PASSIVE SAMPLING PILOT STUDY REPORT

STRINGFELLOW HAZARDOUS WASTE SITE

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SUBMITTED TO:

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PREFACE

GeoLogic Associates is a contractor for the Groundwater Monitoring Program at Stringfellow Hazardous Waste Site (Stringfellow Site), Riverside County, California. This work was performed for the State of California, Department of Toxic Substances Control, contract number 00-T2122.

This document provides results obtained for groundwater samples that were collected as part of a passive sampling pilot study at the Stringfellow Site during March 2008, and compares these results with analytical data obtained for samples that were collected using traditional purge-and-sample methods during the Spring 2008 and Fall 2008 monitoring events.

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EXECUTIVE SUMMARY

This report presents a summary of a passive sampling pilot study that was performed at the Stringfellow Hazardous Waste Site (Stringfellow Site) to evaluate if there is depth-discrete differences in samples collected with a sampling device that employs passive sampling technology, and determine if the concentrations from the depth-discrete passive sampling devices are comparable with the results obtained from samples that are collected using traditional purge-and-sample techniques. This report summarizes the results from the two sampling methods and provides recommendations for future sampling events.

For this study, passive Hydrasleeve^{TM} sampling devices were deployed in six wells and allowed to equilibrate for 49 to 50 days. To evaluate possible variation in concentrations with respect to variations in permeability or preferential contaminant pathways due to variation in aquifer materials, multiple Hydrasleeve^{TM} sampling devices were deployed in each well. Three passive samplers were deployed at vertically discrete intervals in two wells, and four samplers were deployed at vertically discrete intervals in four wells. The depth of deployment was based on permeable zones as determined from boring logs and the available saturated zone within a well at the time of deployment. The passive samples were tested for perchlorate by EPA Method 314.0 and IC-MS/MS, and VOCs by EPA Method 8260. Analytical results obtained from the passive samples were compared with results for the Spring 2008 and Fall 2008 monitoring events, which employed traditional purge and sample methodology.

Based on the results from the study, it is concluded that the Hydrasleeve^{TM} passive sampling devices provide similar results as samples collected using traditional purge and sample methods, as summarized below:

- Analytical results from one well (CTS-OW3) indicated some vertical stratification for perchlorate, with the highest concentrations reported in the deepest sample. No apparent vertical stratification was noted for perchlorate in the other wells, nor for VOCs in any of the wells.
- The samples from two wells (OC-11B and OW-68D1) required dilution before testing by EPA Method 314.0 because of matrix interference, which resulted in detection limits that were higher than the analytical results provided by the IC-MS/MS test method. Based on the average result from the EPA Method 314.0 testing and IC-MS/MS testing for the other 14 passive samples, the reported analytical result for a specific test method was within 5 percent of the average concentration for 8 samples, within 5 to 8 percent for 4 samples, and within 11 percent for the remaining 2 samples.
- For EPA Method 314.0 testing, the average perchlorate concentrations reported for the passive samples differed from the results from the Spring 2008 sampling by less than 13 percent for 3 samples. However, the concentrations for CTW-OW3 differed by 60 percent due to the relatively high concentrations reported for the deepest passive sample.

- Differences between IC-MS/MS analytical results for the average concentration from passive samples and the concentration from the Fall 2008 sampling event ranged from 0 to 15 percent.
- For detected VOCs, the analytical results for the passive samples were generally within 10 percent of the results for samples collected using traditional purge and sample techniques.
- The differences in concentrations reported for the pumped and passive samples can be partly explained by the elapsed time between sampling events (1 to 8 months).

Based on the conclusions described above and the information obtained during sample collection, the following recommendations have been developed:

- Little variability was noted for depth-discrete samples in a single well. Therefore, it appears to be sufficient to collect one sample in the middle of the saturated screen interval, although the local geology should be evaluated in wells that span several geologic units (alluvium and bedrock, for example).
- The sample volume provided by the passive sampling devices (less than 0.7 liters for a 2-inch device; approximate 1.6 liters for a 4-inch device) may limit the analytical suite, but this limitation could be overcome by deploying multiple Hydrasleeve^{TM} devices in a single well if an expanded analytical suite is planned.
- Retrieval of Hydrasleeve^{TM} sampling devices from open borehole wells should be performed with caution owing to the potential for tearing of the device on rough bedrock walls or the bottom of the protective surface casing.
- If additional comparisons between sampling methods are performed, the temporal difference between the two samples should be minimized. Optimally, the passive samples should be collected immediately prior to purging of the well for samples collected using traditional purge-and-sample techniques.

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1.0 INTRODUCTION

This report presents a summary of a passive sampling pilot study that was performed at the Stringfellow Hazardous Waste Site (Stringfellow Site). As requested by the State of California Department of Toxic Substances Control (DTSC), groundwater samples were collected using Hydrasleeve™ passive sampling devices from two wells in Zone 1B, one well in Zone 2, one well in Zone 3, and two wells in Zone 4. Field activities were conducted in general accordance with the standard operating procedures in the Groundwater Monitoring Program Work Plan (Groundwater Monitoring Work Plan) (GeoLogic Associates (GLA), 2001), except the wells were not purged and sampled as stated in Sections 3.3 and 3.4 of the Groundwater Monitoring Work Plan. Instead, samples were collected using passive sampling devices that were deployed at depth-discrete intervals (LeBlanc and Vroblesky, 2008). Laboratory analyses were completed in accordance with the quality assurance plan that is detailed within Appendices A, B, and C of the Groundwater Monitoring Work Plan.

Section 1.0 of this report provides a brief background of the Stringfellow Site and an overview of the site monitoring program.

Section 2.0 summarizes field data collection activities, including the groundwater monitoring wells that were sampled, and sampling procedures associated with the Hydrasleeve™ sampling devices.

Section 3.0 provides a summary of the sampling and laboratory analytical data validation performed by the Laboratory Data Consultants (LDC) for the passive sampling event.

Section 4.0 summarizes the laboratory analytical results from samples collected in March 2008 using the passive sampling techniques and compares these results with the analytical results from the April 2008 routine monitoring event, which employed purging methodology from the Groundwater Monitoring Work Plan.

Section 5.0 provides a list of references used in this report.

Appendix A provides lithologic logs of the wells included in this program.

Appendix B provides field data sheets that were completed at the time of sampling.

Appendix C provides laboratory certificates of analysis.

Appendix D provides a data validation report prepared by laboratory data consultants.

Appendix E provides time-series charts showing historical monitoring results for the tested wells.

Appendix F provides a comments and response matrix for the draft version of this report.

1.1 BACKGROUND

The Stringfellow Site is a former Class I industrial waste disposal facility located approximately 50 miles east of the City of Los Angeles in southern California (Figure 1-1). The Stringfellow Site is located at the northern edge of Riverside County near the community of Glen Avon (Figures 1-2, 1-3, and 1-4). During its operation from 1956 to 1972, the Stringfellow Site contained as many as 20 surface impoundments to contain and evaporate liquid chemical wastes. About 34 million gallons of liquid industrial process wastes containing spent acids and caustics, solvents, pesticide by-products, metals, and other inorganic and organic constituents were discharged into the site's evaporation ponds during the site's operating life.

After operation for 16 years as an industrial waste disposal facility, the Stringfellow Site stopped accepting wastes in November 1972. From the time that heavy rains in March 1969 first caused impacted surface overflow downstream into Glen Avon, the Stringfellow Site operators had faced a growing number of indications that the facility was not in compliance with waste discharge requirements that had been established by Riverside County and the California Regional Water Quality Control Board, Santa Ana Region (RWQCB). By 1975, all efforts by the site operator to re-open the facility were exhausted and, after the operator was unable to undertake site closure, the RWQCB declared the Stringfellow Site a nuisance. An interim abatement effort was initiated in 1980 after completion of a series of engineering assessments of closure options. The interim abatement included removal of all surface ponds, construction of a subsurface barrier wall on the downgradient side of the site, installation of a surface cover and other drainage control features, and installation of several on-site and downgradient groundwater monitoring wells. The period just prior to initiation of the interim abatement (1977-1980) was marked by three years of heavy rainfall, which resulted in an overflow into the Glen Avon community.

The Stringfellow Site was placed on the Superfund National Priority List (NPL) in 1982 and was, at the same time, declared California's highest priority toxic waste site. In October 1983, the California Department of Health Services declared the Stringfellow Site an "imminent or substantial endangerment to the public health and the environment," reinforcing a May 1983 finding by the U.S. Environmental Protection Agency (EPA) in its lawsuit filed against the Responsible Parties.

At the present time, an active groundwater pump-and-treat system is in place to collect impacted groundwater. The groundwater is treated on-site at a pretreatment plant located in the mid-canyon area, where metals and organics are extracted. The treated effluent from this process is transferred to the Santa Ana Regional Interceptor (SARI) line where it is discharged under a permit from the Santa Ana Water Project Authority (SAWPA). The SARI line presently transports municipal and industrial wastewater to Orange County, California, where after primary treatment it is discharged directly into the Pacific Ocean.

Figure 1-4 illustrates the overall work area and site zones. The specific well locations included in the passive sampling pilot study are shown in Figure 1-5 for Zone 1B, in Figure 1-6 for Zones 2 and 3, and in Figures 1-7 and 1-8 for Zone 4. DTSC selected the wells based on the historical monitoring results such that a relatively wide range of concentrations could be evaluated, from wells with relatively greater groundwater impacts (Zone 1B) to wells with low concentrations of volatile organic compounds (VOCs).

1.2 MONITORING PROGRAM OBJECTIVES

A routine groundwater monitoring program has been implemented at the Stringfellow Hazardous Waste Site since August 1984. In coordination with the EPA, DTSC developed a structured groundwater monitoring program to evaluate the Stringfellow Site. The groundwater monitoring workplan was last revised April 2001 (GLA, 2001). The purpose of the program is to collect groundwater quality data to identify of Stringfellow-related groundwater impacts, and to evaluate waste migration, changes in constituent concentrations, and the effectiveness of the groundwater pump-and-treat system.

The purpose of this pilot study is two-fold:

- To evaluate if there is depth-discrete differences in samples collected with a sampling device that employs passive sampling technology, and
- To determine if the average concentrations from the depth-discrete passive sampling devices are comparable with the results from traditional purge-and-sample techniques.

If passive sampling data quality is consistent with results obtained using standard sampling methods, passive sampling methods could be used during future routine monitoring events to reduce labor and/or purge water disposal costs.

1.3 REVIEW OF PASSIVE SAMPLING TECHNOLOGY

Passive groundwater sampling methods have been developed to reduce the need for pre-sampling well purging and subsequent treatment and disposal of purge waters. Passive sampling techniques may be more cost effective than traditional purge-and-sample techniques and can provide depth-discrete information.

The Hydrasleeve^{TM} disposable sampler was selected for this study because of its effectiveness, cost, and ease of use. The Hydrasleeve^{TM} can be used to test for all compounds, provides a repeatable sampling method, can be used in slow recharge wells, and no purge water disposal is required. The U.S. Geological Survey (USGS) compared results from diffusion bag sampling techniques to traditional purge and sample techniques during an investigation of perchlorate and explosive compounds in groundwater at Camp Edwards in Cape Cod, Massachusetts (LeBlank and Vreblosky, 2008). While the diffusion bag sampling results were similar to the results for pumped samples in the USGS study, the Hydrasleeve^{TM} samplers were selected for this study because they can be used for all compounds.

Sampling involves deployment of the Hydrasleeve^{TM} devices prior to sampling (for this study, the devices were deployed 7 weeks in advance, but the devices could be deployed a day before the sampling event). Samples can be collected in less than 15 minutes and equipment decontamination procedures between wells are not needed. Multiple Hydrasleeve™ sampling devices can be deployed in a well to evaluate impacts at vertically discrete zones.

Disadvantages of the Hydrasleeve™ device include a limited sample volume per device, which limits the analytical testing that could be performed on an individual sample. Field parameter testing is limited because the accuracy of some analytes can be affected if a flow-through cell is not employed. In addition, the Hydrasleeve™ sampler can tear if caution is not used when retrieving the sampling device, especially if the device is deployed in a well without casing such as the open borehole wells at the Stringfellow Site. If depth discrete information is required, care must be used when retrieving the sampling device because if the sampler is raised slowly, the check valve may not immediately open and the sample may be collected at a higher location in the water column than was originally intended.

2.0 SAMPLING PROCEDURES

The passive sampling pilot study was conducted between January 28 and March 18, 2008. DTSC selected six wells representative of the Zones 1 through 4 to be sampled with the passive method. The wells were selected based on their locations along the length of the volatile organic compound (VOC) plume, with high concentrations historically measured in samples from Zone 1 wells to concentrations near the regulatory limit to concentrations near the detection limit in wells located at the distal ends of the VOC plume. In each well, the sample depths were selected based on the most permeable water bearing zones identified on the lithologic boring logs (Appendix A).

2.1 SAMPLE LOCATIONS

The locations of the six groundwater monitoring wells selected for the passive sampling pilot study are shown on Figures 1-4 through 1-8. A total of 22 Hydrasleeve™ passive sampling devices were deployed at up to 4 depth-discrete interwell intervals (Table 2-1). Due to small water columns, only three sampling devices were deployed in two of the wells. The vertical intervals for Hydrasleeve^{TM} placement were selected based on the most permeable water-bearing zone identified on the lithologic boring log (Appendix A). For bedrock wells, the samplers were positioned at variable intervals to evaluate changes in contaminant concentrations with depth.

2.2 SAMPLING PROCEDURES

General: The Hydrasleeve^{TM} sampler includes a sleeve to which a weight is attached to the bottom, and the empty device is lowered into a well with a rope. Water pressure keeps the bag collapsed and a check valve located at the top of the sleeve closed, preventing entry of water. Following deployment, the water level in the well is allowed to return to equilibrium prior to sampling. For sampling, the device must be raised faster than one foot per second, which allows the check valve to open and the bag fills with water. The check valve may not open immediately if the Hydraseelve^{TM} is removed at a slower rate, which would result in sample collection at a more shallow depth than originally intended. The water level change is minimal and there is minimal agitation to the sample. When the bag is full, the check valve closes, disallowing extraneous water from entering the Hydraseelve^{TM} sampling device. The Hydraseelve^{TM} can then be removed from the well, and the water within the sleeve can be transferred to appropriate sample containers (HYDRASleeve, 2008).

Stringfellow Passive Sampling: The sampling procedures listed below were employed during passive sampler deployment and retrieval:

- Hydrasleeve™ passive sampling devices were deployed at depths listed in Table 2-1 and were retrieved 49 to 50 days after deployment.
- During sampler retrieval, field measured pH, conductivity, turbidity, dissolved oxygen, and temperature values were recorded on field sampling sheets (Appendix B).
- All samples were transferred to approved sample containers, and each container was filled completely and immediately capped, labeled, and placed in a cooler with ice.
- Samples were immediately placed in an ice-filled cooler for transport to E.S. Babcock & Sons Laboratory, a California-certified laboratory located in Riverside, California. Samples were kept chilled (at about 4°C) until delivery.
- A trip blank that was provided by the laboratory was added to the chain of custody as a QC sample and added to the cooler.
- A completed Chain-of-Custody form, detailing the sample identification numbers, date and time collected, analyses requested, and other project information accompanied each sample to the laboratory. The Chain-of-Custody forms were signed and dated by all personnel retaining custody of the samples.

2.3 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

The Quality Assurance/Quality Control (QA/QC) program included collection and analyses of duplicate samples from wells MW-9B (57 feet) and OW-68D1 (53 feet). The duplicate samples were collected, handled, and tested in the same manner as the primary samples. A trip blank sample was scheduled to be submitted and tested for volatile organic compounds; the sampling crew reported that the trip blank was in the cooler (trip blank indicated on chain of custody), but the laboratory reported that no trip blank was received with the sample delivery and was not analyzed.

2.4 LABORATORY TESTING AND DATA VALIDATION

Samples were submitted for testing of volatile organic compounds (EPA Method 8260) and perchlorate [EPA Method 314.0 and ion chromatography tandem mass spectrometry (IC-MS/MS)]. Both test methods for perchlorate were performed because EPA Method 314.0 can be subject to matrix interferences, especially if the sample contains high concentrations of other anions. In addition, p-chlorobenzenesulfonic acid (pCBSA), a known contaminant at the Stringfellow Site, has been identified as an interfering compound near the retention time for perchlorate by EPA Method 314.0, and the IC-MS/MS method provides confirmation regarding the presence of perchlorate.

Certificates of analysis for the samples collected using passive techniques are provided in Appendix C.

Data validation was performed by Laboratory Data Consultants (LDC) under a separate contract to DTSC. A copy of LDC's data validation report is provided in Appendix D.

3.0 MONITORING RESULTS

A description of the local geology of the wells sampled in this study and a summary of the monitoring results are provided in this section.

3.1 PASSIVE SAMPLER DEPLOYMENT AND MONITORING RESULTS

A summary of the analytical results for the passive samples, Spring 2008 routine monitoring event, and Fall 2008 routine monitoring event is presented in Table 3-1. Figures 3-1 through 3-6 summarize well construction, local geology, depth to groundwater measurements, Hydrasleeve^{TM} placement intervals, a summary of the purging record from the April and November 2008 monitoring events (which employed traditional purge and sample techniques), and bar graphs for the analytical results for commonly detected VOCs and perchlorate obtained from the passive sampling and routine monitoring events. A graphical depiction of a comparison between analytical results for perchlorate test methods (EPA Method 314.0 and IC-MS/MS) from passive samples is shown in Figure 3-7, and analytical result comparisons between sampling techniques are shown on Figures 3-8 through 3-14.

Zone 1B Well OC-11B

The local geology at well OC-11B includes about 30 feet of alluvium overlying granodiorite (Figure 3-1). Groundwater at this location occurs in fractured bedrock. The depth to groundwater at the time of deployment of the Hydrasleeve^{TM} samplers was 32.70 feet. Four samplers were deployed within the open-borehole well at depths of 39 feet, 42 feet, 68 feet, and 71 feet. During sampler retrieval, the sampler that was installed at a depth of 39 feet was damaged (presumably by either the bottom of the metal casing or by scraping against the bedrock) and a portion of the water leaked from the bag. As a result, this sample could only be tested for VOCs.

Comparison of the water quality results indicates that there is no apparent vertical stratification of contaminant concentrations in this well (Figure 3-1). While the laboratory diluted the samples that were collected during the routine monitoring events (April and November 2008), which resulted in higher detection limits, the VOC concentrations reported for the routine monitoring events are generally comparable to the four passive samples (Table 3-1). As shown on Table 3-1, the detection limit for the April 2008 routine samples were higher than the concentrations reported for the passive samples and the November 2008 routine samples. For the passive samples, no perchlorate was detected in any of the tests that employed EPA Method 314.0 because of the high detection limits; perchlorate was measured in the samples that were tested using IC-MS/MS, which had a lower detection limit. For the routine samples, the laboratory reported sample matrix interference using EPA Method 314.0, and the reported concentration (1,200 micrograms per liter [μg/L]) may be elevated due to the interference. For the IC-MS/MS testing, the perchlorate concentration reported for the November 2008 sampling event was equal to the average concentration from the passive samples (160 μg/L).

Zone 1B Well OW-68D1

Well OW-68D1 is screened in fractured bedrock. Owing to a small water column, the passive sampling devices were installed at only three intervals (50, 53, and 56 feet). Upon retrieval of the sampling devices, only the lower two contained sufficient water for analytical testing. As shown on Figure 3-2 and Table 3-1, the VOC concentrations for each of the passive sampling intervals are similar to the routine sample except for low concentrations of gasoline compounds that were detected in the November 2008 routine sample. Perchlorate was identified using the IC-MS/MS method in both of the passive samples. No perchlorate was identified in any of the samples using EPA Method 314.0 because the samples required dilution, which resulted in higher detection limits. The perchlorate concentration from IC-MS/MS testing reported for the November 2008 sampling event (150 μg/L) was 25 percent higher than the average passive sample results (120 μg/L).

Zone 2 Well MW-9B

Zone 2 Well MW-9B was constructed in sand and gravelly sand (Figure 3-3). Four sampling devices were deployed at depths ranging from 57 to 81 feet within this well. The analytical results from the passive samplers indicated no apparent vertical stratification for VOC or perchlorate concentrations (Figure 3-3). Perchlorate and trichloroethene (TCE) concentrations for the sample collected during the routine sampling events were similar to those measured in the passive samples (within 15 percent). However, low concentrations of chloroform [5.0 to 6.0 micrograms per liter (μg/L)] were reported for each of the passive samples, but no chloroform was detected in the samples from the routine monitoring events. It should be noted that all six of the samples were diluted because of the relatively high TCE concentrations, and the reported chloroform values for the samples that were collected using passive techniques were slightly above the method detection limit (MDL; 4.6 μg/L).

Zone 3 Well LEO-11A

Well LEO-11A is screened in silty sand and silty sand with gravel (Figure 3-4). While three Hydrasleeve^{TM} sampling devices were deployed in this well at depths ranging from 55 to 61 feet, insufficient water was present for sampling of the upper device. TCE, chloroform, and perchlorate were detected in both passive samples at similar concentrations, indicating no vertical stratification. In addition, the analytical results for the samples collected using purge and sample techniques were generally similar to the average concentrations of the passive samples (within 20 percent), although the November 2008 TCE concentration was 24 percent higher than the average TCE concentration reported for the passive sampling devices.

Zone 4 Well CTS-OW3

The screen interval for well CTS-OW3 was constructed across interbedded sand and silty sand (Figure 3-5). Four Hydrasleeve^{TM} sampling devices were deployed within two of the screened sand horizons. Perchlorate, chloroform, and TCE were detected in each of the samples; the reported concentrations of each of these compounds were highest in the deepest sample (by factors of about 1.5 to 2), suggesting some vertical stratification. All three compounds were also detected in the samples that were collected using purge and sample techniques. For perchlorate monitoring results, the IC-MS/MS testing of the November 2008 pumping sample was within 5 percent of the average concentration reported for the passive samples. However, for EPA Method 314.0 testing, the pumped result (11 µg/L) was less than half of the average from the passive samples (28.5 µg/L). The TCE concentrations for both of the pumped samples were less than half of the average concentration reported for the passive samples (Table 3-1). It is also noted that the TCE concentrations reported for each of the Hydraseelve^{TM} samples was higher than the regulatory limit (5 µg/L), while the TCE concentrations for both of the pumped samples were below the regulatory limit.

Zone 4 Well FC-1020A

Well FC-1020A is screened across silty sand from 15 feet to 55 feet, and in decomposed granitic bedrock from 55 to 60 feet (Figure 3-6). Four passive sampling devices were deployed at 5-foot intervals at depths ranging from 35 to 50 feet. Perchlorate and TCE were detected in all samples (Table 3-1). The analytical results for the passive samplers suggested no apparent vertical stratification of contaminant concentrations. The TCE and perchlorate concentrations reported for the Spring 2008 routine monitoring event were within 25 percent of the average concentrations reported for the passive samples. For the November 2008 routine sample, the TCE concentration was within 25 percent of the average concentration reported for the passive samples, but perchlorate was 35 percent higher than for the average from the passive samples.

