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Rev. 0

DNAPL Investigation Report

Author
D. L. Parker

Date Published
September 1995

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Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

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Richland, Washington

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DNAPL INVESTIGATION REPORT

1.0 BACKGROUND

An Interim Remedial Measure (IRM) is currently underway at the 200-ZP-1 Groundwater Operable Unit. The IRM addresses groundwater contaminated with carbon tetrachloride, trichloroethylene, and chloroform. As part of the IRM, a limited investigation was performed to determine if dense non-aqueous phase liquid (DNAPL) is present in the saturated zone. If present, DNAPL could provide a continuing source of carbon tetrachloride to contaminate groundwater.

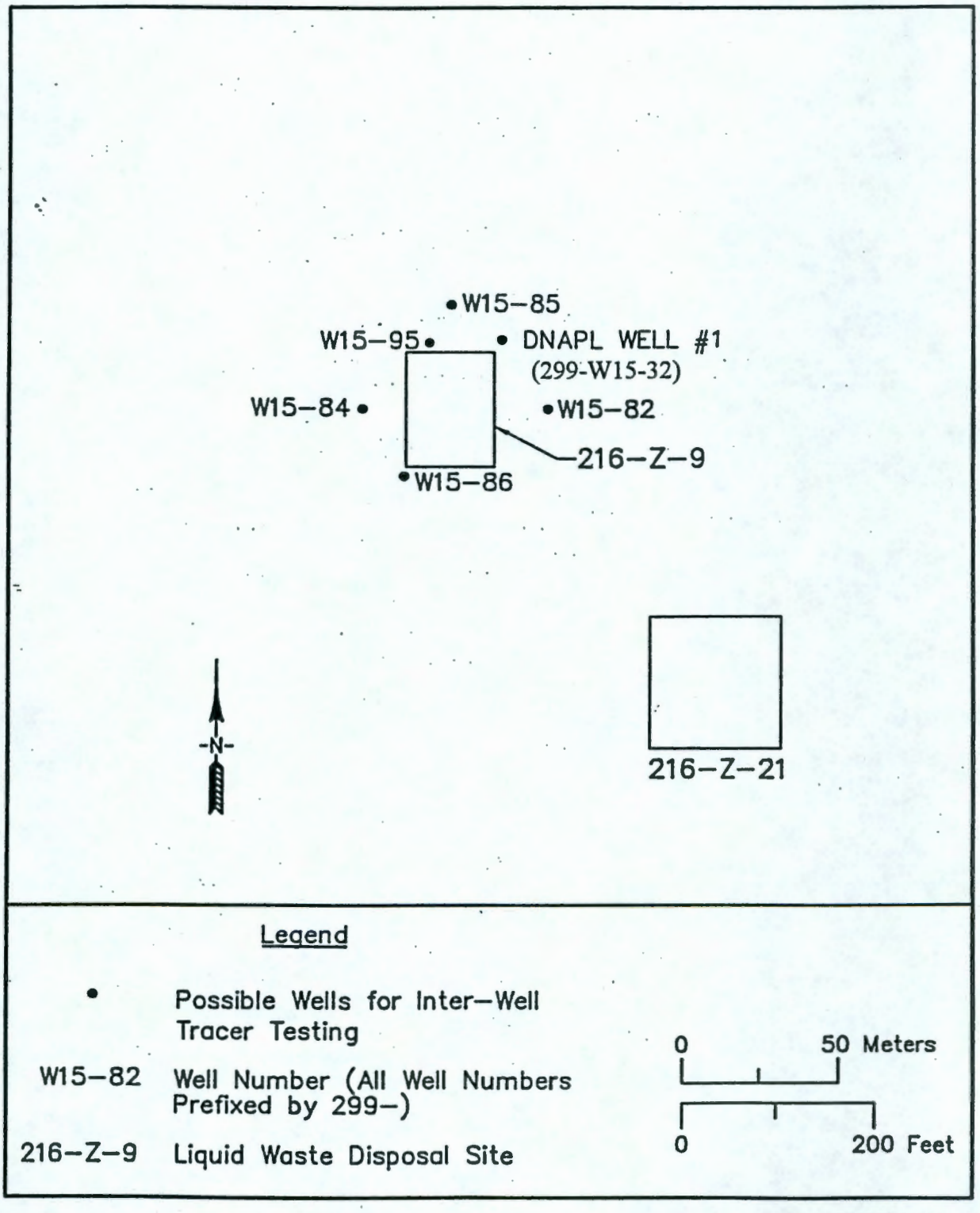
Visual methods were used to examine sediment and groundwater samples collected from the construction of Well 299-W15-32. The visual methods used are generally as described in *Evaluation of Visual Methods to Detect NAPL in Soil and Water* (Cohen, et al. 1992), and in *DNAPL Site Evaluation* (Cohen and Mercer, 1993). The use of visual methods had been proposed as part of a larger DNAPL investigation that included constructing two wells and conducting a partitioning interwell tracer test. Use of visual methods was intended as a low-cost way of acquiring data to supplement data from the partitioning interwell tracer test. Plans to drill a second well and perform the partitioning interwell tracer test have been indefinitely postponed. A groundwater monitoring well was needed in the vicinity of the 216-Z-9 Trench, and its construction allowed a limited DNAPL investigation to be conducted.

The plan for use of "visual methods" was provided in Attachment B of the *Description of Work (DOW) for Two DNAPL Investigation Wells*, BHI-00183 (BHI, 1995b). The test methods used were volatile organic compounds analysis, unaided visual examination, ultraviolet (UV) fluorescence, soil-water shake test, centrifugation of soil-water suspension, hydrophobic dye soil-water test, and centrifugation on hydrophobic dye soil-water suspension. If DNAPL could be identified and collected through a syringe, a sample would have been sent for off-site confirmation and identification of the DNAPL.

2.0 TEST LOCATION

The test was performed at Well 299-W15-32 (DNAPL Well #1). Well 299-W15-32 is located north of the 216-Z-9 Trench (Figure 1) in an area where DNAPL, if present, is likely to occur. This well location was originally chosen to support the partitioning interwell tracer test, and was retained after the tracer test was canceled.

Figure 1. Location Map.



The 216-Z-9 Trench operated from July 1955 to June 1962, receiving solvent and aqueous wastes. It is estimated that 21,900 to 79,200 gal of carbon tetrachloride were disposed to the sediment column at this site.

Well 299-W15-32 was constructed in May and June 1995 as a dual-use monitoring/extraction well, and is completed in the unconfined aquifer. Sediment samples were collected at various intervals from above the capillary fringe [~191 ft below ground surface (bgs)] to total depth (~239 ft bgs) during drilling. In all, 46 sediment samples were collected and analyzed. Data from the sediment and groundwater testing are provided in *DNAPL Analysis Data Package* (McCain, 1995) which is attached as Attachment A.

Groundwater samples were collected during well development/testing. For groundwater samples, the pump intake was set at ~232 ft bgs. Seven groundwater samples were collected for analysis.

3.0 TEST PROCEDURE

Testing was conducted on both sediment and groundwater samples in accordance with BHI (1995b). As testing progressed, test procedures were refined to simplify and improve the testing process, and to minimize waste generation. The analyses for sediment and groundwater samples are discussed in Sections 3.1 and 3.2.

3.1 Sediment Sample Analyses

Sediment samples were collected from split-spoon or resonant sonic core samplers. Sample locations were chosen at random when the core liner or split spoon was opened. Samples chosen were generally of finer grained material which was best suited for the analysis techniques employed. A single individual would typically identify sample locations for an entire core liner or split-spoon. Responsibility for choosing sample locations was rotated between persons performing the analyses to eliminate personal bias.

- Volatile Organic Compound Analysis: Samples were collected in VOA vials and analyzed for organic vapor concentrations using a gas chromatograph. The test was performed to *Field Screening Procedures* (BHI 1995a), "Analysis of Volatile Organic Compounds in Soil." The purpose of this analysis was to provide a confirmation of VOC presence to supplement information gained from the visual methods. An explanation of this testing and results is provided in *200-ZP-1 DNAPL Test Well: Soil and Groundwater VOC Field Screening Results* (Jacques, 1995) which is attached as Attachment B.

- Unaided Visual Examination: Samples were placed in clear plastic sample bags and manipulated in an attempt to identify DNAPL that might be present. Sometimes water was added to the sediment. The use of clear plastic bags was discontinued after the first day. It was found that although the plastic bags allowed good manipulation of the samples, their use greatly increased the amount of waste generated. In addition, it was found that silty samples produced a silty, muddy mixture that was difficult to examine. Centrifuge tubes were used for unaided visual examination from the second day until completion of the testing.

- UV-Fluorescence: The clear sample bags were examined under a short- and long-wave-length UV light. This was intended to detect any DNAPL that was UV fluorescent. After the use of sample bags was discontinued on the second day, samples were examined on a sheet of paper.

- Soil-Water Shake Test: Approximately 20 cm^3 of sample was placed in a 50-mL polypropylene centrifuge tube with approximately 20 mL of deionized water. The tube was then shaken by hand for approximately 10 to 30 seconds to create a soil-water suspension. The contents of the tube were examined through the tube wall to attempt to identify any DNAPL that might be present.

