Second Quarterly Background Report
Former Plum Brook Ordnance Works
Sandusky, Ohio

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IT Project No. 833886

Revision 0

May 2002

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List of Acronyms

DNT	dinitrotoluene
DO	dissolved oxygen
DOD	U.S. Department of Defense
DQO	data quality objective
Eh	oxidation-reduction potential
EPA	U.S. Environmental Protection Agency
FUDS	Formerly Used Defense Sites
GSA	General Services Administration
IDW	investigation-derived waste
IT	IT Corporation
µg/L	micrograms per liter
MCL	maximum contaminant level
NASA	National Aeronautics and Space Administration
OEPA	Ohio Environmental Protection Agency
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
pH	hydrogen ion concentration
PRG	preliminary remediation goal
PRRWP	Pentolite Road Red Water Ponds
QA	quality assurance
QC	quality control
QAPP	quality assurance project plan
RI	remedial investigation
SAP	sampling and analysis plan
SSAP	site-specific sampling and analysis plan
SSHP	site-specific sampling health and safety plan
SVOC	semivolatile organic compound
TNT	trinitrotoluene
TNTA	TNT Area A
TNTB	TNT Area B
TNTC	TNT Area C

List of Acronyms (Continued)

VOC	volatile organic compound
USACE	U.S. Army Corps of Engineers
WARWP	West Area Red Water Ponds

1.0 Introduction

The U.S. Army is conducting studies of the environmental impact of suspected hazardous waste sites at properties previously owned by the U.S. Department of Defense (DOD). The former Plum Brook Ordnance Works (PBOW) located in Sandusky, Ohio is currently being investigated under the Defense Environmental Restoration Program for Formerly Used Defense Sites (FUDS). Figure 1-1 shows the geographical location of the former PBOW site. This 9,000-acre facility was used for the manufacture of explosives during World War II. The site is currently owned by the National Aeronautics and Space Administration (NASA) and is operated as the Plum Brook Station (PBS) of the John Glenn Research Center with headquarters based out of Lewis Field in Cleveland, Ohio.

The investigation is being managed and technically overseen by the Nashville, Tennessee and Huntington, West Virginia District Offices of the U.S. Army Corps of Engineers (USACE). IT Corporation (IT) was contracted by the USACE, Nashville District to continue a groundwater remedial investigation (RI) at two red water pond areas and three former trinitrotoluene (TNT) manufacturing areas at PBOW. The two red water pond areas are the West Area Red Water Ponds (WARWP) and the Pentolite Road Red Water Ponds (PRRWP). The three former TNT manufacturing areas are TNT Area A (TNTA), TNT Area B (TNTB), and TNT Area C (TNTC) (Figure 1-2). This work was begun under Delivery Order 0010 of Contract Number DACA62-00-D-0002, dated December 10, 2001, and negotiations held on December 7, 2001. Background quarterly sampling is being performed under Delivery Order 0014, of the same contract number.

Second quarter groundwater sampling activities were conducted pursuant to the following documents: the final site-specific sampling and analysis plan (SSAP) and final site-specific safety and health plan (SSHP) (IT, 2001), the March 2002 letter amendment to the SSHP (IT, 2002), the site-wide sampling and analysis plan (SAP) (IT, 1996a), the quality assurance project plan (QAPP) (IT, 1996b), and the site-wide safety and health plan (IT, 1996c).

The purpose of the quarterly background sampling is to provide four seasonal collection events to evaluate groundwater quality and determine if a trending pattern is present in the groundwater of the background monitoring wells. If contaminate concentrations in the background wells have not changed significantly over the first year of quarterly sampling, background groundwater

concentrations may be established and a second year of quarterly sampling will not be conducted.

1.1 Objectives

The objectives, as scoped (USACE, 2001), for the quarterly background sampling were as follows:

1. Determine the quality of bedrock groundwater entering the PBOW site
2. Determine the quality of residuum groundwater upgradient of selected sites at PBOW
3. Determine the range of background concentrations for inorganics in both residuum and bedrock groundwater
4. Perform trend analysis to determine if any change in the concentration of inorganics is seasonally dependent
5. Establish background concentrations of inorganics in residuum and bedrock groundwater.

It should be noted that due to drought conditions, establishing background concentrations of inorganics in residuum groundwater was eliminated from the objectives.

The groundwater sampling is scoped to include four quarters of data collection. After collection and analysis of the fourth quarter data, a full evaluation will be prepared. Trend analysis will be reviewed to determine if the data obtained are sufficient to establish background concentrations of inorganics in groundwater. If the evaluation suggests the data set is inconclusive, an additional four quarters of data will be required. The decision for continued groundwater sampling beyond the initial four quarters will be made by the USACE in conjunction with the Ohio Environmental Protection Agency (OEPA).

This report presents:

- Groundwater sampling procedures
- Results of the first and second quarterly groundwater sampling events
- Laboratory analytical data of the second quarter sampling (first quarter results were presented in the 2001 Groundwater Remedial Investigation report)

- Handling and disposal of investigation-derived waste (IDW)

1.2 Facility Location and Description

As mentioned above, the former PBOW site is currently owned by NASA. Most of the aerospace testing facilities at PBOW were constructed in the 1960s and are presently in a standby or inactive status. The site is located approximately 4 miles south of Sandusky, Ohio, and 59 miles west of Cleveland. Although primarily in Perkins and Oxford Townships, the eastern edge of the site extends into Huron and Milan Townships. PBOW is bounded on the north by Bogart Road, on the south by Mason Road, on the west by County Road 43, and on the east by U.S Highway 250. The immediate area surrounding PBOW is mostly agricultural but along the northern and northeast perimeter, residential sections are present. Public access at PBOW is restricted except during the annual deer hunting season.

1.3 Site History and Potential for Contamination

The PBOW site was built in early 1941 as a manufacturing plant for 2,4,6-TNT, dinitrotoluene (DNT), and pentolite. Production of explosives began on December 16, 1941 and continued until 1945. It is estimated that more than one billion pounds of explosives were manufactured during the 4-year operating period.

After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began. Decontamination was completed during the last quarter of 1945. The property was initially transferred to the Ordnance Department and then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration (GSA).

NASA acquired PBOW on March 15, 1963, and is presently utilizing the site. On April 18, 1978, NASA declared approximately 2,152 acres of land as excess. The Perkins Township Board of Education acquired 46 acres of the excess for use as a bus transportation center. The GSA retains the remaining acreage and currently has a use agreement with the Ohio National Guard for 604 acres of the land. NASA presently controls about 6,400 acres and is using the site to conduct space research as a satellite operation of its John Glenn Research Center. The details of these land transactions are listed in the site management plan and can be found at the NASA PBS.

Based on review of historical use of the site and findings of previous investigations, potential contaminants in the groundwater at PBOW may include nitroaromatic compounds (nitroaromatics), volatile organic compounds (VOC), semivolatile organic compounds (SVOC), cyanide, and inorganics.

2.0 Field Activities

2.1 Investigative Methods

Second quarter groundwater sampling of background monitoring wells was conducted following the same procedures used during the previous groundwater sampling event, first semi-annual/first quarter, conducted September 25 through October 10, 2001. Specific sampling procedures are detailed in the approved 2001 SSAP/SSHP and include minimal drawdown (low-flow) purging and sample collection or bailing.

2.2 Groundwater Sampling

Second quarter groundwater sampling was conducted from January 15 through 17, 2002. Monitoring well IT-MW01 was also included in the background groundwater sampling. Based upon the monitoring well location (Figure 2-1), it may provide local residuum background data for TNT Area B and other nearby areas of concern. The sampled wells included five bedrock wells (PB-BED-MW20, PB-BED-MW24, BG8-BEDGW-001, PB-BED-MW25, and PB-BED-MW26). No groundwater sample was able to be collected from overburden monitoring well IT-MW01 due to a dent in the riser section that prevented the pump and bailer from entering the well. Table 2-1 shows a list of the groundwater samples collected. The background bedrock monitoring wells sampled are located on the extreme west and southwest portion of PBOW and were selected by the USACE based on the groundwater investigation conducted in 1997 (USACE, 2001). Groundwater samples were analyzed for nitroaromatics, metals (filtered and unfiltered), VOCs, SVOCs, and water quality parameters (alkalinity, chloride, cyanide, hardness, nitrate, sulfate, total dissolved solids, total organic carbon, total suspended solids, and turbidity). Sample collection logs are provided in Appendix A.

Groundwater samples were collected from 5 wells, as listed in Table 2-1. Well locations are shown on Figure 2-1. Final field measurements of groundwater samples are presented in Table 2-2.

Two procedures were used for purging and sampling wells. Minimal drawdown (low-flow) was the preferred purging and sampling method in wells where adequate recharge was present. If a well did not recharge adequately to use minimal drawdown (low-flow) sampling (i.e., water level dropped 6 inches or more), removal of 3 to 5 volumes of groundwater was performed and samples collected with a bailer.

Groundwater recharge rates permitted 4 of the 5 wells to be sampled with the minimal drawdown (low-flow) sampling methodology. A bladder pump was used for the low-flow sampling. The pump was inserted into the screened portion of the monitoring well and the well was pumped at a rate that minimized drawdown. Typically, purging rates were on the order of 200 to 500 milliliters per minute. The purge rate was set such that drawdown in the well was never greater than 0.5 foot. Water chemistry parameters (hydrogen ion concentration [pH], oxidation-reduction potential [Eh], conductivity, temperature, dissolved oxygen, and turbidity) were monitored for stability.

Samples collected for metals analysis were filtered in the field through a 0.45-micrometer high-capacity filter attached to the discharge line of the bladder pump. If the well was sampled with a disposable bailer and not with the bladder pump, a hand-operated 0.45-micrometer filter was used. Sample filtration, preservation, packing, and shipment were performed in accordance with Section 5.4 of the site-wide QAPP (IT, 1996b).

During the initial static water level measurement on January 15, 2002, very little groundwater was present in monitoring well PB-BED-MW26 (2.65 feet) and it was determined that minimal drawdown (low-flow) sampling could not be performed. Groundwater was removed from the well to determine the recharge rate and minimal groundwater recharge was observed. Due to the small volume of groundwater, metals (unfiltered) was the only analytical parameter able to be collected.

2.3 Decontamination Procedures

Decontamination of all sampling equipment was performed in accordance with Section 4.3 of the SSAP (IT, 2001). Specifically, the water level indicator and low-flow pump were the only instruments that needed the complete decontamination procedures. Decontaminated was performed in sequence by rinsing with soapy water, deionized water, isopropyl alcohol, and a final rinse with deionized water. The bladder pump was decontaminated by running the decontamination fluids through the pump head. Equipment was then air dried before use. The bladder pump was wrapped in aluminum foil (shiny side out) after decontamination. Bailers, if needed, and tubing were not decontaminated because new items were used for each well. The water quality instrument (Horiba) was thoroughly rinsed with deionized water to prevent damage to the sensitive membranes.

2.4 IDW Management

Investigation-derived waste (IDW) generated during the January 2002 second quarter groundwater sampling event included groundwater, decontamination water, and personnel protective equipment. All IDW was managed and handled in accordance with procedures described in the SAP (IT, 1996a).

An estimated total of 21 gallons of decontamination and purge water were generated during sampling activities. All liquid was contained in a labeled 55-gallon drum that was stored in an igloo located within the PBOW magazine area to protect from freezing temperatures and possible drum rupture. Soiled personal protective gear and disposable field equipment generated during the project was double-bagged and placed in the on-site industrial dumpster.

The IDW drum was removed on April 2, 2002 from the PBOW facility by U.S. Liquids of Detroit, Inc., following proper IDW disposal procedures. All water was transported to the U.S. Liquids office in Detroit, Michigan, treated, and disposed of at the facility.

2.5 Variance/Nonconformance

Variances are defined as necessary changes to the standard operating procedures employed in field or office activities and modification to the original scope of work as specified in the SAP (IT, 1996a) and the QAPP (IT, 1996b). Variances do not significantly affect the quality of the data or process being changed. However, nonconformances are defined as malfunctions, deficiencies, or deviations that may render the quality of information or data unacceptable or indeterminate. One variance and one nonconformance occurred during the second quarterly sampling event. Variance and nonconformance logs were prepared by the IT field personnel and are retained in the project files. A description of the variance and nonconformance are listed below:

Variance

- A second laboratory to analyze the one quality assurance (QA) sample for the five background groundwater samples could not be secured prior to field sampling activities. On January 11, 2002, USACE and IT Corporation agreed that in place of the delinquent second quarterly QA sample, an additional QA sample would be collected during the third quarterly sampling event.

Nonconformance

- On February 6, 2002, ELAB reported to IT that the explosives analytical data collected during the second quarterly sampling event were not reportable due to QA/quality control (QC) problems within the laboratory. Due to the error, no results would be obtained. IT reported the situation to the USACE. Based upon the elapsed time from the second quarter sampling event and because no explosives had been detected in the background wells during the first quarterly sampling event, a decision was made not to resample the background wells.

3.0 Analytical Program

Primary and field duplicate project samples were analyzed by ELAB of Nashville, Tennessee. IT Corporation performed data validation. The validation summary is provided in Appendix B. The analytical results are summarized in Appendix C. Tables of detected hits that exclude "B" qualified data (data that were not detected significantly above method blank or field blank levels) are included in Appendix D. A data quality evaluation is located in Appendix E. The groundwater analytical data were compared to U.S. Environmental Protection Agency (EPA) Region 9 PRGs, defined in Section 3.4. The PRG tables provided in Section 4.0 include compounds detected above the PRG screening concentrations only.

3.1 Analytical Program and Methodologies

Chemical analyses for the investigation were performed in accordance with guidelines detailed in the EPA's *Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods,* Third Edition, September 1986 (EPA, 1986) and subsequent revisions and EPA 600/4-79-020, *Method for Chemical Analysis of Water and Wastes*. The groundwater samples and associated QA/QC samples were analyzed for VOCs, SVOCs, metals, and several water quality parameters. Methods used for analysis are summarized in Table 3-1.

All data analyzed were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following guidelines in the *EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999 (EPA, 1999) and *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, February 1994 (EPA, 1994a). Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness, and comparability goals established to meet the project data quality objectives (DQO). The criteria for blank evaluation were based on those detailed in *Region III Modifications to National Functional Guidelines for Organic Data Review,* September 1994 (EPA, 1994b) and *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* (EPA, 1993). The procedure is outlined in Section 3.3.

3.2 Data Quality Evaluation

The reliability of the sampling and analytical procedures used during the investigation was demonstrated by implementing the project-specific QA procedures specified in the site-wide

SAP (IT, 1996a) and QAPP (IT, 1996b) and its site-specific attachments. Successful execution of these procedures provides supporting evidence that the data is representative of the background area under investigation.

The DQOs for this project were to produce scientifically valid data of known accuracy and precision that were complete with respect to identified critical samples, comparable with similar data types, and representative of the media sampled so as to be useful for the cited purposes. Evaluation of the data using the DQOs and the data validation process resulted in the determination that most of the data set is valid and of sufficient quality to meet the objectives of the investigation. Cyanide results were rejected in samples because of poor recovery of the matrix spike and matrix spike duplicate. All cyanide results were non-detects.

The laboratory did not meet requirements for completion. Samples were sent to the lab for analysis for nitroaromatics by SW-846 8330. Upon completion of analysis and subsequent review, it appeared that the project samples and laboratory QC samples were not spiked with surrogates or spike compounds. The data was not submitted.

A complete evaluation of the analytical results is given in the data quality evaluation found in Appendix E.

3.3 Blank Evaluation

The purpose of blank analysis is to detect contamination resulting from laboratory and field activities. Blank evaluation involves qualification of data based on the results of associated field blanks, trip blanks, equipment rinsates, and laboratory method blanks. The criteria for blank evaluation are as follows:

- If a parameter is found in a blank but not detected in the sample, no action is taken.
- For organics, if the sample result is greater than the contract-required quantitation limit, but is less than 5X or 10X of the blank result, the sample result is qualified "B."
- For organics, if the sample result is less than the contract-required quantitation limit and less than 5X or 10X of the blank result, the sample result is qualified "B." The "J" qualifier is not used.
- For inorganics, if the sample result is greater than the instrument detection limit but less than 5X of the blank result, the sample result is qualified "B."

- If the sample result is greater than 5X or 10X of the blank result, the sample result is not qualified.

In instances where more than one blank is associated with a given sample, qualification is based upon a comparison with the associated blank having the highest concentration of a contaminant. Blank results are not subtracted from sample concentrations.

3.4 Screening Criteria

The analytical data were screened against preliminary remediation goals (PRGs) published in EPA Region 9 tables (EPA, 2000). With a few exceptions, PRGs are chemical concentrations that correspond to a one-in-one million [10^{-6}] cancer risk or a noncarcinogenic hazard quotient of 1 in soil, air, and water, whichever is lower, for the media of concern.

The Region 9 PRG table combines EPA toxicity values with exposure factors to estimate "safe" contaminant concentrations in soil, air, and water. In situations where a PRG is exceeded, further evaluation of the risks that may be posed by site contaminants is appropriate. Residential concentrations are used for screening.

No attempt was made to develop PRGs for ubiquitous, nutritionally essential elements unlikely to be toxic at concentrations ordinarily found in environmental media and for which toxicity values are unavailable (e.g., calcium, magnesium, potassium, and sodium). PRGs used in the screening of groundwater investigation data are presented in Section 4.0, Table 4-1. PRGs for tap water were used to screen contaminants in groundwater. It was assumed that household use of groundwater results in the most restrictive contamination level.

4.0 Analytical Results

4.1 Groundwater Sampling Events

In January 2002, background groundwater samples representative of high groundwater levels (or wet season) conditions were collected. The background samples were collected from the same monitoring wells as sampled in November 1997 and May 1998 as well as from the three new wells installed in 2001. A quarterly sampling schedule was chosen for these wells to obtain background bedrock groundwater data to determine if similar patterns or trends of chemical constituents are present and thus establish background groundwater constituent concentrations for the bedrock groundwater.

4.2 Analytical Results

The following sections present the blank-corrected results of the first and second quarterly sampling events. November 2000 PRGs have been used to evaluate the detected constituents. Only analytes exceeding PRGs are shown on Figure 2-1. As a comparison tool, the November 1997, May 1998, and September-October 2001 results, compared to PRGs, are also shown on the figure with the January 2002 data. The first quarter analytical results are re-presented along with the second quarter analytical results. Analytes detected below PRGs are not discussed in detail but are presented in the referenced data table. Analytical detections above PRG limits for both the first and second quarter are presented in Table 4-1. All analytical data is presented in Appendices C and D.

4.2.1 Background Monitoring Wells

Five bedrock wells were selected to be sampled on a quarterly basis to determine background bedrock groundwater values. These background bedrock monitoring wells include PB-BED-MW20, PB-BED-MW24, PB-BED-MW25, BG8-BEDGW-001, and PB-BED-MW26 (Figure 2-1). Overburden well IT-MW01 is included to be sampled as part of the quarterly sampling events and due to its location has previously been considered as providing information relative to possible background overburden groundwater values. Groundwater from these wells was analyzed for VOCs, SVOCs, nitroaromatics, metals (total and dissolved), cyanide, and water quality parameters.

4.2.2 Overburden

First Quarterly Sampling Event (September-October 2001). Due to an indentation of the PVC riser, monitoring well IT-MW01 could not be sampled during the September-October 2001 dry season event.

