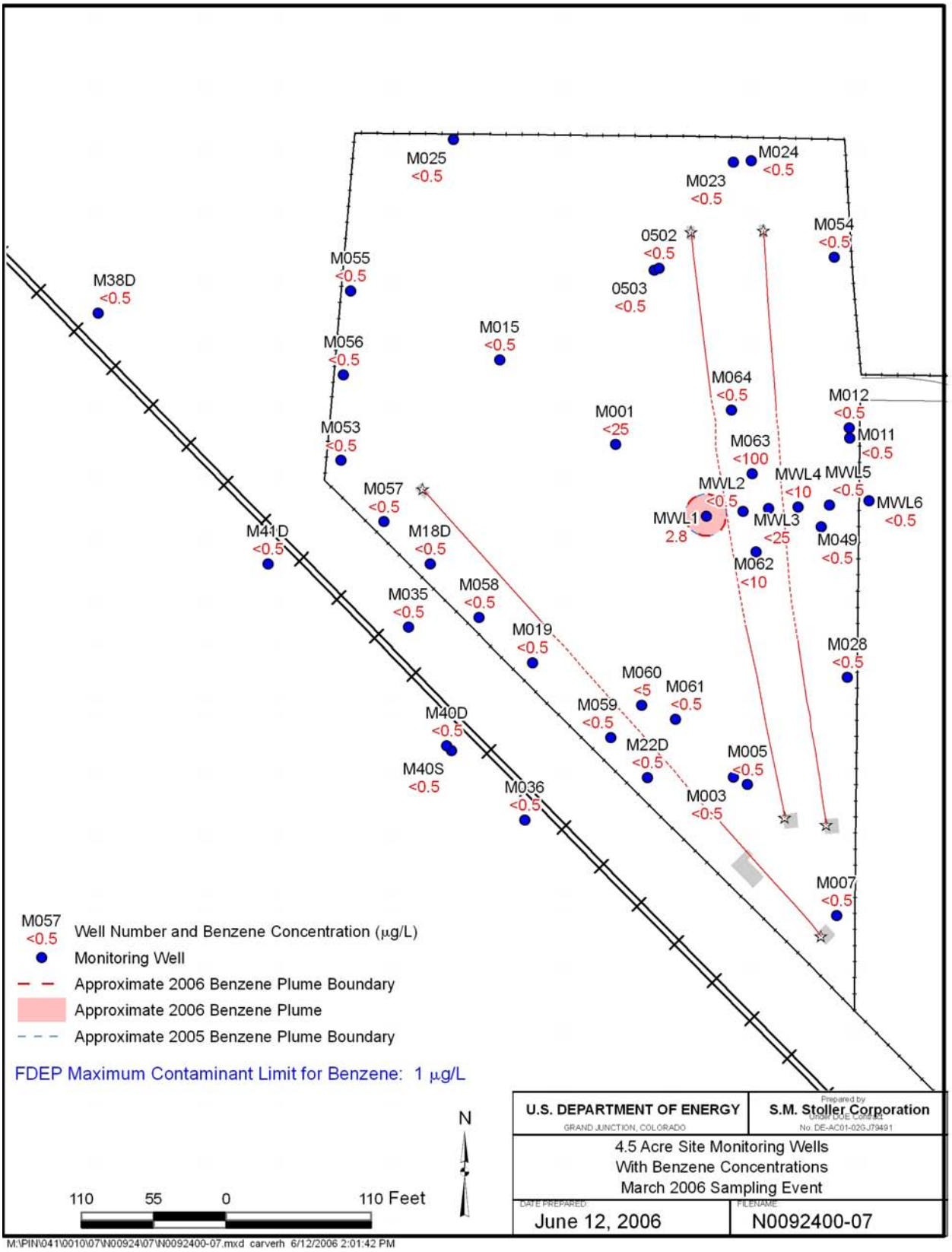

Figure 14. 4.5 Acre Site Monitoring Wells with Benzene Concentrations March 2006 Sampling Event