3.2 PERCHLORATE TEST METHOD COMPARISON

Samples collected from the passive sampling devices were tested for perchlorate using EPA Method 314.0 and IC-MS/MS methods, while only EPA Method 314.0 was employed for the Spring 2008 routine samples and only IC-MS/MS test methods were employed for the Fall 2008 perchlorate testing. To compare the analytical test methods for a given sample, the perchlorate results from the passive samples from wells MW-9B, LEO-11A, CTS-OW3, and FC-1020A were plotted on a single graph (Figure 3-7). Wells OC-11B and OW-68D1 were omitted because the samples were diluted for the EPA Method 314.0 testing, which resulted in elevated detection limits.

On Figure 3-7, equal concentrations for both test methods would plot on the 1:1 diagonal line. As shown, the data points plot close to the 1:1 diagonal line, indicating that the perchlorate results from EPA Method 314.0 are comparable to the results from IC-

MS/MS. The good agreement was observed at a wide variation in concentration levels (from 16 μg/L to nearly 500 μg/L).

3.3 SAMPLING METHOD COMPARISON

The reported concentrations for the pumped and passive samples for select contaminants of concern [perchlorate by EPA Method 314.0, perchlorate by IC-MS/MS, tetrachloroethene (PCE), trichloroethene (TCE), and chloroform] are compared graphically on Figures 3-8 through 3-14. On these figures, only the Spring 2008 data are plotted against the passive sampling results to minimize temporal variations. As described above, if the passive and pumped sampling methods produced samples with equal concentrations, all of the points on the graphs would fall on the respective 1:1 diagonal line.

The finding that most of the points fell close to the 1:1 diagonal lines indicates that the analytical results from the Hydrasleeve^{TM} samples were comparable to the samples that were collected following the purge-and-sample collection techniques. The results from well CTS-OW3 showed the greatest variance from the 1:1 diagonal line; the results from this well also showed the most variance for the depth-discrete passive samples, with the highest concentrations reported for the deepest sample.

While 35 to 42 days elapsed between collection of the Hydrasleeve^{TM} samples and the Spring 2008 samples, time-series charts (Appendix E) suggest that the concentrations for both sample sets correlate with historical analytical results. The concentration differences between the two sampling methods are not significant for samples with high concentrations, but are significant for samples with concentrations near the regulatory limits. For example, at well CTS-OW3, the TCE concentrations for the Hydrasleeve^{TM} samples exceeded the regulatory limit but were below the regulatory limit for each of the pumped samples. Additional sampling of wells with VOC concentrations near regulatory limits should be performed to further evaluate the variation in VOC concentrations for the two sampling methods.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Based on the results of the sampling program described in this report, the following conclusions were developed:

- Passive Hydrasleeve™ sampling devices were deployed in six wells and allowed to equilibrate for 49 to 50 days.
- To evaluate possible variation in concentrations with respect to variations in permeability or preferential contaminant pathways due to variation in aquifer materials, multiple Hydrasleeve™ sampling devices were deployed in each well. Three passive samplers were deployed at vertically discrete intervals in two wells, and four samplers were deployed at vertically discrete intervals in four wells. The depth of deployment was based on permeable zones as determined from boring logs and the available saturated zone within a well at the time of deployment.
- The passive samples were tested for perchlorate by EPA Method 314.0 and IC-MS/MS, and VOCs by EPA Method 8260.
- Analytical results from one well (CTS-OW3) indicated some vertical stratification for perchlorate, with the highest concentrations reported in the deepest sample. No apparent vertical stratification was noted for perchlorate in the other wells, nor for VOCs in any of the wells.
- The samples from two wells (OC-11B and OW-68D1) required dilution before testing by EPA Method 314.0 because of matrix interference, which resulted in detection limits that were higher than the analytical results provided by the IC-MS/MS test method. Based on the average result from the EPA Method 314.0 testing and IC-MS/MS testing for the other 14 passive samples, the reported analytical result for a specific test method was within 5 percent of the average concentration for 8 samples, within 5 to 8 percent for 4 samples, and within 11 percent for the remaining 2 samples.
- For EPA Method 314.0 testing, the average perchlorate concentrations reported for the passive samples differed from the results from the Spring 2008 sampling by less than 13 percent for 3 samples. However, the concentrations for CTW-OW3 differed by 60 percent due to the relatively high concentrations reported for the deepest passive sample.
- The routine sampling events were performed one month (Spring 2008) and eight months (Fall 2008) following the passive sampling event.
- Differences between IC-MS/MS analytical results for the average concentration from passive samples and the concentration from the Fall 2008 sampling event ranged from 0 to 15 percent.
- For detected VOCs, the analytical results for the passive samples were generally within 10 percent of the results for samples collected using traditional purge and sample techniques. A notable exception includes TCE concentrations in samples from well CTS-OW3, where Hydrasleeve™ samples contained TCE concentrations at levels above the regulatory limits, while TCE concentrations in

samples collected using traditional purge-and-sample techniques were below regulatory limits.

- The differences in concentrations reported for the pumped and passive samples might be partly explained by the elapsed time between sampling events (1 to 8 months).

In summary, it is concluded that the Hydrasleeve^{TM} passive sampling devices provide similar results as samples collected using traditional purge and sample methods.

4.2 RECOMMENDATIONS

Based on the conclusions described above and the information obtained during sample collection, the following recommendations have been developed:

- Little variability was noted for depth-discrete samples in a single well. Therefore, it appears to be sufficient to collect one sample in the middle of the saturated screen interval, although the local geology should be evaluated in wells that span several geologic units (alluvium and bedrock, for example).
- The sample volume provided by the passive sampling devices (less than 0.7 liters for a 2-inch device; approximate 1.6 liters for a 4-inch device) may limit the analytical suite, but this limitation could be overcome by deploying multiple Hydrasleeve^{TM} devices in a single well if an expanded analytical suite is planned.
- Retrieval of Hydrasleeve^{TM} sampling devices from open borehole wells should be performed with caution owing to the potential for tearing of the device on rough bedrock walls or the bottom of the protective surface casing.
- If additional comparisons between sampling methods are performed, the temporal difference between the two samples should be minimized. Optimally, the passive samples should be collected immediately prior to purging of the well for samples collected using traditional purge-and-sample techniques.
- Additional testing of wells with concentrations near regulatory limits should be performed to support selection of optimal sampling and analytical methods.

5.0 REFERENCES

GeoLogic Associates, 2001, “Work Plan, Groundwater Monitoring Program, Stringfellow Hazardous Waste Site,” prepared for California Department of Toxic Substances Control, Stringfellow Branch, April.

HYDRASleeve, 2008, No-Purge Groundwater Sampler, http/www.nopurgesampling.com/.

LeBlanc, D.R., and Vroblesky, D.A. 2008, Comparison of pumped and diffusion sampling methods to monitor concentrations of perchlorate and explosive compounds in ground water, Camp Edwards, Cape Cod, Massachusetts, 200-05: U.S. Geological Survey Scientific Investigations Report 2008-5109, 16 p.

U.S. Environmental Protection Agency, 1989, “Test Methods for Evaluation Solid Waste,” U.S. EPA SW-846.

TABLES

TABLE 2-1
WELL LOCATIONS AND DEPTH OF HYDRASLEEVE™ DEPLOYMENT
PASSIVE SAMPLING PILOT STUDY REPORT
STRINGFELLOW HAZARDOUS WASTE SITE

Zone 1A	Zone 1B	Zone 2	Zone 3	Zone 4	
OC-11B	OW-68D1	MW-9B	LEO-11A	CTS-OW3	FC-1020A
39	50	57	55	55	35
42	53	65	58	58	40
68	56	73	61	75	45
71	-	81	-	78	50

Note: Depths are listed in feet below top of well casing.

TABLE 3-1
SUMMARY OF ANALYTICAL RESULTS
PASSIVE SAMPLING PILOT STUDY REPORT
STRINGFELLOW HAZARDOUS WASTE SITE

Well Name	Zone	Sample Type	Depth Interval of Sample (feet below TOC)	Date Passive Sampler Deployed	Date Sample Collected	Days Passive Sampler in Well	Days Between Collection of Passive and Pumped Samples	Depth to Groundwater (feet below TOC)	Perchlorate IC-MS/MS (µg/L)	Perchlorate 314.0 (µg/L)	1,2-DCB (µg/L)	1,3-DCB (µg/L)	1,4-DCB (µg/L)	Chlorobenzene (µg/L)	Chloroform (µg/L)	MTBE (µg/L)	PCE (µg/L)	TCE (µg/L)	Acetone (µg/L)	cis-1,2-DCE (µg/L)	Methylene Chloride (µg/L)	1,2,4-TMB (µg/L)	Toluene (µg/L)	MIBK (µg/L)	Ethylbenzene (µg/L)	Xylenes (m+p) (µg/L)	Xylenes (ortho) (µg/L)
OC-11B	1B	Passive	39	1/28/2008	3/17/2008	49	-	32.7	not tested	not tested	1000	35j	260	170	380	<43	110	2400	320j	110	400	<9.3	<22	<95	<26	<36	<41
	1B	Passive	42	1/28/2008	3/17/2008	49	-	32.7	150	<230	1300	37j	330	220	470	<43	110	2500	290j	75	520	10j	27j	<95	<26	<36	<41
	1B	Passive	68	1/28/2008	3/17/2008	49	-	32.7	160	<230	1200	42j	300	200	430	<43	110	2300	330j	92	470	<9.3	26j	<95	<26	<36	<41
	1B	Passive	71	1/28/2008	3/17/2008	49	-	32.7	170	<230	1200	38j	310	190	460	<43	120	2700	220j	82	540	<9.3	28j	98j	<26	<36	<41
	1B	Passive	Average	NA	NA	NA	-	-	160	NC	1175	38j	300	195	435	NC	112.5	2475	290j	90	483	<9.3	23	<95	<26	<36	<41
	1B	Routine	NA	NA	4/21/2008	-	35	33.72	NA	1200*	1100	<60	320	210	480	<170	110	2500	<2000	<74	560	<37	<89	<380	<110	<160	<160
	1B	Routine	NA	NA	11/26/2008	-	254	34.06	160	NA	850	30	210	140	410	<43	110	2500	<500	120	370	<9.3	22	<95	<26	<36	<41
OW-68D1	1B	Passive	50	1/28/2008	3/18/2008	50	-	49.6	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	1B	Passive	53	1/28/2008	3/18/2008	50	-	49.6	120	<1200*	6000	190j	1600	1500	1100	<170	470	6300	3000	120j	870	50j	110j	420	<110	<140	<160
	1B	Passive	56	1/28/2008	3/18/2008	50	-	49.6	120	<2300*	5300	160j	1400	1500	980	<170	410	6200	2800	110j	830	<37	100j	470	<110	<140	<160
	1B	Passive	Average	NA	NA	NA	-	-	120	NC	5650	175	1500	1500	1040	NC	440	6250	2900	115j	850	<37	105j	445	<110	<140	<160
	1B	Routine	NA	NA	4/24/2008	-	37	51.3	NA	<460*	5400	160j	1600	1500	1000	<170	440	7100	2600	130j	870	50j	140j	440	<110	<140	<160
	1B	Routine	NA	NA	11/26/2008	-	253	48.65	150	NA	5900	190	1600	2200	1300	<43	430	6700	2400	100	960	21j	100	430j	110	94	41j
MW-9B	2	Passive	57	1/28/2008	3/17/2008	49	-	47.4	390	440	<2.0	<1.5	<0.72	<2.3	5.6	<4.3	<1.7	120	27j	<1.8	<5.0	<0.93	<2.2	<9.5	<2.6	<3.6	<4.1
	2	Passive	65	1/28/2008	3/17/2008	49	-	47.4	410	420	<2.0	<1.5	<0.72	<2.3	5	<4.3	<1.7	130	33j	<1.8	<5.0	<0.93	<2.2	<9.5	<2.6	<3.6	<4.1
	2	Passive	73	1/28/2008	3/17/2008	49	-	47.4	410	460	<2.0	<1.5	<0.72	<2.3	5.2	<4.3	<1.7	140	28j	<1.8	<5.0	<0.93	<2.2	<9.5	<2.6	<3.6	<4.1
	2	Passive	81	1/28/2008	3/17/2008	49	-	47.4	410	470	<2.0	<1.5	<0.72	<2.3	6	<4.3	<1.7	140	30j	<1.8	<5.0	<0.93	<2.2	<9.5	<2.6	<3.6	<4.1
	2	Passive	Average	NA	NA	NA	-	-	405	447.5	NC	NC	NC	NC	5.5	NC	NC	132.5	30j	NC	NC	NC	NC	NC	NC	NC	NC
	2	Routine	NA	-	4/28/2008	-	42	49.61	NA	410	<2.0	<1.5	<0.72	<2.3	<4.6	<4.3	<1.7	130	<50	<1.8	<5.0	<0.93	<2.2	<9.5	<2.6	<3.6	<4.1
	2	Routine	NA	-	12/1/2008	-	259	51.35	350	NA	<2.0	<1.5	<0.72	<2.3	<4.6	<4.3	<1.7	120	<50	<1.8	<5.0	<0.93	<2.2	<9.5	<2.6	<3.6	<4.1
LEO-11A	3	Passive	55	1/28/2008	3/17/2008	49	-	53.71	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	3	Passive	58	1/28/2008	3/17/2008	49	-	53.71	120	150	<0.2	<0.15	<0.072	<0.23	2.4	<0.43	<0.17	36	1.3j	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	3	Passive	61	1/28/2008	3/17/2008	49	-	53.71	120	140	<0.2	<0.15	<0.072	<0.23	2.7	<0.43	<0.17	38	1.5j	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	3	Passive	Average	NA	NA	NA	-	-	120	145	NC	NC	NC	NC	2.6	NC	NC	37	1.4j	NC	NC	NC	NC	NC	NC	NC	NC
	3	Routine	NA	-	4/21/2008	-	35	55.09	NA	120	<0.2	<0.15	<0.072	<0.23	2.3	<0.43	<0.17	36	<5.0	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	3	Routine	NA	-	11/21/2008	-	249	54.69	140	NA	<0.2	<0.15	<0.072	<0.23	3	<0.43	<0.17	46	<5.0	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
CTS-OW3	4	Passive	55	1/28/2008	3/17/2008	49	-	26.05	25	26	<0.2	<0.15	<0.072	<0.23	0.82	<0.43	<0.17	8.1	1.7j	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Passive	58	1/28/2008	3/17/2008	49	-	26.05	22	23	<0.2	<0.15	<0.072	<0.23	0.68	<0.43	<0.17	7	2.4j	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Passive	75	1/28/2008	3/17/2008	49	-	26.05	20	25	<0.2	<0.15	<0.072	<0.23	0.61	<0.43	<0.17	8.2	2.6j	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Passive	78	1/28/2008	3/17/2008	49	-	26.05	36	40	<0.2	<0.15	<0.072	<0.23	1.3	<0.43	<0.17	16	<1.2	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Passive	Average	NA	NA	-	-	-	25.8	28.5	NC	NC	NC	NC	0.9	NC	NC	9.8	1.8j	NC	NC	NC	NC	NC	NC	NC	NC
	4	Routine	NA	-	4/21/2008	-	35	25.47	NA	11	<0.2	<0.15	<0.072	<0.23	0.53	<0.43	<0.17	3.7	5.3	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Routine	NA	-	11/19/2008	-	247	27.22	27	NA	<0.2	<0.15	<0.072	<0.23	0.59	<0.43	<0.17	4.7	<5.0	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
FC-1020A	4	Passive	35	1/28/2008	3/17/2008	49	-	12.31	17	16	<0.2	<0.2	<0.072	<0.23	<0.46	<0.43	<0.17	0.67	1.6j	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Passive	40	1/28/2008	3/17/2008	49	-	12.31	16	17	<0.2	<0.2	<0.072	<0.23	<0.46	<0.43	<0.17	0.62	1.5j	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Passive	45	1/28/2008	3/17/2008	49	-	12.31	17	16	<0.2	<0.2	<0.072	<0.23	<0.46	<0.43	<0.17	0.57	<1.2	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Passive	50	1/28/2008	3/17/2008	49	-	12.31	18	18	<0.2	<0.2	<0.072	<0.23	<0.46	<0.43	<0.17	0.58	1.5j	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Passive	Average	NA	NA	-	-	-	17	16.8	NC	NC	NC	NC	NC	NC	NC	0.61	1.3j	NC	NC	NC	NC	NC	NC	NC	NC
	4	Routine	NA	-	4/23/2008	-	37	14.74	NA	13	<0.2	<0.2	<0.072	<0.23	<0.46	<0.43	<0.17	0.72	5.2	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.36	<0.41
	4	Routine	NA	-	11/19/2008	-	247	16.52	23	NA	<0.2	<0.2	<0.072	<0.23	<0.46	<0.43	<0.17	0.74	<5.0	<0.18	<0.50	<0.093	<0.22	<0.95	<0.26	<0.41	<0.41

Notes:
* - Indicates lab reporting limit elevated due to sample matrix.
j - Indicates estimated trace concentration (between MDL and PQL).
NA - Not applicable.
NC - Not calculated.