- Centrifugation of Soil-Water Suspension: The centrifuge tube was centrifuged at approximately 1250- 2000 rpm for one minute. The contents of the tube were examined through the tube wall to attempt to identify any DNAPL that might be present. This step was discontinued during the first day of testing. Experience with spikes showed that carbon tetrachloride was only visible if hydrophobic dye was used, or if a large volume of carbon tetrachloride was present.

- Hydrophobic Dye Soil-Water Test: Approximately 2 mg of Sudan IV dye was added to the centrifuge tube. The tube contents were mixed by shaking vigorously for 10 to 30 seconds. The tube was examined through the tube wall to identify any DNAPL which might be present.

- Centrifugation of Hydrophobic Dye Soil-Water Suspension: The centrifuge tube was then centrifuged at approximately 1250 to 2000 rpm for one to 20 minutes. The contents of the tube were examined through the tube wall to identify any DNAPL that might be present.

3.2 Groundwater Sample Analyses

Groundwater samples were collected as Well 299-W15-32 was developed. Samples were analyzed as discussed below:

- Organic Vapor Analysis: Groundwater samples were examined for organic vapor concentrations using a gas chromatograph. This test was performed using *Field Screening Procedures* (BHI 1995c), "Aqueous Headspace Analysis of Volatile Organic Compounds in Water." An explanation of groundwater sample analyses and test results is provided in Jacques (1995).

- UV-Fluorescence: Approximately 45 mL of water was put into a 50-mL polypropylene centrifuge tube. The tube contents were examined through the tube wall to attempt to identify any DNAPL that might be present. The centrifuge tube was then examined under a short- and long-wave-length UV light to detect any DNAPL that is UV fluorescent.

- Hydrophobic Dye Water Shake Test: Approximately 2 mg of Sudan IV dye was added to centrifuge tube and the tube shaken vigorously for 10 to 30 seconds. The contents of the tube were then examined through the tube wall to attempt to identify any DNAPL that might be present.

- Centrifugation of Hydrophobic Dye and Water: The centrifuge tube was then centrifuged at approximately 1250 to 2000 RPM for one to five minutes. The tube contents were then examined through the tube wall to attempt to identify any DNAPL that might be present.

4.0 RESULTS/RECOMMENDATIONS

Results of the testing are discussed in Section 4.1. Recommendations concerning any future use of these methods are provided in Section 4.2.

4.1 Results

The results of the DNAPL Investigation were inconclusive (i.e., DNAPL may or may not be present in the saturated zone). Due to test design, the presence of DNAPL could be confirmed, but the absence of DNAPL could not be confirmed. Although no DNAPL was positively identified, DNAPL may be present in sediment or water that was not sampled, or in areas not investigated by the borehole. The low probability of detecting DNAPL with a single well was the main reason that the partitioning interwell tracer test was proposed for the DNAPL investigation.

Results of the testing are discussed in *DNAPL Analysis Data Package* (McCain, 1995) (Attachment A) and in *200-ZP-1 DNAPL Test Well: Soil and Groundwater VOC Field Screening Results* (Jacques, 1995) (Attachment B).

4.2 Recommendations

The following recommendations are provided for future DNAPL investigations:

- The description of work should identify a maximum sample temperature above which drilling is stopped, and identify corrective measures to be implemented. A target temperature of 78°F was identified for the test in the drilling specification, but no corrective measures plan was developed. When the 78°F target was exceeded during drilling, corrective measures were implemented based on on-the-spot decisions rather than on a preconceived plan. Samples taken from above 205.5 ft bgs were above the target temperature with a maximum recorded temperature of approximately 151°F for the interval 197.0 to 199.5 ft bgs. (It should be noted that temperatures for core runs above this interval were not measured.)

  Following implementation of corrective measures (i.e., pre-chilling coring equipment, non-rotational drilling, shorter core runs) temperatures were generally kept below the target temperature. Nearly all samples taken between 205.5 feet bgs and total depth achieved the target temperature based upon temperatures measured at the shoe immediately after the core was retrieved from the borehole. A single core run in this interval (i.e., the run from 216.0 to 221.0 ft bgs) slightly exceeded the target temperature at 82°F.

- Sediment samples in the area of the capillary fringe were very well consolidated. Drilling was difficult and samples were heated. Without a circulating fluid to cool the bit or drive shoe, any DNAPL present was probably volatilized. Both split-spoon and sonic drilling methods were attempted above the saturated zone, with neither providing sufficiently cool samples. A cost effective drilling method is needed which can keep vadose zone sample temperatures low without the use of a circulating fluid that could flush samples.

- The visual methods did not work well with unstained samples. Carbon tetrachloride in the spiked samples prepared prior to the actual investigation proved difficult to detect unless a large volume of carbon tetrachloride was added to the samples. Cohen, et al. (1992) and Cohen and Mercer (1993) made similar observations. For this reason, centrifuging of samples without hydrophobic dyes was discontinued early in the investigation. Visual examination of the unstained samples was made, but the samples were not centrifuged. This saved time during the investigation and eliminated one opening and closing of the

sample vials. Centrifugation of unstained samples does not appear to be a necessary step in these analyses and it is recommended that future efforts not include this procedure.

- Minimize the number of samples to be taken from an interval. The variability of the sample limited the amount of sample that could be obtained and considered to represent a single sediment type. During testing, sample volumes were reduced by obtaining three samples for each interval, rather than four . The three samples taken were one sample for visual inspection, one sample for UV inspection, and one for head space analysis. It was originally planned that an additional sample would be taken in a plastic sample bag for visual examination. This practice was discontinued after the first day and the sample in the centrifuge tube was used for visual examination.

- Headspace analyses should be performed on all samples collected and analyzed using other visual methods. A sample was taken as grab-sample to provide a fourth sample to balance the centrifuge, with no corresponding headspace sample. The sample was taken from 213.1 feet bgs and was noticed to contain minute globules of dye distributed within the sediment after staining and centrifuging the sample. After the globules were discovered, much effort went into trying to determine what caused the globules. If a headspace analysis had been available, it could have eliminated some of this effort. It is thought that the globules were clumped dye with perhaps some silt or clay fraction. This sample and its analysis are described in detail in McCain (1995).

5.0 REFERENCES

BHI, 1995a, *Field Screening Procedures*, Procedure 1.2, "Analysis of Volatile Organic Compounds in Soil," BHI-EE-05, Bechtel Hanford Inc., Richland, Washington.

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Cohen, R. M., A. P. Bryda, S. T. Shaw, and C. P. Spalding, 1992, "Evaluation of Visual Methods to Detect NAPL in Soil and Water," *Groundwater Monitoring Review*, 12(4):132-141, Groundwater Publishing Company, Dublin, Ohio.

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ATTACHMENT A

DNAPL ANALYSIS DATA PACKAGE

DNAPL Analysis Data Package

DNAPL Investigation: 216-Z-9 Trench

Well 299-W15-32 was drilled in the Hanford 200 West Area near the 216-Z-9 Trench to support the dense non-aqueous phase liquid (DNAPL) investigation at the 200-ZP-1 Operable Unit. This well was to be the first phase of a partitioning interwell tracer test planned to determine if carbon tetrachloride is present as a DNAPL in the saturated zone.

During well drilling and well development, Analytical Services personnel provided field screening support for detection and evaluation of carbon tetrachloride in soil samples obtained from the saturated interval, and from water samples collected during well development activities. Field screening results for soil samples are summarized in Table 1, and results for the development water are summarized in Table 2.

If present in the aquifer in sufficient quantity (solubility approximately 800 ppm) carbon tetrachloride (CCl4) will behave as a dense nonaqueous phase liquid (DNAPL). The presence of CCl4 as a residual DNAPL in the aquifer below the 216-Z-9 Trench has important implications regarding the conceptual model for the 200-ZP-1 Interim Remedial Measure as well as for the final remedy selection process.

The test procedure for DNAPL is based on that described in Cohen, et al (1992), and is described in detail in BHI-00183, Appendix B. Specific tests to detect DNAPL included the following:

Unaided Visual Examination

Samples were placed in a clear plastic bag and manipulated to identify any DNAPL which may be present. This test was attempted on the first soil samples and abandoned because of the difficulty of effectively examining the sample.

UV fluorescence

The sample bags were also examined under both long (365 nm) and short (254 nm) wave UV light. While CCl4 itself does not fluoresce, other contaminants may also be present.

Soil-water shake test

Approximately 15 to 20 ml of the sample was placed in a polypropylene centrifuge tube and 20 ml of water was added. After shaking the tube for 10 sec., the contents of the tube were examined through the sidewalls to detect any DNAPL. The tube was then centrifuged at 2000 RPM for 1 to 5 minutes and again examined. After the first few samples, centrifugation of undyed samples was discontinued in favor of the centrifugation of dyed samples discussed below.

Hydrophobic dye test

A small amount of a hydrophobic dye (Sudan IV or Oil Red O) was added to the centrifuge tube from above and it was again shaken for 10 sec. Since the dye is hydrophobic, it will only dissolve in a nonaqueous phase. Both Sudan IV and Oil Red O are known to be soluble in carbon tetrachloride. The contents of the tube was then examined through the sidewall to detect any DNAPL. Finally, the tube was centrifuged again for 5 minutes at 2000 RPM. Early experience with the two dyes showed that Sudan IV exhibited less tendency to coat the tube sidewalls, and so the use of Oil Red O was discontinued.