Second Quarterly Sampling Event (January 2002). On January 16, 2002, an attempt was made to sample IT-MW01. As with the September-October 2001 sampling, an indentation of the PVC riser (2 feet below the top of the casing) prevented sampling equipment (pump and bailer) from reaching groundwater in the well. Review of IT-MW01 well construction diagram showed that the bottom of the only riser joint (3.2 feet stickup to 4 feet below ground surface) was located within the filter pack. This, therefore, prevented attempted removal of the riser for replacement. In addition, sampling personnel used force in an attempt to insert the bladder pump and bailer past the indentation in the riser. Success was not achieved.

4.2.3 Bedrock

First Quarterly Sampling Event (September-October 2001). No nitroaromatics were detected in any of the background monitoring wells. VOCs benzene and methylene chloride were detected above PRG limits in well PB-BED-MW24. Benzene and chloroform were detected above the limit in well PB-BED-MW25. No SVOCs were detected in any of the wells above PRG limits. Only groundwater from well PB-BED-MW20 showed metals above allowable PRGs. Barium was detected in both the total and dissolved metal samples, while arsenic was found above its PRG limit in only the dissolved sample.

Second Quarterly Sampling Event (January 2002). No nitroaromatics were reported in the analytical data from the second quarterly groundwater samples. Only VOC benzene and SVOC naphthalene was detected above allowable PRG limits. Both were detected in background well PB-BED-MW24. Groundwater from all five background wells showed metals above allowable PRGs. Thallium was detected above its PRG in both the total and dissolved metals samples from wells BG8-BEDGW-001, PB-BED-MW20, and PB-BED-MW24 and in the total sample in well PB-BED-MW25. All of the thallium detections are noted with a "B" qualifier. Barium was detected above PRG limits in both the total and dissolved metals samples from well PB-BED-MW20. Due to a small water column, only unfiltered metals were sampled

in well PB-BED-MW26. Analytes above PRG limits included aluminum, arsenic, chromium, iron, lead, and manganese.

Third Quarterly Sampling Event. Fieldwork occurred April 2-15, 2002 during the PBOW wet season. The report of the results is in preparation.

Fourth Quarterly Sampling Event. Fieldwork is scheduled to occur during the PBOW dry season in July 2002.

4.2.4 Summary of Sampling Events

A summary of four quarters of background well sampling along with one wet season and one dry season sampling event from non-background wells, will be provided in a final report titled "First Annual Data Summary and Evaluation Report" at the completion of the first year of quarterly sampling (September-October 2001 [1st round] through July 2002 [4th round]).

5.0 Planned Activities

The following activities are scheduled:

- A third quarterly background report will be submitted following receipt and evaluation of the April 2002 quarterly background data.

- A fourth quarterly background sampling report in conjunction with the wet and dry season sampling analytical data titled "First Annual Data Summary and Evaluation Report" will be submitted following receipt and evaluation of the fourth quarterly background data.

- First Annual Data Summary and Evaluation Report, in conjunction with USACE and the OEPA, will determine if four quarters of analytical background data is sufficient to establish background metals concentrations or if an additional year of sampling will be required.

6.0 References

IT Corporation (IT), 2002, ***Letter Amendment to Site-Specific Sampling and Analysis Plan, Groundwater Remedial Investigation, TNT and Red Water Ponds Areas, Plum Brook Ordnance Works, Sandusky, Ohio,*** March.

IT Corporation (IT), 2001, ***Site-Specific Sampling and Analysis Plan, Groundwater Remedial Investigation, TNT and Red Water Ponds Areas, Plum Brook Ordnance Works, Sandusky, Ohio,*** July.

IT Corporation (IT), 1996a, ***Site-Wide Sampling and Analysis Plan in Site Investigations and Groundwater Investigation, Plum Brook Ordnance Works, Sandusky, Ohio,*** September.

IT Corporation (IT), 1996b, ***Quality Assurance Project Plan, Plum Brook Ordnance Works, Sandusky, Ohio.***

IT Corporation (IT), 1996c, ***Site-Wide Safety and Health Plan, Plum Brook Ordnance Works, Sandusky, Ohio.***

U.S. Army Corps of Engineers (USACE), 2001, ***Scope of Work; Groundwater Remedial Investigation of TNT and Red Water Ponds Areas, Former Plum Brook Ordnance Works, Sandusky, Ohio,*** Nashville, Tennessee, Revised 19, March.

U.S. Environmental Protection Agency (EPA), 2000, ***Region 9 Preliminary Remediation Goals (PRGs) 2000 Update***, online, November 1.

U.S. Environmental Protection Agency (EPA), 1999, ***Contract Laboratory Program National Functional Guidelines of Organic Data Review***, October.

U.S. Environmental Protection Agency (EPA), 1994a, ***Contract Laboratory Program National Functional Guidelines for Inorganic Data Review***, February.

U.S. Environmental Protection Agency (EPA), 1994b, ***Region III Modifications to National Functional Guidelines for Organic Data Review***, September.

U.S. Environmental Protection Agency (EPA), 1993, ***Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses***, April.

U.S. Environmental Protection Agency (EPA), 1986, ***Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods***, Third Edition, September.

TABLES

Table 2-1

Summary of Groundwater Samples Collected
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Well Identification	Sample Identification	Sample Date	Sample Number
IT-BG8-BEDGW-001	PBOW-02-GW-IT-BG8-BEDGW-001-CA3006	01/16/02	CA3006
PB-BED-MW20	PBOW-02-GW-PB-BED-MW20-CA3005	01/15/02	CA3005
PB-BED-MW24	PBOW-02-GW-PB-BED-MW24-CA3001	01/17/02	CA3001
PB-BED-MW25	PBOW-02-GW-PB-BED-MW25-CA3002	01/16/02	CA3002
PB-BED-MW25	PBOW-02-GW-PB-BED-MW25-CA3003	01/16/02	CA3003[1]
PB-BED-MW26	PBOW-02-GW-PB-BED-MW26-CA3004	01/17/02	CA3004

[1] Field duplicate

Table 2-2

Final Field Measurements of Groundwater Samples
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Well Identification	Date	Time	Low-Flow Sampled	PID (ppm)	Eh (mV)	pH	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved O_2 (ppm)	Temperature (°C)	Volume Purged (gal)
Overburden Wells (First and Second Quarterly Sampling)											
IT-MW01	1/16/02	NA	NA	NM	Not sampled. Riser section dented and prohibited bailer from entering well.						
	9/27/01	1040	NA	NM	Not sampled. Riser section dented and prohibited bailer from entering well.						
Bedrock Wells (First and Second Quarterly Sampling)											
BG8-BEDGW-001	1/16/02	1450	Yes	0.0	-79	7.38	0.856	2.8	0.00	10.69	2.22
	9/27/01	1220	Yes	0.0	-339	13.03	3.75	0.0	0.00	12.65	2.97
PB-BED-MW20	1/15/02	1415	Yes	1.6	-55	6.83	52.60	15.0	0.00	7.22	1
	9/26/01	1415	No	0.0	-73	8.95	53.60	53.5	0.00	10.54	10.33
PB-BED-MW24	1/17/02	1005	Yes	114	-333	6.82	1.99	2.5	0.00	9.69	2.11
	10/9/01	0935	Yes	NM	-144	9.38	1.81	73.3	5.32	11.20	2.99
PB-BED-MW25	1/16/02	1030	Yes	0.0	-291	7.23	2.42	5.8	0.00	10.54	4.44
	10/5/01	0920	Yes	0.0	-237	10.58	1.89	5.7	2.41	11.90	3.67
PB-BED-MW26	1/15/02[a]	1030	No	2.2	-59	6.87	31.0	999	8.04	8.69	0.5
	10/10/01	NA	No	3.6	No sample collected due to insufficient water volume.						

[a]Final water quality reading collected from last purged groundwater due to a very limited water volume. Well was purged on 1/15/02, sample was collected on 1/17/02 at 0820.

°C - Degrees Celsius.
Eh - Oxidation-reduction potential.
gal - Gallon.
µmhos/cm - Micromhos per centimeter.
mV - Millivolts.
NA - Not applicable.
NM - Not measured.
NTU - Nephelometric turbidity unit.
O_2 - Oxygen.
PID - Photoionization detector.
ppm - Parts per million.

Table 3-1

Summary of Analytical Parameters and Methods
Second Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Matrix	Analytical Parameters[a]	Analytical Method[b]
Groundwater (Monitoring Well)	TCL Volatile Organic Compounds	SW-846 5030/8260B
	TCL Semivolatile Organic Compounds	SW-846 3510C/8270C
	TAL Metals (T/D)	SW-846 3005A/6010B/7470A
	Turbidity	EPA 180.1
	Alkalinity	EPA 310.1
	Hardness	EPA 200.7
	Total Organic Carbon	EPA 415.1
	Total Dissolved Solids	EPA 160.1
	Total Suspended Solids	EPA 160.2
	Chloride	EPA 325.2
	Cyanide, total	SW-846 9012A
	Nitrate	EPA 353.2
	Sulfate	EPA 375.4

[a]Target analyte list (TAL) and target compound list (TCL) are used to designate parameter lists with no requirements for Contract Laboratory Program (CLP) method quality control or data reporting packages.
[b] Analyses found in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* Third Edition and *Methods for Chemical Analysis of Water and Wastes*, March 1983 and their subsequent revisions.

T/D - Total/dissolved.

Table 4-1

Detected Constituents in Bedrock Monitoring Wells
Second Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Sample Area:	Background Wells															
		Sample Location:	IT-BG8-BEDGW-001								PB-BED-MW20							
		Sample Number:	5410		5415		BD3007		CA3006		5960		5965		BD3026		CA3005	
		Sample Date:	17-Nov-97		15-May-98		27-Sep-01		16-JAN-02		17-Nov-97		28-May-98		26-Sep-01		15-JAN-02	
Parameter	Unit	PRG	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr
Volatiles																		
Acetone	µg/L	610													1.2	J		
Benzene	µg/L	0.35									[redacted]	J	[redacted]		0.25	J		
Butanone, 2-	µg/L	1900																
Carbon disulfide	µg/L	1000	0.65	J									0.17	J				
Chloroform	µg/L	0.16																
Chloromethane	µg/L	1.5																
Ethylbenzene	µg/L	1300									0.15	J						
Methyl-2-pentanone, 4-	µg/L	160																
Methylene chloride	µg/L	4.3	0.37	B							0.3	B	0.49	B			2.4	B
Toluene	µg/L	720									0.73	B	0.95	B				
Xylenes, total	µg/L	1400	0.38	B							2.6		0.91	J				
Semivolatiles																		
Bis(2-ethylhexyl)phthalate	µg/L	4.8	1.7	J	4	B							[redacted]	B	2.9	J		
Dimethylphenol, 2,4-	µg/L	730																
Methylnaphthalene, 2-	µg/L	NE									1.1	J						
Naphthalene	µg/L	6.2																
Phenol	µg/L	22000																
Metals - Unfiltered																		
Aluminum	µg/L	36000	9020		307		51.6	B	78.7	B	3290		678	J	207	J		
Antimony	µg/L	150																
Arsenic	µg/L	0.045	[redacted]															
Barium	µg/L	2600	520				285		68	J	[redacted]		[redacted]		[redacted]		[redacted]	
Beryllium	µg/L	73							1.2	B								
Cadium	µg/L	18																
Chromium	µg/L	110	18.2				1.4	B							7.6	B		
Cobalt	µg/L	2200													7.1	J		
Copper	µg/L	1400	59.5								32.8				15.8	B	32.8	
Iron	µg/L	11000	[redacted]		1230	J	204		118	B	[redacted]		6770		5920	J	6480	
Lead	µg/L	15	[redacted]		6.8													
Manganese	µg/L	880	[redacted]		130		71.6		107		180		153		189	J	128	
Mercury	µg/L	11																
Nickel	µg/L	730													3.5	J		
Thallium	µg/L	2.4							[redacted]	B							[redacted]	B
Vanadium	µg/L	260																
Zinc	µg/L	11000	126		49.7	B			12.6	J	41.6		42.1	B	5.3		23.4	

Table 4-1

Detected Constituents in Bedrock Monitoring Wells
Second Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Sample Area:	Background Wells															
		Sample Location:	IT-BG8-BEDGW-001								PB-BED-MW20							
		Sample Number:	5410		5415		BD3007		CA3006		5960		5965		BD3026		CA3005	
		Sample Date:	17-Nov-97		15-May-98		27-Sep-01		16-JAN-02		17-Nov-97		28-May-98		26-Sep-01		15-JAN-02	
Parameter	Unit	PRG	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr
Metals - Filtered																		
Aluminum	µg/L	36000					56.6	B	83.6	B					40.9	B		
Antimony	µg/L	150																
Arsenic	µg/L	0.045													[redacted]	J		
Barium	µg/L	2600	366				279		83.6	J	[redacted]		[redacted]		[redacted]		[redacted]	
Beryllium	µg/L	73							1.5	B								
Chromium	µg/L	110																
Cobalt	µg/L	2200													6.4	J		
Copper	µg/L	1400													2	B	5.7	J
Iron	µg/L	11000	563				169		216		2310		1320		5350		6180	
Manganese	µg/L	880	[redacted]		658		73.5		117		162		47		188		129	
Mercury	µg/L	11											0.24					
Nickel	µg/L	730													2.9	J		
Thallium	µg/L	2.4							[redacted]	B							[redacted]	B
Vanadium	µg/L	260																
Zinc	µg/L	11000			44.9	B			13.5	J					3.3	J	21.6	
Water Quality Parameters																		
Alkalinity	µg/L	NE	350000		180000		357000		200000		240000		260000		255000		280000	
Chloride	µg/L	NE	780000		34000		932000		78000		19000000		21000000		22400000		18000000	
Hardness	µg/L	NE	1000000		340000		719000		380000		20000000		10000000		9360000		8200000	
Nitrate	µg/L	NE	200						22000									
Nitrate	µg/L	NE			7300													
Sulfate	µg/L	NE	70000		45000		28300		68000								3200	
Turbidity	NTU	NE					104								48.4		8.8	
Total dissolved solids	µg/L	NE	1800000		300000		1990000		500000		32000000		24000000		27400000	J	26000000	
Total organic carbon	µg/L	NE			1000										500	J	1100	J
Total suspended solids	µg/L	NE	10000		280000		4000				74000		90000		125000		13000	

Table 4-1

Detected Constituents in Bedrock Monitoring Wells
Second Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Sample Area:	Background Wells									
		Sample Location:	PB-BED-MW24				PB-BED-MW25				PB-BED-MW26	
		Sample Number:	BD3029		CA3001		BD3030		CA3002		CA3004	
		Sample Date:	9-Oct-01		17-JAN-02		5-Oct-01		16-JAN-02		17-JAN-02	
Parameter	Unit	PRG	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr
Volatiles												
Acetone	µg/L	610	120	J			1.7	B			NS	
Benzene	µg/L	0.35	30		31		0.57	J			NS	
Butanone, 2-	µg/L	1900			8.1						NS	
Carbon disulfide	µg/L	1000			1.2		0.48	J	1.5		NS	
Chloroform	µg/L	0.16					0.71				NS	
Chloromethane	µg/L	1.5			1.3	J					NS	
Ethylbenzene	µg/L	1300	19	J	32		0.22	J			NS	
Methyl-2-pentanone, 4-	µg/L	160					0.3	J			NS	
Methylene chloride	µg/L	4.3	25	J			0.3	B			NS	
Toluene	µg/L	720	58		90		0.8	J			NS	
Xylenes, total	µg/L	1400	110		180		1.5				NS	
Semivolatiles												
Bis(2-ethylhexyl)phthalate	µg/L	4.8					0.86	J			NS	
Dimethylphenol, 2,4-	µg/L	730	1.1	J							NS	
Methylnaphthalene, 2-	µg/L	NE	3.6	J	5.6						NS	
Naphthalene	µg/L	6.2	2.9	J	2						NS	
Phenol	µg/L	22000	1.4	J							NS	
Metals - Unfiltered												
Aluminum	µg/L	36000	37.8	J	77.7	B	78.2	B	79.8	B	11900	
Antimony	µg/L	150										
Arsenic	µg/L	0.045									0.1	
Barium	µg/L	2600	932		938		226		247		1970	
Beryllium	µg/L	73			1.2	B			1.2	B	5.2	
Cadium	µg/L	18									3.3	J
Chromium	µg/L	110									0.4	
Cobalt	µg/L	2200									82.8	
Copper	µg/L	1400									293	
Iron	µg/L	11000	48.3	J	72.7	B	795		357		20000	
Lead	µg/L	15									7.3	
Manganese	µg/L	880	24.8		19.2		89		56.2		770	
Mercury	µg/L	11									0.14	J
Nickel	µg/L	730									457	
Thallium	µg/L	2.4			0.2	B			0.2	B		
Vanadium	µg/L	260									142	
Zinc	µg/L	11000					7.7	J			789	

Table 4-1

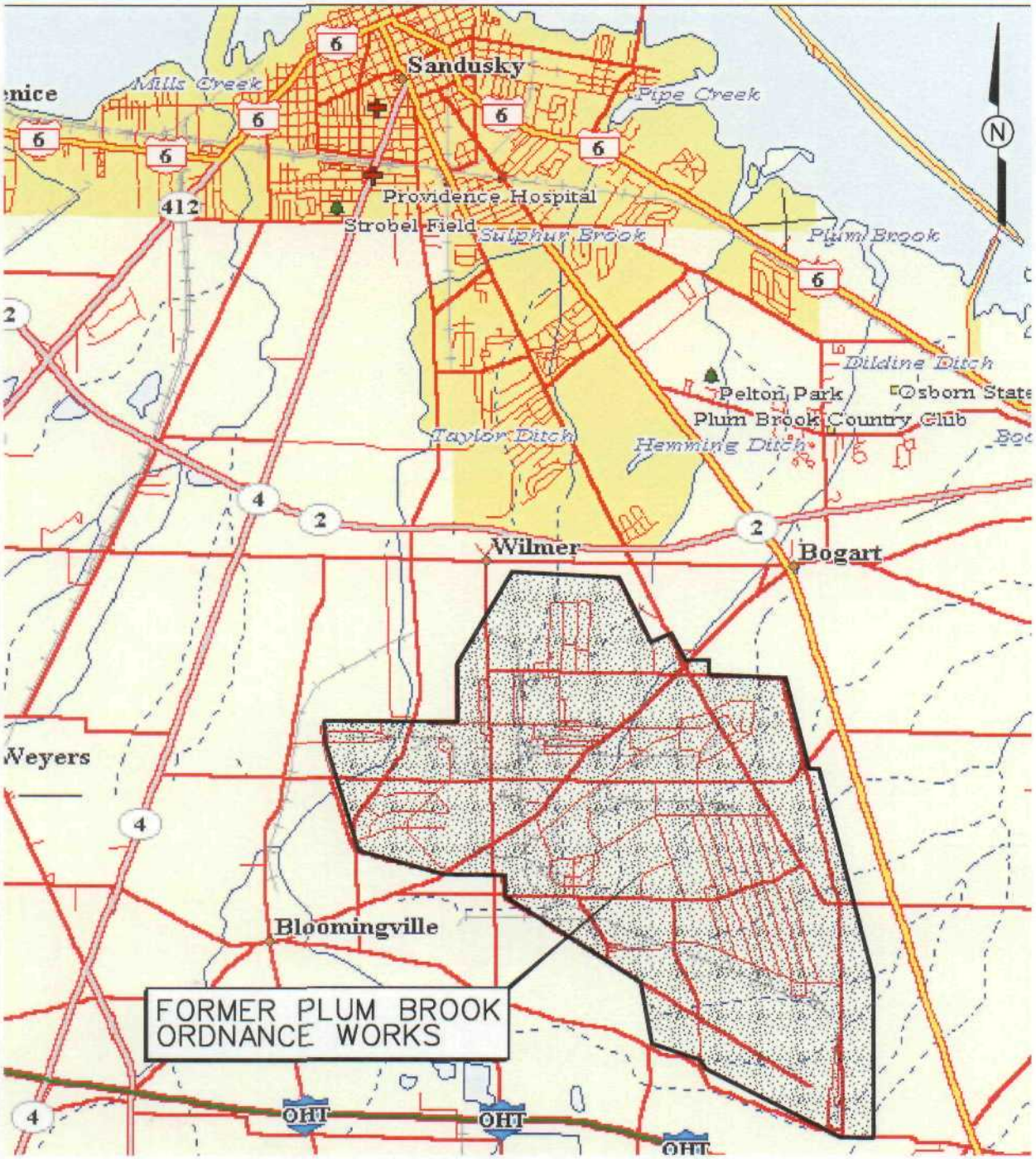
Detected Constituents in Bedrock Monitoring Wells
Second Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