FIGURES

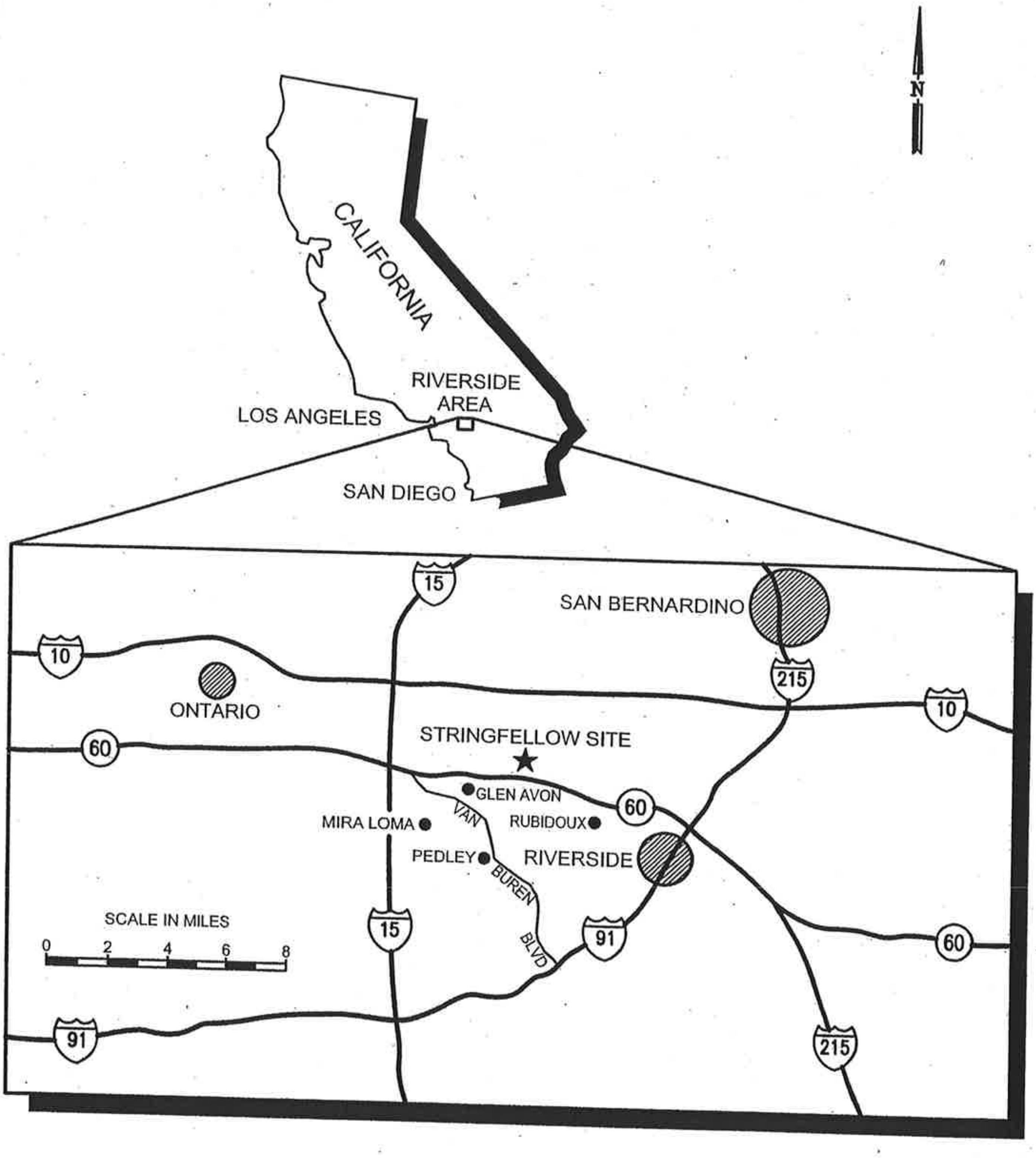


Figure 1-1 Project Location Plan

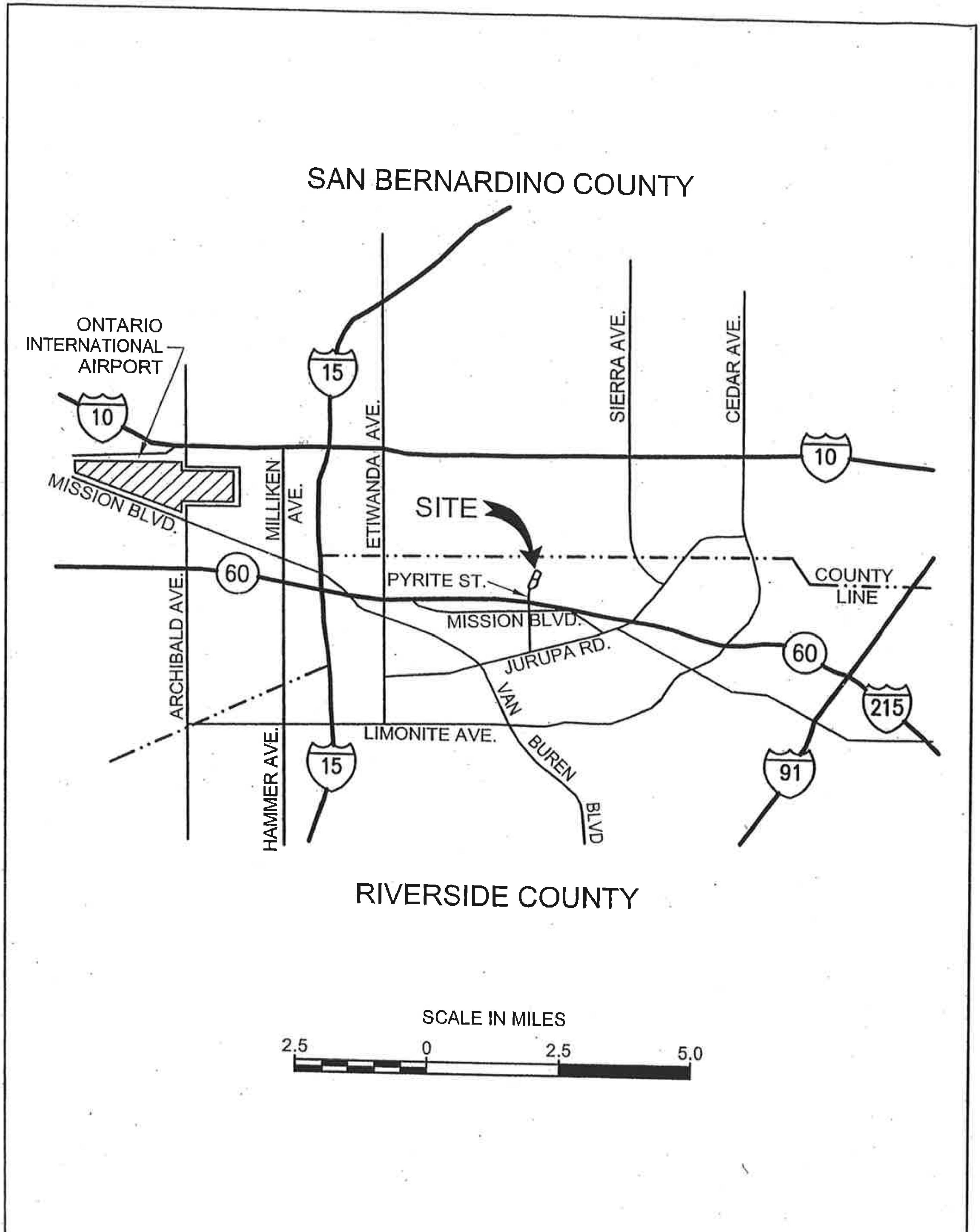


Figure 1-2 Site Vicinity

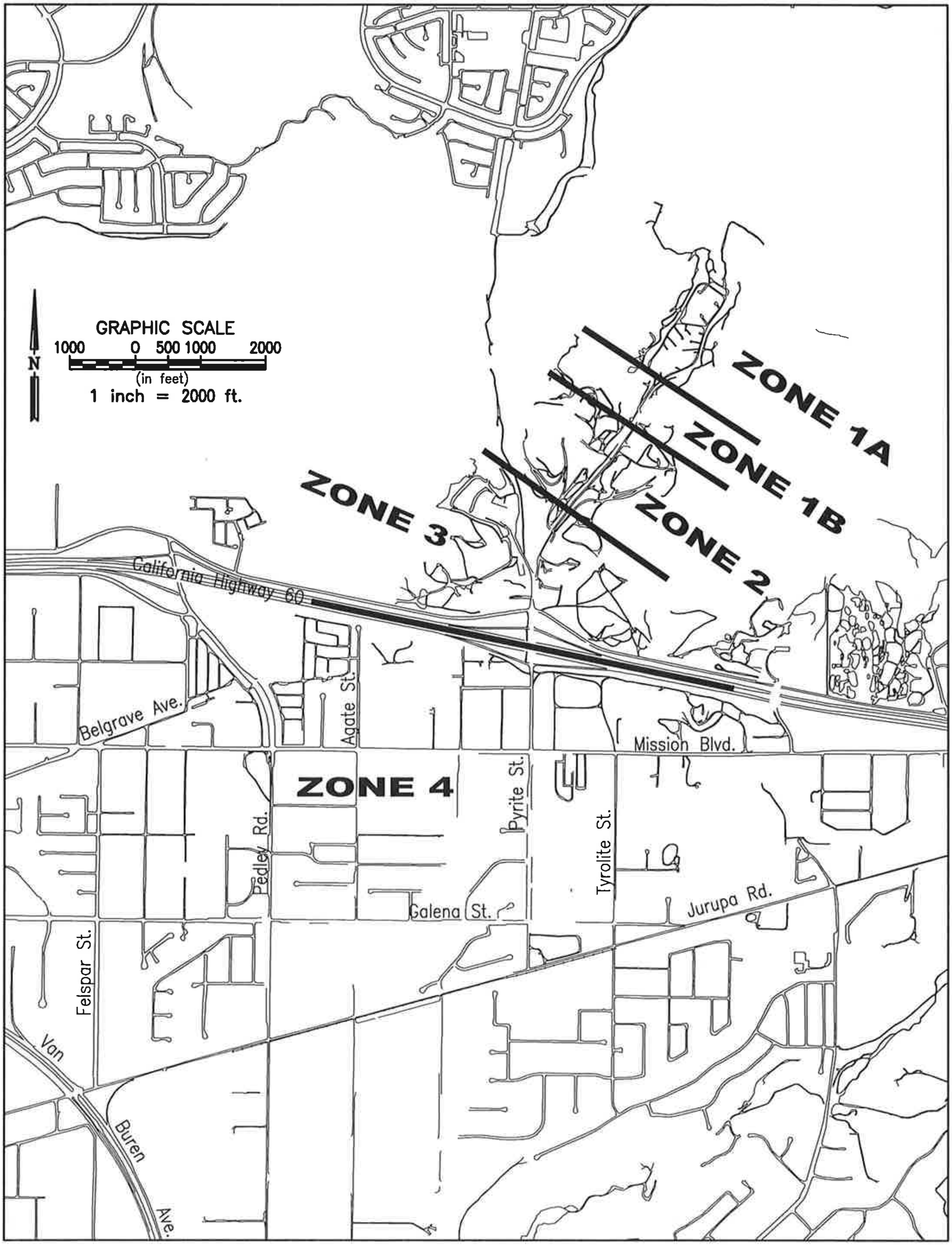


Figure 1-3 Location of Zones 1 - 4

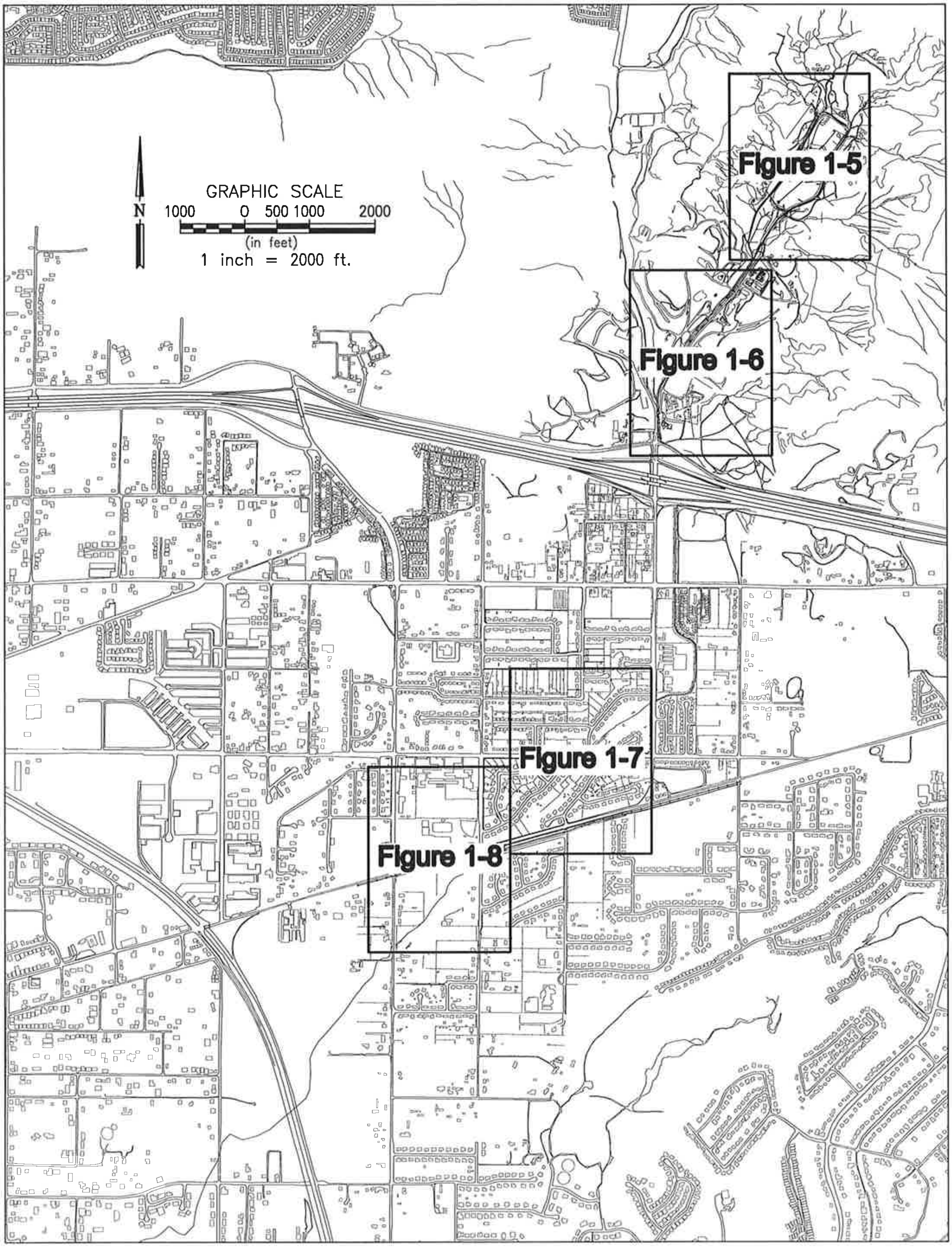


Figure 1-4 Index Map - Passive Sampler Pilot Study, May 2008

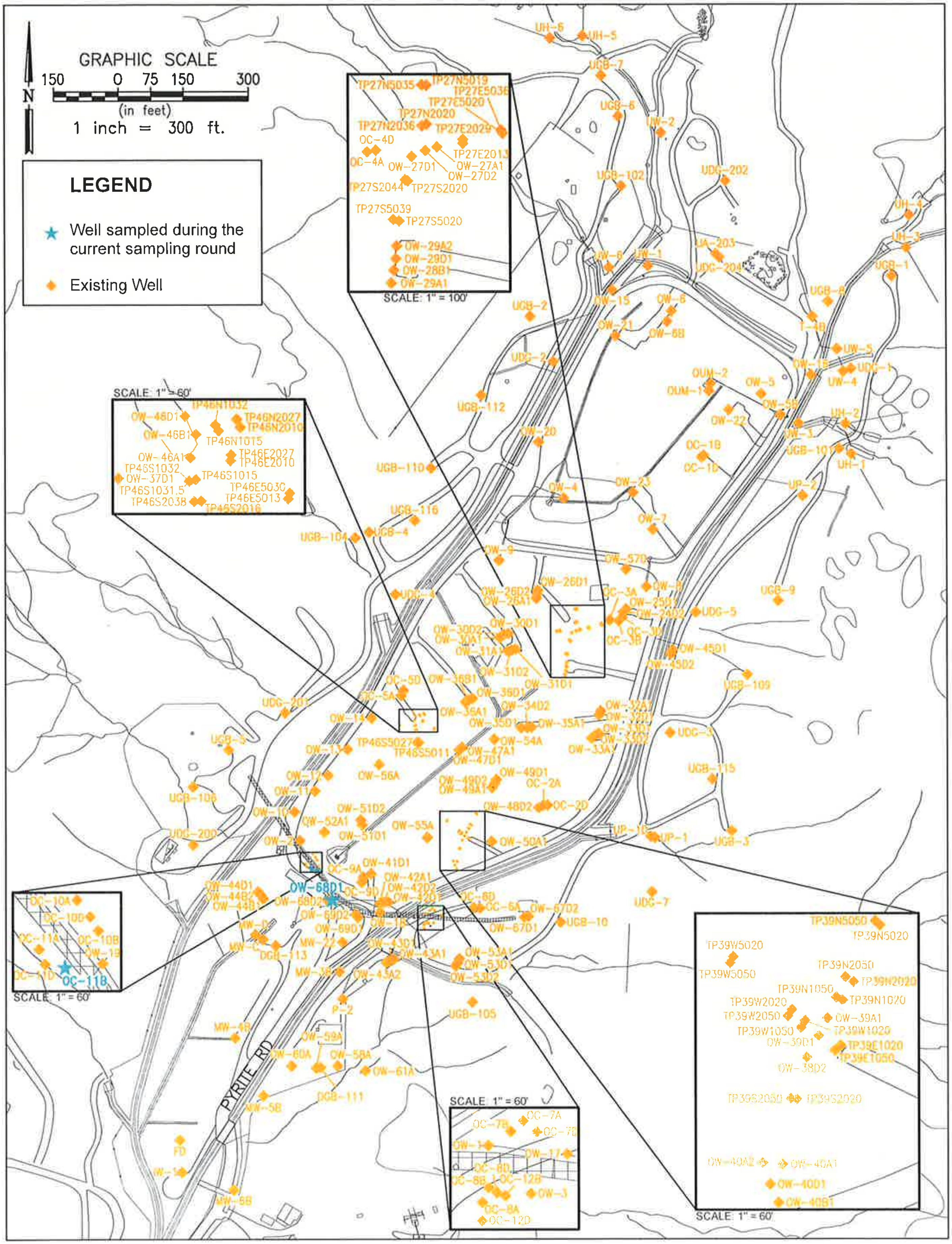


Figure 1-5 Zones 1A and 1B Well Location Map - Passive Sampler Pilot Study, May 2008

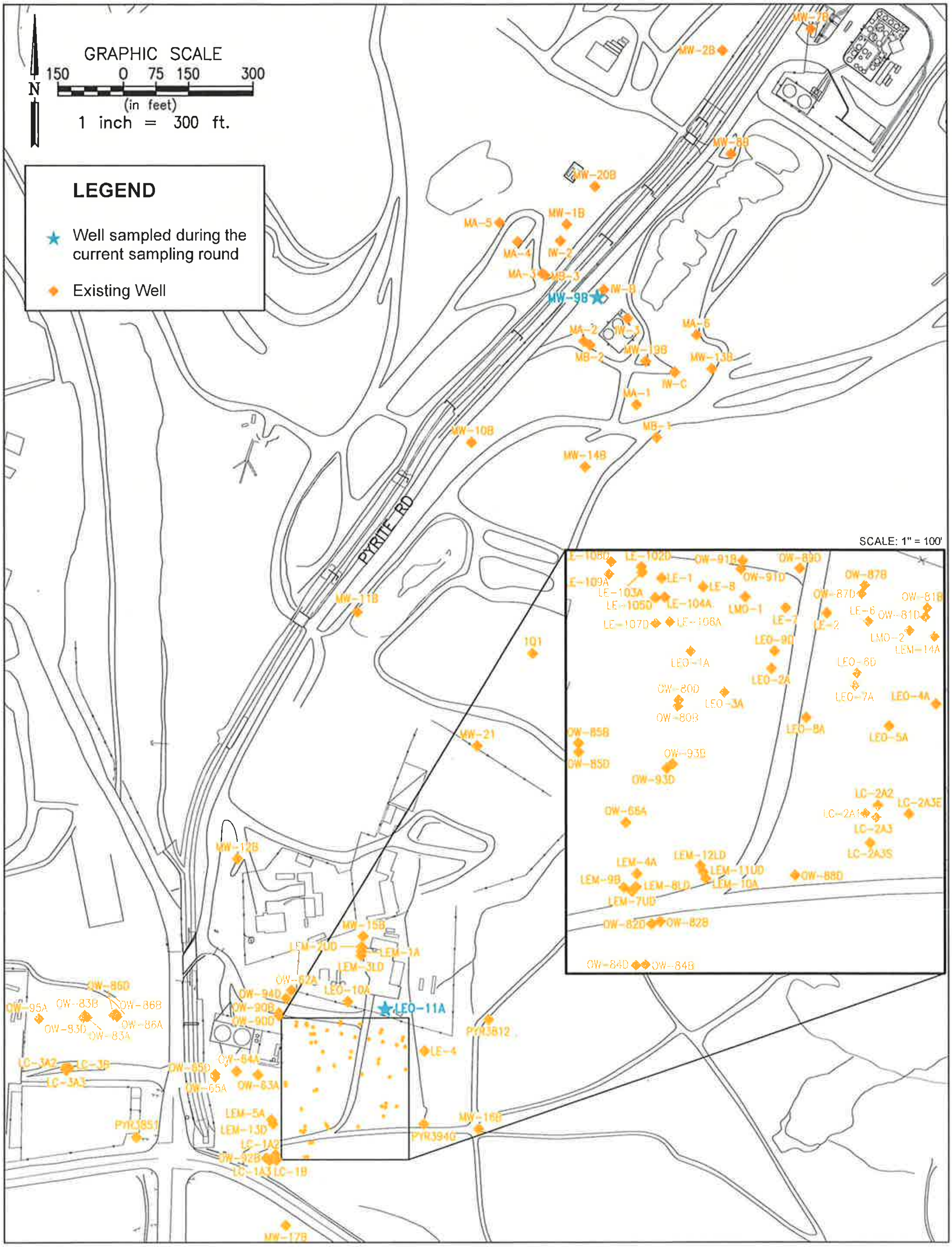


Figure 1-6 Zones 2 and 3 Well Location Map - Passive Sampler Pilot Study, May 2008

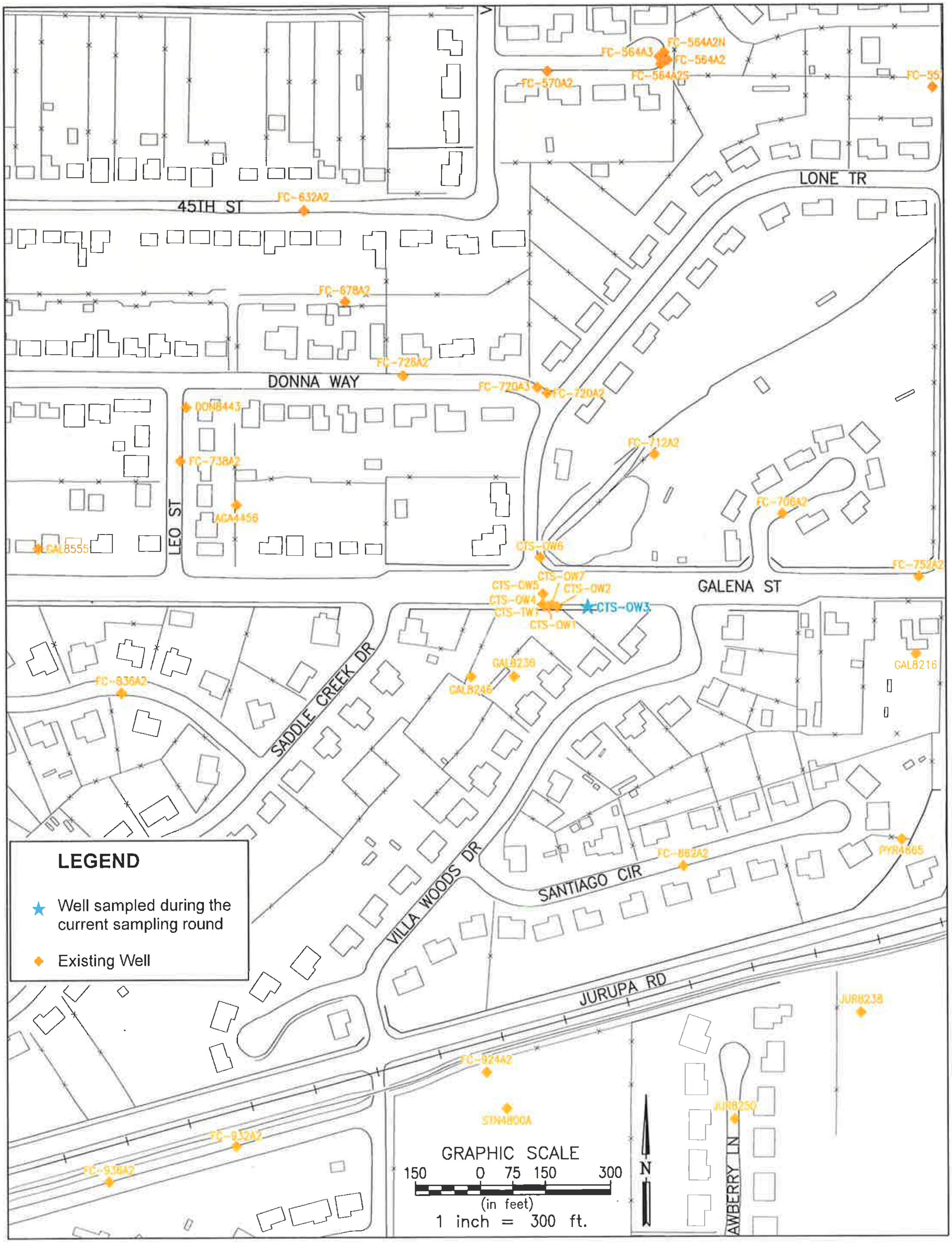


Figure 1-7 Upgradient Zone 4 Well Location Map - Passive Sampler Pilot Study, May 2008