Field GC Analysis - Aqueous Headspace Method

Soil samples were also analyzed for volatile organics using the aqueous headspace method in accordance with FSP-1.2 "Sampling and Analysis of Volatile Organics Compounds in Soil Using the Aqueous Headspace Method" (BHI-EE-05). The results of these analyses are summarized in a separate memorandum, dated July 11, 1995. (Attachment A)

Results of experiments

Experiments were conducted with a silty sand, a coarse sand, a medium sand, and a very fine sand. 0.25 ml of CCl4 was added to one sample, and a second was run as a blank. Both Oil Red O and Sudan IV dyes were used. The Sudan IV showed a much better tendency to segregate into the CCl4, so use of the Oil Red O was discontinued. Experience with the centrifuge showed that 1 minutes at 1250 RPM was inadequate to achieve separation, particularly in the silty material. Hence, the centrifuge run was increased to 5 to 20 minutes at 2000 RPM.

Experiments with pure CCl4 indicated that it would be very difficult to detect a clear DNAPL. However, the Sudan IV readily dissolves in CCl4, giving a bright red color. When no DNAPL is present, the dye does not dissolve at all.

Sample Results

Sample results are summarized in Table 1. GC results for trichloromethane (chloroform) and carbon tetrachloride are also included. The HEIS numbers shown on Table 1 correlate to SAFs B95-066 and B95-071.

Analysis of Water Samples During Well Development:

On June 28, 1995, samples of the well development water were analyzed in accordance with FSP-1.1 "Aqueous Headspace Analysis of Volatile Organic Compounds in Water" (BHI-EE-05). HEIS numbers for the water samples correlate to SAF B95-060. These results are discussed in *200-ZP-1 DNAPL Test Well: Soil and Groundwater VOC Field Screening Results* (Jacques, 1995).

In addition to the GC analysis, samples of the development water were screened for carbon tetrachloride using a Draeger DLE kit. This consists of a glass vessel equipped with a purge tube. 200 ml of water are added to the vessel and the headspace gas is drawn through a colorimetric tube using a conventional Draeger Air sampling pump. As the headspace gas is withdrawn, additional air is drawn in through the glass frit in the bottom of the sampling tube through an activated carbon filter. Volatile compounds are thus purged from the water and swept onto the colorimetric tube. The concentration of a specific contaminant or group of contaminants in solution is calculated based on the extent of reaction in the colorimetric tube. These results are reported in Table 2.

SUMMARY AND CONCLUSIONS

Field screening tests were conducted on both soil and water samples from well 299-W15-32 to detect the presence of carbon tetrachloride and associated contaminants. A variety of tests were oriented toward detection of carbon tetrachloride present as a DNAPL. Experiments with spiked samples suggest that the dye/centrifuge test has the best chance of being effective. However, no definitive evidence of a DNAPL phase in the soil or water was detected. One sample exhibited questionable evidence of a possible DNAPL, as discussed in Attachment A. Headspace analysis did detect carbon tetrachloride and other associated volatile compounds such as

trichloromethane (chloroform) in both soil and water samples, but the observed concentration levels appeared to be consistent with the presence of carbon tetrachloride and chloroform as dissolved phases in the pore water. This indicates that the material detected was likely present as a dissolved component in the water phase.

Table 1
Summary of DNAPL Test Results

date	sample	HEIS No	depth	soil description	visual	dye/ cent	GC results	
							TCM	CCL4
6/12/95	DNAPL1B	BOFZX0	191.4	gravelly silt / silty gravel	neg	neg	ND	ND
6/12/95	DNAPL1C	BOFZW9	191.9	gravelly silt / silty gravel	neg	neg	ND	ND
6/12/95	DNAPL1D	BOFZW8	192.4	gravelly silt / silty gravel	neg	neg	ND	ND
6/12/95	SPIKE	NA	NA	gravelly silt / silty gravel	neg	pos	NA	NA
6/12/95	DNAPL2D1	BOFZX1	193.0	gravelly silty sand	neg	neg	ND	ND
6/12/95	DNAPL2D2	NA	193.5	gravelly silty sand	neg	neg	NA	NA
6/13/95	DNAPL3A	BOFZX3	193.8	gravelly silty sand	neg	neg	ND	ND
6/13/95	DNAPL3B	BOFZX2	194.8	gravelly silty sand	neg	neg	ND	ND
6/13/95	DNAPL3C	NA	NA	gravelly silty sand	neg	neg	NA	NA
6/13/95	DNAPL3D	BOFZX4	196.8	gravelly silty sand	neg	neg	ND	ND
6/13/95	DNAPL4A	BOFZX5	197.0	slough	neg	neg	ND	ND
6/13/95	DNAPL4B	NA	197.5	gravelly silty sand / sandy silt	neg	neg	NA	NA
6/13/95	DNAPL4C	NA	198.0	gravelly silty sand / sandy silt	neg	neg	NA	NA
6/13/95	DNAPL4D	BOFZX6	199.3	gravelly silty sand / sandy silt	neg	neg	29	11
6/13/95	DNAPL5A	BOFZX7	199.5	slough	neg	neg	80	ND
6/13/95	DNAPL5B	BOFZX8	199.5	gravelly silty sand / sandy silt	neg	neg	18	ND
6/13/95	DNAPL5C	BOFZY0	200.2	gravelly silty sand / sandy silt	neg	neg	54	ND
6/13/95	DNAPL5D	BOFZX9	201.0	gravelly silty sand / sandy silt	neg	neg	ND	ND
6/13/95	DNAPL6A	BOFZY1	199.4	slough	neg	neg	24	115
6/13/95	DNAPL6B	BOFZY2	201.5	silty sandy gravel / gravelly sand	neg	neg	48	176
6/13/95	DNAPL6C	BOFZY3	202.9	silty sandy gravel / gravelly sand	neg	neg	58	7
6/14/95	DNAPL7	NA	204.0	water	neg	neg	NA	NA
6/14/95	DNAPL7A	BOFZY7	204.0	sand	neg	neg	270	ND
6/14/95	DNAPL7B	BOFZY8	206.5	sandy gravel	neg	neg	87	ND

Table 1
Summary of DNAPL Test Results

6/14/95	DNAPL8A	BOFZY9	207.3	gravelly sand	neg	neg	ND	79
6/14/95	DNAPL8B	BOFZZ5	208.4	gravelly sand	neg	neg	ND	12
6/14/95	DNAPL8C	BOFZZ3	209.3	gravelly sand	neg	neg	ND	25
6/14/95	DNAPL8D	BOFZZ4	210.4	gravelly sand	neg	neg	ND	11
6/14/95	DNAPL9A	NA	211.0	slough	neg	neg	NA	NA
6/14/95	DNAPL9B	BOFZZ7	212.2	gravelly sand	neg	neg	31	10
6/14/95	DNAPL9C	NA	213.1	gravelly sand	neg	neg *	NA	NA
6/14/95	NA	BOG086	213.1	gravelly sand	NA	NA	ND	ND
6/14/95	NA	BOG087	213.0	gravelly sand	NA	NA	ND	ND
6/14/95	NA	BOG088	213.7	sandy gravel with silt	NA	NA	ND	ND
6/14/95	DNAPL9D	BOFZZ6	215.3	gravelly sand	neg	neg	20	53
6/14/95	DNAPL10A	BOG001	216.0	sandy gravel	neg	neg	ND	38
6/14/95	NA	BOFZZ8	NA	slough	neg	neg	ND	Nd
6/14/95	DNAPL10B	BOG000	218.4	sandy gravel	neg	neg	130	18
6/14/95	DNAPL10C	BOFZZ9	220.7	sandy gravel	neg	neg	ND	40
6/14/95	DNAPL11A	BOG004	222.0	silty sandy gravel	neg	neg	ND	23
6/14/95	DNAPL11B	BOG003	223.5	silty sandy gravel	neg	neg	75	56
6/14/95	DNAPL11C	BOG002	225.8	silty sandy gravel	neg	neg	47	120
6/14/95	DNAPL12A	BOG006	226.4	silty sandy gravel	neg	neg	85	12
6/14/95	DNAPL12B	BOG007	228.5	silty sandy gravel	neg	neg	ND	63
6/14/95	DNAPL12D	BOG005	230.7	silty sandy gravel	neg	neg	ND	160
6/15/95	DNAPL13A	BOG012	231.4	silty sandy gravel	neg	neg	ND	35
6/15/95	DNAPL13B	BOG011	232.2	silty sandy gravel	neg	neg	ND	150
6/15/95	DNAPL13C	BOG010	234.7	silty sandy gravel	neg	neg	ND	26
6/15/95	DNAPL14A	BOG083	236.2	sandy gravel	neg	neg	ND	26
6/15/95	DNAPL14B	BOG084	237.6	sandy gravel	neg	neg	ND	60
6/15/95	DNAPL14C	BOG085	238.9	sandy gravel	neg	neg	ND	78

TABLE 1 NOTES:

* The analysis of this sample is discussed in detail in Attachment B.