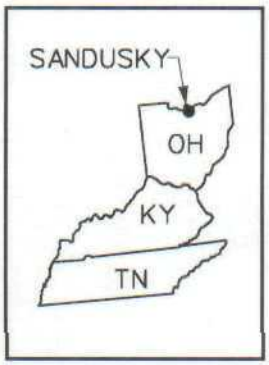
		Sample Area:	Background Wells									
		Sample Location:	PB-BED-MW24				PB-BED-MW25				PB-BED-MW26	
		Sample Number:	BD3029		CA3001		BD3030		CA3002		CA3004	
		Sample Date:	9-Oct-01		17-JAN-02		5-Oct-01		16-JAN-02		17-JAN-02	
Parameter	Unit	PRG	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr
Metals - Filtered												
Aluminum	µg/L	36000	55.1	B	89.6	B	68.7	B			NS	
Antimony	µg/L	150									NS	
Arsenic	µg/L	0.045									NS	
Barium	µg/L	2600	942		962		224		234		NS	
Beryllium	µg/L	73			1.5	B					NS	
Chromium	µg/L	110									NS	
Cobalt	µg/L	2200									NS	
Copper	µg/L	1400									NS	
Iron	µg/L	11000			4.7	B	713		337		NS	
Manganese	µg/L	880	22.1		18.7		87		52.2		NS	
Mercury	µg/L	11									NS	
Nickel	µg/L	730									NS	
Thallium	µg/L	2.4			[illegible]	B					NS	
Vanadium	µg/L	260									NS	
Zinc	µg/L	11000					3	J			NS	
Water Quality Parameters												
Alkalinity	µg/L	NE	697000		810000		278000		320000		NS	
Chloride	µg/L	NE	149000		140000		404000		460000		NS	
Hardness	µg/L	NE	566000		710000		627000		720000		NS	
Nitrate	µg/L	NE									NS	
Nitrate	µg/L	NE									NS	
Sulfate	µg/L	NE	21400		150000		121000		79000		NS	
Turbidity	NTU	NE	266		61		21.7		21		NS	
Total dissolved solids	µg/L	NE	948000		1000000		1000000		1100000		NS	
Total organic carbon	µg/L	NE	3000		1800		4000	B	2000		NS	
Total suspended solids	µg/L	NE					4000				NS	

µg/L - Micrograms per liter.
PRG - Preliminary remedial goal.
NTU - Nephelometric turbidity unit.
NS - Not sampled.
NE - Not established.
Shaded cell indicates value is above PRG limit.

Validation Qualifiers
B - The analyte was not detected significantly above the level found in the associated blank or field blanks.
J - The compound/analyte was positively identified; the reported value is an estimated concentration.

FIGURES





NOT TO SCALE

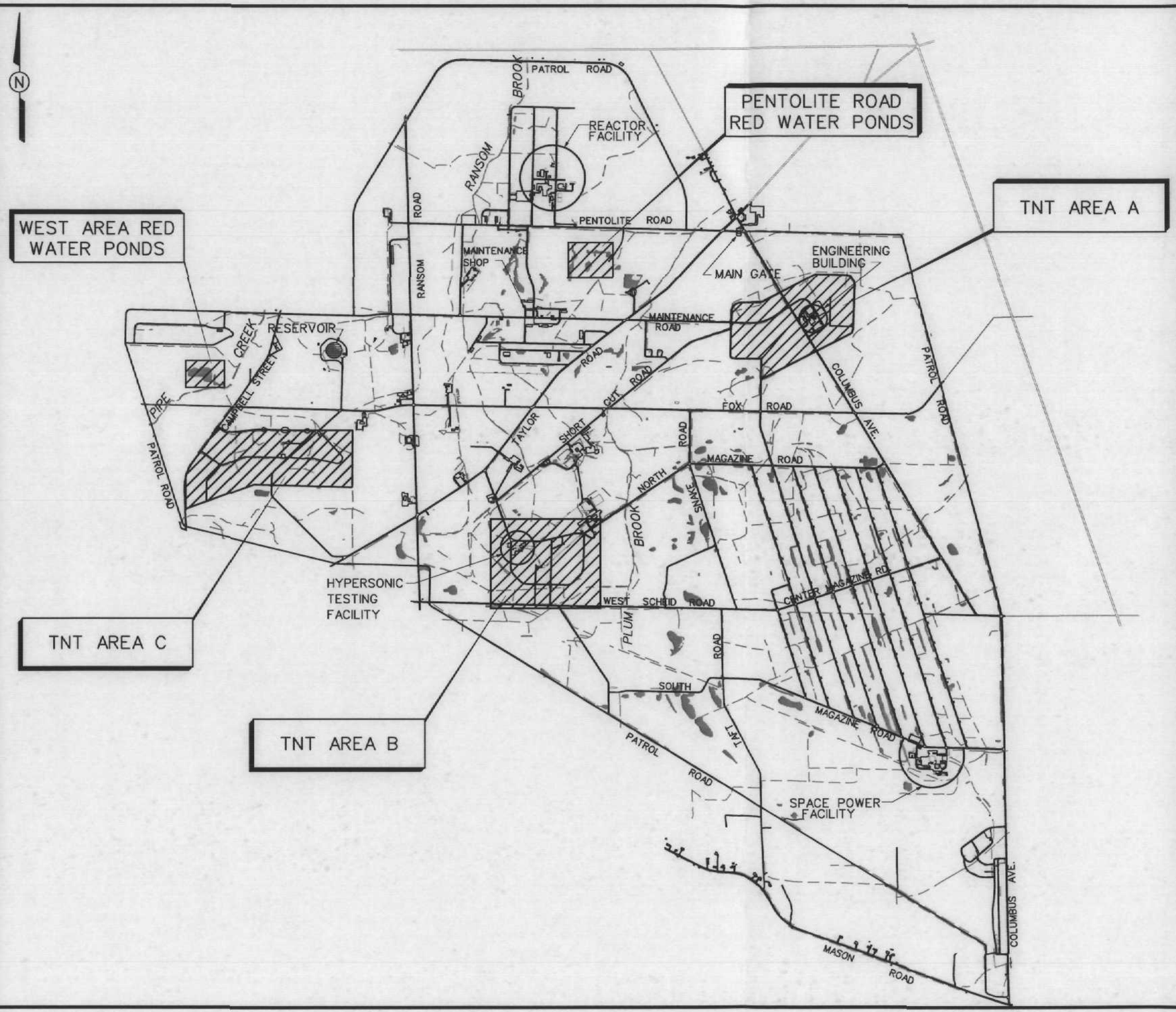
FIGURE 1-1
VICINITY MAP

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 12/16/97	DATE LAST REV.: 10/30/01	DRAFT. CHCK. BY:	INITIATOR: D. KESSLER
DRAWN BY: D. BILLINGSLEY	DRAWN BY: bvanderg	ENGR. CHCK. BY: D. KESSLER	PROJ. MGR.: M.SPANGBERG
			DWG. NO.: \773701ES.001
			PROJ. NO.: 773701

01:08:56
10/30/01
bvanderg
c:\cadd\design\773701es.001



LEGEND:

- BUILDINGS
- STREAMS OR DITCHES
- ROAD
- SURFACE WATER
- AREAS OF CONCERN

NOTES:

BACKGROUND MONITORING WELLS ARE LOCATED ALONG THE WEST AND SOUTHWEST SIDE OF THE FACILITY.

SCALE

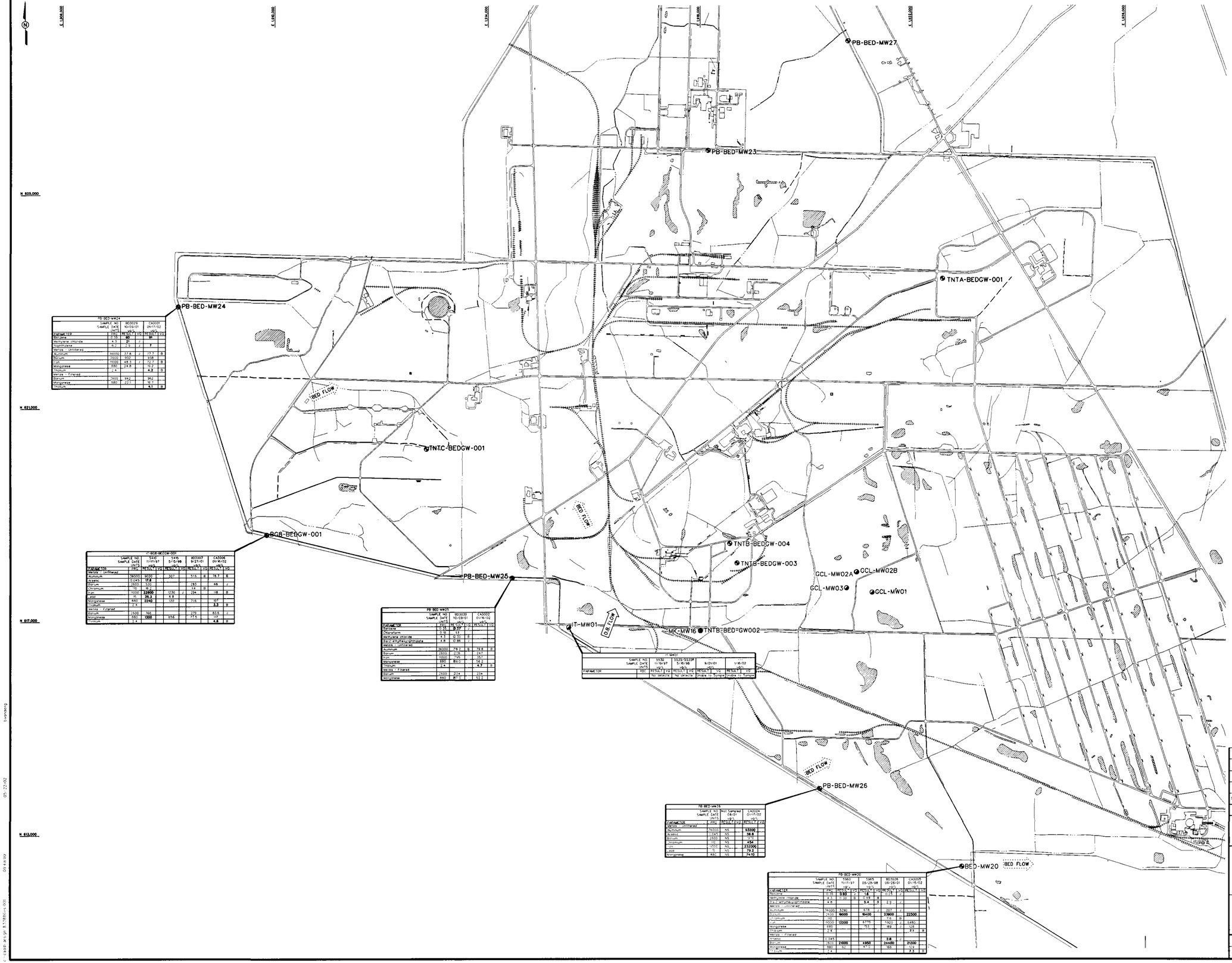
0 2400 4800 FEET

FIGURE 1-2
SITE MAP WITH AREAS OF CONCERN

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 05/06/02	DATE LAST REV.:	DRAFT. CHCK. BY:	INITIATOR: D. KESSLER
DRAWN BY: B. VANDERGRIFF	DRAWN BY:	ENGR. CHCK. BY: D. KESSLER	PROJ. MGR.: S. DOWNEY
05/22/02	09:43:15		DWG. NO.: \825635es.027
c:\cadd\design\825635es.027	bvanderg		PROJ. NO.: 825635



PB-BED-MW24						
SAMPLE NO		3590		9D3029		CA3001
SAMPLE DATE		11/17/97		10/29/01		01/17/02
UNITS		ug/L		ug/L		ug/L
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ
Metals - Unfiltered							
Aluminum	7300	17.8	J	22.3	B		
Barium	2600	93.2		33.8			
Iron	1100	48.3	J	42.3	B		
Manganese	880	14.9		12.2			
Thallium	2.4			4.2	B		
Metals - Filtered							
Barium	2600	94.3		36.2			
Manganese	880	22.1		4			
Thallium	2.4			4.1	B		

IT-BCB-BEDGW-001								
SAMPLE NO		3590		3615		9D3007		CA3006
SAMPLE DATE		11/17/97		5/15/98		9/27/01		01/16/02
UNITS		ug/L		ug/L		ug/L		ug/L
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ	RESULT	VQ
Metals - Unfiltered									
Aluminum	36500	9020		307		515	B	78.7	B
Arsenic	0.045	17.8							
Barium	2600	520				283		48	J
Chromium	110	16.6				1.4	B		
Iron	11000	23600		1330	J	284		118	B
Lead	15	26.3		6.8					
Manganese	880	2240		133		71.6		107	
Thallium	2.4							3.3	B
Metals - Filtered									
Barium	2600	166				279		83.6	J
Manganese	880	1300		85.6		77.5		42.2	
Thallium	2.4							4.8	B

PB-BED-MW25						
SAMPLE NO		3590		9D3035		CA3002
SAMPLE DATE		11/17/97		10/29/01		01/16/02
UNITS		ug/L		ug/L		ug/L
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ
Benzene	0.15	0.37	J				
Chloroform	0.16	1.1					
Methylene chloride	4.3	0.12	B				
Bis(2-ethylhexyl)phthalate	4.8	0.86	J				
Metals - Unfiltered							
Aluminum	36500	78.2	B	79.8	B		
Barium	2600	224		247			
Iron	11000	795		757			
Manganese	880	81.0		56.2			
Thallium	2.4			4.7	B		
Metals - Filtered							
Barium	2600	224		234			
Manganese	880	87.0		52.2			

IT-MW01									
SAMPLE NO		3530		3535/3535R		9D3001		01/16/02	
SAMPLE DATE		11/19/97		5/16/98		9/27/01		01/16/02	
UNITS		ug/L		ug/L		ug/L		ug/L	
PARAMETER		RESULT	VQ	RESULT	VQ	RESULT	VQ	RESULT	VQ
		No detects		No detects		Unable to Sample		Unable to Sample	

PB-BED-MW26						
SAMPLE NO		3590	Well Sampled		CA3001	
SAMPLE DATE		11/17/97	08/01		01/17/02	
UNITS		ug/L	ug/L		ug/L	
PARAMETER	PRG	RESULT	VQ		RESULT	VQ
Metals - Unfiltered						
Aluminum	36500	NS			53100	
Arsenic	0.045	NS			56.8	
Barium	2600	NS			710	
Magnesium	NC	NS			4560	
Iron	11000	NS			232000	
Lead	15	NS			79.2	
Manganese	880	NS			2470	

PB-BED-MW20											
SAMPLE NO		3560		3565		9D3006		CA3005			
SAMPLE DATE		11/17/97		05/29/98		09/26/01		01/15/02			
UNITS		ug/L		ug/L		ug/L		ug/L			
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ	RESULT	VQ		
Benzene	0.15	0.93	J	1.6		0.78	J				
Methylene chloride	4.3	0.20	B	0.49	B						
Bis(2-ethylhexyl)phthalate	4.8			5.4	B	2.2	J				
Metals - Unfiltered											
Aluminum	36500	3190		610		200					
Barium	2600	9600		6400		23600		22500			
Chromium	110					1.2	B				
Iron	11000	13200		6770		7920		6480			
Manganese	880			753		169		128			
Thallium	2.4							7.1	B		
Metals - Filtered											
Arsenic	0.045					2.8	J				
Barium	2600	2900		4950		24400		21300			
Manganese	880	24		47.5		98		52.8			
Thallium	2.4							7.3	B		

LEGEND:

IT-MW01	OVERBURDEN MONITORING WELL LOCATION
BED-MW20	BEDROCK MONITORING WELL LOCATION
	BUILDINGS
	RAILROAD
	SURFACE WATER
	DITCH
	FENCE
O.B. FLOW	OVERBURDEN GROUNDWATER FLOW DIRECTION
BED FLOW	BEDROCK GROUNDWATER FLOW DIRECTION

NOTES:

1. GROUNDWATER FLOW DIRECTION ON NOVEMBER 14-16, 2001.
2. UNABLE TO SAMPLE IT-MW01. PVC CASING WAS DAMAGED AND PREVENTED ACCESS.

SCALE
0 800 1600 FEET

NO	DATE	REVISION	BY	CHKD	DSGN ENGR	ENGR	PROJ MGR	APPR

STARTING DATE 05/06/02	INITIATOR D. KESSLER	CHKD	DRAWN VANDERGRIFF/C. TUMLIN	CHKD	PROJECT MNGR S. DOWNEY

IT CORPORATION
A Member of The IT Group
KNOXVILLE, TENNESSEE

SECOND QUARTERLY BACKGROUND SAMPLING REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 2-1
DETECTED CONSTITUENTS IN OVERBURDEN/BEDROCK BACKGROUND MONITORING WELLS ABOVE PRGs
(NOVEMBER 1997, MAY 1998, SEPTEMBER-OCTOBER 2001, & JANUARY 2002)

AREA	JOB NO.	DRAWING NO.	REV
	833886	833886ES.001	

APPENDIX A

SAMPLE COLLECTION LOGS

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE W

Manager: Mike Spangberg

RFA / COC Number: PB011502ELABF

Location Code: **PB-BED-MW20**

Sample Number: **CA3005**

Sample Name: **PBOW-02-GW-PB-BED-MW20-CA3005-00-**

Sampling Method: **LF**

Sample Type: **GW** *Sample Purpose:* **REG**

Collection Date: 1/15/02

Collection Time: 1415

Start Depth: 14.10

End Depth: 14.15

Sample Matrix: **WATER**

Sample Team: DK / RT

QC Partners:

(TB) CA5002 (ER) (FB) CA5001 (DI water)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
HARDNESS	N	B	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	2	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
NITRATE-W	N	F	1	250	mL	Amb. Glass
TOC	N	F	1	250	mL	Amb. Glass
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE

- PB011502ELABF

Low Flow Sampled

Comments: Removed ~1gal

Sketch Location:

Logged BY / Date: David Kessler 1/15/02 *Reviewed BY / Date:* David Kessler 1/15/02

GROUNDWATER SAMPLING FORM

IT CORPORATION
A Member of The IT Group

Project Number: 825635
Project Name: PBOW Groundwater
Investigation Site: Background
RFA/COC Number:

Collection Date: 1/15/02
Collection Time: 1445
Sample Filtered (Yes / No): yes
Weather/Temp: Cloudy, cold (32°), flurries

Form Completed By: D. Kessler
Sampler(s): D. Kessler / R. Thompson
Reviewed By: Donald Keesler

Sample Number: PBOW – 02 – GW – PBBE – DMW20 – CA3005 – 14.10 – 14.15

MONITORING WELL INFORMATION [use top of casing (TOC) for all measurements]

Well Number: PB-BED-MW20
Well Secure (Yes / No): yes
Well Labeled (Yes / No): yes
Well Condition: good
Screen Height: No screen
Casing Type: PVC

Outside Casing Dia. (in): 2
Depth to Product (ft): None
Total Well Depth (ft): 45.5
Depth to Water (ft): 13.90
Water Column (ft): 31.60
Elev. Ref. for Water Level:

Odor:
Vapor Monitor Type: PID / VRAE
- Vapor Monitor S/N: 1
- Reading (ppm): 1.6 / LEL: 0 O_2: 20.4 H2S: 0 CO: 0.0 ppm
Remarks:

MONITORING WELL PURGE CALCULATIONS AND PURGE RECORD

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where d is casing diameter in inches = (0.041 x (_____)^2) = _____ gal/ft
Well Volume (gallons) = Water Column (ft) x Gal/ft = _____ ft x _____ Gal/ft = _____ gallons

Volume of Water in Filter Pack: Gallons/foot = 0.041 x (D^2 - d^2), where D is total borehole dia. in inches & d is casing dia. in inches = 0.041 x ((_____)^2 - (_____)^2) = _____ gal/ft
Filter Pack Volume (gal) = ((Screen Height + lesser of 2 ft or water column) x gal/ft) x porosity (0.3) = ((Screen Height _____ ft + _____ ft) x _____ gal/ft) x 0.3 = _____ gallons

Purge Well Volume: Purge Well Volume = Filter Pack Volume + Well Volume = _____ gal + _____ gal = _____ gal

1 x Purge Well Volume (gal.)	2 x Purge Well Volume (gal.)	3 x Purge Well Volume (gal.)	4 x Purge Well Volume (gal.)	5 x Purge Well Volume (gal.)

