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Lawrence Livermore National Laboratory
University of California, Livermore, California 94550
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LLNL
Ground Water Project

2005 Annual Report

Technical Editors

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Environmental Protection Department
Environmental Restoration Program and Division

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Summary

In 2005, restoration activities for the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) included:

- Operating 27 ground water treatment facilities and 8 soil vapor treatment facilities.
- Operating 77 ground water extraction wells, 1 ground water injection well, 22 dual extraction[1] wells, 20 soil vapor extraction wells, and 1 soil vapor injection well.
- Installing one dual extraction well, three ground water monitoring wells and eight soil vapor wells.
- Installing three anode wells for the institution and decommissioning (drilling out old equipment and grouting the borehole) three anode wells.
- Conducting 4 hydraulic tests.
- Conducting 13 soil vapor extraction (SVE) tests.
- Meeting all regulatory/DOE milestones by starting treatment facilities ahead of schedule at:
  - TFD East Traffic Circle South
  - TFD Hotspot
  - TFE Hotspot
  - TF406 Hotspot
- Removing over 71 kilograms (kg) of volatile organic compounds (VOCs) from ground water and over 196 kg of soil vapor (Table Summ-1).

Since remediation began in 1989, over 2.8 billion gallons of ground water and over 175 million cubic feet of soil vapor have been treated, removing a combined total of over 2,079 kg of VOCs (Table Summ-2).

[1]Extraction of ground water using a downhole pump with concurrent application of vacuum to the well. Ground water and soil vapors are removed in separate pipe manifolds and treated.

Table Summ-1. Summary of Livermore Site 2005 VOC remediation.

Treatment facility area[a]	Volume of ground water treated (Mgal)[b]	VOC mass removed from ground water (kg)	Volume of soil vapor treated (kft³)[b]	VOC mass removed from soil vapor (kg)	Estimated total VOC mass removed (kg)
TFA	110.5	6.9	na	na	6.9
TFB	29.5	3.2	na	na	3.2
TFC	36.6	5.8	na	na	5.8
TFD	75.8	42.7	15,687.0	58.4	101.1
TFE	26.4	9.9	38,733.7	27.4	37.3
TFG	7.3	1.2	na	na	1.2
TFH	12.1	1.5	28,401.5	110.5	112.0
Total[c]	298[c]	71[c]	82,822[c]	196[c]	267[c]

Notes:

Mgal = Millions of gallons.

kft^3 = Thousands of cubic feet.

kg = Kilograms.

na = Not applicable.

[a] Treatment areas and facilities (Refer to Table 2 for abbreviations):

TFA area: TFA, TFA-E

TFB area: TFB

TFC area: TFC, TFC-E, TFC-SE

TFD area: TFD, TFD-E, TFD-HPD, TFD-S, TFD-SE, TFD-SS, TFD-W, VTFD-ETCS, VTFD-HPD, VTFD-HS

TFE area: TFE-E, TFE-HS, TFE-NW, TFE-SE, TFE-SW, TFE-W, VTFE-ELM, VTFE-HS

TFG area: TFG-1, TFG-N

TFH area: TF406, TF406-NW, VTF406-HS, TF518-N, VTF518-PZ, TF5475-1, TF5475-2, TF5475-3, VTF5475

[b] Total volumes for each treatment facility area.

[c] Rounded numbers.

Table Summ-2. Summary of cumulative Livermore Site VOC remediation.

Treatment facility area	Volume of ground water treated (Mgal)[a]	VOC mass removed from ground water (kg)	Volume of soil vapor treated (kft^3)[a]	VOC mass removed from soil vapor (kg)	Estimated total VOC mass removed (kg)
TFA	1,301.8	178.6	na	na	178.6
TFB	296.6	65.7	na	na	65.7
TFC	254.7	71.9	na	na	71.9
TFD	625.5	649.8	21,033.8	66.0	715.8
TFE	224.1	172.4	66,208.7	123.0	295.4
TFG	37.7	7.2	na	na	7.2
TFH	107.0	22.6	88,020.8	722.2	744.8
Total[b]	2,847[b]	1,168[b]	175,263[b]	911[b]	2,079[b]

Notes:

Kg = Kilograms.

kft^3 = Thousands of cubic feet.

Mgal = Millions of gallons.

na = Not applicable.

[a] Total volumes for each treatment facility area.

[b] Rounded numbers.

1. Introduction

This report summarizes the Lawrence Livermore National Laboratory (LLNL) Livermore Site Ground Water Project (GWP) activities for calendar year 2005.

Figures 1 and 2 (a, b, c, d) show the treatment areas, treatment facilities, and wells at the Livermore Site. Table 1 summarizes the types and numbers of Livermore Site wells. Table 2 lists all the treatment facilities and summarizes their abbreviations, including those with upcoming 2006 regulatory milestones. Table 3 lists the 12 wells that were installed in 2005, and the additional three anode wells for LLNL cathodic protection system that were paid for by the institution. In addition, the Environmental Restoration Division (ERD) decommissioned three anode wells. Tables 4 and 5 summarize the hydraulic, dual extraction, and soil vapor extraction (SVE) tests conducted in 2005. Table 6 documents achievement of all the 2005 Remedial Action Implementation Plan (RAIP) milestones. Table 7 lists each treatment facility along with its discharge sampling location(s) and extraction wells.

Appendices A through E present Well Construction and Closure Data, Hydraulic Test Results, Soil Vapor Extraction Test Results, the 2006 Ground Water Sampling Schedule, and the Haussmann Lake Annual Monitoring Program Summary, respectively. Water level elevations, volatile organic compound (VOC) analytical results, and the TF406 fuel hydrocarbon analyses are available on request.

2. Regulatory Compliance

In 2005, the U.S. Department of Energy (DOE)/LLNL submitted the GWP 2004 Annual Report (Karachewski et al., 2005) and GWP quarterly self-monitoring reports on schedule (Yow and Wong 2005 a, b, c, and 2006). In addition, DOE/LLNL completed four 2005 RAIP milestones (Table 6) ahead of schedule (Dresen et al., 1993).

Livermore Site community relations activities in 2005 included communications and meetings with neighbors and local, regional, and national interest groups and other community organizations; making public presentations; producing and distributing the Environmental Community Letter; maintaining the Information Repositories and the Administrative Record; conducting tours of the site environmental activities; and responding to public and news media inquiries. In addition, DOE/LLNL met with the Community Work Group, and met with members of Tri-Valley Communities Against a Radioactive Environment and their scientific advisor as part of the activities funded by a U.S. Environmental Protection Agency (EPA) Technical Assistance Grant. Community questions were also addressed via electronic mail, and project documents, letters, and public notices were posted on a public website at:

http://www-envirinfo.llnl.gov/

3. Field Investigations

3.1. Ground Water Monitoring

In 2005, the GWP collected 1,017 ground water samples from 359 wells during 823 sampling events. The wells were sampled at varying frequencies depending upon their data quality objectives. The ground water samples were collected using the following methods:

- Specific-Depth Grab Sampling (SDGS) using a Voss EasyPump or Geotech Specific Depth Sampler pump: 518 events (63%),
- Three-volume purge using a dedicated electric submersible pump: 104 events (13%),
- Low-volume purge: 71 events (8%), and
- Other (bailer, electronic submersible pump, etc.): 130 events (16%).

The ground water samples were analyzed for VOCs, fuel hydrocarbons, polychlorinated biphenyls, metals, radionuclides, or combinations thereof depending upon sampling plan specifications.

Both ERD and the LLNL Water Guidance and Monitoring Group (WGMG) Project Leaders, in conjunction with the Sampling Coordinator, evaluated data quality objectives, historical analytical results, the Cost-effective Sampling (CES) algorithm, and other hydraulic data to determine the sampling frequency, required analyses, and appropriate sampling method for each well.

Ongoing and significant cost reduction was achieved again in 2005 through the use of SDGS and low-volume purge methods. The benefits of these methods include:

- Ongoing cost savings by eliminating the need to replace dedicated pumps and related sampling equipment,
- Increased technician efficiency and reduction in sampling time,
- Increased personnel safety, and
- Elimination of approximately 50,000 gallons of purge water that may have required treatment and disposal.

SDGS is the preferred method for collecting ground water samples from wells that can produce mixed-waste (VOCs and tritium) purge water. This method eliminates the collection, treatment, and disposal of mixed-waste water, which results in significant cost savings.

3.2. Source Investigations

Gore-Sorber® investigations and drilling activity continued to focus on source areas to achieve upcoming RAIP milestones (Fig. 3). During 2005, two passive soil vapor investigations were conducted in the TFC and TFH (Trailer 5475) areas to fill data gaps (Whetzel, 2005a,b). Fifty Gore-Sorber® modules each were installed in the TFC area and near Trailer 5475 (Fig. 3). The Gore-Sorber® modules were installed to a depth of approximately three feet below the surface and were left in the ground for three weeks prior to retrieval and submission for VOC analysis.

In the TFC area, VOCs were not detected at 32 of 50 locations and where present, the trichloroethylene (TCE) or tetrachloroethylene (PCE) concentrations were very low (maximum 4.6 micrograms). Near Trailer 5475, VOCs were not detected at 28 of 50 locations; however, the TCE and PCE concentrations ranged up to a maximum of 40.2 micrograms. Results of these investigations will be incorporated into models to assess the potential risk to ground water and the need for future remediation using soil vapor extraction systems.

3.3. Soil Vapor Extraction Tests

SVE and/or dual extraction tests were conducted at the TFD and TFE Hotspots (Fig. 2). The results of these tests were incorporated into planning the design, startup, and operation of these RAIP milestone-related treatment facilities. The SVE test wells are listed in Table 5 and the results are summarized in Appendix C.

4. Flow and Transport Modeling

Ground water flow and contaminant transport models are used at the Livermore Site to optimize the design and operation of remediation systems; to support ongoing subsurface characterization activities; and to improve the ability to forecast, monitor, and interpret the progress of the remediation program. In addition, site-specific models are developed to assess the potential impact to ground water from residual contamination in surfacial sediments and subsurface sediments above the water table.

In the last few years Livermore Site field activities have focused on completing RAIP milestones that mainly address source areas by deploying dual-extraction technologies. The operation of these systems necessitated development of modeling tools that allow simulation of these dual-phase systems. To better understand the impact of these source areas, a Zone-Partitioning-Flux (ZPF) model was developed to simulate the behavior of chlorinated VOCs, partitioned between dense non-aqueous phase liquid, aqueous, gaseous, and adsorbed phases, in response to soil vapor and ground water extraction. By history matching the ZPF models with observed downgradient VOC concentrations, realistic source release functions can be developed that will be incorporated into the basin-scale three-dimensional (3-D) model. The ZPF model is also useful for optimizing operation of the dual-extraction remediation systems.

In 2005, ERD continued development of the comprehensive 3-D basin-scale ground water flow and transport model to simulate all relevant subsurface hydrologic processes influencing contaminant transport at the Livermore Site. The model is currently applied to improve the remediation efficiency for the distal plumes west of the site. This model will also be applied to better understand dewatering processes observed at the eastern portion of the site, predict the migration of VOCs between adjacent HSUs and, as described above, it will incorporate realistic source terms to better estimate cleanup times.

In addition, a series of one-dimensional vadose zone models were constructed to evaluate potential impacts from residual contamination in shallow soil to ground water at the Building 514 Area. The models were used to support closure activities at the Building 514 Area. The approach developed for this evaluation can also be applied to support other building closure activities where determining potential impact to ground water from shallow soil is important.

5. Summary of Remedial Action Program

This section summarizes activities performed in 2005 to support the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Action Program at the Livermore Site. These activities included designing and constructing new treatment facilities, modifying existing systems, monitoring performance of treatment facilities, conducting treatability tests, installing wells, and performing preliminary hydraulic and SVE tests.

In 2005, DOE/LLNL operated 27 ground water treatment facilities in the TFA, TFB, TFC, TFD, TFE, TFG, and TFH (TF406, TF518, and TF5475) areas (Fig. 1 and Table 7). The 77 ground water extraction wells and 20 dual extraction wells produced over 298 million gallons of ground water at an average flow rate of about 570 gallons per minute (gpm), removing over 71 kilograms (kg) of VOCs (Table Summ-1). For comparison, in 2004 the ground water treatment facilities removed approximately 86 kg of VOCs. The lower quantity of mass removed in 2005 is partially due to decreasing concentrations in the TFD and TFE source areas and declining extraction well flow rates due to remediation-induced dewatering at the site. Since remediation began in 1989, over 2.8 billion gallons of ground water have been treated, resulting in removal of over 1,168 kg of VOCs (Fig. 4 and Table Summ-2).

In 2005, DOE/LLNL also operated eight soil vapor treatment facilities: VTFD East Traffic Circle South, VTFD Helipad, VTFD Hotspot, VTFE Eastern Landing Mat, VTFE Hotspot, VTF406 Hotspot, VTF518 Perched Zone, and VTF5475 (Fig. 1 and Table 7). The 20 soil vapor extraction wells and 22 dual extraction wells produced nearly 83 million standard cubic ft (scf) of soil vapor, and the treatment facilities removed over 196 kg of VOCs (Table Summ-1). For comparison, in 2004 the soil vapor treatment facilities removed approximately 133 kg of VOCs. The significantly higher rate of mass removal in 2005 (a 47% increase) is due to activation of new vapor treatment facilities VTFD-ETCS, VTFD-HS, VTFE-HS, and VTF406-HS. Since initial operation, more than 175 million cubic feet of soil vapor has been extracted and treated, removing over 911 kg of VOCs (Fig. 4 and Table Summ-2) from the subsurface.

Four hydraulic tests were conducted in 2005 (Table 4 and Appendix B). Fourteen SVE or dual extraction tests were also conducted in 2005 (Table 5 and Appendix C).

Treatment facility performance is evaluated using multiple data sets. Figures 5 through 10 show the estimated hydraulic capture areas in HSUs 1B, 2, 3A, 3B, 4, and 5, respectively, based on ground water elevation data collected during the fourth quarter in 2005. Figures 11 through 16 show the total VOC isoconcentration maps in the same six HSUs during the third quarter 2005. Contaminant concentration trends (Section 7) are also used to evaluate treatment facility performance and hydraulic capture.

5.1. Treatment Facility A Area

Two treatment facilities, TFA and TFA East (Figs. 1 and 2b), operated in compliance with all permits throughout 2005 with one exception. A leak was reported on December 27, 2005 from the pipeline that connects the well W-415 to TFA. The leak was caused by an improperly connected pipe flange when a contractor modified the pipeline as part of a realignment of Arroyo Seco. Well W-415 and its pipeline were shut down. About 10,200 gallons of untreated ground water flowed into Arroyo Seco. Ground water from well W-415 contains about 21 parts per billion (ppb) total VOCs, principally PCE. The discharged water contained about 0.81 grams of total VOCs. The San Francisco Bay Regional Water Quality Control Board was notified and corrective action was taken by properly securing the flange. The pipeline was tested for leaks before restarting operations. Once surface water flow resumed in Arroyo Seco after a rainstorm, a receiving water sample (TFG-ASW) was collected. No VOCs were detected in the receiving water sample.

Except at two locations, TFA area extraction wells continue to hydraulically control all of the VOC plumes in HSUs 1B and 2, based on the capture zones shown in Figures 5 and 6 and total VOC isoconcentration maps (Figs. 11 and 12). In HSU-1B, well W-552 remains outside the capture area of extraction well W-408. Well W-552 PCE concentrations were 1 ppb in July 2005. In HSU-2, the westernmost offsite plume is outside the capture area of extraction well W-109. However, capture zone analysis and stable concentrations at well W-404 (20 ppb PCE, September 2005) suggest that the plume remains immobilized within a stagnant zone west of the TFA extraction well field (Figs. 6 and 12). Pumping continues at offsite extraction well W-408 to ensure hydraulic control of the residual HSU-1B plume at wells W-506 and W-1425 (Fig. 11), where the PCE concentrations were 3.7 ppb in July 2005 and 11 ppb in December 2005, respectively. Six of the eight HSU-1B and 2 extraction wells in the TFA South area remained off in 2005, as concentrations in this area continue to decline without the need for additional ground water extraction from these two HSUs. In HSU-3A, pumping at extraction well W-712 continues to capture a low-concentration carbon tetrachloride plume near Vasco Road. VOC concentrations in offsite HSU-3A well W-505 remain below MCLs for all contaminants of concern (Figs. 7 and 13).

5.2. Treatment Facility B Area

TFB (Figs. 1 and 2a) operated in compliance with all permits throughout 2005.

Except for two small offsite areas in HSU-1B that are below MCLs for all contaminants of concern (wells W-517 and W-571), the TFB area extraction wells hydraulically control the VOC plumes in HSUs 1B and 2, based on the capture zones shown in Figures 5 and 6, the total VOC isoconcentration maps (Figs. 11 and 12), and stable or declining VOC concentrations in the area. To improve hydraulic capture of the HSU-2 plume along Vasco Road, extraction well W-655 was restarted at a flow rate of 5 gpm and the W-621 flow rate was increased from 7 gpm to 8 gpm on July 14, 2005.

5.3. Treatment Facility C Area

Three treatment facilities, TFC, TFC East, and TFC Southeast, (Figs. 1 and 2c), operated in compliance with all permits throughout 2005.

A passive soil vapor survey using 50 Gore-Sorber® modules was conducted in the TFC area in 2005 (Section 3.2). In addition, an anode well for pipeline cathodic protection was installed. The previous anode well was also decommissioned by drilling out the old well and grouting the borehole.

In the central and western TFC area, VOCs are confined to HSU-1B. In the eastern TFC area, VOCs are in both HSU-1B and HSU-2. The TFC area extraction wells hydraulically control the VOC plumes in HSU-1B and HSU-2, based on the capture zones shown in Figures 5 and 6 and the total VOC isoconcentration maps (Figs. 11 and 12).

5.4. Treatment Facility D Area

Ten treatment facilities operated in the TFD area during 2005 (Figs. 1 and 2c): TFD, TFD East, TFD Helipad, TFD South, TFD Southeast, TFD Southshore, TFD West, VTFD East Traffic Circle South, VTFD Helipad, and VTFD Hotspot. The treatment facilities operated in compliance with all permits throughout the year.

Twelve new wells were installed in the TFD area in 2005 (Fig. 2c). These included three ground water monitor wells, eight soil vapor monitor wells, and one anode well for pipeline cathodic protection (Table 3). The previous anode well was also decommissioned. Tables 4 and 5 list the wells for which hydraulic, dual extraction, and soil vapor extraction tests were performed. The test results are summarized in Appendices B and C.

The TFD East Traffic Circle South milestone was completed on July 13, 2005. This milestone consisted of adding two ground water extraction wells (W-2005 and W-1403) and two dual extraction wells (W-1904 and SIP-ETC-201) to TFD Southeast (Table 7). In addition to the dual extraction wells, three soil vapor extraction wells (W-ETC-2003, W-ETC-2004A, and W-ETC-2004B) were connected to VTFD East Traffic Circle South (Table 7). The TFD Hotspot milestone, which targets a high-concentration, low-permeability VOC source area within HSU-3A, was completed on September 20, 2005. This milestone consisted of connecting four dual extraction wells (W-653, W-2011, W-2101, and W-2102) to both TFD and a new vapor treatment facility, VTFD Hotspot (Table 7).

The TFD area extraction wells exert significant hydraulic control over VOC plumes in HSUs 3A, 3B, and 4 and over large portions of VOC plumes in HSU-2 and 5 based on the capture zones shown in Figures 6, 7, 8, 9, and 10 and the total VOC isoconcentration maps (Figs. 12, 13, 14, 15, and 16). Distal portions of VOC plumes in HSUs 1B and 2 (Figs. 5, 6, 11, and 12) in the western TFD area are being hydraulically contained by TFC East. Distal portions of the VOC plume in HSU-3A in the northwestern TFD area are being hydraulically contained by extraction wells at TFD West and TFD (Figs. 7 and 13).

5.5. Treatment Facility E Area

Eight treatment facilities operated in the TFE area during 2005 (Figs. 1 and 2d): TFE East, TFE Hotspot, TFE Northwest, TFE Southeast, TFE Southwest, TFE West, VTFE-Eastern Landing Mat, and VTFE Hotspot. The treatment facilities operated in compliance with all permits throughout the year.

Tables 4 and 5 list the wells for which hydraulic, dual extraction, and soil vapor extraction tests were performed. The test results are summarized in Appendices B and C.

The TFE Hotspot milestone was completed on August 23, 2005. This milestone, which addresses the clean up of a vadose zone source area, consisted of connecting one dual extraction well (W-2105) and one ground water extraction well (W-2012) to a new ground water treatment facility, TFE Hotspot (Table 7). In addition to the dual extraction well, five soil vapor extraction wells (W-ETS-2008A, W-ETS-2008B, W-ETS-2009, W-ETS-2010A, and W-ETS-2010B) were also connected to a new vapor treatment facility, VTFE Hotspot (Fig. 2d and Table 7).

The TFE East, TFE Northwest, TFE Southeast, TFE Southwest, TFE Hotspot, and TFE West extraction wells hydraulically contain portions of the VOC plume in HSU-3A and most of the

VOC plumes in HSUs 2, 3A, 3B, 4, and 5 based on the capture zones shown in Figures 6, 7, 8, 9, and 10 and the total VOC isoconcentration maps (Figs. 12, 13, 14, 15, and 16).

5.6. Treatment Facility G Area

Two treatment facilities, TFG-1 and TFG North (Figs. 1 and 2d), operated in compliance with all permits throughout 2005. An anode well for pipeline cathodic protection was installed in the TFG area. The previous anode well was also decommissioned.

Extraction well W-1111 hydraulically controls most of the VOC plume in HSU-2 in the southern TFG-1 area based on the capture zones shown in Figure 6 and the total VOC isoconcentration map (Fig. 12). Extraction wells W-1806 and W-1807 hydraulically control a significant portion of the VOC plumes in HSUs 1B and 2, respectively, in the northern portion of the TFG area (Figs. 5, 6, 11 and 12).

5.7. Treatment Facility H Area

The southeast corner of the Livermore Site includes multiple treatment facilities and upcoming milestones with various names (e.g., TF406, B419, B511, TF518, and TF5475). These facility/milestone locations are grouped into Treatment Facility H (TFH) (Berg and Wong, 2005). Activities in the TFH area are discussed below.

5.7.1. Treatment Facilities Near Building 406

Three treatment facilities, TF406, TF406 Northwest, and VTF406 Hotspot (Figs. 1 and 2d), operated in compliance with all permits in 2005. Passive bioremediation of fuel hydrocarbons in HSUs 3A and 3B continued during 2005.

The TF406 Hotspot milestone was completed on August 30, 2005. This milestone consisted of connecting three soil vapor extraction wells (W-514-2007A, W-514-2007B, and W-217) to a new vapor treatment facility (VTF406 Hotspot) to implement vadose zone cleanup in a VOC source area.

The TF406, TF406 Northwest, and adjacent TF518 North (see Section 5.7.2) extraction wells hydraulically control most of the VOC plumes in HSUs 4 and 5 and provide significant hydraulic control of VOC plumes in HSUs 3A based on the capture zones shown in Figures 7, 9, and 10, the total VOC isoconcentration maps (Figs. 13, 15, and 16), and stable or declining VOC concentrations.

5.7.2. Treatment Facilities Near Building 518

The two treatment facilities near Building 518, TF518 North and VTF518 Perched Zone (Figs. 1 and 2d), were in compliance with all permits in 2005.

VTF518 Perched Zone continued to treat soil vapor and collect perched ground water from this source area. As in 2004, the water collected from the facility's dual extraction wells is stored in a 500-gallon tank (TF518-HDTANK) and transferred to TF406 Northwest for treatment.

HSU-4 extraction well W-1410 at TF518 North and HSU-5 extraction wells at TF406 and TFE Southeast continue to hydraulically control most of the VOC plumes based on the capture zones shown in Figures 9 and 10 and the total VOC isoconcentration maps (Figs. 15 and 16). HSU-5 remained dewatered throughout 2005 in the area where TF518 was formerly located.

The sustained dewatering in HSU-5 increases hydraulic control by widening the capture areas of existing extraction wells.

5.7.3. Treatment Facilities Near Trailer 5475

Three ground water treatment facilities, TF5475-1, TF5475-2, TF5475-3, and one vapor treatment facility, VTF5475 (Figs. 1 and 2d) operated near Trailer 5475 in 2005. TF5475-1 and TF5475-3 use catalytic reductive dehalogenation (CRD) to remediate VOCs in ground water. TF5475-2 and VTF5475 use granular activated carbon to remediate VOCs. Former ground water extraction wells W-1606 and W-1608 continued to operate as soil vapor extraction wells at TF5475-3 since HSU-3A remains dewatered near Trailer 5475.

During the year, LLNL resolved several operational issues that occurred during 2004 at TF5475-1 (CRD-1) and TF5475-3 (CRD-2) (Karachewski et al., 2005).

- In August 2005, DOE/LLNL added aqueous phase carbon after CRD-1 treatment to mitigate an increase in the ratio of recalcitrant to treatable VOCs. CRD-1 treatment efficiency is now 100% with no detectable VOCs in the effluent.
- LLNL installed electrically-powered heater tape along the hydrogen lines, the gas/water heat exchanger, and the hydrogen meter at CRD-2 to improve VOC destruction efficiency in cold weather. The CRD-2 VOC destruction efficiency was tested on February 16, 2005 and February 28, 2005 before restarting the treatment facility. Both tests showed that the process was in compliance with a removal efficiency of 93.3% and 96.6%, respectively. ERD is also planning to add aqueous phase carbon to CRD-2, based on the success of this approach at CRD-1.

Two compliance issues occurred in 2005: TF5475-3 (CRD-2) exceeded the chromium discharge limit and there was accidental spill in the TFE yard where ground water collected near Trailer 5475 was temporarily stored.

- TF5475-3 (CRD-2) exceeded the 50 ppb chromium discharge limit on May 26, 2005 with a total chromium effluent concentration of 56 ppb. The CRD process reduces the hexavalent chromium to trivalent chromium, which adheres to the catalyst. ERD is currently evaluating alternatives in this area. The treated ground water which exceeded the discharge limit from CRD-2 is reinjected into the subsurface and did not impact surface water quality.
- A minor accidental spill occurred when a painter's vehicle collided with a spherical tank on a two-wheel trailer (a 'bubble') and knocked it over, releasing 250 gallons of stored ground water that was to be used for an injection test. The ground water in the tank was from well W-1108 had a total VOC concentration of 388 ppb, mainly TCE (310 ppb). The ground water spilled onto asphalt at the TFE yard containing an estimated 0.37 grams of VOCs. In the future, ERD will use trailer outriggers to stabilize the water tank and prevent similar accidents.

A passive soil vapor survey using 50 Gore-Sorber® modules was conducted near Trailer 5475 in 2005 (Section 3.2).

6. Ground Water Discharges

In 2005, approximately 254.4 millions of gallons (Mgal) of treated ground water was discharged to Arroyo Las Positas, and an estimated 44.2 Mgal of treated ground water was discharged to Arroyo Seco.

7. Trends in Ground Water Analytical Results

In 2005, concentrations continued to decrease in most Livermore Site VOC plumes. The decline in VOC concentrations is primarily attributed to active remediation and reflects the removal of over 267 kg of VOCs by the ground water and soil vapor extraction wells during the year (Table Summ-1). Notable trends and results from the third quarter 2004 through the third quarter 2004 through the third quarter 2005 are discussed below.

VOC concentrations on the western margin of the site generally continued to decline very slowly, indicating continued effective hydraulic control of the boundary plumes in the TFA, TFB, and TFC areas. The offsite HSU-1B VOC plumes were below MCLs except at one well, where a slight decrease in PCE concentration (from 11 ppb in July 2004 to 9.7 ppb at well W-1425 in August 2005) was observed. The entire offsite and onsite TFA HSU-2 total VOC plume remained below 50 ppb (Fig. 12). The highest PCE levels offsite remain at wells W-404 and W-654, where third quarter 2005 concentrations were 20 ppb and 13 ppb, respectively. All TFA, TFB, and TFC source areas remained unchanged, except at the TFC Hotspot area. Concentrations of TCE in this area increased from 170 ppb (October, 2004) to 260 ppb (October, 2005) in HSU-1B well SIP-501-007 (Fig. 11). Ground water remediation is scheduled to begin in this area during Fiscal Year (FY) 2006 as part of the TFC Hotspot RAIP milestone.

VOC concentrations in a mobile HSU-2 plume located in the western TFE area continue to decline. Downgradient from the source area, total VOC concentrations decreased below 100 ppb in TFE-W extraction well W-305. Total VOCs in piezometer SIP-331-001, located in the distal part of the plume, declined from 69 ppb in March 2004 to 36 ppb in June 2005 due to continued ground water extraction at the TFE West treatment facility. Concentrations in the VOC source area at the Eastern Landing Mat have remained relatively constant over the last two years (210 ppb TCE at extraction well W-1109, July 2005) (Fig. 12).

PCE and TCE appeared in TFB HSU-3A well W-310 for the first time (3.5 ppb, and 1.3 ppb, respectively) in November 2004. Testing is planned to determine whether these VOCs represent the leading edge of an HSU-3A plume emanating from the TFD area or are due to faulty well completion. Total VOC concentrations in TFD Helipad HSU-3A source area extraction wells continued to decline, in part due to vacuum-enhanced ground water extraction. For example, the VOC concentrations in well W-1657 declined from 884 ppb in July 2004 to 502 ppb in August 2005. A large concentration decline was observed in the Trailer 5425 area, where total VOCs in well W-206 were 1,651 ppb in July 2004 and 378 ppb in August 2005. Further downgradient to the southwest at well W-1201, total VOC concentrations increased from 230 ppb in August 2004 to 375 ppb in August 2005. These changes may be due in part to ground water extraction at the TFE Hotspot (well W-2012), which began operation this year (Fig. 13). Elsewhere in HSU-3A, VOC concentrations remained largely unchanged.

VOC concentrations in HSU-3B and HSU-5 remained largely unchanged during 2005. Concentrations in HSU-4 also remained relatively unchanged except for well W-351 in the TFD area, where TCE concentrations decreased from 470 ppb in July 2004 to 120 ppb in October 2005. This decrease may be due to ground water extraction at the TFD Helipad (well W-1254), which began operation in June 2004. Concentrations continued to decline in HSU-5 on Sandia property in the TF406 South area, with only TCE remaining above MCLs in two offsite wells (10 ppb in well W-509 and 5.6 ppb in well W-1113, October 2005). The ongoing cleanup at the TF406 South location indicates that construction of a new facility is not warranted at this time. Accordingly, a revised schedule of remedial actions was signed by the Remedial Project Managers on October 11, 2005 removing the TF406 South facility as an FY 2006 milestone.

During 2005, tritium activities in ground water from all wells at the Livermore Site, including those in the Trailer 5475 and Building 292 areas, were below the 20,000 picocuries per liter (pCi/L) MCL and continued to decrease by natural decay.