Table 1
Summary of DNAPL Test Results

ND Less than detection level (15ppb)
NA Not applicable

ATTACHMENT A

Narrative for Sample DNAPL9C (213.1 ft)
June 15, 1995

On June 15, a centrifuge tube of a sample taken the previous day was examined under a microscope and a possible indication of a DNAPL was observed. The sample in which this occurred was DNAPL9C, taken at a depth of 213.1 ft. Unfortunately, no sample had been collected at this depth for GC analysis. The possible indication of DNAPL was the presence of small globules of Sudan IV dye distributed within the sediment after staining and centrifuging the sample. These globules retained the "brick-red" color of the dye, rather than the bright red color of stained carbon tetrachloride. The globules were visually identical to globules formed by the dye in nearly all of the centrifuge tubes, the difference being that these globules were trapped within the sediment in the centrifuge tube after centrifugation, rather than floating at the waters surface. Because a bright red color was not observed, the dye probably did not dissolve in the substance.

Samples BOG086, BOG087 and BOG088 were collected from the same general depth range, but no compounds were detected by field GC analysis. It must be noted that the sample had been left out overnight before these samples were collected, however. After analysis of the first headspace sample from the suspect interval (BOG086) failed to detect any volatile compounds, a sample of the headspace vapor from the DNAPL9C centrifuge tube was obtained by penetrating the wall of the centrifuge tube with a syringe needle. A 250 microliter injection was made into the Photovac 10S Plus GC. Results indicated a significant peak for carbon tetrachloride (76 ppb) and minor peaks for dichloromethane (2 ppb), 2-butanone (37 ppb), chloroform (12 ppb) and trichloroethylene (1 ppb). The concentrations given above are water concentrations based on the peak associated with the headspace vapor. This concentration is substantially below the reported value for solubility of carbon tetrachloride (800 ppm at 20°C). Because the weight of soil and volume of water in the centrifuge tube were not known, it is impossible to provide an accurate estimate of soil concentration. However, it is likely that the soil concentration of carbon tetrachloride was on the order of 50 to 100 ppb.

After the above analysis, a sample of the water used in the dye centrifuge test was analyzed using the headspace method. No volatile compounds were detected. A second headspace sample was obtained from the centrifuge tube and analyzed. The same compounds noted above were again detected. Finally the remaining two headspace samples collected earlier in the day were analyzed, yielding no detectable peaks.

When the sediment was disturbed by examination, the globules floated to the surface of the water where visually similar globules were already floating. Efforts to collect a sample of the globules for analysis per the sampling and analysis plan were not successful because the globules floated

away from the syringe needle. The globules could not be extracted from the centrifuge tube using the method specified in the sampling and analysis plan. In addition, the fact that the globules floated to the surface when disturbed would seem to indicate that they probably were not DNAPL. However, it is unclear why the globules would be trapped in the sediment during centrifugation.

The available data indicate that DNAPL9C contained a trace of carbon tetrachloride. However, it is not clear that any existed as a non-aqueous phase. The carbon tetrachloride concentration observed in DNAPL9C is of the same order of magnitude as that observed in other samples both above and below the interval in question. If the globular mass observed in DNAPL9C had in fact been carbon tetrachloride, it is likely that the Sudan IV would have dissolved, giving it a bright red color. It is also likely that the headspace concentration observed in the centrifuge tube would have been much higher if carbon tetrachloride had been present as a DNAPL.

9513388.2118

ATTACHMENT B

200-ZP-1 DNAPL TEST WELL: SOIL AND GROUNDWATER VOC FIELD SCREENING RESULTS

BHI-00431
Rev. 0

Environmental Restoration Contractor **ERC Team**

Interoffice Memorandum

Job No. 22192
Written Response Required? N0
Closes CAN: N/A
OF: 200-ZP-1
TSD: N/A
ERA: N/A
Subject Code: 8960

TO: D. L. Parker, H6-02

DATE: July 11, 1995

COPIES: See Below

FROM: Duane Jacques
Analytical Services/Field Screening
H6-04/372-9400

SUBJECT: **200-ZP-1 DNAPL TEST WELL: SOIL AND GROUNDWATER VOC FIELD SCREENING RESULTS**

The attached tables provide results for soil and groundwater samples collected from a test well installed near the 216-Z-9 facility which is a part of the 200-ZP-1 Operable Unit. The well was installed to assess the presence of Dense Non-Aqueous Phase Liquid (DNAPL) contaminants in the vadose zone and saturated zone beneath the 216-Z-9 facility.

The soil samples were collected and prepared for analysis following Field Screening Procedure (FSP) 1.2, "Sampling and Analysis of Volatile Organic Compounds in Soil Using the Aqueous Headspace Method" contained in BHI-EE-05, *Field Screening Procedures*, January, 1995. Soil samples were collected from drilled soil borings using a disposable plastic coring device. The soil samples consisted primarily of silt and sand collected from selected regions within each soil boring. Rocks and gravels in the soil boring were not sampled. Soil plugs of about 5 to 7 grams each were quickly transferred from the disposable coring device into 40-mL VOA vials containing 30 mL of deionized water. The vials were capped and the contents were shaken vigorously to distribute the soil in the water matrix. The vials were placed in a heater block set at about 25°C to await analysis. Just prior to analysis, the samples were shaken vigorously for one minute to ensure equilibrium between the liquid and vapor phase. The samples were analyzed for selected volatile organic compounds (VOC) using an aqueous headspace analysis method. The samples were analyzed the same day they were collected, usually within about one hour after collection.

The samples were analyzed following FSP 1.1 "Aqueous Headspace Analysis of Volatile Organic Compounds in Water" contained in BHI-EE-05. Headspace aliquots of 250 µL were obtained from each sample vial using a gas-tight syringe. The headspace samples were then analyzed using a Photovac 10S Plus portable gas chromatograph (Serial Number TB920109). The Photovac 10S Plus (10S Plus) is a self-contained, battery-powered gas chromatograph that is equipped with a 10-meter non-polar, wide-bore, capillary column and a photoionization detector with an 11.7 eV lamp. The 10S Plus was operated isothermally at 40°C using ultra-high purity air carrier gas at a flow rate of 5 mL/min.

The 10S Plus is programmed with a library to detect common chlorinated VOC in a water matrix based on retention time. The library was updated and calibrated using a prepared liquid standard containing chloroform, carbon tetrachloride, and trichloroethylene in the concentration range anticipated for the

samples. Headspace from a sample of deionized water was run after the calibration as a blank to establish a baseline for the analyses. In addition, the calibration standard was reanalyzed at the end of the analytical session to determine any deviation from the original calibration. The deviations were within the acceptable limits for this method (±20%).

Table 1 contains the results for each soil sample analyzed. The HEIS numbers for each soil sample correlate to SAF B95-066 and B95-071. The soil concentrations are expressed in µg/Kg (parts-per-billion) and represent an estimate of the concentration of contaminants extracted from the soil into the water matrix. These values were determined by calculating the total mass of contaminant in the water matrix and back-calculating the concentration to the soil mass. This calculation is based on the assumption that contaminants detected in the water matrix were desorbed from the soil.

This assumption probably represents a simplistic evaluation of the distribution of contaminants in the soil matrix. It is likely the pore spaces in soil samples collected from the saturated portions of the test-well boring contained groundwater contaminated with the analytes of concern. This method is not able to distinguish between contaminants originating in water in the pore spaces and contaminants adsorbed to the soil matrix. The method also assumes 100% of the contaminants adsorbed to the soil particles are desorbed into the water matrix. Realistically, the percentage of desorption is probably less than 100%. The literature on this analytical method concludes that soils containing large amounts of clay and organic material show relatively lower recovery of VOC than sandy soils. The VOC tend to remain bound to the clay and organic materials, are not readily desorbed into the water matrix, and are therefore not detected by the analytical method. Some the soil samples collected from the test-well boring contained a relatively large amount of clay and fine silt material.

Table 2 contains results for groundwater samples. The HEIS numbers for each soil sample correlate to SAF B95-060. The groundwater concentrations detected are expressed in µg/L (parts-per-billion). These groundwater samples were collected on June 28, 1995 as the well was being developed. The samples were collected with zero headspace, preserved with concentrated hydrochloric acid, and stored at 4°C. The samples were analyzed on June 29, 1995 using the aqueous headspace method described earlier in this letter. About 12 mL of liquid was removed from each sample prior to analysis using a disposable syringe to create the desired headspace in each vial. The values reported are the actual measured concentrations for each groundwater sample detected by the gas chromatograph.

Please contact me if you have any questions on this information. I will retain copies of the calibration, quality control, and sample chromatograms in my files. Notes concerning the analyses are contained in the 68N-1985 mobile laboratory logbook. Copies of the laboratory custody/log sheets are included in this package to document sample custody and quality control samples analyzed as part of this project. In addition, the work sheets used to document and calculate the soil concentrations are included in the package.

Duane Jacques

Duane Jacques

IDJ:idj

Attachments: Table 1. 200-ZP-1 DNAPL Test Well Soil Sample Results.
Table 2. 200-ZP-1 DNAPL Test Well Groundwater Sample Results.