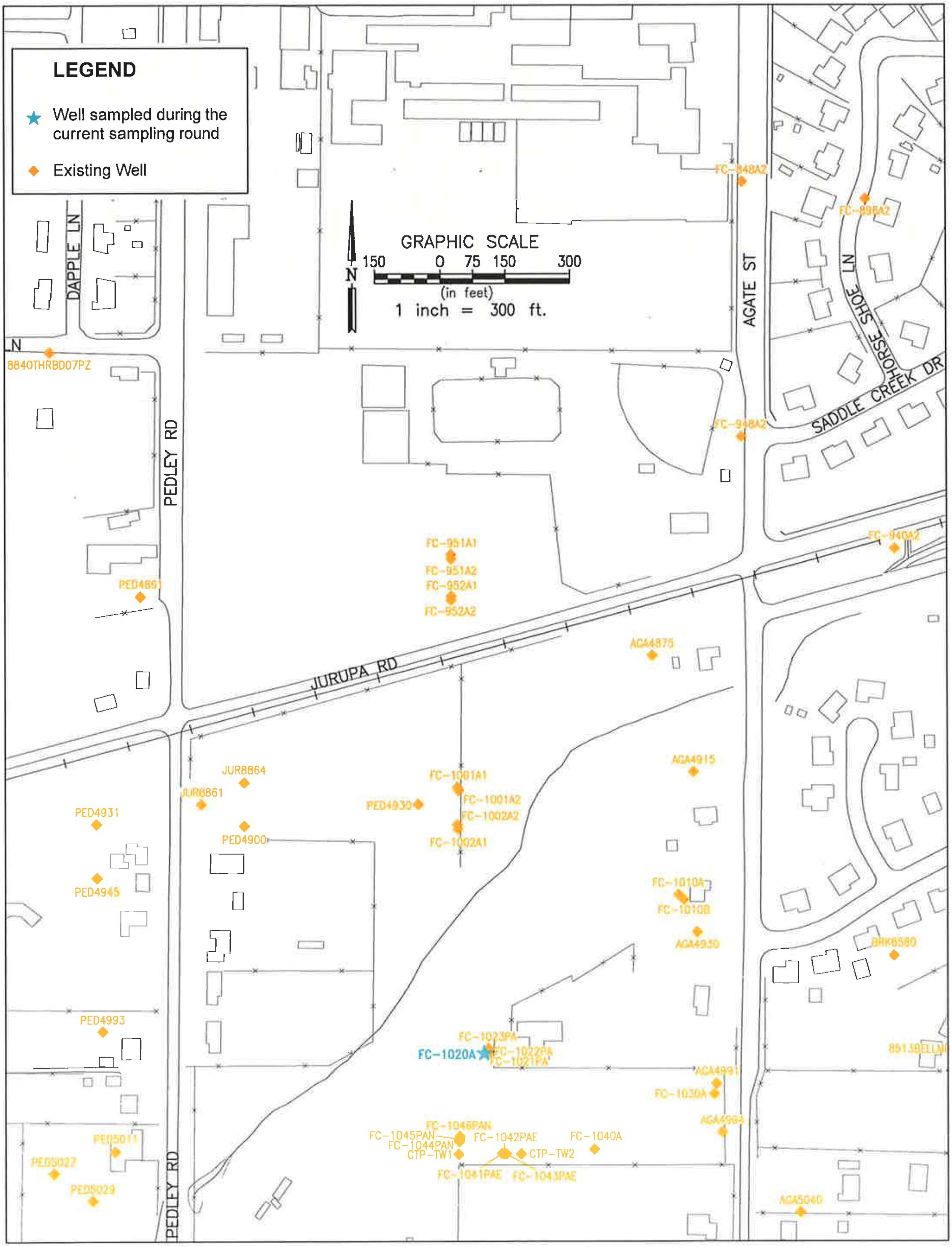
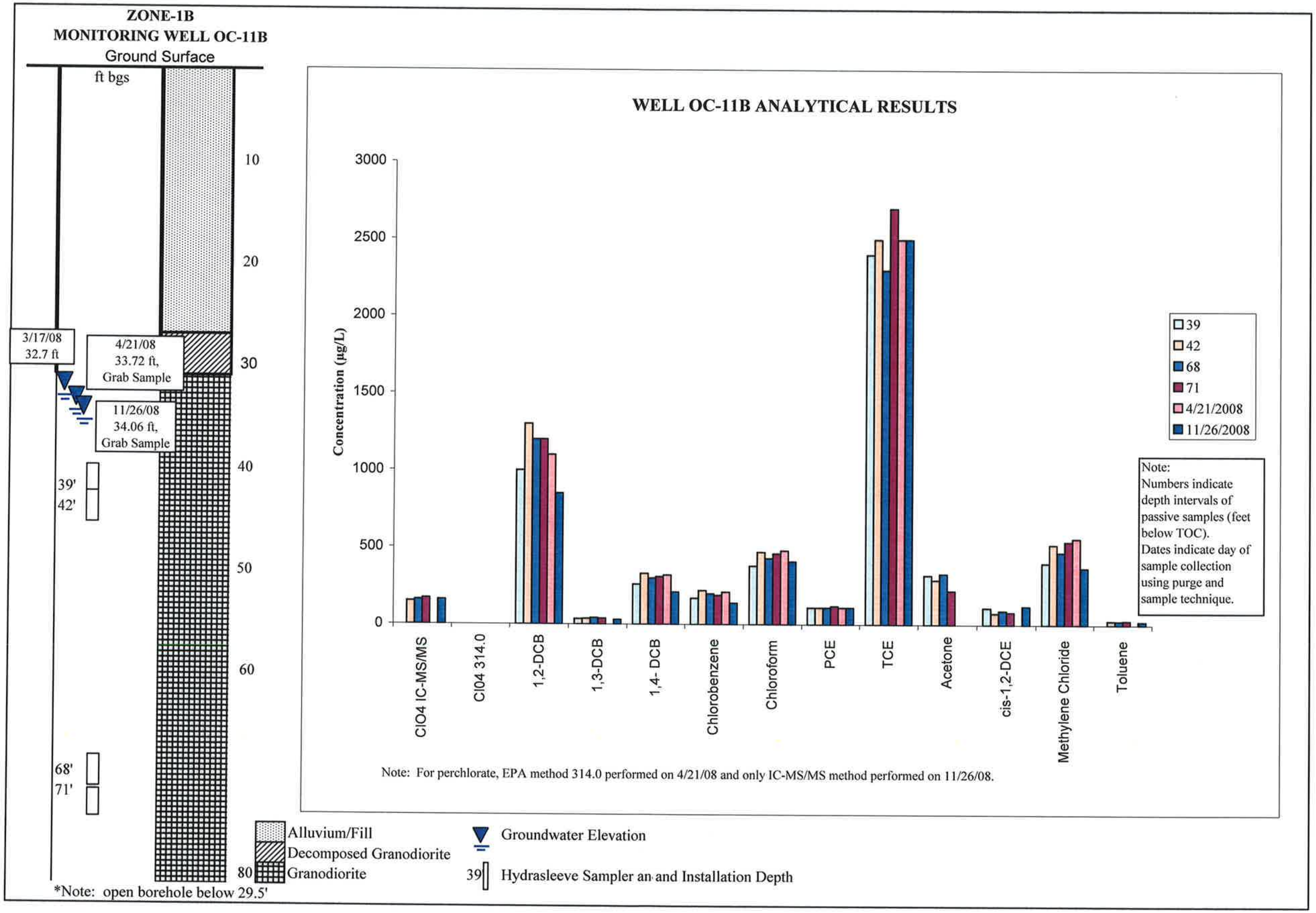


Figure 1-8 Downgradient Zone 4 Well Location Map - Passive Sampler Pilot Study, May 2008

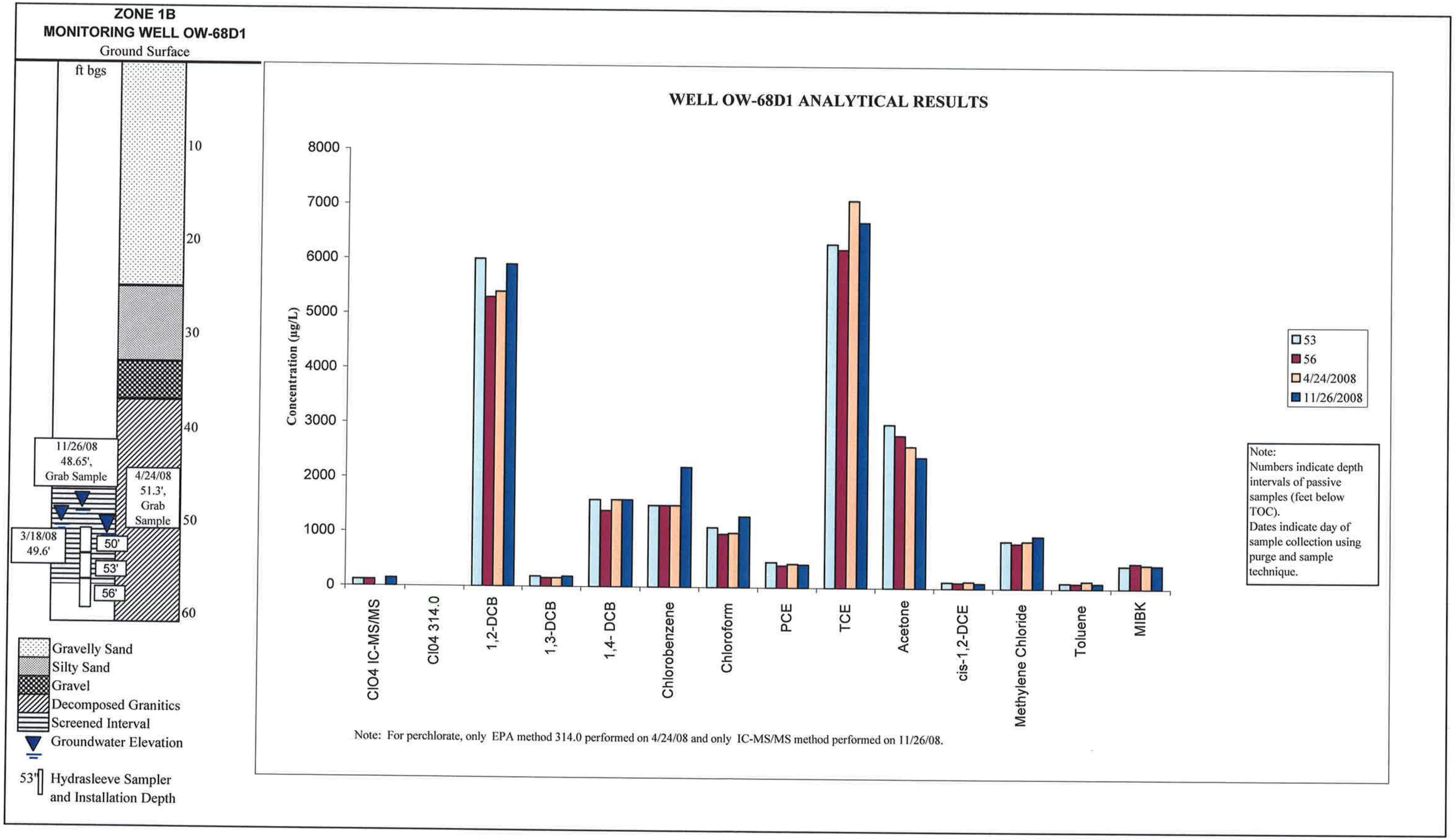


Note:
Numbers indicate depth intervals of passive samples (feet below TOC).
Dates indicate day of sample collection using purge and sample technique.

Note: For perchlorate, EPA method 314.0 performed on 4/21/08 and only IC-MS/MS method performed on 11/26/08.

*Note: open borehole below 29.5'

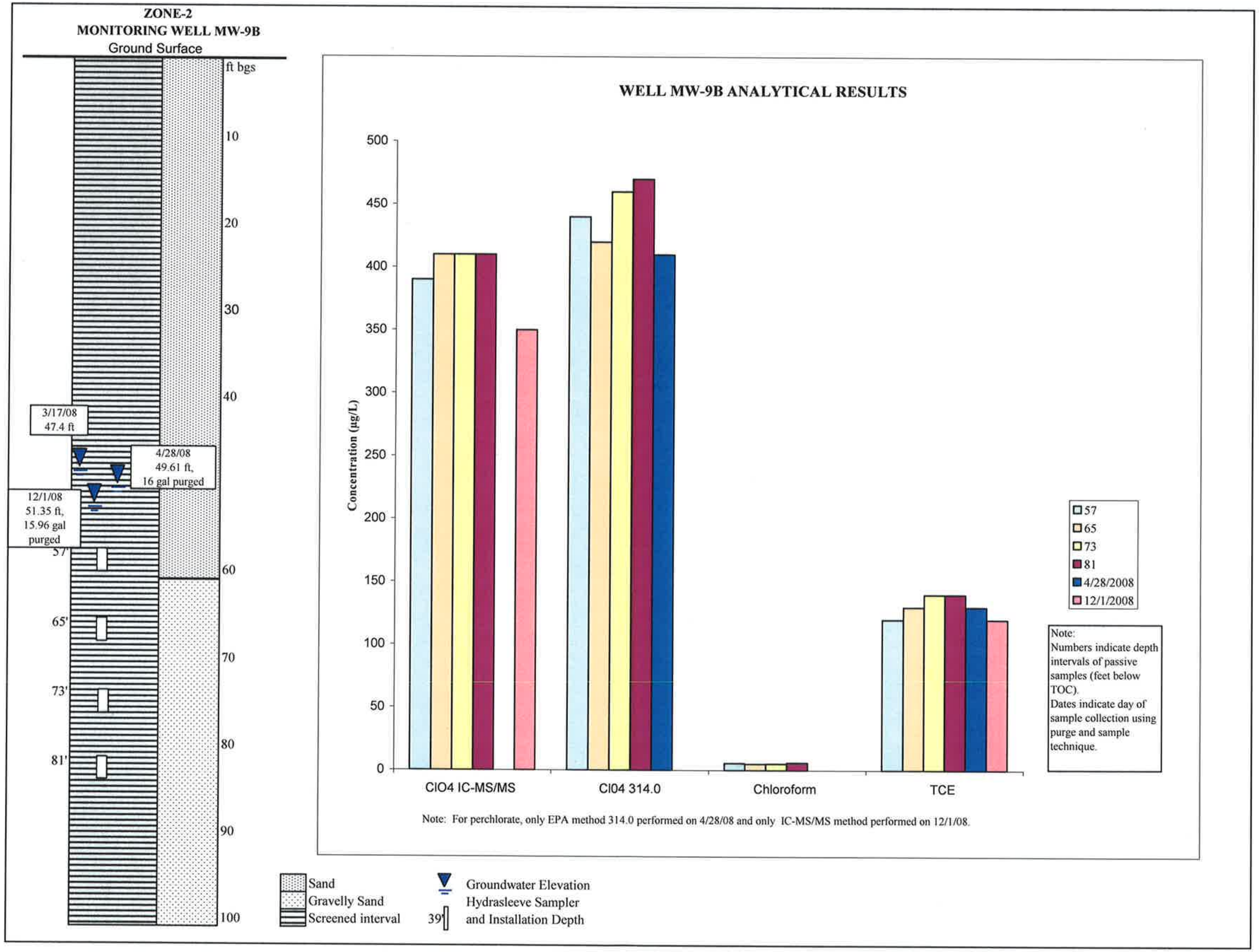
FIGURE 3-1 WELL OC-11B RESULTS



Note: Numbers indicate depth intervals of passive samples (feet below TOC). Dates indicate day of sample collection using purge and sample technique.

Note: For perchlorate, only EPA method 314.0 performed on 4/24/08 and only IC-MS/MS method performed on 11/26/08.

FIGURE 3-2 WELL OW-68D1 RESULTS



Note: Numbers indicate depth intervals of passive samples (feet below TOC). Dates indicate day of sample collection using purge and sample technique.

Note: For perchlorate, only EPA method 314.0 performed on 4/28/08 and only IC-MS/MS method performed on 12/1/08.

FIGURE 3-3 WELL MW-9B RESULTS

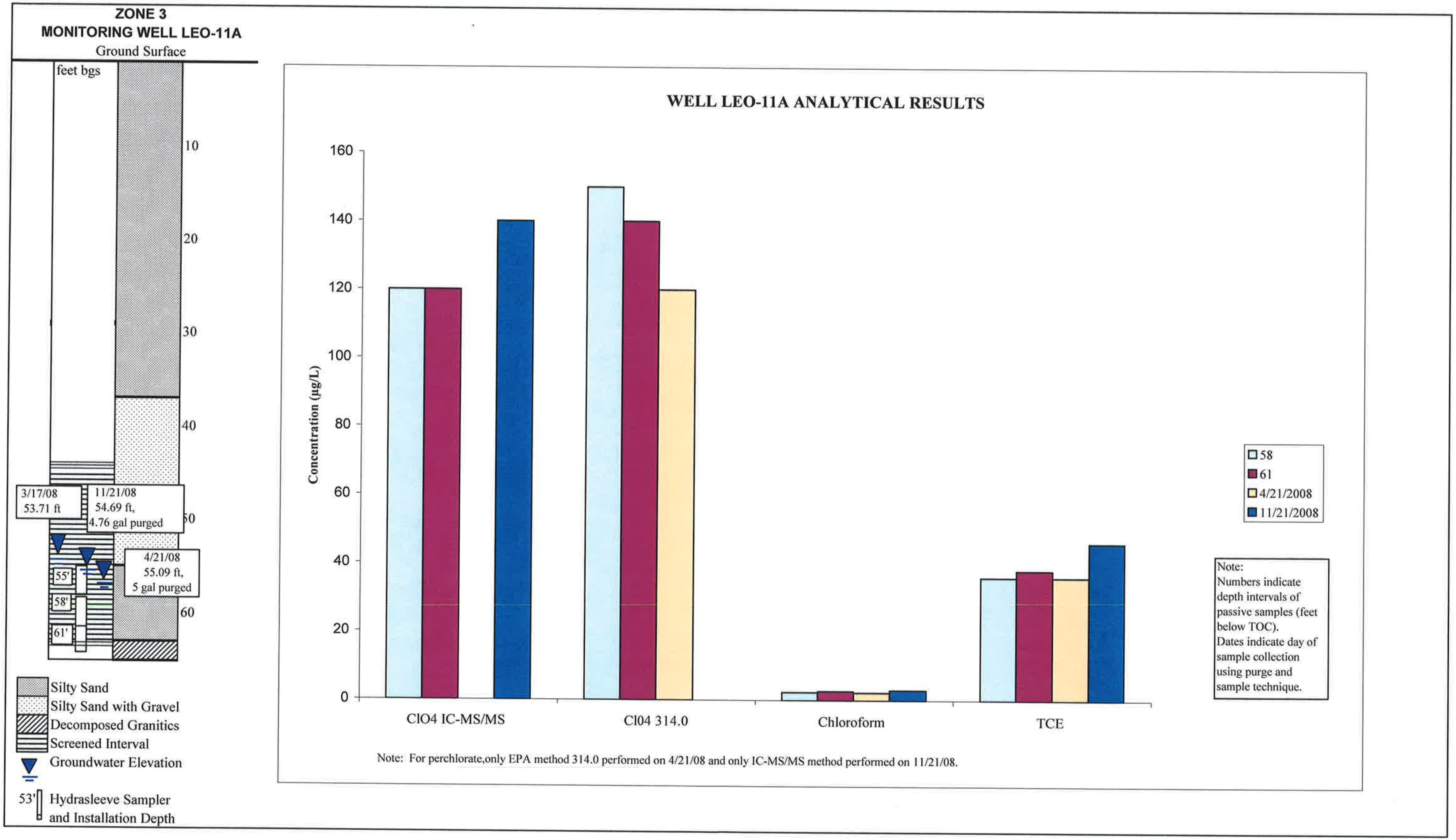


FIGURE 3-4 WELL LEO-11A RESULTS

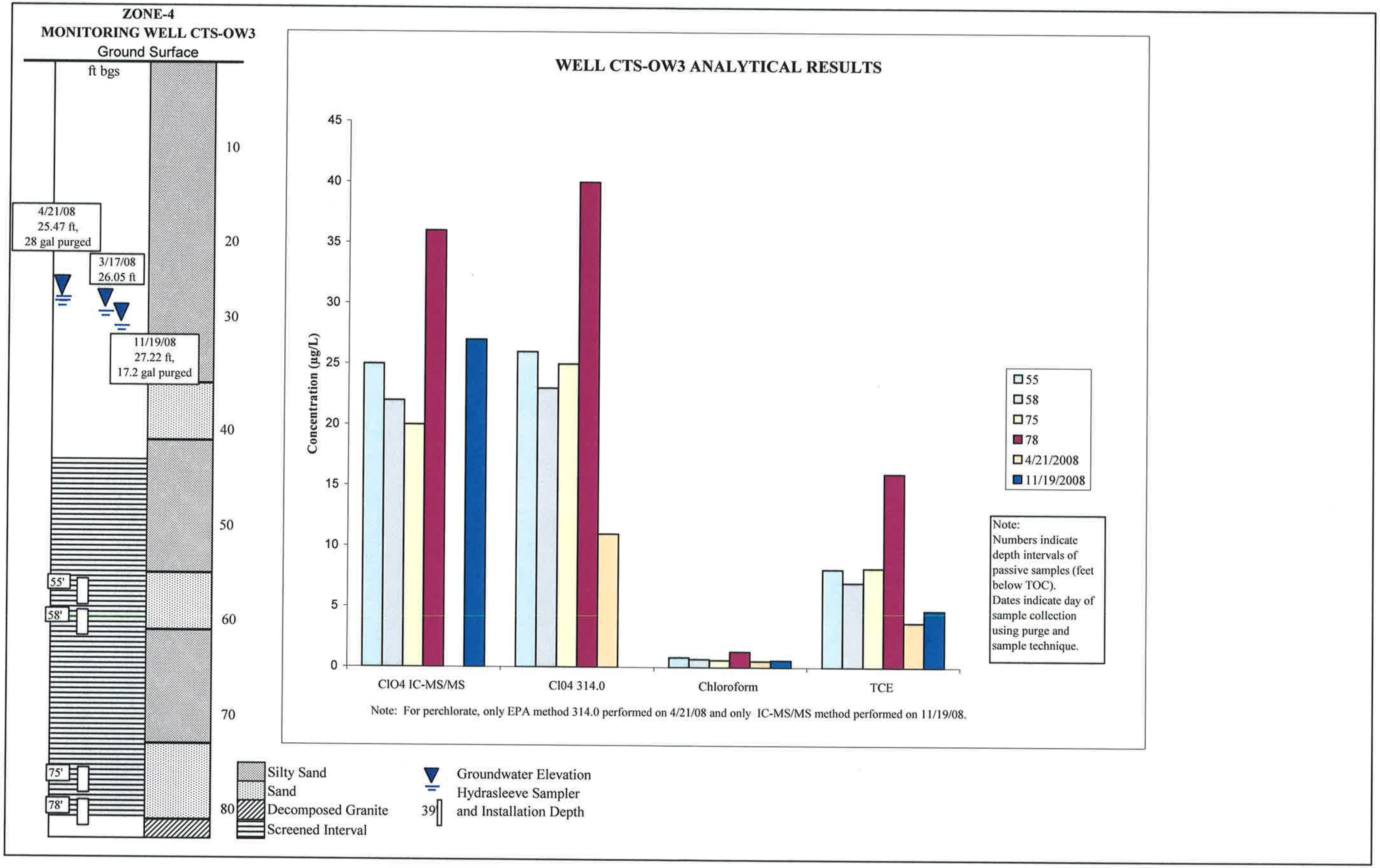
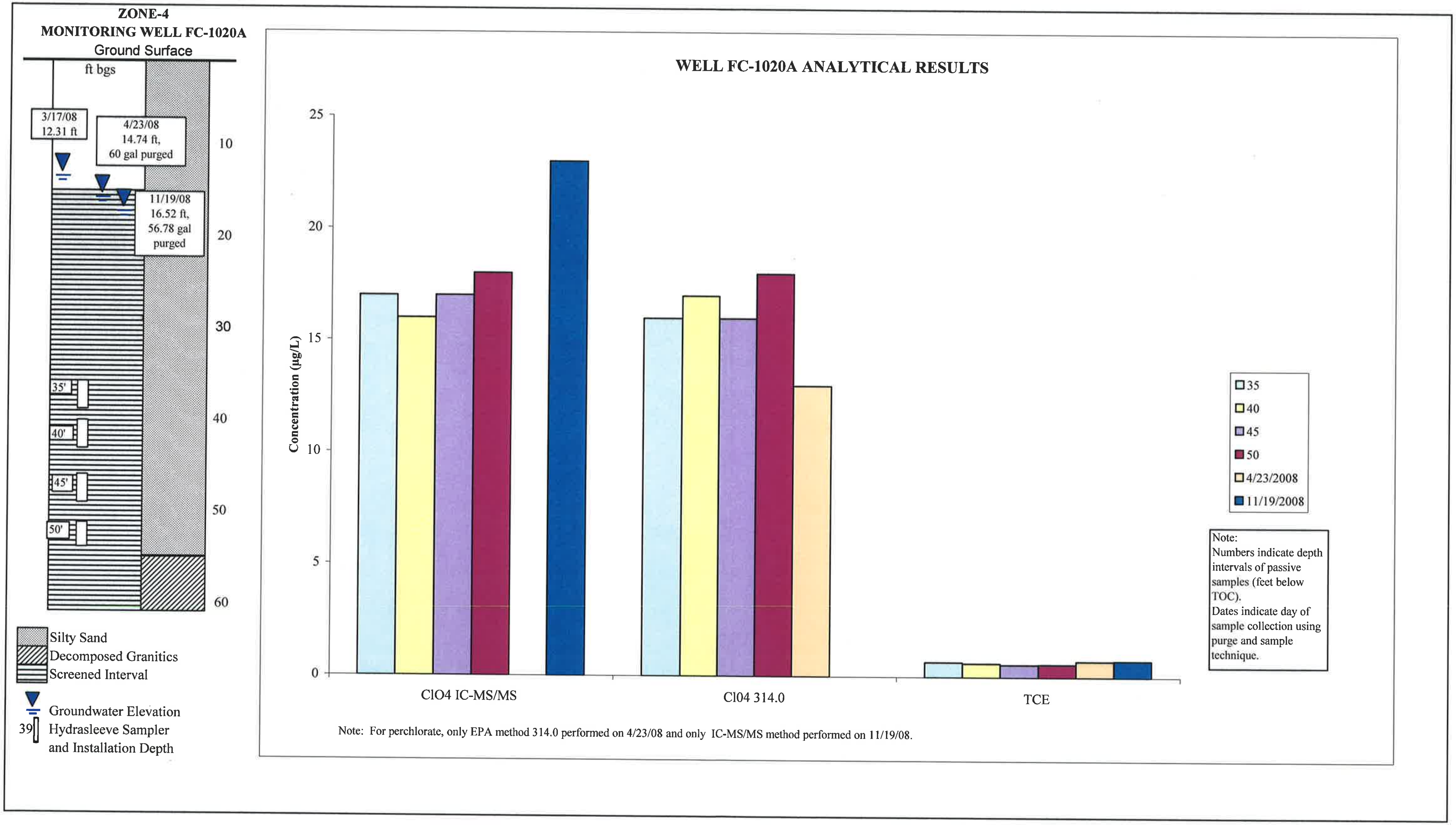


FIGURE 3-5 WELL CTS-OW3 RESULTS



Note:
Numbers indicate depth intervals of passive samples (feet below TOC).
Dates indicate day of sample collection using purge and sample technique.