8. References

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Figures

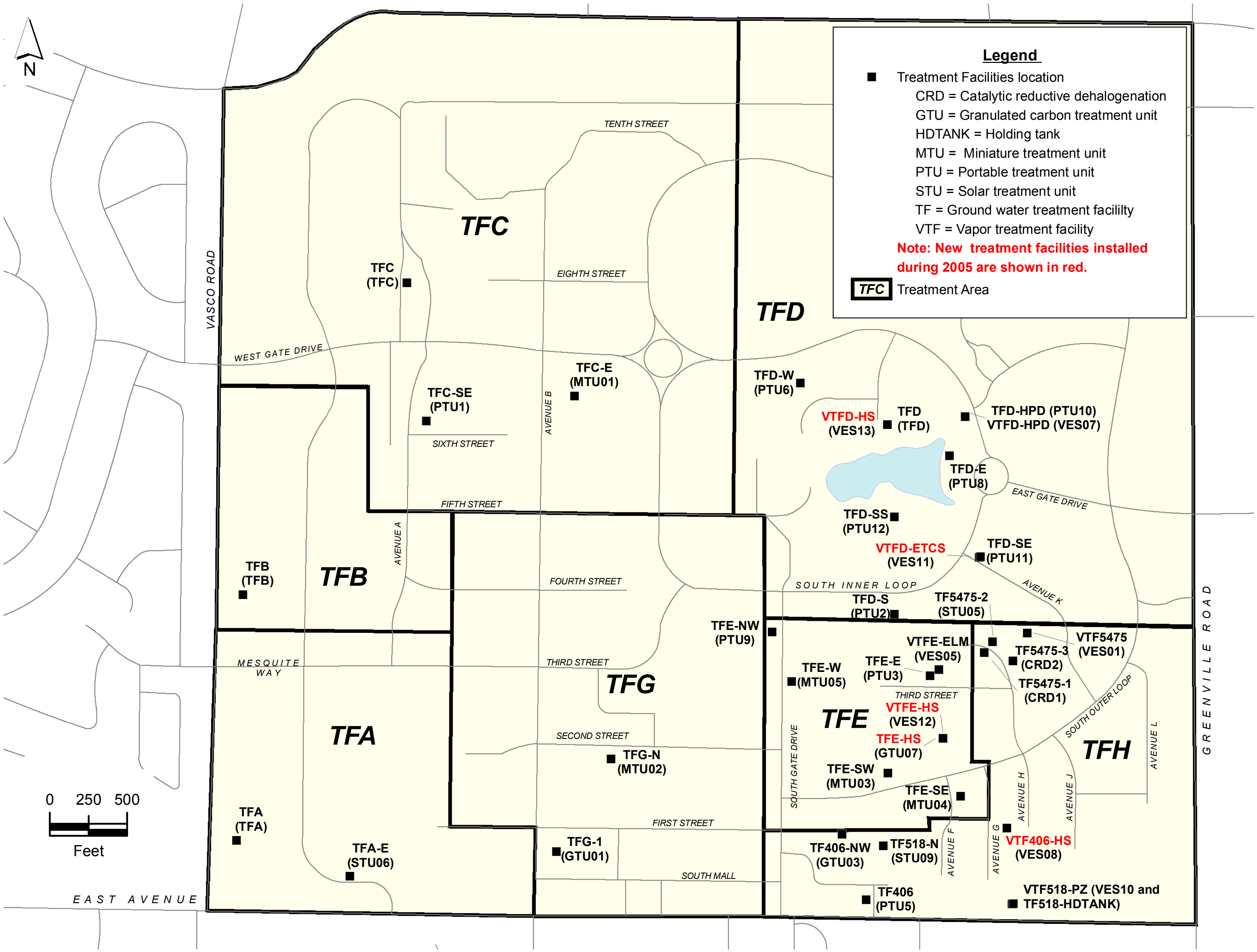

Figure 1. Livermore Site treatment areas and treatment facility locations.

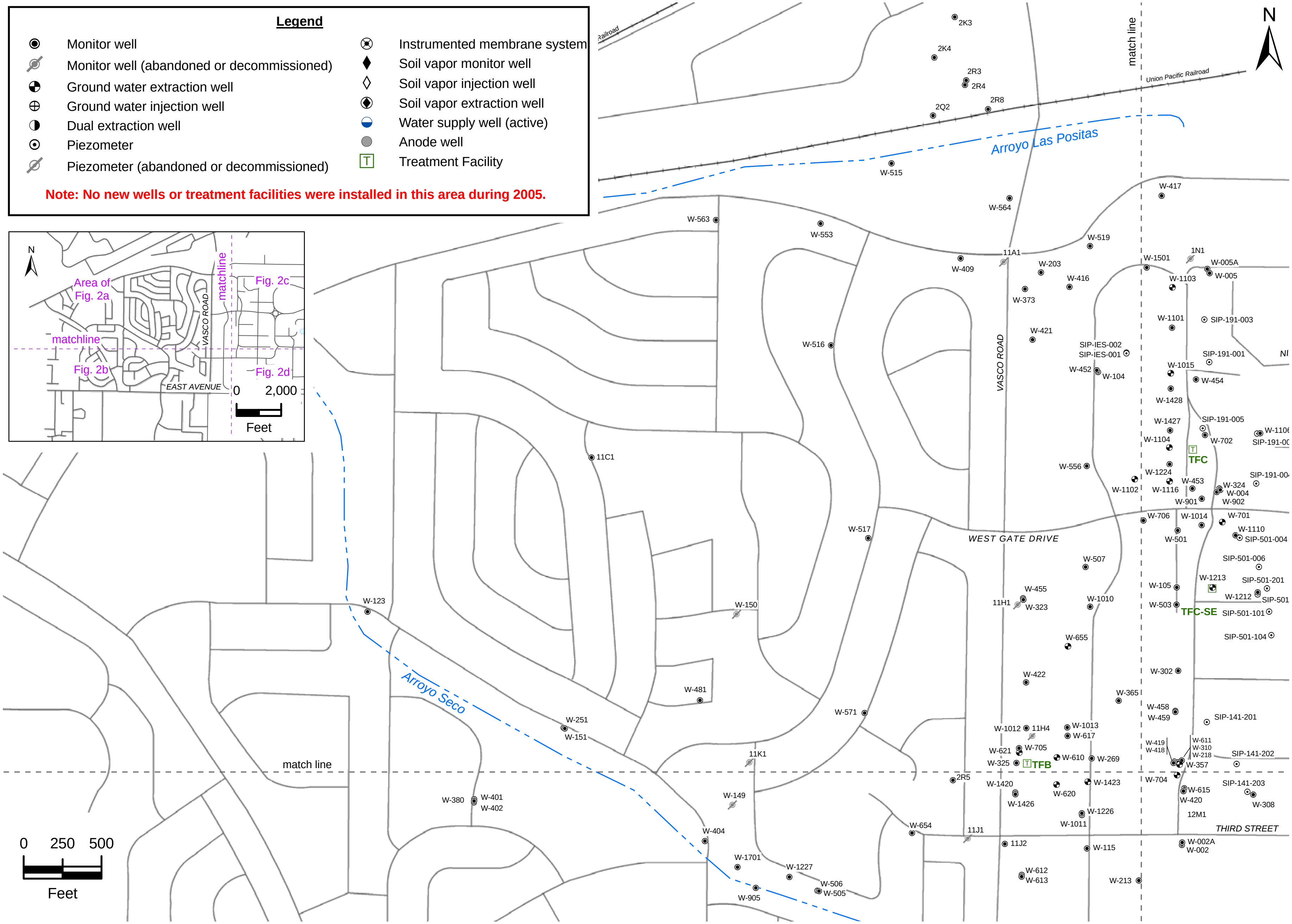

Figure 2a. Locations of Livermore Site wells and treatment facilities, December 2005.

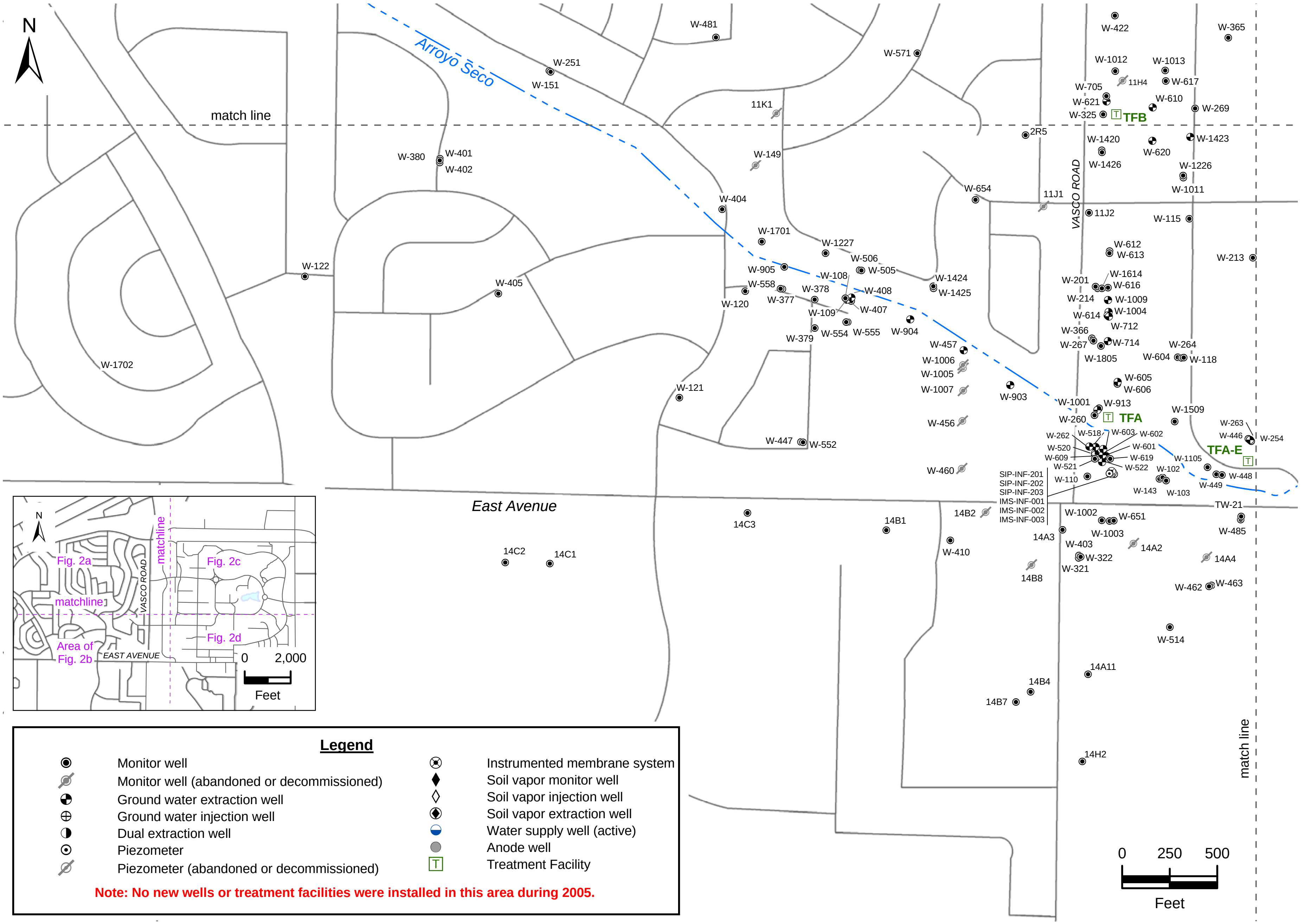

Figure 2b. Locations of Livermore Site wells and treatment facilities, December 2005.

Figure 2c. Locations of Livermore Site wells and treatment facilities, December 2005.

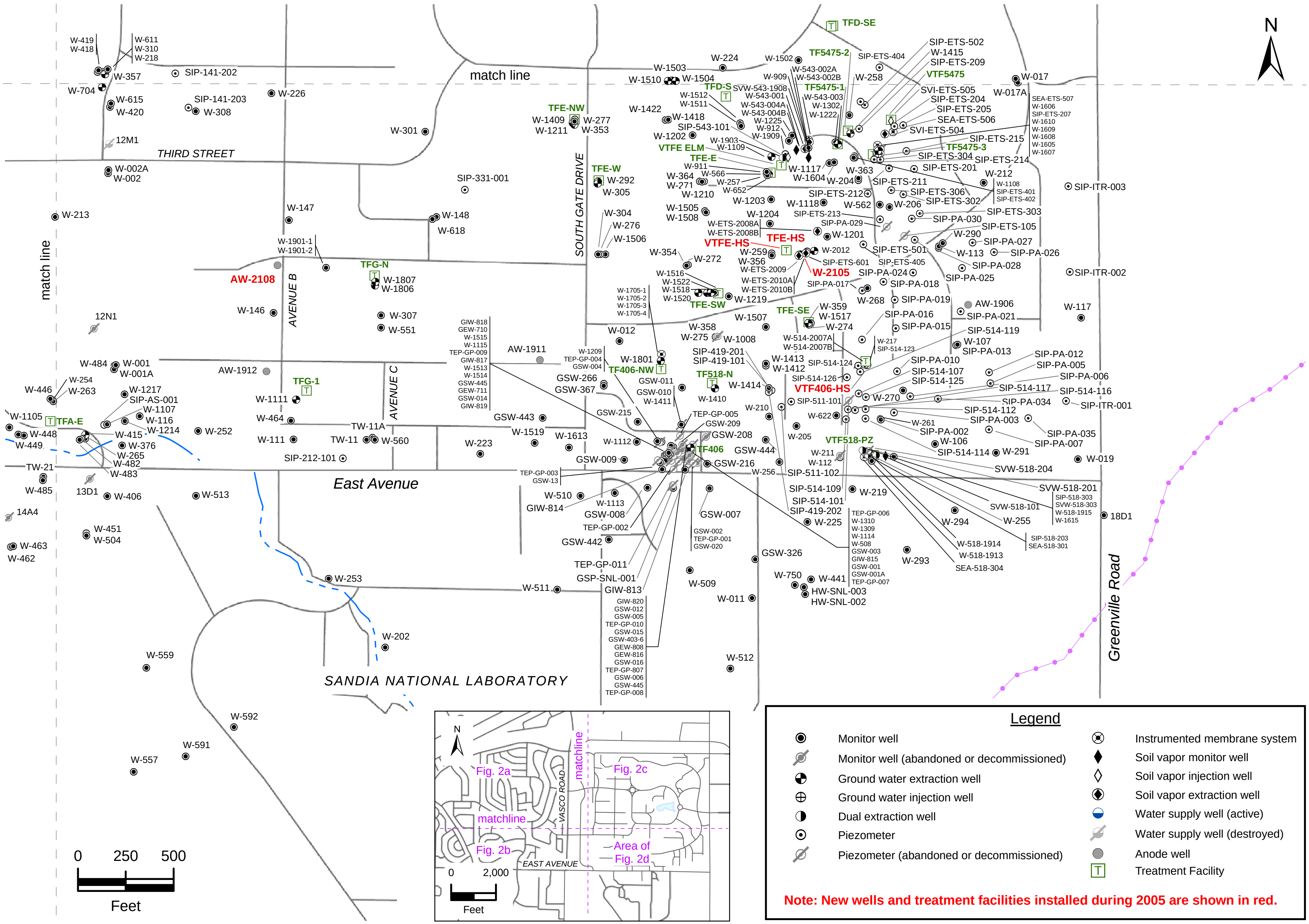

Figure 2d. Locations of Livermore Site wells and treatment facilities, December 2005.

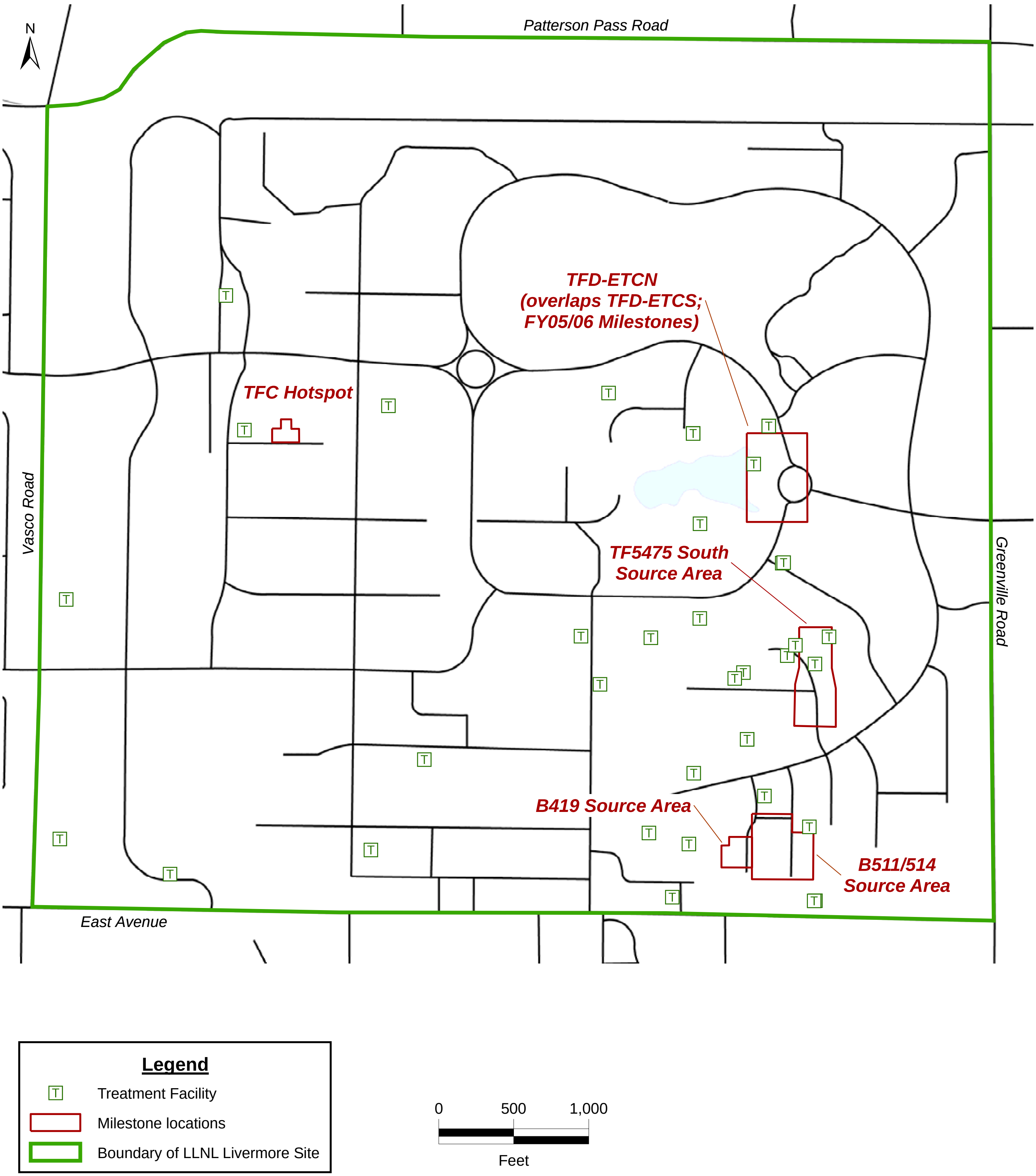

Figure 3. FY 2006 RAIP milestone locations on the Livermore Site.

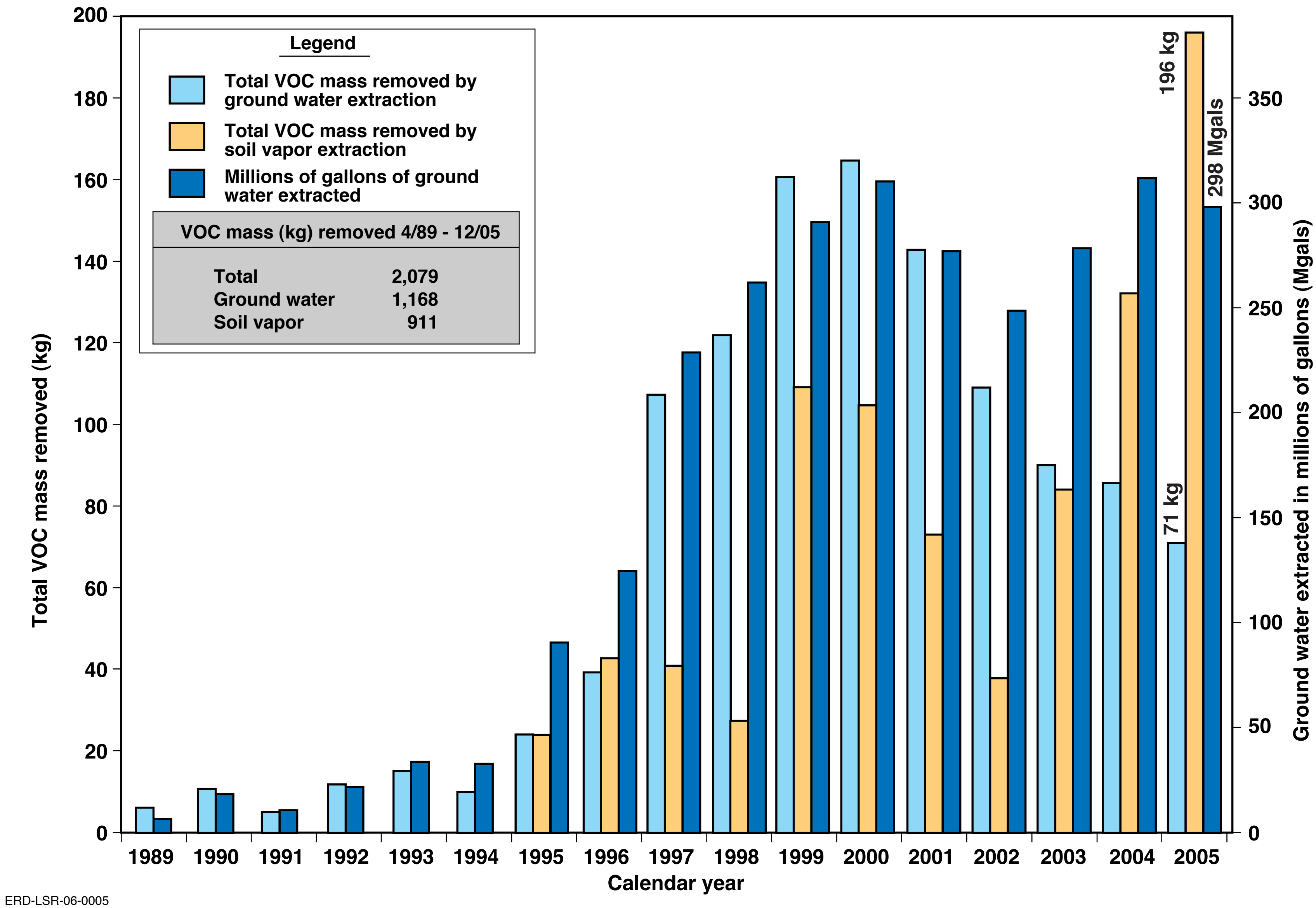

Figure 4. Total VOC mass removed from the Livermore Site subsurface since 1989.

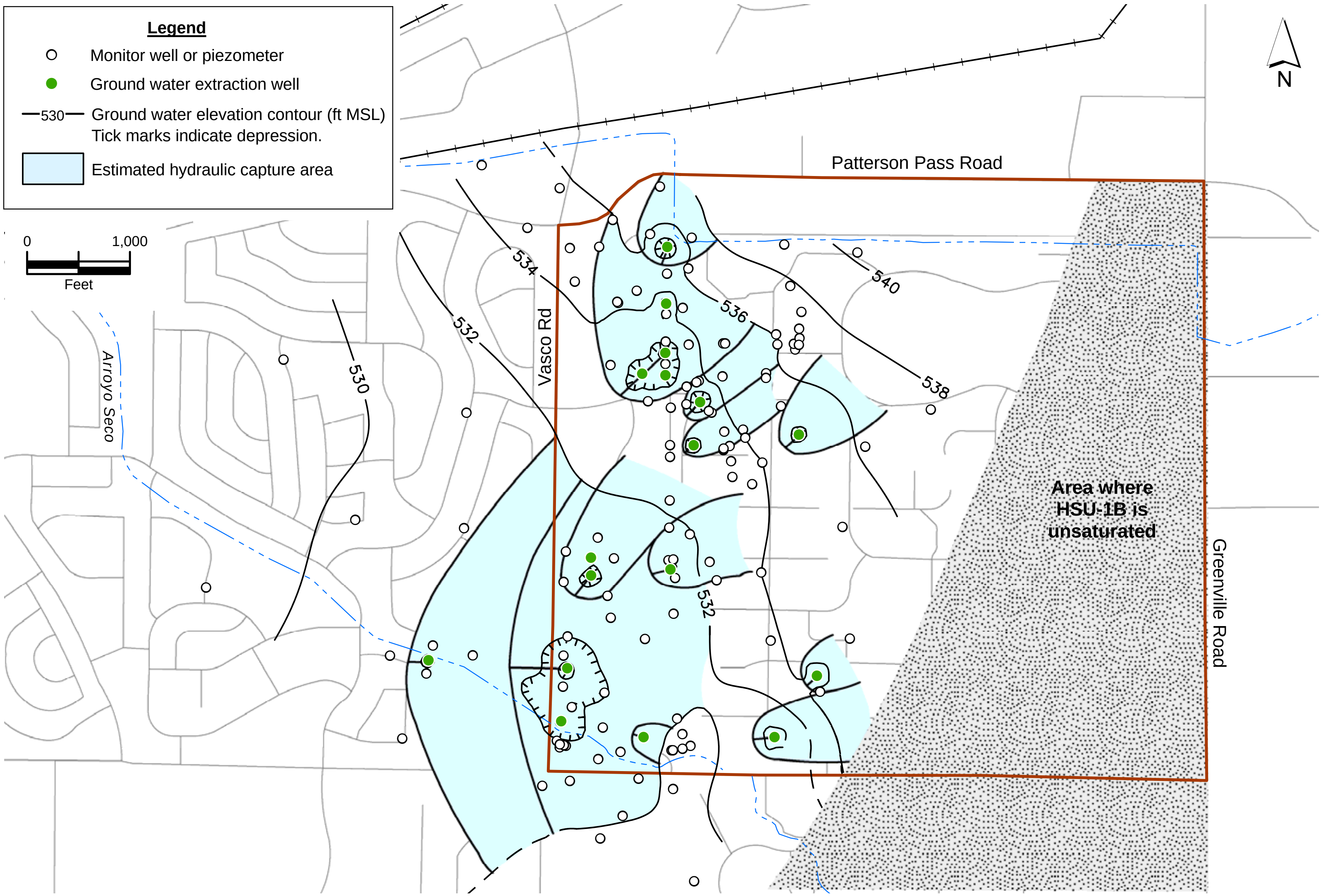

Figure 5. Ground water elevation contour map based on 135 wells completed within HSU-1B showing estimated hydraulic capture areas, LLNL and vicinity, October 2005.

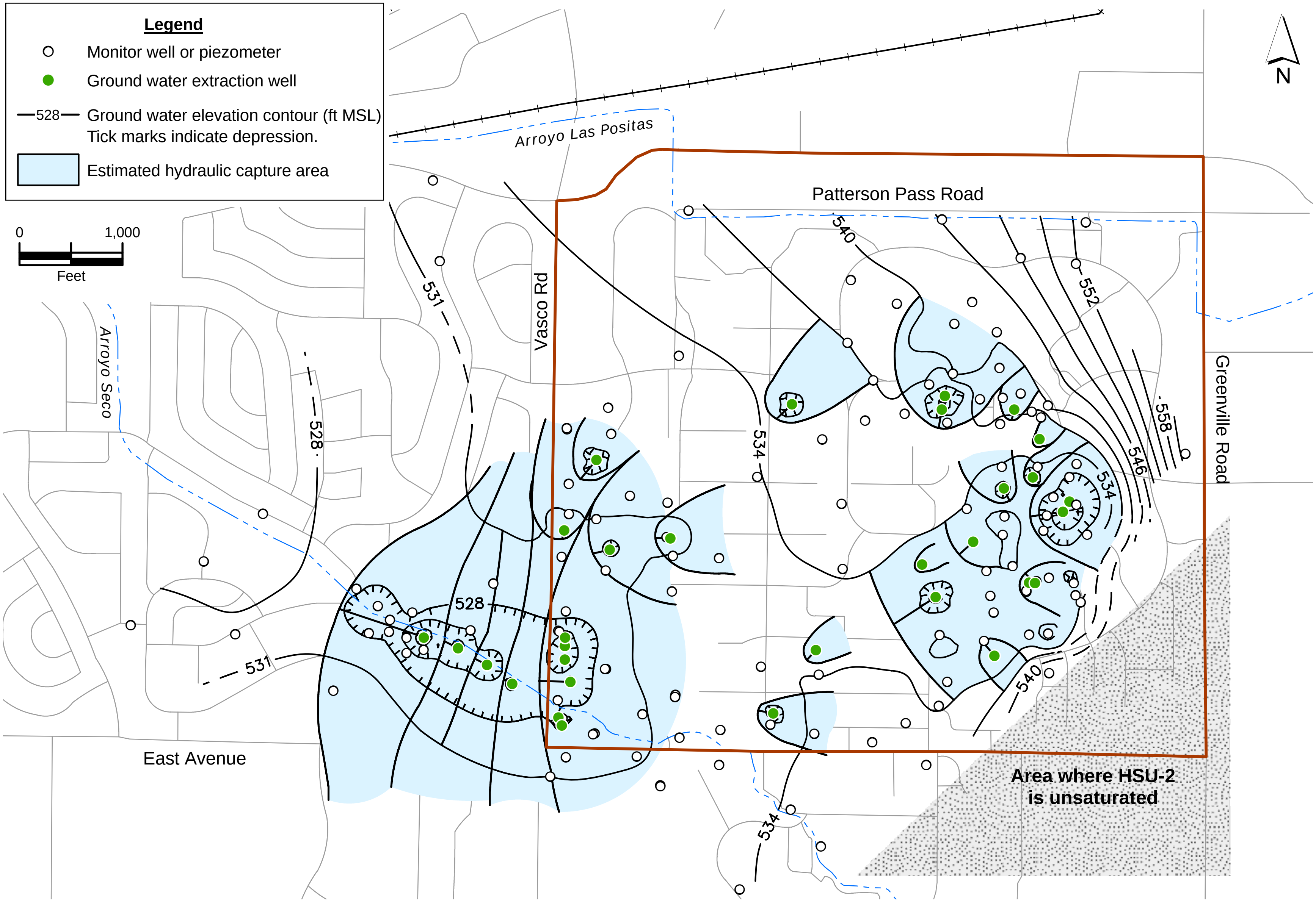

Figure 6. Ground water elevation contour map based on 160 wells completed within HSU-2 showing estimated hydraulic capture areas, LLNL and vicinity, October 2005.