Copies
R. A. Casto, H6-04, w/a
J. R. Freeman-Pollard, H6-04, w/a
D. R. Jordan, X2-10, w/a
J. A. Lerch, H4-14, w/a
K. L. Lookabill-Stump, H6-02, w/a
R. G. McCain, H6-02, w/a
W. H. Price, H6-04, w/a
IDJ - File, w/a
BHI Document Control H4-79, w/a

Table 1. 200-ZP-1 DNAPL Test Well Soil Sample Results

Date	Time	HEIS #	Depth (ft)	Soil Type	TCM (ug/Kg)	CCl4 (ug/Kg)
6/1/95	8:27	B0FN66	92.5 - 93.0	Silty Sand	<15	<15
6/1/95	8:27	B0FN67	92.0 - 92.5	Silty Sand	<15	<15
6/1/95	8:27	B0FN68	91.5 - 92.0	Silty Sand	<15	<15
6/1/95	8:27	B0FN69	91.0 - 91.5	Silty Sand	<15	<15
6/1/95	8:27	B0FN70	91.0 - 91.5	Silty Sand	<15	<15
6/1/95	10:50	B0FN78	Spiked	B0FN66	530	400
6/1/95	14:17	B0FN73	105.5 -106.0	Silty Sand	<15	<15
6/1/95	14:17	B0FN74	106.0 -106.5	Silt	<15	7.1J
6/1/95	14:17	B0FN75	106.5 -107.0	Silt	<15	<15
6/1/95	14:17	B0FN76	107.0 -107.5	Silty Sand	<15	<15
6/1/95	14:17	B0FN77	107.0 -107.5	Silty Sand	<15	<15
6/6/95	11:08	B0FN81	140.5 - 141.0	Sand	<15	<15
6/6/95	11:08	B0FN82	141.0 - 141.5	Silt	<15	17.6
6/6/95	11:08	B0FN83	141.5 - 142.0	Sand	<15	<15
6/6/95	11:08	B0FN84	142.0 - 142.5	Sand	<15	<15
6/6/95	11:08	B0FN85	142.0 -142.5	Sand	<15	<15
6/12/95	9:29	B0FZX0	191.4	Silt	<15	<15
6/12/95	9:25	B0FZW9	191.9	Silt	<15	<15
6/12/95	9:23	B0FZW8	192.4	Silt	<15	<15
6/12/95	1104	B0FZX1	193	Silt	<15	<15
6/13/95	9:17	B0FZX3	193.8	Sandy Gravel	<15	<15
6/13/95	9:15	B0FZX2	194.8	Sandy Gravel	<15	<15
6/13/95	9:26	B0FZX4	196.8	Sandy Gravel	<15	<15
6/13/95	13:15	B0FZX5	slough	Sandy slough	<15	<15
6/13/95	13:18	B0FZX8	197.5	Silty Sand	18	<15
6/13/95	13:16	B0FZX6	199.3	Sandy Silt	29	11J
6/13/95	14:34	B0FZX7	slough	Silty slough	80	<15
6/13/95	15:22	B0FZY0	200.2	Sandy Silt	54	<15
6/13/95	14:36	B0FZX9	201.0	Sandy Silt	<15	<15
6/13/95	15:46	B0FZY1	slough	Sandy slough	24	115
6/13/95	15:48	B0FZY2	201.5	Sandy gravel	48	176
6/13/95	15:49	B0FZY3	202.9	Sandy Silt	58	6.6J
6/14/95	8:39	B0FZY7	204	sand	270	<15
6/14/95	8:41	B0FZY8	206.5	sandy gravel	87	<15
6/14/95	9:40	B0FZY9	207.3	sandy gravel	<15	79
6/14/95	9:42	B0FZZ5	208.4	sandy gravel	<15	12J
6/14/95	9:44	B0FZZ3	209.3	sandy gravel	<15	25
6/14/95	9:46	B0FZZ4	210.4	sandy gravel	<15	11J
6/14/95	11:44	B0FZZ7	212.2	sandy gravel	31	10J
6/14/95	11:43	B0FZZ6	215.3	sandy gravel	20	53
6/14/95	13:34	B0G001	216.0	SS Sandy gravel	<15	38
6/14/95	11:45	B0FZZ8	slough	sandy gravel	<15	<15
6/14/95	13:32	B0G000	218.4	SS Sandy gravel	130	18
6/14/95	13:30	B0FZZ9	220.7	SS Sandy gravel	<15	40
6/14/95	15:39	B0G004	222.0	Silty Sandy Gravel	<15	23
6/14/95	15:36	B0G003	223.5	Silty Sandy Gravel	75	56

Table 1. 200-ZP-1 DNAPL Test Well Soil Sample Results

Date	*Time*	*HEIS #*	*Depth (ft)*	*Soil Type*	*TCM (ug/Kg)*	*CCl4 (ug/Kg)*
6/14/95	15:34	B0G002	225.8	Silty Sandy Gravel	47	120
6/14/95	16:15	B0G006	226.4	Silty Sandy Gravel	85	12
6/14/95	16:18	B0G007	228.5	Silty Sandy Gravel	<15	63
6/14/95	16:13	B0G005	230.7	Silty Sandy Gravel	<15	160
6/15/95	8:20	B0G012	231.4	Silty Sandy Gravel	<15	35
6/15/95	8:18	B0G011	232.2	Silty Sandy Gravel	<15	150
6/15/95	8:15	B0G010	234.7	Silty Sandy Gravel	<15	26
6/15/95	9:31	B0G083	236.2	Sandy Gravel	<15	26
6/15/95	9:33	B0G084	237.6	Sandy Gravel	<15	60
6/15/95	9:35	B0G085	238.9	Sandy Gravel	<15	78

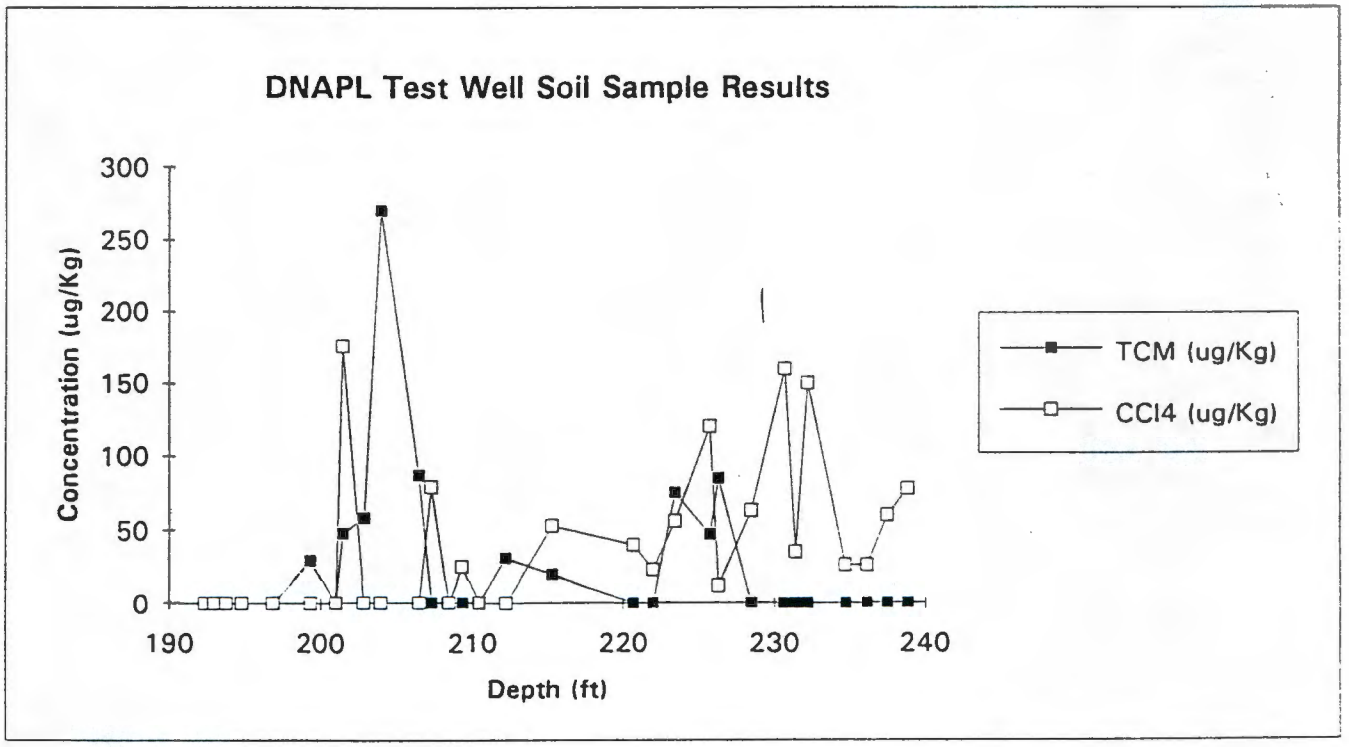
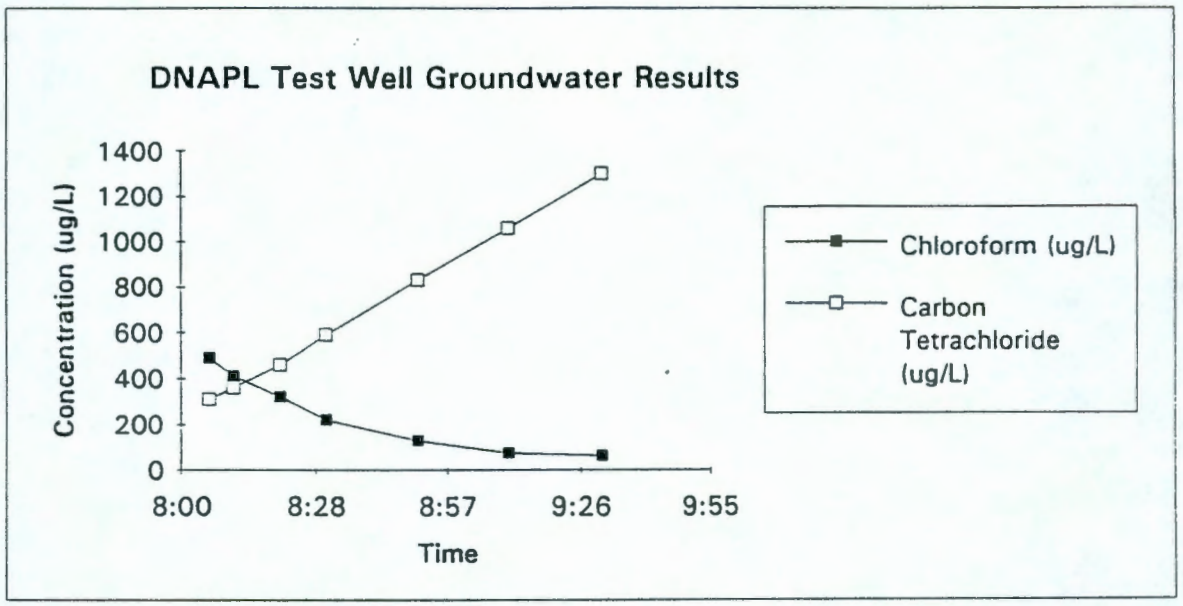


