Pinellas Environmental Restoration Project
Interim Remedial Action
Quarterly Progress Report
for the Young-Rainey Star Center's
4.5-Acre Site

January through March 2002

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Prepared by
U.S. Department of Energy
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Appendix A will be provided upon request. Click Appendix to request.

Acronyms and Abbreviations

bls	below land surface
BTEX	benzene, toluene, ethylbenzene, and xylene
°C	degrees Celsius
Center	Young - Rainey STAR Center
CFU	colony forming units
ComQAP	Comprehensive Quality Assurance Plan
DCE	dichloroethene
DOE	U.S. Department of Energy
DPE	dual-phase extraction
DPT	direct push technology
EPA	U.S. Environmental Protection Agency
FDEP	Florida Department of Environmental Protection
ft	feet
ft/ft	feet per foot
HPC	Heterotrophic Plate Count
HSWA	Hazardous and Solid Waste Amendments
IRA	Interim Remedial Action
IRAPA	Interim Remedial Action Plan Addendum
MACTEC–ERS	MACTEC Environmental Restoration Services, LLC
MCL	maximum contaminant level
µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
mg/L	milligrams per liter
mV	millivolts
NELAC	National Environmental Laboratory Accreditation Conference
NGVD	national geodetic vertical datum
NTU	Nephelometric Turbidity Units
PCIC	Pinellas County Industrial Council
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
STAR	Science, Technology, and Research
STL	Severn Trent Laboratories
TCE	trichloroethene
TVOCs	total volatile organic compounds
VOCs	volatile organic compounds

1.0 Introduction

The Young - Rainey Science, Technology, and Research Center (STAR Center) is a former U.S. Department of Energy (DOE) facility constructed in the mid-1950s in Pinellas County, Florida. The STAR Center, while owned by DOE, primarily manufactured neutron generators for nuclear weapons. Other products manufactured at the STAR Center have included radioisotopically-powered thermoelectric generators, thermal batteries, specialty capacitors, crystal resonators, neutron detectors, lightning arrestor connectors, and vacuum switch tubes. In 1987, the U.S. Environmental Protection Agency (EPA) performed a Resource Conservation and Recovery Act (RCRA) Facility Assessment at the site to gather information on potential releases of hazardous materials. In February of 1990, EPA issued a Hazardous and Solid Waste Amendments (HSWA) Permit to DOE, enabling DOE to investigate and perform remediation activities in those areas contaminated by hazardous materials resulting from DOE operations. In November 2000, the State of Florida received HSWA authorization from the EPA. On March 17, 1995, DOE sold the facility to the Pinellas County Industrial Council (PCIC). The sales contract includes clauses to ensure continued compliance with Federal, State, and local regulations while DOE remediates the site. On July 1, 1999, the PCIC was disestablished and ownership of the STAR Center changed to the Pinellas County government.

Administration of DOE activities at the facility is the responsibility of the DOE Idaho Operations Office. Responsibility for environmental restoration activities, conducted under the EPA RCRA Corrective Action Program of 1984, was transferred from DOE's Pinellas Area Office to DOE's Grand Junction Office in October 1997. MACTEC Environmental Restoration Services, LLC (MACTEC–ERS), a prime contractor to DOE's Grand Junction Office, 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 STAR Center is a 99-acre facility located in Largo, Florida, and lies in the northeast quarter of Section 13, Township 30 South, Range 15 East (Figure 1). The 4.5 Acre Site is located to the northwest of the STAR Center (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, toluene, trichloroethene (TCE), and 1,2-dichloroethene (DCE). DOE completed a source removal in 1985. An Interim Remedial Action (IRA) consisting of groundwater extraction and treatment via air stripping, and a routine groundwater 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 groundwater contamination. In November 1999, the DPE/air-stripping system was replaced with an in-situ biosparge treatment system. All activities associated with this site are conducted consistent with the Florida Department of Environmental Protection (FDEP) *Corrective Actions for Contamination Site Cases* (FDEP not dated) and the *Remediation Agreement for the Four and One-Half Acre Site in Largo, Pinellas County, Florida, Between: State of Florida Department of Environmental Protection and U.S. Department of Energy* (FDEP 2001).

The *4.5 Acre Site Biosparge System Integration Plan* (DOE 2000a) was approved by FDEP on January 17, 2001. This plan states that performance monitoring would be undertaken on a quarterly basis. Therefore, in July 2001, performance monitoring of the remedial system through the use of direct push technology (DPT) was undertaken. Samples of groundwater were collected

from 35 locations to depths up to 30 feet (ft) and were analyzed for volatile organics and iron. Additionally, microbiological analyses were performed on 10 samples. Table 1 shows DPT sampling locations and the sampling depths. Section 2.3 provides results from analysis of samples that were collected as part of these activities. Additional information related to the biosparge treatment systems are discussed in more detail in Section 3.0.

Groundwater cleanup at the 4.5 Acre Site is proceeding, in part, according to provisions in the document *Remediation Agreement for the Four and One-Half Acre Site in Largo, Pinellas County, Florida* (FDEP 2001), an agreement between DOE and the FDEP. The Remediation Agreement requires preparation of a Remedial Action Plan (RAP) to evaluate and select the final remedial action alternative to clean up groundwater beneath the Site to levels that are protective of public health and the environment. The RAP was completed in July 2001, and was approved by the FDEP in August 2001.

This document is the quarterly progress report for the 4.5 Acre Site for January through March 2002, as requested by the FDEP. The results of monitoring activities, an assessment of plume movement, a summary of the IRA treatment system performance, and a summary of ongoing and projected work are provided in this report.

1.1 Quarterly Site Activities

- Obtained water-level measurements from all monitoring wells on January 7, 2002.
- Conducted the semiannual sampling event (i.e., collected 12 groundwater samples from selected monitoring wells and 60 groundwater samples from 35 DPT sample locations) in January 2002 for analysis of VOCs. Five of these DPT locations were also sampled for heterotrophic bacterial plate count (10 total samples).
- Measured geochemical parameters.
- Reported the results of quarterly sampling events (this document).
- Performed preventive maintenance on the biosparge systems throughout the quarter.
- Installed a hearing protection area around each of the biosparge blowers based on previously performed noise survey.

2.0 Monitoring Data

2.1 Groundwater Elevations and Flow

Within a 2-hour period on January 7, 2002, depth-to-water measurements were taken in all monitoring wells at the 4.5 Acre Site as part of the sitewide quarterly sampling event. The depth to water in each well was measured with an electronic water-level indicator. The January 2002 groundwater elevation data for the 4.5 Acre Site are listed in Table 2. The data and information from deep wells included in Table 2 were used to construct contours of water levels in the deep surficial aquifer in Figure 3.

The water levels were measured 3 days following shutdown of the biosparging system on January 4, 2002. The interpretative flow patterns shown on Figure 3 indicate a groundwater low in the center of the site, with groundwater flowing towards this low from all directions. These flow patterns suggest that groundwater in the center of the site was displaced by air from the biosparging system, and 3 days following system shutdown, water was still flowing towards this hydraulic low. This flow pattern is consistent with the pattern observed in July and October 2001. Flow patterns for the site will be closely monitored in future events. Under static, non-pumping conditions, groundwater at the site has historically been observed to flow to the north-northwest with no hydraulic low in the center of the site.