Purge Cycle	Time (24 hr)	Depth to Water	Conductivity	pH	~~Eh~~ ORP	Temperature	Turbidity	Diss. O_2	Purge Volume
Units:		Feet	umhos/cm	Standard Units	~~ppm~~ mV	°C	NTU	ppm	gallons
~~Purge Vol 1~~	1340	14.02	52.5	6.81	-49	7.45	10.5	0.00	0.2
~~Purge Vol 2~~	1345	14.09	52.5	6.82	-51	7.53	12.5	0.00	
~~Purge Vol 3~~	1350	14.09	52.5	6.83	-55	7.50	14.2	0.00	
~~Purge Vol 4~~	1355	14.09	52.7	6.82	-55	7.14	19.7	0.00	
~~Purge Vol 5~~	1400	14.10	52.5	6.83	-55	7.43	26.8	0.00	
~~SAMPLE~~	1405	14.11	52.6	6.83	-55	7.22	15.0	0.00	
Sample	1405		52.8	6.77	-36	7.18	10.6	0.00	~1 gal

SAMPLE ANALYTICAL INFORMATION

Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)
Nitroaromatics	Mod. 8330	2 - 1 Liter Amber Glass	Dissolved TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Chloride	325.3	1 - 1 Liter HDPE See Note A
TCL Volatile Organics	5030 / 8260B	3 - 40 mL Glass Vials	Total Cyanide	9010A/9012	1 - 1 Liter HDPE	Sulfate	375.3	A. Sample for alkalinity, chloride, sulfate, TSS. TDS, and turbidity combined in one 1-liter HDPE container.
TCL SVOCs	3510C / 8270C	2 - 1 Liter Amber Glass	Total Organic Carbon	9060	1 - 250 mL Amber Glass	Tot. Suspended Solids	160.2	
Total TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Nitrate	353.2		Total Dissolved Solids	160.1	
Hardness	130.2		Alkalinity	310.1	1 - 1 Liter HDPE See Note A	Turbidity	180.1	

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE W

Manager: Mike Spangberg

RFA / COC Number: PB011702ELAB

Location Code: PB-BED-MW24

Sample Number: CA3001

Sample Name: PBOW-02-GW-PB-BED-MW24-CA3001-00-

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: 1/17/02

Collection Time: 1005

Start Depth: 26.46

End Depth: 26.47

Sample Matrix: WATER

Sample Team: DK/RT

QC Partners:

(TB) CA5003 (ER) (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
HARDNESS	N	B	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	2	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
NITRATE-W	N	F	1	250	mL	Amb. Glass
TOC	N	F	1	250	mL	Amb. Glass
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE

← PB011702ELABF

Comments: Depth to water - 26.32 Ft. TD - 42.78 Ft, water column = 16.46 Ft, 15 Ft screen. Pump set at 36 Ft. pumping 200ml/min
* Removed ~3 gals

Sketch Location:

Logged BY / Date: David Kessler 1/17/02

Reviewed BY / Date: David Kessler 1/17/02

GROUNDWATER SAMPLING FORM

IT CORPORATION
A Member of The IT Group

Project Number: 825635
Project Name: PBOW Groundwater
Investigation Site: Background
RFA/COC Number:

Collection Date: 1/17/02
Collection Time: 1005
Sample Filtered (Yes / No): yes
Weather/Temp: cloudy, cold (34°), windy

Form Completed By: D. Kessler
Sampler(s): D. Kessler, R. Thompson
Reviewed By: David Kessler

Sample Number: PBOW – 02 – GW – PBBE – DMW24 – CA3001 – 26.46 – 26.47

MONITORING WELL INFORMATION [use top of casing (TOC) for all measurements]

Well Number: PB-BED-MW24
Well Secure (Yes / No): yes
Well Labeled (Yes / No): yes
Well Condition: Excellent
Screen Height: 15 ft
Casing Type: PVC

Outside Casing Dia. (in): 2
Depth to Product (ft): None
Total Well Depth (ft): 42.78
Depth to Water (ft): 26.32
Water Column (ft): 16.46
Elev. Ref. for Water Level:

Odor:
Vapor Monitor Type: PID / VRAE
- Vapor Monitor S/N: 1
- Reading (ppm): 114 / over 1000 ppm / LEL = / O_2 = 20.3 / CO_2 = / H_2S = 0
Remarks:

MONITORING WELL PURGE CALCULATIONS AND PURGE RECORD

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where d is casing diameter in inches = (0.041 x (_____)^2) = _____ gal/ft
Well Volume (gallons) = Water Column (ft) x Gal/ft = _____ ft x _____ Gal/ft = _____ gallons

Low Flow

Volume of Water in Filter Pack: Gallons/foot = 0.041 x (D^2 - d^2), where D is total borehole dia. in inches & d is casing dia. in inches = 0.041 x ((_____)^2 - (_____)^2) = _____ gal/ft
Filter Pack Volume (gal) = ((Screen Height + lesser of 2 ft or water column) x gal/ft) x porosity (0.3) = ((Screen Height _____ ft + _____ ft) x _____ gal/ft) x 0.3 = _____ gallons

Purge Well Volume: Purge Well Volume = Filter Pack Volume + Well Volume = _____ gal + _____ gal = _____ gal

1 x Purge Well Volume (gal.)	2 x Purge Well Volume (gal.)	3 x Purge Well Volume (gal.)	4 x Purge Well Volume (gal.)	5 x Purge Well Volume (gal.)

Purge Cycle	Time (24 hr)	Depth to Water	Conductivity	pH	~~Eh~~ ORP	Temperature	Turbidity	Diss. O_2	Purge Volume
Units:		Feet	umhos/cm	Standard Units	~~ppm~~ mV	°F C	NTU	ppm	gallons
~~Purge Vol 1~~	0925	26.45	2.38	7.37	-161	10.20	14.2	0.00	200 ml/min
~~Purge Vol 2~~	0930	26.45	2.36	7.28	-263	10.00	10.3	0.00	
~~Purge Vol 3~~	0935	26.45	2.32	7.09	-299	9.73	9.6	0.00	
~~Purge Vol 4~~	0940	26.45	2.24	6.96	-317	9.71	8.0	0.00	
~~Purge Vol 5~~	0945	26.45	2.14	6.89	-323	9.57	6.9	0.00	
NSM SAMPLE	~~1005~~ 1040	26.47	1.87	6.78	-359		0.0	0.00	~ 3 gal

SAMPLE ANALYTICAL INFORMATION

Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)
Nitroaromatics	Mod. 8330	2 - 1 Liter Amber Glass	Dissolved TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Chloride	325.3	1 - 1 Liter HDPE See Note A
TCL Volatile Organics	5030 / 8260B	3 - 40 mL Glass Vials	Total Cyanide	9010A/9012	1 - 1 Liter HDPE	Sulfate	375.3	A. Sample for alkalinity, chloride, sulfate, TSS. TDS, and turbidity combined in one 1-liter HDPE container.
TCL SVOCs	3510C / 8270C	2 - 1 Liter Amber Glass	Total Organic Carbon	9060	1 - 250 mL Amber Glass	Tot. Suspended Solids	160.2	
Total TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Nitrate	353.2		Total Dissolved Solids	160.1	
Hardness	130.2		Alkalinity	310.1	1 - 1 Liter HDPE See Note A	Turbidity	180.1	

IT CORPORATION
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By DKK Date 1/17/02 Subject PBOW Low Flow Purge Readings Sheet No. 2 of 2

Chkd. By ____ Date ____ PB-BED-MW24 Proj. No. 825635

.25 in. X .25 in.

Time	Depth to water	pH	Cond	Temp	Turbidity	DO	ORP
0950	26.45	6.86	2.09	9.67	6.1	0.00	-326
0955	26.47	6.83	2.04	9.70	4.9	0.00	-329
1000	26.47	6.82	1.99	9.69	2.5	0.00	-333

Sampled 1005 see page 1 for readings after sample collected

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE W

Manager: Mike Spangberg

RFA / COC Number: PB011702ELAB

Location Code: PB-BED-MW25

Sample Number: CA3002

Sample Name: PBOW-02-GW-PB-BED-MW25-CA3002-00-

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: 1/16/02

Collection Time: 1030

Start Depth: 14.1

End Depth: 14.2

Sample Matrix: WATER

Sample Team: bk/RT

QC Partners:

(TB) CA5003 (ER) (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
HARDNESS	N	B	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	2	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
NITRATE-W	N	F	1	250	mL	Amb. Glass
TOC	N	F	1	250	mL	Amb. Glass
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE

- PB011702ELABF

Comments: static = 14.29 ft, TD = 40.60 ft, water column = 26.31 ft
Removed ~ 5 gallons

Sketch Location:

Logged BY / Date: David Kersh 1/16/02 *Reviewed BY / Date:* David Kersh 1/16/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE W

Manager: Mike Spangberg

RFA / COC Number: PB011702ELAB

Location Code: PB-BED-MW25

Sample Number: CA3002-MS

Sample Name: PBOW-02-GW-PB-BED-MW25-CA3002-MS

Sampling Method: LF

Sample Type: GW *Sample Purpose:* MS

Collection Date: 1/16/02

Collection Time: 1030

Start Depth: 14.1

End Depth: 14.2

Sample Matrix: WATER

Sample Team: DK/RT

QC Partners:

(TB) CA5003 (ER) (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
HARDNESS	N	B	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	2	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
NITRATE-W	N	F	1	250	mL	Amb. Glass
TOC	N	F	1	250	mL	Amb. Glass
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE

- PB011702ELABF

Comments:

Sketch Location:

Logged BY / Date: David Kussh 1/16/02 *Reviewed BY / Date:* David Kussh 1/16/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE W

Manager: Mike Spangberg

RFA / COC Number: PB011702ELAB

Location Code: PB-BED-MW25

Sample Number: CA3002-MSD

Sample Name: PBOW-02-GW-PB-BED-MW25-CA3002-MS

Sampling Method: LF

Sample Type: GW *Sample Purpose:* MSD

Collection Date: 1/16/02

Collection Time: 1030

Start Depth: 14.1

End Depth: 14.2

Sample Matrix: WATER

Sample Team: DK/RT

QC Partners:

(TB) CA5003 (ER) (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
HARDNESS	N	B	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	2	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
NITRATE-W	N	F	1	250	mL	Amb. Glass
TOC	N	F	1	250	mL	Amb. Glass
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE

-PB011702ELABF

Comments: ~~[illegible]~~

Sketch Location:

Logged BY / Date: David Kuash 1/16/02 *Reviewed BY / Date:* David Kuash 1/16/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE W

Manager: Mike Spangberg

RFA / COC Number: PB011702ELAB

Location Code: PB-BED-MW25

Sample Number: CA3003

Sample Name: PBOW-02-GW-PB-BED-MW25-CA3003-00-

Sampling Method: LF

Sample Type: GW *Sample Purpose:* FD

Collection Date: 1/14/02

Collection Time: 1030

Start Depth: 14.1

End Depth: 14.2

Sample Matrix: WATER

Sample Team: DK/RT

QC Partners:

(TB) CA5003 (ER) (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	2	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass

-PB011702ELABF

Comments:

Sketch Location:

Logged BY / Date: David Kusch / 1/14/02 *Reviewed BY / Date:* David Kusch 1-16-02

GROUNDWATER SAMPLING FORM

IT CORPORATION
A Member of The IT Group

Project Number: 825635
Project Name: PBOW Groundwater
Investigation Site: Background
RFA/COC Number:

Collection Date: 11/16/02
Collection Time: 1030
Sample Filtered (Yes / No): yes
Weather/Temp: cloudy, cold (30°), calm

Form Completed By: D. Kessler
Sampler(s): D. Kessler, R. Thompson
Reviewed By: David Kessler

Sample Number: PBOW – 02 – GW – PBBE – DMW25 – CA3002 – 14.1 – 14.2

MONITORING WELL INFORMATION [use top of casing (TOC) for all measurements]

Well Number: PB-BED-MW25
Well Secure (Yes / No): yes
Well Labeled (Yes / No): yes
Well Condition: excellent
Screen Height: 10
Casing Type: PVC

Outside Casing Dia. (in): 2
Depth to Product (ft): None
Total Well Depth (ft): 40.60 ft
Depth to Water (ft): 14.29
Water Column (ft): 26.31
Elev. Ref. for Water Level:

Odor:
Vapor Monitor Type: PID / VRAE
- Vapor Monitor S/N: 1
- Reading (ppm): 0.0 LEL-0 O_2 20.9% CO_2 0 H_2S 0
Remarks:

MONITORING WELL PURGE CALCULATIONS AND PURGE RECORD

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where d is casing diameter in inches = (0.041 x (_____)^2) = _____ gal/ft
Well Volume (gallons) = Water Column (ft) x Gal/ft = _____ ft x _____ Gal/ft = _____ gallons

Flow

Volume of Water in Filter Pack: Gallons/foot = 0.041 x (D^2 - d^2), where D is total borehole dia. in inches & d is casing dia. in inches = 0.041 x ((_____)^2 - (_____)^2) = _____ gal/ft
Filter Pack Volume (gal) = ((Screen Height + lesser of 2 ft or water column) x gal/ft) x porosity (0.3) = ((Screen Height _____ ft + _____ ft) x _____ gal/ft) x 0.3 = _____ gallons

Purge Well Volume: Purge Well Volume = Filter Pack Volume + Well Volume = _____ gal + _____ gal = _____ gal

1 x Purge Well Volume (gal.)	2 x Purge Well Volume (gal.)	3 x Purge Well Volume (gal.)	4 x Purge Well Volume (gal.)	5 x Purge Well Volume (gal.)

Purge Cycle	Time (24 hr)	Depth to Water	Conductivity	pH	~~Eh~~ ORP	Temperature	Turbidity	Diss. O_2	Purge Volume
Units:		Feet	umhos/cm	Standard Units	~~ppm~~ mV	°C	NTU	ppm	gallons
~~Purge Vol 1~~	0930	14.41	2.17	7.18	-136	10.46	40.7	0.00	300 ml/min
~~Purge Vol 2~~	0935	14.41	2.24	7.28	-186	10.56	24.7	0.00	
~~Purge Vol~~ 3	0940	14.41	2.25	7.28	-243	10.57	11.0	0.00	
~~Purge Vol 4~~	0945	14.41	2.35	7.25	-271	10.56	6.5	0.00	
~~Purge Vol 5~~	0950	14.41	2.40	7.24	-284	10.56	6.1	0.00	270 ml/min
~~SAMPLE~~ Start	0955	14.41	2.42	7.23	-291	10.54	5.8	0.00	
After ~~SAMPLE~~	1140	14.41	2.27	7.24	-301	10.90	9.7	0.00	~5 gal

SAMPLE ANALYTICAL INFORMATION

Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)
Nitroaromatics	Mod. 8330	2 - 1 Liter Amber Glass	Dissolved TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Chloride	325.3	1 - 1 Liter HDPE See Note A
TCL Volatile Organics	5030 / 8260B	3 - 40 mL Glass Vials	Total Cyanide	9010A/9012	1 - 1 Liter HDPE	Sulfate	375.3	A. Sample for alkalinity, chloride, sulfate, TSS. TDS, and turbidity combined in one 1-liter HDPE container.
TCL SVOCs	3510C / 8270C	2 - 1 Liter Amber Glass	Total Organic Carbon	9060	1 - 250 mL Amber Glass	Tot. Suspended Solids	160.2	
Total TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Nitrate	353.2		Total Dissolved Solids	160.1	
Hardness	130.2		Alkalinity	310.1	1 - 1 Liter HDPE See Note A	Turbidity	180.1	

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE W

Manager: Mike Spangberg

RFA / COC Number: PB011702 ELAB

Location Code: PB-BED-MW26

Sample Number: CA3004

Sample Name: PBOW-02-GW-PB-BED-MW26-CA3004-00-

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: 1/17/02

Collection Time: 0820

Start Depth: 59

End Depth: 60

Sample Matrix: WATER

Sample Team: DK/RT

QC Partners:

(TB) ~~CA5003~~ DK (ER) (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
~~METALS3-W-F~~	~~Y~~	~~A~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~
~~HARDNESS~~	~~N~~	~~B~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~
METALS3-W	N	B	1	500	mL	HDPE
~~EXPLOSIVES~~	~~N~~	~~C~~	~~2~~	~~1~~	~~L~~	~~Amb. Glass~~
~~VOLATILES3~~	~~N~~	~~D~~	~~3~~	~~40~~	~~mL~~	~~GVIAL,SEP~~
~~SEMIVOLATILES3~~	~~N~~	~~E~~	~~2~~	~~1~~	~~L~~	~~Amb. Glass~~
~~NITRATE-W~~	~~N~~	~~F~~	~~1~~	~~250~~	~~mL~~	~~Amb. Glass~~
~~TOC~~	~~N~~	~~F~~	~~1~~	~~250~~	~~mL~~	~~Amb. Glass~~
~~CYANIDE~~	~~N~~	~~G~~	~~1~~	~~500~~	~~mL~~	~~HDPE~~
~~ALKALINITY~~	~~N~~	~~H~~	~~1~~	~~1~~	~~L~~	~~HDPE~~
~~CHLORIDE~~	~~N~~	~~H~~	~~1~~	~~1~~	~~L~~	~~HDPE~~
~~SULFATE~~	~~N~~	~~H~~	~~1~~	~~1~~	~~L~~	~~HDPE~~
~~TDS~~	~~N~~	~~H~~	~~1~~	~~1~~	~~L~~	~~HDPE~~
~~TSS~~	~~N~~	~~H~~	~~1~~	~~1~~	~~L~~	~~HDPE~~
~~TURB 180.1~~	~~N~~	~~H~~	~~1~~	~~1~~	~~L~~	~~HDPE~~

← Only parameter collected

Comments: Turbidity content > 999. Collected only Total metals due to lack of groundwater sample volume

Sketch Location:

Logged BY / Date: David Kersh 1/17/02

Reviewed BY / Date: David Kersh 1/17/02

GROUNDWATER SAMPLING FORM

IT CORPORATION
A Member of The IT Group

Project Number: 825635
Project Name: PBOW Groundwater
Investigation Site: Background
RFA/COC Number:

Collection Date: 1/17/02
Collection Time: 0820
Sample Filtered (Yes / No): No
Weather/Temp: Cloudy, windy, cold (34)

Form Completed By: D. Kessler
Sampler(s): D. Kessler / R. Thompson
Reviewed By: David Kessler

Sample Number: PBOW – 02 – GW – PBBE – DMW26 – CA3004 – 59 – 60

MONITORING WELL INFORMATION [use top of casing (TOC) for all measurements]

Well Number: PB-BED-MW26
Well Secure (Yes / No): yes
Well Labeled (Yes / No): yes
Well Condition: excellent
Screen Height: 15 ft
Casing Type: PVC

Outside Casing Dia. (in): 2"
Depth to Product (ft): None
Total Well Depth (ft): 60.35
Depth to Water (ft): 57.70
Water Column (ft): 2.65
Elev. Ref. for Water Level:

Odor: None
Vapor Monitor Type: PID / VRAE
- Vapor Monitor S/N: ~~2.2~~ / LEL = 15%
- Reading (ppm): 2.2 / H2S = 0 ppm
Remarks: 59.05 ft 1/17/02

MONITORING WELL PURGE CALCULATIONS AND PURGE RECORD

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where d is casing diameter in inches = (0.041 x (2)^2) = 0.164 gal/ft
Well Volume (gallons) = Water Column (ft) x Gal/ft = 2.65 ft x 0.164 Gal/ft = 0.44 gallons

Bailed Dry (1/15/02)

Volume of Water in Filter Pack: Gallons/foot = 0.041 x (D^2 - d^2), where D is total borehole dia. in inches & d is casing dia. in inches = 0.041 x ((____)^2 - (____)^2) = ____ gal/ft

Filter Pack Volume (gal) = ((Screen Height + lesser of 2 ft or water column) x gal/ft) x porosity (0.3) = ((Screen Height ____ ft + ____ ft) x ____ gal/ft) x 0.3 = ____ gallons

Purge Well Volume: Purge Well Volume = Filter Pack Volume + Well Volume = ____ gal + ____ gal = ____ gal

1 x Purge Well Volume (gal.)	2 x Purge Well Volume (gal.)	3 x Purge Well Volume (gal.)	4 x Purge Well Volume (gal.)	5 x Purge Well Volume (gal.)