Table 2. 200-ZP-1 DNAPL Test Well Groundwater Sample Results

Date	*Time*	*HEIS #*	*Chloroform (ug/L)*	*Carbon Tetrachloride (ug/L)*
6/28/95	8:06	B0G3V3	490	310
6/28/95	8:11	B0G3V4	410	360
6/28/95	8:21	B0G3V5	320	460
6/28/95	8:31	B0G3V6	220	590
6/28/95	8:51	B0G3V7	130	830
6/28/95	9:11	B0G3V8	75	1060
6/28/95	9:31	B0G3V9	63	1300



MOBILE LABORATORY DATA/LOG SHEET

Site Name: 200-ZP-1 DNAPL Well Date: 6-1-95

Sample Number	Sample Time	Sample Type	Sampler (initials)	Analysis Time	Analytical Results	Comments
B0FN66	0827	Soil	JF	0952	No Detects	Sleeve A 92.5-93.0 SS
B0FN67	0827	Soil	JF	1008	No Detects	Sleeve B 92.0-92.5 SS
B0FN68	0827	Soil	JF	1019	No Detects	Sleeve C 91.5-92.0 SS
B0FN69	0827	Soil	JF	1030	No Detects	Sleeve D 91.0-91.5 Silty SS
B0FN70	0827	Soil	JF	1039		Sleeve D 91.0-91.5 dupe.
B0FN71	0920	Cal Standard	IDJ	0930	TCM = 0.17 CCl4=0.055 TCE= 0.048	Good Cal
B0FN72	0830	Blank Sample	IDJ	0942	No Detects	—
AC-1	0940	H_2O	IDJ	1307	TCM=41 CCl4=2900, TCE=1.4	
SC-6	0942	H_2O	IDJ	1315	TCM=41 CCl4=3100, TCE=1.8	
SC-3	0944	H_2O	IDJ	1153	CCl4 = 223 ppb	
SC-4	0945	H_2O	IDJ	1142	No detects	
AC-9	0950	H_2O	IDJ	1133	No Detects	
B0FN78	1050	Spiked Soil	IDJ	1100	TCM=80 (-8%) CCl4=60 (+15%) TCE=70 (+15%)	TCM=87 TCE=6 CCl4=52
ZP-1Cal32	0929 ~~HH~~	H_2O	IDJ	1114	TCM=170 CCl4=55 TCE=48	Good Cal
ZP-1 Blk32	0830	H_2O	IDJ	1123	No detects	Blank
ZPLCalc32	0920	H_2O	IDJ	1205		Lo Cal Check
ZP1Cal-32	1040	H_2O	~~IDJ~~	1244	TCM=145 CCl4=2600, TCE=56	GOOD CAL
ZPSC6-32	0942	H_2O	~~IDJ~~	1257	X	BAD INJECTION
RL ~~ZPAC1-32~~	~~0940~~	~~H_2O~~	~~IDJ~~	~~1307~~	TCM=40.5 CCl4=2410, TCE=1.4	*See AC-1 ABOVE
RL ~~ZPSC6-32~~	~~0942~~	~~H_2O~~	~~IDJ~~	~~1315~~	TCM=41 CCl4=3100, TCE=1.8	*See SC-6 ABOVE
ZHClk-32	1040	H_2O	IDJ	1346	TCM=160 CCl4=3640, TCE=55.7	TCM=+10% CCl4=+2% TCE=-1%
DMJ ~~B0FN71a~~	~~0920~~	~~H_2O~~	IDJ	~~1400~~	TCM=167 CCl4=533 TCE=45.7	TCM=-2% CCl4=-3%, TCE=-5%
B0FN73	1417 d	H_2O	JF	1456	No Detects	Sleeve D
B0FN74	1417 c	H_2O	JF	1510	Trace CCl4 <2.0	Sleeve C
B0FN75	1417 b	H_2O	JF	1520	No Detects	Sleeve B
B0FN76	1417 a	H_2O	JF	1530	No Detects	Sleeve A

MOBILE LABORATORY DATA/LOG SHEET

Site Name: 200-ZP-1 DNAPL Well

Date: 6-1-95 / 6-6-95

Sample Number	Sample Time	Sample Type	Sampler (initials)	Analysis Time	Analytical Results	Comments
B0FN77	1417 a	H_2O	JF	1539	NO DETECTS	sleeve + Out
B0FN79	0920	H_2O Cal Std	IDJ	1549	TCM = 164, CCl_4 = 46 TCE = 43	Cal check
B0FN80	1045	H_2O Cal Std	RBK	1207	TCM = 200, CCl_4 = 52 TCE = 56	GOOD CAL.
B0FN81	1108 d	H_2O + Soil	JF	1232	NO DETECTS	
B0FN82	1108 c	H_2O + Soil	JF	1243	TCM = ND, CCl_4 = 3.0	
B0FN83	1108 b	H_2O + Soil	JF	1253	NO DETECTS	
B0FN84	1108 a	H_2O + Soil	JF	1307	NO DETECTS	
B0FN85	1108 a	H_2O + Soil	JF	1320	NO DETECTS	
B0FN86	1045	H_2O BLANK	RBK	1221	NO DETECTS	BLANK
B0FN87	1045	H_2O Cal Std	RBK	1333	TCM = 195, CCl_4 = 50 TCE = 57	TCM = -3%, CCl_4 = -4% TCE = +2%
B0FZW6	0950	H_2O Cal Std	IDJ	1014	TCM = 170 CCl_4 = 52 TCE = 47	Good cal.
B0FZW7	~~0715~~ ~~1200~~	H_2O Blank	IDJ	1101	No detects	Blank
B0FZW8	0923 ~~1119~~	H_2O + Soil	IDJ	1119	No detects	—
B0FZW9	0925	H_2O/Soil	IDJ	1128	No detects	—
B0FZX0	0929	H_2O/Soil	IDJ	1139	No detects	—
B0FZX1	1104	H_2O/Soil	IDJ	1154	No detects	—
B0FZY4	0950	Cal Check	IDJ	1531	Could not detect peaks over failure.	
B0FZY5	0940	Cal Standard	RBK	1055 ~~1025~~	TCM = 150, CCl_4 = 99, TCE = 93	Good Cal!
B0FZY6	0930	H_2O Blank	IDJ	1104	No detects	Good run
B0FZX2	0915	Soil in H_2O	IDJ	1113	No detects	—
B0FZX3	0917	Soil in H_2O	IDJ	1121	No detects	—
B0FZX4	0926	Soil/H_2O	IDJ	1130	No detects	—
B0FZX5	1315	Soil/H_2O	IDJ	1335	No detects	100 ml inj - No detects 1340 - 250 ml inj
B0FZX6	1316	Soil/H_2O	IDJ	1355	CCl_4 = 2.7 ppb	250 ml inj
B0FZX8	1318	Soil/H_2O	IDJ	1405	No detects	250 ml inj
B0FZX7	1434	Soil/H_2O	KLS			