The water table ranged from about 4 to 8 ft below land surface (bls), with groundwater elevations that ranged from a high of 14.03 ft at PIN20–TE01 to a low of 10.18 ft at PIN20–M049. The hydraulic gradient in the south and north areas of the site were approximately 0.011 and 0.003 feet per foot (ft/ft), respectively. These gradients are similar to those observed in October 2001. Using Darcy's Law, along with approximations of 1 ft/day for hydraulic conductivity and 0.3 for effective porosity, groundwater in the south part of the site is estimated to move about 13 ft/year, which is slightly greater than typical observed velocities of about 6 ft/year.

2.2 Groundwater Sampling

Twelve monitoring wells and 60 DPT samples at 35 locations were sampled by MACTEC–ERS personnel in January 2002. All DPT locations were sampled at approximately 22 to 30 ft bls. A selected subset of 24 DPT locations was also sampled at approximately 16–18 ft bls. All DPT locations were filled with bentonite chips after sampling. The sample start depth bls is used as part of the identifier for the DPT locations for the tables in this report.

All samples were collected in accordance with the MACTEC–ERS *Sampling and Analysis Plan for the Young - Rainey STAR Center*, using FDEP procedures. All samples collected were submitted to Severn Trent Services Laboratories (STL) for VOCs, using EPA Method 8021. A subset of 10 samples collected from DPT locations was submitted for heterotrophic plate count (HPC) analysis. STL is accredited by the Florida Department of Health in accordance with the National Environmental Laboratory Accreditation Conference (NELAC), certification number E84282.

The monitoring wells were purged with dedicated bladder pumps. The wells were micropurged, and the samples were collected when the field measurements stabilized. DPT locations were purged using a peristaltic pump and sampled when the field measurements stabilized. Table 3 and Table 4 list measurements of pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity, and temperature recorded at the time the sample was collected. These measurements were collected using a flow cell and multiparameter meter. Values for total iron and ferrous iron were measured at the DPT locations using a colorimeter and are discussed in Section 2.4.

2.3 Groundwater Analytical Results

Total VOCs (TVOCs) and benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations in samples collected from wells and direct-push locations at the 4.5 Acre Site are included in Table 5 through Table 8. Table 9 shows results for additional VOCs detected. Figure 4 shows the TVOCs concentrations, including the BTEX compounds.

No VOCs were detected in samples from the nine monitoring wells and 23 DPT sample locations listed below.

PIN20–DP03 18 ft	PIN20–DP20 18 ft	PIN20–DP30 24 ft	PIN20–M019
PIN20–DP03 24 ft	PIN20–DP23 25 ft	PIN20–DP31 18 ft	PIN20–M023
PIN20–DP04 25 ft	PIN20–DP24 18 ft	PIN20–DP32 18 ft	PIN20–M024
PIN20–DP09 26 ft	PIN20–DP28 18 ft	PIN20–DP33 18 ft	PIN20–M035
PIN20–DP10 26 ft	PIN20–DP28 23 ft	PIN20–DP34 18 ft	PIN20–M036
PIN20–DP13 18 ft	PIN20–DP29 18 ft	PIN20–DP34 23 ft	PIN20–M053
PIN20–DP13 25 ft	PIN20–DP29 22 ft	PIN20–DP35 18 ft	PIN20–M054
PIN20–DP19 24 ft	PIN20–DP30 18 ft	PIN20–M011	PIN20–M22D

Samples from the three monitoring wells and 37 DPT sample locations listed below contained VOCs at detectable levels.

PIN20–DP01 18 ft	PIN20–DP08 24 ft	PIN20–DP17 18 ft	PIN20–DP25 24 ft
PIN20–DP01 26 ft	PIN20–DP11 18 ft	PIN20–DP17 23 ft	PIN20–DP26 24 ft
PIN20–DP02 18 ft	PIN20–DP11 26 ft	PIN20–DP18 18 ft	PIN20–DP27 24 ft
PIN20–DP02 26 ft	PIN20–DP12 18 ft	PIN20–DP18 24 ft	PIN20–DP31 22 ft
PIN20–DP05 23.5 ft	PIN20–DP12 26 ft	PIN20–DP20 25 ft	PIN20–DP32 22 ft
PIN20–DP06 18 ft	PIN20–DP14 18 ft	PIN20–DP21 18 ft	PIN20–DP33 23 ft
PIN20–DP06 24 ft	PIN20–DP14 23 ft	PIN20–DP21 23 ft	PIN20–DP35 22 ft
PIN20–DP07 18 ft	PIN20–DP15 18 ft	PIN20–DP22 24 ft	PIN20–M001
PIN20–DP07 26 ft	PIN20–DP15 22 ft	PIN20–DP24 23 ft	PIN20–M049
PIN20–DP08 18 ft	PIN20–DP16 24 ft	PIN20–DP25 18 ft	PIN20–M18D

Detected TVOCs values ranged from 1 micrograms per liter (µg/L) at location PIN20–DP27 24 ft to 32,700 µg/L at PIN20–DP02 26 ft. The compound detected at the highest concentration in PIN20–DP02 26 ft was cis-1,2-DCE at a concentration of 20,000 µg/L.

Laboratory reports for quarterly samples collected in January 2002 are provided in Appendix A.

2.4 Geochemical Parameters

As part of the regular quarterly monitoring, 10 water samples for analysis via the HPC method were collected from five locations during the DPT sampling in January 2002. HPC measures the number of aerobic bacteria present in the sample. The purpose of measuring aerobic bacteria is to monitor the conversion from anaerobic to aerobic conditions during biosparging. As the biosparging system continues operation, the abundance of aerobic organisms should increase due to the oxygen that is injected into the subsurface.

The HPC data are shown in Table 10. The precision of the colony forming units (CFU) method is plus or minus approximately 100 percent (at the 95 percent confidence level). In other words, the number of CFU needs to increase or decrease by more than 100 percent of the CFU value for the increase or decrease to be interpreted as real.

Also as part of the regular quarterly monitoring, samples for field analysis of dissolved total and ferrous iron were also collected during the DPT sampling. Collection of these data is intended to monitor conversion from reducing to oxidizing conditions during biosparging. As the biosparging system continues operation, the reduced iron should be converted to oxidized iron. The measured iron values are shown in Table 4, and the percent of oxidized iron is shown in Table 11.

Laboratory reports for quarterly samples collected in January 2002 are provided in Appendix A.

2.5 Quality Assurance/Quality Control

Five duplicate VOCs samples were compared and the relative percent differences (RPDs) between the results were calculated. There were 185 duplicate analyses performed. Results of VOCs analysis for each duplicate sample are listed in Table A–1 in Appendix A. One sample/duplicate pair failed the suggested control limit of an RPD of less than 30 percent when the concentration was greater than 5 times the detection limit. Location PIN20–DP16 24 ft failed for cis-1,2-DCE. This is less than a 1 percent failure rate. All data are considered Class A level, indicating that the data may be appropriately used for quantitative and qualitative purposes.

According to the MACTEC-ERS Sampling Plan, duplicate samples should be collected at a frequency of one duplicate for every 20 or less samples. There were 12 PIN20 groundwater VOCs samples collected from standard monitoring wells and one duplicate sample. For the DPT locations, there were 60 VOCs samples collected and three duplicate samples. There were no duplicates taken for the HPC analysis as these are not required samples. The requirement of 10 percent frequency for duplicates was met.

Four trip blanks and three equipment blanks were submitted for analysis. Estimated quantities of methylene chloride were observed in three of the samples. These results were above the analytical method detection limit but below the reporting limit. The highest methylene chloride value seen in the blanks was 1.6 µg/L.