Note: For perchlorate, only EPA method 314.0 performed on 4/23/08 and only IC-MS/MS method performed on 11/19/08.

FIGURE 3-6 WELL FC-1020A RESULTS

FIGURE 3-7
COMPARISON OF PERCHLORATE CONCENTRATIONS IN PASSIVE SAMPLES

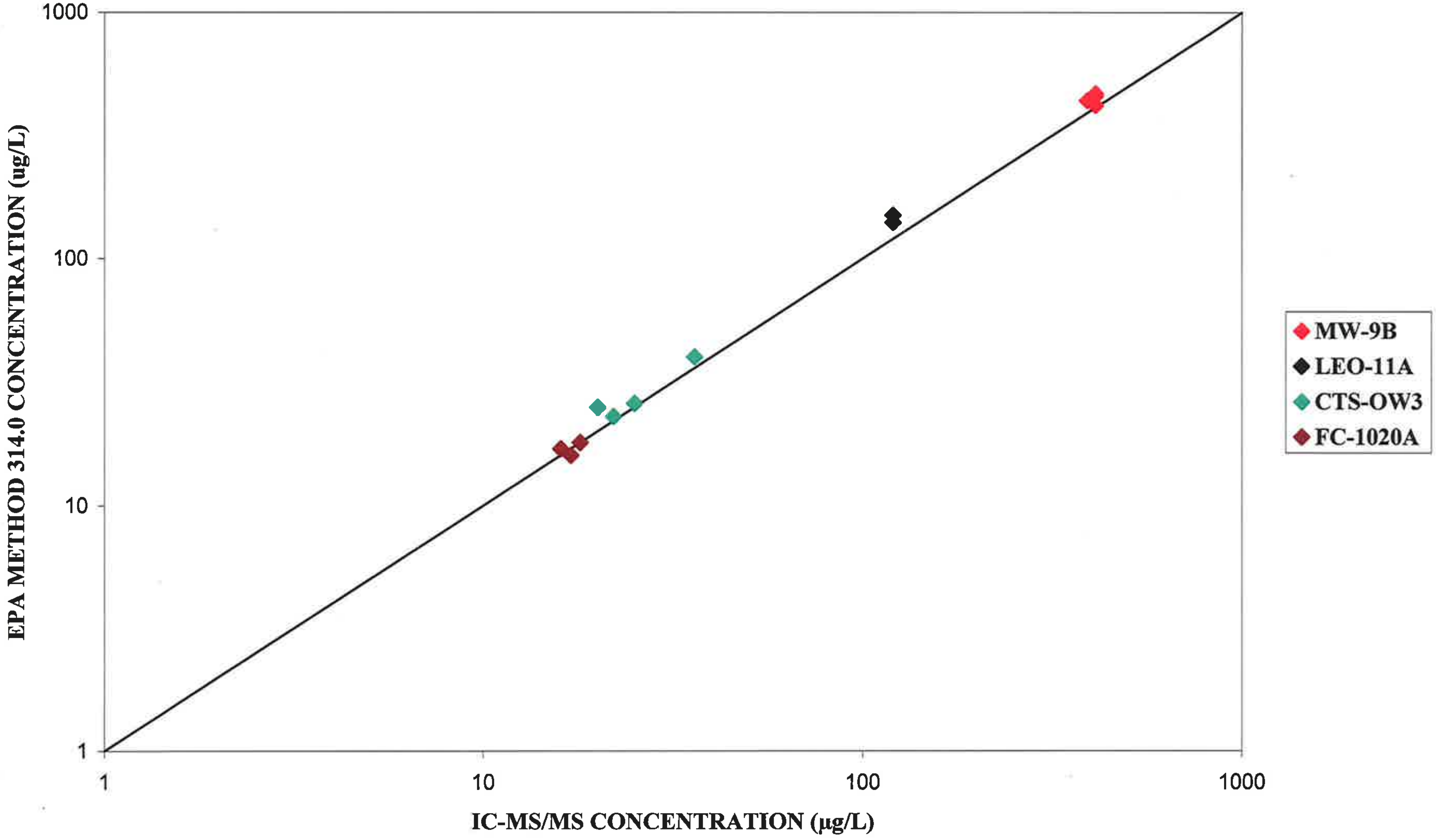


FIGURE 3-8
COMPARISON OF PERCHLORATE (EPA METHOD 314.0) CONCENTRATIONS

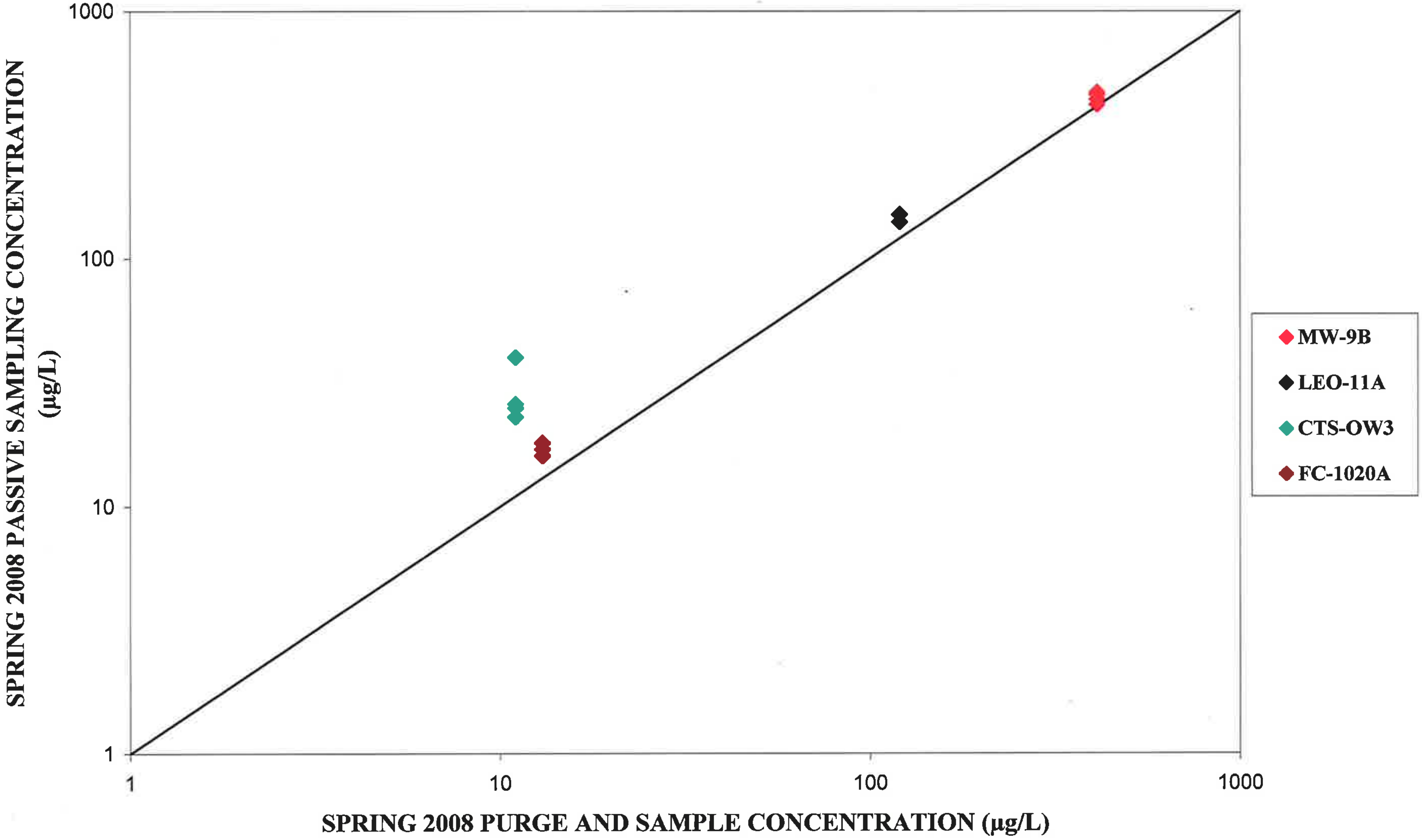


FIGURE 3-9
COMPARISON OF PERCHLORATE (IC-MS/MS) CONCENTRATIONS

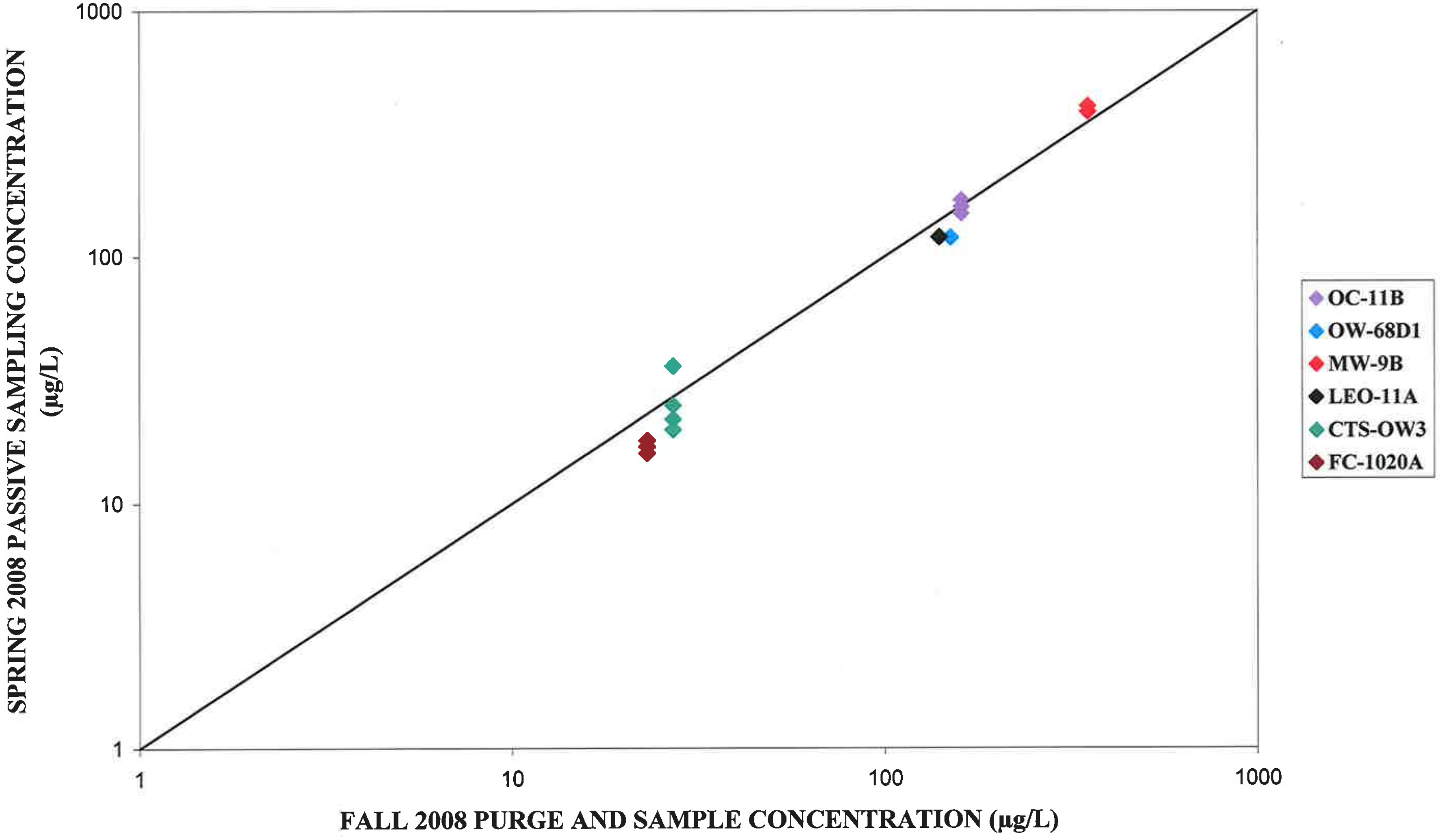


FIGURE 3-10
COMPARISON OF PCE CONCENTRATIONS

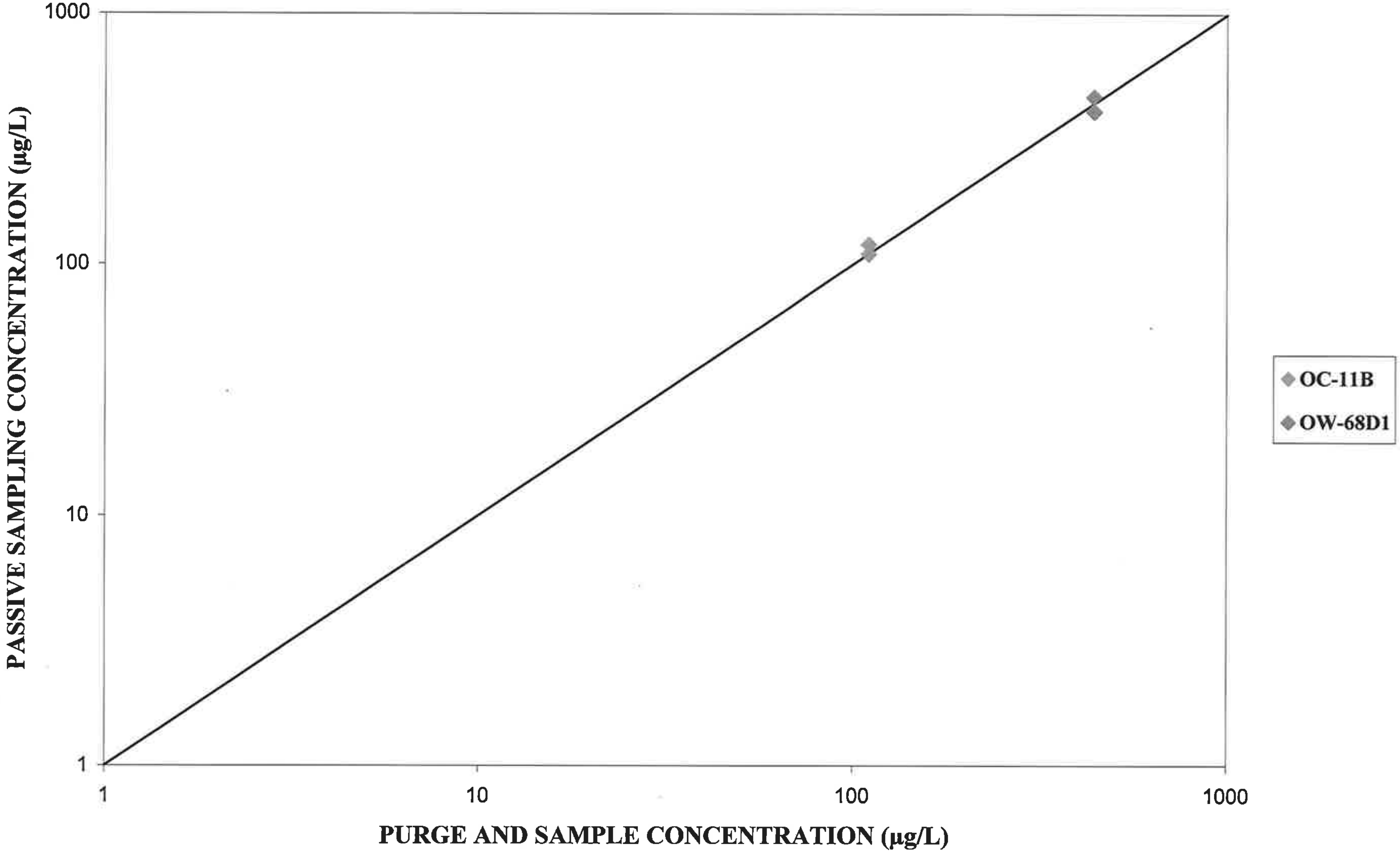


FIGURE 3-11
COMPARISON OF TCE CONCENTRATIONS

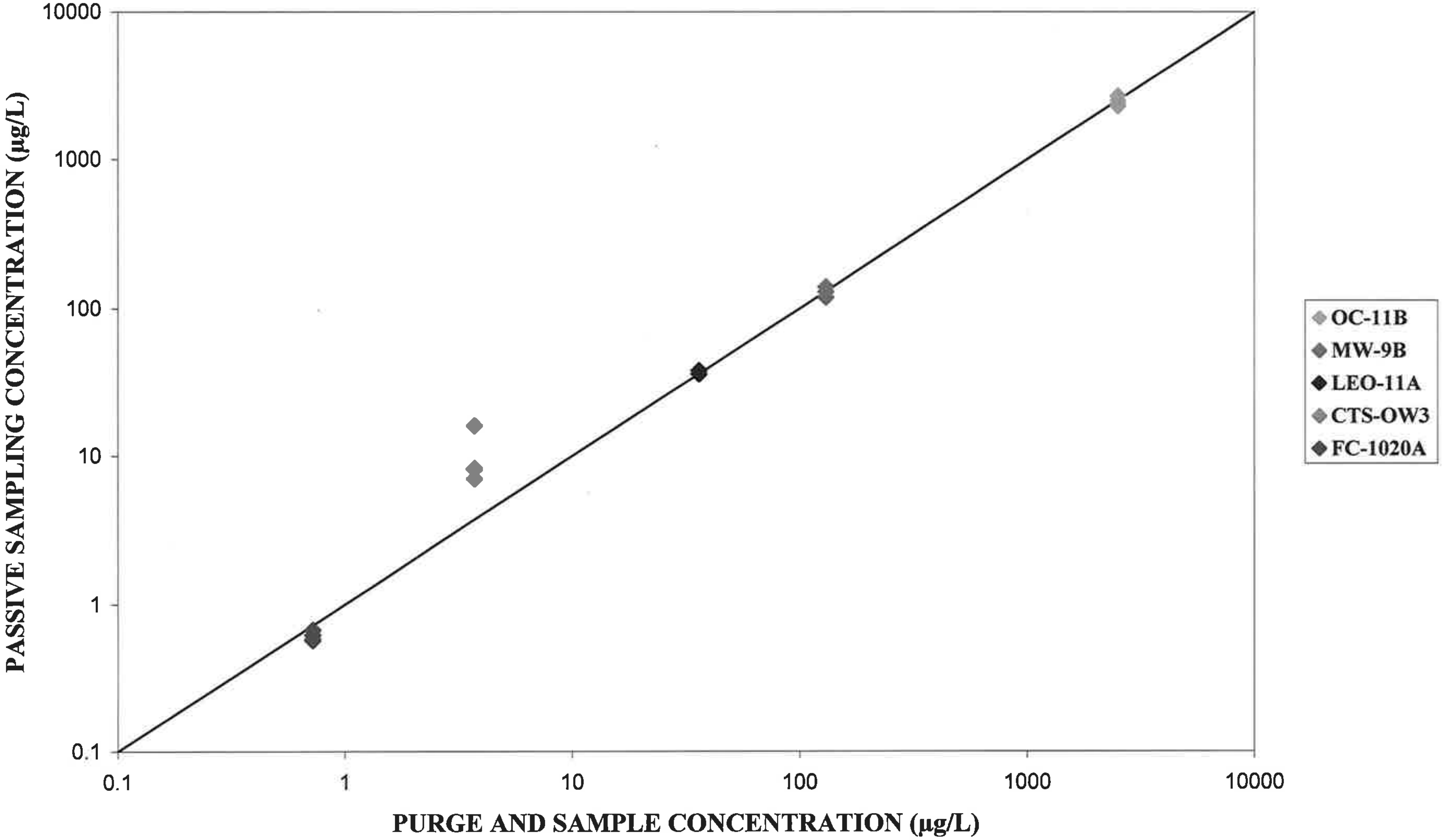


FIGURE 3-12
COMPARISON OF CHLOROFORM CONCENTRATIONS

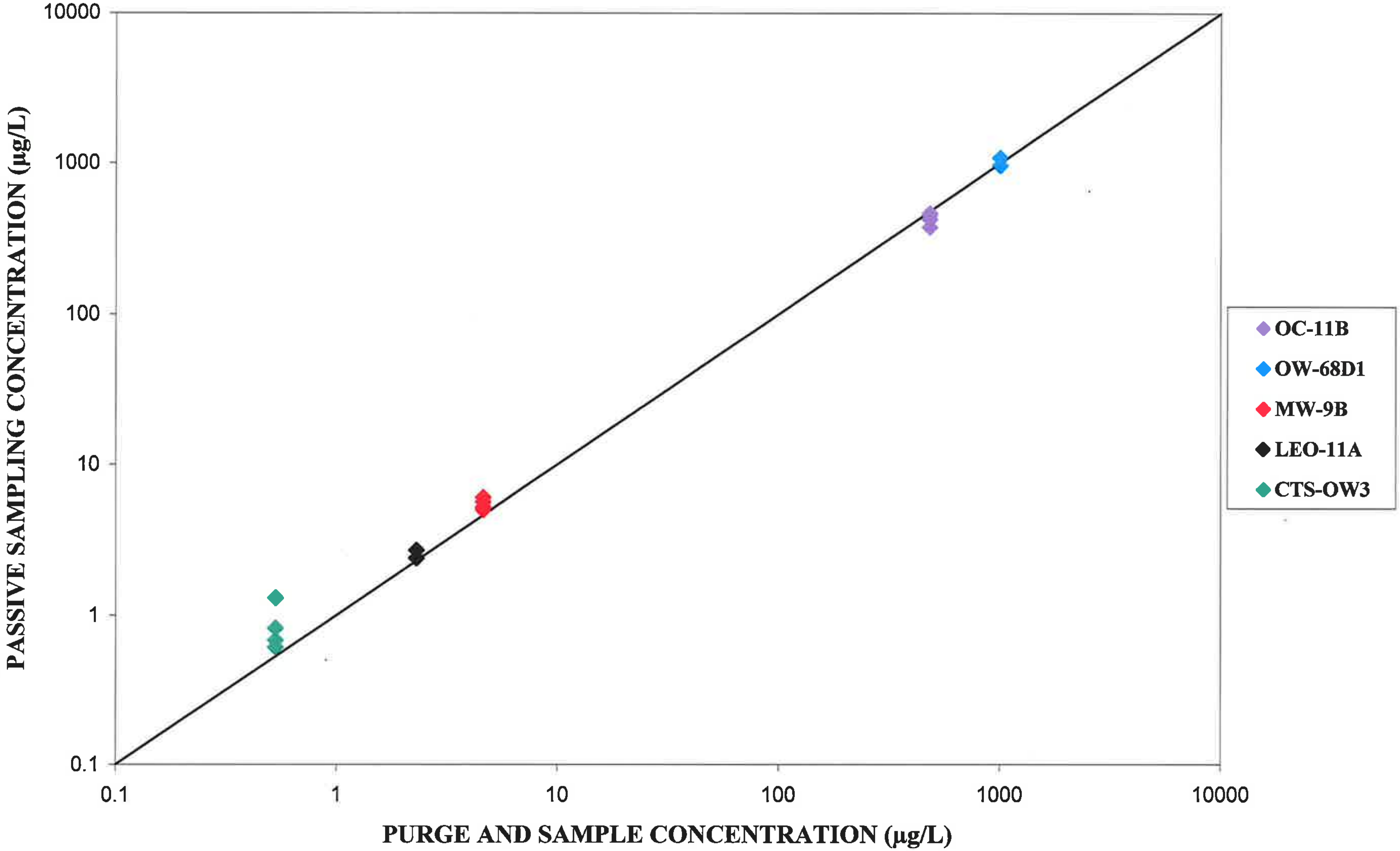


FIGURE 3-14
COMPARISON OF METHYLENE CHLORIDE CONCENTRATIONS

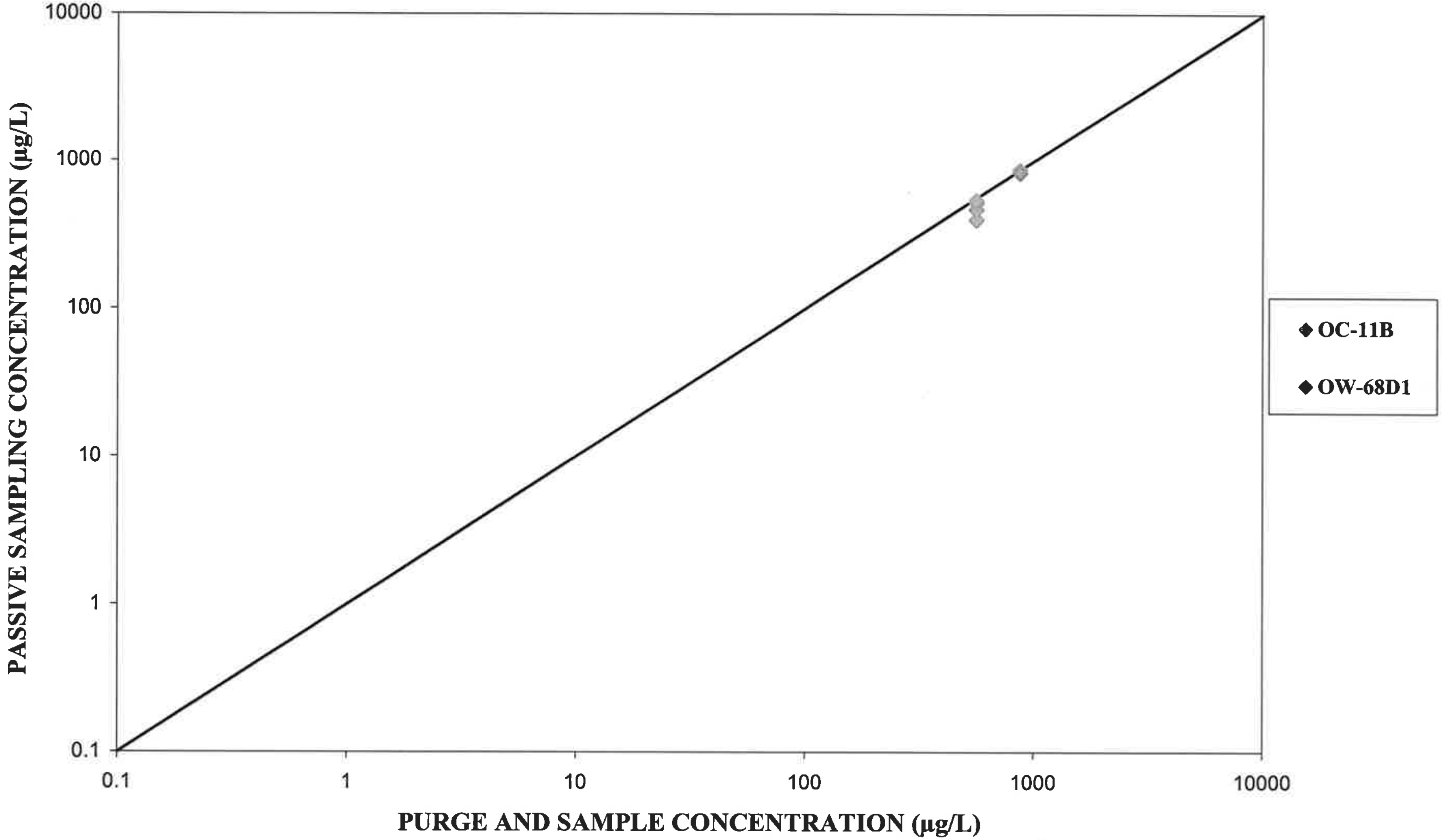
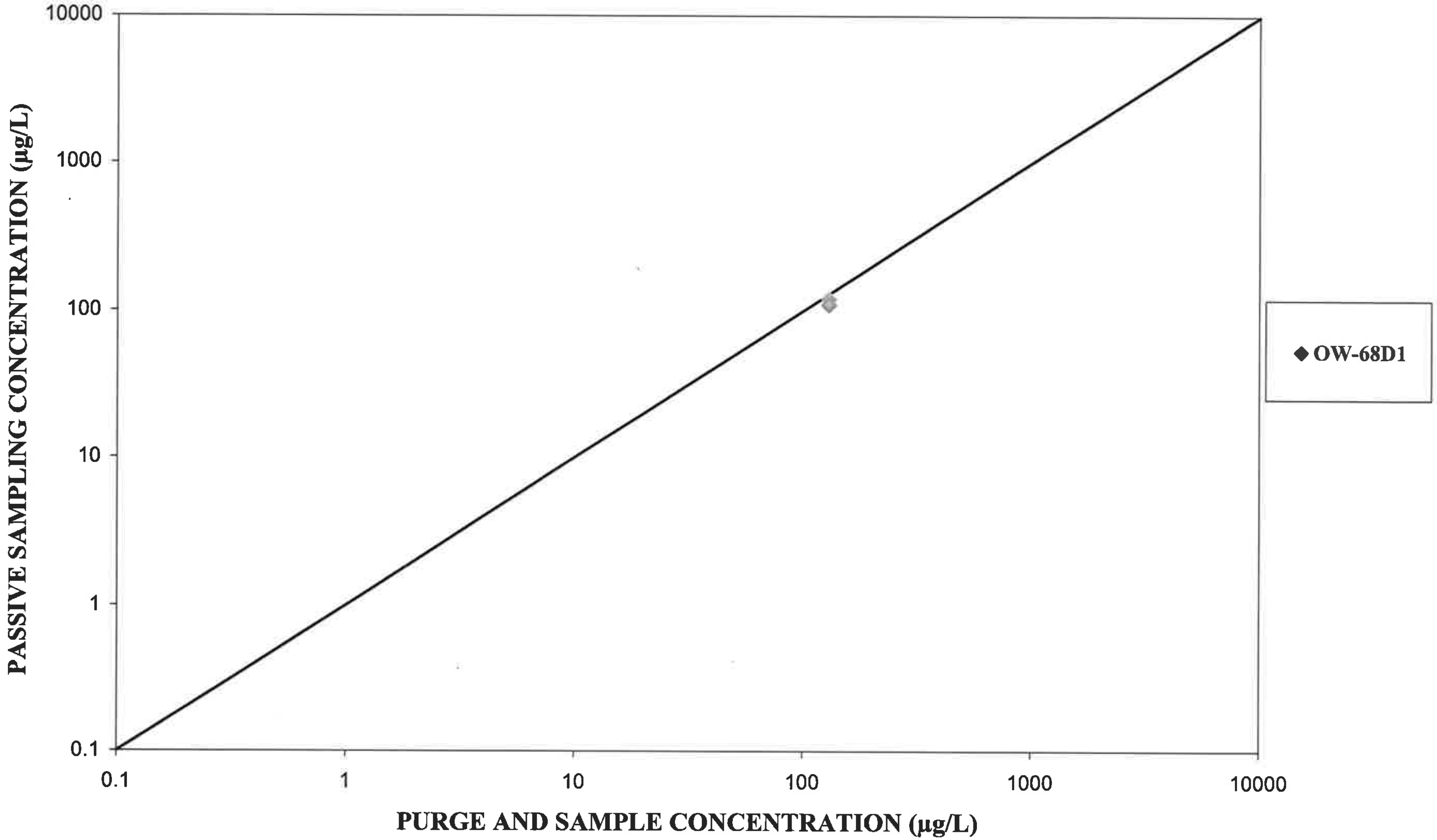


FIGURE 3-13
COMPARISON OF CIS-1,2-DCE CONCENTRATIONS



APPENDIX A

LITHOLOGIC LOGS

TETRA TECH BORING LOG

BORING I.D. NO. OW-68D2

Page 1 of 2

CLIENT DTSC T.C. 10740-02 LOCATION Stringfellow DATE 12/27/89

DRILL METHOD MUD ROTARY AUGER DIAMETER 2.4" FIELD GEOLOGIST Stephen Anderson

DEPTH (feet)	BLOW COUNT	OVA (ppm)	USCS	GEOLOGIC DESCRIPTION
			GW	GRAVELLY SAND - Yellowish Brown (10YR 5/6), well-graded fine-to coarse-grained sand with angular gravel, dry.
5		0.0		Gravelly sand as above.
10		0.0		Gravelly sand as above.
15		0.0		Gravelly sand as above.
20		0.0		Gravelly sand as above.
25		0.0	SM	SILTY SAND - Yellowish Brown (10YR 5/4), poorly graded fine grained sand with 20% silt, dry.
30		0.0		
			GP	GRAVEL
35		N/R	DGr	DECOMPOSED GRANITICS - Friable, crumbles to a coarse sand.
			Ms	METASEDIMENTS
			DGr	
40				

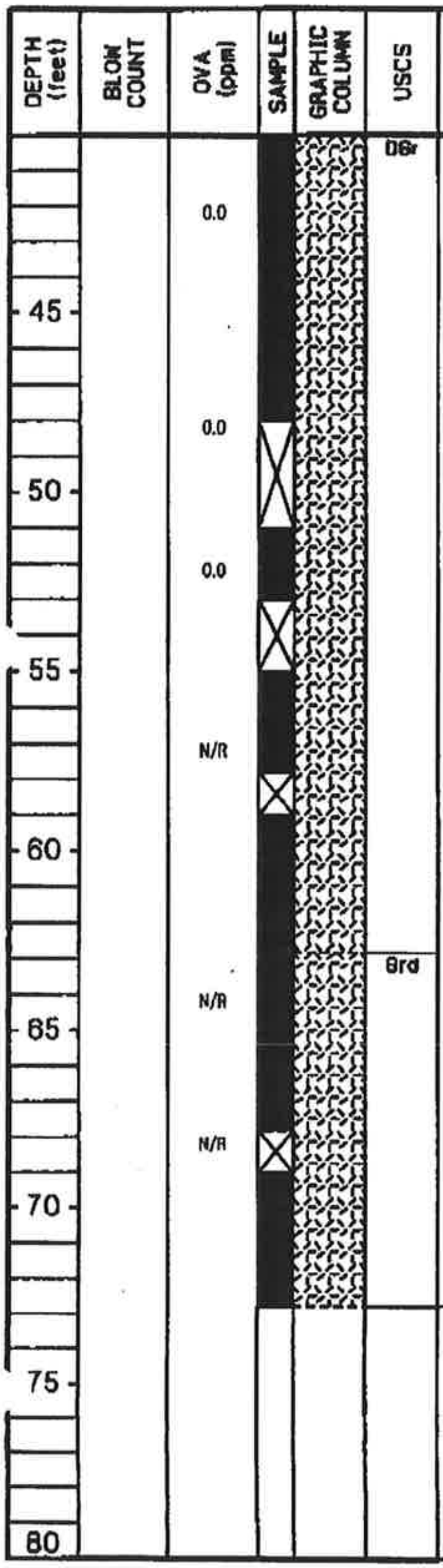
REVIEWING GEOLOGIST Stephen Anderson SIGNATURE Stephen Anderson REG. NO. 4591

TETRA TECH BORING LOG

BORING I.D. NO. OW-68D2

Page 2 of 2

CLIENT DTSC
T.C. 10740-02
LOCATION Stringfellow
DATE 12/27/99
DRILL METHOD MUD ROTARY
AUGER DIAMETER 2.4"
FIELD GEOLOGIST Stephen Anderson

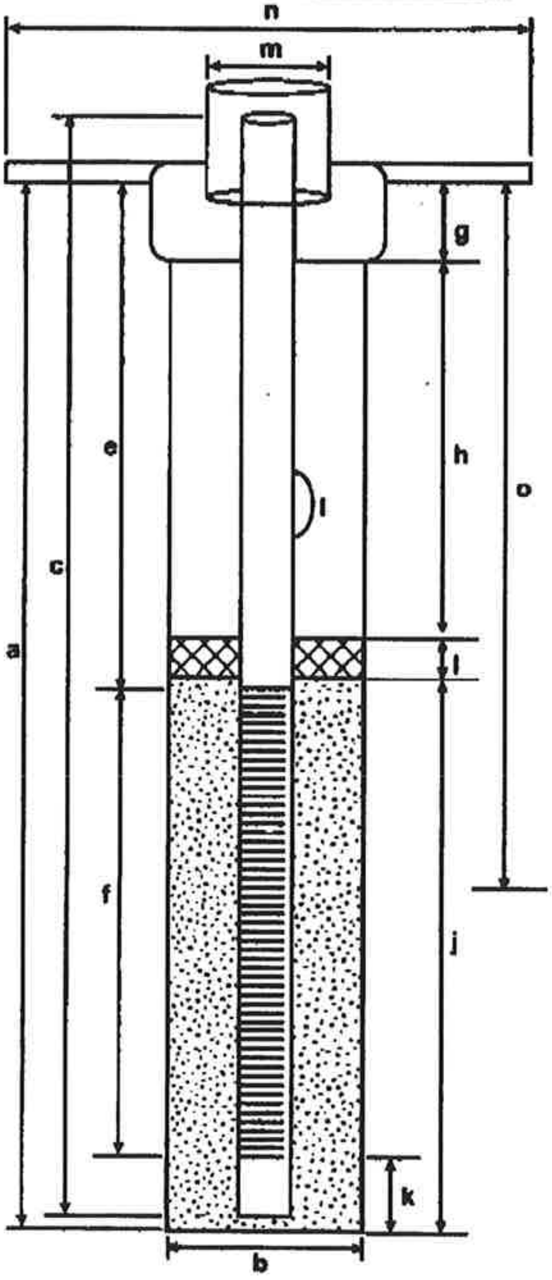


DEPTH (feet)	BLOW COUNT	OVA (ppm)	USCS	GEOLOGIC DESCRIPTION
			DGr	
		0.0		
				DECOMPOSED GRANITICS - (Granodiorite) fractures at 45 degrees from horizontal, mafics are mostly weathered and brown.
45				
		0.0		
50				soft zone, possibly silt, lost recovery.
		0.0		
55				
				DECOMPOSED GRANITICS as above, soft zone, possibly silt, lost recovery.