Table 1. Water-Level Data at the 4.5 Acre Site

Location	Measurement		Water Depth From Land Surface (ft)	Ground Water Elevation (ft NGVD)
	Date	Time		
PIN05	**Trench Site**			
0500	3/7/2006	10:28	3.05	15.45
PIN20	**4.5 Acre Site**			
0502	3/7/2006	08:50	3.33	14.07
0503	3/7/2006	08:51	3.37	14.03
M001	3/7/2006	08:55	2.84	14.76
M003	3/7/2006	09:39	3.09	15.11
M005	3/7/2006	09:40	3.07	15.23
M007	3/7/2006	09:44	4.16	15.29
M011	3/7/2006	10:16	2.88	15.22
M012	3/7/2006	10:11	2.86	15.14
M015	3/7/2006	08:58	2.86	14.64
M019	3/7/2006	09:15	3.06	14.94
M023	3/7/2006	08:44	6.90	12.57
M024	3/7/2006	08:45	3.49	14.31
M025	3/7/2006	08:40	2.51	13.79
M028	3/7/2006	09:46	2.99	15.21
M035	3/7/2006	08:14	3.93	14.87
M036	3/7/2006	08:24	4.33	14.97
M049	3/7/2006	09:49	2.66	15.14
M053	3/7/2006	09:04	2.67	14.53
M054	3/7/2006	08:48	3.43	14.27
M055	3/7/2006	08:36	3.00	14.40
M056	3/7/2006	09:01	2.57	14.53
M057	3/7/2006	09:08	3.19	14.71
M058	3/7/2006	09:13	2.82	14.88
M059	3/7/2006	09:27	2.81	14.99
M060	3/7/2006	09:36	2.13	15.20
M061	3/7/2006	09:33	2.07	15.21
M062	3/7/2006	10:04	2.41	15.42
M063	3/7/2006	10:05	2.96	15.14
M064	3/7/2006	10:08	2.36	15.35
M18D	3/7/2006	09:11	2.91	14.79
M22D	3/7/2006	09:29	2.80	15.00
M38D	3/7/2006	08:06	4.76	13.74
M40D	3/7/2006	08:17	4.45	14.95
M40S	3/7/2006	08:18	4.24	14.96
M41D	3/7/2006	08:10	4.49	14.61
MWL1	3/7/2006	10:03	3.30	14.94
MWL2	3/7/2006	10:00	2.77	15.00
MWL3	3/7/2006	09:58	2.65	15.05
MWL4	3/7/2006	09:56	2.64	15.10
MWL5	3/7/2006	09:52	3.41	15.16
MWL6	3/7/2006	10:19	3.27	15.18

Table 1 (continued). Water-Level Data at the 4.5 Acre Site

Location	Measurement		Water Depth From Land Surface (ft)	Ground Water Elevation (ft NGVD)
	Date	Time		
RW01	3/7/2006	08:34	2.97	14.63
RW02	3/7/2006	09:06	2.45	14.65
RW03	3/7/2006	09:25	2.55	15.05
TE01	3/7/2006	10:40	2.63	15.47