Purge Cycle	Time (24 hr)	Depth to Water	Conductivity	pH	~~Eh~~ ORP	Temperature	Turbidity	Diss. O_2	Purge Volume
Units:		Feet	umhos/cm	Standard Units	~~ppm~~ mV	°C	NTU	ppm	gallons
Purge Vol 1	1045	57.70	32.10	6.61	-34	9.41	16.1	2.38	0
Purge Vol 2	1053	59.33	31.0	6.87	-59	8.69	9.46	6.04	0.5
Purge Vol 3									
Purge Vol 4									
Purge Vol 5									
SAMPLE									

SAMPLE ANALYTICAL INFORMATION

Collected only Total metals

Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)
Nitroaromatics	Mod. 8330	2 - 1 Liter Amber Glass	Dissolved TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Chloride	325.3	1 - 1 Liter HDPE See Note A
TCL Volatile Organics	5030 / 8260B	3 - 40 mL Glass Vials	Total Cyanide	9010A/9012	1 - 1 Liter HDPE	Sulfate	375.3	A. Sample for alkalinity, chloride, sulfate, TSS. TDS, and turbidity combined in one 1-liter HDPE container.
TCL SVOCs	3510C / 8270C	2 - 1 Liter Amber Glass	Total Organic Carbon	9060	1 - 250 mL Amber Glass	Tot. Suspended Solids	160.2	
Total TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Nitrate	353.2		Total Dissolved Solids	160.1	
Hardness	130.2		Alkalinity	310.1	1 - 1 Liter HDPE See Note A	Turbidity	180.1	

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE W

Manager: Mike Spangberg

RFA / COC Number: PB011702ELAB

Location Code: IT-BG8-BEDGW-001

Sample Number: CA3006

Sample Name: PBOW-02-GW-IT-BG8-BEDGW-001-CA300

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: 1/16/02

Collection Time: 1450

Start Depth: 6.05

End Depth: 6.07

Sample Matrix: WATER

Sample Team: DK/RT

QC Partners:

(TB) CA5003 (ER) (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
HARDNESS	N	B	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	2	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
NITRATE-W	N	F	1	250	mL	Amb. Glass
TOC	N	F	1	250	mL	Amb. Glass
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE

- PB011702ELABF

Comments: Static = 5.74 Ft. TD = 20.0 Ft. Pump set at 12 Ft. Rate 420 ml/min

Removed ~~1~~ 3 gals

Sketch Location:

Logged BY / Date: David Kessler

Reviewed BY / Date: David Kessler

GROUNDWATER SAMPLING FORM

IT CORPORATION
A Member of The IT Group

Project Number:	825635	**Collection Date:**	11/16/02	**Form Completed By:**	D. Kessler
Project Name:	PBOW Groundwater	**Collection Time:**	1450	**Sampler(s):**	D. Kessler, Rogan Thompson
Investigation Site:	Background	**Sample Filtered (Yes / No):**	yes		
RFA/COC Number:		**Weather/Temp:**	Snowing, (30°)	**Reviewed By:**	David Kerr

Sample Number: P B O W – 0 2 – G W – B G 8 B – E D 0 0 1 – C A 3 0 0 6 – 6.05 – 6.07

MONITORING WELL INFORMATION [use top of casing (TOC) for all measurements]

Well Number:	BG8-BEDGW-001	**Outside Casing Dia. (in):**	2	**Odor:**	
Well Secure (Yes / No):	yes	**Depth to Product (ft):**	None	**Vapor Monitor Type:**	PID / VRAE
Well Labeled (Yes / No):		**Total Well Depth (ft):**	20	**- Vapor Monitor S/N:**	1
Well Condition:	Good	**Depth to Water (ft):**	5.74	**- Reading (ppm):**	0.0 / LEL=0 O_2=20.2 CO_2=0 ppm H_2S=0
Screen Height:	15	**Water Column (ft):**	14.26	**Remarks:**	
Casing Type:	PVC	**Elev. Ref. for Water Level:**			

MONITORING WELL PURGE CALCULATIONS AND PURGE RECORD

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where d is casing diameter in inches = (0.041 x (_____)^2) = _____ gal/ft

Well Volume (gallons) = Water Column (ft) x Gal/ft = _____ ft x _____ Gal/ft = _____ gallons

Low Flow

Volume of Water in Filter Pack: Gallons/foot = 0.041 x (D^2 - d^2), where D is total borehole dia. in inches ~~& d is casing dia.~~ in inches = 0.041 x ((_____)^2 - (_____)^2) = _____ gal/ft

Filter Pack Volume (gal) = ((Screen Height + lesser of 2 ft or water column) ~~x gal/ft~~) x porosity (0.3) = ((Screen Height _____ ft + _____ ft) x _____ gal/ft) x 0.3 = _____ gallons

Purge Well Volume: Purge Well Volume = Filter Pack Volume + Well Volume = _____ gal + _____ gal = _____ gal

1 x Purge Well Volume (gal.)	2 x Purge Well Volume (gal.)	3 x Purge Well Volume (gal.)	4 x Purge Well Volume (gal.)	5 x Purge Well Volume (gal.)

Purge Cycle	Time (24 hr)	Depth to Water	Conductivity	pH	~~Eh~~ ORP	Temperature	Turbidity	Diss. O_2	Purge Volume
Units:		Feet	umhos/cm	Standard Units	~~ppm~~ mV	°C	NTU	ppm	gallons
Purge Vol 1	1430	6.05	0.812	7.42	-62	10.00	3.6	0.00	420 ml/min
Purge Vol 2	1435	6.05	0.815	7.40	-71	10.39	3.3	0.00	
Purge Vol 3	1440	6.07	0.820	7.40	-75	10.59	~~4.0~~ 2.8	0.00	
Purge Vol 4	1445	6.07	0.839	7.39	-78	10.76	2.9	0.012	
Purge Vol 5	1450	6.07	0.856	7.38	-79	10.69	2.8	0.00	
SAMPLE	~~1450~~ 1515	6.05	0.901	7.30	-170	10.51	5.7	0.00	~3 gal

SAMPLE ANALYTICAL INFORMATION

Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)	Requested Analysis	Method	Sample Container(s)
Nitroaromatics	Mod. 8330	2 - 1 Liter Amber Glass	Dissolved TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Chloride	325.3	1 - 1 Liter HDPE See Note A
TCL Volatile Organics	5030 / 8260B	3 - 40 mL Glass Vials	Total Cyanide	9010A/9012	1 - 1 Liter HDPE	Sulfate	375.3	A. Sample for alkalinity, chloride, sulfate, TSS. TDS, and turbidity combined in one 1-liter HDPE container.
TCL SVOCs	3510C / 8270C	2 - 1 Liter Amber Glass	Total Organic Carbon	9060	1 - 250 mL Amber Glass	Tot. Suspended Solids	160.2	
Total TAL Metals	3005A/6010B / 7470A	1 - 500 mL HDPE	Nitrate	353.2		Total Dissolved Solids	160.1	
Hardness	130.2		Alkalinity	310.1	1 - 1 Liter HDPE See Note A	Turbidity	180.1	

APPENDIX B

DATA VALIDATION SUMMARY

Data Validation Summary Report for the Site Investigation Performed for Plum Brook Ordnance Works

1.0 Introduction

Level III data validation was performed on environmental samples collected from Plum Brook Ordnance Works. The analytical data consisted of one sample delivery group (SDG) P0001, which was analyzed by ELAB Laboratory. The parameters for which the data were analyzed and validated are identified below:

Parameter (Method)
Volatile Organic Compounds by SW846 8260B
Semivolatile Organic Compounds by SW846 8270C
Total/Dissolved Metals by SW846 6010B/7471A
Wet Chemistry

2.0 Procedures

The sample data were validated following the logic identified in the *USEPA Contract Laboratory Program (CLP) National Functional Guidelines For Inorganic Data Review (February 1994)* and *USEPA Contract Laboratory Program National Functional Guidelines For Organic Review (October 1999)* for all areas except Blanks. *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (April 1993)* and *Region III Modifications to National Functional Guidelines for Organic Data Review (September 1994)* were applied to the areas associated with blank contamination. Specific quality control (QC) criteria, as identified in the Quality Assurance Plan (QAP), analytical methods, and laboratory Standard Operating Procedures (SOP's) were applied to all sample results. As the result of the use of Update III SW846 test methods for the analytical data and the application of the CLP guidelines during the validation process, there were instances where specific QC requirements for all target compounds were not defined. This primarily occurred in the

organic, Gas Chromatograph (GC) and Gas Chromatograph/Mass Spectra (GC/MS) calibration areas and is due to the fact that the analytical methods are "performance-based", and allows the use of average calibration responses, in lieu of, individual responses, which are defined by CLP protocol. In light of applying CLP guidelines to SW846 methods and evaluating the usability of the data during the validation process, specific QC criteria were determined to address all target compounds and are identified in this report for each parameter, as well as, in the validation checklists, which function as worksheets. All completed validation checklists are included in Attachment A. For those analytical methods not addressed by the CLP and Region III guidelines, the validation was based on the method requirements (i. e. SW846, CFR, SOP's) and technical judgement, following the logic of the CLP validation guidelines.

3.0 Summary of Data Validation Findings

The overall quality of the data was determined to be acceptable with minimal qualification. The only rejected data were inorganic analyte (cyanide), which experienced poor MS/MSD recoveries.

Individual validation reports have been prepared for each parameter and the overall results of the validation findings are summarized in this report. The following section highlights the key findings of the data validation for each analysis.

4.0 Analysis-Specific Data Validation Summaries

4.1 Volatile Organics by GC/MS SW846 8260B

Overall, the data are of good quality and are usable as reported by the laboratory, with the noted exceptions. Data were reviewed for the following:

Holding Times. Technical holding time criteria were met for all samples.

Initial and Continuing Calibration. All initial and continuing calibrations associated with the project samples met QC criteria, with the exceptions of the following:

- The following exhibited individual ICAL %RSD > 30% and/or CCAL %D > 25%.

SDG	Samples Affected	Analyte/Analytes	Validation Qualifier
P0001	CA3003, CA3002, CA3006, CA3001	Chloroethane	UJ

Blanks. The 5X/10X rule for contaminants found in the associated trip and method blanks was applied to all sample results. All were found to be acceptable, with the exception of the following:

SDG	Samples Affected	Analyte	Blank	Validation Qualifier
P0001	CA3005	Toluene	Trip/Field	B

Surrogate Recoveries. All surrogate recoveries were within acceptable QC limits.

Matrix Spike/Matrix Spike Duplicate. MS/MSD was performed and all QC criteria were met.

Laboratory Control Sample. LCS was performed for the project samples and all QC criteria were met.

Internal Standards. All internal standards met QC criteria. It should be noted that IS4 (1,4-dichlorobenzene-d4) experienced low area counts for some samples. No qualification was necessary since associated compounds were not target analytes.

Field Duplicates. Original and field duplicate results were reviewed to evaluate the precision and accuracy of field activities. All QC criteria were met (30% water).

Quantitation. Results quantified between the MDL and the RL, which the lab qualified as "J," were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.2 Semivolatiles by SW846 8270C

Overall, the data are of good quality and are usable as reported by the laboratory with the noted exceptions. Data were reviewed for the following:

Holding Times. Technical holding time criteria were met for all samples.

Initial and Continuing Calibration. All initial and continuing calibrations associated with the project samples met QC criteria, with the exception of the following:

- The following exhibited individual ICAL %RSD > 30% and/or CCAL %D > 25%.

SDG	Samples Affected	Analytes	Validation Qualifier
P0001	All	Carbazole, 3-Nitroaniline	UJ
	CA3002, CA3006, CA3001, CA3003	4-Chloroaniline	UJ

Blanks. The 5X/10X rule for contaminants found in the associated equipment rinses, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries. All surrogate recoveries met QC criteria.

Matrix Spike/Matrix Spike Duplicate. MS/MSD was performed for the project samples and all QC criteria were met

Laboratory Control Sample/Laboratory Control Sample Duplicate. LCS was performed for the project samples and all QC criteria were met.

Internal Standards. All internal standards met QC criteria.

Field Duplicates. Original and field duplicate results were reviewed to evaluate the precision and accuracy of field activities and all QC criteria were met.

Quantitation. Results quantified between the MDL and the RL, which the lab qualified as "J," were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.3 Total/Dissolved Metals by SW846 6010B/7471A

Overall, the data are of good quality and are usable as reported by the laboratory, with the noted exceptions. Data were reviewed for the following:

Holding Times. Technical holding time criteria were met for all samples.

Initial and Continuing Calibrations. All initial and continuing calibrations associated with the project samples met QC criteria, with the exception of the following:

SDG	Samples Affected	Element	Validation Qualifier
P0001	CA3006sol, CA3001sol, CA3003sol	Beryllium, Cobalt, Sodium	J/UJ

Blanks. The 5X rule for contaminants found in the associated equipment rinse, calibration, and method blanks was applied to all sample results. All were acceptable, with the noted exceptions:

SDG	Samples Affected	Analyte	Blank	Validation Qualifier
P0001	CA3005, CA3005sol, CA3002, CA3006, CA3006sol, CA3001, CA3001sol, CA3003, CA3003sol	Thallium	ICB/CCB/Ambient	B
	CA3002, CA3006, CA3006sol, CA3001, CA3001sol, CA3003, CA3003sol	Aluminum, Beryllium	ICB/CCB	B
	CA3006, CA3001, CA3001sol	Iron	Method	B

Matrix Spike/Matrix Spike Duplicate. MS/MSD was performed for the project samples and all QC criteria were met, with the exception of the following:

SDG	Samples Affected	Element	Validation Qualifier
P0001	CA3002, CA3006, CA3001, CA3005	Cyanide	R

Laboratory Control Sample/Laboratory Control Sample Duplicate. LCS was performed for the project samples and all QC criteria were met.

Interference Check Sample (ICS). All ICS % recoveries, where applicable, were acceptable, with the exception of the following:

SDG	Samples	Elements	Validation Qualifier
P0001	All	Selenium	UJ

ICP Serial Dilutions. Serial dilution 10% D criteria were met.

Field Duplicates. Original and field duplicate results were evaluated and all QC criteria were met, with the exception of the following:

SDG	Samples	Elements	Validation Qualifier
P0001	CA3002 (original) CA3003 (FD)	Thallium	B

- "B" qualifiers (which are identification qualifiers) assigned to designate blank contamination, take precedence over quantitative estimating ("J") qualifiers.

Quantitation. Results quantified between the MDL and the RL (flagged by the laboratory as B) were qualified as estimated "J", unless blank contamination was present or results were rejected.

4.4 Wet Chemistry

Overall, the data are of good quality and are usable as reported by the laboratory, with the noted exceptions. Data were reviewed for the following:

Holding Times. Technical holding time criteria were met for all samples.

Initial and Continuing Calibration. All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks. The 5X rule for contaminants found in the associated equipment rinses, and method blanks was applied to all sample results. All were found to be acceptable.

Matrix Spike/Matrix Spike Duplicate. MS/MSD was performed for the project samples and all QC criteria were met, with the exception of the following:

SDG	Samples	Elements	Validation Qualifier
P0001	CA3005	TOC	J

Laboratory Control Sample. LCS was performed for the project samples and all QC criteria were met.

Field Duplicates. Original and field duplicate results were evaluated and all QC criteria were met.

Quantitation. Results quantified between the MDL and the RL, which the lab qualified as "B," were qualified as estimated "J" unless blank contamination was present or the results were rejected.

APPENDIX C

CHEMICAL ANALYTICAL DATA SUMMARY

Laboratory and Validation Qualifier Definitions
Plum Brook Ordnance Works

Qualifier	Definition
Laboratory - Organic	
J	The compound was positively identified; the reported value is an estimated concentration between the method detection limit and the reporting limit.
U	Not detected. The compound was analyzed for, but not detected above the associated reporting limit.
Laboratory - Inorganic	
B	The analyte was positively identified; the reported value is an estimated concentration between the method detection limit and the reporting limit.
N	Spiked sample recovery not within control limits
U	Not detected. The analyte was analyzed for, but not detected above the associated reporting limit.
Validation - All	
B	The analyte was not detected significantly above the levels found in the associated method blank or field blanks
J	The compound/analyte was positively identified; the reported value is an estimated concentration.
R	Rejected due to severe deficiencies in the analytical process or supporting quality control data. The presence or absence of the compound/analyte cannot be verified.
U	Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.
UJ	Not detected. The associated reporting limit may be inaccurate or imprecise.

ORGANIC CASE NARRATIVE
IT – Plum Brook Ordinance
SDG: P0001
Work Orders: 0201063 and 0201094

Volatiles

Method: The samples were analyzed by USEPA SW-846 Methods 5030B/8260B (low concentration purge and trap followed by capillary column GC/MS) for waters upon receipt to the laboratory in satisfactory condition.
Comments: The analyses for these samples were satisfactorily completed within sample holding times and met the corresponding specifications with the following exception:

- Area counts for the internal standard d4-1,2-dichlorobenzene in samples CA3005, CA5001 and CA5002 (0201063-02, -03 and -01) were below 50% of the area counts in the associated continuing calibration verification (CCV) standard. The lowest recovery was 47% of the area count in the associated CCV. No associated target analytes were detected in these samples.