3.0 Biosparge System Operation

3.1 Biosparge System Performance

The biosparge systems at the 4.5 Acre Site were continuously operational throughout the quarter, with the exception of the period from January 4 through 10, 2002. During that period, quarterly sampling was performed at the 4.5 Acre Site. Upon completion of sampling on January 10, the biosparge operations were restarted. All three systems continue to operate successfully with the new single pulley/single belt drive configuration.

3.2 Biosparge System Sampling and Monitoring

As described in the previous quarterly report, the Interim Remedial Action Plan Addendum (IRAPA) for the 4.5 Acre Site outlined sampling and monitoring activities to monitor biosparging activities. The *4.5 Acre Site Biosparge Monitoring Report* (DOE 2000b), presents the data collection activities associated with the biosparging system start-up, analyzes the monitoring results, and makes recommendations for continued operations. This report was issued in July 2000. Subsequently, biosparging activities will be monitored on a quarterly basis during regular quarterly sampling events.

4.0 Tasks to be Performed Next Quarter

The following tasks are scheduled during the next quarterly period (April through June 2002).

- Sampling and analysis of groundwater and water level measurements in early April.
- DPT sampling of groundwater.
- Routine preventive maintenance activities.

5.0 References

FDEP, not dated. *Corrective Actions for Contamination Site Cases*, http://www.dep.state.fl.us

———, 2001. *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.

U.S. Department of Energy, 2000a. *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.

———, 2000b. *4.5 Acre Site Biosparge Monitoring Report*, MAC–PIN 25.5.1, prepared by U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado, July.

———, 2002. *Sampling and Analysis Plan for the Young – Rainey STAR Center,* Draft, GJO–2001–206–TAR, MAC–PIN 2.4-1, prepared by U.S. Department of Energy, Grand Junction Office, Grand Junction, Colorado, April.