Table 2. Field Measurements of Samples Collected at the 4.5 Acre Site

Location	Screen Depth (ft bls)	Temperature (°C)	Specific Conductance (µmhos/cm)[a]	Turbidity (NTU)	pH	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)
PIN20	**4.5 Acre Site**						
0502	21.2–31.2	23.7	1,365	21.5	6.73	-57.7	0.36
0503	13.2–23.2	24.2	604	25.1	6.77	-60.1	1.16
M001	20–25	23.42	1,328	11.9	6.7	-63.5	0.58
M003	9–14	22.9	633	1.1	6.76	22.7	1.1
M005	25.8–30.7	24.57	744	1.21	6.84	-56.5	0.83
M007	25.3–30.3	24.4	542	1.4	6.92	-80.3	0.75
M011	23.7–28.7	24	580	6.1	6.85	-88.2	0.54
M012	8.6–13.6	21.9	482	28.1	6.81	-34.7	0.62
M015	20.8–25.8	23.6	444	7.1	6.89	-52.3	0.71
M019	22–27	23.3	953	12.8	7.19	-50.3	1.68
M023	19.8–24.8	23.9	463	38.5	6.91	-90.7	0.86
M024	8.7–13.7	22.2	330	4.9	6.85	7.3	1.06
M025	8.6–13.6	22.69	1,360	26.8	6.62	-50.8	0.44
M028	22–27	24.16	567	12.9	6.83	-91.5	0.7
M035	9–14	22.44	2,222	17.2	6.78	-55.7	0.69
M036	25–30	23.8	537	4.3	6.89	-72.4	0.87
M049	20–30	23.61	764	10.9	6.71	-71.2	0.77
M053	20–30	24.09	623	125	6.89	-91.4	0.32
M054	20–30	23.7		101	6.75	-105.2	0.32
M055	21–31	24.74	816	59.3	6.85	1	0.56
M056	19–29	24.7	899	35	6.82	-69.7	0.33
M057	20–30	23.85	1,525	23	6.79	-75.3	0.46
M058	18–28	23.3	1,150	28.2	6.88	-108.4	0.56
M059	19–29	22.92	1,152	104	6.88	68.6	0.86
M060	18–28	23.66	832	37.1	6.88	-107.8	0.96
M061	20–30	23.22	773	23	6.93	-88	0.5
M062	20–30	22.83	1,890	>1,000	6.6	-61.2	0.35
M063	19.5–29.5	24.17	2,272	205	6.3	-92.6	0.9
M064	15–25	22.62	2,882	204	6.43	-84	0.93
M18D	20–30	23.73	1,120	13.9	6.87	-88.5	0.33
M22D	20–30	23.7	1,201	12.2	6.82	-110.6	0.55
M38D	20–30	23.3	490	7.5	7.13	-64.8	0.88
M40D	18–28	23.7	662	10	6.98	-58.7	1
M40S	4–14	21.2	143	7.2	6.4	24.8	2.85
M41D	16–26	23.6	1,361	8.1	6.83	-84.2	1.22
MWL1	21–26	24.66	1,821	11	5.83	-19.4	1.14
MWL2	21–26	25.21	1,810	4.57	6.5	-60.5	0.79
MWL3	21–26	23.28	1,007	2.47	6.48	-87.8	0.99
MWL4	20.8–25.8	23.52	571	1.35	6.75	-82	0.65
MWL5	20.8–25.8	24.88	520	2.76	6.76	-78.5	0.77
MWL6	21.5–26.5	23.71	615	1.91	6.81	-77.8	1.04

[a]Temperature corrected to 25°C.

Table 3. COPC Concentrations from Wells at the 4.5 Acre Site[a]
(reported in micrograms per liter)

Location	Screen Depth (ft)	Date Sampled	TCE	cis-1,2-DCE	trans-1,2-DCE	Total 1,2-DCE[b]	Vinyl chloride	Benzene	Total COPC[c]
FDEP MCL			**3**	**70**	**100**	**63**	**1**	**1**	
PIN20	**4.5 Acre Site**								
0502	21.2–31.2	4/14/2005	<0.5	148	<0.5	148	225	<0.5	373
		10/12/2005	<0.5	67.2	0.61J	67.2	110	<0.5	177.2
		3/9/2006	0.69J	86.5	2	88.5	243	<0.5	331.5
0503	13.2–23.2	4/6/2005	<0.5	<0.5	<0.5	ND	4.2	<0.5	4.2
		10/12/2005	<0.5	0.75J	<0.5	0.75J	3.3	<0.5	3.3
		3/9/2006	<0.5	<0.5	<0.5	ND	1	<0.5	1
M001	20–25	4/14/2005	43.7	1,900	161	2,061	1,940	<10	4,044.7
		10/11/2005	<100	2,050	243	2,293	2,240	<100	4,533
		3/9/2006	<25	2,230	208	2,438	1,910	<25	4,348
M003	9–14	4/7/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M005	25.8–30.7	4/7/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M007	25.3–30.3	4/12/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M011	23.7–28.7	4/8/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/13/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M012	8.6–13.6	4/8/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/13/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M015	20.8–25.8	4/11/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/11/2005	<0.5	<0.5	<0.5	ND	0.64J	<0.5	ND
		3/13/2006	<0.5	<0.5	<0.5	ND	0.91J	<0.5	ND
M019	22–27	4/11/2005	<0.5	1.3	<0.5	1.3	<0.5	<0.5	1.3
		7/14/2005	<0.5	1.7	<0.5	1.7	<0.5	<0.5	1.7
		10/11/2005	<0.5	1.1	<0.5	1.1	0.64J	<0.5	1.1
		3/13/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M023	19.8–24.8	4/6/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/10/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/9/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M024	8.7–13.7	4/6/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/10/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/9/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M025	8.6–13.6	4/6/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/10/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M028	22–27	4/13/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/13/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND

Table 3 (continued). COPC Concentrations from Wells at the 4.5 Acre Site (reported in micrograms per liter)

Location	Screen Depth (ft)	Date Sampled	TCE	cis-1,2-DCE	trans-1,2-DCE	Total 1,2-DCE[b]	Vinyl chloride	Benzene	Total COPC[c]
FDEP MCL			3	70	100	63	1	1	
M035	9–14	4/7/2005	<0.5	2	<0.5	2	<0.5	<0.5	2
		7/14/2005	<0.5	2.2	<0.5	2.2	<0.5	<0.5	2.2
		10/11/2005	<0.5	2.9	<0.5	2.9	<0.5	<0.5	2.9
		3/9/2006	0.53J	1.8	<0.5	1.8	<0.5	<0.5	1.8
M036	25–30	4/7/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/12/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M049	20–30	4/8/2005	<0.5	7.1	0.61J	7.1	4.2	<0.5	11.3
		10/12/2005	<0.5	7.1	0.62J	7.1	2.7	<0.5	9.8
		3/10/2006	<0.5	5.6	0.54J	5.6	4.8	<0.5	10.4
M053	20–30	4/14/2005	<0.5	<0.5	<0.5	ND	5.2	<0.5	5.2
		7/14/2005	<0.5	<0.5	<0.5	ND	5.3	<0.5	5.3
		10/11/2005	<0.5	<0.5	<0.5	ND	2.9	<0.5	2.9
		3/10/2006	<0.5	<0.5	<0.5	ND	1.6	<0.5	1.6
M054	20–30	4/6/2005	<1	<1	<1	ND	<1	<1	ND
		3/9/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M055	21–31	4/6/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		7/14/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/10/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	1.7	<0.5	1.7
M056	19–29	4/7/2005	<0.5	<0.5	<0.5	ND	3.4	<0.5	3.4
		7/14/2005	<0.5	<0.5	<0.5	ND	1.9	<0.5	1.9
		10/11/2005	<0.5	<0.5	<0.5	ND	1.1	<0.5	1.1
		3/10/2006	<0.5	1.1	<0.5	1.1	2.2	<0.5	3.3
M057	20–30	4/7/2005	<0.5	9.5	<0.5	9.5	3.1	<0.5	12.6
		7/14/2005	<0.5	15.1	<0.5	15.1	3.6	<0.5	18.7
		10/11/2005	<0.5	16	<0.5	16	3	<0.5	19
		3/8/2006	0.71J	17	0.52J	17	3.2	<0.5	20.2
M058	18–28	4/7/2005	<0.5	1.8	<0.5	1.8	1.2	<0.5	3
		7/14/2005	<0.5	3	<0.5	3	2.1	<0.5	5.1
		10/11/2005	<0.5	1.5	<0.5	1.5	1.2	<0.5	2.7
		3/13/2006	<0.5	1.3	<0.5	1.3	2.2	<0.5	3.5
M059	19–29	4/7/2005	<0.5	1	<0.5	1	16	<0.5	17
		7/14/2005	<0.5	0.97J	<0.5	0.97J	8.1	<0.5	8.1
		10/11/2005	<0.5	1.3	<0.5	1.3	11.4	<0.5	12.7
		3/8/2006	<0.5	0.69J	<0.5	0.69J	6.7	<0.5	6.7
M060	18–28	4/14/2005	2.5	1,300	123	1,423	361	<0.5	1,786.5
		7/19/2005	<0.5	102	23.4	125.4	75.2	<0.5	200.6
		10/12/2005	<0.5	355	109	464	280	<0.5	744
		3/8/2006	5.1J	707	119	826	2,400	<5	3,226
M061	20–30	4/13/2005	89.9	116	9.9	125.9	167	<0.5	382.8
		7/18/2005	623	377	24.2	401.2	505	<0.5	1,529.2
		10/12/2005	35.2	20.4	<2.5	20.4	224	<2.5	279.6
		3/8/2006	228	775	49.2	824.2	402	<0.5	1,454.2