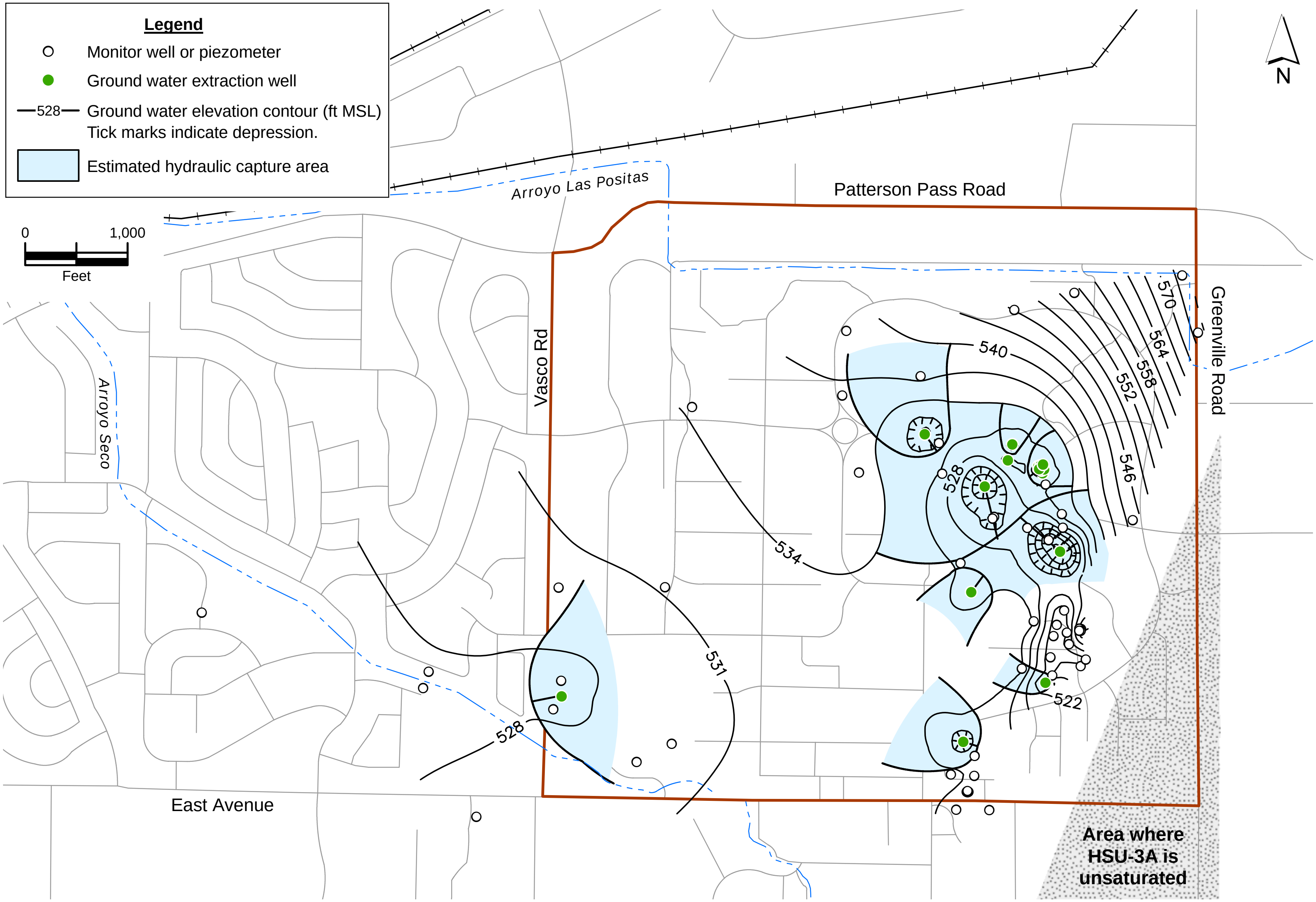

Figure 7. Ground water elevation contour map based on 72 wells completed within HSU-3A showing estimated hydraulic capture areas, LLNL and vicinity, December 2005.

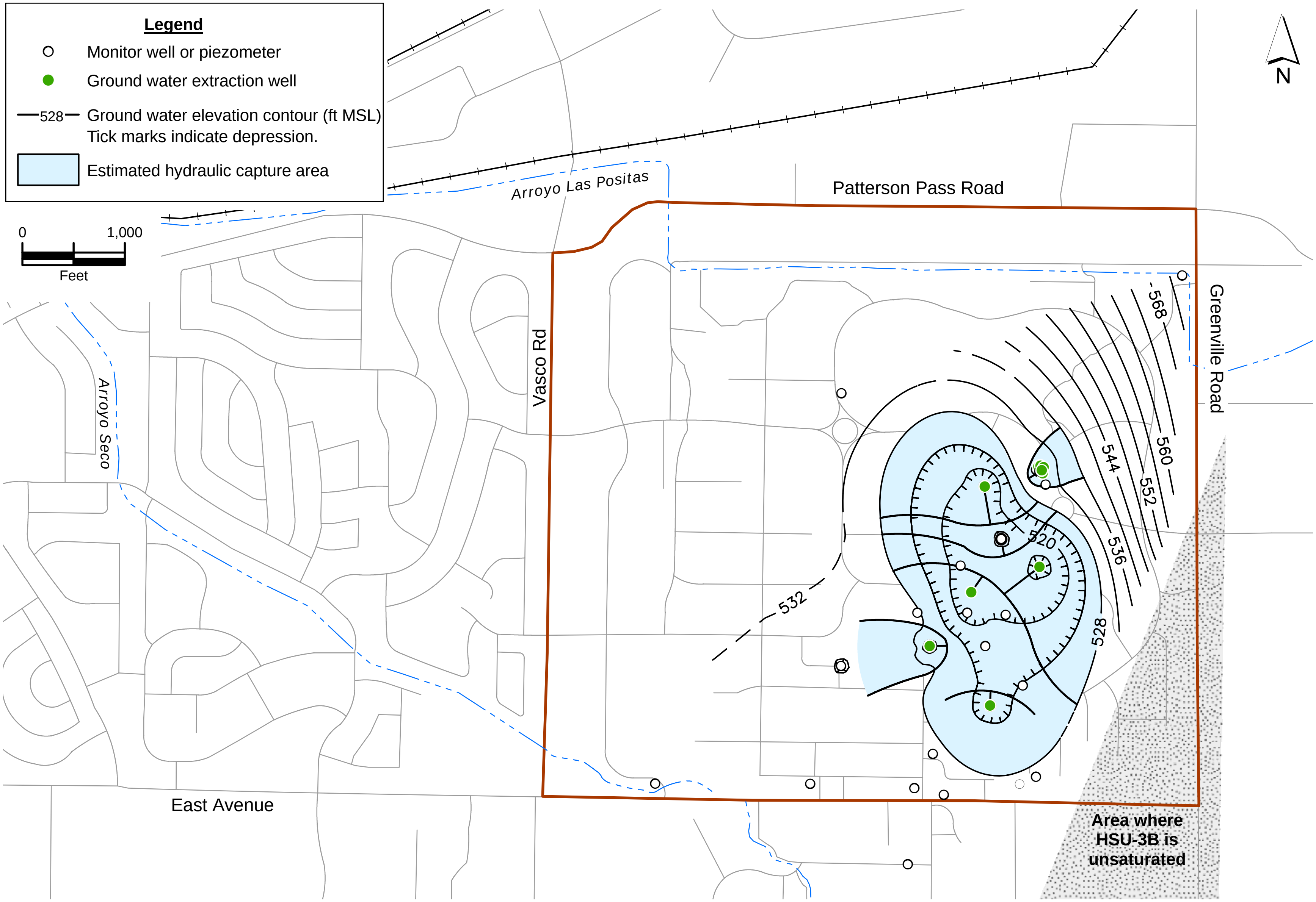

Figure 8. Ground water elevation contour map based on 31 wells completed within HSU-3B showing estimated hydraulic capture areas, LLNL and vicinity, December 2005.

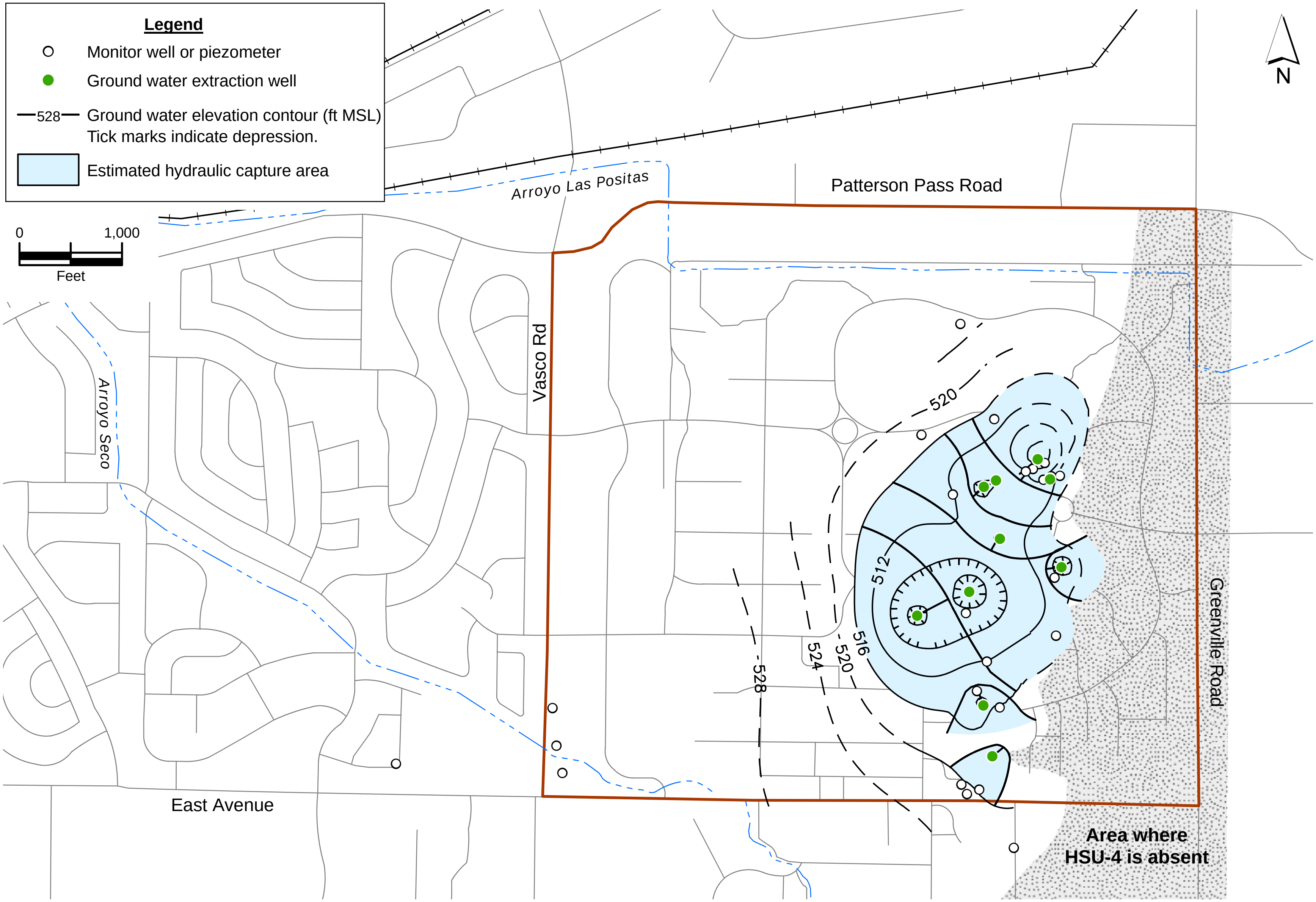

Figure 9. Ground water elevation contour map based on 34 wells completed within HSU-4 showing estimated hydraulic capture areas, LLNL and vicinity, November 2005.

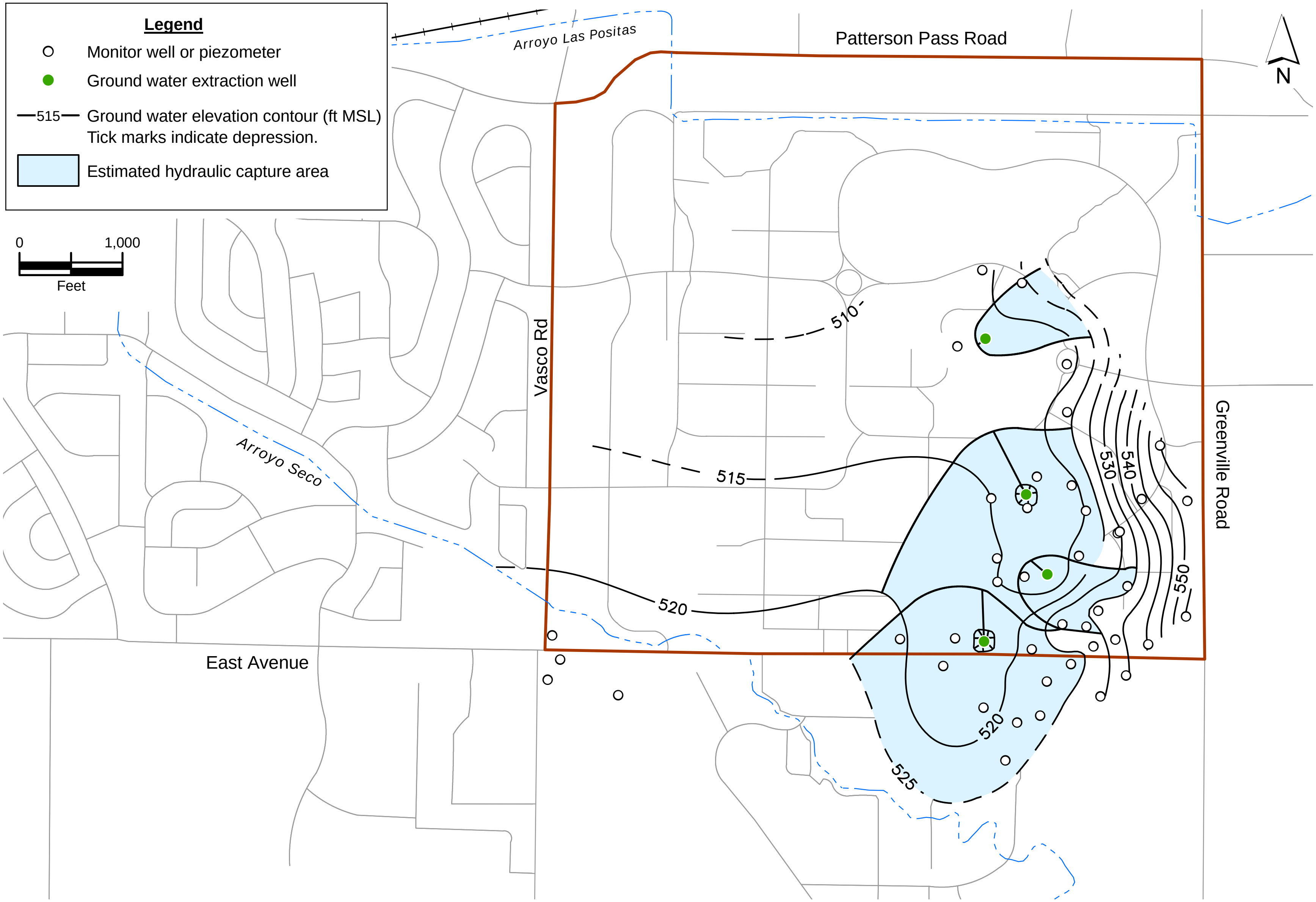

Figure 10. Ground water elevation contour map based on 48 wells completed within HSU-5 showing estimated hydraulic capture areas, LLNL and vicinity, October 2005.

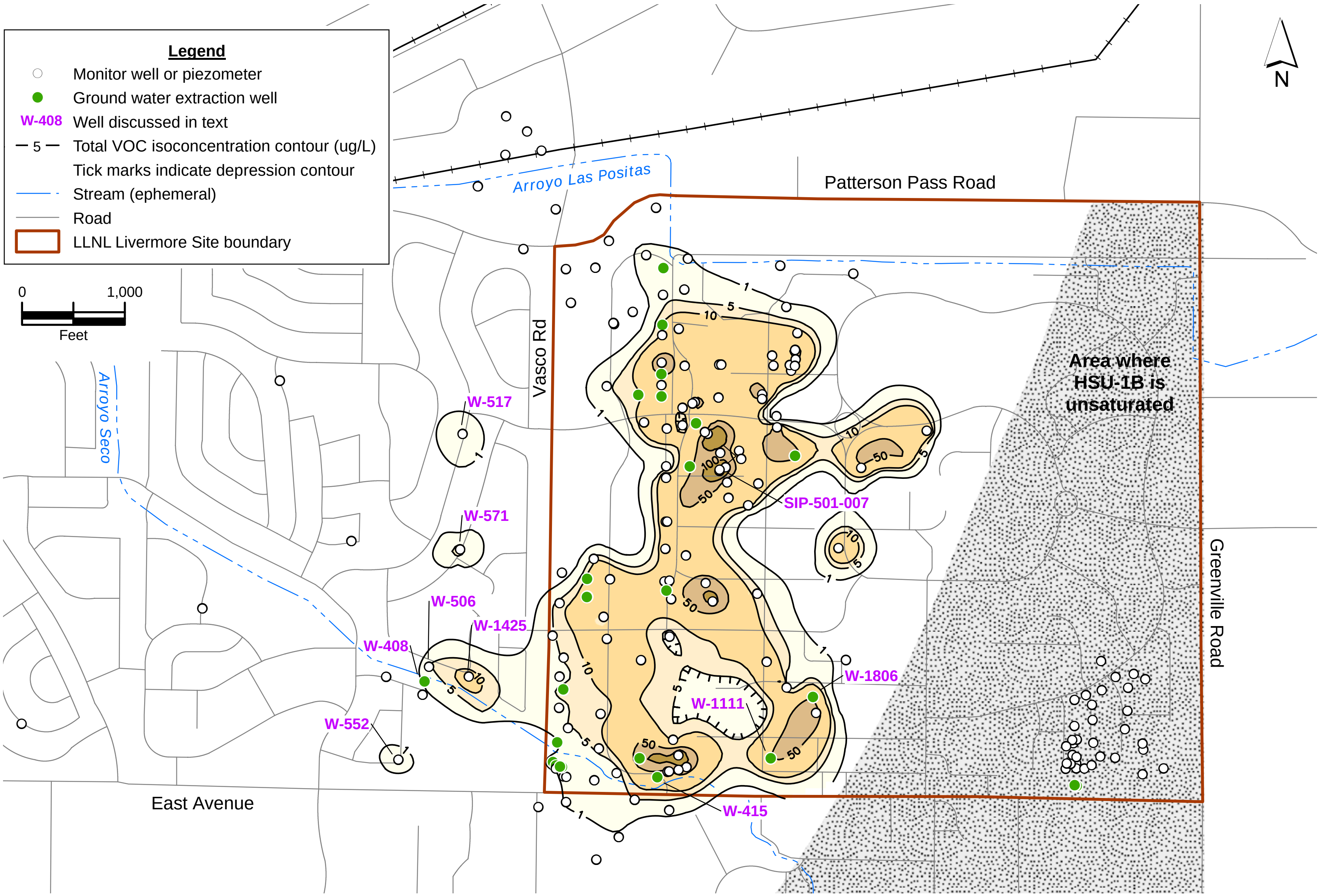

Figure 11. Isoconcentration contour map of total VOCs from 132 wells completed within HSU-1B, fourth quarter 2005 (or the next most recent data), and supplemented with soil chemistry data from 39 borehole locations.

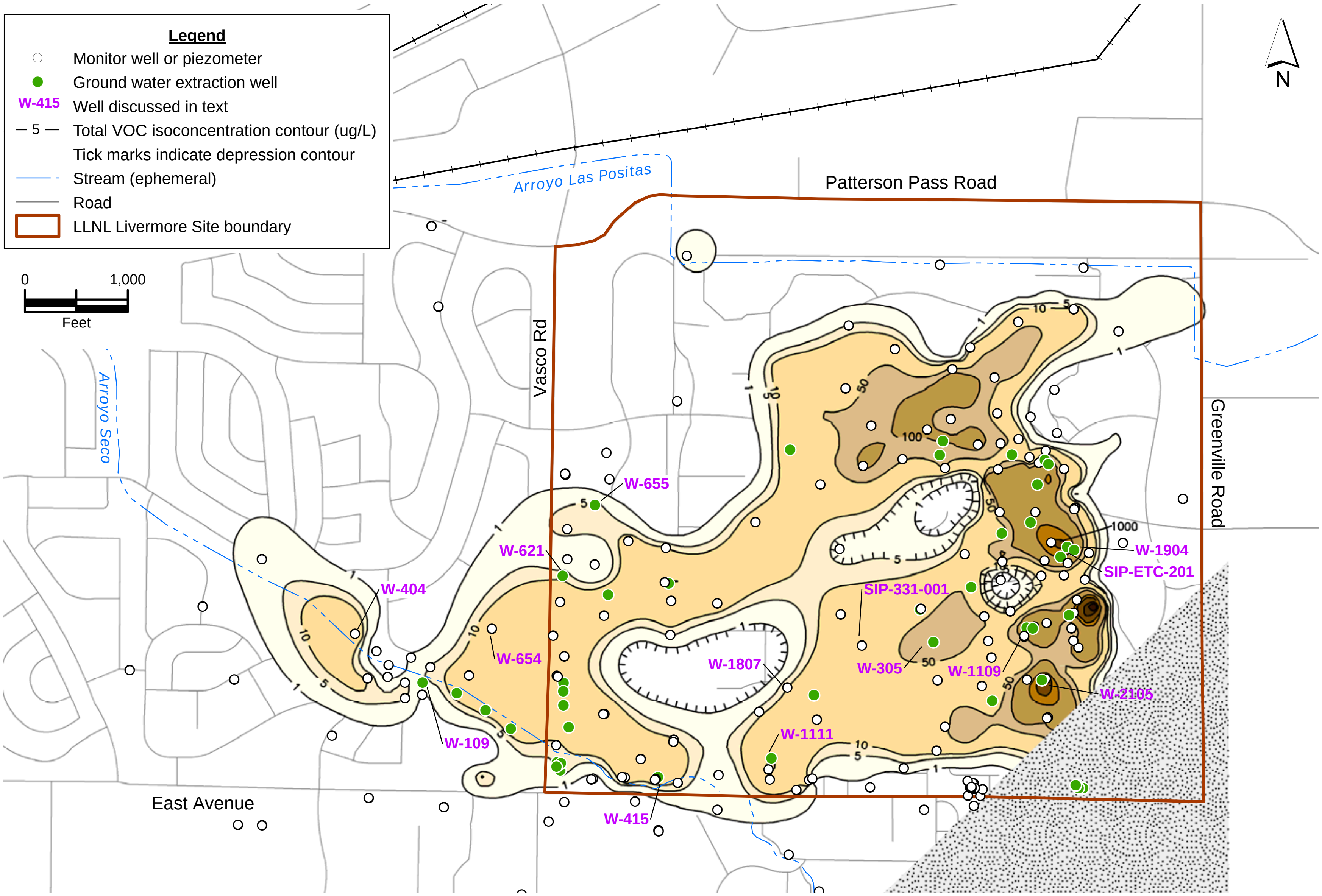

Figure 12. Isoconcentration contour map of total VOCs from 190 wells completed within HSU-2, fourth quarter 2005 (or the next most recent data), and supplemented with soil chemistry data from 66 borehole locations.

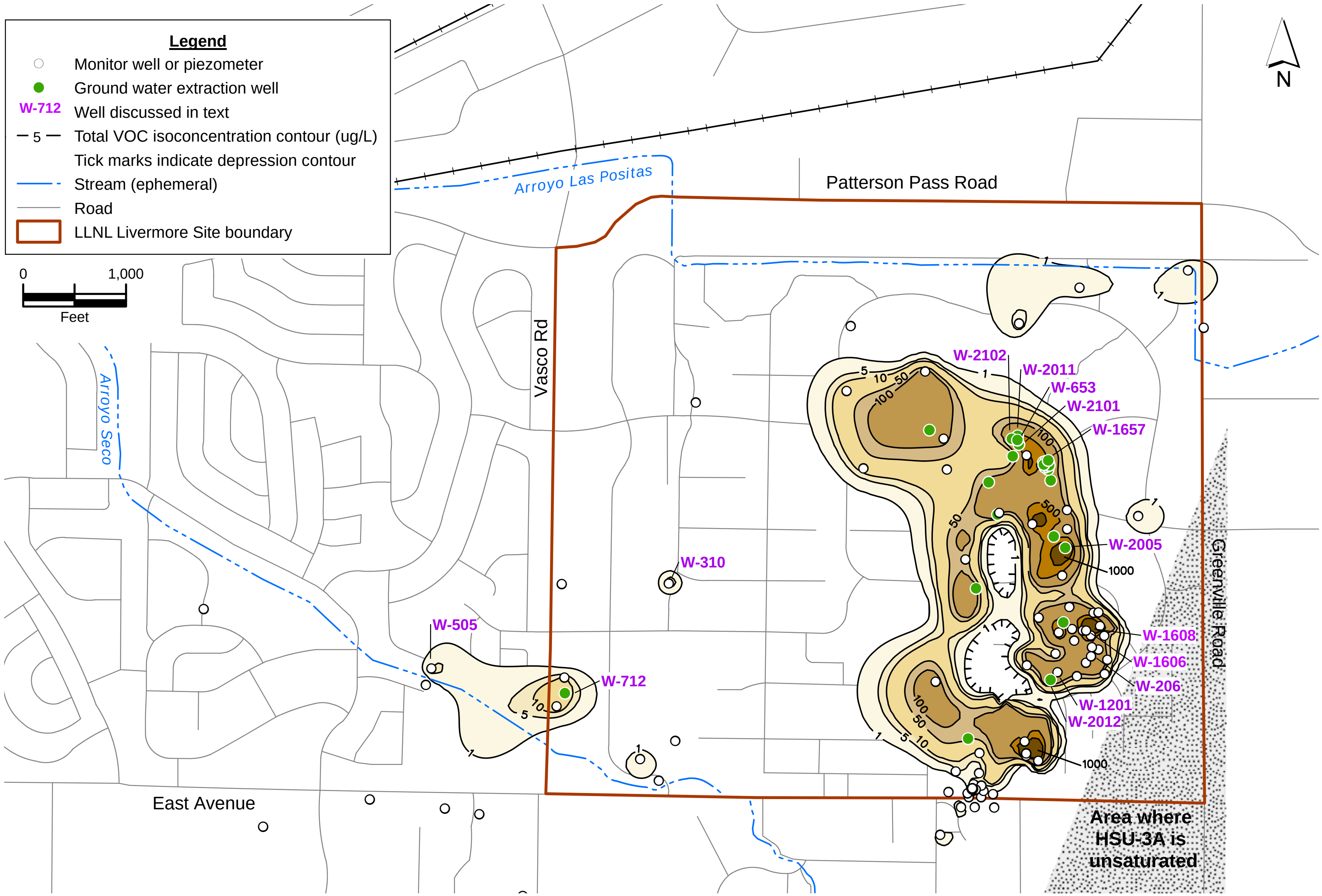

Figure 13. Isoconcentration contour map of total VOCs from 108 wells completed within HSU-3A, fourth quarter 2005 (or the next most recent data), and supplemented with soil chemistry data from 139 borehole locations.

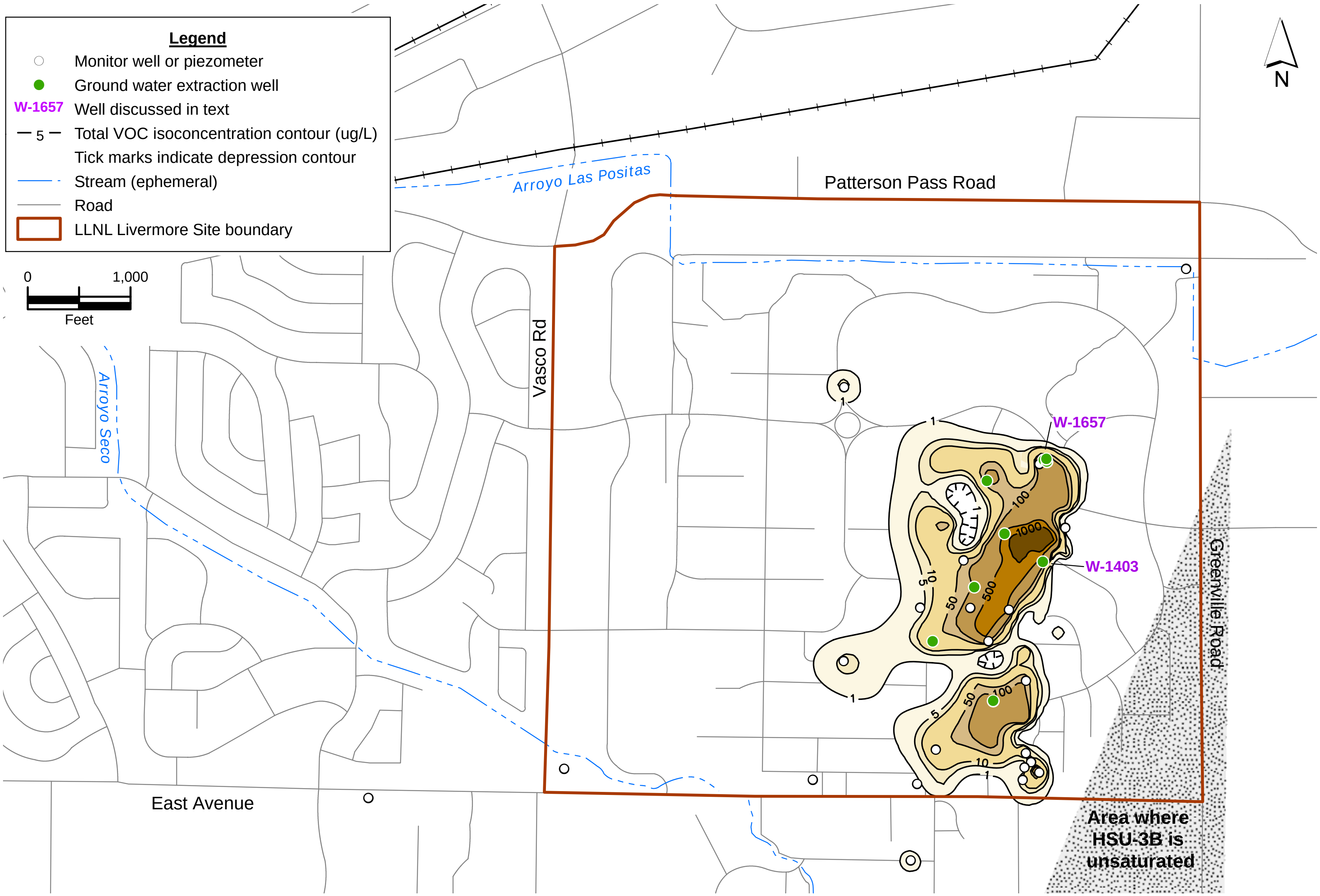

Figure 14. Isoconcentration contour map of total VOCs from 42 wells completed within HSU-3B, fourth quarter 2005 (or the next most recent data), and supplemented with soil chemistry data from 104 borehole locations.

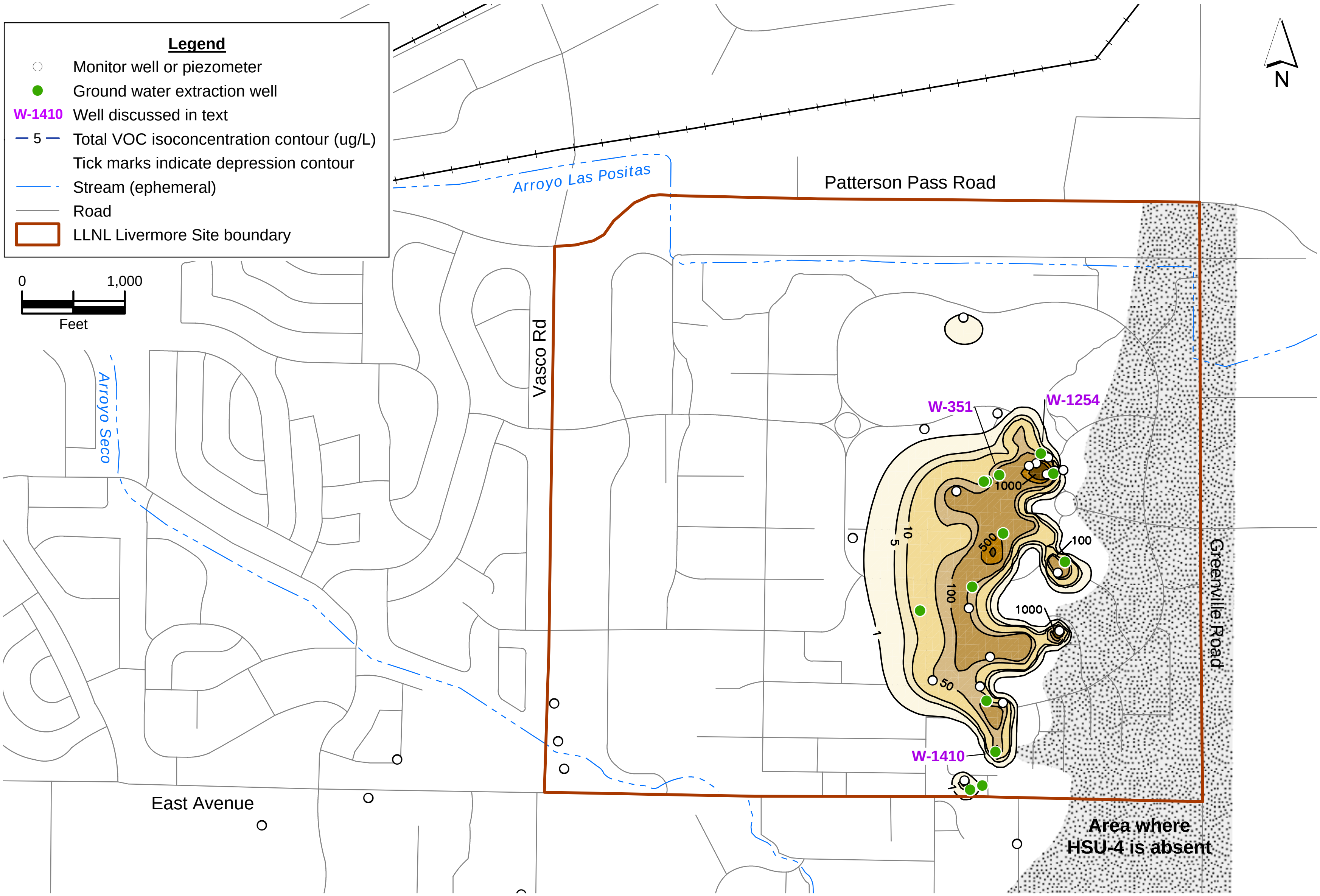

Figure 15. Isoconcentration contour map of total VOCs from 44 wells completed within HSU-4, fourth quarter 2005 (or the next most recent data), and supplemented with soil chemistry data from 51 borehole locations.