Semi-volatile Samples

Method: The samples were analyzed by USEPA SW-846 Methods 3510C/8270C (separatory funnel extraction followed by capillary column GC/MS) for waters upon receipt to the laboratory in satisfactory condition.
Comments: The analyses for these samples were satisfactorily completed within sample holding times and met the corresponding specifications with the following exception:

- The lowest calibration points for 3,3'-dichlorobenzidine and 3-nitroaniline in the 1/16/02 initial calibration curve are 10 µg/L and 20 µg/L, respectively. These concentrations are reflected as the quantitation limit on the Form I's for the associated samples.

INORGANIC CASE NARRATIVE
IT Corporation
Work Order # 0201063, 0201094
January, 2002

ELAB ID	CLIENT ID
0201063-01	CA3005
0201063-02	CA5001
0201094-01	CA3002
0201094-02	CA3006
0201094-03	CA3001
0201094-04	CA3003
0201094-05	CA3004

Methods:

The samples were analyzed using USEPA SW846 method 6010B for total and soluble ICAP metals, method 7470A for total and soluble mercury and 9012 for Cyanide. Other analytes were analyzed using USEPA "Methods for Chemical Analysis of Water and Wastes" method 200.7 for hardness, method 310.1 for alkalinity, method 325.2 for chloride, method 353.2 for nitrate + nitrite as N, method 375.4 for sulfate, method 160.1 for TDS, method 415.1 for TOC, method 160.2 for TSS and method 180.1 for turbidity. Note: A "U" on the form ones indicates that the analyte is reported down to the CRDL. The "B" flag indicates that the analyte result is between the MDL and the CRDL. All samples were analyzed within specified US EPA holding times.

Specific Comments:

All analyses performed by the Inorganic section were completed meeting satisfactorily the corresponding specifications for Quality Control with the following exceptions:

I. ICAP METALS

A. Continuing Calibration Verification (CCV) Specification Limits (±10%)

1. CCV5, 6 and 7 on the second calibration were out of the specification limits for beryllium @ 88.9%, cobalt @ 89.9%, and sodium @ 89.3 on CCV5; for beryllium @ 87.6%, cobalt @ 89.5%, sodium @ 88.0% and vanadium @ 89.4% on CCV6; and for beryllium @ 87.2%, cobalt @ 89.7%, sodium @ 87.9% and vanadium @ 89.0% on CCV7. CCV5

affects samples 0201094-02 soluble (CA3006), 0201094-03 soluble (CA3001) and 0201094-04 soluble (CA3003). The other CCV's affect only quality control.

B. Continuing Calibration Blank (CCB)
Specification Limits (±RL)

1. CCB4 on the third calibration was out of the specification limits for iron @ 111.6 ug/L. This ccb only affected quality control.

C. Interfering Check Standard A and AB (ICSA/ICSAB)
Specification Limits ±20%

1. There were random problems with the ICSAB with regard to cobalt, selenium and zinc but we believe the affect is insignificant.

II. Cyanide

A. Matrix Spike and Matrix Spike Duplicate (MS/MSD)
Specification Limits ±25%

1. The matrix spike and matrix spike duplicate were out of the specification limit with no spike recovery on either for sample # 0201094 (CA3002). The sample and spikes were analyzed three times with the same results. **All associated samples will be flagged with an "N" on the final report.**

III. TOC

A. Matrix Spike and Matrix Spike Duplicate (MS/MSD)
Specification Limits ±25%

1. The matrix spike and matrix spike duplicate were out of the specifiction limit both at 28%. The sample and spikes were analyzed a second time and confirmed this recovery. **All associated samples will be flagged with an "N" on the final report.**

Plum Brook Ordnance Works
Groundwater
Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
		Associated Site:	WELLS			WELLS			WELLS			WELLS		
		Sample No:	CA3006			CA3005			CA3001			CA3002		
		Sample Date:	16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
GEN CHEMISTRY														
Alkalinity		ug/L	200000			280000			810000			320000		
Chloride		ug/L	78000			18000000			140000			460000		
Cyanide, total		ug/L	10	U	R	10	U	R	10	U	R	10	UN	R
Hardness		ug/L	380000			8200000			710000			720000		
Nitrate		ug/L	22000			250	U	U	250	U	U	250	U	U
Sulfate		ug/L	68000			3200			150000			79000		
Total dissolved solids		ug/L	500000			26000000			1000000			1100000		
Total organic carbon		ug/L	1000	U	U	1100	N	J	1800			2000		
Total suspended solids		ug/L	4000	U	U	13000			4000	U	U	4000	U	U
Turbidity		NTU	1	U	U	8.8			61			21		
METALS														
Aluminum	Y	ug/L	83.6	B	B	200	U	U	89.6	B	B	200	U	U
Aluminum		ug/L	78.7	B	B	200	U	U	77.7	B	B	79.8	B	B
Antimony	Y	ug/L	60	U	U	60	U	U	60	U	U	60	U	U
Antimony		ug/L	60	U	U	60	U	U	60	U	U	60	U	U
Arsenic	Y	ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Arsenic		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Barium	Y	ug/L	83.6	B	J	21300			962			234		
Barium		ug/L	68	B	J	22500			938			247		
Beryllium	Y	ug/L	1.5	B	B	5	U	U	1.5	B	B	5	U	U
Beryllium		ug/L	1.2	B	B	5	U	U	1.2	B	B	1.2	B	B
Cadmium	Y	ug/L	5	U	U	5	U	U	5	U	U	5	U	U
Cadmium		ug/L	5	U	U	5	U	U	5	U	U	5	U	U
Calcium	Y	ug/L	98300			1720000			158000			146000		
Calcium		ug/L	91300			1860000			157000			158000		
Chromium	Y	ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Chromium		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Cobalt	Y	ug/L	50	U	UJ	250	U	U	50	U	UJ	50	U	U
Cobalt		ug/L	50	U	U	500	U	U	50	U	U	50	U	U

Plum Brook Ordnance Works
Groundwater
Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
GEN CHEMISTRY								
Alkalinity		ug/L						
Chloride		ug/L						
Cyanide, total		ug/L						
Hardness		ug/L						
Nitrate		ug/L						
Sulfate		ug/L						
Total dissolved solids		ug/L						
Total organic carbon		ug/L						
Total suspended solids		ug/L						
Turbidity		NTU						
METALS								
Aluminum	Y	ug/L	85.9	B	B			
Aluminum		ug/L	82.7	B	B	93200		
Antimony	Y	ug/L	60	U	U			
Antimony		ug/L	60	U	U	60	U	U
Arsenic	Y	ug/L	10	U	U			
Arsenic		ug/L	10	U	U	56.8		
Barium	Y	ug/L	237					
Barium		ug/L	243			1970		
Beryllium	Y	ug/L	1.5	B	B			
Beryllium		ug/L	1.3	B	B	5.2		
Cadmium	Y	ug/L	5	U	U			
Cadmium		ug/L	5	U	U	3.3	B	J
Calcium	Y	ug/L	150000					
Calcium		ug/L	157000			2180000		
Chromium	Y	ug/L	10	U	U			
Chromium		ug/L	10	U	U	454		
Cobalt	Y	ug/L	50	U	UJ			
Cobalt		ug/L	50	U	U	82.8		

Plum Brook Ordnance Works
Groundwater
Summary of Analytical Results

Report Date: 05/07/02

	Location Code:		IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
	Associated Site:		WELLS			WELLS			WELLS			WELLS		
	Sample No:		CA3006			CA3005			CA3001			CA3002		
	Sample Date:		16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
METALS														
Copper	Y	ug/L	25	U	U	5.7	B	J	25	U	U	25	U	U
Copper		ug/L	25	U	U	32.8			25	U	U	25	U	U
Iron	Y	ug/L	216			6180			40.7	B	B	337		
Iron		ug/L	118		B	6480			72.7	B	B	357		
Lead	Y	ug/L	3	U	U	3	U	U	3	U	U	3	U	U
Lead		ug/L	3	U	U	3	U	U	3	U	U	3	U	U
Magnesium	Y	ug/L	43300			829000			78800			74400		
Magnesium		ug/L	38400			860000			78900			80000		
Manganese	Y	ug/L	117			129			18.7			52.2		
Manganese		ug/L	107			128			19.2			56.2		
Mercury	Y	ug/L	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Mercury		ug/L	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Nickel	Y	ug/L	40	U	U	40	U	U	40	U	U	40	U	U
Nickel		ug/L	40	U	U	40	U	U	40	U	U	40	U	U
Potassium	Y	ug/L	16700			170000			43300			20200		
Potassium		ug/L	13300			165000			46600			21600		
Selenium	Y	ug/L	5	U	UJ	5	U	UJ	5	U	UJ	5	U	UJ
Selenium		ug/L	5	U	UJ	5	U	UJ	5	U	UJ	5	U	UJ
Silver	Y	ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Silver		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Sodium	Y	ug/L	121000		J	6870000			87800		J	114000		
Sodium		ug/L	93200			6830000			90600			115000		
Thallium	Y	ug/L	4.6	B	B	7.3	B	B	4.1	B	B	10	U	U
Thallium		ug/L	3.3	B	B	7.1	B	B	4.2	B	B	4.7	B	B
Vanadium	Y	ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Vanadium		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Zinc	Y	ug/L	13.5	B	J	21.6			20	U	U	20	U	U
Zinc		ug/L	12.6	B	J	23.4			20	U	U	20	U	U

Plum Brook Ordnance Works
Groundwater
Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
METALS								
Copper	Y	ug/L	25	U	U			
Copper		ug/L	25	U	U	293		
Iron	Y	ug/L	305					
Iron		ug/L	341			232000		
Lead	Y	ug/L	3	U	U			
Lead		ug/L	3	U	U	79.2		
Magnesium	Y	ug/L	76000					
Magnesium		ug/L	78500			958000		
Manganese	Y	ug/L	51.1					
Manganese		ug/L	55.5			7470		
Mercury	Y	ug/L	0.2	U	U			
Mercury		ug/L	0.2	U	U	0.14	B	J
Nickel	Y	ug/L	40	U	U			
Nickel		ug/L	40	U	U	457		
Potassium	Y	ug/L	20900					
Potassium		ug/L	21300			334000		
Selenium	Y	ug/L	5	U	UJ			
Selenium		ug/L	5	U	UJ	25	U	UJ
Silver	Y	ug/L	10	U	U			
Silver		ug/L	10	U	U	10	U	U
Sodium	Y	ug/L	109000		J			
Sodium		ug/L	113000			3790000		
Thallium	Y	ug/L	4.5	B	B			
Thallium		ug/L	7	B	B	10	U	U
Vanadium	Y	ug/L	50	U	U			
Vanadium		ug/L	50	U	U	142		
Zinc	Y	ug/L	20	U	U			
Zinc		ug/L	20	U	U	789		

Plum Brook Ordnance Works
Groundwater
Summary of Analytical Results

Report Date: 05/07/02

	Location Code:		IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
	Associated Site:		WELLS			WELLS			WELLS			WELLS		
	Sample No:		CA3006			CA3005			CA3001			CA3002		
	Sample Date:		16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
SEMIVOLATILES														
Acenaphthene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Acenaphthylene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Anthracene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Benzo(a)anthracene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Benzo(a)pyrene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Benzo(b)fluoranthene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Benzo(ghi)perylene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Benzo(k)fluoranthene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Bis(2-chloroethoxy)methane		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Bis(2-chloroethyl)ether		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Bis(2-chloroisopropyl)ether		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Bis(2-ethylhexyl)phthalate		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Bromophenyl phenyl ether, 4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Butyl benzyl phthalate		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Carbazole		ug/L	5	U	UJ	5.5	U	UJ	5	U	UJ	5	U	UJ
Chloro-3-methylphenol, 4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Chloroaniline, 4-		ug/L	5	U	UJ	5.5	U	U	5	U	UJ	5	U	UJ
Chloronaphthalene, 2-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Chlorophenol, 2-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Chlorophenyl phenyl ether, 4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Chrysene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Di-n-butyl phthalate		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Di-n-octyl phthalate		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dibenz(a,h)anthracene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dibenzofuran		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dichlorobenzene, 1,2-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dichlorobenzene, 1,3-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dichlorobenzene, 1,4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dichlorobenzidine, 3,3'-		ug/L	10	U	U	11	U	U	10	U	U	10	U	U
Dichlorophenol, 2,4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
SEMIVOLATILES								
Acenaphthene		ug/L	5	U	U			
Acenaphthylene		ug/L	5	U	U			
Anthracene		ug/L	5	U	U			
Benzo(a)anthracene		ug/L	5	U	U			
Benzo(a)pyrene		ug/L	5	U	U			
Benzo(b)fluoranthene		ug/L	5	U	U			
Benzo(ghi)perylene		ug/L	5	U	U			
Benzo(k)fluoranthene		ug/L	5	U	U			
Bis(2-chloroethoxy)methane		ug/L	5	U	U			
Bis(2-chloroethyl)ether		ug/L	5	U	U			
Bis(2-chloroisopropyl)ether		ug/L	5	U	U			
Bis(2-ethylhexyl)phthalate		ug/L	5	U	U			
Bromophenyl phenyl ether, 4-		ug/L	5	U	U			
Butyl benzyl phthalate		ug/L	5	U	U			
Carbazole		ug/L	5	U	UJ			
Chloro-3-methylphenol, 4-		ug/L	5	U	U			
Chloroaniline, 4-		ug/L	5	U	UJ			
Chloronaphthalene, 2-		ug/L	5	U	U			
Chlorophenol, 2-		ug/L	5	U	U			
Chlorophenyl phenyl ether, 4-		ug/L	5	U	U			
Chrysene		ug/L	5	U	U			
Di-n-butyl phthalate		ug/L	5	U	U			
Di-n-octyl phthalate		ug/L	5	U	U			
Dibenz(a,h)anthracene		ug/L	5	U	U			
Dibenzofuran		ug/L	5	U	U			
Dichlorobenzene, 1,2-		ug/L	5	U	U			
Dichlorobenzene, 1,3-		ug/L	5	U	U			
Dichlorobenzene, 1,4-		ug/L	5	U	U			
Dichlorobenzidine, 3,3'-		ug/L	10	U	U			
Dichlorophenol, 2,4-		ug/L	5	U	U			

	Location Code:		IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
	Associated Site:		WELLS			WELLS			WELLS			WELLS		
	Sample No:		CA3006			CA3005			CA3001			CA3002		
	Sample Date:		16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
SEMIVOLATILES														
Diethyl phthalate		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dimethyl phthalate		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dimethylphenol, 2,4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dinitro-2-methylphenol, 4.6-		ug/L	20	U	U	22	U	U	20	U	U	20	U	U
Dinitrophenol, 2,4-		ug/L	20	U	U	22	U	U	20	U	U	20	U	U
Dinitrotoluene, 2,4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Dinitrotoluene, 2,6-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Fluoranthene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Fluorene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Hexachlorobenzene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Hexachlorobutadiene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Hexachlorocyclopentadiene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Hexachloroethane		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Indeno(1,2,3-cd)pyrene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Isophorone		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Methylnaphthalene, 2-		ug/L	5	U	U	5.5	U	U	5.6			5	U	U
Methylphenol, 2-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Methylphenol, 4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Naphthalene		ug/L	5	U	U	5.5	U	U	7			5	U	U
Nitroaniline, 2-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Nitroaniline, 3-		ug/L	20	U	UJ	22	U	UJ	20	U	UJ	20	U	UJ
Nitroaniline, 4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Nitrobenzene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Nitrophenol, 2-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Nitrophenol, 4-		ug/L	10	U	U	11	U	U	10	U	U	10	U	U
Pentachlorophenol		ug/L	20	U	U	22	U	U	20	U	U	20	U	U
Phenanthrene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Phenol		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Pyrene		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Trichlorobenzene, 1.2.4-		ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U

Report Date: 05/07/02

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
SEMIVOLATILES								
Diethyl phthalate		ug/L	5	U	U			
Dimethyl phthalate		ug/L	5	U	U			
Dimethylphenol, 2,4-		ug/L	5	U	U			
Dinitro-2-methylphenol, 4,6-		ug/L	20	U	U			
Dinitrophenol, 2,4-		ug/L	20	U	U			
Dinitrotoluene, 2,4-		ug/L	5	U	U			
Dinitrotoluene, 2,6-		ug/L	5	U	U			
Fluoranthene		ug/L	5	U	U			
Fluorene		ug/L	5	U	U			
Hexachlorobenzene		ug/L	5	U	U			
Hexachlorobutadiene		ug/L	5	U	U			
Hexachlorocyclopentadiene		ug/L	5	U	U			
Hexachloroethane		ug/L	5	U	U			
Indeno(1,2,3-cd)pyrene		ug/L	5	U	U			
Isophorone		ug/L	5	U	U			
Methylnaphthalene, 2-		ug/L	5	U	U			
Methylphenol, 2-		ug/L	5	U	U			
Methylphenol, 4-		ug/L	5	U	U			
Naphthalene		ug/L	5	U	U			
Nitroaniline, 2-		ug/L	5	U	U			
Nitroaniline, 3-		ug/L	20	U	UJ			
Nitroaniline, 4-		ug/L	5	U	U			
Nitrobenzene		ug/L	5	U	U			
Nitrophenol, 2-		ug/L	5	U	U			
Nitrophenol, 4-		ug/L	10	U	U			
Pentachlorophenol		ug/L	20	U	U			
Phenanthrene		ug/L	5	U	U			
Phenol		ug/L	5	U	U			
Pyrene		ug/L	5	U	U			
Trichlorobenzene, 1,2,4-		ug/L	5	U	U			

Plum Brook Ordnance Works
Groundwater
Summary of Analytical Results

Report Date: 05/07/02

Location Code:		IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
Associated Site:		WELLS			WELLS			WELLS			WELLS		
Sample No:		CA3006			CA3005			CA3001			CA3002		
Sample Date:		16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group													
Parameter	*Flt* *Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
SEMIVOLATILES													
Trichlorophenol, 2,4,5-	ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
Trichlorophenol, 2,4,6-	ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
n-Nitroso-di-n-propylamine	ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
n-Nitrosodiphenylamine	ug/L	5	U	U	5.5	U	U	5	U	U	5	U	U
VOLATILES													
Acetone	ug/L	5	U	U	5	U	U	5	U	U	5	U	U
Benzene	ug/L	1	U	U	1	U	U	91			1	U	U
Bromodichloromethane	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Bromoform	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Bromomethane	ug/L	2	U	U	2	U	U	2	U	U	2	U	U
Butanone, 2-	ug/L	5	U	U	5	U	U	8.1			5	U	U
Carbon disulfide	ug/L	1	U	U	1	U	U	1.2			1.5		
Carbon tetrachloride	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Chlorobenzene	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Chloroethane	ug/L	2	U	UJ	2	U	U	2	U	UJ	2	U	UJ
Chloroform	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Chloromethane	ug/L	2	U	U	2	U	U	1.3	J	J	2	U	U
Dibromochloromethane	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethane, 1,1-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethane, 1,2-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethene, 1,1-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethene, 1,2-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethene, cis-1,2-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloroethene, trans-1,2-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloropropane, 1,2-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloropropene, cis-1,3-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Dichloropropene, trans-1,3-	ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Ethylbenzene	ug/L	1	U	U	1	U	U	32			1	U	U
Hexanone, 2-	ug/L	5	U	U	5	U	U	5	U	U	5	U	U