		N/R		
60				
				end of highly weathered zone.
			Grd	
		N/R		GRANODIORITE - 50% of core has weathered mafics that have turned brown.
65				
				GRANODIORITE - Unweathered, possibly one horizontal fracture.
		N/R		
70				
				three horizontal fractures, some brown weathered mafics.
				Total Depth = 72.8'. Borehole converted to monitoring well.
75				
80				

REVIEWING GEOLOGIST Stephen Anderson
SIGNATURE
REG. NO. 4591

MONITORING WELL CONSTRUCTION SPECIFICATIONS

CLIENT: DTSC
BORING WELL #: OW-68D1
DATE: 1/4/2000
PROJECT #: 10740-02
GEOLOGIST: Stephen Anderson
PROJECT NAME: Stringfellow
SIGNATURE: Stephen Anderson
COUNTY: Riverside
REGISTRATION: #4591
WELL PERMIT #: N/A
DRILLING CONTRACTOR: Water Development Corporation



EXPLORATORY BORING

a. TOTAL DEPTH 59 ft.
b. DIAMETER 10.625 in.
DRILLING METHOD Mud Rotary

WELL CONSTRUCTION

c. TOTAL CASING LENGTH 61 ft.
MATERIAL Schedule 40 PVC
d. INSIDE DIAMETER 4 in.
e. DEPTH TO TOP PERFORATIONS 41 ft.
f. PERFORATED LENGTH 15 ft.
PERFORATED INTERVAL FROM 41 to 56 ft.
PERFORATION TYPE PVC Slotted
PERFORATION SIZE .020 in.
g. SURFACE SEAL 2 ft.
SEAL MATERIAL Cement
h. BACKFILL 33 ft.
BACKFILL MATERIAL Cement/Quick Gel
i. SEAL 3 ft.
SEAL MATERIAL Bentonite
j. GRAVEL PACK 21 ft.
PACK MATERIAL Lapus Lustre #3, Monterey sand
k. SEDIMENT TRAP 3 ft.
l. CENTRALIZERS 15, 36, 57 ft.
m. WELL COVER DIAMETER 10.75 in.
n. CONCRETE PAD DIAMETER 2 ft.
THICKNESS 3.5 in.
o. APPROXIMATE GROUND WATER DEPTH N/A ft.

SAIC

Science Applications International Corporation

8400 Westpark Drive, McLean, Virginia 22102 (703) 734-2528

BORING No. 0C-11B

DEPTH DRILLED 80.1'BLS

SCREENED FORMATION(S) Granodiorite

CLIENT California DHS

LOCATION Stringfellow

PROJECT No. 078-65

SURVEY DATA (Coord.) N679,349.29 E1,634,711.53

TOP of PIPE ELEV. 1030.65' GROUND ELEV. 1029.65'

DRILLING

DRILLER PCE-Orlandi/Hickman RIG TYPE Portadrill/IR TH-60

START 6/20/85 END 7/31/85

BIT SCHEDULE 15" Tricone (LS-20.7'BLS); 9 7/8" Tricone (LS-29.5'BLS); 6 1/4" Hammer (LS-80.1'BLS)

DRILLING FLUIDS American Colloidal Super Gel-X (LS-30'BLS); Air (30'BLS-80.1'BLS)

WATER ENCOUNTERED AT not discernible

CONSTRUCTION

CASING SCHEDULE 10" SCD 40 Steel (20.7'BLS-LS); 7" SCD 40 Steel (29.5'BLS-1.0'ALS)

BACKFILL SCHEDULE Type I-II Portland Cement: Corrochem (29.5'BLS-LS)

GEOPHYSICAL LOGS Suite "B"

COMMENTS

Packer/Slugtest interval: 29.5'- 80.1' bgs

K= 9.44 x10-6 cm/s.