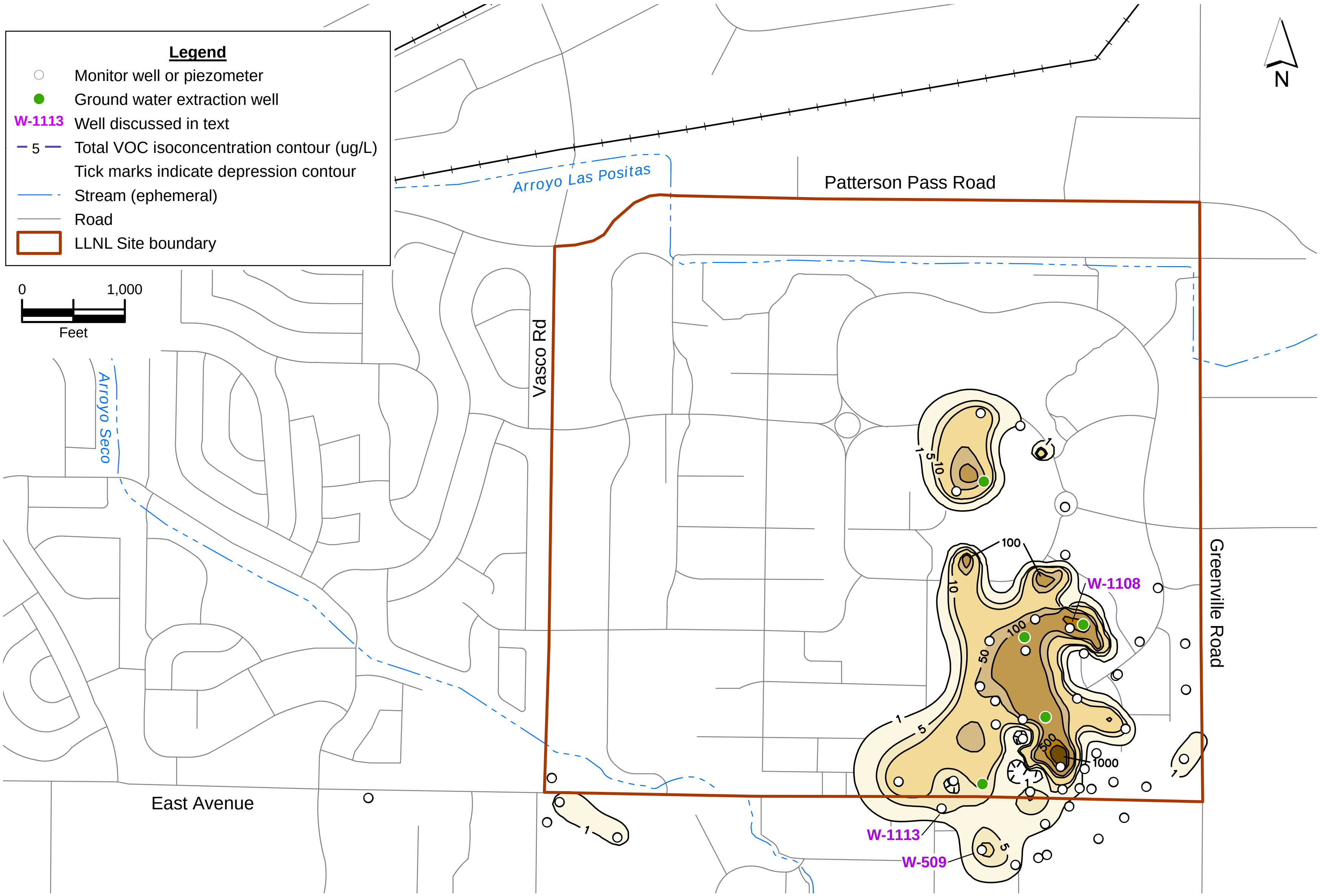

Figure 16. Isoconcentration contour map of total VOCs from 55 wells completed within HSU-5, fourth quarter 2005 (or the next most recent data), and supplemented with soil chemistry data from 94 borehole locations.

Tables

Table 1. Types and numbers of wells.

Well type	Number of wells
Dual Extraction[1]	23
FLUTe	1
Ground Water Extraction	86
Ground Water Injection	1
Ground Water Monitor	405
Piezometer	103
Soil Vapor Extraction	21
Soil Vapor Injection	2
Soil Vapor Monitor	17
Total	659

Notes:

See Table 7 for a list of extraction wells and Table A-1 of Appendix A for a detailed list of all wells.

[1] Extraction of ground water using a downhole pump with concurrent application of vacuum to the well. Ground water and soil vapors are removed in separate pipe manifolds and treated.

Table 2. Treatment facility abbreviations.

Treatment facility	Abbreviation
TFA	TFA
TFA East	TFA-E
TFB	TFB
TFC	TFC
TFC East	TFC-E
TFC Southeast	TFC-SE
TFD	TFD
TFD East	TFD-E
TFD Helipad	TFD-HPD
TFD South	TFD-S
TFD Southeast	TFD-SE
TFD Southshore	TFD-SS
TFD West	TFD-W
VTFD East Traffic Circle South	VTFD-ETCS
VTFD Helipad	VTFD-HPD
VTFD Hotspot	VTFD-HS
TFE East	TFE-E
TFE Hotspot	TFE-HS
TFE Northwest	TFE-NW
TFE Southeast	TFE-SE
TFE Southwest	TFE-SW
TFE West	TFE-W
VTFE Eastern Landing Mat	VTFE-ELM
VTFE Hotspot	VTFE-HS
TFG-1	TFG-1
TFG North	TFG-N
TF406	TF406
TF406 Northwest	TF406-NW
VTF406 Hotspot	VTF406-HS
VTF511[a]	VTF511
TF518 North	TF518-N
VTF518 Perched Zone	VTF518-PZ
TF5475-1	TF5475-1
TF5475-2	TF5475-2
TF5475-3	TF5475-3
VTF5475	VTF5475

Notes:

TF = Ground water treatment facility.

VTF = Soil vapor treatment facility.

[a] 2006 RAIP milestone.

Table 3. Wells installed in 2005.

Treatment facility area	Wells[a]
TFA	None
TFB	None
TFC	AW-2107
TFD	W-2103, W-2104A, W-2104B, AW-2106, W-2110A, W-2110B, W-2111A, W-2111B, W-2112A, W-2112B W-2113, W-2202
TFE	W-2105
TF406	None
TFG	AW-2108
TFH	None

Notes:
See Figure 2 for well locations.

[a] Anode well AW-2109 was cancelled and well W-2201 was completed in February 2006.

Table 4. Hydraulic tests conducted in 2005.

Treatment facility area	Well(s)
TFD	W-653[a]
TFE	W-1108, W-1609[b], W-1610[b]

Notes:
See Figure 2 for well locations.

[a] Dual extraction test.

[b] Injection test.

Table 5. Soil vapor extraction tests conducted in 2005.

Treatment facility area	Wells
TFD	W-653[a], W-2011[a], W-2101[a], W-2102[a], W-2103[a], W-2104A, W-2104B W-2110A, W-2110B, W-2111A, W-2111B, W-2112A, W2112B

Notes:
See Figure 2 for well locations.
[a] Dual extraction test.

Table 6. 2005 Livermore Site Remedial Action Implementation Plan milestones.

Milestone	Milestone date	Completion date
Begin TFD East Traffic Circle South remediation	9-30-05	7-13-05
Begin TFD Hotspot remediation	9-30-05	9-20-05
Begin TFE Hotspot remediation	9-30-05	8-23-05
Begin TF406 Hotspot remediation	9-30-05	8-30-05

Table 7. Summary of treatment facilities, discharge sampling locations, and extraction wells.

Treatment facility	Discharge sampling location	Hydrostratigraphic unit	Extraction wells
TFA	Arroyo Seco (TFG-ASW) and West Perimeter Drainage Channel (TFB-R002)	1B	W-262[a], W-408, W-520[a], W-601[a], W-602[a], W-1001, W-1004
		1B/2	W-415
		2	W-109, W-457, W-518, W-522, W-603[a], W-605, W-609[a], W-614, W-714, W-903, W-904, W-1009
		3A	W-712
TFA East	Arroyo Seco (TFG-ASW)	1B	W-254
TFB	West Perimeter Drainage Channel (TFB-R002)	1B	W-610, W-620, W-704
		2	W-357, W-621, W-655, W-1423
TFC	Arroyo Las Positas (TFC-R003)	1B	W-701, W-1015, W-1102, W-1103, W-1104, W-1116
TFC East	Arroyo Las Positas (TFC-R003)	1B	W-368
		2	W-413
TFC Southeast	Arroyo Las Positas (TFC-R003)	1B	W-1213
TFD	Arroyo Las Positas (TFC-R003)	2/3A	W-906
		3A	W-653[b], W-2011[b], W-2101[b], W-2102[b]
		3A/3B	W-1208
		4	W-351, W-1206
		5	W-907-2
TFD East	Arroyo Las Positas (TFC-R003)	2	W-1303, W-1306
		3A	W-1301[a], W-1550
		4	W-1307
TFD Helipad	Arroyo Las Positas (TFC-R003)	2/3A	W-1655[b]
		2/3A/3B	W-1651[b]
		3A	W-1551, W-1552[b], W-1650[b], W-1653[b], W-1654[b], W-1656[b]
		3A/3B	W-1652[b], W-1657[b]
		4	W-1254

Table 7. Summary of treatment facilities, discharge sampling locations, and extraction wells.

Treatment facility	Discharge sampling location	Hydrostratigraphic unit	Extraction wells
TFD South	Arroyo Las Positas (TFC-R003)	2	W-1510
		3A/3B	W-1504
		4	W-1503
TFD Southeast	Arroyo Las Positas (TFC-R003)	2	SIP-ETC-201[b], W-1308, W-1904[b]
		3A	W-2005
		3B	W-1403
		4	W-314
TFD Southshore	Arroyo Las Positas (TFC-R003)	2	W-1602
		3A	W-1603
		3B	W-1601
		4	W-1523
TFD West	Arroyo Las Positas (TFC-R003)	2	W-1215, W-1216
		3A	W-1902
VTFD East Traffic Circle South	Treated vapor to atmosphere	1B	W-ETC-2003
		1B/2	W-ETC-2004A
		2	SIP-ETC-201[b], W-1904[b], W-ETC-2004B
VTFD Helipad	Treated vapor to atmosphere	1B	W-HPA-002A[a]
		2	W-HPA-002B
		2/3A	W-1655[b]
		2/3A/3B	W-1651[b]
		3A	W-1552[b], W-1650[b], W-1653[b], W-1654[b], W-1656[b]
		3A/3B	W-1652[b], W-1657[b]
VTFD Hotspot	Treated vapor to atmosphere	3A	W-653[b], W-2011[b], W-2101[b], W-2102[b]

Table 7. Summary of treatment facilities, discharge sampling locations, and extraction wells.

Treatment facility	Discharge sampling location	Hydrostratigraphic unit	Extraction wells
TFE East	Arroyo Las Positas (TFC-R003)	2	W-1109, W-1903[b]
		5	W-566
TFE Hotspot	Arroyo Las Positas (TFC-R003)	2	W-2105[b]
		3A	W-2012
TFE Northwest	Arroyo Las Positas (TFC-R003)	2	W-1409
		4	W-1211
TFE Southeast	Arroyo Las Positas (TFC-R003)	5	W-359
TFE Southwest	Arroyo Las Positas (TFC-R003)	2	W-1518
		3B	W-1522
		4	W-1520
TFE West	Arroyo Las Positas (TFC-R003)	2	W-305
		3B	W-292
VTFE Eastern Landing Mat	Treated vapor to atmosphere	1B	W-543-1908
		2	W-543-001, W-543-003, W-1903[b]
VTFE Hotspot	Treated vapor to atmosphere	1B	W-ETS-2008A
		1B/2	W-ETS-2010A
		2	W-2105[b], W-ETS-2008B, W-ETS-2009, W-ETS-2010B
TFG-1	Arroyo Seco (TFG-ASW)	1B/2	W-1111
TFG North	Arroyo Las Positas (TFC-R003)	1B	W-1806
		2	W-1807
TF406	Arroyo Las Positas (TFC-R003)	5	W-1309[a], W-1310 GSW-445[a]
TF406 Northwest	Arroyo Las Positas (TFC-R003)	3A	W-1801

Table 7. Summary of treatment facilities, discharge sampling locations, and extraction wells.

Treatment facility	Discharge sampling location	Hydrostratigraphic unit	Extraction wells
VTF406 Hotspot	Treated vapor to atmosphere	1B/2	W-514-2007A
		2/5	W-514-2007B
		5	W-217
TF518 North	Arroyo Las Positas (TFC-R003)	4	W-1410
VTF518 Perched Zone[c]	Treated vapor to atmosphere	1B	W-518-1914[a,b]
		2	W-1615[b], SVB-518-201[b], SVB-518-204[b], W-518-1913[b], W-518-1915[b]
TF5475-1	CRD-1 injection (W-1302)[d]	3A	W-1302[d]
TF5475-2	Arroyo Las Positas (TFC-R003)	2	W-1415
TF5475-3	CRD-2 injection (W-1609)	3A	W-1605[a], W-1606[a], W-1607[a], W-1608[a]
		5	W-1610
VTF5475	Injection (SVI-ETS-505)	2	SVI-ETS-504
		3A	W-1605 , W-1606 , W-1607 , W-1608

Note:

Haussmann Lake is located in the central portion of the Livermore Site and was formerly known as the Drainage Retention Basin (DRB).

[a] **Extraction well did not operate in 2005.**

[b] **Dual extraction[1] well.**

[c] **Ground water is treated at TF406 Northwest.**

[d] **Ground water is extracted from a lower screened interval in well W-1302, and after treatment is injected into an upper screened interval isolated by a packer.**

[1] Extraction of ground water using a downhole pump with concurrent application of vacuum to the well. Ground water and soil vapors are removed in separate pipe manifolds and treated.

Appendix A

Well Construction and Closure Data

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-001	GW Monitor	10/21/1980	122.5	116	1	95-100	1B/2	6
W-001	GW Monitor	10/21/1980	122.5	116	2	104-114	1B/2	6
W-001A	GW Monitor	4/12/1984	180	156	1	145-156	2	5.3
W-002	GW Monitor	8/29/1980	102.5	101	1	86-101	1B	2.8
W-002A	GW Monitor	4/2/1984	185	164	1	150-164	2	9.3
W-004	GW Monitor	7/28/1980	92	92	1	75-90	1B	7
W-005	GW Monitor	10/24/1980	93.5	90	1	56-71	1B	7
W-005	GW Monitor	10/24/1980	93.5	90	2	81-86	1B	7
W-005A	GW Monitor	4/9/1984	115	105	1	95-105	2	11.5
W-007	GW Monitor	10/3/1980	110.5	100	1	76-81	2/3A	1.5
W-007	GW Monitor	10/3/1980	110.5	100	2	88-98	2/3A	1.5
W-008	GW Monitor	5/14/1981	110	105	1	72-77	3A/3B	7
W-008	GW Monitor	5/14/1981	110	105	2	92-102	3A/3B	7
W-011	GW Monitor	6/3/1981	252	191	1	136-141	5	8.5
W-011	GW Monitor	6/3/1981	252	191	2	177-187	5	8.5
W-012	GW Monitor	8/14/1980	115.8	115	1	99-114	2	5
W-017	GW Monitor	10/8/1980	114	109	1	94-109	5	0.4
W-017A	GW Monitor	5/20/1981	181.4	160	1	127-132	7	5.5
W-017A	GW Monitor	5/20/1981	181.4	160	2	147-157	7	5.5
W-019	GW Monitor	9/19/1980	164.8	161	1	147-157	7	5
W-101	GW Monitor	1/25/1985	77	72	1	62-72	1B	2
W-102	GW Monitor	2/14/1985	396.5	171.5	1	151.5-171.5	2	6.6
W-103	GW Monitor	2/14/1985	96	89.5	1	79.5-89.5	1B	6.2
W-104	GW Monitor	2/21/1985	61.5	56.5	1	38.75-56.5	1B	3.1
W-105	GW Monitor	2/26/1985	69	62	1	42-62	1B	1
W-106	GW Monitor	3/6/1985	144	134.5	1	127.5-134.5	5	0.3
W-107	GW Monitor	3/13/1985	128	122	1	115-122	5	2.5
W-108	GW Monitor	3/21/1985	113.5	69	1	57-69	1A	13
W-109	GW Extraction	4/2/1985	289	147	1	137-147	2	13
W-110	GW Monitor	4/26/1985	371	365	1	340-365	5	16
W-111	GW Monitor	5/2/1985	122	117	1	97-117	2	3.4
W-112	GW Monitor	5/10/1985	129	123.5	1	111-123.5	5	3.5
W-113	GW Monitor	5/16/1985	124	115	1	100-115	5	0.4
W-114	GW Monitor	5/23/1985	70.5	66	1	51-63	1B	0.5
W-115	GW Monitor	6/3/1985	106	95	1	88-95	1B	5.4

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-116	GW Monitor	6/14/1985	181	92.6	1	86-91	1B	0.3
W-117	GW Monitor	6/27/1985	202	150.1	1	138-148	7	6
W-118	GW Monitor	7/19/1985	206.5	110	1	99-110	2	10
W-119	GW Monitor	8/2/1985	139	102.5	1	87.5-102.5	2	9
W-120	GW Monitor	8/19/1985	195	153	1	147-153	2	3.5
W-121	GW Monitor	8/23/1985	194	171	1	159-171	2	6
W-122	GW Monitor	8/17/1985	189	132	1	125-132	2	13.4
W-123	GW Monitor	10/1/1985	174	47.7	1	37.3-47.7	1A	6
W-141	GW Monitor	3/23/1985	61.5	60	1	45-60	1B	0.5
W-142	GW Monitor	3/29/1985	74.2	72	1	62-72	2	0.5
W-143	GW Monitor	4/12/1985	130	126	1	121-126	2	6
W-146	GW Monitor	7/16/1985	225	125	1	115-125	2	9.4
W-147	GW Monitor	7/26/1985	137	87	1	77-87	1B	0.5
W-148	GW Monitor	8/8/1985	152	98	1	83-98	1B	0.5
W-151	GW Monitor	9/30/1985	237	157	1	148.5-157.5	2	8
W-201	GW Monitor	10/17/1985	211	161	1	151-161	2	14
W-202	GW Monitor	11/7/1985	191	109	1	99-109	2	0.4
W-203	GW Monitor	11/15/1985	87	41	1	31-41	1A	5
W-204	GW Monitor	11/22/1985	160	110	1	100-110	2	2.5
W-205	GW Monitor	12/9/1985	180	117	1	107-117	3B	0.3
W-206	GW Monitor	12/19/1985	188	118	1	106-118	3A	NA
W-207	GW Monitor	1/24/1986	150	85	1	69-85	2	0.4
W-210	GW Monitor	3/11/1986	176	113	1	108-113	3B	0.3
W-212	GW Monitor	3/28/1986	183	136	1	124-136	5	1.3
W-213	GW Monitor	4/4/1986	174	100	1	94-100	1B	4
W-214	GW Monitor	4/11/1986	146	141.5	1	134-141.5	2	18
W-217	SV Extraction	5/20/1986	200	112.5	1	98.5-112.5	5	0.3
W-218	GW Monitor	5/30/1986	201	71	1	64.5-71	1B	10
W-219	GW Monitor	6/13/1986	214	148	1	141-148	5	4.5
W-220	GW Monitor	6/25/1986	196	92.5	1	82.5-92.5	2	0.4
W-221	GW Monitor	7/7/1986	178	95	1	82-95	3A	2
W-222	GW Monitor	7/17/1986	197	83	1	63-83	2	15
W-223	GW Monitor	8/15/1986	202	153	1	146-153	2	4.2
W-224	GW Monitor	8/26/1986	199	88	1	78-88	2	8.1
W-225	GW Monitor	9/9/1986	238	166	1	152-166	5	4.2

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-226	GW Monitor	9/25/1986	173	86	1	71-86	1B	0.5
W-251	GW Monitor	10/3/1985	50	47.5	1	35.5-47.5	1A	7.9
W-252	GW Monitor	10/18/1985	197	126	1	108-126	2	6
W-253	GW Monitor	10/30/1985	180	128	1	112.5-128	2	2.3
W-254	GW Extraction	11/21/1985	277	89	1	82-89	1B	2
W-255	GW Monitor	12/5/1985	187	124	1	115-124	5	10
W-256	GW Monitor	12/19/1985	187	137	1	132-137	5	6
W-257	GW Monitor	1/15/1986	197	96.5	1	82.5-96.5	2	0.5
W-258	GW Monitor	1/31/1986	157	121.5	1	116.5-121.5	3A	NA
W-259	GW Monitor	2/7/1986	200	99	1	93.5-99	2	0.3
W-260	GW Monitor	2/27/1986	215	151	1	141-151	2	5.1
W-261	GW Monitor	3/12/1986	225	118.5	1	109-118.5	5	0.5
W-262	GW Extraction	3/20/1986	256	100	1	91-100	1B	12
W-263	GW Monitor	4/7/1986	146	130	1	123-130	2	3
W-264	GW Monitor	4/14/1986	170	151	1	141-151	2	15
W-265	GW Monitor	4/25/1986	216	211	1	205-211	3A	2.5
W-267	GW Monitor	5/27/1986	196	179	1	172.5-179	3A	3.3
W-268	GW Monitor	6/4/1986	213	150.5	1	138-150.5	5	6
W-269	GW Monitor	6/16/1986	185	92	1	79-92	1B	6.8
W-270	GW Monitor	6/26/1986	185	127	1	113-127	5	0.3
W-271	GW Monitor	7/7/1986	201	112	1	105-112	2	7.2
W-272	GW Monitor	7/18/1986	226	110	1	95-110	2	1.3
W-273	GW Monitor	8/11/1986	203	84	1	64-84	2	3.4
W-274	GW Monitor	8/21/1986	217	95	1	90-95	2	NA
W-275	GW Monitor	9/5/1986	262	184	1	179-184	5	5.9
W-276	GW Monitor	9/17/1986	267	170	1	153.5-169.5	3A	12
W-277	GW Monitor	10/3/1986	254	169	1	163-169	3B	6
W-290	GW Monitor	7/8/1986	181	126	1	119.5-126	5	0.3
W-291	GW Monitor	7/24/1986	194	137	1	127-137	5	0.3
W-292	GW Extraction	8/10/1986	250	184.5	1	176-184.5	3B	NA
W-293	GW Monitor	8/27/1986	229	155	1	145-155	5	5
W-294	GW Monitor	9/15/1986	251	139	1	122-139	5	6
W-301	GW Monitor	10/7/1986	203	141	1	136-141	2	10
W-302	GW Monitor	10/22/1986	191	83.5	1	78-83.5	1B	2
W-303	GW Monitor	10/28/1986	197	128	1	124-128	2	24

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-304	GW Monitor	11/12/1986	207	200	1	195-200	4	0.7
W-305	GW Extraction	11/18/1986	146	138	1	128-138	2	16.2
W-306	GW Monitor	12/4/1986	207	110	1	98-110	2	8.3
W-307	GW Monitor	12/15/1986	214	102	1	93-102	1B	1.4
W-308	GW Monitor	1/13/1987	194	113	1	107-113	2	2.4
W-310	GW Monitor	2/4/1987	202	184.5	1	176.5-184.5	3A	20
W-311	GW Monitor	2/20/1987	226.5	147.5	1	134.5-147.5	3A	NA
W-312	GW Monitor	3/5/1987	224.5	168	1	160-168	4	16.7
W-313	GW Monitor	3/12/1987	99	85	1	80-85	2	7.8
W-314	GW Extraction	3/20/1987	228	142	1	129-142	4	19
W-315	GW Monitor	4/3/1987	215	156	1	141-156	3A	15
W-316	GW Monitor	4/15/1987	196	72	1	68-71	2	7
W-317	GW Monitor	4/20/1987	100	95	1	88-95	2	14
W-318	GW Monitor	4/28/1987	200	81	1	74-81	2	6
W-319	GW Monitor	5/5/1987	198	125	1	119-125	3A	15
W-320	GW Monitor	5/11/1987	106	99	1	94-99	2	5
W-321	GW Monitor	5/29/1987	356	321.5	1	305-321.5	5	17
W-322	GW Monitor	7/1/1987	565.5	152	1	142-152	2	8
W-323	GW Monitor	8/4/1987	200	127	1	122-127	2	5.6
W-324	GW Monitor	8/17/1987	219	189	1	184-189	3A	15
W-325	GW Monitor	8/28/1987	312	170	1	158-170	3A	10
W-351	GW Extraction	10/17/1986	191	152	1	146-152	4	6.5
W-353	GW Monitor	11/12/1986	205	101	1	95.5-101	2	2.4
W-354	GW Monitor	11/24/1986	185	179	1	163-179	4/5	17.6
W-355	GW Monitor	12/5/1986	202	107	1	102-107	2	1.7
W-356	GW Monitor	12/18/1986	237	137	1	133-137	3B	5
W-357	GW Extraction	1/12/1987	197	123	1	107-123	2	13.6
W-359	GW Extraction	2/10/1987	195	150.5	1	138-150.5	5	5
W-361	GW Monitor	3/5/1987	257	135	1	125-135	3A	6
W-362	GW Monitor	3/13/1987	151	145	1	131-145	4	15
W-363	GW Monitor	3/24/1987	195	129	1	117-129	3A	6
W-364	GW Monitor	3/31/1987	195	165	1	155-165	3B	6.5
W-365	GW Monitor	4/9/1987	187	125	1	120-125	2	10
W-366	GW Monitor	4/20/1987	273	251	1	240-251	4	17.6
W-368	GW Extraction	5/6/1987	206	78	1	70-78	1B	3.5

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-369	GW Monitor	5/14/1987	204	113	1	107-113	2	7
W-370	GW Monitor	5/29/1987	286	208	1	196.5-208	4	10
W-371	GW Monitor	6/12/1987	233	162	1	155-162	3A	5
W-372	GW Monitor	6/25/1987	218	152.5	1	147.5-152.5	4	7.5
W-373	GW Monitor	7/6/1987	178	99	1	89-99	1B	9
W-375	GW Monitor	7/29/1987	223	71	1	65-71	2	0.4
W-376	GW Monitor	8/27/1987	249	172	1	162-172	2	4
W-377	GW Monitor	9/4/1987	159	144	1	141.5-144	2	0.5
W-378	GW Monitor	9/9/1987	155	150	1	146-150	2	0.5
W-379	GW Monitor	9/14/1987	155	150	1	146-150	2	0.5
W-380	GW Monitor	10/1/1987	195	182	1	170-182	3A	9.1
W-401	GW Monitor	11/5/1987	159	153	1	109-153	2	18
W-402	GW Monitor	10/13/1987	104	102	1	92-102	1B	20
W-403	GW Monitor	11/16/1987	585	495	1	485-495	7	15
W-404	GW Monitor	12/4/1987	245	158	1	150-158	2	20
W-405	GW Monitor	1/4/1988	244	162	1	132-162	2	20
W-406	GW Monitor	1/20/1988	213	94	1	79-84	1B	5
W-407	GW Monitor	2/4/1988	215	205	1	192-205	3A	10
W-408	GW Extraction	2/16/1988	131	122.5	1	101-122.5	1B	20
W-409	GW Monitor	3/7/1988	272	78	1	71-78	1B	20
W-410	GW Monitor	3/30/1988	369	205	1	193-205	3A	16
W-411	GW Monitor	4/12/1988	192	138	1	131-138	2	20
W-412	GW Monitor	4/18/1988	104	74	1	67-74	1B	4
W-413	GW Extraction	4/28/1988	163	115	1	100-115	2	12
W-415	GW Extraction	8/12/1988	205	183.7	1	79-179	1B/2	50
W-416	GW Monitor	6/10/1988	152	80.5	1	72-80.5	1B	20
W-417	GW Monitor	6/20/1988	152	60	1	51-60	1B	5
W-418	GW Monitor	6/24/1988	124	124	1	108-118	2	0.5
W-419	GW Monitor	6/29/1988	82	82	1	62.5-75.5	1B	0.5
W-420	GW Monitor	7/26/1988	127	111	1	105-111	2	4
W-421	GW Monitor	8/23/1988	181	90	1	75-90	1B	5
W-422	GW Monitor	9/2/1988	203	139.5	1	133-139.5	2	9
W-423	GW Monitor	9/9/1988	308	118	1	106-118	2	19
W-424	GW Monitor	10/4/1988	208	144	1	137-144	3A	6
W-441	GW Monitor	10/14/1987	250	144	1	135-144	5	3

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-446	GW Monitor	12/18/1987	202	196	1	186-196	3A	0.5
W-447	GW Monitor	2/5/1988	353	274	1	256-274	4	8
W-448	GW Monitor	2/17/1988	235	127.5	1	120.5-127.5	2	20
W-449	GW Monitor	3/7/1988	172	165	1	152-165	2	6
W-450	GW Monitor	3/21/1988	300	200	1	193-200	5	6
W-451	GW Monitor	4/6/1988	202	112	1	106-112	2	3
W-452	GW Monitor	4/15/1988	210	79.5	1	64-79.5	1B	7
W-453	GW Monitor	4/27/1988	185	130	1	121-130	2	8
W-454	GW Monitor	5/9/1988	196	83	1	73-83	1B	3
W-455	GW Monitor	5/19/1988	184	162.5	1	148-162.5	2	5
W-457	GW Extraction	6/22/1988	289	149.5	1	130-149.5	2	20
W-458	GW Monitor	6/30/1988	212.5	116	1	108-116	2	2
W-459	GW Monitor	7/20/1988	76	73	1	59.5-73	1B	0.5
W-461	GW Monitor	8/16/1988	133	50.5	1	41.5-50.5	2	0.5
W-462	GW Monitor	9/12/1988	385	337	1	331-336.5	5	10
W-463	GW Monitor	9/16/1988	93	92.8	1	87-92.5	1B	20
W-464	GW Monitor	9/30/1988	253	104.5	1	96-104.5	2	7
W-481	GW Monitor	11/4/1987	224.5	105	1	100-105	1B	2
W-482	GW Monitor	1/15/1988	218	170	1	165-170	2	0.5
W-483	GW Monitor	1/26/1988	140	130	1	115-130	2	0.5
W-484	GW Monitor	2/11/1988	255	188	1	185-188	3A	0.5
W-485	GW Monitor	2/25/1988	249	157	1	151-157	2	0.5
W-486	GW Monitor	3/11/1988	167	110	1	100-108	2	6
W-487	GW Monitor	3/17/1988	180	151	1	148-151	3B	5
W-501	GW Monitor	10/13/1988	174	92	1	84-92	1B	6
W-502	GW Monitor	10/25/1988	158	59	1	55-59	1B	0.5
W-503	GW Monitor	11/2/1988	187	80	1	74-80	1B	2
W-504	GW Monitor	11/21/1988	358	167	1	157-167	2	8
W-505	GW Monitor	12/15/1988	278	180	1	167-180	2/3A	18
W-506	GW Monitor	12/22/1988	120	115	1	101-115	1B	9
W-507	GW Monitor	1/18/1989	158	139	1	129-139	2	15
W-509	GW Monitor	3/3/1989	305	184	1	179-184	5	2
W-510	GW Monitor	3/15/1989	300	119.1	1	111-119	2	0.5
W-511	GW Monitor	3/31/1989	316	176	1	167-176	3B	2
W-512	GW Monitor	4/13/1989	261	176.5	1	166-176	5	2.5