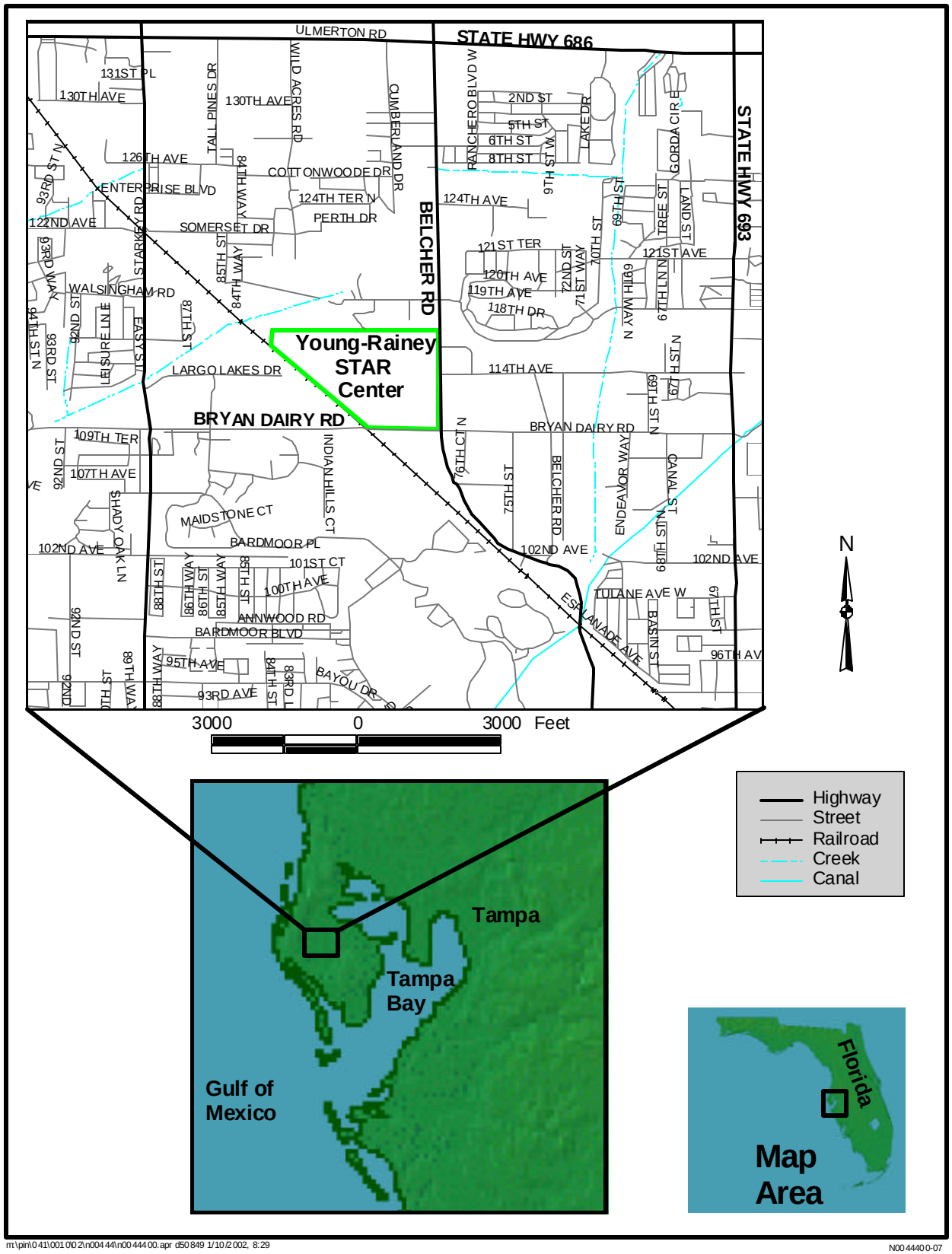

Figure 1. Young - Rainey STAR Center Location

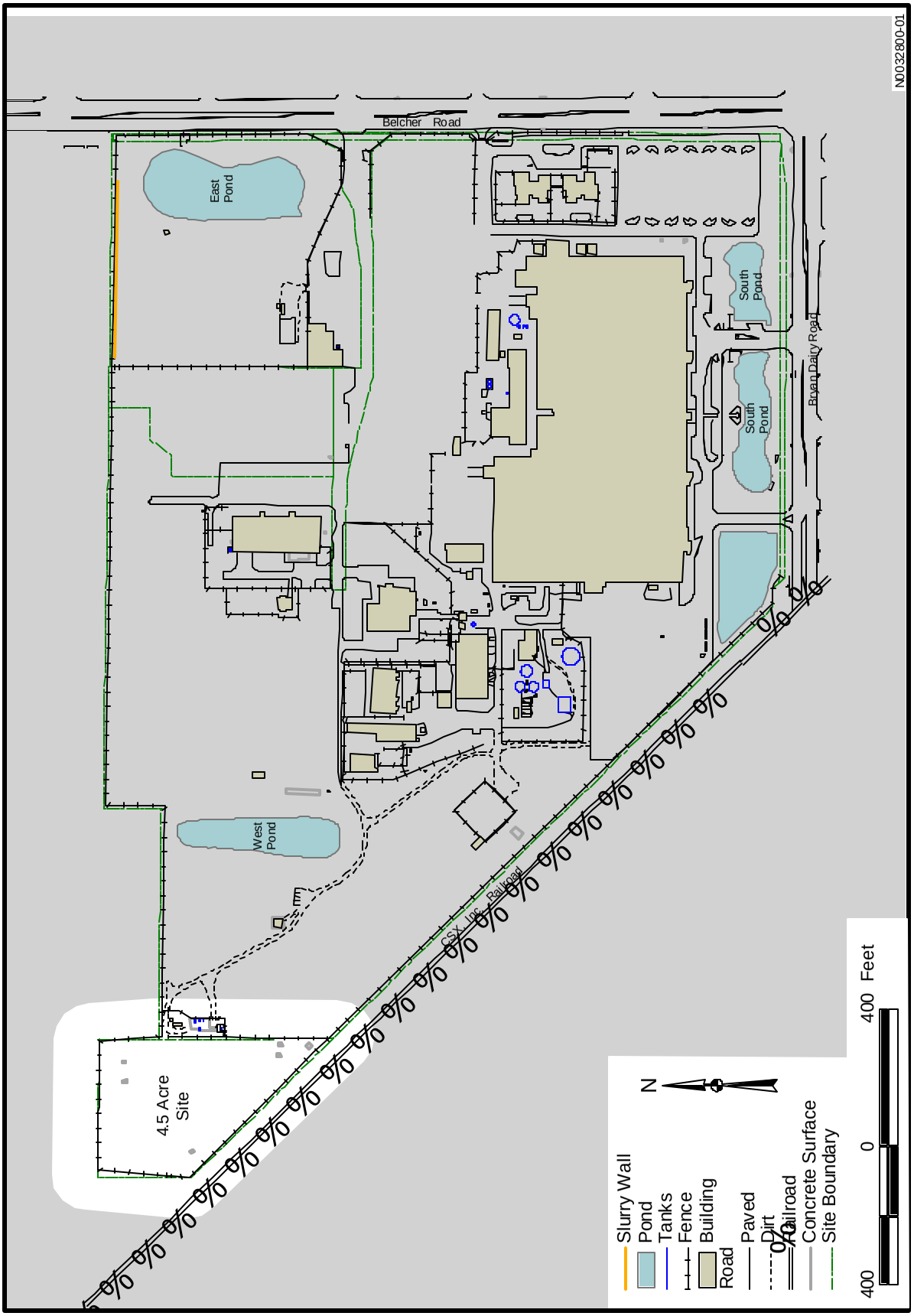

Figure 2. 4.5 Acre Site Location

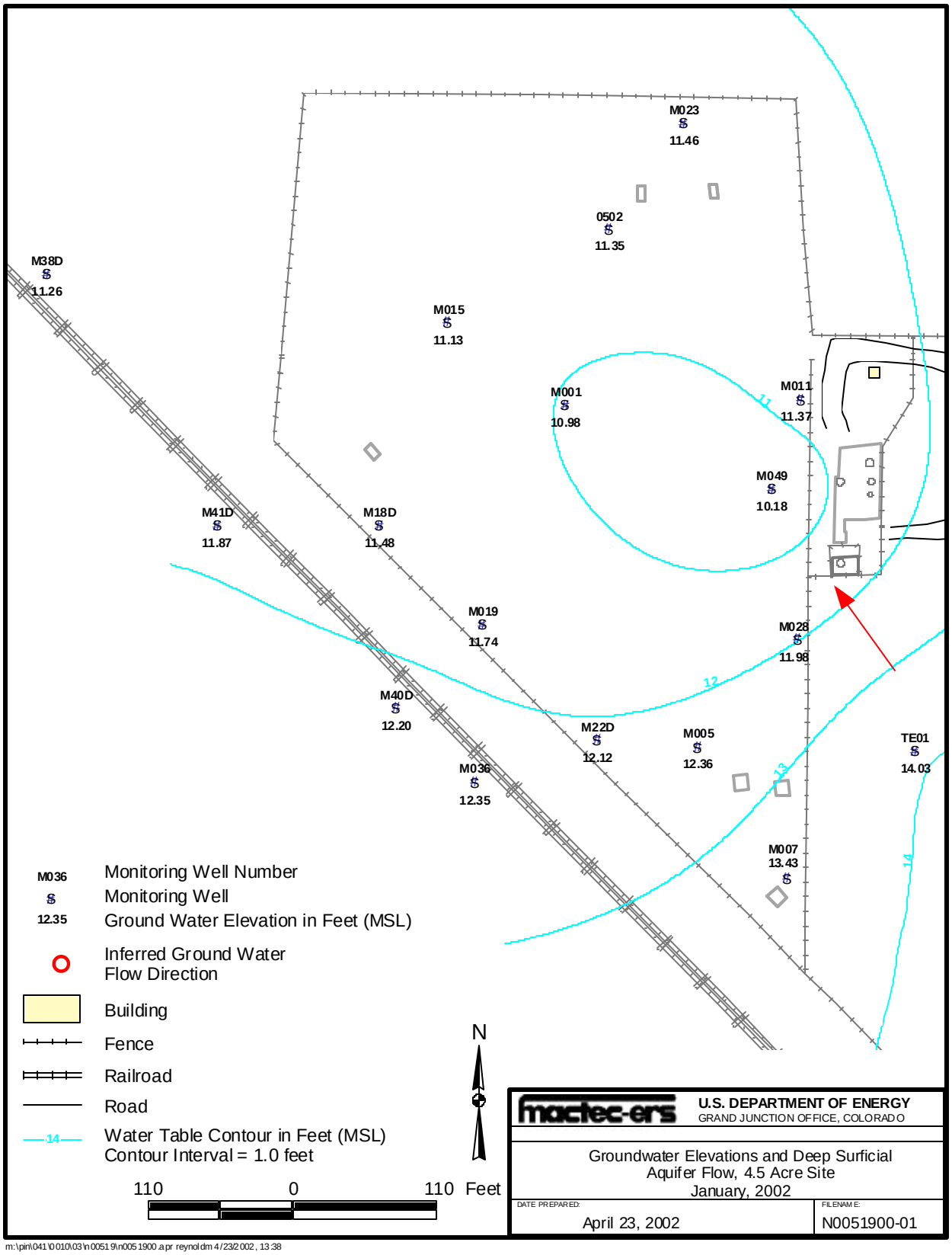

Figure 3. Groundwater Elevations and Deep Surficial Aquifer Flow, 4.5 Acre Site, January 2002