Plum Brook Ordnance Works

Groundwater

Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
SEMIVOLATILES								
Trichlorophenol, 2,4,5-		ug/L	5	U	U			
Trichlorophenol, 2,4,6-		ug/L	5	U	U			
n-Nitroso-di-n-propylamine		ug/L	5	U	U			
n-Nitrosodiphenylamine		ug/L	5	U	U			
VOLATILES								
Acetone		ug/L	5	U	U			
Benzene		ug/L	1	U	U			
Bromodichloromethane		ug/L	1	U	U			
Bromoform		ug/L	1	U	U			
Bromomethane		ug/L	2	U	U			
Butanone, 2-		ug/L	5	U	U			
Carbon disulfide		ug/L	1.2					
Carbon tetrachloride		ug/L	1	U	U			
Chlorobenzene		ug/L	1	U	U			
Chloroethane		ug/L	2	U	UJ			
Chloroform		ug/L	1	U	U			
Chloromethane		ug/L	2	U	U			
Dibromochloromethane		ug/L	1	U	U			
Dichloroethane, 1,1-		ug/L	1	U	U			
Dichloroethane, 1,2-		ug/L	1	U	U			
Dichloroethene, 1,1-		ug/L	1	U	U			
Dichloroethene, 1,2-		ug/L	1	U	U			
Dichloroethene, cis-1,2-		ug/L	1	U	U			
Dichloroethene, trans-1,2-		ug/L	1	U	U			
Dichloropropane, 1,2-		ug/L	1	U	U			
Dichloropropene, cis-1,3-		ug/L	1	U	U			
Dichloropropene, trans-1,3-		ug/L	1	U	U			
Ethylbenzene		ug/L	1	U	U			
Hexanone, 2-		ug/L	5	U	U			

Plum Brook Ordnance Works

Groundwater

Summary of Analytical Results

Report Date: 05/07/02

Location Code:			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
Associated Site:			WELLS			WELLS			WELLS			WELLS		
Sample No:			CA3006			CA3005			CA3001			CA3002		
Sample Date:			16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
VOLATILES														
Methyl-2-pentanone, 4-		ug/L	5	U	U	5	U	U	5	U	U	5	U	U
Methylene chloride		ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Styrene		ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Tetrachloroethane, 1,1,2,2-		ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Tetrachloroethene		ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Toluene		ug/L	1	U	U	2.4		B	90			1	U	U
Trichloroethane, 1,1,1-		ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Trichloroethane, 1,1,2-		ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Trichloroethene		ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Vinyl chloride		ug/L	1	U	U	1	U	U	1	U	U	1	U	U
Xylenes, total		ug/L	1	U	U	1	U	U	180			1	U	U

Plum Brook Ordnance Works
Groundwater
Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
VOLATILES								
Methyl-2-pentanone, 4-		ug/L	5	U	U			
Methylene chloride		ug/L	1	U	U			
Styrene		ug/L	1	U	U			
Tetrachloroethane, 1,1,2,2-		ug/L	1	U	U			
Tetrachloroethene		ug/L	1	U	U			
Toluene		ug/L	1	U	U			
Trichloroethane, 1,1,1-		ug/L	1	U	U			
Trichloroethane, 1,1,2-		ug/L	1	U	U			
Trichloroethene		ug/L	1	U	U			
Vinyl chloride		ug/L	1	U	U			
Xylenes, total		ug/L	1	U	U			

APPENDIX D

DETECTED HITS SUMMARY EXCLUDING "B" QUALIFIERS

Plum Brook Ordnance Works

Groundwater

Hits Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
		Associated Site:	WELLS			WELLS			WELLS			WELLS		
		Sample No:	CA3006			CA3005			CA3001			CA3002		
		Sample Date:	16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
GEN CHEMISTRY														
Alkalinity		ug/L	200000			280000			810000			320000		
Chloride		ug/L	78000			18000000			140000			460000		
Hardness		ug/L	380000			8200000			710000			720000		
Nitrate		ug/L	22000			-	-	-	-	-	-	-	-	-
Sulfate		ug/L	68000			3200			150000			79000		
Total dissolved solids		ug/L	500000			26000000			1000000			1100000		
Total organic carbon		ug/L	-	-	-	1100	N	J	1800			2000		
Total suspended solids		ug/L	-	-	-	13000			-	-	-	-	-	-
Turbidity		NTU	-	-	-	8.8			61			21		
METALS														
Aluminum	Y	ug/L				-	-	-				-	-	-
Aluminum		ug/L				-	-	-						
Arsenic	Y	ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic		ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Barium	Y	ug/L	83.6	B	J	21300			962			234		
Barium		ug/L	68	B	J	22500			938			247		
Beryllium	Y	ug/L				-	-	-				-	-	-
Beryllium		ug/L				-	-	-						
Cadmium	Y	ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium		ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	Y	ug/L	98300			1720000			158000			146000		
Calcium		ug/L	91300			1860000			157000			158000		
Chromium	Y	ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Chromium		ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	Y	ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt		ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Copper	Y	ug/L	-	-	-	5.7	B	J	-	-	-	-	-	-
Copper		ug/L	-	-	-	32.8			-	-	-	-	-	-
Iron	Y	ug/L	216			6180						337		

Plum Brook Ordnance Works
Groundwater
Hits Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
GEN CHEMISTRY								
Alkalinity		ug/L						
Chloride		ug/L						
Hardness		ug/L						
Nitrate		ug/L						
Sulfate		ug/L						
Total dissolved solids		ug/L						
Total organic carbon		ug/L						
Total suspended solids		ug/L						
Turbidity		NTU						
METALS								
Aluminum	Y	ug/L						
Aluminum		ug/L				93200		
Arsenic	Y	ug/L	-	-	-			
Arsenic		ug/L	-	-	-	56.8		
Barium	Y	ug/L	237					
Barium		ug/L	243			1970		
Beryllium	Y	ug/L						
Beryllium		ug/L				5.2		
Cadmium	Y	ug/L	-	-	-			
Cadmium		ug/L	-	-	-	3.3	B	J
Calcium	Y	ug/L	150000					
Calcium		ug/L	157000			2180000		
Chromium	Y	ug/L	-	-	-			
Chromium		ug/L	-	-	-	454		
Cobalt	Y	ug/L	-	-	-			
Cobalt		ug/L	-	-	-	82.8		
Copper	Y	ug/L	-	-	-			
Copper		ug/L	-	-	-	293		
Iron	Y	ug/L	305					

Plum Brook Ordnance Works
Groundwater
Hits Summary of Analytical Results

Report Date: 05/07/02

Location Code:			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
Associated Site:			WELLS			WELLS			WELLS			WELLS		
Sample No:			CA3006			CA3005			CA3001			CA3002		
Sample Date:			16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
METALS														
Iron		ug/L				6480						357		
Lead	Y	ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Lead		ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium	Y	ug/L	43300			829000			78800			74400		
Magnesium		ug/L	38400			860000			78900			80000		
Manganese	Y	ug/L	117			129			18.7			52.2		
Manganese		ug/L	107			128			19.2			56.2		
Mercury	Y	ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Mercury		ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	Y	ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Nickel		ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	Y	ug/L	16700			170000			43300			20200		
Potassium		ug/L	13300			165000			46600			21600		
Sodium	Y	ug/L	121000		J	6870000			87800		J	114000		
Sodium		ug/L	93200			6830000			90600			115000		
Thallium	Y	ug/L										-	-	-
Thallium		ug/L												
Vanadium	Y	ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium		ug/L	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	Y	ug/L	13.5	B	J	21.6			-	-	-	-	-	-
Zinc		ug/L	12.6	B	J	23.4			-	-	-	-	-	-
SEMIVOLATILES														
Methylnaphthalene, 2-		ug/L	-	-	-	-	-	-	5.6			-	-	-
Naphthalene		ug/L	-	-	-	-	-	-	7			-	-	-
VOLATILES														
Benzene		ug/L	-	-	-	-	-	-	91			-	-	-
Butanone, 2-		ug/L	-	-	-	-	-	-	8.1			-	-	-
Carbon disulfide		ug/L	-	-	-	-	-	-	1.2			1.5		

Plum Brook Ordnance Works
Groundwater
Hits Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
METALS								
Iron		ug/L	341			232000		
Lead	Y	ug/L	-	-	-			
Lead		ug/L	-	-	-	79.2		
Magnesium	Y	ug/L	76000					
Magnesium		ug/L	78500			958000		
Manganese	Y	ug/L	51.1					
Manganese		ug/L	55.5			7470		
Mercury	Y	ug/L	-	-	-			
Mercury		ug/L	-	-	-	0.14	B	J
Nickel	Y	ug/L	-	-	-			
Nickel		ug/L	-	-	-	457		
Potassium	Y	ug/L	20900					
Potassium		ug/L	21300			334000		
Sodium	Y	ug/L	109000		J			
Sodium		ug/L	113000			3790000		
Thallium	Y	ug/L						
Thallium		ug/L				-	-	-
Vanadium	Y	ug/L	-	-	-			
Vanadium		ug/L	-	-	-	142		
Zinc	Y	ug/L	-	-	-			
Zinc		ug/L	-	-	-	789		
SEMIVOLATILES								
Methylnaphthalene, 2-		ug/L	-	-	-			
Naphthalene		ug/L	-	-	-			
VOLATILES								
Benzene		ug/L	-	-	-			
Butanone, 2-		ug/L	-	-	-			
Carbon disulfide		ug/L	1.2					

Plum Brook Ordnance Works

Groundwater

Hits Summary of Analytical Results

Report Date: 05/07/02

	Location Code:		IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
	Associated Site:		WELLS			WELLS			WELLS			WELLS		
	Sample No:		CA3006			CA3005			CA3001			CA3002		
	Sample Date:		16-JAN-02			15-JAN-02			17-JAN-02			16-JAN-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
VOLATILES														
Chloromethane		ug/L	-	-	-	-	-	-	1.3	J	J	-	-	-
Ethylbenzene		ug/L	-	-	-	-	-	-	32			-	-	-
Toluene		ug/L	-	-	-				90			-	-	-
Xylenes, total		ug/L	-	-	-	-	-	-	180			-	-	-

Plum Brook Ordnance Works

Groundwater

Hits Summary of Analytical Results

Report Date: 05/07/02

		Location Code:	PB-BED-MW25			PB-BED-MW26		
		Associated Site:	WELLS			WELLS		
		Sample No:	CA3003			CA3004		
		Sample Date:	16-JAN-02			17-JAN-02		
User Test Group								
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
VOLATILES								
Chloromethane		ug/L	-	-	-			
Ethylbenzene		ug/L	-	-	-			
Toluene		ug/L	-	-	-			
Xylenes, total		ug/L	-	-	-			

APPENDIX E

DATA QUALITY EVALUATIONS

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List of Acronyms

AR/COC	Analysis Request/Chain of Custody
CFR	Code of Federal Regulations
CI	Chemical Investigation
DI	deionized
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
ID	identification
IT	IT Corporation
LCS	laboratory control sample
MB	material blank or method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NFG	national functional guidelines
PQL	practical quanitation limit
PBOW	Plum Brook Ordnance Works
QA/QC	quality assurance/quality control
SAP	quality assurance project plan
RI	remedial investigation
RL	reporting limit
RPD	relative percent difference
SDG	Sample Delivery Group
SOP	Standard Operating Procedures
USACE	U.S. Army Corps of Engineers
VOC	Volatile Organic Compounds

E.1.0 Introduction

This appendix of the Second Quarterly Background Report presents results of the quality assurance/quality control (QA/QC) measures implemented for the sampling and analysis activities at the Plum Brook Ordnance Works (PBOW) – Sandusky, Ohio. The quality indicators from every aspect of the data collection have been reviewed, and an assessment of the data with regard to project-specific objectives is presented. Successful execution of project-specific objectives and procedures provides strong support for the acceptance of the data generated as adequate for the purpose of evaluating the analytical results from this assessment at PBOW.

IT Corporation (IT) conducted field-sampling activities at PBOW in January 2002. ELAB of Nashville, Tennessee analyzed the project samples. All data analyzed were reviewed for accuracy and completeness. One hundred percent of the data analyzed and submitted were subjected to data validation following guidelines in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999 (EPA, 1999) and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, February 1994. The criteria for blank evaluation were based on those detailed in *Region III Modifications to National Functional Guidelines for Organic Data Review* (September 1994) and *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses,* (April 1993). Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness and comparability goals established to meet the project data quality objectives (DQO). To verify that these DQOs were met, field measurements, sampling and handling procedures, laboratory analysis and reporting, and all nonconformances and discrepancies in the data were examined to determine compliance with the appropriate and applicable procedures defined in the SAP. The results of this review are presented in the following sections, with all analytical outliers or nonconformances discussed where they occurred.

This report is divided into three subsections. Section E.2.0 discusses the field investigation and QC procedures used during the sampling effort. Section E.3.0 outlines the analytical program and the associated QC activities performed. The final part of this document, Section E.4.0, summarizes the data findings and their overall impact on the usability of the analytical data.

E.2.0 Field Sampling and QC Activities

IT was retained by the U. S. Army Corps of Engineers, Nashville District to conduct investigation and sampling activities at PBOW. Field activities at this site included collection of monitoring well groundwater samples. The collection of these samples along with their associated QC samples are discussed in this section of the Data Quality Evaluation (DQE).

Five project and one field duplicate samples were submitted to ELAB. Sample shipments from the field were performed under custody and documented using standard IT Analysis Request/Chain of Custody (AR/COC) forms. These forms provided project-specific analytical specifications and QC instructions to the laboratory. A formal COC transfer record was prepared and included with these forms to document custody during sample transportation, storage, and disposition by the laboratory. Table E-1 summarizes the field sample number, location, sample type, date of collection, and lot number for each sample collected. Table E-2 summarizes the detected compounds in the various blanks associated with the PBOW samples.

E.2.1 Field Blanks

Field blanks or material blanks are collected to assess potential contamination introduced to the sample matrix in the field through sample handling procedures. The field blank data are used for point of reference or for trouble shooting purposes to eliminate the possibility that the source water may be the source of any recurring contamination problems. Field blanks are generally prepared from the clean source water (DI water) or the site source water used during decontamination procedures. One field blank was collected.

The data validator applied the 5X-10X rule to the samples for the analytes detected. The following sample was qualified "B" by the data validator indicating that the sample result is indicative of blank contamination:

Lot Number	Sample Affected	Blank Contaminant	Validation Qualifier
P0001	CA3005	Toluene	B

E.2.2 Trip Blanks

Aqueous samples designated for volatile organic compound (VOC) analysis may be susceptible to contamination by diffusion of organic compounds into the sample container. Trip blanks are analyzed in order to assess the potential for contamination to be introduced to an aqueous volatile sample during transport and handling procedures. A trip blank is a sample of analyte-free deionized (DI) water that is prepared at the laboratory, shipped to the field with sample containers, and returned to the laboratory with the water matrix samples receiving VOC analysis. A trip blank is then analyzed for volatile organics using the same sample preparation and analysis procedures used for the actual field samples. Two trip blank samples were collected.

The data validator applied the 5X-10X rule to the samples for the analytes detected. The following sample was qualified "B" by the data validator indicating that the sample result is indicative of blank contamination:

Lot Number	Sample Affected	Blank Contaminant	Validation Qualifier
P0001	CA3005	Toluene	B

E.2.3 Field Duplicates

Field duplicate samples are collected and submitted to the laboratory for analysis along with their corresponding original sample. The data generated from the analysis of field duplicate samples are used to evaluate the precision of the sample collection and analysis procedures. It is difficult to collect and analyze soil samples in duplicate due to the heterogeneous nature of a soil. High relative percent difference (RPD) between an original sample and its field duplicate may indicate a difference in sample matrix or sample collection rather than true problems with precision of sample analysis. Also, when estimated "J" or nondetected "U" results are reported, there is a potential for increased variability between the primary and duplicate sample results

Field duplicate samples were collected at a frequency of approximately one for every ten samples collected (10 percent). One field duplicate sample was collected during this sampling event. Table E-3 compares the original and field duplicate results and shows the RPDs calculated for those detected compounds. Compounds not presented in the table were not detected in either the original or field duplicate samples. In cases where duplicates were performed and one result is less than the reporting limit, but greater than the method detection limit, the RPD is reported, but

should be considered an estimated value. RPDs were not calculated if the analytes were detected in only one sample.

The acceptance criterion of 30 percent RPD for waters was used to evaluate these sample results. The original and field duplicate data compared well as demonstrated by the RPDs calculated. RPD is calculated by using the following formula:

$$RPD = \left| \frac{A - B}{(A + B)/2} \right| \quad x \quad 100$$

where:

RPD	=	relative percent difference
A	=	original result
B	=	field duplicate result.

E.2.4 Field Split Samples

No field split samples were collected in January 2002. An additional field split will be collected during the next round of sampling.

E.3.0 Analytical Program and QC Activities

The project QA/QC program described in the SAP was followed for the collection and laboratory analysis of samples. Each of the analytical methods used require that method-specific QA/QC protocols be followed during sample analysis. These protocols are a critical part of the methods employed and were followed by the laboratory during sample analysis. Specific measures included detailed record keeping procedures, instrument calibrations, and analysis of method blanks, blank spikes, MS/MSD, surrogates, and internal standards. The following SW-846 and USEPA Methods were used to analyze PBOW samples:

Parameter	SW-846 Method
Volatiles	SW-846 8260B
Semivolatiles	SW-846 8270C
Metals	SW-846 6010B/7470A
Sulfate	EPA 375.4
Turbidity	EPA 180.1
Alkalinity	EPA 310.1
TOC	EPA 415.1
Hardness	EPA 200.7
Total Dissolved Solids	EPA 160.1
Total Suspended Solids	EPA 160.2
Chloride	EPA 325.2
Total Cyanide	SW-846 9012A
Nitrate	EPA 353.2

Appendix C contains validated analytical data summaries for the samples collected during this field investigation. The QA/QC criteria defined in the SAP were used by the validator to evaluate the data for all parameters for which criteria were provided. If acceptance criteria were not provided in the SAP, laboratory-derived acceptance criteria were used by the validator to qualify data or the criteria established in the analytical method were used. Any qualifiers added to these data by the data validator are included in the summaries.

E.3.1 Laboratory QA/QC Procedures

The following sections discuss specific QA/QC protocols required and performed by the laboratory during this investigation.

E.3.1.1 Method/Calibration Blanks

Method blanks are analyzed with each analytical "batch" processed on a per matrix (i.e., soil and water) basis. Method blanks are carried step-wise through the same analytical procedure as their associated field samples including the addition of solvents, surrogate and standard spikes, and reagents as required in the analysis process. The purpose of a method blank is to identify any possible contaminants that may be introduced to the sample as a result of any part of the analytical process. Table E-2 summarizes the compounds detected in associated blanks by lot number. The data validator evaluated all blank data associated with each sample. When estimated or positive concentrations of compounds/analytes were reported in the corresponding field samples, associated samples were evaluated and qualified using the 5X-10X rule.

For some analyses, an initial and continuing calibration blank are performed throughout the run sequence. These blanks verify the presence of carry over contamination for the analytes of interest.