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-513	GW Monitor	4/26/1989	259	115	1	102-115	2	1
W-514	GW Monitor	5/17/1989	386	115.5	1	92-115.5	1B	2
W-515	GW Monitor	5/30/1989	211	78	1	68-78	1B	3
W-516	GW Monitor	6/9/1989	203	119	1	114-119	2	10
W-517	GW Monitor	6/20/1989	215	88.2	1	80-88	1B	8
W-518	GW Extraction	8/8/1989	251	139.3	1	131-139	2	6.7
W-519	GW Monitor	8/14/1989	186.5	80.6	1	60-80.5	1B	20
W-520	GW Extraction	8/30/1989	160	101.5	1	94-101.5	1B	10
W-521	GW Monitor	9/13/1989	166	95.4	1	86-95	1B	1.5
W-522	GW Extraction	10/5/1989	145.5	141.5	1	134-141.5	2	16
W-551	GW Monitor	10/18/1988	308	155.5	1	151-155.5	2	9
W-552	GW Monitor	10/25/1988	70.5	64.5	1	48.5-64	1B	15
W-553	GW Monitor	11/3/1988	186	106.5	1	99-106.5	2	2
W-554	GW Monitor	11/22/1988	239	141.5	1	126.5-141.4	2	15
W-555	GW Monitor	12/5/1988	122	116.5	1	102.5-116.5	1B	14.5
W-556	GW Monitor	12/15/1988	192	81.5	1	76-81.5	1B	15
W-557	GW Monitor	12/22/1988	122.5	118	1	102-118	2	10
W-558	GW Monitor	1/17/1989	117	110.5	1	101-110.5	1B	20.5
W-559	GW Monitor	1/24/1989	105	100	1	93-100	1B	1.2
W-560	GW Monitor	2/7/1989	263	206.5	1	201-206.5	3B	5
W-561	GW Monitor	2/23/1989	180	152	1	143-152	5	1
W-562	GW Monitor	3/8/1989	263	158.5	1	145-158	5	1.5
W-563	GW Monitor	3/17/1989	192	105.5	1	95-105	2	8
W-564	GW Monitor	3/30/1989	184	85	1	79.5-85	1B	3.5
W-565	GW Monitor	4/6/1989	177	82.5	1	75-82.5	1B	15
W-566	GW Extraction	4/19/1989	317	207.5	1	197-207	5	15
W-567	GW Monitor	4/27/1989	194	61.5	1	51-61	1B	10.5
W-568	GW Monitor	6/5/1989	156	101	1	97-101	2	10
W-569	GW Monitor	5/16/1989	215	109.5	1	101-109.5	2	3
W-570	GW Monitor	6/9/1989	180	175	1	161-175	5	2
W-571	GW Monitor	6/15/1989	223.5	107.5	1	102-107	1B	20
W-591	GW Monitor	11/29/1988	112	107.5	1	97-107.5	2	0.4
W-592	GW Monitor	12/12/1988	136.5	113	1	101-112	2	1.2
W-593	GW Monitor	2/6/1989	159	92.5	1	82-92.5	3A	2.1
W-594	GW Monitor	2/27/1989	156	61	1	55-61	2	0.5

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-601	GW Extraction	10/13/1989	146	96	1	88-96	1B	12
W-602	GW Extraction	11/6/1989	268	100.2	1	90-100	1B	11
W-603	GW Extraction	11/15/1989	150	147	1	141-147	2	6
W-604	GW Monitor	11/27/1989	111	83	1	76-82	1B	0.4
W-605	GW Extraction	12/8/1989	246	136	1	130-136	2	5
W-606	GW Monitor	12/21/1989	145	89	1	73-89	1B	0.4
W-607	GW Monitor	1/24/1990	186	55.1	1	49-55	1B	2
W-608	GW Monitor	2/7/1990	162	66.3	1	55-66	1B	2
W-609	GW Extraction	2/21/1990	120	112	1	104-112	2	3
W-610	GW Extraction	3/16/1990	453	84.5	1	69-84.5	1B	5
W-611	GW Monitor	4/4/1990	161	98	1	87.5-98	1B	3
W-612	GW Monitor	4/19/1990	222	137	1	126-136	2	10
W-613	GW Monitor	5/2/1990	93	88	1	81.5-88	1B	4.5
W-614	GW Extraction	5/18/1990	262	123	1	100-123	2	6
W-615	GW Monitor	6/1/1990	121	99.3	1	91-99	1B	5
W-616	GW Monitor	6/14/1990	255	188	1	178-188	3A	4
W-617	GW Monitor	6/26/1990	200	110	1	103-110	2	3
W-618	GW Monitor	7/17/1990	357	205	1	201-205	3B	3
W-619	GW Monitor	8/7/1990	330	252	1	232-252	3B/4	20
W-620	GW Extraction	8/30/1990	206	88.5	1	75-88.5	1B	6
W-621	GW Extraction	9/9/1990	149	120	1	113-120	2	3.5
W-622	GW Monitor	9/28/1990	206	112	1	113-120	5	0.3
W-651	GW Monitor	2/22/1990	155	89	1	82-89	1B	0.4
W-652	GW Monitor	3/15/1990	318	256	1	245-256	7	2
W-653	Dual Extraction	3/29/1990	225	128	1	122-128	3A	1
W-654	GW Monitor	4/11/1990	240	158	1	140-158	2	20
W-655	GW Extraction	4/25/1990	193	130	1	121-129.5	2	15
W-701	GW Extraction	10/10/1990	159	86	1	74-86	1B	14
W-702	GW Monitor	10/24/1990	180.5	95	1	77-95	1B	4
W-703	GW Monitor	12/3/1990	586	325	1	298-325	5	NA
W-704	GW Extraction	2/2/1991	135	107	1	67-76	1B	20
W-704	GW Extraction	2/2/1991	135	107	2	88-97	1B	20
W-705	GW Monitor	12/26/1990	126	90	1	77-90	1B	1
W-706	GW Monitor	1/25/1991	178	85	1	71-85	1B	NA
W-712	GW Extraction	8/28/1991	200	185.5	1	170-185.5	3A	8

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-714	GW Extraction	12/5/1991	128.5	128	1	107-128	2	NA
W-750	GW Monitor	4/10/1991	152	150	1	130-150	5	NA
W-901	GW Monitor	2/24/1993	97.8	88	1	80-83	1B	1
W-902	GW Monitor	1/22/1993	95.5	88	1	80-83	1B	1
W-903	GW Extraction	4/28/1993	223	145	1	132-140	2	20
W-904	GW Extraction	5/6/1993	212	154	1	121-133	2	30
W-905	GW Monitor	4/7/1993	221	144.5	1	134-144	2	3.5
W-906	GW Extraction	7/23/1993	200	132	1	58-132	2/3A	8
W-907	GW Extraction	8/3/1993	239	222	1	172.7-188.7	4/5	40
W-907	GW Extraction	8/3/1993	239	222	2	204.5-215	4/5	40
W-908	GW Monitor	8/17/1993	239	197	1	180-197	5/6	0.4
W-909	GW Monitor	11/4/1993	252	113.5	1	80.5-113.5	2	2.5
W-911	GW Monitor	10/20/1993	180	113.65	1	73.65-108.65	2	1.5
W-912	GW Monitor	10/7/1993	239	174	1	168-174	5	3.5
W-913	GW Monitor	11/24/1993	454	255	1	235-255	4	30
W-1001	GW Extraction	12/15/1993	105	92	1	85-92	1B	1.5
W-1002	GW Monitor	11/12/1993	293	260	1	246-260	5	20
W-1003	GW Monitor	2/2/1994	184	147	1	140-147	2	1.5
W-1004	GW Extraction	2/23/1994	100	97	1	71-91	1B	5
W-1008	GW Monitor	4/13/1994	246	238	1	229.5-238	7	9.5
W-1009	GW Extraction	5/2/1994	191	140	1	134-140	2	25
W-1010	GW Monitor	5/24/1994	463	142	1	130-142	2	25
W-1011	GW Monitor	6/6/1994	106	89	1	75-89	1B	2
W-1012	GW Monitor	6/20/1994	161	117	1	96-112	2	2.5
W-1013	GW Monitor	6/29/1994	147	73	1	65-73	1B	1.5
W-1014	GW Monitor	7/12/1994	99	89	1	65-89	1B	30
W-1015	GW Extraction	8/10/1994	437	94	1	84-94	1B	25
W-1101	GW Monitor	11/10/1994	200	79	1	76-79	1B	1
W-1102	GW Extraction	11/29/1994	163	95.6	1	76-94	1B	11
W-1103	GW Extraction	12/15/1994	200	82	1	70-82	1B	4.5
W-1104	GW Extraction	1/18/1995	165	99.3	1	77-87	1B	35
W-1104	GW Extraction	1/18/1995	165	99.3	2	92-98	1B	35
W-1105	GW Monitor	1/18/1995	105	93	1	78-93	1B	3.75
W-1106	GW Monitor	1/17/1995	245	86	1	76-85	1B	17.5
W-1107	GW Monitor	3/6/1995	199.5	93	1	74-88	1B	1.5

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1108	GW Monitor	3/27/1995	250	156	1	142-156	5	22.5
W-1109	GW Extraction	4/11/1995	121	113	1	94-113	2	6.5
W-1110	GW Monitor	5/4/1995	252	92.9	1	68-92	1B	NA
W-1111	GW Extraction	6/1/1995	152	129	1	88-108	1B/2	NA
W-1111	GW Extraction	6/1/1995	152	129	2	120-124	1B/2	NA
W-1112	GW Monitor	6/28/1995	263	210	1	201-210	5	NA
W-1113	GW Monitor	7/12/1995	260	214	1	204-214	5	NA
W-1115	GW Monitor	10/12/1995	126.5	118	1	108-118	3A	0.5
W-1116	GW Extraction	8/17/1995	214.8	101	1	72-98	1B	NA
W-1117	GW Monitor	8/21/1996	154	132.2	1	122-132	3A	1
W-1118	GW Monitor	9/27/1995	225	125	1	115-125	3A	NA
W-1201	GW Monitor	10/18/1995	225	133	1	125-133	3A	1
W-1202	GW Monitor	10/25/1995	99.3	99	1	83-99	2	5
W-1203	GW Monitor	11/7/1995	224	206.2	1	196-206	5	18
W-1204	GW Monitor	11/20/1995	225	126.2	1	118-126	3A	2.5
W-1205	GW Monitor	11/27/1995	91	82	1	72-82	2	1
W-1206	GW Extraction	12/6/1995	220	191	1	174-186	4	40
W-1207	GW Monitor	12/13/1995	92	90	1	70-90	2	1
W-1208	GW Extraction	1/9/1996	166	163	1	135-163	3A/3B	40
W-1209	GW Monitor	1/26/1996	210	164	1	148-164	4	3
W-1210	GW Monitor	2/12/1996	250	223	1	213-223	5	3
W-1211	GW Extraction	3/5/1996	273	205	1	185-200	4	25
W-1212	GW Monitor	3/19/1996	150	75	1	52-75	1B	3
W-1213	GW Extraction	4/2/1996	129	76	1	64-76	1B	5
W-1214	GW Monitor	4/22/1996	180	100	1	80-100	1B	2
W-1215	GW Extraction	4/17/1996	175	120	1	108-118	2	8.5
W-1216	GW Extraction	5/7/1996	200	124	1	94-124	2	14
W-1217	GW Monitor	5/15/1996	182	98.5	1	78-98	1B	0.25
W-1219	GW Monitor	6/4/1996	201	142	1	138-142	4	0.18
W-1222	GW Monitor	6/26/1996	175	125.2	1	115-125	3A	6
W-1223	GW Monitor	7/23/1996	175	102	1	87-97	2	4
W-1224	GW Monitor	9/5/1996	125	104.5	1	99-104	1B	4.3
W-1225	GW Monitor	8/14/1996	150	121.2	1	113-121	3A	2
W-1226	GW Monitor	8/6/1996	155	126.5	1	116-126	2	1
W-1227	GW Monitor	10/9/1996	200	134	1	126-134	2	11

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1250	GW Monitor	6/7/1996	210	200.3	1	130-135	4	0.25
W-1251	GW Monitor	7/3/1996	210	200.3	1	134-139	4	1.3
W-1252	GW Monitor	7/25/1996	208	202.3	1	135-140	4	0.15
W-1253	GW Monitor	8/15/1996	206	200.3	1	127-132	4	0.15
W-1254	GW Extraction	8/28/1996	210	200	1	131-141	4	26
W-1255	GW Monitor	8/27/1996	208	200.7	1	124-129	4	0.2
W-1301	GW Extraction	12/4/1996	180	120.3	1	112-120	3A	15
W-1302	GW Extraction	1/21/1997	145	138.9	1	116.5-121.2	3A	7.5
W-1302	GW Extraction	1/21/1997	145	138.9	2	125.8-133.8	3A	7.5
W-1303	GW Extraction	2/6/1997	199.5	107	1	78-102	2	10
W-1304	GW Monitor	2/20/1997	149.5	125	1	120-125	3A	0.75
W-1306	GW Extraction	5/6/1997	200	106	1	81-101	2	3.3
W-1307	GW Extraction	7/2/1997	150	141	1	126-136	4	20
W-1308	GW Extraction	7/22/1997	154	116	1	81-111	2	7
W-1309	GW Extraction	8/11/1997	220	157	1	142-152	4	6
W-1310	GW Extraction	9/15/1997	220	198	1	173-193	5	28
W-1311	GW Monitor	10/1/1997	150	120.5	1	100-120	2	14
W-1401	GW Monitor	10/21/1997	254	120	1	105-120	2	7.8
W-1402	GW Monitor	11/6/1997	135	112	1	102-112	3A	4.1
W-1403	GW Extraction	11/13/1997	175	142.5	1	132-142	3B	5
W-1404	GW Monitor	11/24/1997	162	97.7	1	87-97	2	3.1
W-1405	GW Monitor	11/24/1997	100	97.8	1	87-97	2	4.5
W-1406	GW Monitor	12/15/1997	201	150	1	139.2-149.2	4	9.2
W-1407	GW Monitor	12/18/1997	224	118	1	105-118	2	2
W-1408	GW Monitor	1/12/1998	134	128	1	118-128	3A	3.8
W-1409	GW Extraction	1/23/1998	143	140	1	80-135	2	13
W-1410	GW Extraction	2/19/1998	208.5	131.1	1	126-131	4	9
W-1411	GW Monitor	2/4/1998	133	128.1	1	114-128	3A	10.6
W-1412	GW Monitor	3/11/1998	201	108	1	92-107	3A	1
W-1413	GW Monitor	3/26/1998	163.5	163.5	1	147-157	5	1
W-1414	GW Monitor	3/31/1998	128	107.5	1	97-107	3A	0.018
W-1415	GW Extraction	4/15/1998	182	104.72	1	74.5-104.5	2	2
W-1416	GW Monitor	6/2/1998	194.5	105	1	85-100	2	10.8
W-1417	GW Monitor	4/23/1998	225	155	1	130-150	3A	8.9
W-1418	GW Monitor	5/5/1998	252.5	190	1	176-190	4	9

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1419	GW Monitor	5/13/1998	175	115.5	1	90-110	2	4.45
W-1420	GW Monitor	6/17/1998	175.5	112.5	1	102-112	2	20
W-1421	GW Monitor	5/28/1998	230	172	1	157-167	3B	2.1
W-1422	GW Monitor	5/14/1998	173.5	169.1	1	162-169	3B	11
W-1423	GW Extraction	7/2/1998	175	134.5	1	99.5-109.5	2	22.4
W-1423	GW Extraction	7/2/1998	175	134.5	2	119.5-129.5	2	22.4
W-1424	GW Monitor	8/13/1998	225.3	146	1	126-146	2	6.2
W-1425	GW Monitor	8/26/1998	115	100.5	1	88.5-100.5	1B	1
W-1426	GW Monitor	9/3/1998	89	85	1	70-85	1B	10
W-1427	GW Monitor	9/17/1998	104	80.2	1	70-80	1B	17.7
W-1428	GW Monitor	9/29/1998	104	78.2	1	63-78	1B	30
W-1501	GW Monitor	10/12/1998	126.1	88	1	72-88	1B	7.5
W-1502	GW Monitor	10/27/1998	204	98.7	1	88-98	2	1.7
W-1503	GW Extraction	11/16/1998	234	181.5	1	171-181	4	24
W-1504	GW Extraction	12/14/1998	165.2	162.5	1	140-160.4	3A/3B	21.7
W-1505	GW Monitor	1/20/1999	276	184.5	1	174-184	4	10
W-1506	GW Monitor	2/3/1999	160	120.5	1	110-120	2	3
W-1507	GW Monitor	2/19/1999	201.5	169.5	1	159-169	5	0.5
W-1508	GW Monitor	3/3/1999	135	128.5	1	118-128	2	0.75
W-1509	GW Monitor	3/24/1999	175	88.5	1	73-88	1B	8
W-1510	GW Extraction	4/9/1999	114.5	113.5	1	93-113	2	5
W-1511	GW Monitor	4/27/1999	229	146	1	138-146	3B	15
W-1512	GW Monitor	5/3/1999	100	100	1	88-98	2	0.5
W-1513	GW Monitor	5/11/1999	122	120	1	108-120	2/3A	NA
W-1514	GW Monitor	5/24/1999	127.5	126	1	103-121	2/3A	6.5
W-1515	GW Monitor	6/8/1999	130	121.5	1	102-120	2/3A	3
W-1516	GW Monitor	6/17/1999	204.5	188	1	188-200	5	17
W-1517	GW Monitor	6/6/1999	154	122.4	1	87-97	2	0.1
W-1518	GW Extraction	7/8/1999	184	115	1	84-107	2	3
W-1519	GW Monitor	8/3/1999	245	238	1	222-237	5	30
W-1520	GW Extraction	7/27/1999	178.3	173	1	160-168	4	3.5
W-1522	GW Extraction	8/11/1999	169	161	1	141-156	3B	9
W-1523	GW Extraction	9/7/1999	216	172.3	1	164-172	4	15
W-1550	GW Extraction	6/24/1999	200	130	1	98-125	3A	10
W-1551	GW Extraction	7/15/1999	153	129	1	93-124	3A	10.5

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1552	Dual Extraction	6/24/1999	153.5	130	1	97.2-124.5	3A	2
W-1553	GW Monitor	8/17/1999	153	130	1	98-125	3A/3B	1
W-1601	GW Extraction	10/13/1999	169	160	1	150-155	3B	2.7
W-1602	GW Extraction	11/2/1999	115.5	110.7	1	80-90	2	8
W-1603	GW Extraction	11/16/1999	144	140	1	130-135	3A	71.2
W-1604	GW Monitor	12/2/1999	194	148.7	1	138-148	4	8
W-1605	SV Extraction	3/7/2000	120.5	112	1	90-107	3A	NA
W-1606	SV Extraction	1/27/2000	175	112	1	90-107	3A	NA
W-1607	SV Extraction	2/10/2000	155.4	112	1	90-107	3A	0.1
W-1608	SV Extraction	2/28/2000	155	112	1	90-107	3A	NA
W-1609	GW Injection	4/17/2000	155	135	1	110-130	5	0.1
W-1610	GW Extraction	5/4/2000	155.3	135	1	110-130	5	0.5
W-1613	GW Monitor	4/27/2000	219	173	1	168.4-173.4	3B	NA
W-1614	GW Monitor	5/18/2000	100	89.8	1	79-89	1B	3
W-1615	Dual Extraction	8/15/2000	55	48	1	15-48	1B/2	NA
W-1650	Dual Extraction	1/19/2000	145	126	1	96-121	3A	2
W-1651	Dual Extraction	1/27/2000	145	129	1	94-124	2/3A/3B	1
W-1652	Dual Extraction	2/9/2000	145	127	1	92-122	3A/3B	0.5
W-1653	Dual Extraction	2/24/2000	144	124	1	94-119	3A	1.2
W-1654	Dual Extraction	2/25/2000	146.5	128	1	93-123	3A	1
W-1655	Dual Extraction	3/8/2000	145	125	1	90-120	2/3A	0.5
W-1656	Dual Extraction	3/14/2000	145	125.3	1	95.1-120.1	3A	5
W-1657	Dual Extraction	3/23/2000	145	128	1	95-123	3A/3B	0.5
W-1701	GW Monitor	7/3/2001	185	180.8	1	140-155	2	15
W-1701	GW Monitor	7/3/2001	185	180.8	2	165-175	2	15
W-1702	GW Monitor	6/15/2001	15	14.25	1	4-13	1B	NA
W-1703	GW Monitor	8/23/2001	358	341.5	1	331-341	LL	22.6
W-1704	GW Monitor	9/19/2001	240	118.8	1	98-118	2	2
W-1705	FLUTe	10/16/2001	225	208.8	1	93-103	2/3A/3B/5	5
W-1705	FLUTe	10/16/2001	225	208.8	2	123-128	2/3A/3B/5	5
W-1705	FLUTe	10/16/2001	225	208.8	3	138-143	2/3A/3B/5	5
W-1705	FLUTe	10/16/2001	225	208.8	4	203-208	2/3A/3B/5	5
W-1801	GW Extraction	3/18/2002	143	134.4	1	124-134	3A	5
W-1802	GW Monitor	4/2/2002	175	162.2	1	147-157	3A	NA
W-1803	GW Monitor	4/24/2002	245	240.8	1	175-185	4/5	15