MOBILE LABORATORY DATA/LOG SHEET

Site Name: 200-ZP-1 DNAPL Date: 6-13-95

Sample Number	Sample Time	Sample Type	Sampler (initials)	Analysis Time	Analytical Results	Comments
B0FZX9	1436	soil/H_2O	KLS	1457	See Soil	Sheet
B0FZY0	1532	↓	IDJ	1530	↓	
B0FZY1	1548		IDJ	1557		
B0FZY2	1608		IDJ	1608		
B0FZY3	1619	↓	IDJ	1620	↓	
B0FZZ0	1500	Cal Check	RBK	1639	TCM = 145 TCE = 93	CCl_4 = 83
UP-1 Pre	0940	H_2O	CR	1215	CCl_4 = 84 ppb TCE = 10.2	
UP-1 Post	0940	H_2O	BCR	1225	CCl_4 = 55 ppb TCE = 2.6 ppb	
SC-4	1000	↓	IDJ	1157	No detects	—
SC-3	0959		IDJ	1206	CCl_4 = 220 ppb	—
SC-6	0958		IDJ	1315	TCM = 50 ppb CCl_4 = 3000 ppb	TCE = 2.8
SC-1	0956		IDJ	1324	TCM = 57 CCl_4 = 3140	TCE = 2.3
AC-9	1010	↓	IDJ	1150	No detects	—
ZP1Cal33	1045	H_2O Cal	IDJ	1130	TCM = 150 CCl_4 = 52 TCE = 61	Good Cal
ZP1Blk33	1045	H_2O Blank	IDJ	1140	No detects	Good Blank
ZLoChk33	1045	Cal Check	IDJ	1235	TCM = 146	CCl_4 = 50 TCE = 57
ZHiCal33	1250	H_2O Cal	IDJ	1257	TCM = 150 CCl_4 = 2600 TCE = 61	Good Cal
ZHiBlk33	1045	H_2O	IDJ	1306	No detects	Good Blank
ZHiChk33	1250	H_2O	IDJ	1332	TCM = 146 TCE = 61	CCl_4 = 2652

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68N-1985 Mobile Laboratory Custody/Log Sheet

Site Name: 200-ZP-1 DNAPL Well

Site/Sample Number	Sample Type	Sample Depth	Sample Date/Time	Sampler (Initials)	HEIS Number	Analysis Date/Time	Analyst (Initials)	Comments
CAL	H2O CAL STD	MID CAL	6/29/95 1140	RBK	BOG089 ~~BOG3V0~~	6/29/95 1240	RBK	TCM = 145, CCl4 = 416 TCE = 98
—	H2O BLANK	—	6/29/95 1000	RBK	BOG090 ~~BOG3V1~~	6/29/95 1249	RBK	—
ZP-1 DNAPL	H2O		6/28/95 0806	DB	BOG3V3	6/29/95 1305	RBK	11DCE ? TCM = 485 CCl4 = 309 ppb
"	H2O		6/28/95 0811	DB	BOG3V4	6/29/95 1323	RBK	TCM = 412 CCl4 = 357
"	H2O		6/28/95 0821	DB	BOG3V5	6/29/95 1331	RBK	TCM = 316 CCl4 = 464
"	H2O		6/28/95 0831	DB	BOG3V6	6/29/95 1340	RBK	TCM = 217 CCl4 = 591
"	H2O		6/28/95 0851	DB	BOG3V7	6/29/95 1349	RBK	TCM = 130 CCl4 = 825
"	H2O		6/28/95 0911	DB	BOG3V8	6/29/95 1358	RBK	TCM = 97 ppb CCl4 = 921 ppb
"	H2O		6/28/95 0931	DB	BOG3V9	6/29/95 1411	RBK	TCM = 85 CCl4 = 1130
—	H2O BLANK	—	6/29/95 1000	RBK	BOG091 ~~BOG3V2~~	6/29/95 1419	RBK	—
—	H2O CAL STD	MID CAL	6/29/95 1140	RBK	BOG092 ~~BOG3V0~~	6/29/95 1428	RBK	TCM = 157 (+8%), CCl4 = 428 (+3%) TCE = 111 (+3%)
~~—~~	~~H2O BLANK~~	—	6/29/95 1000	~~RBK~~	~~BOG3V2~~	6/29/95 1437	~~RBK~~	— LNJ
Hi CAL	H2O CAL STD	Hi CAL STD	6/29/95 1420	RBK	BOG093 ~~BOG3V1~~	6/29/95 1531	RBK	TCM = 315 CCl4 = 1053 ppb. GOOD CAL.
—	H2O Blank	—	6/29/95 1000	RBK	BOG094 BOG3V2	6/29/95 1541	RBK	—
ZP-1 DNAPL	H2O		6/28/95 0911	DB	BOG3V8	6/29/95 1551	RBK	TCM = 75 CCl4 = 1062 ppb.
"	H2O		6/28/95 0931	DB	BOG3V9	6/29/95 1608	RBK	TCM = 63 CCl4 = 1313 ppb
CAL CHeck	H2O Hi Cal	Hi Cal STD	6/29/95 1420	RBK	BOG095 ~~BOG3V1~~	6/29/95 1620	RBK	TCM = 313 (-2%) CCl4 = 1041 (-1%)

9513388.2128

BHI-00431 Rev. 0

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VOC IN SOIL FIELD ANALYSIS DATA/LOG SHEET

Site Name: 200-ZP-1 DNAPL Well

Date: 6-1-95

Sample Number	Sample Time	[1] H_2O (g)	[2] Vial Tare (g)	[3] Total Sample (g)	[4] Net Soil (g) (3-2)	[5] Analytical Results (µg/g)	Soil Concentration (µg/kg) (5*1/4)	Comments
B0FN66	0827	30	58.0	62.5	4.5	No detects, <2.0	No detects <15	Silty Sand
B0FN67	0827	30	57.7	62.6	4.9	No detects <2.0	TCM/CCl4/TCE = <15	Silty Sand
B0FN68	0827	30	58.8	63.3	4.5	No detects TCM/CCl4/TCE = <2.0	TCM/CCl4/TCE = <15	Silty Sand
B0FN69	0827	30	58.2	62.9	4.7	No detects <2.0	TCM/CCl4/TCE = <15	Siltier Silty Sand
B0FN70	0827	30	58.4	63.2	4.8	No detects <2.0	TCM/CCl4/TCE = <15	Siltier Silty Sand
B0FN78	1050	30	58.0	62.5	4.5	TCM = 80, CCl4 = 60 TCE = 70	TCM = 530 CCl4 = 400 TCE = 470	Spiked B0FN66 TCM = 87, CCl4 = 52, TCE = 61
B0FN73	1417 d	30	57.9	62.4	4.5	No Detects, <2.0	No detects (<15)	105.5 - 107.5 Silty Sand
B0FN74	1417 c	30	58.2	62.0	3.8	TRACE CCl4 (.9ppb), <2.0	No detects, <15	~~Silty Sand~~
B0FN75	1417 b	30	57.7	62.1	4.4	NO DETECTS, <2.0	NO DETECTS, <15	~~Silty Sand~~
B0FN76	1417 a	30	58.6	62.9	4.3	NO DETECTS, <2.0	NO DETECTS, <15	Silty Sand
B0FN77	1417 a	30	58.4	63.0	4.6	NO DETECTS, <2.0	TCM/CCl4/TCE = <15	Silty Sand
~~B0FN81~~	1109 d	30	58.4	62.5	4.1	NO DETECTS, <2.0	TCM/CCl4/TCE = <15	
~~B0FN82~~	1108 c	30	57.7	62.8	5.1	TCM = ND, CCl4 = 3.0 TCE = ND	TCM = <15, CCl4 = 17.6 TCE = <15	*
~~B0FN83~~	1106 b	30	58.2	62.8	4.6	NO DETECTS, <2.0	TCM/CCl4/TCE = <15	
~~B0FN84~~	1108 a	30	58.4	62.8	4.4	NO DETECTS, <2.0	TCM/CCl4/TCE = <15	
~~B0FN85~~	1108 a	30	58.2	62.7	4.5	NO DETECTS, <2.0	TCM/CCl4/TCE = <15	