Qualifiers applied to samples based on detects in the method or calibration blanks are summarized below:

Lot Number	Sample Number Affected	Blank Contaminant	Blank	Validation Qualifier
Metals				
P0001	CA3001, CA3001(F), CA3002, CA3003, CA3003(F), CA3006, CA3006(F)	Aluminum	Calibration	B
	CA3001, CA3001(F), CA3002, CA3003, CA3003(F), CA3006, CA3006(F)	Beryllium	Calibration	B
	CA3001, CA3001(F), CA3006	Iron	Method	B
	CA3001, CA3001(F), CA3002, CA3003, CA3003(F), CA3005, CA3005(F), CA3006, CA3006(F)	Thallium	Ambient/Calibration	B

E.3.1.2 Matrix Spikes and Laboratory Control Spikes

Two types of spikes were generally performed for all analyses: matrix spikes (MS) and laboratory control samples (LCS). MS compounds are spiked into an aliquot of a field sample. LCS compounds are spiked into a blank matrix. The spiked compounds are representative compounds that are quantified during performance of the method. Recovery of the spiked compound is used as an assessment of analytical accuracy on the sample matrix analyzed. These results are useful in distinguishing sample matrix interferences from analysis interferences through a comparison of MS and LCS recovery data. Often, spikes are performed in duplicate (as an MSD or LCS duplicate). In this manner, the precision of the assessment can be quantified as the RPD of the original and duplicate spike.

Matrix spikes were assigned at a frequency of 1 for every 20 field samples collected. One MS/MSD pair was assigned in the field to sample CA3002. This corresponds to location PB-BED-MW25. Additional sample volume was provided to the laboratory for the MS/MSD analyses. This sampling frequency meets the collection criteria for this program as specified in the SAP. In addition to the overall collection frequency, the analytical method requires that the laboratory analyze 1 set of spikes per analytical batch. To comply with this method requirement, the laboratory may have to analyze "batch" QC with a work order. The validator evaluated the "batch" QC. The laboratory statistically determined target acceptance limits were used to assess the spike recovery and RPD.

The MS/MSD criteria were met with the exception of the following, which exhibited % recoveries and/or RPDs outside QC limits:

Lot Number	Sample Number Affected	Compound(s)	Validation Qualifier
Inorganics			
P0001	CA3001, CA3002, CA3005, CA3006	Cyanide	R
Wet Chemistry			
P0001	CA3005	TOC	J

LCS results are used to evaluate lab method performance in the same manner as the MS/MSD results except the LCS is not performed on an actual field sample matrix. A LCS is prepared for each analytical "batch" for each parameter and matrix analyzed.

All LCS recoveries met the established QC criteria.

E.3.1.3 Calibration

Several analytes were qualified because of unacceptable performance in the calibration standards. For specific examples refer to the validation report in Appendix J and Table E-5.

E.3.2 Reporting Limits

Practical quantitation limits (PQL) or RLs, used for this project are those statistically determined by the laboratories. The analytical program executed for this project required the use of SW-846 methods, which specify the procedure for calculating the PQLs presented. Each laboratory is required to demonstrate method performance through method detection limit (MDL) studies for every method employed. These studies are required to be laboratory-specific so that individual laboratory variables such as equipment brands, reagent suppliers, and chemist technique are factored into the performance study. MDLs are established using controlled matrices (i.e., DI water). The PQL calculation adjusts the limit by a predetermined mathematical factor for the analysis of actual environmental sample matrices (i.e. soil, groundwater, etc.). For purposes of clarity and consistency with respect to terminology, the term "reporting limit" has been substituted for PQL when referencing the limit of detection reported by the laboratory for each individual sample and parameter. The actual values reported have been corrected for all necessary dilutions, dryness, and interference factors as applicable based on the resulting analytical data for a sample.

Standard operating procedures (SOP) address MDLs, PQLs, and RLs when dealing with low concentrations of analytes in samples. These limits are generally defined as follows:

- ***MDL.*** The minimum concentration of an analyte that can be determined with 99 percent confidence that the true value is greater than zero.
- ***PQL.*** The lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
- ***RL.*** This number is equivalent to the PQL.

An MDL is the lower limit at which the laboratory can differentiate a measurement from background. The MDL is determined in accordance with the procedures in 40 CFR Part 136. A PQL, or RL, is the lower limit at which a measurement becomes meaningful. This measurement (the PQL or the RL) is generally a multiple of three to five times the MDL.

All samples were handled and analyzed as expected without significant changes to the anticipated project RLs due to matrix interference or high dilutions.

E.3.3 Holding Times/Preservation

All laboratory results submitted for this investigation have been reviewed with respect to laboratory adherence to extraction and analysis holding times. Maximum sample extraction and analysis hold times were those specified in USACE document EM200-1-3. All were acceptable.

E.4.0 Data Evaluation and Usability

The analytical data review process identified a few analytical nonconformance issues that were noted during this analytical program. These anomalies have been discussed in the previous sections of this appendix. Table E-4 summarizes all compounds requiring qualifier application due to anomalies discovered during data validation. Table E-5 defines the reason codes for qualification and Table E-6 defines the data validation qualifiers.

The following definitions are used for defining precision, accuracy, representativeness, completeness, and comparability as they have been applied to this evaluation.

Precision. Precision is a measurement of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision data were obtained through the analysis and evaluation of duplicate QA samples. Accuracy was determined through the analysis and evaluation of method blanks, LCSs, trip blanks, equipment rinsates, and MS samples.

Accuracy. Accuracy is a measurement of bias in a system and is expressed as a percent recovery. These QA samples were collected and/or analyzed at the frequency established in the SAP, verifying the completeness element of the DQOs along with the evaluation of holding times and reporting limits. Percent recovery is calculated as follows:

$$Percent\ \mathrm{Recov}ery = \left(\frac{(x-s)}{T}\right) * 100$$

Where:

X = the lab determined concentration of a spiked sample

S = the sample native concentration prior to spike

T = the true concentration of the spike

Relative Percent Difference is calculated as follows:

$$Relative\ Percent\ Difference = \left[\frac{|D1 - D2|}{\frac{D1 + D2}{2}} \right] * 100$$

Where:

D1 and D2 = the results of duplicate measurements

Representativeness. Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix and site conditions. For example, in conducting ground water monitoring, representativeness requires proper location of wells and the collection of samples under consistent, documented procedures. Wells are located based upon the results of the hydrological study in progress and are designed to provide maximum coverage of the flow conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness also can be monitored by reviewing field documentation and by performing field audits.

The samples were collected using IT SOPs and were fully documented through the use of standard IT field forms. Samples are representative of the matrix and site sampled.

Completeness. Completeness is a measure of the amount of valid data that are obtained during a sampling event as compared to the amount of data planned to be collected under optimum conditions. Some data for this project were qualified as estimated in the validation process because of the outliers noted in the MS recoveries, duplicate results for certain elements, and various other calibration and inductively coupled plasma serial dilution results. A total of 76 data points were qualified as rejected in the validation process due to various QC criteria as described in the previous sections of this report. Precision is calculated as follows:

$$Completeness\ \% = \left(\frac{D_r}{D_c} \right) X\ 100$$

Where:

D_r = the number of data points for which valid results are reported

D_c = the number of valid samples/data points that are collected and reach the laboratory for analysis.

During this task, 6 samples were collected. Five of those samples were submitted for nitroaromatics and were not completed. This resulted in approximately 788 data points out a 863 possible data points. 4 data points were rejected due to anomalies discovered during the validation process. Using the above calculation, 91% completeness is achieved for the task.

Comparability. Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Comparability ensures that results for the sampling event can be compared with data from other past and/or future sampling programs. Comparability for this sampling event was achieved through the use of established and recognized techniques and accepted standard EPA methods. All samples collected and analyzed were subjected to the same sampling, handling, preparation, analysis, reporting, and validation criteria for the purpose of achieving comparability goals within the data set.

E.4.1 Statement of Data Usability

The overall results of the analyses, as discussed in this evaluation, suggest that representative samples were collected and analyzed, and the results are indicative of the media analyzed, with the exception of the few anomalies noted. The data do reflect expected site conditions and are usable for their intended purpose.

Tables E-1 through E-6 summarize the analytical program and the results for the data validation effort for all samples collected by IT at PBOW.

Table E-1
Sample Cross-reference
Former Plum Brook Ordnance Works

Sample Type	Sample Location	Sample Number	Sample Date	Sample Purpose	Lot Number
Monitoring Well Groundwater	PB-BED-MW24	CA3001	17-Jan-02	REG	P0001
	PB-BED-MW25	CA3002	16-Jan-02	REG	P0001
	PB-BED-MW25	CA3003	16-Jan-02	FD	P0001
	PB-BED-MW26	CA3004	17-Jan-02	REG	P0001
	PB-BED-MW20	CA3005	15-Jan-02	REG	P0001
	IT-BG8-BEDGW-001	CA3006	16-Jan-02	REG	P0001

Table E-2

Summary of Compounds Detected in Associated Blanks
Former Plum Brook Ordnance Works

Lot Number	Sample Number	Sample Date	Sample Purpose	Parameter	Result	Units	Lab Qualifier
P0001	02I04A	18-Jan-02	Method Blank	Iron	35.82	ug/L	B
	02I04B	25-Jan-02	Method Blank	Iron	38.394	ug/L	B
	CA5001	15-Jan-02	Field Blank	Acetone	21	ug/L	B
				Thallium	4.3	ug/L	
				Toluene	1.5	ug/L	
	CA5002	15-Jan-02	Trip Blank	2-Butanone	10	ug/L	
				Benzene	3	ug/L	
				Toluene	1.8	ug/L	
	CA5003	16-Jan-02	Trip Blank	Acetone	23	ug/L	
				Methylene chloride	2.3	ug/L	

TABLE E-3

Summary of Original and Field Duplicate Hits
Relative Percent Difference Calculations
Plum Brook Ordnance Works

			PB-BED-MW25 WELLS CA3002 16-Jan-02 REG		PB-BED-MW25 WELLS CA3003 16-Jan-02 FD		Relative Percent Difference between REG and FD
Parameter	Units	Filtered	Result	Qual	Result	Qual	
Aluminum	ug/L	N	79.8	B	82.7	B	3.57
Aluminum	ug/L	Y	-	-	85.9	B	NC
Barium	ug/L	N	247		243		1.63
Barium	ug/L	Y	234		237		1.27
Beryllium	ug/L	N	1.2	B	1.3	B	8.00
Beryllium	ug/L	Y	-	-	1.5	B	NC
Calcium	ug/L	N	158000		157000		0.63
Calcium	ug/L	Y	146000		150000		2.70
Iron	ug/L	N	357		341		4.58
Iron	ug/L	Y	337		305		9.97
Magnesium	ug/L	N	80000		78500		1.89
Magnesium	ug/L	Y	74400		76000		2.13
Manganese	ug/L	N	56.2		55.5		1.25
Manganese	ug/L	Y	52.2		51.1		2.13
Potassium	ug/L	N	21600		21300		1.40
Potassium	ug/L	Y	20200		20900		3.41
Sodium	ug/L	N	115000		113000		1.75
Sodium	ug/L	Y	114000		109000	J	4.48
Thallium	ug/L	N	4.7	B	7	B	39.32
Thallium	ug/L	Y	-	-	4.5	B	NC
Carbon disulfide	ug/L	N	1.5		1.2		22.22

Table E-4
Summary of Data Validation Reason Codes
Plum Brook Ordnance Works

Reason Code	Description
01	Sample received outside of 4+/-2 degrees Celsius
01A	Improper sample preservation
02	Holding Time Exceeded
02A	Extraction
02B	Analysis
03	Instrument Performance - Outside Criteria
03A	BFB
03B	DFTPP
03C	DDT and/or Endrin % breakdown exceeds criteria
03D	retention time windows
03E	Resolution
04	Initial Calibration results outside specified criteria
04A	Compound mean RRF<0.05
04B	Compound %RSD>30
04C	Correlation Coefficient<0.995
05	Continuing Calibration results outside specified criteria
05A	Compound mean RRF<0.05
05B	Compound %D>25
06	Result qualified as a result of the 5x/10x blank correction
06A	Method or Preparation Blank
06B	ICB or CCB
06C	ER
06D	TB
06E	FB
07	Surrogate Recoveries outside control limits
07A	Sample
07B	Associated method blank or LCS
08	MS/MSD/Duplicate results outside criteria
08A	MS and/or MSD recovery not within control limits (accuracy)
08B	%RPD outside acceptance criteria (precision)
09	Post Digestion Spike outside criteria (GFAA)
10	Internal Standards outside specified control limits
10A	Recovery
10B	Retention Time
11	Laboratory Control Sample recoveries outside specified control limits
11A	Recovery
11B	%RPD (if run in duplicate)
12	Interference Check Standard
13	Serial Dilution
14	Tentatively Identified Compounds
15	Quantitation
16	Multiple results available; alternate analysis preferred
17	Field duplicate RPD criteria exceeded
18	Percent difference between original and second column > 25%
19	Professional judgement was used to qualify the data
20	Pesticide clean-up checks
21	Target compound identification
22	Radiological calibration
23	Radiological quantitation
24	Reported result and/or lab qualifier revised to reflect validation findings
999	See hard copy for details.

Table E-5
Summary of Data Validation Qualifiers Assigned
and Reason Codes for Qualification
Plum Brook Ordnance Works

SDG	Sample Number	Analysis	Parameter	VQ	Reason Codes (1,2) R1	R2	R3	R4
P0001	CA3001	Cyanide	Cyanide	R	08A			
P0001	CA3001	Metals	Aluminum	B	06B	15		
P0001	CA3001	Metals	Beryllium	B	06B	15		
P0001	CA3001	Metals	Iron	B	06A	15		
P0001	CA3001	Metals	Selenium	UJ	12			
P0001	CA3001	Metals	Thallium	B	06B	15		
P0001	CA3001	Semivolatiles	3-Nitroaniline	UJ	05B			
P0001	CA3001	Semivolatiles	4-Chloroaniline	UJ	05B			
P0001	CA3001	Semivolatiles	Carbazole	UJ	05B			
P0001	CA3001	Volatiles	Chloroethane	UJ	05B			
P0001	CA3001	Volatiles	Chloromethane	J	15			
P0001	CA3001(F)	Metals	Aluminum	B	06B	15		
P0001	CA3001(F)	Metals	Beryllium	B	05B	06B	15	
P0001	CA3001(F)	Metals	Cobalt	UJ	05B			
P0001	CA3001(F)	Metals	Iron	B	06A	15		
P0001	CA3001(F)	Metals	Selenium	UJ	12			
P0001	CA3001(F)	Metals	Sodium	J	05B			
P0001	CA3001(F)	Metals	Thallium	B	06B	15		
P0001	CA3002	Cyanide	Cyanide	R	08A			
P0001	CA3002	Metals	Aluminum	B	06B	15		
P0001	CA3002	Metals	Beryllium	B	06B	15		
P0001	CA3002	Metals	Selenium	UJ	12			
P0001	CA3002	Metals	Thallium	B	06B	15	17	
P0001	CA3002	Semivolatiles	3-Nitroaniline	UJ	05B			
P0001	CA3002	Semivolatiles	4-Chloroaniline	UJ	05B			
P0001	CA3002	Semivolatiles	Carbazole	UJ	05B			
P0001	CA3002	Volatiles	Chloroethane	UJ	05B			
P0001	CA3002(F)	Metals	Selenium	UJ	12			
P0001	CA3003	Metals	Aluminum	B	06B	15		
P0001	CA3003	Metals	Beryllium	B	06B	15		
P0001	CA3003	Metals	Selenium	UJ	12			
P0001	CA3003	Metals	Thallium	B	06B	15	17	
P0001	CA3003	Semivolatiles	3-Nitroaniline	UJ	05B			
P0001	CA3003	Semivolatiles	4-Chloroaniline	UJ	05B			
P0001	CA3003	Semivolatiles	Carbazole	UJ	05B			
P0001	CA3003	Volatiles	Chloroethane	UJ	05B			
P0001	CA3003(F)	Metals	Aluminum	B	06B	15		
P0001	CA3003(F)	Metals	Beryllium	B	05B	06B	15	
P0001	CA3003(F)	Metals	Cobalt	UJ	05B			
P0001	CA3003(F)	Metals	Selenium	UJ	12			
P0001	CA3003(F)	Metals	Sodium	J	05B			
P0001	CA3003(F)	Metals	Thallium	B	06B	15		
P0001	CA3004	Metals	Cadmium	J	15			
P0001	CA3004	Metals	Mercury	J	15			
P0001	CA3004	Metals	Selenium	UJ	12			
P0001	CA3005	Cyanide	Cyanide	R	08A			
P0001	CA3005	Metals	Selenium	UJ	12			

Table E-5
Summary of Data Validation Qualifiers Assigned
and Reason Codes for Qualification
Plum Brook Ordnance Works

SDG	Sample Number	Analysis	Parameter	VQ	Reason Codes (1,2) R1	R2	R3	R4
P0001	CA3005	Metals	Thallium	B	06B	06E	15	
P0001	CA3005	Semivolatiles	3-Nitroaniline	UJ	05B			
P0001	CA3005	Semivolatiles	Carbazole	UJ	05B			
P0001	CA3005	Total Organic Carbon	Total Organic Carbon	J	08A			
P0001	CA3005	Volatiles	Toluene	B	06D	06E		
P0001	CA3005(F)	Metals	Copper	J	15			
P0001	CA3005(F)	Metals	Selenium	UJ	12			
P0001	CA3005(F)	Metals	Thallium	B	06B	06E	15	
P0001	CA3006	Cyanide	Cyanide	R	08A			
P0001	CA3006	Metals	Aluminum	B	06B	15		
P0001	CA3006	Metals	Barium	J	15			
P0001	CA3006	Metals	Beryllium	B	06B	15		
P0001	CA3006	Metals	Iron	B	06A			
P0001	CA3006	Metals	Selenium	UJ	12			
P0001	CA3006	Metals	Thallium	B	06B	15		
P0001	CA3006	Metals	Zinc	J	15			
P0001	CA3006	Semivolatiles	3-Nitroaniline	UJ	05B			
P0001	CA3006	Semivolatiles	4-Chloroaniline	UJ	05B			
P0001	CA3006	Semivolatiles	Carbazole	UJ	05B			
P0001	CA3006	Volatiles	Chloroethane	UJ	05B			
P0001	CA3006(F)	Metals	Aluminum	B	06B	15		
P0001	CA3006(F)	Metals	Barium	J	15			
P0001	CA3006(F)	Metals	Beryllium	B	05B	06B	15	
P0001	CA3006(F)	Metals	Cobalt	UJ	05B			
P0001	CA3006(F)	Metals	Selenium	UJ	12			
P0001	CA3006(F)	Metals	Sodium	J	05B			
P0001	CA3006(F)	Metals	Thallium	B	06B	15		
P0001	CA3006(F)	Metals	Zinc	J	15			

Footnotes:
defines all reason codes.
importance to the validation qualifiers applied with R1 being
most important.
Definitions:
validation qualifier

Table E-6

Laboratory and Validation Qualifier Definitions
Plum Brook Ordnance Works

Qualifier	Definition
Laboratory - Organic	
J	The compound was positively identified; the reported value is an estimated concentration between the method detection limit and the reporting limit.
U	Not detected. The compound was analyzed for, but not detected above the associated reporting limit.
Laboratory - Inorganic	
B	The analyte was positively identified; the reported value is an estimated concentration between the method detection limit and the reporting limit.
N	Spiked sample recovery not within control limits
U	Not detected. The analyte was analyzed for, but not detected above the associated reporting limit.
Validation - All	
B	The analyte was not detected significantly above the levels found in the associated method blank or field blanks
J	The compound/analyte was positively identified; the reported value is an estimated concentration.
R	Rejected due to severe deficiencies in the analytical process or supporting quality control data. The presence or absence of the compound/analyte cannot be verified.
U	Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.
UJ	Not detected. The associated reporting limit may be inaccurate or imprecise.