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-1803	GW Monitor	4/24/2002	245	240.8	2	225-235	4/5	15
W-1804	GW Monitor	5/22/2002	155	110.8	1	80-95	3A/3B	0.5
W-1804	GW Monitor	5/22/2002	155	110.8	2	100-105	3A/3B	0.5
W-1805	GW Monitor	8/20/2002	110	100.8	1	70-80	1B	6
W-1805	GW Monitor	8/20/2002	110	100.8	2	85-95	1B	6
W-1806	GW Extraction	9/12/2002	260	106.2	1	80.7-101.2	1B	3
W-1807	GW Extraction	10/7/2002	165	130	1	115-125	2	10
W-1901	GW Monitor	10/31/2002	175	127	1	92-97	1B/2	7
W-1901	GW Monitor	10/31/2002	175	127	2	107-122	1B/2	7
W-1902	GW Extraction	11/21/2002	175	165	1	140-145	3A	20
W-1902	GW Extraction	11/21/2002	175	165	2	150-160	3A	20
W-1903	Dual Extraction	12/16/2002	120	109	1	84-104	2	0.5
W-1904	Dual Extraction	1/23/2003	120	101	1	75-100	2	0.5
W-1905	GW Monitor	5/20/2003	210	123.5	1	103-113	3	2.5
W-1905	GW Monitor	5/20/2003	210	123.5	2	118-123	3	2.5
W-1909	GW Monitor	6/24/2003	110	106.35	1	86-106	2	1.5
W-518-1913	Dual Extraction	10/8/2003	63	61	1	50.5-60.5	2	NA
W-518-1914	Dual Extraction	10/9/2003	18	16	1	5.5-15.5	1B	NA
W-518-1915	Dual Extraction	10/15/2003	44	41	1	30.5-40.5	2	NA
W-ETC-2001A	SV Monitor	11/10/2003	95	23.5	1	18-23	1B	NA
W-ETC-2001B	SV Monitor	11/10/2003	95	88.5	1	78-88	2	NA
W-ETC-2002A	SV Monitor	11/25/2003	95	64.5	1	34-64	1B/2	NA
W-ETC-2002B	SV Monitor	11/25/2003	95	85.5	1	75-85	2	NA
W-ETC-2003	SV Extraction	12/9/2003	95	45.5	1	20-45	1B	NA
W-ETC-2004A	SV Extraction	12/17/2003	95	53.5	1	28-53	1B/2	NA
W-ETC-2004B	SV Extraction	12/17/2003	95	88.5	1	63-68	2	NA
W-ETC-2004B	SV Extraction	12/17/2003	95	88.5	2	78-88	2	NA
W-2005	GW Extraction	2/3/2004	160	125	1	109-119	3A	2
W-2006	GW Monitor	2/24/2004	160	132.5	1	122-132	3	NA
W-514-2007A	SV Extraction	3/18/2004	110	45.5	1	15-45	1B/2	NA
W-514-2007B	SV Extraction	3/18/2004	110	102.5	1	72-102	2/5	NA
W-ETS-2008A	SV Extraction	4/7/2004	110	40.5	1	20-40	1B	NA
W-ETS-2008B	SV Extraction	4/7/2004	110	85.5	1	50-85	2	NA
W-ETS-2009	SV Extraction	5/3/2004	120	79.5	1	54-79	2	NA
W-ETS-2010A	SV Extraction	5/19/2004	110.3	70.5	1	35-70	1B/2	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
W-ETS-2010B	SV Extraction	5/19/2004	110.3	100.5	1	80-100	2	NA
W-2011	Dual Extraction	2/29/2004	155	116.3	1	106-116	3A	0.3
W-2012	GW Extraction	10/21/2004	155	136.6	1	111-116	3A	4
W-2012	GW Extraction	10/21/2004	155	136.6	2	126-131	3A	4
W-2101	Dual Extraction	11/18/2004	160	135.3	1	110-130	3A	0.25
W-2102	Dual Extraction	12/14/2004	160	138.35	1	118-133	3A	0.33
W-2103	GW Monitor	1/18/2005	160	133.35	1	113-128	3A	0.5
W-2104A	SV Monitor	2/8/2005	80	45.5	1	30-45	1B	NA
W-2104B	SV Monitor	2/8/2005	80	72.6	1	52-72	2	NA
W-2105	Dual Extraction	3/9/2005	126	115.33	1	90-110	2	0.25
W-2110A	SV Monitor	6/14/2005	100	58.49	1	38-58	1B/2	NA
W-2110B	SV Monitor	6/14/2005	100	85.49	1	65-85	2	NA
W-2111A	SV Monitor	6/22/2005	90	40.3	1	25-40	1B	NA
W-2111B	SV Monitor	6/22/2005	90	75.3	1	60-80	2	NA
W-2112A	SV Monitor	6/28/2005	100	58.49	1	38-58	1B/2	NA
W-2112B	SV Monitor	6/28/2005	100	78.49	1	68-78	2	NA
W-2113	GW Monitor	7/21/2005	220	201.5	1	190.5-200.5	4	9
W-2202	GW Monitor	12/21/2005	140	122.25	1	102-107	3A	0.4
W-2202	GW Monitor	12/21/2005	140	122.25	2	112-117	3A	0.4
W-543-001	SV Extraction	2/25/2003	71.5	67.5	1	52-67	2	NA
W-543-002A	SV Monitor	3/10/2003	96	82.5	1	45-65	2	NA
W-543-002B	SV Monitor	3/10/2003	96	82.5	1	72-82	2	NA
W-543-003	SV Extraction	3/20/2003	95	80	1	69-79	2	NA
W-543-004A	SV Monitor	3/27/2003	95	64.5	1	49-64	2	NA
W-543-004B	SV Monitor	3/27/2003	95	64.5	1	70-80	2	NA
W-543-1908	SV Extraction	6/12/2003	40.8	40.4	1	20-40	1B	NA
W-HPA-001A	SV Monitor	4/15/2003	80	45.5	1	30-45	1B	NA
W-HPA-001B	SV Monitor	4/15/2003	80	73.5	1	63-73	2	NA
W-HPA-002A	SV Extraction	4/29/2003	80	43	1	32.5-42.5	1B	NA
W-HPA-002B	SV Extraction	4/29/2003	80	72.5	1	52-72	2	NA
SIP-141-201	Piezometer	2/2/1996	77	74.2	1	57-74	1B	0.5
SIP-141-202	Piezometer	2/12/1996	80	74	1	64-74	1B	0.5
SIP-141-203	Piezometer	2/20/1996	87	83	1	72-83	1B	NA
SIP-191-002	Piezometer	4/21/1994	66	61	1	45-61	1B	NA
SIP-191-003	Piezometer	4/26/1994	50.5	45	1	35-45	1B	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
SIP-191-005	Piezometer	5/4/1994	54	48	1	42-48	1A	NA
SIP-191-101	Piezometer	11/18/1994	68.5	64	1	58-64	1B	NA
SIP-212-101	Piezometer	3/14/1996	94	90.5	1	87-90.5	2	NA
SIP-293-001	Piezometer	12/5/1990	56.5	50	1	45-50	1B	NA
SIP-331-001	Piezometer	9/21/1995	122	116.5	1	106.5-116.5	2	NA
SIP-419-101	Piezometer	9/8/1995	127	123	1	112-123	3B	NA
SIP-419-202	Piezometer	3/6/1996	110	106.5	1	97-106.5	3A	NA
SIP-490-102	Piezometer	11/8/1995	75	73.5	1	53.5-73.5	2	0.5
SIP-501-004	Piezometer	10/20/1992	60	56.9	1	48.5-56.9	1B	NA
SIP-501-006	Piezometer	11/11/1992	59.5	56	1	50-56	1B	NA
SIP-501-007	Piezometer	11/16/1992	64	59	1	53-59	1B	NA
SIP-501-101	Piezometer	5/10/1994	77.5	73	1	69-73	1B	NA
SIP-501-102	Piezometer	5/16/1994	77	73	1	67-73	1B	NA
SIP-501-103	Piezometer	5/20/1994	63	57.5	1	51-57.5	1B	NA
SIP-501-104	Piezometer	7/15/1994	67	62	1	50-62	1B	NA
SIP-501-105	Piezometer	9/1/1994	73	68	1	63-68	1B	NA
SIP-501-201	Piezometer	11/29/1994	65	58.5	1	54-58.5	1B	NA
SIP-501-202	Piezometer	7/1/1995	70	64.5	1	58-64.5	1B	NA
SIP-511-101	Piezometer	1/25/1996	110	106.7	1	100-106.7	3A	0.5
SIP-511-102	Piezometer	4/2/1996	114	110	1	108-110	3B	0.5
SIP-514-107	Piezometer	1/3/1990	21.5	17	1	9-17	1B	NA
SIP-514-109	Piezometer	1/5/1990	21.5	21.5	1	7-21.5	1B	NA
SIP-514-112	Piezometer	1/8/1990	21.5	18	1	7-18	1B	NA
SIP-514-114	Piezometer	1/9/1990	21.5	17	1	4-17	1B	NA
SIP-514-116	Piezometer	1/10/1990	21.5	17	1	7-17	1B	NA
SIP-514-117	Piezometer	1/11/1990	21.5	17.5	1	6-17.5	1B	NA
SIP-514-119	Piezometer	1/12/1990	21.5	16	1	5-16	1B	NA
SIP-514-123	Piezometer	1/17/1990	26.5	23	1	11.5-23	1B	NA
SIP-514-124	Piezometer	1/18/1990	21.5	17	1	6-17	1B	NA
SIP-514-125	Piezometer	1/19/1990	21.5	15	1	6-15	1B	NA
SIP-514-126	Piezometer	1/19/1990	26.5	21.5	1	4-21.5	1B	NA
SIP-518-101	SV Monitor	9/20/1990	125	61	1	55-61	2	NA
SIP-518-203	Piezometer	10/21/1993	132.1	127	1	121-127	5	NA
SIP-543-101	Piezometer	7/1/1995	111	104	1	93-103	2	NA
SIP-ALP-001	Piezometer	5/3/1990	66.5	60	1	45-60	2	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
SIP-ALP-002	Piezometer	5/7/1990	62	57.5	1	47.5-57.5	2	NA
SIP-AS-001	Piezometer	4/30/1990	100.5	90.5	1	81-90.5	1B	NA
SIP-CR-049	Piezometer	2/26/1990	41.5	40	1	36-40	1B	NA
SIP-EGD-001	Piezometer	10/16/1990	101.5	85	1	75-85	2	NA
SIP-ETC-201	Dual Extraction	3/26/1996	106	100	1	80-100	2	0.5
SIP-ETC-303	Piezometer	5/24/1999	111	82	1	82-88	2	NA
SIP-ETS-101	Piezometer	9/15/1995	100	NA	1	NA	NA	NA
SIP-ETS-201	Piezometer	2/5/1991	95	90	1	85-90	3A	NA
SIP-ETS-204	Piezometer	5/7/1991	102.5	97	1	87-97	3A	NA
SIP-ETS-205	Piezometer	6/20/1991	103	95	1	89.5-95	3A	NA
SIP-ETS-209	Piezometer	7/25/1991	96.6	90	1	79.75-90.5	2	NA
SIP-ETS-211	Piezometer	8/6/1991	103	98.5	1	95-98.5	3A	NA
SIP-ETS-212	Piezometer	8/14/1991	106.5	102.5	1	97.5-102.25	2	NA
SIP-ETS-213	Piezometer	11/15/1991	118.5	116.5	1	108.5-116.5	3A	NA
SIP-ETS-214	Piezometer	11/22/1991	101	101	1	86-101	3A	NA
SIP-ETS-215	Piezometer	12/3/1991	94.5	94.5	1	84.5-94.5	3A	NA
SIP-ETS-302	Piezometer	3/30/1992	117.4	113	1	97-113	3A	NA
SIP-ETS-303	Piezometer	4/2/1992	110.7	102	1	95-102	3A	NA
SIP-ETS-304	Piezometer	8/27/1992	100	97	1	90-97	3A	NA
SIP-ETS-306	Piezometer	9/11/1992	101	93	1	80.5-93	3A	NA
SIP-ETS-401	Piezometer	8/2/1995	122	122	1	116-121	3A	NA
SIP-ETS-402	Piezometer	8/8/1995	110	110	1	97-107	2	NA
SIP-ETS-404	Piezometer	8/22/1995	99	99	1	83.5-95.5	2	NA
SIP-ETS-405	Piezometer	8/29/1995	126	126	1	114.5-123	3A	NA
SIP-ETS-501	Piezometer	11/16/1995	110	106.5	1	100-106.5	3A	NA
SIP-ETS-502	Piezometer	12/5/1995	95	88	1	80-88	2	NA
SIP-ETS-601	Piezometer	6/7/1999	115.5	104.8	1	98.3-104.8	2	NA
SIP-HPA-001	Piezometer	4/20/1990	92.75	75	1	65-75	2	NA
SIP-HPA-003	Piezometer	4/19/1990	91.5	66	1	61-66	2	NA
SIP-HPA-201	Piezometer	5/14/1996	97.5	76	1	71-76	2	NA
SIP-IES-001	Piezometer	9/16/1992	50	46.5	1	44-46.5	1B	NA
SIP-IES-002	Piezometer	10/5/1992	41.5	39.2	1	33-39.2	1A	NA
SIP-ITR-001	Piezometer	4/19/1991	121.5	115	1	105-115	5	NA
SIP-ITR-002	Piezometer	4/2/1991	100	84	1	79-84	5	NA
SIP-ITR-003	Piezometer	4/25/1991	121.5	106	1	98.66-106	5	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
SIP-NEB-101	Piezometer	9/23/1992	68.7	66	1	57-66	2	NA
SIP-PA-002	Piezometer	1/29/1990	16.5	16.5	1	4-16.5	1B	NA
SIP-PA-003	Piezometer	1/26/1990	18	14	1	4-14	1B	NA
SIP-PA-005	Piezometer	1/4/1990	11.5	8	1	3-8	1B	NA
SIP-PA-006	Piezometer	1/4/1990	13.5	12	1	5-12	1B	NA
SIP-PA-007	Piezometer	1/4/1990	11.5	5	1	1-5	1B	NA
SIP-PA-010	Piezometer	1/25/1990	11.5	9	1	3-9	1B	NA
SIP-PA-012	Piezometer	1/29/1990	11.5	9	1	2-9	1B	NA
SIP-PA-013	Piezometer	1/24/1990	16.5	13	1	8-13	1B	NA
SIP-PA-015	Piezometer	1/25/1990	21.5	17.5	1	2-17.5	1B	NA
SIP-PA-016	Piezometer	1/24/1990	11.5	11.5	1	7-11.5	1B	NA
SIP-PA-017	Piezometer	1/24/1990	16.5	14	1	7-14	1B	NA
SIP-PA-018	Piezometer	1/25/1990	11.5	8	1	6-8	1B	NA
SIP-PA-019	Piezometer	1/26/1990	16.5	12	1	2-12	1B	NA
SIP-PA-021	Piezometer	1/23/1990	11.5	10	1	2-10	1B	NA
SIP-PA-024	Piezometer	1/23/1990	16.5	15	1	5-15	1B	NA
SIP-PA-025	Piezometer	1/23/1990	11.5	7	1	4-7	1B	NA
SIP-PA-026	Piezometer	1/29/1990	11.5	10	1	2-10	1B	NA
SIP-PA-027	Piezometer	1/29/1990	8.5	7	1	2-7	1B	NA
SIP-PA-028	Piezometer	1/23/1990	11	8	1	5-8	1B	NA
SIP-PA-030	Piezometer	1/24/1990	11.5	8	1	4-8	1B	NA
SIP-PA-034	Piezometer	1/4/1990	6.5	5	1	3-5	1B	NA
SIP-PA-035	Piezometer	1/4/1990	11.5	11.5	1	6.5-11.5	1B	NA
SVB-518-201	Dual Extraction	3/3/1993	59.8	50	1	34-50	2	NA
SVB-518-204	Dual Extraction	11/5/1993	121.5	50	1	24-46	2	NA
SVB-518-302	Piezometer	6/22/1995	104.5	39.5	1	11-39	NA	NA
SVI-ETS-504	SV Extraction	7/9/1996	76.5	67	1	42-67	2	NA
SVI-ETS-505	SV Injection	7/18/1996	80	77.5	1	45-75	2	NA
UP-292-006	Piezometer	1/7/1991	74	57.5	1	47.5-57.5	1B	NA
UP-292-007	Piezometer	1/7/1991	71	56	1	46-56	1B	NA
UP-292-012	Piezometer	1/29/1992	67.7	60	1	45-60	1B	NA
UP-292-014	Piezometer	1/29/1992	66	66	1	50-60	1B	NA
UP-292-015	Piezometer	1/29/1992	61.5	61.5	1	49.5-60.5	1B	NA
UP-292-020	Piezometer	2/3/1993	68.5	68.5	1	56.5-64	1B	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
TW-11	GW Monitor	6/9/1981	112.5	107	1	97-107	2	NA
TW-11A	GW Monitor	3/16/1984	163	160	1	133-160	2	6
TW-21	GW Monitor	6/12/1981	111.5	95	1	85-95	1B	3
GSW-004	GW Monitor	2/22/1985	112	106	1	86-106	2	NA
GSW-006	GW Monitor	2/28/1986	212	137	1	121-137	3A	11
GSW-007	GW Monitor	3/14/1986	176.5	123.4	1	110.8-123.4	3A	5
GSW-008	GW Monitor	4/1/1986	176	133	1	127.5-133	3A	2
GSW-009	GW Monitor	4/14/1986	197.5	152.5	1	147-152.5	3A	5
GSW-011	GW Monitor	5/7/1986	182.5	126	1	116-126	3A	5
GSW-013	GW Monitor	6/27/1986	198	134.5	1	125-134.5	3A	NA
GSW-016	GW Monitor	10/19/1987	146	145	1	23-28	2/3A	NA
GSW-016	GW Monitor	10/19/1987	146	145	2	38-43	2/3A	NA
GSW-016	GW Monitor	10/19/1987	146	145	3	50-55	2/3A	NA
GSW-016	GW Monitor	10/19/1987	146	145	4	61-66	2/3A	NA
GSW-016	GW Monitor	10/19/1987	146	145	5	78-83	2/3A	NA
GSW-016	GW Monitor	10/19/1987	146	145	6	95-105	2/3A	NA
GSW-016	GW Monitor	10/19/1987	146	145	7	120-130	2/3A	NA
GSW-215	GW Monitor	4/22/1986	214	133.5	1	127-133.5	3A	6
GSW-216	GW Monitor	5/9/1986	193	120.5	1	110.5-120.5	3A	7
GSW-266	GW Monitor	5/8/1986	220	166	1	159-166	3B	3
GSW-326	GW Monitor	10/2/1987	230	134	1	129-134	4	NA
GSW-367	GW Monitor	4/29/1987	159	124	1	114-124	2	7
GSW-442	GW Monitor	10/27/1987	270	145	1	138-145	3A	1
GSW-443	GW Monitor	11/9/1987	291	141	1	123-141	2	5
GSW-444	GW Monitor	11/20/1987	278	120	1	110-120	3B	NA
GSW-445	GW Extraction	12/9/1987	319	161	1	155-161	4	3
GEW-710	GW Monitor	9/23/1991	159	158	1	94-137	2/3A	NA
GEW-808	GW Monitor	6/5/1992	150	150	1	50-140	2/3A	NA
GIW-813	GW Monitor	8/5/1992	140.7	127	1	67-87	2/3A	NA
GIW-813	GW Monitor	8/5/1992	140.7	127	2	89-99	2/3A	NA
GIW-813	GW Monitor	8/5/1992	140.7	127	3	107-127	2/3A	NA
GIW-814	GW Monitor	8/5/1992	149.6	141	1	86.5-106.5	2/3A	NA
GIW-814	GW Monitor	8/5/1992	149.6	141	2	110-120	2/3A	NA
GIW-814	GW Monitor	8/5/1992	149.6	141	3	121-141	2/3A	NA
GIW-815	GW Monitor	8/5/1992	143	137.5	1	77-97	2/3A	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
GIW-815	GW Monitor	8/5/1992	143	137.5	2	102-112	2/3A	NA
GIW-815	GW Monitor	8/5/1992	143	137.5	3	112.8-132.5	2/3A	NA
GEW-816	GW Monitor	8/4/1992	161.7	150	1	50-140	2/3A	NA
GIW-818	GW Monitor	8/5/1992	150	140	1	82-102	2/3A	NA
GIW-818	GW Monitor	8/5/1992	150	140	2	110-120	2/3A	NA
GIW-818	GW Monitor	8/5/1992	150	140	3	120-140	2/3A	NA
GIW-819	GW Monitor	8/5/1992	150	141	1	78.6-98.6	2/3A	NA
GIW-819	GW Monitor	8/5/1992	150	141	2	108-118	2/3A	NA
GIW-819	GW Monitor	8/5/1992	150	141	3	121-141	2/3A	NA
GIW-820	GW Monitor	8/5/1992	143.3	132	1	85-105	3A	NA
GIW-820	GW Monitor	8/5/1992	143.3	132	2	112-132	3A	NA
C-SNL-20B	GW Monitor	6/28/1984	140	140	1	90-105	NA	NA
C-SNL-20C	GW Monitor	7/16/1984	165	156	1	140-155	NA	NA
MW-NLF-1	GW Monitor	3/13/1991	NA	NA	1	NA	NA	NA
MW-NLF-2	GW Monitor	3/13/1991	NA	NA	1	NA	NA	NA
MW-NLF-3	GW Monitor	3/13/1991	NA	NA	1	NA	NA	NA
MW-NLF-4	GW Monitor	3/13/1991	NA	NA	1	NA	NA	NA
11C1	GW Monitor	6/8/1976	68	66	1	56.2-61.2	1B	1
11J2	GW Monitor	4/26/1979	112	112	1	90-92	1B/2	5
11J2	GW Monitor	4/26/1979	112	112	2	102-108	1B/2	5
14A11	GW Monitor	12/20/1983	NA	NA	NA	NA	NA	NA
14A3	GW Monitor	12/7/1977	110	110	1	100-105	1B	NA
14B1	GW Monitor	8/13/1959	300	300	1	146-149	2/3A	NA
14B1	GW Monitor	8/13/1959	300	300	2	192-195	2/3A	NA
14B1	GW Monitor	8/13/1959	300	300	3	209-213	2/3A	NA
14B4	GW Monitor	8/1/1960	260	260	1	143-148	2/3A/4	NA
14B4	GW Monitor	8/1/1960	260	260	2	155-159	2/3A/4	NA
14B4	GW Monitor	8/1/1960	260	260	3	186-189	2/3A/4	NA
14B4	GW Monitor	8/1/1960	260	260	4	205-215	2/3A/4	NA
14B4	GW Monitor	8/1/1960	260	260	5	245-250	2/3A/4	NA
14B7	GW Monitor	8/25/1987	NA	NA	NA	NA	NA	NA
14C1	GW Monitor	7/31/1991	523	NA	1	NA	2/3A/4	NA
14C2	GW Monitor	1/7/1988	217	NA	1	135-150	2	NA
14C3	GW Monitor	1/19/1988	405	NA	1	160-388	2/3A/3B/4/5	NA
14H1	GW Monitor	12/21/1983	NA	288	NA	NA	NA	NA

Table A-1. Well construction data, LLNL Livermore Site and vicinity, Livermore, California.

Well	Well type	Date Completed	Borehole depth (ft)	Casing depth (ft)	Screen position	Screen interval (ft)	HSU	Initial flow rate (gpm)
14H2	GW Monitor	8/28/1987	NA	NA	NA	NA	NA	NA
18D1	GW Monitor	4/20/1984	NA	NA	NA	NA	7	12
2J2	GW Monitor	1/4/1990	NA	NA	1	NA	NA	NA
2K3	GW Monitor	3/6/1991	35	NA	1	NA	NA	NA
2K4	GW Monitor	3/6/1991	35	NA	1	NA	1B	NA
2Q2	GW Monitor	3/6/1991	40	NA	1	NA	1B	NA
2R3	GW Monitor	3/5/1991	37	NA	1	NA	1B	NA
2R4	GW Monitor	3/5/1991	37	NA	1	NA	NA	NA
2R8	GW Monitor	3/6/1991	40	NA	1	NA	1B	NA
5F1	GW Monitor	2/19/1985	NA	NA	1	NA	NA	NA
7D2	GW Monitor	6/7/1976	74	72	1	63.2-67.3	3A	NA

Notes.

ft = Feet.
gpm = Gallons per minute.
GW = Ground Water.
HSU = Hydrostratigraphic Units
NA = Not available.
SV = Soil Vapor.

Screen positions are numbered consecutively downward within a single well. Well numbers ending in A and B, indicate two wells installations in the same borhole. The "A" refers to the shallow well and "B" refers to the deeper well.

Hydrostratigraphic Units (HSUs) are numbered consecutively downward from ground surface. An HSU is defined as sediments that are grouped together based on their hydrogeologic and contaminant transport properties. The permeable layers within an HSU are considered to be in good hydraulic communication, whereas permeable layers in different HSUs are considered to be in poor hydraulic communication. HSU contacts are interpreted and are periodically revised based on new data.

Initial flow rate is based on at least 4 hours of air-lift pumping/surging.

Well numbers were changed in December 1988 to be consistent with Alameda County Flood Control and Water Conservation District, Zone 7 well identification. Well number changes made on this table are:

4A6 ------> 14H2
18D81 ------> 18D1
14A84 ------> 14A11

Wells installed for the Dynamic Underground Stripping Demonstration Project include extraction wells (GEW series), injection wells (GIW series), gasoline spill piezometer (GSP series), and heating wells (HW series).

FLUTe refers to instrumented membranes with ports set at varying depths within a borehole.

Piezometer SVI-518-303 was drilled out and replaced by SVW-518-1915.

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
11A1	Other non-LLNL	08-Jun-76	66	64.7	54.7-59.7	NA	18-Aug-88
11BA[a]	Other non-LLNL	02-Mar-87	NA	NA	NA	NA	10-Jun-87
11H1	Other non-LLNL	04-Nov-41	NA	519	157-161	2/3A/4/5/6/7	31-Oct-88
					169-177		
					224-228		
					243-245		
					254-256		
					306-314		
					319-327		
					339-342		
					414-419		
					424-431		
					477-479		
11H4	Other non-LLNL	05-Apr-60	272	272	166-170	3/4/5	07-Oct-88
					174-176		
					183-185		
					200-202		
					211-214		
					224-230		
					250-252		
					260-265		
11J1	Other non-LLNL	01-Jan-41	160	160	NA	2	03-Aug-88
11J4	Other non-LLNL	01-Jan-65	NA	NA	NA	NA	11-Oct-88
11K1	Other non-LLNL	06-Jan-42	621	621	247-255	4/5/6	26-Sep-88
					272-276		
					297-304		
					322-339		
					554-557		
					580-602		
11K2	Other non-LLNL	NA	NA	232	NA	NA	03-Oct-88
11Q2	Other non-LLNL	20-Dec-83	NA	264	NA	NA	16-Aug-88
11Q3	Other non-LLNL	20-Dec-83	NA	120	NA	NA	10-Aug-88
11Q6	Other non-LLNL	20-Dec-83	NA	280	NA	NA	11-Jan-89
11R3	Other non-LLNL	08-May-61	140	117	NA	NA	03-Sep-85
11R4	Other non-LLNL	13-Mar-84	NA	NA	NA	NA	03-Sep-85
11R5	Other non-LLNL	19-Dec-83	NA	NA	NA	NA	26-Jul-85
12M1	Other non-LLNL	10-Mar-54	702	702	375-657		14-Apr-84
					420-426		
					452-473		

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
					560-564		
					609-621		
					626-657		
12N1	Other non-LLNL	14-Apr-42	702	NA	392-399	7	24-Jan-89
					478-483		
					492-496		
					514-518		
					527-536		
					666-670		
					678-681		
13D1	Other non-LLNL	29-Oct-56	402	400	200-400	3B/4/5/6	23-Aug-88
14A1	Other non-LLNL	12-Jul-43	246	227	102-107	NA	13-Sep-88
					113-119	NA	
					144-148	NA	
					176-179	NA	
					188-190	NA	
					192-194	NA	
					219-222	NA	
					223-227	NA	
14A2	Other non-LLNL	15-Nov-56	229	229	122-130	2/3A	12-Sep-88
					140-150		
					160-180		
14A4	Other non-LLNL	15-Jun-59	252	248	167-170	3/4	29-Aug-88
					175-179		
					192-202		
					235-246		
14A8	Other non-LLNL	NA	NA	86	NA	NA	22-Jul-88
14B2	Other non-LLNL	22-Aug-56	312	312	185-312	3A/3B/4/5	11-Nov-88
14B8	Other non-LLNL	03-May-88	385	306	NA	NA	NA
1N1	Other non-LLNL	15-Jan-48	600	600	427-442	7	21-Oct-88
					450-453		
					465-469		
					500-515		
					575-588		
2R9 (11A5)	Other non-LLNL	NA	NA	NA	NA	NA	19-Jul-88
GEW-711	Extraction	24-May-91	167.5	157	94-137	3A/3B	16-Jun-92
GSW-001	Monitor	05-Feb-85	112	109	85-106	2	06-Jun-86
GSW-001A	Monitor	12-Jun-86	208	133	115-133	3A	NA
GSW-002	Monitor	14-Feb-85	113	107	87-107	2	NA
GSW-003	Monitor	07-Feb-85	115	105	85-105	2	NA

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
GSW-005	Monitor	19-Mar-85	110	104	94-104	2	NA
GSW-010	Monitor	29-Apr-86	205.5	127.5	114-127.5	3A	28-Jan-98
GSW-012	Monitor	27-May-86	205	191	186.5-191	5	NA
GSW-014	Monitor	17-Jul-86	141	NA	NA	NA	01-Nov-92
GSW-015	Monitor	14-Aug-87	148	145	20.5-28	2/3A	NA
					38-44		
					50-56		
					60-64		
					68-73		
					77-83		
					95-105		
					120-130		
GSW-020	Monitor	18-May-84	134	101.3	95-101.3	2	03-Sep-87
GSW-208	Monitor	06-Feb-86	211	123	108-118	3A	NA
GSW-209	Monitor	27-Feb-86	204	135.2	112.8-132.8	3A	15-Aug-94
GSW-403-6	Monitor	11-May-84	138	100	90-110	2	NA
SIP-419-201	Monitor	29-Feb-96	126	107	97-107	3A/3B	NA
SIP-490-101	Piezometer	01-Nov-95	59	56	53–56	2	21-Dec-95
SIP-514-101	Piezometer	28-Dec-89	26	22	7-22	1B	03-Sep-96
SVI-518-303	Monitor	29-Jun-95	104.5	40	6-40	1B	NA
SIP-ETC-302	Piezometer	22-Apr-99	104	89.4	79–89	2	26-Apr-99
SIP-ETS-105	Piezometer	11-Dec-90	110	103	87-103	3A	06-Dec-93
SIP-ETS-207	Piezometer	11-Jul-91	103	98.5	89.75-98.5	3A	05-Jan-00
SIP-HPA-102	Piezometer	08-Dec-94	76	72	67-72	2	09-Apr-02
SIP-HPA-103	Piezometer	01-Mar-95	77	73.5	67-72.5	2	09-Apr-02
SIP-PA-029	Piezometer	22-Jan-90	11.5	7	5-7	1B	18-Nov-93
UP-292-001	Piezometer	07-Jan-91	54.5	49.5	44.5-49.5	1B	25-Sep-95
W-010A	Monitor	08-Sep-80	110.7	110	85-95	2	26-Feb-02
					100-105		
W-014A	Monitor	26-Aug-80	112.8	109	79	2	11-Dec-87
					94		
					104		
W-015	Monitor	17-Nov-80	285	267	239-265	7	13-May-88
W-018	Monitor	22-Aug-80	161	152.5	80-90	2	11-Nov-85
					100-105	2	
					112-117	3A	
					128-133	5	
					142-152	5	
W-149	Monitor	23-Aug-85	201	169	161-169	2	03-Sep-96
W-150	Monitor	13-Sep-85	212	162	157-162	2	11-Apr-90

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
W-150	Monitor	13-Sep-85	212	162	157-162	2	11-Apr-90
W-211	Monitor	19-Mar-86	215.5	193	183-193	7	13-Jun-02
W-352	Monitor	29-Oct-86	235	201	181-201	4	05-Jan-98
W-358	Monitor	04-Feb-87	248	239	230-239	7	13-Apr-94
W-360	Monitor	24-Feb-87	260	204.5	181.5-204.5	4	26-Feb-02
W-414	Monitor	20-May-88	179	74	69.5-74	2	26-Feb-02
W-456	Monitor	09-Jun-88	343	180.5	172-180.5	3A	15-Nov-00
W-460	Monitor	22-Jul-88	361	140.5	135-140.5	2	15-Nov-00
W-508	Monitor	17-Feb-89	316	306	287-305	7	NA
W-1005	Monitor	14-Mar-94	192	110	98-110	1B	13-Nov-00
W-1006	Monitor	10-Mar-94	154	149	141-149	2	14-Nov-00
W-1007	Monitor	31-Mar-94	199.5	182	172-182	3A	14-Nov-00
W-1114	Monitor	07-Aug-95	223	205	177-200	5	23-Apr-97
W-1218	Monitor	29-May-96	240	145.5	127-145	3A	27-Feb-02
W-1220	Monitor	12-Jun-96	120	117	90-112	2	27-Feb-02
W-1221	Monitor	01-Jul-96	220	172	162-172	4	28-Feb-02
TEP-GP-001	Dynamic Stripping	21-Jan-92	165	97	88-97	2	09-Feb-93
				117	107-117	2/3A	
				160.5	NA	NA	
TEP-GP-002	Dynamic Stripping	24-Jun-92	161.4	NA	102-112.5	2/3A	13-Feb-93
				133	122-133	3A	
				161	NA	NA	
TEP-GP-003	Dynamic Stripping	28-Jan-92	161	129.5	124.5-129.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-004	Dynamic Stripping	05-Feb-92	161	106	96-106	2	13-Feb-93
				134	124-134	3A	
				161	NA	NA	
TEP-GP-005	Dynamic Stripping	18-Feb-92	161	124.5	114.5-124.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-006	Dynamic Stripping	26-Feb-92	161	127	107-127	2/3A	13-Feb-93
				161	NA	NA	
TEP-GP-007	Dynamic Stripping	13-Mar-92	161	125.5	115.5-125.5	3A	13-Feb-93
				161	NA	NA	
TEP-GP-008	Dynamic Stripping	03-Mar-92	161	110	100-110	2	13-Feb-93
				129	119-129	3A	
				161	NA	NA	
TEP-GP-009	Dynamic Stripping	06-May-92	161.7	107	98-107	2	13-Feb-93
				130.5	120.5-130.5	3A	
				161	NA	NA	
TEP-GP-010	Dynamic Stripping	24-Mar-92	161	124.5	114.5-124.5	3A	12-Feb-93

Table A-2. Well closure data, LLNL Livermore Site and vicinity, Livermore, California.

Well number	Well type	Date installed	Borehole depth (ft)	Casing depth (ft)	Screen interval(s) (ft)	HSU monitored	Closure date
				161	NA	NA	
TEP-GP-011	Dynamic Stripping	07-Apr-92	161	108	98-108	2	13-Feb-93
				161	NA	NA	
TEP-GP-106	Dynamic Stripping	21-Sep-93	137.5	135.5	NA	NA	NA
CPRS-02	Anode Well	NA	290	NA	NA	NA	
CPRS-03 (B482)	Anode Well	NA	180	NA	NA	NA	26-Sep-03
CPS-1-325CT (B323)	Anode Well	24-Feb-77	290	NA	NA	NA	30-Oct-03
CPS-622	Anode Well	14-Feb-77	290	NA	NA	NA	15-Jan-04
CPS SC-5	Anode Well	NA	290	NA	NA	NA	21-Jul-05
W-1218	Monitor	29-May-96	240	145.5	127-145	3A	27-Feb-02
W-1220	Monitor	12-Jun-96	120	117	90-112	2	27-Feb-02
W-1221	Monitor	01-Jul-96	220	172	162-172	4	28-Feb-02

Notes.

ft = Feet.
HSU = Hydrostratigraphic unit.
NA = Not available.

Well 11BA not recognized by Alameda County Flood Control and Water Conservation District, Zone 7.

Well numbers were changed in December 1988 to be consistent with Alameda County Flood Control and Water.

Conservation District, Zone 7 well identification. Well number changes made on this table are:

11J81 ------> 11J4
11R81 ------> 11R5
11Q81 ------> 11Q6
13D81 ------> 13D1
14A81 ------> 14A1
14A82 ------> 14A2
14A83 ------> 14A4

Well 11A5 was renamed 2R9 by the Alameda County Flood Control and Water Conservation District, Zone 7 in November 1997. Well 11A5 now applies to monitor well W-409.

Piezometer SVI-518-303 was drilled out and replaced by well SVW-518-1915.

Temperature monitoring wells (TEP series) consist of a blank fiberglass 2-in. inside diameter (ID) casing instrumented with geophysical sensors. The blank fiberglass casing has no screened interval. Some boreholes also had one or two 1-in ID piezometers installed adjacent to the blank casing. Therefore, the casing depths with accompanying screened intervals refer to the piezometers.