B-12

105.5-106

106 - 106

106.5 - 107

107 - 107

9513388.2129

Sampler: JF

Analyst: IOJ/RAK

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0173022
9513388.2130

VOC IN SOIL FIELD ANALYSIS DATA/LOG SHEET

Site Name: 200-ZP-1 DNAPL Well

Date: ~~6-6-95~~ 6-9-95 DOJ

Sample Number	Sample Time	[1] H_2O (g)	[2] Vial Tare (g)	[3] Total Sample (g)	[4] Net Soil (g) (3-2)	[5] Analytical Results (µg/g)	Soil Concentration (µg/g) (5*1/4)	Comments
B0FZW8	0923	30	57.4	61.2	3.8	ND	<15 ppb	top of Tower sleeve (D) 191.7 fine silt 192.4
B0FZW9	0925	30	58.2	63.0	4.8	ND	<15	top of sleeve C 192.9
B0FZX0	0929	30	58.7	60.8	2.1	ND	<15	top of sleeve B 191.4
B0FZX1	1604	30	57.8	61.0	3.2	ND	<15	top of D 193.0 192.9 - 193.5
B0FZX2	0915	30	58.1	64.0	5.9	ND	<15	~~Top of sleeve~~ silty sandy gravel Depth = 195 194.8
B0FZX3	0917	30	58.1	62.4	4.3	ND	<15	~~top of B~~ ss sandy gravel 193.8
B0FZX4	0926	30	58.1	63.7	5.6	ND	<15	~~Top of A~~ ss sandy gravel depth = 197.0
B0FZX5	1315	30	57.4	63.6	6.2	ND	<15	dark silt layer middle bottom of slough B-13
B0FZX6	1316	30	56.8	64.0	7.2	TCM = 7.0 CCl4 = 2.78 ppb	TCM = 29 CCl4 = 11	Silt at bottom 199.3 sandy gravelly silt
B0FZX7	~~1434~~ 1318	30	57.2	63.2	6.0	TCM = 16	TCM = 80 CCl4 <15	2ft ~~from~~ bottom 197.5 ~~Silt~~ layer
B0FZX8	1318	30	56.9	62.3	5.4	TCM = 3.3 ~~Non detect~~	TCM = 18 CCl4 <15	silty sandy gravel 197.5
B0FZX9	1436	30	56.9	63.3	6.4	No detect	~~A~~ <15	set 201 ft sandy silt
B0FZY0	1522	30	57.1	64.3	7.2	TCM = 13	CCl4 <15; TCM = 54	200.1 ft Sandy silt
B0FZY1	1546	30	57.4	65.5	8.1	TCM = 31 CCl4 = 6.6	CCl4 = 24 TCM = 115	top = slough Sandy gravel
B0FZY2	1548	30	56.8	62.6	5.8	TCM = 9.2 CCl4 = 34	TCM = 48 CCl4 = 176	middle = 201.5 Sandy gravel"
B0FZY3	1549	30	57.3	64.6	7.3	TCM = 14 CCl4 = 1.6	TCM = 58 CCl4 = ~~4.5~~ 6.6	bottom = 202.9 sandy silt

Sampler: (D) Jacques

Analyst: (D Jacques

BHI-EE-135, 5/95

9513388.2131

0017302

VOC IN SOIL FIELD ANALYSIS DATA/LOG SHEET

Site Name: 200-ZP-1 DNAPL Well

Date: 6-13-95 (14)

Sample Number	Sample Time	[1] H_2O (g)	[2] Vial Tare (g)	[3] Total Sample (g)	[4] Net Soil (g) (3-2)	[5] Analytical Results (µg/kg)	Soil Concentration (µg/kg) (5*1/4)	Comments
BOFZY7	0839	30	56.8	64.2	7.4	TCM = 66 ppb TCE = 0.54	TCM = 270 ppb TCE = 2.2 ppb	A - 206.Top 204 Sand
BOFZY8	0841	30	57.1	~~64.3~~ 64.0	6.9	TCM = 20 ppb	TCM = 97	B 206.5 Sandy Gravel
BOFZY9	0940	30	56.8	64.8	8.0	CCl4 = 21 ppb	CCl4 = 79	Sandy Silty Gravel 207.3
BOFZZ3	0944	30	57.4	64.3	6.9	CCl4 = 5.8 ppb	CCl4 = 25	Sandy gravel wl 209.3 silty lenses
BOFZZ4	0946	30	57.1	64.3	7.2	CCl4 = 8.7	CCl4 = 11.25 → 11	Sandy gravel wl 210.4 silty lenses
BOFZZ5	0942	30	57.0	65.3	8.3	CCl4 = 3.3	CCl4 = 12	Sandy gravel wl 208.4 silty lenses
BOFZZ6	1143	30	57.1	62.7	5.6	CCl4 = 9.9 ppb	CCl4 = 53 ppb	bottom 215.3 Sandy gravel
BOFZZ7	1144	30	57.0	63.6	6.6	TCM = 4.4 CCl4 = 2.2	TCM = 20 ppb C.Cl4 = 10 ppb	middle 212.2 Sandy gravel
BOFZZ8	1145	30	57.0	62.3	5.3	TCM = 5.5	TCM = 31 ppb	top slough Sandy gravel
BOFZZ9	1330	30	56.9	64.4	7.5	CCl4 = 10 ppb	CCl4 = 40 ppb	220.7 SS Sandy gravel
BOGG00	1332	30	57.0	62.9	5.9	TCM = 26 ppb CCl4 = 4 ppb	TCM = ~~26~~ → 130 132 ppb CCl4 = ~~20 ppb~~ 19 ppb	218.4 Silty Sandy gravel
BOGOOI	1334	30	56.8	63.0	6.2	CCl4 = 7.9	CCl4 = 38 ppb	216.0 Silty Sandy gravel
BOFZZ1	0750	30	—	—		TCM = 150 CCl4 = 109, TCE = 107	Cal Standard	
BOFZZ2	0780	30	—	—		Clean H_2O	Blank	
BOGOOZ	1534	30	57.1	64.8	7.7	TCM = 12 ppb CCl4 = 31 ppb	TCM = 47 ppb CCl4 = 120 ppb	225.8 Silty Sandy G
BOGOO3	1536	30	56.9	62.5	5.6	TCM = 14 ppb CCl4 = 10 ppb	TCM = 75 ppb CCl4 = 56 ppb	223.3 SSG

B-14

Sampler: L. D. Jacques

Analyst: L. D. Jacques

BHI-EE-135, 5/95

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9513388.2132
0017302

VOC IN SOIL FIELD ANALYSIS DATA/LOG SHEET

Site Name: 200-ZP-1 DNAPL

Date: 6-15-95

Sample Number	Sample Time	[1] H_2O (g)	[2] Vial Tare (g)	[3] Total Sample (g)	[4] Net Soil (g) (3-2)	[5] Analytical Results (µg/g)	Soil Concentration (µg/g) (5*1/4)	Comments
BOG004	1539	30	57.4	65.9	8.5	CCl_4 = 6.5 ppb	CCl_4 = ~~22.5~~ 23 ppb	228.82 MSG
BOG005	1613	30	56.5	61.8	5.3	CCl_4 = 28 ppb	CCl_4 = 160 ppb	238.70 carbonaceous
BOG006	1615	30	57.1	64.5	7.4	TCM = 21 ppb CCl_4 = 3.0 ppb	TCM = 85 ppb CCl_4 = 12 ppb	top 226.4 MSG
BOG007	1618	30	57.1	62.3	5.2	CCl_4 = 11 ppb	CCl_4 = 63 ppb	228.5 MSG middle
BOG008	0811	30	57.2	—	—	—	TCE = 121 ppb CCl_4 = 112 ppb TCM = 174 ppb	Cal std
BOG009	0811	30	57.0	—	—	—	—	blank
BOG010	0815	30	57.2	62.6	5.4	CCl_4 = 4.7 ppb	CCl_4 = 26 ppb	Silty sandy gravel depth = ~~238.7~~ 234.7
BOG011	0818	30	56.7	58.2	1.5	CCl_4 = 7.7	CCl_4 = 154 ppb	silty sandy gravel depth = 232.2
BOG012	0820	30	57.4	62.4	5.0	CCl_4 = 5.8	CCl_4 = 35 ppb	silty sandy gravel depth = 231.4
~~BOG013~~	—	30	~~57.2~~	—	—	—	—	—
~~BOG014~~	~~1015~~	~~30~~	~~56.8~~	—	—	—	—	~~cal std~~
BOG083	0931	30	56.3	63.9	7.6	CCl_4 = 6.7	CCl_4 = 26 ppb	~~silty~~ sandy gravel depth = 236.2 top
BOG084	0933	30	57.8	62.9	5.1	CCl_4 = ~~17~~ 10 ppb	CCl_4 = ~~76~~ 60 ppb	sandy gravel depth = 237.6
BOG085	0935	30	58.0	63.4	5.4	CCl_4 = 14 ppb	CCl_4 = 78 ppb	sandy gravel depth = 238.9 bottom
BOG086	0943	30	~~57.9~~	63.6	5.7	0	0	sandy gravel w/ silt depth = 213.1
BOG087	0945	30	58.0	62.4	4.4	0	0	sandy gravel w/ silt depth = 213.0

~~BOG088 0947~~ ~~depth = 213.7~~

B-15 -87 51 — Dup — duplicate

Sampler: D. D. Jaegnes

Analyst: D. D. Jaegnes

BHI-EE-135, 5/95

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VOC IN SOIL FIELD ANALYSIS DATA/LOG SHEET

Site Name: 200-ZP-1 DNAPL

Date: 6-15-95

Sample Number	Sample Time	[1] H_2O (g)	[2] Vial Tare (g)	[3] Total Sample (g)	[4] Net Soil (g) (3-2)	[5] Analytical Results (µg/g)	Soil Concentration (µg/g) (5*1/4)	Comments
B0G098	0947	30	57.9	63.4	5.5	—	—	sandy gravel w/ silt depth = 213.7
B0G096	0815	30	—	—	—	Cal Check	TCM = 58 (-67%) CCl4 = 45 (-60%)	TCE = 39 (-68%)
		30						
		30						
		30						
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		30						

Sampler: _____

Analyst: _____

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B-16

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