Table 3 (continued). COPC Concentrations from Wells at the 4.5 Acre Site (reported in micrograms per liter)

Location	Screen Depth (ft)	Date Sampled	TCE	cis-1,2-DCE	trans-1,2-DCE	Total 1,2-DCE[b]	Vinyl chloride	Benzene	Total COPC[c]
FDEP MCL			**3**	**70**	**100**	**63**	**1**	**1**	
M062	20–30	4/8/2005	<10	538	<10	538	964	<10	1,502
		7/14/2005	<0.5	778	10	788	1,770	1.3	2,559.3
		10/12/2005	<10	372	<10	372	827	<10	1,199
		3/9/2006	<10	180	<10	180	949	<10	1,129
M063	19.5–29.5	4/13/2005	2,420	7,230	325	7,555	2,750	0.94J	12,725
		7/15/2005	984	2,440	127	2,567	788	0.93J	4,339
		10/10/2005	2,000	4,890	273	5,163	1,720	<100	8,883
		3/9/2006	1,390	4,820	274	5,094	2,080	<100	8,564
M064	15–25	4/14/2005	<0.5	0.9J	<0.5	0.9J	5.9	<0.5	5.9
		7/15/2005	<0.5	2.1	<0.5	2.1	8.4	<0.5	10.5
		10/10/2005	<0.5	<0.5	<0.5	ND	2.1	<0.5	2.1
		3/9/2006	<0.5	5.4	0.78J	5.4	10	<0.5	15.4
M18D	20–30	4/13/2005	<0.5	16.2	<0.5	16.2	4.1	<0.5	20.3
		7/14/2005	<0.5	13.6	0.55J	13.6	6.8	<0.5	20.4
		10/11/2005	<0.5	14.7	0.67J	14.7	3.9	<0.5	18.6
		3/10/2006	<0.5	13.1	0.64J	13.1	6.8	<0.5	19.9
M22D	20–30	4/7/2005	<0.5	<0.5	<0.5	ND	0.89J	<0.5	ND
		7/14/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/11/2005	<0.5	<0.5	<0.5	ND	0.67J	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	0.85J	<0.5	ND
M38D	20–30	4/7/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/11/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M40D	18–28	4/7/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/12/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M40S	4–14	4/7/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/12/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
M41D	16–26	4/7/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		10/11/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
MWL1	21–26	4/8/2005	<0.5	<0.5	<0.5	ND	43.2	5.6	48.8
		10/12/2005	<0.5	<0.5	<0.5	ND	9.4	3.4	12.8
		3/10/2006	<0.5	<0.5	<0.5	ND	7	2.8	9.8
MWL2	21–26	4/8/2005	<0.5	7.7	10.7	18.4	58.4	0.52J	76.8
		10/12/2005	<0.5	3.8	6.5	10.3	20.8	<0.5	31.1
		3/10/2006	<0.5	2.9	5.1	8	25.8	<0.5	33.8
MWL3	21–26	4/13/2005	0.61J	348	4.5	352.5	2,560	<0.5	2,912.5
		10/12/2005	1	299	6.1	305.1	2,320	<0.5	2,626.1
		3/10/2006	<25	286	<25	286	1,790	<25	2,076

Table 3 (continued). COPC Concentrations from Wells at the 4.5 Acre Site (reported in micrograms per liter)

Location	Screen Depth (ft)	Date Sampled	TCE	cis-1,2-DCE	trans-1,2-DCE	Total 1,2-DCE[b]	Vinyl chloride	Benzene	Total COPC[c]
FDEP MCL			**3**	**70**	**100**	**63**	**1**	**1**	
MWL4	20.8–25.8	4/13/2005	78.3	1,730	45.3	1,775.3	371	<0.5	2,224.6
		10/12/2005	43.6	1,070	35.9	1,105.9	306	<0.5	1,455.5
		3/10/2006	23.3	759	28.4	787.4	417	<10	1,227.7
MWL5	20.8–25.8	4/8/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
MWL6	21.5–26.5	4/11/2005	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND
		3/10/2006	<0.5	<0.5	<0.5	ND	<0.5	<0.5	ND

[a]Before December 18, 2003, "<" values are reporting limits. On or after December 18, 2003, "<" values are method detection limits.
[b]Total 1,2–DCE is the sum of cis–1,2–DCE and trans–1,2–DCE.
[c]Total COPC is the sum of the individual COPC concentrations. The cis–1,2–DCE and trans–1,2–DCE values are not part of the total COPC value because these values are included in the total 1,2–DCE value. "J" values are not included in the total COPC value.
ND = Not detected.
J = Estimated value, result is between the reporting limit and the method detection limit.
Arsenic, while a COPC, is not included in this table, nor in the Total COPC value.

Table 4. Arsenic Concentrations from Wells at the 4.5 Acre Site

Location	Sample Date	Concentration (mg/L)
0502	3/9/2006	0.0084B
0503	3/9/2006	0.0193

B = Inorganic result is between the IDL and CRDL.
"<" values are method detection limits.

Table 5. Dissolved Gas and Dehalococcoides ethenogenes

Location		Date Sampled	Ethane µg/L	Ethene µg/L	Hydrogen nmol/L	Methane µg/L	Carbon dioxide mg/L	Dehalococcoides ethenogenes copy numbers/L
PIN20	0502	3/9/2006	7.9	2.4	1.4	290	110	<10,000
PIN20	M001	3/9/2006	10	9	1.4	150	75	400,000
PIN20	M035	3/9/2006	0.018	0.02	6.5	110	57	<7,000
PIN20	M057	3/8/2006	0.005J	0.017	1.3	70	150	<10,000
PIN20	M059	3/8/2006	0.44	0.32	2.1	880	63	<10,000
PIN20	M060	3/8/2006	17	340	2	1,800	72	2,000,000
PIN20	M061	3/8/2006	0.03	22	3.5	1,300	63	800,000
PIN20	M062	3/9/2006	1.2	33	7.1	810	120	10,000,000
PIN20	M063	3/9/2006	39	80	1.7	420	190	2,000,000
PIN20	M064	3/9/2006	1.5	0.21	18	120	130	<20,000

"<"=not detected above the associated value

Table 6. RPD for Duplicate Samples, 4.5 Acre Site

Sample ID	Duplicate ID	Case Number	Constituent	S[a]	D[b]	RPD Value	5 times DL[c]	Fail[d]
PIN20−M001	PIN24−0507	F39187	1,1-dichloroethene	12.5	20	46.2	0.5	2.5
			Benzene	12.5	2.6	131.1	0.5	2.5
			cis-1,2-dichloroethene	2,230	1,760	23.6	25	125
			trans-1,2-dichloroethene	208	199	4.4	50	250
			Vinyl chloride	1,910	1,860	2.7	25	125
PIN20−M036	PIN24−0508	F39187	Nondetect for VOCs					
PIN20−MWL3	PIN24−0509	F39224	cis-1,2-dichloroethene	286	338	16.7	25	125
			trans-1,2-dichloroethene	12.5	8	43.9	0.5	2.5
			Trichloroethene	12.5	0.85	174.5	0.5	2.5
			Vinyl chloride	1,790	2,940	48.6	25	125

[a]S = Original sample (N001), VOC concentration in µg/L.
[b]D = Duplicate sample (N002), VOC concentration in µg/L.
[c]DL = Detection limit.
[d]Fail is an RPD greater than ±30% and an original or duplicate sample more than 5 times the detection limit.