Appendix B

Hydraulic Test Results

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-001	01-Dec-83	Drawdown	5.7	2,000	110	Fair
W-001	23-Jan-85	Drawdown	7.1	3,100	170	Good
W-001A	22-Jan-85	Drawdown	1.4	190	19	Good
W-002	01-Dec-83	Slug	NA	110	34	Poor
W-002A	24-Jan-85	Drawdown	10.3	2,700	200	Good
W-004	01-Dec-83	Drawdown	3.3	63	13	Good
W-005	01-Dec-83	Drawdown	4.3	110	20	Good
W-005	24-Jan-85	Drawdown	7.9	1,100	210	Fair
W-005A	23-Jan-85	Drawdown	13.0	1,300	130	Poor
W-007	01-Dec-83	Slug	NA	43	14	Fair
W-008	01-Dec-83	Drawdown	2.9	29	4.9	Fair
W-011	01-Dec-83	Drawdown	4.1	130	15	Good
W-017	01-Dec-83	Slug	NA	38	2.5	Good
W-017	21-Feb-86	Slug	NA	85	5.7	Good
W-018	01-Dec-83	Drawdown	2.6	20	2.7	Poor
W-102	25-Mar-86	Drawdown	6.4	1,100	76	Good
W-102	05-Sep-86	Drawdown	24.0	770	53	Good
W-102	15-Sep-86	Longterm	27.5	4,200	290	Good
W-103	25-Apr-86	Drawdown	6.7	15,000	1,500	Good
W-104	03-Mar-88	Drawdown	5.4	1,200	170	Fair
W-104	25-Mar-88	Drawdown	3.3	450	45	Fair
W-105	06-Apr-87	Drawdown	0.8	73	7.3	Fair
W-106	19-Feb-86	Slug	NA	7.4	1.3	Excel
W-107	17-Jun-85	Drawdown	1.0	94	9.4	Poor
W-108	29-Oct-85	Drawdown	7.9	750	63	Poor
W-109	05-Mar-86	Drawdown	8.1	3,200	530	Good
W-109	04-Sep-87	Drawdown	20.0	1,600	270	Good
W-109	29-Sep-87	Longterm	11.6	130	22	Fair
W-109	16-Oct-87	Drawdown	8.0	2,300	380	Fair
W-110	18-Jun-85	Drawdown	5.0	1,300	130	Good
W-111	13-Jun-85	Drawdown	1.0	370	37	Good
W-111	21-Nov-85	Drawdown	1.0	370	37	Good
W-112	18-Nov-86	Drawdown	13.4	2,100	170	Fair
W-112	15-Dec-86	Longterm	13.2	3,100	260	Fair
W-112	05-Nov-96	Longterm	13.7	3,300	260	Fair
W-113	17-Apr-86	Slug	NA	7.4	1.2	Excel
W-115	05-Mar-86	Drawdown	1.1	180	30	Good
W-116	24-Dec-85	Slug	NA	37	7.5	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-117	20-Feb-86	Slug	NA	2	0.4	Good
W-118	05-Mar-86	Drawdown	10.0	2,100	230	Good
W-119	08-Aug-85	Drawdown	2.0	1,600	110	Good
W-120	22-Apr-86	Drawdown	1.1	23	5.6	Poor
W-121	10-Sep-85	Drawdown	2.0	120	7.5	Good
W-121	23-Sep-85	Drawdown	4.0	23	1.5	Excel
W-121	14-Oct-85	Drawdown	3.0	34	2.2	Excel
W-121	15-Oct-85	Drawdown	4.5	45	3.0	Excel
W-122	28-Oct-85	Drawdown	10.8	490	49	Good
W-123	28-Oct-85	Drawdown	5.8	40	4.4	Poor
W-142	03-Mar-88	Slug	NA	2,600	330	Excel
W-143	03-Mar-88	Slug	NA	1,200	240	Excel
W-149	09-Sep-85	Drawdown	4.0	120	19	Good
W-149	11-Sep-85	Drawdown	8.0	95	16	Excel
W-149	11-Oct-85	Drawdown	4.8	58	9.7	Excel
W-149	11-Oct-85	Drawdown	7.0	70	12	Good
W-150	02-Oct-85	Drawdown	3.1	640	210	Fair
W-150	03-Oct-85	Drawdown	6.0	720	240	Fair
W-150	10-Oct-85	Drawdown	8.8	630	210	Fair
W-150	10-Oct-85	Drawdown	12.0	620	210	Fair
W-151	28-Oct-85	Drawdown	5.8	550	61	Poor
W-201	05-Mar-86	Drawdown	10.0	740	86	Excel
W-203	02-Mar-88	Drawdown	6.6	1,100	110	Good
W-204	23-Jan-86	Drawdown	1.9	100	15	Fair
W-205	14-Feb-86	Slug	NA	5.9	1.9	Good
W-205	18-Feb-86	Slug	NA	5.9	1.9	Good
W-206	14-Apr-86	Slug	NA	120	11	Good
W-207	02-Mar-88	Slug	NA	380	32	Excel
W-210	09-Jun-86	Slug	NA	0.6	0.1	Good
W-211	22-Oct-86	Drawdown	2.9	37	12	Fair
W-211	08-Dec-86	Longterm	1.0	44	15	Fair
W-211	16-Sep-97	Longterm	1.1	14	1.4	Good
W-212	12-May-86	Drawdown	0.8	18	3.1	Poor
W-213	22-Apr-86	Drawdown	3.8	190	38	Good
W-214	07-Oct-86	Longterm	27.6	2,300	350	Good
W-217	15-Jul-86	Slug	NA	750	120	Good
W-218	17-Jun-86	Drawdown	11.7	6,400	1,100	Good
W-218	12-Nov-86	Longterm	7.7	4,000	670	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-219	15-Jul-86	Drawdown	4.3	620	76	Good
W-219	23-Feb-87	Longterm	5.2	66	8.0	Fair
W-220	21-Aug-86	Slug	NA	28	5.5	Excel
W-221	05-Aug-86	Drawdown	2.1	120	16	Fair
W-222	12-Aug-86	Drawdown	16.0	1,700	160	Excel
W-222	08-Mar-85	Longterm	7.7	1,100	180	Good
W-223	27-Aug-86	Drawdown	4.0	510	110	Good
W-224	28-Oct-86	Drawdown	7.6	3,600	400	Excel
W-225	23-Oct-86	Drawdown	4.0	85	11	Good
W-225	12-Jan-87	Longterm	2.0	62	8.5	Fair
W-226	31-Mar-87	Slug	NA	1,700	160	Fair
W-252	04-Nov-85	Drawdown	4.0	920	50	Fair
W-252	19-Nov-85	Drawdown	5.6	800	43	Fair
W-254	27-Jan-86	Drawdown	4.2	340	38	Fair
W-254	27-Feb-86	Drawdown	3.2	370	41	Good
W-255	21-Jan-86	Drawdown	5.0	2,800	250	Fair
W-255	21-Jan-86	Drawdown	6.0	2,000	180	Fair
W-255	06-Jan-87	Longterm	2.0	400	36	Fair
W-256	11-Apr-86	Slug	NA	11	5.5	Good
W-257	15-Apr-86	Slug	NA	120	24	Good
W-258	05-Jun-86	Slug	NA	35	9.0	Excel
W-258	29-Oct-86	Slug	NA	32	8.0	Good
W-259	26-Mar-88	Slug	NA	15	5.0	Good
W-260	25-Mar-86	Drawdown	3.0	140	22	Good
W-260	01-Oct-86	Longterm	1.4	120	18	Good
W-261	27-May-86	Slug	0.0	7	2.3	Excel
W-262	11-Apr-86	Drawdown	12.5	2,000	250	Excel
W-262	23-Sep-86	Longterm	22.0	2,750	340	Good
W-262	27-Apr-87	Longterm	23.1	6,800	810	Good
W-263	22-Apr-86	Drawdown	1.2	37	7.4	Poor
W-263	04-Nov-86	Longterm	1.8	76	15	Excel
W-264	07-May-86	Drawdown	8.1	930	100	Good
W-264	29-Oct-86	Longterm	23.0	480	50	Good
W-265	19-May-86	Drawdown	0.7	180	34	Fair
W-267	02-Jun-86	Drawdown	0.5	420	85	Poor
W-268	14-Nov-86	Drawdown	5.0	230	18	Good
W-269	14-Jul-86	Drawdown	5.0	570	95	Good
W-270	30-Dec-86	Slug	NA	14	2.0	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-271	04-Aug-86	Drawdown	5.5	340	76	Fair
W-272	19-Aug-86	Drawdown	0.8	150	30	Fair
W-273	27-Aug-86	Drawdown	3.2	600	90	Good
W-274	25-Mar-85	Slug	NA	38	7.6	Fair
W-274	02-Feb-99	Slug	NA	10	2	Fair
W-275	30-Oct-86	Drawdown	7.0	730	150	Fair
W-275	02-Mar-87	Longterm	5.5	830	170	Fair
W-276	21-Nov-86	Drawdown	13.0	960	110	Good
W-276	04-May-87	Longterm	24.0	2,700	300	Fair
W-277	03-Nov-86	Drawdown	0.9	74	25	Fair
W-290	05-Jan-87	Slug	NA	14	4.0	Excel
W-291	27-Jan-87	Slug	NA	25	7.1	Fair
W-292	28-Aug-86	Drawdown	6.0	400	56	Excel
W-294	29-Dec-86	Drawdown	5.3	5,300	29	Fair
W-294	29-Dec-86	Drawdown	5.9	5,400	300	Good
W-301	30-Oct-86	Drawdown	6.0	460	100	Good
W-302	18-Nov-86	Drawdown	1.0	100	27	Good
W-302	18-Nov-86	Drawdown	2.0	76	21	Fair
W-303	12-Nov-86	Drawdown	11.1	210	70	Good
W-304	13-Mar-87	Drawdown	0.9	74	25	Fair
W-305	26-Nov-86	Drawdown	19.0	720	72	Excel
W-305	18-May-87	Longterm	20.1	640	64	Excel
W-306	31-Mar-87	Drawdown	9.5	270	68	Good
W-307	26-Mar-87	Drawdown	0.9	66	33	Fair
W-308	04-Dec-87	Drawdown	2.6	27	5.4	Good
W-310	17-Feb-87	Drawdown	6.7	58	850	Good
W-311	19-Mar-87	Drawdown	9.8	130	12	Good
W-311	17-Nov-87	Longterm	9.9	370	26	Good
W-312	27-Mar-87	Drawdown	20.5	1,800	300	Poor
W-312	03-Nov-87	Longterm	18.8	1,700	280	Good
W-313	25-Mar-87	Drawdown	7.9	3,000	600	Good
W-313	05-Oct-87	Longterm	9.6	3,400	680	Good
W-314	10-Apr-87	Drawdown	26.4	2,900	390	Good
W-314	13-Jul-87	Longterm	13.6	2,500	330	Fair
W-314	14-Oct-97	Longterm	12	1,400	100	Fair
W-315	09-Apr-87	Drawdown	15.4	150	11	Good
W-315	05-Jan-85	Longterm	24.5	571	41	Excel
W-316	04-May-87	Drawdown	7.8	1,400	280	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-317	12-May-87	Drawdown	12.1	300	43	Fair
W-317	15-Dec-87	Longterm	8.2	120	17.1	Good
W-318	07-Aug-87	Slug	NA	120	16	Good
W-319	29-Jul-87	Drawdown	48.0	7,200	1,500	Good
W-320	15-May-87	Drawdown	1.8	58	17	Fair
W-320	15-May-87	Drawdown	3.0	22	3.7	Fair
W-320	26-Jun-87	Drawdown	2.1	49	14	Fair
W-321	28-Jul-87	Drawdown	40.0	6,600	450	Good
W-322	03-Aug-87	Drawdown	3.1	85	15	Good
W-323	11-Aug-87	Drawdown	3.4	205	59	Good
W-324	10-Sep-87	Drawdown	6.6	200	50	Good
W-325	10-Sep-87	Drawdown	6.0	160	13	Excel
W-351	12-Nov-86	Drawdown	5.7	27	14	Poor
W-352	30-Dec-86	Drawdown	20.0	280	14	Good
W-352	07-Jul-87	Longterm	19.5	120	6.0	Excel
W-353	20-Nov-86	Drawdown	2.1	60	17	Good
W-354	30-Dec-86	Drawdown	17.6	2,000	220	Fair
W-354	30-Dec-86	Drawdown	18.0	2,400	260	Good
W-354	20-Apr-87	Longterm	17.8	310	34	Good
W-355	29-Dec-86	Drawdown	2.1	19	5.0	Fair
W-356	17-Mar-87	Drawdown	5.7	180	59	Good
W-356	16-Jul-96	Longterm	4.9	230	57	Poor
W-357	18-Feb-87	Drawdown	15.0	1,300	110	Good
W-357	21-Jul-87	Longterm	9.2	210	18	Good
W-358	18-Mar-87	Drawdown	9.2	210	32	Excel
W-359	09-Mar-87	Longterm	19.0	2,800	290	Fair
W-359	20-Mar-87	Drawdown	18.6	1,100	110	Good
W-360	22-May-87	Drawdown	30.0	4,800	210	Excel
W-361	16-Mar-87	Drawdown	4.3	67	11	Good
W-361	12-Jan-85	Longterm	5.3	178	30	Good
W-362	23-Mar-87	Drawdown	16.4	470	49	Good
W-362	21-Sep-87	Longterm	13.6	370	39	Good
W-363	24-Jul-87	Slug	NA	20	3.0	Excel
W-364	08-Apr-87	Drawdown	8.6	51	10	Fair
W-364	01-Jun-87	Longterm	4.8	110	22	Good
W-365	14-May-87	Drawdown	10.0	36	15	Fair
W-366	11-May-87	Drawdown	19.0	780	92	Fair
W-368	11-May-87	Drawdown	2.9	81	8.5	Fair

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-368	31-Jul-01	Step	6.0	2,600	350	Fair
W-369	25-Jun-87	Drawdown	7.0	580	96	Good
W-369	10-Nov-87	Longterm	5.5	89	18	Good
W-370	23-Jun-87	Drawdown	4.4	84	10	Fair
W-371	24-Jun-87	Drawdown	3.3	15	3.0	Good
W-372	23-Nov-87	Slug	NA	310	62	Excel
W-373	28-Jul-87	Drawdown	4.0	660	77	Fair
W-373	28-Jul-87	Drawdown	6.5	50	6.0	Poor
W-376	26-Jan-88	Drawdown	2.9	65	8.5	Fair
W-380	23-Oct-87	Drawdown	4.0	33	4.7	Excel
W-401	23-Oct-87	Drawdown	42.0	950	24	Excel
W-402	22-Oct-87	Drawdown	41.0	13,500	1,400	Good
W-403	03-Dec-87	Drawdown	9.7	370	26	Good
W-404	04-Feb-85	Drawdown	45.0	3,200	530	Good
W-405	16-Feb-85	Drawdown	47.2	546	14	Good
W-406	28-Jan-85	Drawdown	7.4	7,500	940	Fair
W-407	23-Feb-85	Drawdown	14.4	75	7.5	Fair
W-408	05-Apr-85	Drawdown	45.0	43,000	3,100	Good
W-409	22-Mar-85	Drawdown	20.0	230	38	Good
W-410	28-Apr-85	Drawdown	35.0	6,800	570	Fair
W-411	05-May-85	Drawdown	14.0	50	83	Good
W-412	06-May-88	Drawdown	4.1	700	64	Fair
W-413	30-Aug-01	Drawdown	20.0	9,400	790	Good
W-414	27-Jul-85	Slug	NA	150	38	Good
W-415	31-Aug-85	Drawdown	10.0	3,100	78	Fair
W-416	11-Jul-85	Drawdown	50.0	2,600	330	Good
W-417	27Jun-88	Drawdown	5.3	340	57	Fair
W-420	16-Aug-85	Drawdown	3.5	710	100	Excel
W-421	12-Sep-85	Drawdown	4.8	320	27	Excel
W-422	19-Sep-85	Drawdown	8.6	230	42	Good
W-423	12-Oct-85	Drawdown	22.0	1,500	130	Good
W-424	17-Oct-85	Drawdown	4.5	130	19	Good
W-441	30-Oct-87	Drawdown	6.0	500	56	Good
W-441	13-Apr-88	Drawdown	13.0	2,200	240	Poor
W-441	19-Apr-88	Longterm	14.0	470	52	Good
W-447	26-Feb-88	Drawdown	7.1	124	850	Poor
W-448	24-Mar-85	Drawdown	24.5	4,200	600	Good
W-449	21-Mar-85	Drawdown	6.2	170	11	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-450	14-Apr-88	Drawdown	3.3	38	650	Fair
W-451	27-Apr-88	Drawdown	2.1	80	16	Good
W-452	02-May-88	Drawdown	5.2	310	21	Excel
W-453	03-May-88	Drawdown	5.8	67	7.4	Fair
W-455	22-Jun-88	Drawdown	5.8	160	13	Good
W-456	14-Jul-85	Drawdown	4.5	260	33	Fair
W-457	29-Jul-85	Drawdown	20.5	450	24	Excel
W-458	02-Aug-85	Drawdown	0.8	24	150	Fair
W-460	01-Sep-85	Drawdown	17.0	1,900	380	Fair
W-461	07-Sep-85	Slug	NA	690	140	Good
W-462	27-Sep-85	Drawdown	19.0	360	60	Good
W-463	11-Oct-85	Drawdown	24.0	1,600	200	Good
W-464	08-Nov-88	Drawdown	9.0	370	53	Good
W-481	02-Dec-87	Drawdown	1.1	8	1.7	Good
W-486	23-Mar-85	Drawdown	6.0	230	30	Good
W-487	14-Apr-88	Drawdown	2.2	45	15	Good
W-501	21-Oct-85	Drawdown	9.7	170	21	Good
W-502	14-Nov-85	Slug	NA	12	30	Good
W-503	11-Nov-88	Drawdown	1.3	15	3.0	Fair
W-504	08-Dec-85	Drawdown	10.0	590	84	Good
W-505	21-Mar-89	Drawdown	34.2	653	76	Good
W-506	10-Feb-89	Drawdown	31.0	7,423	460	Good
W-507	06-Feb-89	Drawdown	39.0	2,900	290	Good
W-508	29-Mar-89	Drawdown	30.0	47,000	2,600	Good
W-509	11-May-89	Drawdown	0.9	10	2.0	Fair
W-510	11-May-89	Slug	NA	220	110	Good
W-511	11-May-89	Drawdown	1.7	63	11	Fair
W-512	27-Apr-89	Drawdown	2.9	85	9.4	Good
W-513	09-May-89	Drawdown	0.6	33	3.0	Fair
W-514	26-May-89	Drawdown	1.4	84	530	Fair
W-515	06-Jun-89	Drawdown	2.8	37	4.2	Fair
W-516	19-Jun-89	Drawdown	19.5	1,428	286	Good
W-517	27-Jun-89	Drawdown	7.3	370	53	Good
W-518	10-Aug-89	Drawdown	6.2	1,421	178	Good
W-519	31-Aug-89	Drawdown	31.5	5,700	475	Excel
W-520	24-Jan-90	Drawdown	22.8	3,300	560	Excel
W-521	01-Feb-90	Drawdown	0.6	44	4.9	Fair
W-522	05-Feb-90	Drawdown	20.0	3,700	620	Fair

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-551	08-Nov-85	Drawdown	37.0	350	88	Good
W-552	12-Dec-88	Drawdown	38.0	4,700	390	Good
W-553	17-Nov-85	Drawdown	2.2	55	7.9	Fair
W-554	10-Jan-89	Drawdown	21.5	1,800	150	Good
W-555	28-Dec-88	Drawdown	14.0	460	23	Fair
W-556	25-Jan-89	Drawdown	17.0	850	170	Fair
W-557	23-Jan-89	Drawdown	1.2	570	36	Poor
W-558	23-Mar-89	Drawdown	24.7	5,200	650	Good
W-560	08-Mar-89	Drawdown	1.7	30	7.6	Fair
W-561	13-Mar-89	Drawdown	1.1	12	2.1	Fair
W-562	28-Mar-89	Drawdown	1.0	16	2.3	Fair
W-563	31-Mar-89	Drawdown	1.1	14	2.3	Fair
W-564	26-Apr-89	Drawdown	1.6	44	5.0	Poor
W-565	18-Apr-89	Drawdown	15.6	1,600	260	Good
W-566	02-May-89	Drawdown	17.0	780	86	Good
W-566	31-Aug-93	Longterm	22.5	2,580	520	Fair
W-567	04-May-89	Drawdown	10.4	2,600	320	Excel
W-568	20-Jun-89	Drawdown	18.3	620	160	Fair
W-569	24-May-89	Drawdown	2.8	100	15	Fair
W-570	08-Jun-89	Drawdown	1.1	7	1.1	Fair
W-571	17-Jul-89	Drawdown	17.7	1,000	200	Excel
W-592	23-Jan-89	Drawdown	2.2	2,200	280	Poor
W-593	22-Feb-89	Drawdown	2.2	57	11.4	Good
W-594	16-Mar-89	Slug	NA	380	54	Excel
W-601	08-Feb-90	Drawdown	22.5	6,900	770	Excel
W-602	29-Jan-90	Drawdown	24.0	5,300	620	Good
W-603	07-Feb-90	Drawdown	6.1	100	20	Fair
W-604	20-Feb-90	Slug	NA	380	63	Good
W-605	28-Feb-90	Drawdown	4.8	50	12	Good
W-606	21-Feb-90	Slug	NA	120	20	Fair
W-607	22-Feb-90	Drawdown	1.4	800	100	Good
W-608	28-Feb-90	Drawdown	1.2	230	30	Fair
W-609	09-Mar-90	Drawdown	6.7	470	70	Good
W-610	28-Mar-90	Drawdown	5.8	5,500	380	Good
W-611	16-Apr-90	Drawdown	3.5	1,000	110	Fair
W-612	24-May-90	Drawdown	13.5	550	55	Good
W-612	05-Apr-94	Longterm	14	230	40	Good
W-613	23-May-90	Drawdown	4.8	2,550	360	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-614	07-Jun-90	Drawdown	6.7	1,650	130	Good
W-615	21-Jun-90	Drawdown	1.3	130	19	Fair
W-616	27-Jun-90	Drawdown	2.0	390	40	Fair
W-617	12-Jul-90	Drawdown	2.8	53	6.8	Good
W-618	01-Aug-90	Drawdown	1.9	24	4.8	Fair
W-619	30-Aug-90	Drawdown	11.8	190	11	Good
W-620	01-Oct-90	Drawdown	5.8	6,500	650	Good
W-621	04-Oct-90	Drawdown	3.8	310	39	Good
W-622	12-Oct-90	Slug	NA	130	16	Fair
W-651	16-Mar-90	Slug	NA	530	180	Fair
W-652	22-Mar-90	Drawdown	1.0	11	3.8	Good
W-653	11-Apr-90	Drawdown	0.3	2	2.0	Fair
W-653	16-Mar-05	Drawdown	0.45	1.0	1.0	Good
W-654	25-Apr-90	Drawdown	21.7	390	25	Fair
W-655	12-May-90	Drawdown	12.2	1,000	220	Good
W-701	23-Oct-90	Drawdown	14.5	6,800	650	Good
W-701	03-Oct-92	Step	16.5	5,200	430	Good
W-701	01-Apr-93	Drawdown	24.0	3,700	370	Good
W-702	29-Nov-90	Drawdown	2.5	150	30	Good
W-702	25-Feb-93	Step	4.6	36	7	Poor
W-703	19-Dec-90	Drawdown	7.0	230	9.1	Good
W-704	04-Mar-91	Drawdown	19.0	1,800	140	Fair
W-705	20-Feb-91	Drawdown	0.8	40	6.1	Fair
W-706	29-Jan-91	Drawdown	0.2	8	1	Fair
W-712	25-Feb-92	Drawdown	7.8	750	48	Good
W-712	18-Mar-93	Longterm	15.1	1,440	93	Good
W-714	06-Dec-91	Drawdown	2.9	140	6.7	Good
W-902	25-Mar-93	Drawdown	0.6	6	2	Fair
W-909	18-Oct-95	Drawdown	2.7	150	5.1	Good
W-911	02-Feb-96	Drawdown	1.4	53	2.1	Good
W-912	10-Nov-95	Drawdown	4.1	65	11	Poor
W-913	16-Aug-95	Drawdown	23.5	730	36	Good
W-1001	13-Aug-95	Drawdown	1.3	170	25	Fair
W-1002	19-Jun-97	Drawdown	16.8	680	49	Good
W-1003	26-Jun-97	Drawdown	1.2	5.1	0.7	Poor
W-1006	17-Jun-97	Drawdown	17.4	180	23	Fair
W-1007	23-Sep-95	Drawdown	1.6	13	1.3	Fair
W-1008	17-Jan-97	Drawdown	7.3	110	13	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1010	10-Jul-95	Drawdown	20.3	1,650	140	Fair
W-1011	11-Jul-95	Drawdown	3.8	240	17	Good
W-1012	13-Jul-95	Drawdown	3.3	35	2.2	Fair
W-1013	13-Jul-95	Drawdown	2.7	2,000	250	Poor
W-1014	28-Aug-96	Drawdown	31.1	7,700	320	Good
W-1101	22-Nov-95	Drawdown	0.8	9.9	3.3	Good
W-1102	29-Jan-96	Drawdown	14.7	81	4.5	Fair
W-1103	29-Nov-95	Drawdown	3	19	1.6	Fair
W-1105	17-Jul-95	Drawdown	2.4	320	26	Fair
W-1106	24-Jul-96	Drawdown	7.1	5,200	580	Good
W-1107	09-Apr-97	Drawdown	6.7	3,500	250	Poor
W-1107	04-May-99	Drawdown	6.6	4,300	310	Fair
W-1108	03-Nov-95	Drawdown	12.3	950	68	Good
W-1108	25-Jun-96	Longterm	11.6	1,000	70	Poor
W-1108	1-Nov-05	Drawdown	7.1	800	57	Fair
W-1109	26-Jun-95	Drawdown	8.7	460	33	Fair
W-1109	04-Jun-96	Longterm	6.8	760	40	Poor
W-1110	22-Jan-96	Drawdown	6.3	690	29	Fair
W-1111	20-Oct-95	Drawdown	15.8	2,100	95	Good
W-1111	09-Dec-96	Longterm	11.2	160	7.9	Poor
W-1112	24-May-96	Drawdown	6.4	94	10	Fair
W-1113	26-Aug-96	Drawdown	1	5.5	0.6	Good
W-1114	27-Oct-95	Longterm	15.1	270	12	Fair
W-1116	23-Feb-96	Drawdown	6.6	290	11	Fair
W-1117	23-Aug-96	Drawdown	0.7	3.4	0.34	Fair
W-1118	18-Jan-96	Drawdown	5.6	350	35	Good
W-1201	01-Nov-96	Drawdown	1	8.3	0.92	Poor
W-1203	02-May-96	Drawdown	18.8	900	90	Good
W-1204	22-Feb-96	Drawdown	1.3	17	2.2	Poor
W-1205	27-Nov-96	Slug	NA	330	33	Fair
W-1207	27-Nov-96	Slug	NA	900	45	Poor
W-1209	17-May-96	Drawdown	0.98	11	0.69	Good
W-1210	30-May-96	Drawdown	3.8	7.3	0.73	Fair
W-1211	26-Jul-96	Drawdown	28.6	5,000	330	Good
W-1212	14-May-96	Drawdown	1.9	35	2.5	Good
W-1212	10-Sep-96	Longterm	1.3	85	3.6	Poor
W-1213	22-Jul-96	Drawdown	11.6	500	42	Fair
W-1213	30-Jul-96	Longterm	9.6	440	37	Poor

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1214	28-Apr-97	Drawdown	2.2	110	5.4	Fair
W-1215	15-Aug-96	Drawdown	11.6	610	61	Fair
W-1215	08-Oct-96	Longterm	9.8	3,000	300	Poor
W-1216	14-Aug-96	Drawdown	11.4	210	6.9	Good
W-1216	15-Oct-96	Longterm	11.1	160	5.4	Poor
W-1218	11-Nov-96	Drawdown	5.8	83	4.6	Fair
W-1218	08-Jul-97	Longterm	4.8	210	12	Fair
W-1219	27-May-97	Drawdown	0.4	2.5	0.63	Poor
W-1220	13-Nov-96	Drawdown	20.3	2,600	120	Good
W-1220	15-Jul-97	Longterm	20.0	4,700	210	Fair
W-1221	27-Dec-96	Drawdown	3.1	29	2.9	Fair
W-1222	31-Oct-96	Drawdown	6.1	430	43	Good
W-1224	22-May-97	Drawdown	5.0	55	11	Good
W-1225	31-Mar-97	Drawdown	4.1	83	10	Good
W-1226	27-Feb-97	Drawdown	2.2	14	1.4	Excel
W-1227	11-Apr-97	Drawdown	15.1	380	48	Fair
W-1254	19-Nov-96	Longterm	18.9	1,130	110	Fair
W-1301	10-Mar-97	Longterm	4.7	120	15	Fair
W-1303	18-Mar-97	Longterm	7.8	490	21	Fair
W-1304	02-Jul-97	Drawdown	0.7	2.6	0.52	Poor
W-1306	30-Apr-97	Drawdown	2.8	24	1.2	Good
W-1306	18-Jun-97	Longterm	1.6	54	2.7	Poor
W-1307	31-Jul-97	Drawdown	11.6	1,100	110	Good
W-1308	14-Aug-97	Drawdown	6.5	150	5.1	Good
W-1308	07-Oct-97	Longterm	4.0	530	18	Fair
W-1309	15-Oct-97	Drawdown	9.1	90	8.9	Fair
W-1310	10-Mar-97	Drawdown	27.9	1,060	53	Good
W-1311	29-Oct-97	Drawdown	12.2	290	15	Good
W-1401	11-Nov-97	Drawdown	7.0	100	6.8	Excel
W-1402	12-Dec-97	Drawdown	2.6	100	10.2	Fair
W-1403	21-Jul-98	Drawdown	5.4	95	13	Good
W-1404	21-Apr-98	Drawdown	6.5	210	84	Good
W-1405	23-Apr-98	Drawdown	6.4	1,300	360	Fair
W-1406	17-Apr-98	Drawdown	11.1	3,600	360	Good
W-1407	03-Apr-98	Drawdown	1.1	8.7	1.0	Excellent
W-1408	15-Apr-98	Drawdown	2.7	85	28	Fair
W-1410	29-Jun-98	Drawdown	11.5	3,000	500	Poor
W-1410	08-Sep-99	Step	6.5	3,800	650	Poor

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1411	15-May-98	Drawdown	12.3	14,700	1,300	Poor
W-1412	29-May-98	Slug	NA	2	0.67	Fair
W-1413	08-Jun-98	Drawdown	0.63	8.7	3.5	Fair
W-1415	11-Jun-98	Drawdown	0.87	18	1.2	Fair
W-1416	28-Jul-98	Drawdown	12.3	1,300	180	Good
W-1417	01-Jul-98	Drawdown	15.1	130	11	Good
W-1417	16-Jul-98	Step	5.9	150	13	Fair
W-1418	25-Sep-98	Drawdown	10.7	78	6.5	Excellent
W-1418	16-Dec-98	Step	10.5	490	41	Fair
W-1419	15-Jul-98	Step	6.1	47	3	Poor
W-1420	12-Aug-98	Drawdown	13.1	3,000	220	Poor
W-1421	14-Jul-98	Step	1.82	14	1.8	Poor
W-1421	17-Jul-98	Step	3.8	22	2.8	Poor
W-1422	18-Sep-98	Drawdown	12.0	170	33	Excellent
W-1422	18-Dec-98	Step	11.7	160	32	Good
W-1423	12-Nov-98	Drawdown	24.6	540	39	Fair
W-1424	01-Oct-98	Drawdown	6	48	6.9	Excellent
W-1425	01-Oct-98	Drawdown	1.4	15	2.4	Fair
W-1426	13-Nov-98	Drawdown	6.5	840	56	Good
W-1427	11-Jan-99	Drawdown	7.9	2,100	300	Good
W-1428	13-Jan-99	Drawdown	8.1	8,200	550	Good
W-1501	20-Nov-98	Drawdown	7.2	68	11	Good
W-1502	17-May-99	Drawdown	1.5	360	60	Good
W-1503	12-Feb-99	Drawdown	17.6	1,700	180	Good
W-1504	18-Feb-99	Drawdown	15.4	600	60	Fair
W-1505	29-Apr-99	Drawdown	11.2	280	35	Fair
W-1506	19-Apr-99	Drawdown	3.1	50	5.4	Good
W-1507	27-Apr-99	Drawdown	0.65	15	1.9	Fair
W-1508	28-Jun-01	Slug	NA	160	16	Good
W-1509	09-Apr-99	Drawdown	7.2	7,000	700	Good
W-1510	14-Apr-99	Drawdown	6.6	280	20	Fair
W-1512	21-Jun-01	Slug	NA	230	23	Good
W-1514	23-Jun-99	Longterm	5.8	440	90	Good
W-1515	18-Jan-00	Drawdown	1.5	26	1.5	Poor
W-1515	02-Feb-00	Longterm	1.1	75	4.1	Fair
W-1518	22-Mar-00	Step	6.0	440	19	Good
W-1520	21-Mar-00	Longterm	4.0	165	20	Poor
W-1522	20-Mar-00	Step	10.5	3,500	235	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
W-1550	28-Dec-99	Drawdown	10.0	330	35	Fair
W-1601	25-Feb-00	Drawdown	3.0	35	3.6	Good
W-1602	03-Mar-00	Drawdown	8.3	3,100	310	Fair
W-1604	02-Apr-01	Drawdown	4.0	1,600	220	Fair
W-1609	14-Dec-05	Injection	0.30	1.90	0.10	Fair
W-1610	14-Jul-00	Injection	2.0	17	0.8	Good
W-1610	17-Jul-00	Injection	3.0	17	0.8	Excel
W-1610	7-Dec-05	Injection	1.5	17	0.80	Fair
W-1614	25-Aug-00	Drawdown	1.9	75	8.3	Good
W-1654	20-Apr-00	Drawdown	0.5	12	2.0	Good
W-1655	21-Apr-00	Drawdown	1.5	27	4.9	Good
W-1701	23-Jul-01	Drawdown	9.0	160	40	Good
W-1701	26-Sep-01	Longterm	15.0	60	15	Fair
W-1703	25-Oct-01	Drawdown	12.0	16,000	2,300	Fair
W-1801	03-May-02	Drawdown	10.0	6,600	660	Fair
W-1802	30-Sep-02	Drawdown	1.3	11	1.1	Fair
W-1805	22-Jan-03	Drawdown	11.1	13,000	800	Fair
W-1806	15-Apr-03	Drawdown	3.1	450	77	Good
W-1902	19-Mar-03	Step	11.0	1,100	29	Good
SIP-ETC-201	01-Apr-04	Drawdown	1.0	200	10	Fair
TW-11	24-Jan-85	Drawdown	0.3	200	20	Good
TW-11A	24-Jan-85	Drawdown	10.0	3,100	110	Fair
GSW-01	11-Dec-85	Slug	NA	72	0.2	Fair
GSW-01A	14-Jul-86	Drawdown	13.4	12,000	790	Good
GSW-02	17-Dec-85	Slug	NA	240	10	Good
GSW-03	23-Dec-85	Slug	NA	510	41	Good
GSW-04	19-Dec-85	Slug	NA	17	0.9	Good
GSW-05	12-Feb-86	Slug	NA	99	9	Excel
GSW-06	23-Jun-86	Drawdown	25.0	4,800	310	Good
GSW-06	16-Jun-87	Longterm	20.0	5,500	350	Good
GSW-07	03-Apr-86	Drawdown	4.3	230	23	Excel
GSW-08	19-Nov-86	Drawdown	2.0	230	38	Good
GSW-09	28-May-86	Drawdown	1.9	500	63	Poor
GSW-10	22-May-86	Drawdown	14.3	21,000	2,000	Good
GSW-11	02-Jun-86	Drawdown	4.7	390	45	Excel
GSW-12	07-Jun-86	Drawdown	0.8	51	11	Fair
GSW-13	04-Aug-86	Slug	NA	110	13	Excel
GSW-13	08-Aug-86	Slug	NA	62	7	Good

Table B-1. Results of hydraulic tests[a].