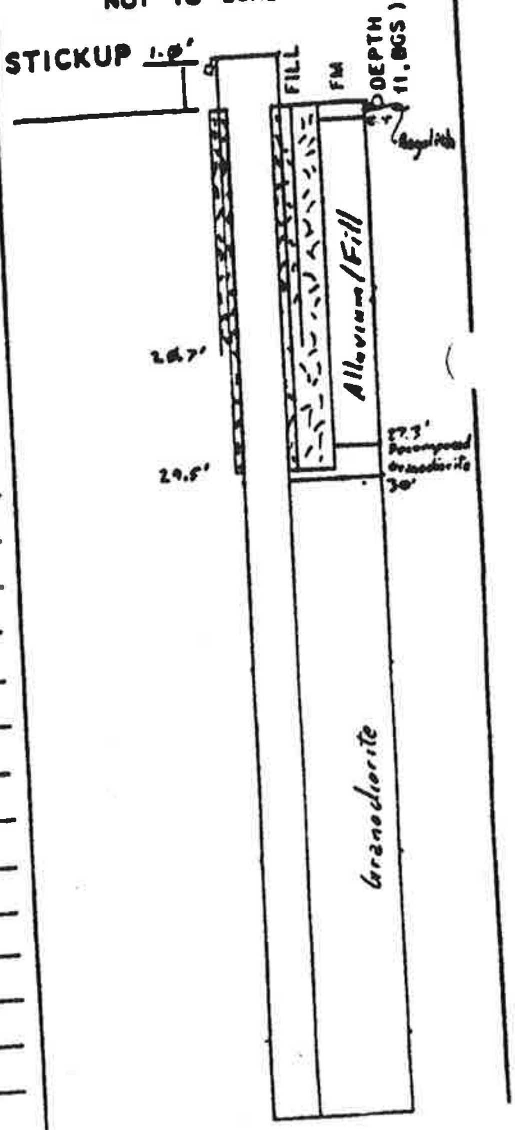
T= 10.1 gpd/Ft

STATIC W.L. 16.61'BLS (10/3/85)

DEVELOPMENT Air Lift: 0.91 hr

NOT TO SCALE

STICKUP 1.0'



TD DRILLED 80.1'BLS

WELL CONSTRUCTION SUMMARY

C-296

0C-11B

SAMPLE TYPE	SYMBOL	DEPTH	DESCRIPTION	COMMENTS
SS2		0-0.4'	silty sand lt yel br (10YR 6/4); fi sa, so si, tr med to co sa; loose; dry; SW-SM	BC: 10-29-9 Rec: 1.5' OVA: 3ppm (bkgd); bkgd (in jar) ← Regolith
"		0.4-1.5'	silty fine sand dk yel br (10YR 4/4) w/wh (5YR N8/1) mtls; fi sa, so si to cl, tr med sa; compact; friable; dry; SW-SM-SC	OVA: 3.3ppm (in jar) ← Fill/alluvium
SS1		5-5.3'	dk yel br (10YR 4/4); si sa fi to med sa, so cl; mod compact; soft; v sl damp; ML-MH	BC: 17-20-20 Rec: 1.45' OVA: bkgd (downhole and in jar
"		5.3-6.5'	dk yel br (10YR 4/6) w/red yel (7.5YR 6/8) and wh (5YR N8/1) mtls; med sa, so si to cl; compact; soft; poorly indurated; dry; SM-SC	OVA: bkgd (in jar)
SS3		10-10.9'	dk br (7.5YR 4/4); si, so cl, tr fi to med sa, tr co pb; compact; mod firm; damp; ML	BC: 11-16-20 Rec: 1.2' OVA: bkgd (downhole and in jar)
"		10.9-11.2'	dk br (7.5YR 3/4) w/pale yel (2.5Y 7/4) mtls; cl, so si, tr co pb; v compact; massive; tight; sl moist; CH	OVA: bkgd (in jar)
"		11.2-11.5'	strong br (7.5YR 4/6); fi sa, so si, so cl; compact; soft; damp; SM-SC	OVA: 3ppm (in jar)
SS4		15-15.2'	dk red br (5YR 3/3); cl, so si; dense; compact; damp; CL	BC: 17-17-17 Rec: 1.2' OVA: 35ppm (downhole); bkgd (in jar)
"		15.2-16.5'	dk yel br (10YR 3/6); si to fi sa, so cl, tr med sa; compact; mod firm; dry; ML-SC	OVA: 4ppm (in jar)
PT		17-19.5'	dk br (10YR 3/3) w/dk gr (10YR 4/1), blk (10YR 2/1) and yel red (5YR 5/6) mtls; fi sa to v fi pb, so si, tr cl, tr med pb (granodioritic); compact; mod firm; brittle; damp; SP	Pulldown: 175-275 lbs; Rec: 1.0'
SS5		20-20.5'	dk yel br (10YR 3/6); si, so cl, so fi sa; compact; firm; v damp; ML	BC: 13-43-25 Rec: 0.9' OVA: 11ppm (downhole); 6.5ppm (in jar)
"		20.5-21.5'	dk yel br (10YR 3/4) to gr (10YR 6/1); si to fi sa, tr cl, tr cb (qtz, 20.5-20.7' 3cs); compact; firm; sl moist; ML-SM	OVA: 13ppm (in jar)
SS6		25-26.5'	dk br (10YR 3/3) w/v dk gr br (10YR 3/2) mtls; fi sa to si, tr cl, tr co sa; compact; mod cohesive; sl moist; SM-MH	BC: 13-18-17 Rec: 1.35' OVA: 40ppm (downhole); 7ppm (in jar) ← decomposed gd contact
		27.3'		BC: 50r Rec: 0
SS7		28'		OVA: 60 ppm (downhole

CLIENT California DHS

LOCATION Stringfellow

PROJECT No. 078-65

SAIC

SAI by C. Kruger

SHEET 1 of 2

BORING No. OC-11

TX_1129646

FIELD LOG
C-292

OC-11

SAMPLE TYPE	SYMBOL	DEPTH	DESCRIPTION	COMMENTS	Drill Rate ft/min
C		30-32.5'	gd; lt gr; med to co xtln; ~10% biot schist inclusions; so lt red br stain	← gd contact	
C		32.5-35'	gd; lt gr; med to co xtln; ~10% biot schist inclusions; tr red br stain		0.77
C		35-39'	gd; lt gr; med to co xtln; ~10% biot schist inclusions		
C		39-42'	biot(~1%) gd; lt br; med to co xtln; extensive red br stain	← fracture @ ~39.5' BLS	
C		42-44'	gd; lt br; med to co xtln; tr biot	rapid drilling	
C		44-47.5'	biot(~1%) gd; lt gr and lt br; med to co xtlne; so yel br stain and coating		
C		47.5-49.5'	biot(5-10% fi xtln) gd; gr; fi to med xtlne; tr yel br stain		
C		49.5-52.5'	biot(5-10% fi xtlne) gd; gr; fi to med xtlne		
C		52.5-56.5'	biot(5-10% fi xtlne) gd; gr; fi to med xtlne; so yel br stain		
C		56.5-61'	biot(2-3%) gd; lt br; med to co xtlne; extensive lt yel br stain		
C		61-68'	biot(2-3%) gd; lt br; med to co xtlne; tr lt yel br stain	fairly slow drilling	
C		68-74'	biot(2-3%) gd; lt br; med to co xtlne; abundant thick yel br stain; so frac fill mat'l (yel br, si to cl)	highly fractured	1.33
C		74-77.5'	biot(2-3%) gd; lt br; med to co xtln; tr lt yel br stain		
C		77.5-80'	biot(2-3%) gd; lt br; med to co xtln; so lt yel br stain		
C		80-80.1'	biot(2-3%) gd; lt br; med to co xtln; tr lt yel br stain		
			TD = 80.1' BLS		

CLIENT California DHS
LOCATION Stringfellow
PROJECT No. 078-65

SAIC

SAI by C. Kruger/W Gross
SHEET 2 of 2
BORING No. OC-11

FIELD LOG
C-293

OC-11

Zone 2

MW-7B, 8B, & 9B

LITHOLOGIC LOGS (Continued)

Well No.	Depth Interval (Feet)	Description
MW-7B	0-30	SAND - dk brn (dry); silt to fine pebble gravel, predom. med. sand; mod. sorted
	30-40	SAND - brn (dry); clay to granule gravel, predom. v. fine sand; mod. sorted
	40-60	SAND and CLAY - brn (dry); clay to v. coarse sand, predom. silt to v. fine sand; well sorted
	60-80	SAND - brn (dry); clay to fine pebble gravel, predom. v. fine sand, mod. sorted
	80-100	SAND with GRAVEL - brn (dry); silt to med. pebble gravel, predom. fine sand; poorly sorted (grains are angular and show hematite staining)
MW-8B	0-20	SAND - brn (dry); v. fine sand to med. pebble gravel (rare); predom. fine sand; mod. to well sorted
	20-40	SAND - brn (dry); clay to med. pebble gravel, predom. fine sand; mod. sorted
	40-80	SAND - brn (dry); clay to granule gravel, predom. v. fine to fine sand; mod. sorted; increasing clay content with depth.
	80-100	SAND with CLAY - brn (dry); clay to granule gravel, predom. fine sand; well sorted
MW-9B	0-30	SAND - brn (dry); silt to fine pebble gravel, predom. fine sand; well sorted
	30-60	SAND - brn (dry); clay to med. pebble gravel, predom. v. fine sand; mod. sorted
	60-85	SAND and GRAVEL - brn (dry); v. fine sand to med. pebble gravel, predom. v. coarse sand to fine pebble gravel; hematite staining
	85-110	SAND and GRAVEL - brn (dry); med. sand to fine pebble gravel, predom. v. coarse sand to granule gravel; extensive hematite staining

"Screen" 16'-100'

} decomposed rock ?

"Screen" 0'-100'

"Screen" 0'-100'

[illegible]

2-5" DIA

} Decomposed Rock.

TX 1124544

L0602.335A LE011A

GEOLOGIC DRILL LOG	PROJECT Stringfellow Hazardous Waste Site	JOB NO. 19742	SHEET NO. 1 OF 3	HOLE NO. LE011A

SITE Lower Canyon	COORDINATES N ; E	ANGLE Vertical	BEARING ------

BEGUN 4-4-89	COMPLETE 4-5-89	DRILLER Datum Exploration	DRILL MAKE CME-75	SIZE 8.25"	OVERBURDEN 63.0	ROCK (FT) 2.0	T.D. (FT) 65.5

CORE RECOVERY /	CORE BOX	SAMP. 13	TOP CASING	GROUND EL.	GROUND WATER 50.0/ 4-5-89 /	TOP OF ROCK 63.0/

HAMMER WEIGHT/FALL 140 lbs. / 30 in.	CASING LEFT IN HOLE	LOGGED BY: G. A. Day

SAMP. TYPE	SAMP. ADV. LEN CORE	RECOVERY	SAMPLE BLOWS % CORE RECOVERY	WATER PRESSURE TESTS LOSS IN G.P.M.	WATER PRESSURE TESTS PRESS. P.S.I.	WATER PRESSURE TESTS TIME MIN.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
										0-63.0 ft. SILTY SAND (SM) Dark Yellowish Brown (10YR 4/2) to Moderate Brown (5YR 4/4) silt and fine to medium grained sand with minor amounts of coarse grained sand. Dry, loose density, poorly sorted, subrounded to angular. Predominately quartz, feldspar, and biotite. Grains tend to be moderately to highly weathered. Traces of clay and angular to subangular gravels and cobbles throughout interval.	Advanced borehole with 4-1/4" hollow stem augers 0-65.0 ft.
SS	1.5	1.5	7-6-9				5				
SS	1.5	1.5	7-9-10				10				Sampled with 2" split spoon 0-65 ft. at 5 ft. intervals.
SS	1.5	1.5	5-5-7				15			12-16 ft. Gravel and cobbles present in matrix.	
SS	1.5	1.5	5-11-13				20			20-30 ft. Increase in clay content of matrix along with decomposed granite.	Encountered decomposed granite "DG" at a depth of 63.0 ft.
SS	1.5	1.0	30-50/5"				25				
SS	1.5	1.0	15-50/5"				30				Descriptive log based on visual examination of split spoon samples and auger

SS=SPLIT SPOON; ST=SHELBY TUBE D=DENNISON; P=PITCHER; O=OTHER	SITE Lower Canyon	HOLE NO. LE011A

☐ NO EXCEPTION NOTED ☒ MAKE CORRECTIONS NOTED
☐ REJECTED ☐ REVISE AND RESUBMIT
☐ SUBMIT SPECIFIED ITEM

CHECKING IS ONLY FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. ANY ACTION SHOWN IS SUBJECT TO THE REQUIREMENTS OF THE PLANS AND SPECIFICATIONS. CONTRACTOR [illegible] DIMENSIONS WHICH SHALL BE CONFIRMED [illegible] AT THE JOB SITE; FABRICATION PROCESSES [illegible] OF CONSTRUCTION; COORDINATION OF HIS [illegible]TH THAT OF ALL OTHER TRADES; AND THE SATISFACTOR[illegible]F HIS WORK.

BY DATE 8/16/89

CH2M HILL, INC.
ENGINEERS PLANNERS ECONOMISTS SCIENTISTS
2510 RED HILL AVE., SUITE A
SANTA ANA, CA 92705

LE011A

OBSERVATION WELL

PROJECT: Stringfellow

WELL NO.: LE011A

JOB NO.: 19742

SITE: Lower Canyon

COORDINATES:

BEGUN: /4/89

COMPLETED: 4/6/89

PREPARED BY: G. A. Day

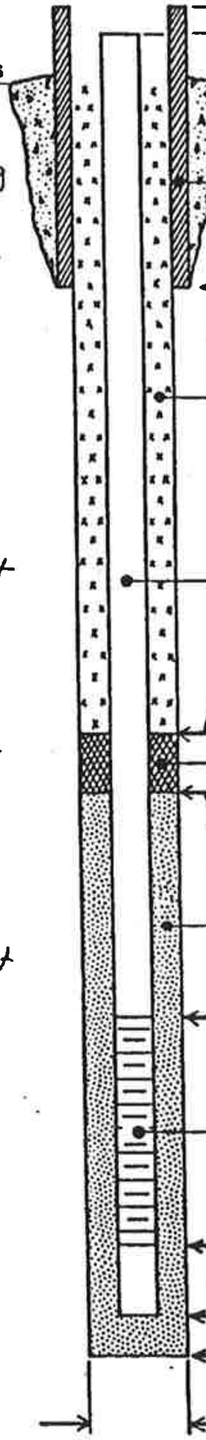
REFERENCE POINT FOR MEASUREMENTS: Ground Surface

ELEV. – TOP OF SURFACE CASING:

ELEV. – TOP OF RISER CASING:

GENERALIZED GEOLOGIC LOG

2-inch PVC Casing and screen assembly in an 8¼-inch bore hole



SURFACE CASING.

DIA:

TYPE: None

BACKFILL MATERIAL

TYPE: Cement Bentonite Grout

RISER CASING

DIA: 2 inch

TYPE: PVC

ANNULAR SEAL

TYPE: Fine Sand 20X40 (Lonestar #1/20)

FILTER PACK

TYPE: 8X20 Sand (Lonestar #3)

SCREEN:

DIA: 2-inch TYPE: PVC

OPENINGS: WIDTH: 0.020 inch

TYPE: mill Slotted

HOLE DIA: 8¼ inch

	DEPTH	ELEV.
GROUND SURFACE	0	
BOTTOM OF SURFACE CASING	N/A	
TOP OF SEAL	38	
TOP OF FILTER PACK	41	
TOP OF SCREEN	43	
BOTTOM OF SCREEN	63	
BOTTOM OF SUMP	64	
BOTTOM OF HOLE	65	

Volumes

Grout

38ft × 0.34 ft³/ft
= 12.9 ft³

Fine Sand

3ft × 0.34 ft³/ft
= 1.02 ft³

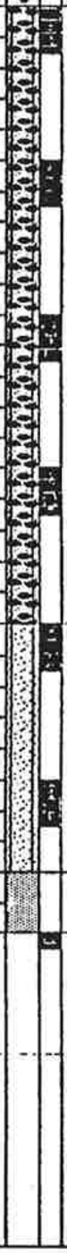
Filter Pack

24ft × 0.34 ft³/ft
= 8.2 ft³

LE011A

GEOLOGIC DRILL LOG	PROJECT Stringfellow Hazardous Waste Site	JOB NO. 19742	SHEET NO. 2 OF 3	HOLE NO. LE011A

SAMP. TYPE	SAMP. AD LEN CORE	RECOVERY	SAMPLE BLOWS / % CORE RECOVERY	WATER PRESSURE TESTS LOSS IN G.P.M	PRESS P.S.I.	TIME IN MIN.	DEPTH
SS	1.5	1.5	20-21-50				35
SS	1.5	1.5	21-30-50				40
						TOS	
SS	1.5	1.0	22-50/5"				45
SS	1.5	0.6	30-50/3"				50
SS	1.5	1.6	13-9-10				55
SS	1.5	1.0	20-50/5"				60
						Gos	
~~SS~~	~~0.5~~	~~0.5~~	~~10-50/4"~~				65



DESCRIPTION AND CLASSIFICATION

35-55 ft. SILTY GRAVELS-SILTY SANDS (GM-SM) Gravel and cobbles angular to subangular, moderately weathered, intermixed with silts and fine to medium grained sands. Includes angular pieces of feldspar, quartz, biotite, and severely weathered decomposed granite. Also traces of clays within matrix.

45 ft. Silty gravely sand becomes slightly moist.

50 ft. Silty gravely sand becomes wet to saturated.

55-63.0 ft. Silty Sand (SM) Moderate Brown (5YR 3/4) fine sand and silt with minor amounts of medium to coarse sand and gravel and traces of clay. Coarse sand to gravel sized pieces of DG, moderately to severely weathered, rock fabric intact, severe loss of strength.

60 ft. Abundant decomposed granite pockets.

63.0-65.0 ft. DECOMPOSED GRANITE Dark Yellowish Orange (10YR 6/6) and Grayish Orange (10YR 7/4), abundant discoloration of minerals (i.e. feldspars

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

cuttings.

Color descriptions from the GSA Rock Color Chart (1948).

Installed 2" alluvium observation well 4- -89.

SS=SPLIT SPOON; ST=SHELBY TUBE
D=DENNISON; P=PITCHER; O=OTHER

SITE	HOLE NO.
Lower Canyon	LE011A

LE011A

GEOLOGIC DRILL LOG	PROJECT Stringfellow Hazardous Waste Site	JOB NO. 19742	SHEET NO. 3 OF 3	HOLE NO. LE011A

SAMP. TYPE	SAMP. AD LEN CORE	RECOVERY	SAMPLE BLOWS % CORE RECOVERY	WATER PRESSURE TESTS LOSS IN G.P.M			DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
				LOSS IN G.P.M	PRESS P.S.I	TIME IN MIN.					
										altering to clay minerals), gravel-cobble sized fragments of granite intermixed with silt and fine to medium grained sand. Predominate minerals include quartz, feldspar, and biotite. Very severely weathered, rock fabric discernible, soft to medium hard. Bottom of Hole 65.0 ft.	

SS=SPLIT SPOON; ST=SHELBY TUBE D=DENNISON; P=PITCHER; O=OTHER	SITE Lower Canyon	HOLE NO. LE011A

Bechtel
GEOLOGIC DRILL LOG

PROJECT Stringfellow					JOB NO. 21106	SHEET NO. 1 OF 2	HOLE NO. CTS-OW3
SITE Community South	COORDINATES N 670815.45; E 1631961.17					ANGLE FROM HORIZ Vertical	BEARING ------
BEGUN 11-7-90	COMPLETED 11-8-90	DRILLER Klyde Chivrell	DRILL MAKE AND MODEL Speedstar SS15	SIZE 6-inch	OVERBURDEN 81.0	ROCK (FT.) 2.0	TOTAL DEPTH 83.0
CORE RECOVERY (FT./%) /	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL. 773.55	DEPTH/EL. GROUND WATER ▽ 19.0/754.6 ▽ /	DEPTH/EL. TOP OF ROCK 81.0/692.5	
SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH See obs. well log	LOGGED BY: Pete West					

(Template= BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN. CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							773.6	0	▩		0 - 5 ft. **FILL**: Fill, silt, sand, gravel.	Drilled with casing hammer Rig with 5 7/8-inch bit and 6-inch Drive casing. Geologic description based on drill cuttings.
							768.6	5	░		5 - 10 ft. **SILTY SAND (SM)**: Grayish-red (10R 4/2), fine-grained, angular.	
							763.6	10	░		10 - 15 ft. **SILTY SAND (SM)**: Dusky red (5R 3/4), fine-grained, angular.	
							758.6	15 ▽ 20 25 30	░		15- 35 ft. **SILTY SAND (SM)**: Dark reddish-brown (10R 3/4), medium-to coarse-grained. From 25-30 ft., finer-grained.	
							738.6	35	░		35 - 40 ft. **SAND (SP)**: Grayish-red (5R 4/2), coarse-grained, angular and small gravel, trace silt.	
							733.6	40 45 50	░		40 - 55 ft. **SILTY SAND (SM)**: Moderate red (5R 4/6), very fine-grained. From 45-50 ft., trace sand.	
							718.6	55	░		55 - 60 ft. **SAND (SP)**: Grayish-red (5R 4/2), medium-to coarse-grained, angular, dirty, some gravel.	
							713.6	60 65	░		60 - 73 ft. **SILTY SAND (SM)**: Dark reddish-brown (10R 3/4), very fine-grained.	

TX 1124990

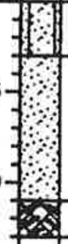
SS = SPLIT SPOON; CA = CALIFORNIA; D = DENNISON; P = PITCHER; O = OTHER	SITE Community South	Last Update: 2-20-91	HOLE NO. CTS-OW3

Bechtel

GEOLOGIC DRILL LOG

PROJECT Stringfellow	JOB NO. 21106	SHEET NO. 2 OF 2	HOLE NO. CTS-OW3

(Template= BCHTLLS)



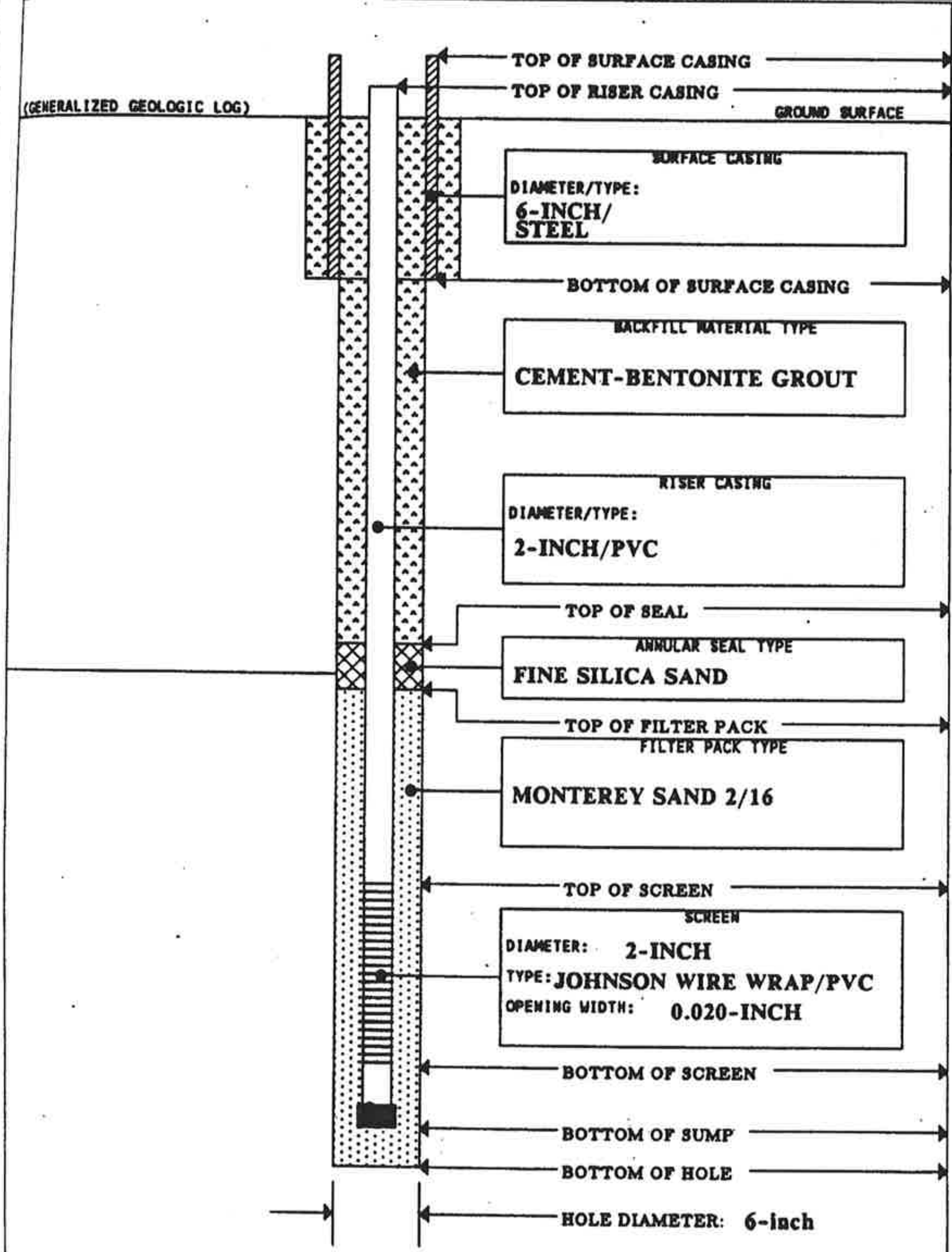
SAMP. TYPE AND DIAM.	SAMP. ADV. LEN. CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							700.6				73 - 81 ft. <u>SAND (SP)</u>: Grayish-red (5R 4/2), medium-to coarse-grained, angular, dirty, with some small gravel.	
								75				
								80				
							692.6				81 - 83 ft. <u>DECOMPOSED GRANITE</u>: Moderate brown (5YR 3/4), medium-to coarse-grained, friable.	
							690.6				BOTTOM OF HOLE : 83.0 FT.	