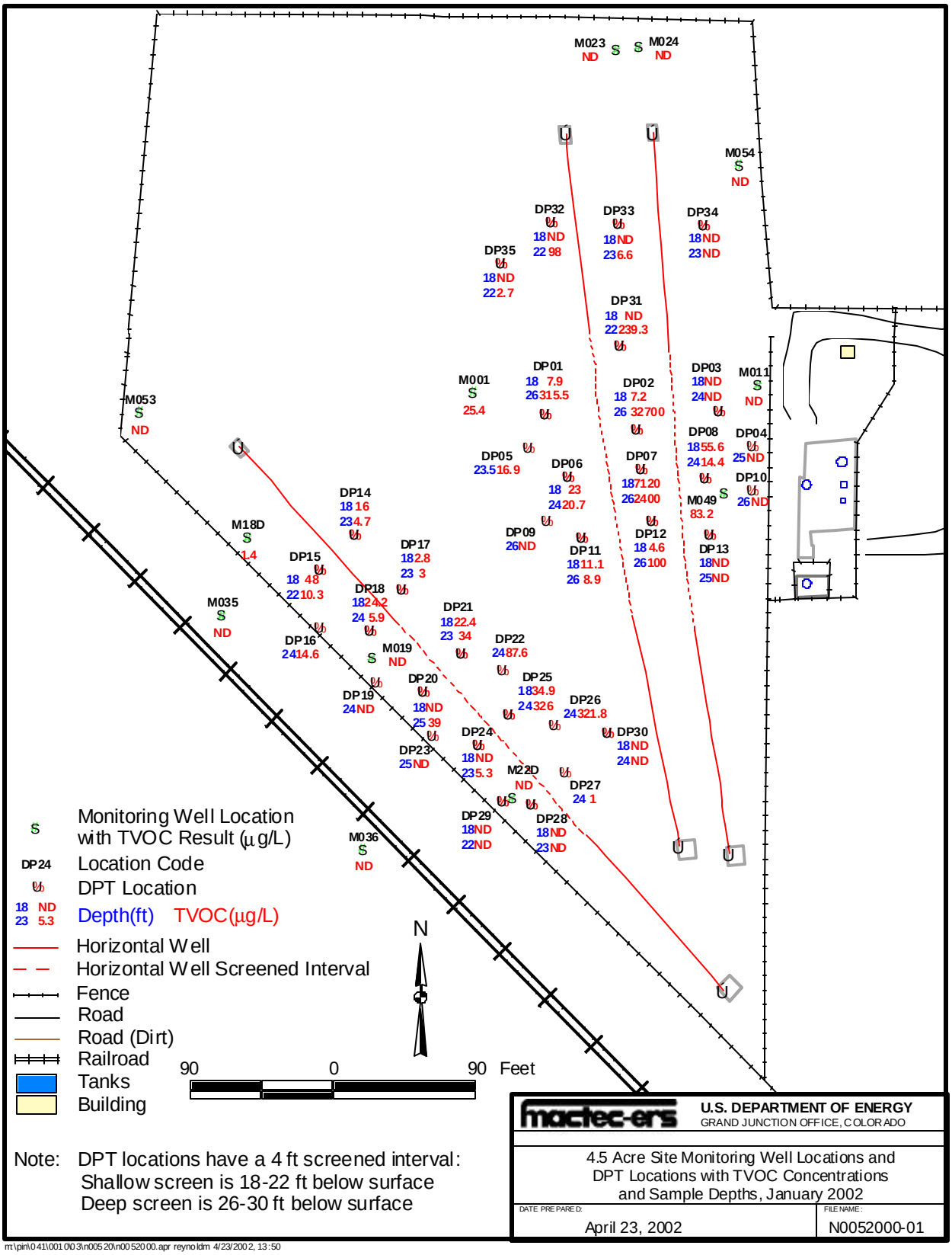

Figure 4. Monitoring Well Locations and DPT Locations with TVOC Concentrations and Sample Depths

Table 1. 4.5 Acre Site DPT Location Sample Collection Depths

Location ID	Sample Depths (ft)
DP01	18 & 26
DP02	18 & 26
DP03	18 & 24
DP04	25
DP05	23.5
DP06	18 & 24
DP07	18 & 26
DP08	18 & 24
DP09	26
DP10	26
DP11	18 & 26
DP12	18 & 26
DP13	18 & 25
DP14	18 & 23
DP15	18 & 22
DP16	24
DP17	18 & 23
DP18	18 & 24
DP19	24
DP20	18 & 25
DP21	18 & 23
DP22	24
DP23	25
DP24	18 & 23
DP25	18 & 24
DP26	24
DP27	24
DP28	18 & 23
DP29	18 & 22
DP30	18 & 24
DP31	18 & 22
DP32	18 & 22
DP33	18 & 23
DP34	18 & 23
DP35	18 & 22
Total Number of Samples	60

Table 2. Water-Level Data at the 4.5 Acre Site

Location	Measurement		Water Depth From Land Surface (ft)	Ground Water Elevation (ft NGVD)
	Date	Time		
PIN20	**4.5 Acre Site**			
0502	1/7/02	09:29	6.05	11.35
0503	1/7/02	09:30	6.11	11.29
M001	1/7/02	09:16	6.62	10.98
M003	1/7/02	08:56	5.26	12.94
M005	1/7/02	09:00	5.94	12.36
M007	1/7/02	09:03	6.02	13.43
M011	1/7/02	09:10	6.73	11.37
M012	1/7/02	09:12	5.82	12.18
M015	1/7/02	09:17	6.67	11.13
M019	1/7/02	08:53	6.26	11.74
M023	1/7/02	09:22	8.01	11.46
M024	1/7/02	09:25	6.01	11.79
M025	1/7/02	09:20	5.13	11.17
M028	1/7/02	09:05	6.22	11.98
M035	1/7/02	08:26	7.2	11.6
M036	1/7/02	08:30	6.95	12.35
M049	1/7/02	09:07	7.62	10.18
M053	1/7/02	09:27	6	11.2
M18D	1/7/02	08:49	6.22	11.48
M22D	1/7/02	08:54	5.68	12.12
M38D	1/7/02	08:25	7.24	11.26
M40D	1/7/02	08:27	7.2	12.2
M40S	1/7/02	08:28	7.19	12.01
M41D	1/7/02	08:26	7.23	11.87
TE01	1/7/02	09:40	4.07	14.03

Table 3. Field Measurements of Samples Collected From Wells at the 4.5 Acre Site

Location	Temperature (°C)	Specific Conductance (µmhos/cm)[a]	Turbidity (NTU)	pH	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)
PIN20	**4.5 Acre Site**					
M001	24.45	755	5.5	6.9	-68	0.89
M011	24.09	840	7	6.8	-74.6	0.97
M019	23.27	864	0.1	6.74	-52.5	1.48
M023	24.94	941	0.9	6.9	-86.9	1.03
M024	24.07	592	14	6.95	-7.7	1.08
M035	23.6	1,123	9.28	7.45	-164	0.41
M036	23.85	790	2.94	7.11	-115.1	0.11
M049	24.16	1,094	69.7	6.85	-74.8	1.08
M053	23.75	818	103.6	6.93	-94.4	1.4
M054	23.97	1,079	102	6.85	-91.5	1
M18D	23.74	832	13.3	6.91	-55.6	1.14
M22D	24.59	868	7.1	6.93	-66	1.4

[a]temperature corrected to 25°C

Table 4. Field Measurements of Samples Collected From DPT Locations at the 4.5 Acre Site

Location	Depth (ft bls)	Temperature (°C)	Specific Conductance (µmhos/cm)[a]	Turbidity (NTU)	pH	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Field Ferrous Iron (mg/L)	Field Total Iron (mg/L)
PIN20		4.5 Acre Site							
DP01	18	24.2	897	606	6.95	-76	1.31	3.9	5.3
DP02	18	25.1	1,955	827	6.62	-79.9	180	33.6	32
DP02	26	24.1	1,492	1,483	6.41	-24.3	2.2	19.3	17.8
DP03	18	24.1	1,434	1,484	6.72	-37.3	3.52	12.1	13.8
DP03	24	24.2	841	480	6.82	-73.5	2.24	5.7	5.5
DP04	25	24.2	952	596	6.82	-65.4	1.39	7.2	7.4
DP05	23.5	24.2	781	695	6.87	-53.5	3.03	4.1	5.6
DP06	18	25.3	1,215	610	6.78	-77.3	1.36	12	12
DP06	24	25.1	857	1,017	6.84	-79.5	1.37	6.6	6.8
DP07	18	25	1,772	579	6.67	-37.3	1.7	15.2	13.7
DP07	26	25	1,085	724	6.77	-51.6	1.58	2.8	2.8
DP08	18	24.9	2,281	569	6.48	-93.7	1.94	52.8	53.2
DP08	24	24.8	960	695	6.8	-83.1	1.54	7.7	7.8
DP09	26	24.7	1,113	453	6.76	-68.7	1.89	5.5	5.6
DP10	26	24.7	920	675	6.81	-50.9	1.45	2.5	3
DP11	18	25	1,410	755	6.79	-96	1.65	12.8	12.9
DP11	26	24.6	1,145	731	6.76	-57.3	1.94	5.1	5.4
DP12	18	24.2	1,790	780	6.65	-49.8	1.42	17.8	17.1
DP12	26	24.4	916	324	6.83	-59	1.31	3.5	3.5
DP13	18	24.7	1,487	516	6.67	-67	1.49	18.2	16.9
DP13	25	24.6	1,078	532	6.79	-75.7	1.45	8.3	8.3
DP14	18	25	861	991	6.89	-85.1	1.53	5.9	7.3
DP14	23	24.6	864	1,071	6.85	-73.9	1.63	3.9	5.2
DP15	18	24.5	872	615	6.99	-85.1	1.51	4	7
DP15	22	24.4	875	1,153	6.91	-75.4	1.56	4.3	5.8
DP16	24	23.7	1,015	599	6.9	-49.6	1.77	4.8	5.8
DP17	18	24.4	733	650	6.97	-91.8	1.43	4.4	6.5
DP17	23	24.3	789	618	6.82	-79.6	1.64	5.7	6.8
DP18	18	23.5	1,067	639	6.94	-75.7	1.27	4	4.8
DP18	24	23.5	1,037	1,481	6.92	-82.8	1.34	5.8	6.6
DP19	24	22.8	994	799	6.91	-52.7	1.08	6	6.6
DP20	18	23.2	1,072	498	6.95	-67.5	1.09	4.2	4.6
DP20	25	23.1	883	438	6.92	-42.9	1.17	2.5	3.4
DP21	18	22.7	1,634	598	6.84	-37	1.52	14.8	15.1
DP21	23	23.2	807	455	6.86	-57.5	1.25	5.7	6.5
DP22	24	23.2	1,187	1,235	6.86	-67	0.91	4.2	4.4
DP23	25	24	918	1,476	6.87	-41.4	1.11	6.3	6.8
DP24	18	23.8	1,721	729	6.68	-43.4	1.42	6.7	7.3
DP24	23	23.9	1,239	543	6.85	-81.6	1.38	7.1	7.6

Table 4 (continued). Field Measurements of Samples Collected From DPT Locations at the 4.5 Acre Site

Location	Depth (ft bls)	Temperature (°C)	Specific Conductance (µmhos/cm)[a]	Turbidity (NTU)	pH	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Field Ferrous Iron (mg/L)	Field Total Iron (mg/L)
DP25	18	24.3	1,666	779	6.73	-54.1	1.55	13	13.4
DP25	24	24.3	1,002	654	6.88	-76.6	1.36	7.3	8.2
DP26	24	24.6	707	1,210	6.96	-152	1.24	1.6	4.4
DP27	24	24.4	723	468	6.91	-64	0.72	2.3	3.1
DP28	18	24.1	850	383	6.89	-31.4	0.68	4.7	4.9
DP28	23	23.8	728	672	6.9	-58.9	0.73	4.1	4.9
DP29	18	23.5	662	512	7.02	-77.8	0.62	4	4.6
DP29	22	23.5	862	977	6.96	-77.8	0.75	4.2	4.4
DP30	18	24.2	855	938	7	-51.6	1	4.5	6.3
DP30	24	24.5	885	1,216	6.91	-107.2	1.74	1.5	2.4
DP31	18	24.3	1,196	679	6.77	-37.5	1.53	11.6	12.2
DP31	22	24.5	1,311	881	6.71	-67.9	1.73	8.7	8.6
DP32	18	24.1	1,410	705	6.92	-48.5	1.04	7.4	7.5
DP32	22	23.5	1,042	577	684	-37.4	1.2	0.9	3.8
DP33	18	24.3	1,402	633	6.86	-80	1.29	6.7	10.9
DP33	23	24.4	1,095	1,397	6.84	-55.4	1.32	6	4.6
DP34	18	24.2	1,122	879	6.87	-79.1	1.25	9.8	10
DP34	23	24.5	934	1,120	6.8	-60.9	1.4	3.8	4.5
DP35	18	24.2	940	338	7.01	-65.8	3.63	9.5	9.3
DP35	22	23.9	602	737	6.99	-44.6	1.21	1	1.5

[a]temperature corrected to 25 °C

Table 5. VOCs Concentrations From Wells at the 4.5 Acre Site
(reported in micrograms per liter)

Location	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl chloride	1,1-DCA	Chloro-ethane	Methylene chloride	Total VOCs[a]
PIN20	**4.5 Acre Site**								
M001	<1	2.4	0.17J	<1	23	<1	<1	0.49J	25.4[b]
M011	<1	<1	<1	<1	<1	<1	<1	0.51J	ND
M019	<1	<1	<1	<1	0.66J	<1	<1	0.51J	ND
M023	<1	<1	<1	<1	<1	<1	<1	<5	ND
M024	<1	<1	<1	<1	<1	<1	<1	0.33J	ND
M035	<1	0.29J	<1	<1	<1	<1	<1	0.45J	ND
M036	<1	<1	<1	<1	<1	<1	<1	0.67J	ND
M049	15	57	2.6	0.42J	8.6	<1	<1	1.6J	83.2
M053	0.15J	0.49J	<1	<1	0.5J	<1	<1	0.37J	ND
M054	<1	0.15J	<1	<1	<1	<1	<1	0.39J	ND
M18D	<1	0.36J	<1	<1	1.4	<1	<1	<5	1.4
M22D	<1	<1	<1	<1	0.9J	<1	<1	0.44J	ND

[a]"J" values are not included in the "Total VOCs" value.
[b]See the "BTEX Table" for additional analytical results.
ND = Not detected.
J = Estimated value, result is between the reporting limit and the method detection limit.

Table 6. VOCs Concentrations From DPT Locations at the 4.5 Acre Site (reported in micrograms per liter)

Location	Depth (ft bls)	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl chloride	1,1-DCA	Chloro-ethane	Methylene chloride	Total VOCs[a]
PIN20		4.5 Acre Site								
DP01	18	<1	<1	<1	<1	2.2	<1	<1	1.2J	7.9[c]
DP01	26	0.52J	140	5.5	0.52J	170	<2.5	<2.5	<12	315.5[b,c]
DP02	18	<1	1.1	<1	<1	6.1	<1	<1	<5	7.2[b]
DP02	26	2,600	20,000	800	160J	6,800	<250	<250	<1,200	32,700[c]
DP03	18	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP03	24	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP04	25	<1	<1	<1	<1	<1	<1	<1	<5	ND[c]
DP05	23.5	<1	0.22J	<1	<1	5	<1	<1	0.97J	16.9[b,c]
DP06	18	<1	<1	<1	<1	11	<1	<1	<5	23[b]
DP06	24	<1	0.23J	<1	<1	12	<1	0.38J	<5	20.7[b]
DP07	18	210	4,000	110	37J	2,800	<100	<100	<500	7,120
DP07	26	<50	14J	<50	<50	2,400	<50	<50	<250	2,400
DP08	18	2.6	37	0.9J	0.19J	16	<1	0.15J	<5	55.6[b]
DP08	24	2	1.4	<1	<1	11	<1	<1	<5	14.4
DP09	26	<1	<1	<1	<1	0.42J	<1	<1	2.3J	ND
DP10	26	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP11	18	<1	0.55J	<1	<1	1.4	<1	<1	2.6J	11.1[b]
DP11	26	<1	<1	<1	<1	3.1	<1	<1	1.3J	8.9[b,c]
DP12	18	<1	<1	<1	<1	4.6	<1	<1	<5	4.6[b]
DP12	26	<5	<5	<5	<5	100	<5	<5	<25	100
DP13	18	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP13	25	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP14	18	<1	2	<1	<1	14	<1	<1	1.2J	16[b]
DP14	23	<1	<1	<1	<1	4.7	<1	<1	<5	4.7[b]
DP15	18	<1	31	1	0.24J	16	<1	<1	1.2J	48[b]
DP15	22	<1	2.1	<1	<1	8.2	<1	<1	1.1J	10.3
DP16	24	<1	12	0.32J	<1	2.6	<1	<1	1.4J	14.6
DP17	18	<1	0.24J	<1	<1	2.8	<1	<1	1.7J	2.8[b]
DP17	23	<1	<1	<1	<1	3	<1	<1	2.3J	3[b]
DP18	18	<1	20	0.94J	<1	4.2	<1	<1	0.46J	24.2
DP18	24	<1	1.1	<1	<1	4.8	<1	<1	0.33J	5.9
DP19	24	<1	<1	<1	<1	<1	<1	<1	0.88J	ND
DP20	18	<1	<1	0.32J	<1	<1	<1	<1	<5	ND
DP20	25	<1	<1	0.27J	<1	39	<1	<1	0.6J	39
DP21	18	0.42J	0.89J	9.4	<1	13	<1	<1	0.59J	22.4
DP21	23	0.3J	0.41J	0.27J	<1	34	<1	<1	<5	34[b]
DP22	24	0.71J	0.95J	1.2	<1	85	<1	0.89J	<5	87.6[b]

Table 6 (continued). VOCs Concentrations From DPT Locations at the 4.5 Acre Site (reported in micrograms per liter)

Location	Depth (ft bls)	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl chloride	1,1-DCA	Chloro-ethane	Methylene chloride	Total VOCs[a]
DP23	25	<1	<1	<1	<1	<1	<1	<1	0.68J	ND[b,c]
DP24	18	<1	0.24J	<1	<1	<1	<1	<1	0.48J	ND
DP24	23	<1	<1	<1	<1	5.3	<1	<1	0.83J	5.3[b]
DP25	18	0.49J	1	2.9	<1	31	<1	<1	0.39J	34.9
DP25	24	90	34	42	2J	160	<2.5	<2.5	2.2J	326
DP26	24	130	52	37	2.8	100	<2.5	<2.5	<12	321.8[c]
DP27	24	0.25J	0.22J	<1	<1	<1	<1	<1	<5	1[b]
DP28	18	0.11J	<1	<1	<1	<1	<1	<1	<5	ND
DP28	23	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP29	18	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP29	22	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP30	18	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP30	24	<1	<1	<1	<1	<1	<1	<1	<5	ND[b]
DP31	18	<1	<1	<1	<1	<1	<1	<1	<5	ND[b]
DP31	22	<2.5	96	3.3	0.69J	140	<2.5	<2.5	<12	239.3[c]
DP32	18	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP32	22	0.22J	25	0.4J	0.28J	73	<1	<1	<5	98[b]
DP33	18	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP33	23	<1	2.2	<1	<1	4.4	<1	<1	<5	6.6[b]
DP34	18	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP34	23	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP35	18	<1	<1	<1	<1	<1	<1	<1	<5	ND
DP35	22	<1	<1	<1	<1	2.7	<1	<1	<5	2.7[b]

[a]"J" values are not included in the "Total VOCs" value.
[b]See the "BTEX Table" for additional analytical results.
[c]See the "Additional VOCs Table" for additional analytical results.
ND = Not detected.
J = Estimated value, result is between the reporting limit and the method detection limit.

Table 7. BTEX Compounds Concentrations From Wells at the 4.5 Acre Site
(reported in micrograms per liter)

Location	Benzene	Toluene	Ethylbenzene	Total Xylenes[a]	Total BTEX[b]
PIN20	**4.5 Acre Site**				
M001	0.34J	<1	<1	ND	ND
M011	<1	<1	<1	ND	ND
M019	<1	<1	<1	ND	ND
M023	<1	<1	<1	ND	ND
M024	<1	<1	<1	ND	ND
M035	<1	<1	<1	ND	ND
M036	<1	<1	<1	ND	ND
M049	<1	<1	<1	ND	ND
M053	<1	<1	<1	ND	ND
M054	<1	<1	<1	ND	ND
M18D	<1	<1	<1	ND	ND
M22D	<1	<1	<1	ND	ND

[a]m-, o-, p- Xylene if detected.
[b]"J" values are not included in the "Total BTEX" value.
ND = Not detected.
J = Estimated value, result is between the reporting limit and the method detection

Table 8. BTEX Compounds Concentrations From DPT Locations at the 4.5 Acre Site (reported in micrograms per liter)

Location	Depth (ft bls)	Benzene	Toluene	Ethylbenzene	Total Xylenes[a]	Total BTEX[b]
PIN20		**4.5 Acre Site**				
DP01	18	<1	<1	<1	ND	ND
DP01	26	2J	<2.5	<2.5	ND	ND
DP02	18	0.44J	<1	<1	ND	ND
DP02	26	<250	<250	<250	ND	ND
DP03	18	<1	<1	<1	ND	ND
DP03	24	<1	<1	<1	ND	ND
DP04	25	<1	<1	<1	ND	ND
DP05	23.5	7.8	<1	<1	0.29J	7.8
DP06	18	12	<1	<1	ND	12
DP06	24	8.7	<1	<1	ND	8.7
DP07	18	<100	<100	<100	ND	ND
DP07	26	<50	<50	<50	ND	ND
DP08	18	0.17J	<1	<1	0.35J	ND
DP08	24	<1	<1	<1	ND	ND
DP09	26	<1	<1	<1	ND	ND
DP10	26	<1	<1	<1	ND	ND
DP11	18	9.7	<1	<1	ND	9.7
DP11	26	0.54J	<1	<1	0.36J	ND
DP12	18	0.16J	<1	<1	ND	ND
DP12	26	<5	<5	<5	ND	ND
DP13	18	<1	<1	<1	ND	ND
DP13	25	<1	<1	<1	ND	ND
DP14	18	0.75J	<1	<1	ND	ND
DP14	23	<1	<1	0.22J	ND	ND
DP15	18	0.28J	<1	<1	ND	ND
DP15	22	<1	<1	<1	ND	ND
DP16	24	<1	<1	<1	ND	ND
DP17	18	0.5J	<1	<1	ND	ND
DP17	23	0.24J	<1	<1	ND	ND
DP18	18	<1	<1	<1	ND	ND
DP18	24	<1	<1	<1	ND	ND
DP19	24	<1	<1	<1	ND	ND
DP20	18	<1	<1	<1	ND	ND
DP20	25	<1	<1	<1	ND	ND
DP21	18	<1	<1	<1	ND	ND
DP21	23	0.57J	<1	<1	ND	ND
DP22	24	1.4	<1	<1	ND	1.4
DP23	25	0.27J	0.23J	<1	0.36J	ND
DP24	18	<1	<1	<1	ND	ND
DP24	23	0.39J	<1	<1	ND	ND
DP25	18	<1	<1	<1	ND	ND

Table 8 (continued). BTEX Compounds Concentrations From DPT Locations at the 4.5 Acre Site (reported in micrograms per liter)

Location	Depth (ft bls)	Benzene	Toluene	Ethylbenzene	Total Xylenes[a]	Total BTEX[b]
DP25	24	<2.5	<2.5	<2.5	ND	ND
DP26	24	<2.5	<2.5	<2.5	ND	ND
DP27	24	<1	1	<1	0.39J	1
DP28	18	<1	<1	<1	ND	ND
DP28	23	<1	<1	<1	ND	ND
DP29	18	<1	<1	<1	ND	ND
DP29	22	<1	<1	<1	ND	ND
DP30	18	<1	<1	<1	ND	ND
DP30	24	<1	<1	<1	0.28J	ND
DP31	18	0.22J	<1	<1	ND	ND
DP31	22	<2.5	<2.5	<2.5	ND	ND
DP32	18	<1	<1	<1	ND	ND
DP32	22	0.2J	<1	<1	0.29J	ND
DP33	18	<1	<1	<1	ND	ND
DP33	23	<1	<1	0.16J	ND	ND
DP34	18	<1	<1	<1	ND	ND
DP34	23	<1	<1	<1	ND	ND
DP35	18	<1	<1	<1	ND	ND
DP35	22	0.35J	<1	<1	ND	ND

[a] m-, o-, p- Xylene if detected.
[b] "J" values are not included in the "Total BTEX" value.
ND = Not detected.
J = Estimated value, result is between the reporting limit and the method detection

Table 9. Additional VOCs Concentrations From DPT Locations at the 4.5 Acre Site (reported in micrograms per liter)

Location	Depth (ft bls)	1,1,2,2-Tetrachloro-ethane	2-Chloroethyl Vinyl Ether	Dichloro-difluoro-methane	Trichloro-fluoro-methane
PIN20	**4.5 Acre Site**				
DP01	18			5.7	
DP01	26			1J	
DP02	26		2,500		
DP04	25			0.25J	
DP05	23.5			4.1	
DP11	26			5.8	
DP23	25				0.22J
DP26	24	0.82J			
DP31	22	0.91J			

J = Estimated value, result is between the reporting limit and the method detection limit.

Table 10. HPC Data for Selected 4.5 Acre Site DPT Locations HPC units are colony forming units (CFU)/mL

Location	Depth	Baseline April 2001	July 2001	October 2001	January 2002
DP06	Shallow	15	>6,000	70	16
DP06	Deep	280	140	42	5
DP07	Shallow	210	150	4	2
DP07	Deep	340	440	15	2
DP08	Shallow	38	150	590	<1
DP08	Deep	170	690	2	2
DP24	Shallow	43	74	160	18
DP24	Deep	160	240	190	15
DP25	Shallow	41	150	18	4
DP25	Deep	270	2,900	36	23

Table 11. Oxidized Iron as Percent of Total Iron
Field analysis of dissolved total and ferrous iron measured in October 2001 are reported in Table 4.

Location	Depth	Baseline April 2001	July 2001	October 2001	January 2002
DP01	Shallow	73	37	10	26
DP01	Deep	11	42	41	-
DP02	Shallow	17	11	24	0[a]
DP02	Deep	23	8	31	0[a]
DP03	Shallow	5	5	10	12
DP03	Deep	-	15	48	0[a]
DP04	Deep	4	21	48	3
DP05	Deep	18	-	44	27
DP06	Shallow	10	48	26	0
DP06	Deep	0[a]	67	21	3
DP07	Shallow	15	11	0[a]	0[a]
DP07	Deep	11	13	6	0
DP08	Shallow	14	7	0[a]	1
DP08	Deep	4	9	5	1
DP09	Deep	4	32	30	2
DP10	Deep	0	18	28	17
DP11	Shallow	15	38	13	1
DP11	Deep	18	38	48	6
DP12	Shallow	9	10	17	0[a]
DP12	Deep	2	16	42	0
DP13	Shallow	0[a]	5	0[a]	0[a]
DP13	Deep	6	12	11	0
DP14	Shallow	12	85	29	19
DP14	Deep	23	56	33	25
DP15	Shallow	21	75	55	43
DP15	Deep	-	40	41	26
DP16	Deep	11	29	30	17
DP17	Shallow	35	66	57	32
DP17	Deep	20	33	54	16
DP18	Shallow	6	27	38	17
DP18	Deep	2	29	28	12
DP19	Deep	2	16	39	9
DP20	Shallow	5	19	20	9
DP20	Deep	4	13	23	26
DP21	Shallow	11	15	23	2
DP21	Deep	6	23	36	12
DP22	Deep	1	32	15	5
DP23	Deep	13	45	34	7
DP24	Shallow	4	3	6	8
DP24	Deep	-	30	25	7
DP25	Shallow	3	14	14	3
DP25	Deep	6	39	68	11
DP26	Deep	4	43	59	64

Table 11 (continued). Oxidized Iron as Percent of Total Iron

Location	Depth	Baseline April 2001	July 2001	October 2001	January 2002
DP27	Deep	24	40	13	26
DP28	Shallow	40	26	90	4
DP28	Deep	7	16	29	16
DP29	Shallow	35	44	14	13
DP29	Deep	14	31	29	5
DP30	Shallow	-	-	-	29
DP30	Deep	-	34	77	38
DP31	Shallow	-	17	21	5
DP31	Deep	-	16	30	0[a]
DP32	Shallow	-	21	53	1
DP32	Deep	-	24	48	76
DP33	Shallow	-	51	42	39
DP33	Deep	-	29	15	0[a]
DP34	Shallow	-	46	17	2
DP34	Deep	-	43	47	16
DP35	Shallow	-	41	47	0[a]
DP35	Deep	-	39	46	33

[a]Ferrous Iron > Total Iron
- Not measured

Appendix A

Laboratory Reports—January 2002 Quarterly Results

Table A–1. Relative Percent Difference (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–DP05–N001	PIN20–0550	B210094	Benzene	7.8	8.8	12.0	5	
			cis-1,2-DCE	0.22	0.24	8.7	5	
			Dichlorodifluoromethane	4.1	0.5	156.5	5	
			m,p-Xylene	0.29	0.5	53.2	5	
			Methylene chloride	0.97	2.5	88.2	25	
			Vinyl chloride	5	5.2	3.9	5	
PIN20–DP33–N002	PIN20–0552	B210109	Ethylbenzene	0.16	0.5	103.0	5	
			Vinyl Chloride	4.4	0.5	159.2	5	
PIN20–DP16–N001	PIN20–0551	B210093	cis-1,2-DCE	12	8.2	37.6	5	Fail
			Methylene chloride	1.4	0.69	67.9	25	
			trans-1,2-DCE	0.32	0.31	3.2	5	
			Vinyl chloride	2.6	1.5	53.7	5	
PIN20–DP20–N001	PIN20–0563	B210070	Methylene chloride	2.5	0.48	135.6	25	
			trans-1,2-DCE	0.32	0.33	3.1	5	
PIN20–M024–N001	PIN20–0563	B210092	Methylene chloride	0.33	0.46	32.9	25	

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

End of current text