Well	Date	Type of test[b]	Flow rate (Q) (gpm)	Transmissivity (T) (gpd/ft)	Hydraulic conductivity (K)[c] (gpd/sq ft)	Data quality[d]
GSW-15	23-Feb-88	Drawdown	25.8	1,500	190	Good
GSW-208	08-May-86	Drawdown	1.9	440	80	Good
GSW-209	08-May-86	Drawdown	6.1	1,200	120	Good
GSW-215	04-Jun-86	Drawdown	1.9	220	40	Poor
GSW-216	16-Jan-92	Drawdown	10.5	3,500	440	Fair
GSW-266	20-Jun-86	Drawdown	2.1	470	72	Good
GSW-266	18-Nov-86	Drawdown	3.0	450	64	Good
GSW-266	18-Nov-86	Drawdown	4.7	410	59	Good
GSW-367	11-May-87	Drawdown	6.9	200	29	Fair
GSW-403-6	08-Dec-85	Slug	NA	4	0.2	Good
GSW-442	23-Nov-87	Drawdown	1.2	32	4.6	Good
GSW-443	30-Nov-87	Drawdown	10.3	260	8.7	Good
GSW-444	28-Jan-88	Slug	NA	9	0.86	Good
GSW-445	26-Jan-85	Drawdown	4.7	43	4.30	Fair
GEW-710	23-Sept-91	Step	36.0	4,800	220	Excel
GEW-816	15-Aug-92	Drawdown	39.0	12,000	1,100	Good
11H4	15-Jan-85	Drawdown	24.6	2,000	77	Good
11H4	19-Jan-85	Longterm	29.5	1,780	18	Good
11J4	10-Jun-88	Drawdown	17.0	1,000	15	Excel
11J4	14-Jun-85	Longterm	16.0	1,100	16	Good
13D1	09-Feb-85	Longterm	50.0	4,800	48	Excel

Notes and footnotes appear on the following page.

Table B-1. Results of hydraulic tests[a].

Notes:

gpd = Gallons per day.
gpm = Gallons per minute.
NA = Not applicable.
sq ft = Square feet.

[a] The pumping test results were obtained by using the analytic techniques of Theis (1935), Cooper and Jacob (1946), Papadopulos and Cooper (1967), Hantush and Jacob (1955), Hantush (1960), or Boulton (1963). The particular method used depends on the character of the data obtained. The slug test results were obtained using the method of Cooper et al. (1967) (See references below).

[b] "Drawdown" denotes 1-hr pumping tests; "Longterm" denotes 24- to 48-hr pumping tests; "Slug" denotes monitoring and recovery after an instantaneous change in ground water elevations; "Step" denotes a step-drawdown test, flow rate given is the maximum or final step. "Injection" denotes the draining of treated ground water under gravity into a well.

[c] K is calculated by dividing T by the thickness of permeable sediments intercepted by the sand pack of the well. This thickness is the sum of all sediments with moderate to high estimated conductivities determined from the geologic and geophysical logs of the well.

[d] Hydraulic test quality criteria:

Excel: High confidence that type curve match is unique. Data are smooth and flow rate well controlled.

Good: Some confidence that curve match is unique. Data are not too "noisy." Well bore storage effects, if present, do not significantly interfere with the curve match. Boundary effects can be separated from properties of the pumped zone.

Fair: Low confidence that curve match is unique. Data are "noisy." Multiple leakiness and other boundary effects tend to obscure the curve match.

Poor: Unique curve match cannot be obtained due to multiple boundaries, well bore storage, uneven flow rate, or equipment problems. Usually, the test is repeated.

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Appendix C

Soil Vapor Extraction Test Results

Table C-1. Soil vapor extraction test results.

Well	Date	HSU	Duration test (hours)	Flow rate (scfm)	Vacuum, inches (Hg)	Max. conc.[a] (ppm_v)	Air permeability (cm^2)
W-543-001	04/22/2003	2	6	19.3	3.7	296	3E-08
W-543-002A	04/30/2003	2	6	10	5.1	138	8E-09
W-543-002B	05/01/2003	2	6	14	5.1	145	2E-08
W-543-003	04/29/2003	2	6	31	5.1	236	7E-08
W-543-004A	04/23/2003	2	6	37	3.7	198	2E-08
W-543-004B	04/28/2003	2	6	36.5	5.1	188	2E-08
W-HPA-001B	05/13/2003	2	1.5	9.3	6.6	31	1E-08
W-HPA-002A	05/20/2003	1B	2	0.8	6.6	4.3	1E-08
W-1552	10/06/2003	3A/B	1.8	1	15	NM	9E-11
W-1650	10/09/2003	3A/B	2.8	0.8	12	22.7[b]	1E-10
W-1651	10/09/2003	3A/B	3	0.9	12	31[b]	1E-10
W-1652	10/07/2003	3A/B	6	1.1	12	29[b]	2E-10
W-1653	10/10/2003	3A/B	2	0.8	12	17.7[b]	3E-10
W-1654	10/10/2003	3A/B	2.5	0.8	12	10[b]	3E-11
W-1655	10/08/2003	3A/B	1	1.5	12	NM	4E-10
W-1656	10/13/2003	3A/B	0.5	NM	12	10[b]	2E-10
W-1657	10/08/2003	3A/B	2.8	1	12	20[b]	3E-10
SIP-518-201	01/26/2004	2	6	4.5	13	102	7E-10
SVB-518-204	01/22/2004	2	6	0.9	25	1,944	2E-11
W-518-1913	01/21/2004	2	6	0.5	26	106	2E-11
W-518-1914	01/23/2004	1B	6	5.5	16	44	1E-09
W-518-1915	01/28/2004	2	6	0.03	25	193	2E-12
W-1615	01/29/2004	2	6	1.4	24	478	4E-11
W-ETC-2001A	03/16/2004	1B	6	8.3	5	52.5	2E-08
W-ETC-2001B	03/19/2004	2	6	0.7	5	145.3	1E-09
W-ETC-2002A	03/11/2004	1B/2	6	6	5	22.6	3E-09
W-ETC-2002B	03/15/2004	2	6	4	5.5	26	NC
W-ETC-2003	03/22/2004	1B	6	17	4.5	77.4	8E-09
W-ETC-2004A	03/05/2004	1B/2	6	12	8	82.8	3E-09
W-ETC-2004B	03/09/2004	2	6	18	3.8	188	3E-09
SIP-ETC-201	03/04/2004	2	6	8	7	185.5	7E-09
W-1904	03/02/2004	2	6	23	4	63.3	2E-08
W-514-2007A	04/19/2004	1B	96	14	7.5	17.6	NC
W-514-2007B	04/26/2004	5	96	21	3.3	39.6	NC
W-217	05/03/2004	5	96	20	3	63.2	NC
W-ETS-2008A	09/28/2004	1B	6	50	7	23.7	NC
W-ETS-2008B	09/29/2004	2	6	33	9.5	67.8	NC
W-ETS-2009	11/30/2004	2	6	76	4.8	16.4	NC
W-ETS-2010A	10/07/2004	1B	6	70	3	20.5	NC

Table C-1. Soil vapor extraction test results.

Well	Date	HSU	Duration test (hours)	Flow rate (scfm)	Vacuum, inches (Hg)	Max. conc.[a] (ppm_v)	Air permeability (cm^2)
W-ETS-2010B	10/11/2004	2	6	63	4.5	39.8	NC
SIP-ETS-601	10/13/2004	2	2.5	0.5	10	153.7	NC
W-653	03/16/2005	3A	2	0	NA	9.6	NC
W-2011	03/18/2005	3A	2	0	NA	1.5	NC
W-2101	04/06/2005	3A	1.75	0	NA	8.1	NC
W-2102	04/25/2005	3A	5	0.46	28	4.7	NC
W-2103	04/14/2005	3A	1.25	0.35	28.2	NM	NC
W-2104A	03/09/2005	1B	24	43	10	0.13	NC
W-2104B	03/14/2005	2	24	43	10	0.16	NC
W-2110A	11/08/2005	1B/2	3	37	6.4	5.2	NC
W-2110B	11/09/2005	2	3	32	6.5	8.4	NC
W-2111A	11/03/2005	1B	3	39	5.4	4.0	NC
W-2111B	11/04/2005	2	3	28	3.0	4.1	NC
W-2112A	11/15/2005	1B/2	3	44	2.9	0.75	NC
W-2112B	11/17/2005	2	3	51	2.8	15	NC

Notes:

cm^2 = Square centimeters.
Hg = Mercury.
HSU = Hydrostratigraphic unit.
Max. conc. = Maximum concentration.
NM = Not measured.
ppm_v = Parts per million by volume.
scfm = Standard cubic feet per minute.
NC = Not Computed. Insufficient data to analyze unless otherwise noted.
NA = Not applicable.
[a] Sample collected in Tedlar bag for TO-14 analysis.
[b] Sample measured with organic vapor analyzer.

References

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Appendix D

2006 Ground Water Sampling Schedule

Appendix D

2006 Ground Water Sampling Schedule

The planned 2006 ground water sampling schedule is presented in Table D-1, which is based on recommendations from the Cost-Effective Sampling (CES) algorithm as well as special needs (e.g., guard wells). The guidelines for the CES biennial sampling frequency have recently been refined. A discussion of the CES algorithm and the new biennial sampling frequency guidelines are presented below.

D-1. Overview of CES

Lawrence Livermore National Laboratory (LLNL) uses the CES program to review ground water data and optimize the site's ground water monitoring plan. The sampling frequency recommendation for a given location is based on trend, variability, and magnitude statistics.

The underlying principle of the CES program is that a location's sampling schedule should be determined primarily by the average *rate of change* in concentrations observed in the recent past (1.5 to 2.5 years depending on the number of data points). A least squares slope of concentration over time estimates the average rate of change. The scheduling frequencies are associated with a base rate of change. For VOCs at LLNL, the annual sampling frequency is reserved for analyte trends of less than 5 ppb change per year. The quarterly frequency is associated with rates of change in excess of 30 ppb per year. The semi-annual frequency falls in the range of 5 - 30 ppb change per year. The parameter ranges are determined based on the type of contaminant (VOCs, semi-volatiles, metals, etc.), the ground water velocity, and the amount of contaminant retardation. However, low or high degrees of data variability or data noise can produce an adjustment, an increase or decrease, to the sampling frequency. The variability is measured by the analyte concentration range divided by the median analyte concentration. The range is the difference between the lowest and highest analyte values, and the median is the middle of a distribution with half of the concentrations above the median and half below the median.

To be eligible for consideration by the CES program, a location (usually a ground water monitoring well or piezometer) must have already been sampled on at least six occasions, which is roughly equivalent to 18 months of quarterly sampling. Newly installed wells must be sampled frequently to build up a history for the purposes of analysis. The decision-rules of the CES system are applied independently to each analyte in the target list (the chemicals for concern) for a particular location. The sampling frequency assigned to the location is the highest frequency recommended for any individual analyte in the target list.

D-2. Refined Biennial Guidelines

In 1998, biennial (every other year) sampling frequency was added to the CES program. The criterion for biennial was 3 consecutive annual recommendations. However, wells that have been sampled biennially since 1998 no longer have annual data to evaluate, and the 3 consecutive annual recommendations rule no longer applies. To address this issue, new guidelines have been developed. For an analyte/well to be given a biennial recommendation, all of the criteria below must be met:

- Annual Sampling Frequency – The standard CES logic must produce an annual frequency recommendation. The average rates of change for both the recent and overall data sets must be in the annual category. (At LLNL, this is less than 5 ppb change in the analyte concentration per year.)

No indication of upward trend – The recent median concentration must be less then the overall median concentration + 2.5 ppb. Over time, small fluctuations of slopes within the low annual category are expected, but there should be no indication of a larger upward trend. The recent median is calculated over a 1.5 years to 2.5 years period with at least 2 data points, and the overall median is calculated over a 4.5 year- to 6-year period with at least 4 data points.

- A low recent median concentration – The both the recent median analyte concentration must be less than 20 ppb.
- Minimum data separation – When determining whether the total number of samples is sufficient, the samples used to meet the requirement must be at least 70 days apart. This prevents, for example, a routine sample and its QC duplicate from both being counted towards meeting the minimum requirement. “Trends” calculated from points too close together in time are not representative of long-term average rates.

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
W-001	E	2-06	
W-001A	A	4-06	
W-002	O	3-07	
W-002A	E	1-06	
W-004	A	1-06	
W-005	O	3-07	
W-005A	E	4-06	
W-007	O	2-07	
W-008	E	4-06	WGMG
W-011	O	4-07	
W-012	S	2-06	
W-017	E	1-06	WGMG
W-017A	O	1-07	
W-019	O	2-07	
W-101	S	1-06	
W-102	O	1-07	
W-103	O	1-07	
W-104	Q	1-06	
W-105	O	4-07	
W-106	E	4-06	
W-107	E	4-06	
W-108	O	3-07	
W-110	Q	1-06	
W-111	S	1-06	
W-113	Q	1-06	
W-114	A	1-06	
W-115	O	2-07	
W-116	Q	1-06	
W-117	O	1-07	
W-118	A	4-06	
W-119	S	1-06	WGMG
W-120	E	1-06	
W-121	Q	1-06	WGMG
W-122	E	1-06	
W-123	E	1-06	
W-141	A	4-06	
W-142	Q	1-06	
W-143	O	3-07	
W-146	S	1-06	
W-147	A	1-06	
W-148	E	1-06	
W-151	Q	1-06	WGMG
W-182	Q	1-06	WGMG
W-201	A	1-06	
W-202	E	1-06	

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
W-203	E	2-06	
W-204	S	1-06	WGMG
W-205	Q	1-06	
W-206	Q	1-06	
W-207	Q	1-06	
W-210	Q	1-06	
W-212	O	1-07	
W-213	E	1-06	
W-214	A	1-06	
W-218	A	3-06	
W-219	O	1-07	
W-220	A	2-06	
W-221	E	2-06	WGMG
W-222	A	3-06	
W-223	O	2-07	
W-224	E	4-06	
W-225	E	2-06	
W-226	E	2-06	
W-251	Q	1-06	
W-252	E	1-06	
W-253	O	2-07	
W-255	E	4-06	
W-256	A	4-06	
W-257	Q	1-06	
W-258	Q	1-06	
W-259	Q	1-06	
W-260	A	1-06	
W-261	Q	1-06	
W-263	Q	1-06	
W-264	A	2-06	
W-265	O	3-07	
W-267	O	2-07	
W-268	A	3-06	
W-269	A	1-06	
W-270	A	4-06	
W-271	Q	1-06	
W-272	A	4-06	
W-273	O	4-07	
W-274	A	1-06	
W-275	S	2-06	
W-276	S	1-06	
W-277	A	1-06	
W-290	O	1-07	
W-291	O	1-07	
W-293	E	2-06	
W-294	E	3-06	

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
W-301	A	1-06	
W-302	O	3-07	
W-303	O	3-07	
W-304	S	1-06	
W-306	A	1-06	
W-307	S	1-06	
W-308	O	4-07	
W-310	A	1-06	
W-311	A	1-06	
W-312	O	2-07	
W-313	S	2-06	
W-315	Q	1-06	
W-316	A	4-06	
W-317	S	1-06	
W-318	Q	1-06	
W-319	E	3-06	
W-320	E	3-06	
W-321	E	1-06	
W-322	Q	1-06	
W-323	Q	1-06	
W-324	E	2-06	
W-325	O	1-07	
W-353	S	1-06	
W-354	Q	1-06	
W-355	S	2-06	
W-356	Q	1-06	
W-361	Q	1-06	
W-362	O	2-07	
W-363	Q	1-06	WGMG
W-364	S	1-06	
W-365	A	2-06	
W-366	O	4-07	
W-369	S	1-06	
W-370	O	2-07	
W-371	O	2-07	
W-372	O	1-07	
W-373	O	3-07	WGMG
W-375	A	3-06	
W-376	A	1-06	
W-377	E	2-06	
W-378	O	2-07	
W-379	S	1-06	
W-380	O	1-07	
W-401	E	2-06	
W-402	O	1-07	
W-403	O	2-07	

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
W-404	E	1-06	
W-405	Q	1-06	
W-406	O	4-07	
W-407	Q	1-06	
W-409	A	4-06	
W-410	Q	1-06	
W-411	S	2-06	
W-412	A	4-06	
W-416	O	2-07	
W-417	O	4-07	
W-418	O	4-07	
W-419	Q	1-06	
W-420	A	1-06	
W-421	Q	1-06	
W-422	S	1-06	
W-423	Q	1-06	
W-424	Q	1-06	
W-446	A	1-06	
W-447	A	1-06	
W-448	A	3-06	
W-449	S	1-06	
W-450	A	1-06	
W-451	E	2-06	
W-452	E	4-06	
W-453	E	2-06	
W-454	A	3-06	
W-455	E	4-06	
W-458	O	4-07	
W-459	O	4-07	
W-461	Q	1-06	
W-462	O	4-07	
W-463	E	2-06	
W-464	S	1-06	
W-481	Q	1-06	
W-482	S	1-06	
W-483	O	3-07	
W-484	O	3-07	
W-485	E	2-06	
W-486	O	2-07	
W-487	O	1-07	
W-501	S	1-06	
W-502	A	3-06	
W-503	E	3-06	
W-504	O	4-07	
W-505	O	2-07	
W-506	S	1-06	

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
W-507	O	3-07	
W-509	A	4-06	
W-510	O	1-07	
W-511	O	2-07	
W-512	O	3-07	
W-513	E	2-06	
W-514	O	4-07	
W-515	Q	1-06	
W-516	O	2-07	
W-517	Q	1-06	
W-519	E	4-06	
W-521	E	4-06	
W-551	O	2-07	
W-552	O	3-07	
W-553	E	4-06	
W-554	A	1-06	
W-555	E	2-06	
W-556	O	3-07	WGMG
W-557	E	4-06	
W-558	Q	1-06	
W-559	E	4-06	
W-560	E	1-06	
W-561	E	3-06	
W-562	E	2-06	
W-563	E	4-06	
W-564	A	2-06	
W-565	A	3-06	
W-567	O	2-07	
W-568	S	1-06	
W-569	S	1-06	
W-570	O	1-07	
W-571	O	1-07	WGMG
W-591	E	4-06	
W-592	O	4-07	
W-593	O	1-07	
W-594	O	2-07	
W-604	O	3-07	
W-606	Q	1-06	
W-607	O	4-07	
W-608	O	3-07	
W-611	S	1-06	
W-612	O	4-07	
W-613	O	1-07	
W-615	A	1-06	
W-616	E	1-06	
W-617	O	4-07	

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
W-618	Q	1-06	
W-619	O	3-07	
W-622	Q	1-06	
W-651	Q	1-06	
W-652	O	2-07	
W-654	S	1-06	
W-702	A	2-06	
W-705	O	4-07	
W-706	A	4-06	
W-750	A	4-06	
W-901	A	1-06	
W-902	E	2-06	
W-905	O	3-07	
W-906	Q	1-06	WGMG
W-908	O	1-07	
W-909	Q	1-06	
W-911	A	4-06	
W-912	Q	1-06	
W-913	Q	1-06	
W-1002	E	4-06	
W-1003	O	4-07	
W-1008	O	1-07	
W-1010	E	1-06	
W-1011	O	3-07	
W-1012	O	4-07	WGMG
W-1013	E	4-06	
W-1014	O	4-07	
W-1101	O	2-07	
W-1105	E	3-06	
W-1106	A	3-06	
W-1107	Q	1-06	
W-1108	Q	1-06	
W-1110	A	1-06	
W-1112	A	1-06	
W-1113	O	4-07	
W-1115	A	4-06	
W-1117	Q	1-06	
W-1118	Q	1-06	
W-1201	Q	1-06	
W-1202	S	1-06	
W-1203	Q	1-06	
W-1204	S	2-06	
W-1205	A	1-06	
W-1207	S	2-06	
W-1209	A	3-06	
W-1210	A	3-06	

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
W-1212	Q	1-06	
W-1214	Q	1-06	
W-1217	S	1-06	
W-1219	S	1-06	
W-1222	Q	1-06	
W-1223	Q	1-06	
W-1224	E	4-06	
W-1225	S	2-06	
W-1226	O	2-07	
W-1227	A	1-06	
W-1250	Q	1-06	
W-1251	S	2-06	
W-1252	Q	1-06	
W-1253	Q	1-06	
W-1255	Q	1-06	
W-1303	Q	1-06	WGMG
W-1304	Q	1-06	
W-1306	Q	1-06	WGMG
W-1308	Q	1-06	WGMG
W-1309	A	2-06	
W-1311	Q	1-06	
W-1401	Q	1-06	
W-1402	Q	1-06	
W-1404	Q	1-06	
W-1405	Q	1-06	
W-1406	Q	1-06	
W-1407	Q	1-06	
W-1408	Q	1-06	
W-1411	O	3-07	
W-1412	Q	1-06	
W-1413	E	1-06	
W-1414	Q	1-06	
W-1416	A	3-06	
W-1417	Q	1-06	
W-1418	Q	1-06	
W-1419	A	3-06	
W-1420	A	2-06	
W-1421	S	1-06	
W-1422	S	1-06	
W-1424	Q	1-06	
W-1425	S	1-06	
W-1426	O	4-07	
W-1427	S	2-06	
W-1428	E	4-06	
W-1501	A	1-06	
W-1502	A	2-06	

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
W-1505	Q	1-06	
W-1506	A	3-06	
W-1507	Q	1-06	
W-1508	Q	1-06	
W-1509	A	1-06	
W-1511	Q	1-06	
W-1512	A	2-07	
W-1513	E	3-06	
W-1514	E	3-06	
W-1515	E	3-06	
W-1516	A	3-06	
W-1517	Q	1-06	
W-1519	A	3-06	
W-1553	Q	1-06	
W-1604	Q	1-06	
W-1613	O	1-07	
W-1614	O	2-07	
W-1701	E	3-06	
W-1703	O	1-07	
W-1704	S	1-06	
W-1802	Q	1-06	
W-1803-1[a]	Q	1-06	
W-1803-2[a]	S	1-06	
W-1804-1[a]	Q	1-06	
W-1804-2 [a]	Q	1-06	
W-1805	S	1-06	
W-1901-1[a]	O	2-07	
W-1901-2[a]	Q	1-06	
W-1905-1[a]	Q	1-06	
W-1905-2[a]	Q	1-06	
W-2103	Q	1-06	
W-2113	Q	1-06	
TW-11	A	1-06	
TW-11A	E	4-06	
TW-21	E	3-06	
11C1	E	2-06	
14A11	O	1-07	
14A3	E	4-06	
14B1	O	2-07	WGMG
14B4	O	3-07	
14C1	Q	1-06	
14C2	E	3-06	
14C3	Q	1-06	
14H1	Q	1-06	
18D1	O	3-07	
GEW-710	O	1-07	

Table D-1. 2006 LLNL Livermore Site VOC ground water sampling schedule.

Well number	VOC sampling frequency	Next quarter sample date	Additional analytes (Q1-06)
GSW-006	E	1-06	
GSW-007	E	1-06	
GSW-008	E	1-06	
GSW-009	Q	1-06	
GSW-011	A	1-06	
GSW-013	O	1-07	
GSW-215	A	3-06	
GSW-216	O	2-07	
GSW-266	Q	1-06	
GSW-326	O	2-07	
GSW-367	O	3-07	
GSW-442	Q	1-06	
GSW-443	O	4-07	
GSW-444	Q	1-06	
GSW-445	A	2-06	

Notes:

All analyses are by EPA Method 601 for purgeable halocarbons.

E = Even years.

O = Odd years.

A = Annual.

S = Semiannual.

Q = Quarterly.

Q1 = First Quarter.

WGMG = LLNL Water Guidance and Monitoring Group. Analyses are related to the environmental surveillance monitoring programs carried out at DOE sites to complement restoration activities.

[a] Wells completed with two discrete screened intervals which are hydraulically isolated from one another by a packer and are sampled individually.

Appendix E

Haussmann Lake
Annual Monitoring Program Summary

Appendix E

Haussmann Lake Annual Monitoring Program Summary

This Appendix summarizes the 2005 LLNL Operations and Regulatory Affairs Division discharge data for Haussmann Lake, formerly known as the Drainage Retention Basin (DRB). Haussmann Lake is an artificial water body that has a capacity of about 37 acre-ft (12 million gallons). Haussmann Lake is located in the central portion of the Livermore Site (Fig. E-1) and receives storm water runoff and treated ground water discharges.

Haussmann Lake release samples are collected at the first planned release of the rainy season and, at a minimum, in conjunction with one additional storm water monitoring event, as requested by the San Francisco Bay Regional Water Quality Control Board (RWQCB). Samples are also collected for each dry season release event or, if the release is continuous, samples are collected each month. Release samples are collected at location CDBX (Fig. E-1) and are compared with the LLNL Arroyo Las Positas outfall samples collected at location WPDC (Fig. E-1). Release samples are used to determine compliance with discharge limits established in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) for the Lawrence Livermore National Laboratory, Livermore Site (DOE, 1992) and the Explanation of Significant Differences for Metals Discharge Limits at the Lawrence Livermore National Laboratory, Livermore Site (Berg et al., 1997). In 2003, Haussmann Lake monitoring strategy was modified according to a letter submitted to the RWQCB in December 2002 (Jackson, 2002) to eliminate monitoring within the lake.

The analytical results for release samples are reported in the LLNL Livermore Site Quarterly Self-Monitoring Reports for 2005 and will be reported in the LLNL Site Annual Environmental Report.

E-1. Haussmann Lake Discharge Monitoring

Releases from Haussmann Lake occurred continuously throughout the year except for brief periods when flow was stopped for maintenance. Dry season release samples were collected June 7, July 6, August 16, and September 29, 2005. Samples for the first release of the 2005–2006 wet season were collected on November 17, 2005. The second wet-season sampling event did not occur because there was no collectible runoff event during the fourth quarter of 2005.

Samples from CDBX were within discharge limits for all parameters except pH. Samples collected at CDBX exceeded the pH limit of 8.5 in all four dry season monitoring events, with a maximum of 9.5. The pH has averaged 8.8 since 1998 and is typically high during the summer due to increased photosynthesis. Corresponding samples collected at location WPDC exceeded the pH discharge limit in two of the six monitoring events. The maximum pH at WPDC was 8.86. Several metals were present above detection limits at both CDBX and WPDC, but all were below discharge limits. All acute aquatic survival bioassay tests resulted in satisfactory survival of the test species.

Haussmann Lake release samples were also analyzed for volatile organic compounds, herbicides, and polychlorinated biphenyl compounds. All these analytical results were below detection limits.

E-2. References

Berg, L., E.N. Folsom, M.D. Dresen, R.W. Bainer, A.L. Lamarre (Eds.) (1997), *Explanation of Significant Differences for Metals Discharge Limits at the Lawrence Livermore National Laboratory Livermore Site,* Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-125927).

Jackson, C.S. (2002), Division Leader, Operations and Regulatory Affairs Division, LLNL "Drainage Retention Basin Monitoring Plan," letter to Naomi Feger, San Francisco Bay Regional Water Quality Control Board, December 6, 2002.

U.S. Department of Energy (DOE) (1992), *Record of Decision for the Lawrence Livermore National Laboratory, Livermore Site*, Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-109105).

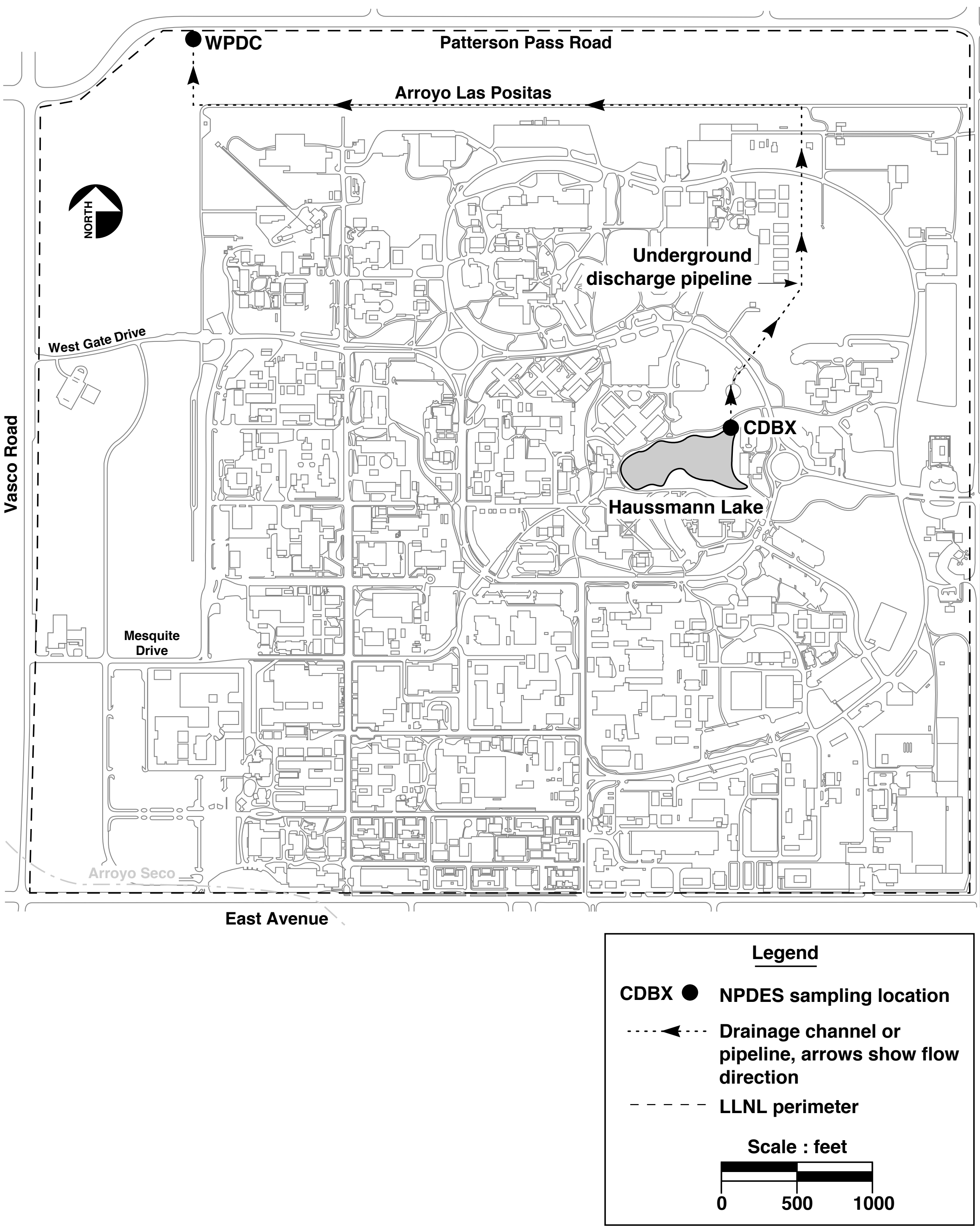

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Figure E-1. Location of the Haussmann Lake showing discharge sampling locations.