SS = SPLIT SPOON; ST = SHELBY TUBE; D = DENNISON; P = PITCHER; O = OTHER	SITE Community South	Last Update: 2-20-91	HOLE NO. CTS-OW3

Bechtel **MONITORING WELL**	PROJECT **Stringfellow**	WELL NO. CTS-OW3

JOB NO.	SITE	COORDINATES
21106	Community South	N 670,815.5 E 1,631,961.2

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
11-7-90	11-8-90	Pete West	Top of 2-inch PVC



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING		773.3
TOP OF RISER CASING		772.8
GROUND SURFACE	0.0	773.6
BOTTOM OF SURFACE CASING	5.0	768.5
TOP OF SEAL	33.0	740.5
TOP OF FILTER PACK	36.0	737.5
TOP OF SCREEN	41.0	732.5
BOTTOM OF SCREEN	81.0	692.5
BOTTOM OF SUMP	82.3	691.2
BOTTOM OF HOLE	83.0	690.6

SURFACE CASING
DIAMETER/TYPE: 6-INCH/ STEEL

BACKFILL MATERIAL TYPE
CEMENT-BENTONITE GROUT

RISER CASING
DIAMETER/TYPE: 2-INCH/PVC

ANNULAR SEAL TYPE
FINE SILICA SAND

FILTER PACK TYPE
MONTEREY SAND 2/16

SCREEN
DIAMETER: 2-INCH
TYPE: JOHNSON WIRE WRAP/PVC
OPENING WIDTH: 0.020-INCH

HOLE DIAMETER: 6-inch

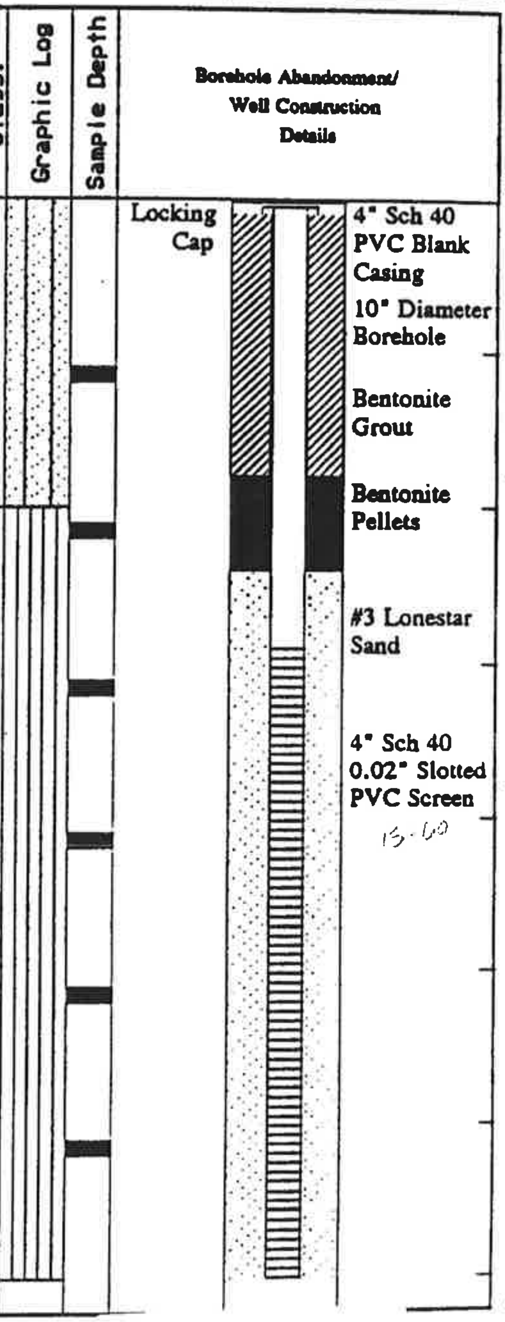
Last Update: 2/19/91 (Template:LASERMON)

SB/MW#: FC1020A
#D- 19030-32
Page 1 of 2
Sampler: Todd Overturf

SOIL DRILLING LOG

ROJECT Pyrite Canyon LOCATION 4930 Agate Street, Glen Avon, CA
LEVATION 735.2 feet MSL MONITORING DEVICE Hnu PI 101
AMPLING DATE(S) 9-23-97 START 9:00 AM FINISH 4:30 PM
AMPLING METHOD CA MOD SPLIT SPOON SUBCONTRACTOR & EQUIPMENT Beylik Drilling CME 75
EMO (5,40,50,5) = Gravel, sand, silt, and clay percentages respectively.

Penetration Results		Sampler Depth Interval (ft.)	Sample ID #	Hnu Reading (ppm)	Soil Description Color, Texture, Moisture, Etc. 0.0	Unified Class.
Blows 6"-6"-6"	BPF					
					Grass surface.	SM
19-28-30	58	5.0 6.5	FC-3S-5	0	@5' Silty sand: (10,70,20,0); yellowish brown (10YR 5/4); coarse to very coarse sand; angular to subangular; poorly graded; medium dense; dry.	
29-32-39	71	10.0 11.5	FC-3S-10	0	10.0 Sandy silt: (0,10,85,5); dark yellowish brown (10YR 4/4); fine sand; poorly graded; medium dense; mottled coloration; moist.	ML
42-43-50	93	15.0 16.5	FC-3S-15	0	@15' As above, color change to olive brown (2.5Y 4/3).	
16-18-24	42	20.0 21.5	FC-3S-20	0	@20' Sandy silt: (2,48,48,2); dark yellowish brown (10YR 4/4); medium dense; very fine to fine sand; gravel is angular; wet.	
12-44-31	75	25.0 26.5	FC-3S-25	0	@25' As above.	
22-39-46	85	30.0 31.5	FC-3S-30	0	@30' Sandy silt: (0,30,60,10); dark yellowish brown (10YR 4/4); fine sand; poorly graded; medium dense; 35.0	



15-60

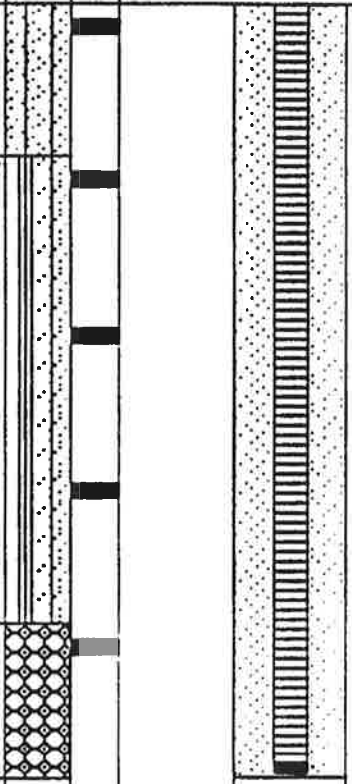
Continued Next Page

SB/MW#: FC1020A
#D- 19030-32
Page 2 of 2
Sampler: Todd Overturf

SOIL DRILLING LOG

PROJECT Pyrite Canyon LOCATION 4930 Agate Street, Glen Avon, CA

Depth Below Surface (ft.)	Penetration Results		Sampler Depth Interval (ft.)	Sample ID #	Hnu Reading (ppm)		Soil Description Color, Texture, Moisture, Etc.	Unified Class.	Graphic Log	Sample Depth	Borehole Abandonment/ Well Construction Details
	Blows 6"-6"-6"	BPF									
	37-50	87	35.0 36.5	FC-3S-35	0	✓	micaceous; saturated. Silty sand: (0,90,10,0); dark yellowish brown (10YR 4/4); medium graded; medium to coarse sand; subangular; dense; saturated.	SM			
40	24-42-50	92	40.0 41.5	FC-3S-40	0	40.0	Sand and silt: (2,50,48,0); dark yellowish brown (10YR 4/4); medium dense; poorly graded; very fine to fine sand; saturated.	ML/ SM			
45	42-76	118	45.0 46.5	FC-3S-45	0		@45' as above.				4" Sch 40 0.02" Slotted PVC Screen
50	43-90	133	50.0 51.5	FC-3S-50	0	✓	@50' Silty sand: (0,80,20,0); dark yellowish brown (10YR 4/3); medium to coarse; subangular; poorly graded; very dense; saturated. @53' Hard drilling.				
55	60-118	178	55.0 56.5	FC-3S-55	0	55.0	Highly weathered granitic rock: 50% plasioclase; 30% quartz; 10% k-feldspar; 10% hornblende and augite; hornblende weathered to mica; minor iron staining.	DG			
60	64-100	164	60.0 61.5	FC-3S-60	0	60.0	@60' As above.				PVC Cap T.D. =60'
65											
70											
75											



APPENDIX B

FIELD DATA SHEETS

BAS

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: **Stringfellow**

Well No. CTS-OW3
Collected By: Hz
Casing Diameter (inches): 2
Starting Water Level (feet): 25.47
Total Depth (feet): 81.10
Water Column (feet): 55.63
Screen Length (feet): N/A
Purge Volume (gallons): 2720
Horiba Model S/N: 303029

Sampling Date: 4-21-08
Purge Start Time: 1710
Purge Stop Time: 1721
Sampling Time: 1730
Ending Water Level (feet): 25.48
Total Purged (gallons): 28
[✓ PID]/FID Reading N/A
Duplicate Sample Yes [✓ No]

Gallons Purged	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C	ORP MV
5	—	6.8	1.37	113.0	5.3	22.7	67
10	—	6.8	1.37	60.9	5.3	22.6	104
15	—	6.7	1.38	57.4	5.2	22.6	111
20	—	6.7	1.38	54.0	5.2	22.6	119
25	—	6.7	1.38	50.4	5.2	22.6	126
28	—	6.7	1.38	48.8	5.2	22.6	130

Purging Sampling Rates Purged @ 885 hz. Flow approx @ 2.5 G.P.M.

Well Condition: OK. water looks little cloudy, NO odor.

Additional Information/Comments: Clear, warm, light winds

BAS

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: Stringfellow

Well No. OW-68D1

Collected By: RR

Casing Diameter (inches): 4"

Starting Water Level (feet): 51.31

Total Depth (feet): 59.00

Water Column (feet): 7.69

Screen Length (feet): —

Purge Volume (gallons): 0

Horiba Model S/N: 303046

Sampling Date: 4-24-08

Purge Start Time: /

Purge Stop Time: /

Sampling Time: 1755

Ending Water Level (feet): /

Total Purged (gallons): /

[✓ PID]/FID Reading 0

Duplicate Sample Yes [✓ No]

Gallons Purged	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C	ORP MV
grab		3.0	12.3	46	—	23.4	259

Purging Sampling Rates sample taken with a disp. bailer

Well Condition: OK

Additional Information/Comments: water dARK RED with strong ODOR. Lab to FILTER FOR METALS. Provided extra 1L. container. zone-1b.

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: Stringfellow

Well No. MW-9B
Collected By: BO-JG
Casing Diameter (inches): 2"
Starting Water Level (feet): 49.61
Total Depth (feet): 100.00
Water Column (feet): 50.39
Screen Length (feet): —
Purge Volume (gallons): 16.42
Horiba Model S/N: 302030

Sampling Date: 4-28-08
Purge Start Time: 1433
Purge Stop Time: 1443
Sampling Time: 1448
Ending Water Level (feet): 50.35
Total Purged (gallons): 16
PID/FID Reading —
Duplicate Sample Yes [✓ No]

Gallons Purged	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C	ORP MV
4	—	6.9	0.578	237.0	8.5	24.1	182
8	—	6.6	0.548	179.0	6.2	23.9	177
12	—	6.5	0.581	165.0	4.4	23.9	174
16	—	6.5	0.580	148.0	3.7	23.8	172

Purging Sampling Rates PURGED WELL @ 300 HZ FLOW @ APPROX 2 GPM

Well Condition: OK, WATER TURBID W/NO ODOR

Additional Information/Comments: SUNNY, HOT LIGHT BREEZE

*CHECK PH WITH PH STRIP.

(I:\DTSC\Stringfellow\forms\ Well Data.xls: Last Update 5/2/03)

BAS

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: **Stringfellow**

Well No. LEO-11A
Collected By: BO, BS
Casing Diameter (inches): 2
Starting Water Level (feet): 55.09
Total Depth (feet): 65.10
Water Column (feet): 10.01
Screen Length (feet): —
Purge Volume (gallons): 4.89
Horiba Model S/N: MP-20

Sampling Date: 4-26-08
Purge Start Time: 0940
Purge Stop Time: 0949
Sampling Time: 1000
Ending Water Level (feet): 55.18
Total Purged (gallons): 5
PID/FID Reading —
Duplicate Sample Yes [✓ No]

Gallons Purged	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C	ORP MV
1		6.69	1.74	63.5	—	22.82	156
2		6.65	1.75	258	—	22.74	157
3		6.62	1.75	421	—	23.61	160
5		6.69	1.75	641	—	22.78	165

Purging Sampling Rates Hand bailed well w/ a new 1½" disposable bailer. cloudy water & odors

Well Condition: OK - Rope & weight inside well, Pulled out labeled & placed in a new ziplock bag & set in Carol Wilson's desk

Additional Information/Comments:

Zone-3

BAS

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: **Stringfellow**

Well No.: OC-11B
Collected By: BZS
Casing Diameter (inches): 10
Starting Water Level (feet): 33,72
Total Depth (feet): 80.10
Water Column (feet):
Screen Length (feet): /
Purge Volume (gallons): /
Horiba Model S/N: 408006

Sampling Date: 4-30-08
Purge Start Time: /
Purge Stop Time: /
Sampling Time: 1242
Ending Water Level (feet): /
Total Purged (gallons): /
PID/FID Reading ←
Duplicate Sample Yes [✓ No]

MS/MSD taken here

Gallons Purged	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C	ORP MV
Grab		3,2	6,36	24.6	5,6	22.3	241

Purging Sampling Rates Took a grab sample, liquid appeared clear/light yellowish.

Well Condition: OK

Additional Information/Comments: Cool, light breeze

Zone-1

(I:\DTSC\Stringfellow\forms\ Well Data.xls: Last Update 5/2/03)

BAS

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: **Stringfellow**

Well No.: FC-1020A
Collected By: BS, BO, MA
Casing Diameter (inches): 4
Starting Water Level (feet): 14.74
Total Depth (feet): 60.00
Water Column (feet): 45.26
Screen Length (feet): —
Purge Volume (gallons): 59.10
Horiba Model S/N: 9108

Sampling Date: 4-23-08
Purge Start Time: 0830
Purge Stop Time: 0850
Sampling Time: 0855
Ending Water Level (feet): 14.79
Total Purged (gallons): 60
PID/FID Reading ~~60~~
Duplicate Sample BS ~~Yes~~ [✓ No]

Gallons Purged	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C	ORP MV
15		7.0	1.20	7.5	5.7	22.0	495
30		7.0	1.21	2.1	4.0	22.1	486
45		7.1	1.21	1.1	3.8	22.2	481
60		7.3	1.21	0.4	3.0	22.2	460

Purging Sampling Rates Purged @ 244Hz, flow @ 3gpm. Water looks clear w/no odor.

Well Condition: OK

Additional Information/Comments:

Zone-4

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: SHWS

Well No.: OW-68D1
Collected By: JWB
Casing Diameter (inches): 4
Bubbler Reading:
Starting Water Level (feet): 49.61
Total Depth (feet): 59.2
Water Column (feet):
Screen Length (feet):
3 Well Volumes (gallons):

Sampling Date: 3/18/08
Purge Start Time:
Purge Stop Time:
Sampling Time: 1300
Ending Water Level (feet):
Total Purged (gallons): 0
Counter - Cycles to Fresh H_2O:
Horiba Model S/N: 302030
Control Box #:
Duplicate Sample: [✓ Yes] No

HydraSleeve Depth ~~Gallons Purged~~	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C
50		—	—	—	—	—
53		—	—	—	—	—
56		3.2	9.9	53.9	10.9	19.3

Purging Sampling Rates: Removal rate < 0.5 ft/sec

Well Condition: Good

Additional Information/Comments: Collected a duplicate from 53' interval and an MS/MSD from the 56' interval.

(L:\esd\Forms\Well Data.xls)

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: SHWS

Well No.: OC-11B
Collected By: JNB
Casing Diameter (inches): 2
Bubbler Reading:
Starting Water Level (feet): 32.7
Total Depth (feet): 77.51
Water Column (feet):
Screen Length (feet):
3 Well Volumes (gallons):

Sampling Date: 3/18/08
Purge Start Time:
Purge Stop Time:
Sampling Time: 1800
Ending Water Level (feet):
Total Purged (gallons): 0
Counter - Cycles to Fresh H_20:
Horiba Model S/N: 302030
Control Box #:
Duplicate Sample: Yes [✓ No]

Gallons Purged	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C
39		—	—	—	—	—
42		—	—	—	—	—
68		—	—	—	—	—
71		4.3	8.0	188	11.3	18.5

Purging Sampling Rates: Removal rate < 0.5 ft/sec

Well Condition: Good

Additional Information/Comments: While retrieving the HydraSleeve, the casing punctured the HydraSleeve and there was only enough sample water to fill 2 VOA viles.

BAS

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: SHWS

Well No.: MW-9B

Collected By: JNB

Casing Diameter (inches): 2

Bubbler Reading:

Starting Water Level (feet): 47.38

Total Depth (feet): 85.0

Water Column (feet):

Screen Length (feet):

3 Well Volumes (gallons):

Sampling Date: 3/17/08

Purge Start Time:

Purge Stop Time:

Sampling Time: 1700

Ending Water Level (feet): 46.89

Total Purged (gallons): 0

Counter - Cycles to Fresh H_2O:

Horiba Model S/N: 302030

Control Box #:

Duplicate Sample: [✓ Yes] No

HydraSleeve Depth ~~Gallons Purged~~	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C
57		—	—	—	—	—
65		5.6	0.62	38.6	9.9	18.2
73		5.4	0.63	11.7	10.4	18.0
81		4.4	0.77	87.5	10.6	18.1

Purging Sampling Rates: Removal rate was < 0.5 ft/sec

Well Condition: Good

Additional Information/Comments: Collected a duplicate sample at 57'

(L:\esd\Forms\Well Data.xls)

BAS

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: SHWS

Well No.: LEO - 11A
Collected By: JNB
Casing Diameter (inches): 2
Bubbler Reading:
Starting Water Level (feet): 53.71
Total Depth (feet): 64.0
Water Column (feet):
Screen Length (feet):
3 Well Volumes (gallons):

Sampling Date: 3/17/08
Purge Start Time:
Purge Stop Time:
Sampling Time: 1300
Ending Water Level (feet): 54.34
Total Purged (gallons): 0
Counter - Cycles to Fresh H_20:
Horiba Model S/N: 302030
Control Box #:
Duplicate Sample: Yes [✓ No]

HydraSleeve Depth ~~Gallons Purged~~	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C
55	—	Dry	—			
58	—	Insufficient		water	to Sample	—
61	~~7.1~~ JNB	7.1	0.38	50.2	—	18.6

Purging Sampling Rates: Removal rate < 0.5 ft/sec

Well Condition: Good

Additional Information/Comments: The 55'-56.5' interval was dry.

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BAS

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM
WELL DATA SHEET

SITE: SHWS

Well No.:	GTS-OW3	Sampling Date:	3/17/08
Collected By:	JNB	Purge Start Time:	
Casing Diameter (inches):	2	Purge Stop Time:	
Bubbler Reading:		Sampling Time:	1600
Starting Water Level (feet):	26,05	Ending Water Level (feet):	25,72
Total Depth (feet):	82.2	Total Purged (gallons):	0
Water Column (feet):		Counter - Cycles to Fresh H_20:	
Screen Length (feet):		Horiba Model S/N:	302030
3 Well Volumes (gallons):		Control Box #:	
		Duplicate Sample:	Yes [✓ No]

HydraSleeve Depth ~~Gallons Purged~~	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C
55		—	—	—	—	—
58		6,2	0,58	37,3	9,3	19,2
75		—	—	—	—	—
78		7,0	0,57	920	9,9	18,2

Purging Sampling Rates: Removal rate at < 0,5 ft/sec

Well Condition: Good

Additional Information/Comments:

(L:\esd\Forms\Well Data.xls)

BRYAN A. STIRRAT & ASSOCIATES

GROUNDWATER MONITORING PROGRAM

WELL DATA SHEET

SITE: SHWS

Well No.: FC-1020A

Collected By: JNB

Casing Diameter (inches): 4

Bubbler Reading:

Starting Water Level (feet): 12.31

Total Depth (feet): 60.20

Water Column (feet):

Screen Length (feet):

3 Well Volumes (gallons):

Sampling Date: 3/17/08

Purge Start Time: 1400

Purge Stop Time:

Sampling Time:

Ending Water Level (feet): 12.33

Total Purged (gallons): 0

Counter - Cycles to Fresh H_20:

Horiba Model S/N: 302030

Control Box #:

Duplicate Sample: Yes [✓ No]

HydraSleeve Depth ~~Gallons Purged~~	Water Level	pH	Conductivity ms/cm	Turbidity NTU	D.O. mg/L	Temperature °C
35						
40		6.7	0.56	47.5	11.1	20
45		6.2	0.58	24.8	10.1	18.7
50		6.5	0.63	54.0	9.9	18.2

Purging Sampling Rates: Removal rate <0.5 ft/sec

Well Condition: Good

Additional Information/Comments: