Seventh Quarterly (September 2003) Background Groundwater Report
Former Plum Brook Ordnance Works
Sandusky, Ohio

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List of Acronyms

BHHRA	baseline human health risk assessment
BSC	background screening concentration
DNT	dinitrotoluene
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
HQ	hazard quotient
IDW	investigation-derived waste
ILCR	incremental lifetime cancer risk
IT	IT Corporation
MDC	maximum detected concentration
µg/L	micrograms per liter
NASA	National Aeronautics and Space Administration
OEPA	Ohio Environmental Protection Agency
PAH	polynuclear aromatic hydrocarbon
PBOW	Plum Brook Ordnance Works
PVC	polyvinyl chloride
QAPP	quality assurance project plan
RBSC	risk-based screening concentration
RDX	cyclotrimethylenetrinitramine
RI	remedial investigation
SAP	sampling and analysis plan
Shaw	Shaw Environmental, Inc.
SSAP	site-specific sampling and analysis plan
SSHP	site-specific health and safety plan
STL	Severn Trent Laboratories, Inc.
SVOC	semivolatile organic compound
TBD	to be determined
TNT	trinitrotoluene
VOC	volatile organic compound
USACE	U.S. Army Corps of Engineers
YSI	Yellow Springs Instrument Company

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. 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. 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 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). Shaw Environmental, Inc. (Shaw) (formerly 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 and the Pentolite Road Red Water Ponds. The three former TNT manufacturing areas are TNT Area A, TNT Area B, and TNT Area C (Figure 1-2).

Seventh-quarter sampling activities were conducted pursuant to the following documents: the final site-specific sampling and analysis plan (SSAP) (IT, 2001a), final site-specific safety and health plan (SSHP) (IT, 2001b), the March 2002 letter amendment to the SSAP (IT, 2002a), 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 seasonal collection events to evaluate groundwater quality and determine if a trending pattern of organics and inorganics is present in the groundwater of the background monitoring wells. Background (upgradient) groundwater data will be used as part of a groundwater data set for metals in the various groundwater risk assessments. Upgradient groundwater volatile organic compounds (VOC) and semivolatile organic compounds (SVOC) data will also help describe regional levels of naturally occurring petroleum hydrocarbons. Following completion of the final background sampling

event (anticipated June 2004), groundwater screening concentrations will be calculated. The background data values generated will be compared to values from PBOW site wells for determination of any site-related contamination and may also be used for risk evaluation purposes.

Since minor concentrations of nitroaromatics (less than 0.5 part per million) were detected in three background wells during the month of April 2002 (3rd quarter), a joint decision was made by the USACE, Ohio Environmental Protection Agency (OEPA), NASA, Shaw, and Pacific Environmental Services to continue background groundwater sampling for two additional events. One event was scheduled during the dry season (October 2002), and the other event was scheduled was during the wet season (April 2003).

To determine if locations of present background monitoring wells on PBOW property are truly in "background" locations and to further characterize the background groundwater, two additional background monitoring wells (PB-BED-MW28 and PB-BED-MW29) were installed August 4 through 13, 2003 (Figure 1-2). Well PB-BED-MW28 is located on NASA property outside the security fencing, near the intersection of Taft and Mason Road. It is approximately 2,100 feet upgradient of background well PB-BED-MW20. Monitoring well PB-BED-MW29 is located on private property outside NASA security fencing, approximately 1,100 feet upgradient of background well PB-BED-MW25. With the addition of two new background monitoring wells, background groundwater sampling was decided to be continued for an additional four quarters. Table 1-1 presents a summary of background groundwater sampling investigations and sampling events.

1.1 Objectives

The objectives, as scoped (USACE, 2001, 2003) for the quarterly background sampling, were as follows:

1. Determine the quality of bedrock groundwater entering the PBOW site in the upgradient direction (west, south, and southwest).

2. Determine the quality of residuum groundwater upgradient of selected sites at PBOW.

3. Perform trend analysis to determine if any changes in the concentrations of inorganics are seasonally dependent.

4. Establish the range and determine the background concentrations of inorganics in residuum and bedrock groundwater.

Additional background sampling objectives:

5. Evaluate the detection of nitroaromatics reported in April 2002 in background monitoring wells to determine a possible source for this contamination.

6. Determine if groundwater quality of background monitoring wells is adequate for establishing background concentrations.

7. Provide additional groundwater quality data for risk assessment.

Due to drought conditions, establishing background concentrations of inorganics in overburden groundwater was eliminated from the objectives.

This report presents:

- Groundwater sampling procedures
- Results of the background quarterly sampling events (first through seventh quarterly events)
- Laboratory analytical data of the seventh quarter (September 2003) groundwater sampling. Results from previous events are also presented. These sampling events occurred as follows:
  - First quarter results, September 2001 (IT, 2002b)
  - Second quarter results, January 2002 (IT, 2002c)
  - Third quarter results, April 2002 (IT, 2002d)
  - Fourth quarter results, July 2002 (Shaw, 2003a)
  - Fifth quarter results, October 2002 (IT, 2003)
  - Sixth quarter results, April 2003 (Shaw, 2003b)
- 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, Ohio. Although primarily in Perkins and Oxford Townships, the eastern edge of the site extends into Huron and Milan Townships. PBOW is bound 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 area immediately surrounding PBOW is mostly agricultural, but residential sections are present along the northern and northeast perimeter. 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.

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 General Services Administration 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 Plum Brook Station.

Based on review of historical use of the site and findings of previous investigations, potential chemicals in the groundwater at PBOW may include nitroaromatic compounds, VOC, SVOC, cyanide, and inorganics.

Review of documents and discussions with OEPA personnel indicated that the Columbus and Delaware bedrock units (the same bedrock units in which one of the PBOW background wells is screened) contain actively producing petroleum hydrocarbon wells (Shaw, 2003a). Therefore, it is important to note that some VOCs (primarily benzene, toluene, ethylbenzene, and total xylenes) and SVOCs may be naturally occurring in site groundwater.

2.0 Field Activities

2.1 Investigative Methods

Seventh quarter groundwater sampling of background monitoring wells was conducted following the same procedures used during the previous six background groundwater sampling events. Specific sampling procedures are detailed in the approved SSAP/SSHP (IT, 2001a,b).

2.2 Groundwater Sampling

Seventh quarter groundwater sampling was conducted from September 16 to 19, 2003. Background wells sampled included six bedrock wells (PB-BED-MW20, PB-BED-MW24, BG8-BEDGW-001, PB-BED-MW25, PB-BED-MW28, and PB-BED-MW29). Bedrock well PB-BED-MW26 was scheduled for sampling; however, the well was dry, so no groundwater sample could be collected. Background overburden well IT-MW01 was not sampled. Table 2-1 shows a list of the groundwater samples collected. The background monitoring wells sampled are located on the extreme west and southwest portion of PBOW (Figure 2-1). On-site background monitoring wells were selected by the USACE based on the groundwater investigation conducted in 1997 (USACE, 2001). Newly installed background wells were selected to determine if locations of present background monitoring wells are truly in "background" locations and to further characterize the background groundwater. Bedrock well PB-BED-MW26 was scheduled for sampling; however because the well was dry, no groundwater sample could be collected.

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). Final field measurements of groundwater samples are presented in Table 2-2. Well locations are shown on Figure 2-1. Sample collection logs are provided in Appendix A.

Two procedures were used for purging and sampling wells. Low-flow minimal drawdown was the preferred purging and sampling method in wells where adequate recharge was present. If low-flow sampling was possible, water quality measurements were recorded by use of an inline flow-through cell connected to a Yellow Springs Instrument Company (YSI) meter. If a well did not recharge adequately to use minimal drawdown (low-flow) sampling (i.e., water level dropped

6 inches or more), 3 to 5 well volumes of groundwater were removed and samples were collected with a bailer.

A bladder pump was used for the low-flow minimal drawdown 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 so that drawdown in the well was never greater than 6 inches. The following water chemistry parameters were monitored for stability: hydrogen ion concentration, oxidation-reduction potential, conductivity, temperature, dissolved oxygen, turbidity.

Samples collected for filtered 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).

Groundwater recharge rates permitted six of the seven wells to be sampled using low-flow minimal drawdown sampling methodology, including the following wells: PB-BED-MW24, PB-BED-MW25, PB-BED-MW20, BG8-BEDGW-001, PB-BED-MW28, and PB-BED-MW29. A groundwater sample could not be collected from background bedrock monitoring well PB-BED-MW26 due to an insufficient water column (1.56 feet). Based upon groundwater level measurements from previous events, the calculation of the small water column, and the minimal water recharge in the well, groundwater from monitoring well PB-BED-MW26 was not sampled.

2.3 Decontamination Procedures

Decontamination of all sampling equipment was performed in accordance with Section 4.3 of the SSAP (IT, 2001a). Specifically, the water level indicator, the low-flow pump, and the flow-through cell of the YSI meter were the only instruments that needed complete decontamination procedures. Decontamination was performed in sequence by rinsing with soapy water, deionized water, and isopropyl alcohol, with a final rinse of 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, with the shiny side out, after decontamination. Bailers, if needed, and tubing were not decontaminated because new

items were used for each well. To prevent damage to sensitive membranes, the water quality instrument (YSI 650) was thoroughly rinsed only with deionized water.

2.4 IDW Management

IDW generated during the September 2003 groundwater sampling event included groundwater, decontamination water, and personal protective equipment. All IDW was managed and handled in accordance with procedures described in the SAP (IT, 1996a).

An estimated total of 40 gallons of decontamination and purge water were generated from the background monitoring wells. All liquid was contained in a labeled 55-gallon drum. Since off-site background well PB-BED-MW29 is located on property not owned by NASA, purge water generated from this well was not permitted to be staged at the NASA facility. Purge and decontamination water from all background wells was transferred and stored at the Shaw facility in Findlay, Ohio. Soiled personal protective gear and disposable field equipment generated during the project were double-bagged and placed in an on-site industrial dumpster.

At the time of this report submittal, the September 2003 nonhazardous purge and decontamination water remains at the Shaw office in Findlay, Ohio. Current plans are to dispose the water by one of two methods: either through a publicly owned treatment works discharge permit following OEPA disposal guidelines or, as previously disposed, through a registered disposal company (US Liquids or Evergreen landfill). Final decision for disposal is being determined by the USACE.

3.0 Analytical Program

Severn Trent Laboratories, Inc. (STL) of Knoxville, Tennessee, analyzed primary and field duplicate project samples. STL's Canton, Ohio, laboratory provided analyses for water quality parameters. Accutest Laboratory of Orlando, Florida analyzed the field split. Shaw performed data validation for primary and field duplicate project samples. Datachek validated the field split as part of the preparation of the chemical quality assurance report. The validation summary for the September 2003 background 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. Chain-of-custody documentation is provided in Appendix F. Appendix G contains responses to comments.

3.1 Analytical Program and Methodologies

Chemical analyses for the investigation were performed in accordance with guidelines detailed in the Environmental Protection Agency's (EPA) *Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods,* Third Edition (EPA, 1986) and subsequent revisions and EPA 600/4-79-020, *Method for Chemical Analysis of Water and Wastes* (EPA, 1983). The groundwater samples and associated quality assurance/quality control samples were analyzed for VOCs, SVOCs, metals, nitroaromatics, and several water quality parameters. Methods used for analysis of groundwater during the seventh quarterly sampling event 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 *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, February 2002 (EPA, 2002a). 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, 1994) 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 quality assurance procedures specified in the site-wide SAP (IT, 1996a) and QAPP (IT, 1996b) and their site-specific attachments. Successful execution of these procedures provides strong supporting evidence that the data are representative of the areas 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. 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 practical quantitation limit but is less than 5 times or 10 times the blank result, the sample result is qualified "B." The 10 times limit is applicable only for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, and certain phthalates.
- For organics, if the sample result is less than the practical quantitation limit and less than 5 times or 10 times 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 method detection limit but less than 5 times the blank result, the sample result is qualified "B."
- If the sample result is greater than 5 times or 10 times 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. Sample results are not corrected.

3.4 Comparison to Screening Criteria

Background groundwater data are not subjected to risk assessment screening in this document. For non-background groundwater data, analytical results are compared against risked-based screening concentrations (RBSC). Groundwater RBSCs are derived from EPA Region 9 preliminary remediation goals tap water criteria, based either on chronic noncancer or cancer effects (EPA, 2002b). For noncancer effects, RBSCs are adjusted to a hazard quotient (HQ) of 0.1; noncancer-based RBSCs are based on an HQ of 1. Adjusting the HQ downward accounts for possible additive effects of multiple chemicals during risk-based screening. For cancer-based effects, both RBSCs and preliminary remediation goals are based on an incremental lifetime cancer risk (ILCR) of 1E-6. Some chemicals exhibit both chronic noncancer and cancer effects. For these chemicals, the RBSC represents either an HQ of 0.1 or an ILCR of 1E-6, whichever results in a lower concentration. The RBSCs are based on a generalized residential drinking water scenario, assumed to be the most restrictive use of groundwater. It is emphasized that RBSCs do not imply a regulatory limit or mandated cleanup level.

No attempt was made to develop RBSCs 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).

All tables in Chapter 4.0 include a column for maximum detected concentrations (MDC) and a column for PBOW background screening concentrations (BSC). The MDC represents the maximum concentration of a particular analyte detected within an area of concern. Although "B"-qualified data are identified on the tables, "B"-qualified results are not included in the MDC as all "B"-qualified data will be removed during the baseline human health risk assessment (BHHRA). MDC results for the area of concern may change as additional groundwater samples are collected. BSC values have not been established, and BSC values for inorganics are denoted by "to be determined" (TBD). Three additional background groundwater sampling events will be conducted (December 2003, March and June 2004) prior to the completion of the RI; the

BSCs for inorganics will be based on the resulting data set. These BSC results will be included in the RI and the BHHRA.

A true screening will be performed in the BHHRA to compare site groundwater analytical results to the RBSCs; site inorganics results will be additionally compared to BSC. The RBSCs and their eventual use for screening in the BHHRA are discussed in Subsection 3.4.1. PBOW BSCs and their use in the risk assessment are discussed in Subsection 3.4.2. Although it does not directly apply to this background report, the BHHRA protocol for screening and evaluating analytes detected in groundwater is depicted on Figure 3-1 and briefly discussed in Section 3.4.2.

3.4.1 Risk-Based Screening

In the BHHRA, RBSCs will be used to screen chemicals detected in site groundwater. RBSCs correspond to an ILCR of one in one million (1E-6) or an HQ of 0.1, whichever would result in a lower concentration value. RBSCs do not imply a regulatory limit or mandated cleanup level.

In the BHHRA, each chemical with an MDC less than the RBSC will not be considered further. Those chemicals whose MDCs exceed RBSCs will be subject to further evaluation. Risk-based screening is the initial step of the risk screening and evaluation process, depicted on Figure 3-1, that will be used in the BHHRA. For inorganics, this protocol includes the background screening described in Section 3.4.2 below. Based on the findings of the BHHRA, a chemical exceeding its RBSC may or may not be subject to cleanup.

3.4.2 Background Screening

BSC values can be finalized only after additional background groundwater samples are collected and a subsequent evaluation of flow direction is performed to determine which wells are truly representative of background conditions. Therefore, the BSC column on the tables in Chapter 4.0 are left as "TBD." The finalized BSCs will be included in analogous tables in the RI as points of reference, but screening on the basis of background is performed in the BHHRA.

Background screening in the BHHRA will apply only to inorganic constituents that exceed RBSCs. Although certain organic compounds in site groundwater (benzene, toluene, ethylbenzene, xylenes, and polynuclear aromatic hydrocarbons) may be attributable to background conditions, these will not be summarily screened out, but rather will be carried through the risk assessment process (i.e., exposure assessment, toxicity assessment, risk characterization), unless screened out on the basis of comparison to RBSCs as described in

Section 3.4.1. Final PBOW BSCs will be based on either the 95th upper tolerance limit or the MDC of the background data set (when generated), whichever is less.

3.4.3 Screening and Risk Evaluation Protocol

In the BHHRA, the on-site groundwater MDC for a given inorganic analyte that exceeds its RBSC will be screened against its BSC. Figure 3-1 depicts how risk-based and background screening support the risk assessment decision process. The "further evaluation" box shown on Figure 3-1, just before the "risk management decision," may include a spatial analysis of the data to determine whether the elevated concentrations are found in a small isolated plume or are more evenly distributed throughout the site. This analysis would also examine the potential effect of the distribution on remediation decisions. A geochemical evaluation may be performed for inorganics to further determine whether apparent exceedances in groundwater may be associated with background groundwater conditions.

4.0 Analytical Results

4.1 Groundwater Sampling Events

In September 2003, background groundwater samples representative of low groundwater levels, or dry season conditions, were collected. The background samples were collected from the same monitoring wells sampled in November 1997 and May 1998, BG8-BEDGW-001 and PB-BED-MW20, as well as from the other background wells, PB-BED-MW24 and PB-BED-MW25, and newly installed background wells PB-BED-MW28 and PB-BED-MW29. A groundwater sample was not collected from background well PB-BED-MW26 because it was basically dry. 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-evaluated results of the first through the seventh quarterly sampling events. As a comparison tool, the November 1997, May 1998, and previous results are shown on Figure 2-1 with the September 2003 data. Analytical detections for the first through seventh quarters are presented in Table 4-1. All seventh quarter analytical data are presented in Appendices C and D.

4.2.1 Background Monitoring Wells

Seven bedrock wells were selected to be sampled on a quarterly basis to determine background bedrock groundwater values. These background bedrock monitoring wells are PB-BED-MW20, PB-BED-MW24, PB-BED-MW25, BG8-BEDGW-001, PB-BED-MW26, PB-BED-MW28, and PB-BED-MW29 (Figure 2-1). Groundwater from background wells was analyzed for VOCs, SVOCs, nitroaromatics, metals (total and dissolved), cyanide, and water quality parameters. Groundwater from overburden/shale well IT-MW01 was not scheduled to be collected during September 2003 sampling.

Previous and current groundwater sampling results of background overburden/shale and bedrock monitoring wells are described in the following subsections.

4.2.2 Overburden/Shale

September/October 2001, Dry Season Sampling Event (First Quarterly). Due to an indentation of the polyvinyl chloride (PVC) riser, monitoring well IT-MW01 could not be sampled.

January 2002, Wet Season Sampling Event (Second Quarterly). On January 16, 2002, an attempt was made to repair 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 the IT-MW01 well construction diagram showed that the bottom of the only riser joint (3.2 feet stickup to 4 feet below ground surface) is located within the filter pack. Therefore, this precluded removal of the riser for replacement. Attempts by the sampling personnel were not successful to remove or push back the indentation in the riser.

April 2002, Wet Season Sampling Event (Third Quarterly). Due to an indentation of the PVC riser, monitoring well IT-MW01 could not be sampled.

July 2002, Dry Season Sampling Event (Fourth Quarterly). No nitroaromatics or SVOCs were detected in the overburden background well. Two VOCs, acetone and methylene chloride, were detected and both values were "B" qualified. Several unfiltered and filtered metals were detected. Aluminum, barium, cobalt, copper, iron, manganese, nickel, and zinc were detected in both phases (Table 4-1).

October 2002, Dry Season Sampling Event (Fifth Quarterly). No nitroaromatics or SVOCs were detected in the overburden background well. One VOC, 2-butanone, was detected and it was "B" qualified. Twenty-one unfiltered and 12 filtered metals were detected (Table 4-1).

April 2003, Wet Season Sampling Event (Sixth Quarterly). No nitroaromatics were detected in the overburden background well. Two VOCs, acetone and carbon disulfide, and one SVOC, diethyl phthalate, were detected. Acetone and diethyl phthalate were both "B" qualified. Sixteen unfiltered and 16 filtered metals were detected (Table 4-1).

September 2003, Dry Season Sampling Event (Seventh Quarterly). Overburden/shale monitoring well IT-MW01 was not scheduled to be sampled.

4.2.3 Summary of Overburden/Shale Sampling Events

No nitroaromatics have been detected in the overburden groundwater from well IT-MW01 during the sampling events from November 1997 to April 2003. Six VOCs have been detected, and all but one detection of toluene (May 1998 - 22 micrograms per liter [µg/L]) and carbon disulfide (April 2003 - 0.1 µg/L) were "B" qualified. One SVOC (diethyl phthalate – April 2003) was detected, but it was "B" qualified. A total of 22 unfiltered and 16 filtered metals have been detected.

4.2.4 Bedrock

September-October 2001, Dry Season Sampling Event (First Quarterly). No nitroaromatic compounds were detected in the background monitoring wells. Six VOCs (acetone, benzene, ethylbenzene, methylene chloride, toluene, and total xylenes) were detected in well PB-BED-MW24, and nine VOCs (acetone, benzene, carbon disulfide, chloroform, ethylbenzene, 4-methyl-2-pentanone, methylene chloride, toluene, and total xylenes) were detected in well PB-BED-MW25. SVOC bis(2-ethylhexyl)phthalate was detected in wells PB-BED-MW20 and PB-BED-MW25. Four SVOCs (2,4-dimethylphenol, 2-methylnaphthalene, naphthalene, and phenol) were also detected in well PB-BED-MW24. In the groundwater sample from well BG8-BEDGW-001, nine unfiltered and eight filtered metals were detected, thirteen unfiltered and filtered metals were detected in PB-BED-MW20, eight unfiltered and seven filtered metals were detected in PB-BED-MW24, and nine unfiltered and nine filtered metals were detected in PB-BED-MW25 (Table 4-1).

January 2002, Wet Season Sampling Event (Second Quarterly). No nitroaromatic compounds were detected in any of the background bedrock monitoring wells. The VOC toluene was detected in well PB-BED-MW20; benzene, toluene, ethylbenzene, total xylenes, 2-butanone, carbon disulfide, and chloromethane were detected in well PB-BED-MW24; and carbon disulfide was detected in well PB-BED-MW25. Naphthalene and 2-methylnaphthalene were the only SVOCs detected, and they were found in well PB-BED-MW24. In the groundwater samples from the following wells, the numbers of filtered and unfiltered metals that were detected are listed in parentheses: BG8-BEDGW-001 (eleven unfiltered and eleven filtered), PB-BED-MW20 (ten unfiltered and ten filtered), PB-BED-MW24 (ten unfiltered and

ten filtered), and PB-BED-MW25 (ten unfiltered and seven filtered). All of the bedrock wells exhibited unfiltered thallium detections that were noted with a "B" validation qualifier. The "B" validation qualifier means that thallium was not detected at a level significantly greater than that found in the associated method blanks or field blanks. Due to a low water column, only unfiltered metals were sampled in well PB-BED-MW26. Analyte detections in well PB-BED-MW26 included aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, vanadium, and zinc. Unfiltered metals detections from monitoring well PB-BED-MW26 were compared with analytical results from the other sampled wells, and the results from PB-BED-MW26 were anomalously high. Therefore, these results were considered to be outliers (Table 4-1).

April 2002, Wet Season Sampling Event (Third Quarterly). Three nitroaromatic compounds were detected in background bedrock wells. Nitrobenzene was detected in wells PB-BED-MW20, PB-BED-MW24, and PB-BED-MW25. Nitroaromatics 2,6-DNT and cyclo-trimethylenetrinitramine (RDX) were detected in PB-BED-MW24. VOCs acetone and total xylenes were detected in well BG8-BEDGW-001, while VOCs acetone, benzene, toluene, ethylbenzene, total xylenes, 2-butanone, and carbon disulfide were detected in well PB-BED-MW24 and carbon disulfide, methylene chloride, and toluene were detected in well PB-BED-MW25. The only SVOCs that were detected were naphthalene and 2-methylnaphthalene from well PB-BED-MW24. Groundwater from well BG8-BEDGW-001 contained eleven unfiltered and nine filtered metals, PB-BED-MW20 contained thirteen unfiltered and twelve filtered, PB-BED-MW24 contained seven unfiltered and eight filtered, and PB-BED-MW25 contained nine unfiltered and eight filtered metals (Table 4-1).

July 2002, Dry Season Sampling Event (Fourth Quarterly). No nitroaromatic compounds were detected in any of the background monitoring wells. VOCs acetone and 2-butanone were detected in groundwater from well BG8-BEDGW-001; acetone, benzene, bromomethane, 2-butanone, and toluene were detected in groundwater from well PB-BED-MW20; acetone, benzene, 2-butanone, ethylbenzene, toluene, and total xylenes were detected in groundwater from PB-BED-MW24. Acetone and carbon disulfide were detected in well PB-BED-MW25. SVOC bis(2-ethylhexyl)phthalate was detected in wells BG8-BEDGW-001, PB-BED-MW24, and PB-BED-MW25. Groundwater from monitoring well PB-BED-MW24 also exhibited SVOC compounds 2,4-dimethyphenol, 2-methylnaphthalene, and naphthalene. Groundwater from well BG8-BEDGW-001 showed detections of twelve unfiltered and eleven filtered metals; groundwater from well PB-BED-MW20 contained ten unfiltered and ten filtered

metals. Groundwater from well PB-BED-MW24 detected sixteen unfiltered and seven filtered metals, and groundwater in well PB-BED-MW25 exhibited eight unfiltered and nine filtered metals (Table 4-1).

October 2002, Dry Season Sampling Event (Fifth Quarterly). One nitroaromatic compound, nitrobenzene, was detected and it was found in background well PB-BED-MW25. VOCs acetone and carbon disulfide were detected in groundwater from well BG8-BEDGW-001; benzene, carbon disulfide, and toluene in groundwater from well PB-BED-MW20; benzene, ethylbenzene, toluene, total xylenes, and carbon disulfide were shown in well PB-BED-MW24; and acetone, benzene, total xylenes, and carbon disulfide were found in groundwater from well PB-BED-MW25. The only SVOC that was detected in the groundwater was 2-methylnaphthalene, and it was from monitoring well PB-BED-MW24. Groundwater from well BG8-BEDGW-001 exhibited nine unfiltered and nine filtered metals; groundwater from well PB-BED-MW20 showed twelve unfiltered and eleven filtered metals; groundwater in well PB-BED-MW24 exhibited nine unfiltered and nine filtered metals; and groundwater in well PB-BED-MW25 showed nine unfiltered and nine filtered metals detections (Table 4-1).

April 2003, Wet Season Sampling Event (Sixth Quarterly). One nitroaromatic compound, RDX, was detected in well PB-BED-MW20, and one nitroaromatic compound, 2,4,6-TNT, was detected in well PB-BED-MW24. Although RDX was detected, it was not manufactured at PBOW. VOCs acetone (B qualified) and 2-butanone were detected in the groundwater from well BG8-BEDGW-001; benzene, carbon disulfide, and methylene chloride (B qualified) were detected in groundwater from well PB-BED-MW20; acetone, benzene, ethylbenzene, methylene chloride, toluene, and total xylenes were detected in groundwater from well PB-BED-MW24; and carbon disulfide was detected in the groundwater from well PB-BED-MW25. The only SVOC compounds detected were 2-methylnaphthalene and naphthalene and they were found in the groundwater in well PB-BED-MW24. Groundwater from well BG8-BEDGW-001 showed detections of ten unfiltered and eleven filtered metals; well PB-BED-MW20 showed detections of twelve unfiltered and ten filtered metals; groundwater in well PB-BED-MW24 exhibited ten unfiltered and eight filtered metals; and groundwater in well PB-BED-MW25 showed detections of nine unfiltered and eleven filtered metals (Table 4-1).

September 2003, Dry Season Sampling Event (Seventh Quarterly). One nitroaromatic compound (4-amino-2,6-dinitrotoluene) was detected and it was in the groundwater from background monitoring well PB-BED-MW20. The compound was "J"

qualified, meaning it was detected but it was below the laboratory's reporting limit. VOCs acetone and total xylenes were detected in the groundwater from well PB-BED-MW29 and benzene, toluene, and total xylenes were detected in well PB-BED-MW24. No SVOCs were detected in groundwater from any well above laboratory reporting limits. Groundwater from well BG8-BEDGW-001 showed detections of 9 unfiltered and 9 filtered metals; groundwater from well PB-BED-MW20 exhibited 13 unfiltered and 13 filtered metals; groundwater from PB-BED-MW24 contained 8 unfiltered and 9 filtered metals; and groundwater from well PB-BED-MW25 showed detections of 10 unfiltered and 9 filtered metals. Groundwater in the newly installed background well PB-BED-MW28 exhibited 11 unfiltered and 11 filtered metals detections, while groundwater in well PB-BED-MW29 showed 11 unfiltered and 12 filtered metals detections (Table 4-1).

4.2.5 Summary of Bedrock Sampling Events

Four nitroaromatics (2,6-DNT, nitrobenzene, RDX, and 2,4,6-TNT) were detected in the three bedrock wells sampled during the sampling events (November 1997 to September 2003). Nitrobenzene was found in the groundwater from wells PB-BED-MW20, PB-BED-MW24, and PB-BED-MW25. Nitroaromatics 2,6-DNT, RDX, and 2,4,6-TNT were detected in groundwater from PB-BED-MW24. Benzene, ethylbenzene, toluene, total xylenes, and carbon disulfide were detected in the groundwater from wells PB-BED-MW20 and PB-BED-MW24. Acetone, benzene, total xylenes, and carbon disulfide were detected in the groundwater in well PB-BED-MW25. SVOCs naphthalene and 2-methylnaphthalene were detected only in well PB-BED-MW24. Twenty-two different unfiltered and 19 filtered metals were detected in the groundwater from background wells. Excluding the nutritionally essential compounds (calcium, magnesium, potassium, and sodium), barium, iron, and manganese were the metals most commonly detected in the unfiltered and filtered samples.

5.0 Planned Activities

The following activities are scheduled:

- Continued monitoring and collection of groundwater from the 7 existing background bedrock monitoring wells (remaining sampling events are scheduled for December 2003 and March and June 2004)
- Reporting of analytical data and field activities on a quarterly basis following receipt of validated analytical data
- Preparation of a groundwater data summary and evaluation report presenting all background groundwater analytical results, conclusions, and calculated background screening concentrations.

6.0 References

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TABLES

Table 1-1

Summary of Background Investigations
Seventh Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Investigation Conducted By	Date of Activity	Groundwater Level Conditions	Designation	Activity
IT	August 2001	Dry	Groundwater RI	Included installation of 3 background bedrock wells.
IT	September-October 2001	Dry	1st Quarterly Background	Low-flow groundwater sample collection from background wells and selected non-background wells.
IT	January 2002	Wet	2nd Quarterly Background	Low-flow groundwater sample collection from background wells.
IT	April 2002	Wet	3rd Quarterly Background	Low-flow groundwater sample collection from background wells and selected non-background wells.
[a]Shaw	July 2002	Dry	4th Quarterly Background	Low-flow groundwater sample collection from background wells.
Shaw	October 2002	Dry	5th Quarterly Background	Low-flow groundwater sample collection from background wells.
Shaw	April 2003	Wet	6th Quarterly Background	Low-flow groundwater sample collection from background wells.
Shaw	September 2003	Dry	7th Quarterly Background	Low-flow groundwater sample collection from background wells, including new backgroud wells PB-BED-MW28 and PB-BED-MW29.

RI - Remedial Investigation.
IT - IT Corporation.
[a]Shaw - IT Corporation was purchased by Shaw Environmental and Infrastructure, Inc. June 6, 2002 and given the name Shaw Environmental, Inc.

Table 2-1

Summary of Groundwater Samples Collected
Seventh Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Sample Identification	Sample Date	Sample Number
IT-BG8-BEDGW-001	PBOW-03-IT-BG8-BEDGW-001-DC3000	18-Sep-03	DC3000
PB-BED-MW20	PBOW-03-PB-BED-MW20-DC3001	18-Sep-03	DC3001
PB-BED-MW24	PBOW-03-PB-BED-MW24-DC3002	17-Sep-03	DC3002
PB-BED-MW25	PBOW-03-PB-BED-MW25-DC3003	18-Sep-03	DC3003
PB-BED-MW25	PBOW-03-PB-BED-MW25-DC3006	18-Sep-03	DC3006[a]
PB-BED-MW25	PBOW-03-PB-BED-MW25-DC3007	18-Sep-03	DC3007[b]
PB-BED-MW28	PBOW-03-PB-BED-MW285-DC3004	17-Sep-03	DC3004
PB-BED-MW29	PBOW-03-PB-BED-MW29-DC3005	16-Sep-03	DC3005

[a] Field duplicate.

[b] Field split.

Table 2-2

Final Field Measurements of Groundwater Samples
Seventh Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Date	Time	Low-Flow Sampled	PID (ppm)	H_2S (ppm)	Eh (mV)	pH	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved O_2 (ppm)	Temperature (°C)	Volume Purged (gal)
Background Overburden Well (1997 through September 2003)												
IT-MW01	9/3/2003	NA	NA	NM	NM	Not sampled.						
	4/9/2003	1040	No	0.0	0.0	134.16	5.22	0.572	45	8.08	5.45	6
	10/16/2002	0925	NA	0.0	0.0	-28	6.22	0.765	3.6	3.41	14.4	3.09
	7/10/2002	0900	No	0	0	-8	6.28	0.590	3.7	5.08	17.76	4
	4/2/2002	NA	NA	NM	NM	Not sampled. Riser section dented and prohibited bailer from entering well.						
	1/16/2002	NA	NA	NM	NM	Not sampled. Riser section dented and prohibited bailer from entering well.						
	9/27/2001	1040	NA	NM	NM	Not sampled. Riser section dented and prohibited bailer from entering well.						
	5/16/1998	NA	No	0	NM	57.3	6.23	0.447	0	13.13	14.2	8
	11/19/1997	NA	No	0	NM	-58.2	6.7	0.512	1	10.57	9.6	6.5
Background Bedrock Wells (1997 through September 2003)												
BG8-BEDGW-001	9/18/2003	1550	Yes	0.0	0	-307.9	6.84	3.429	0.0	1.92	15.72	2
	4/10/2003	1545	Yes	1.1	0.0	-64.5	7.79	0.656	2.3	NM	8.61	3
	10/18/2002	1050	Yes	0.0	0.0	-307	5.97	3.88	16.5	1.73	14.2	4.0
	7/12/2002	0920	Yes	0	0	-258	7.21	3.68	10.3	0.41	13.45	5
	4/3/2002	1127	Yes	0.0	0.0	220	7.25	0.43	4.7	NM	6.7	3
	1/16/2002	1450	Yes	0.0	0.0	-79	7.38	0.856	2.8	0.00	10.69	2.22
	9/27/2001	1220	Yes	0.0	NM	-339	13.03	3.75	0.0	0.00	12.65	2.97
	5/15/1998	NA	No	0.1	NM	-36.2	7.80	151	10	8.00	13.0	27.73
	11/17/1997	NA	No	0	NM	-245.3	7.21	3.31	321	6.83	10.5	30
PB-BED-MW20	9/18/2003	0845	Yes	0.0	0	-9.6	6.43	49.71	0.0	0.38	11.97	1.8
	4/11/2003	1050	Yes	0.9	0.0	64.3	6.96	49.75	3.7	9.23	10.17	2.8
	10/17/2002	1510	No	0.0	0.0	-32	5.69	56.3	10.8	3.38	11.60	24
	7/10/2002	1600	Yes	0	0	-57	6.73	52.9	NR	0	13.85	3.5
	4/4/2002	1013	Yes	0.0	NM	51	7.07	53	0.0	0.00	10.37	1.9
	1/15/2002	1415	Yes	1.6	0.00	-55	6.83	52.60	15.0	0.00	7.22	1
	9/26/2001	1415	No	0.0	NM	-73	8.95	53.60	53.5	0.00	10.54	10.33
	5/28/1998	NA	No	0.1	NM	NM	6.65	38.1	999	12.80	13.0	58
	11/17/1997	NA	No	0	NM	-24.7	6.74	48.5	563	4.14	9.4	27
PB-BED-MW24	9/17/2003	1320	Yes	62.9	>500	-323.0	6.14	1.637	0.0	4.88	13.00	3.25
	4/9/2003	1530	Yes	5.6	>200	-337.7	6.64	1.753	0.0	0.0	9.98	3.3
	10/19/2002	1110	No	58.2	>50	-297	6.30	1.85	22.3	5.52	12.20	4.5
	7/12/2002	1405	Yes	84.1	>500	-358	6.66	1.88	350	0	12.93	4.5
	4/3/2002	1730	Yes	76.0	0.0	-318	7.06	1.98	0.0	NM	10.71	1.8
	1/17/2002	1005	Yes	114	0.0	-333	6.82	1.99	2.5	0.00	9.69	2.11
	10/9/2001	0935	Yes	NM	NM	-144	9.38	1.81	73.3	5.32	11.20	2.99

Table 2-2

Final Field Measurements of Groundwater Samples
Seventh Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Date	Time	Low-Flow Sampled	PID (ppm)	H_2S (ppm)	Eh (mV)	pH	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved O_2 (ppm)	Temperature (°C)	Volume Purged (gal)
Background Bedrock Wells (1997 through September 2003), continued												
PB-BED-MW25	9/18/2003	1220	Yes	0.3	0.0	-296.2	6.98	1.707	0.0	0.22	13.91	5.5
	4/10/2003	1035	Yes	0.0	0.0	-333.8	7.22	2.817	3.7	NM	10.93	5.5
	10/17/2002	1035	Yes	0.0	0.0	-290	6.56	2.96	2.1	1.69	12.00	6.0
	7/11/2002	1115	Yes	0	0	-302	7.19	1.86	1.9	0	12.92	8
	4/3/2002	1120	Yes	NM	NM	-333	8.46	2.62	2.7	0.01	10.90	8
	1/16/2002	1030	Yes	0.0	0.0	-291	7.23	2.42	5.8	0.00	10.54	4.44
	10/5/2001	0920	Yes	0.0	0.01	-237	10.58	1.89	5.7	2.41	11.90	3.67
PB-BED-MW26	9/3/2003	NA	NA	NM	NM	No sample collected due to insufficient water volume.						
	4/8/2003	NA	NA	NM	NM	No sample collected due to insufficient water volume.						
	10/16/2002	NA	NA	6.0	0.0	No sample collected due to insufficient water volume.						
	7/12/2002	NA	NA	3.1	0	No sample collected due to insufficient water volume.						
	4/9/2002	NA	NA	NM	NM	No sample collected due to insufficient water volume.						
	1/15/02[a]	1030	No	2.2	0.21	-59	6.87	31.0	999	8.04	8.69	0.5
	10/10/2001	NA	NA	3.6	NM	No sample collected due to insufficient water volume.						
PB-BED-MW28	9/17/2003	0915	Yes	0.0	0	-95.2	7.50	1.408	0.0	0.21	13.88	1.50
PB-BED-MW29	9/16/2003	1520	Yes	0.0	0	6.5	6.66	10.30	25.0	0.22	15.80	3.9

Water quality measurements recorded at time of sample collection. PID and H_2S readings taken as monitoring well lid removed.

°C - Degrees Celsius.
Eh - Oxidation-reduction potential.
H_2S - Hydrogen sulfide.
gal - Gallons.
µmhos/cm - Micromhos per centimeter.
mV - Millivolts.
NA - Not applicable.
NM - Not measured.
NR - Not recorded.
NTU - Nephelometric turbidity unit.
PID - Photoionization detector.
ppm - Parts per million.

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

Table 3-1

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

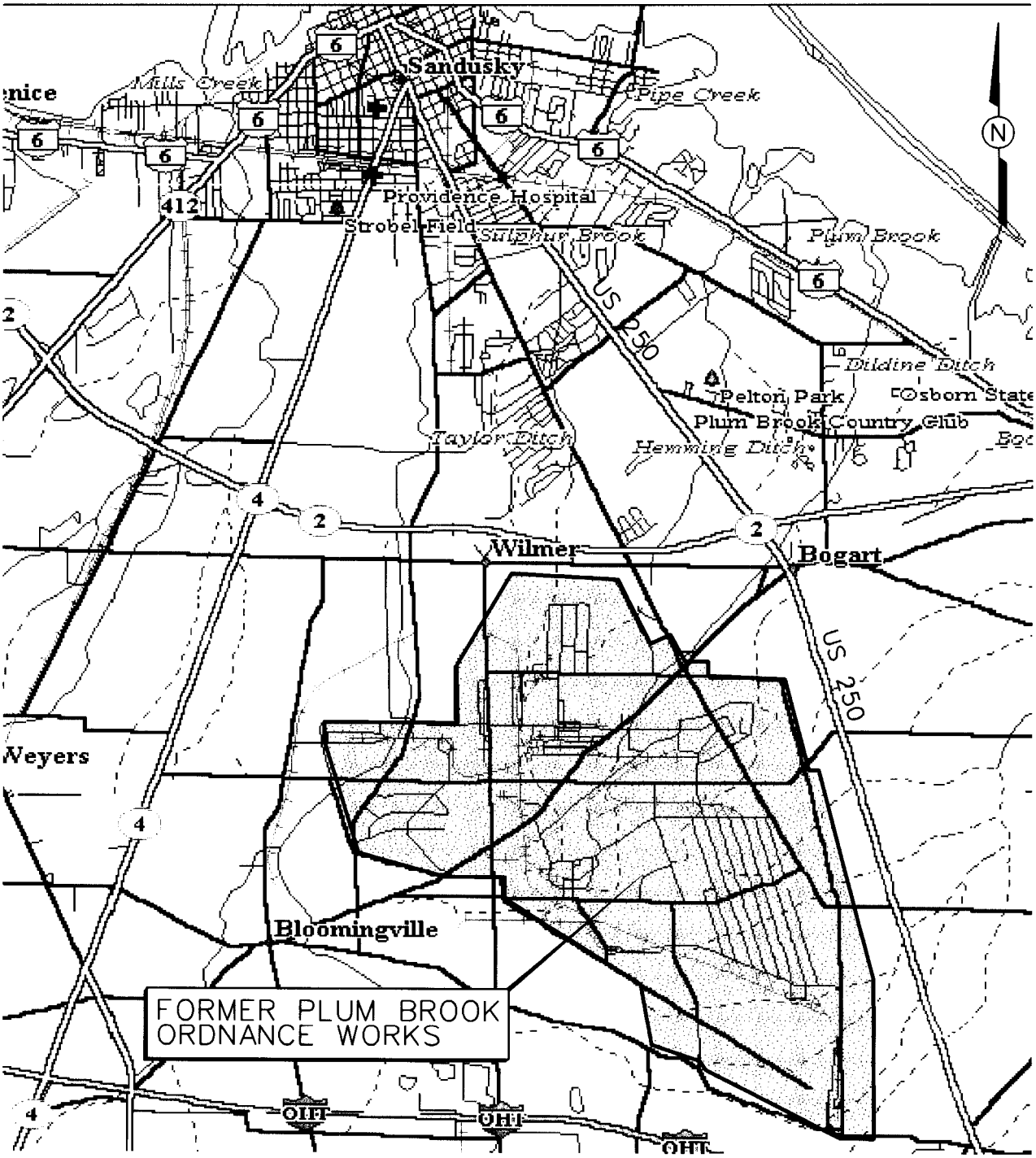
Sample Matrix	Analytical Parameters[a]	Analytical Method[b]
Groundwater (Monitoring Well)	Nitroaromatic Compounds	SW-846 8330M
	TCL Volatile Organic Compounds	SW-846 5030/8260B
	TCL Semivolatile Organic Compounds	SW-846 3510C/8270C
	TAL Metals (T/D)	SW-846 3005A/6010B/7470A
	Turbidity	EPA 180.1
	Alkalinity	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 method quality control or data reporting packages

[b] Analyses found in the U.S. Environmental Protection Agency's (EPA), *Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods,* Third Edition, September 1996, *Methods for Chemical Analysis of Water and Wastes,* March 1983, and their subsequent revisions.

T/D - Total and dissolved (i.e., filtered).

FIGURES



NOT TO SCALE

FIGURE 1-1
VICINITY MAP

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

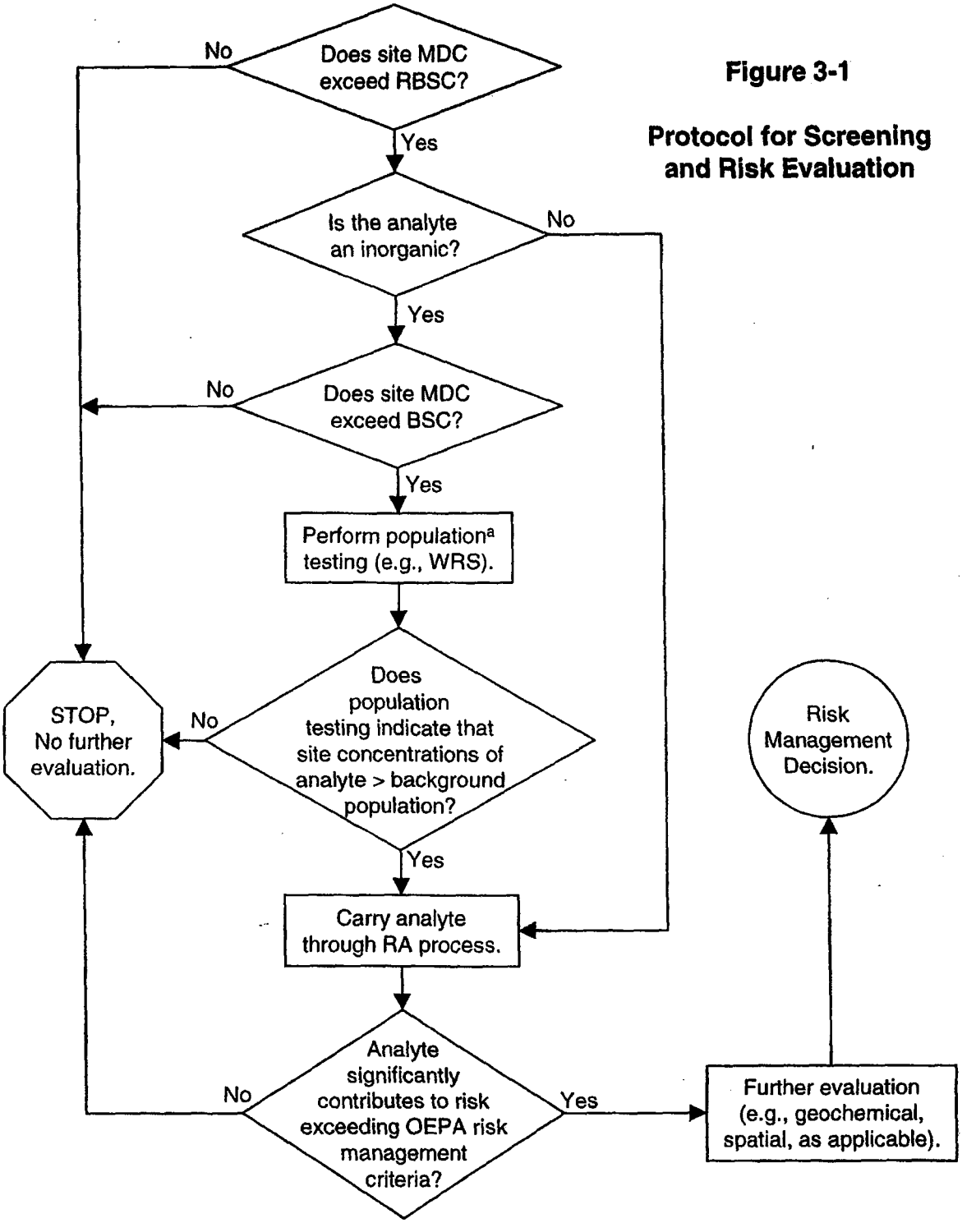
STARTING DATE: 12/16/97	DATE LAST REV: 12/4/2003	DRAFT. CHCK. BY:	INITIATOR: D. KESSLER	DWG. NO.: 773701ES.001
DRAWN BY: D. BILLINGSLEY	DRAWN BY: dhall	ENGR. CHCK. BY: D. KESSLER	PROJ. MGR.: S. DOWNEY	PROJ. NO.: 773701

2:48:35 PM 12/4/2003

dhall 773701es.001

Figure 3-1

Protocol for Screening and Risk Evaluation



Notes:

[a] A judgment may be made at this step to forego or modify population testing if the site data is clearly greater than background and/or individual exceedances suggest the presence of a hot spot. In such cases, the analyte would be carried into the risk assessment process.

BSC - Background screening concentration.
MDC - Maximum detected concentration.
OEPA - Ohio Environmental Protection Agency.
RA - Risk assessment.
RBSC - Risk-based screening concentration.
WRS - Wilcoxon rank sum (test).

Shaw™ Shaw Environmental, Inc.

APPENDIX A

SAMPLE COLLECTION LOGS

Shaw™
Shaw E & I, Inc.

Sample Collection Log

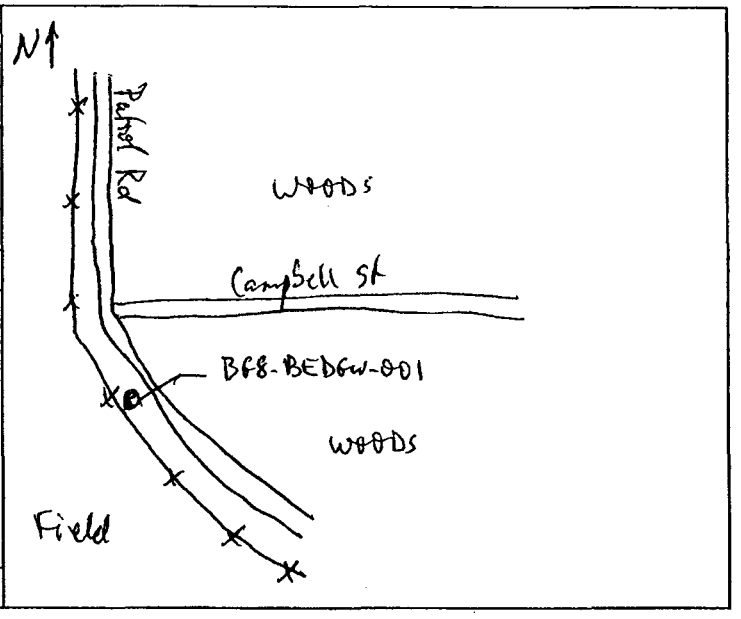
Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**IT-BG8-BEDGW-001**	Collection Date:	9/18/03
Sample Number:	**DC3000**	Collection Time:	1550
Sample Name:	**PBOW-03-IT-BG8-BEDGW-001-GW-DC3000**	Start Depth:	14'
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**REG**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers
LTERED METALS	1 - 250 mL HDPE
TOTAL METALS	1 - 250 mL HDPE
EXPLOSIVES	1 - 1 L Amb. Glass
VOLATILES	3 - 40 mL Vial
SEMIVOLATILES	2 - 1 L Amb. Glass
TOC	2 - 40 mL Vial
CYANIDE	1 - 1 L HDPE
ALKALINITY	1 - 1 L HDPE
CHLORIDE	
NITRATE	
SULFATE	
TDS	
TSS	
TURBIDITY	
HARDNESS	1 - 250 mL HDPE

Sketch Location



Comments: Removed 2 gal

Logged by/Date: Zach Park / 9.18.03

Reviewed by/Date: David Kessler 9/18/03

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GROUNDWATER PURGE FORM

Location Code: **IT-BG8-BEDGW-001**

TPV = 2.0 gal

Sample Number: **DC3000**

Water Quality Parameter Measurements									
Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Conductivity (umhos/cm)	pH (std. units)	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1510	5.28	210	0.0	20.03	3.606	7.08	-229.0	3.09	0
1515	5.48	"	1.05	19.61	3.608	7.01	-261.0	1.98	0
1520	5.57	"	2.10	18.61	3.587	6.92	-286.7	1.89	0
1525	5.58	"	3.15	16.66	3.515	6.88	-308.6	1.76	0
1530	5.58	150	4.20	16.25	3.484	6.87	-307.6	1.77	0
1535	5.59	"	4.95	16.00	3.487	6.87	-307.7	1.86	0
1540	5.51	190	5.70	15.71	3.451	6.86	-307.5	1.87	0
1545	5.53	"	6.65	15.74	3.432	6.85	-307.4	1.91	0
1550	5.53	"	7.60	15.72	3.429	6.84	-307.9	1.92	0
Purging completed. Began sampling DC3000									

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; mL - milliliter; L - Liter

GROUNDWATER SAMPLING FORM

Shaw®

Project Number:	843656	Collection Date:	9.18.03	Form Completed By:	Z. Parham
Project Name:	PBOW	Collection Time:	1550	Sampler(s):	Z. Parham / D. Kessler
Investigation Site:	Background	Sample Filtered (Yes/No):	Metals		
RFA/COC Number:	PB09185TL-K+C	Weather/Temp:	Sunny / warm	Reviewed By:	David Kessler

Sample Name: P B O W - 0 3 - I T - B G 8 - B E D G W - 0 0 1 - G W - D C 3 0 0 0

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):	**Depth to Product (ft):** Nt	**Vapor Monitor Type:** PID / ~~LEL~~ UR Ae
Well Labeled (Yes / No):	**Total Well Depth (ft):** 20	**Vapor Monitor S/N:** 0.01
Well Condition: Good	**Depth to Water (ft):** 5.28	**Reading (ppm):** LEL = 3 % O_2 = 21.2 %
Top of Screen: 5	**Water Column:** 14.72	C = 0 ppm H_2S = 0 ppm
Screen Height: 15	**Top of Filter Pack:** 5'	**Depth Pump Set:** 14'
Casing Type: pvc	**Pump Type:** Bladder	**Pump Settings:** CPM 4 8.0/7.0 Throttle 9 psi
		Remarks:

MONITORING WELL PURGE CALCULATIONS

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 + Sand Above Screen ~~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.)

LOW-FLOW TUBING PURGE CALCULATIONS (3 tubing/pump volumes required for PBOW)

Volume of Water in Tubing: 1/4" ID Tubing = 0.01 Liters/ft. 3/8" ID Tubing = 0.02 Liters/ft. 2" Bladder Pump Volume = 0.3 Liters Tubing Length = 18 ft.

Tubing Volume (Liters) = ([Tubing Liters/ft. x Tubing length] + Pump volume) x 3 = ([0.01 L/ft x 18 ft] + 0.3 L) x 3 = 1.44 L

Total Volume Purged: 1.44 L Liters to gallons = L x 0.26gal/L = 1.44 x 0.26 = .374

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Sample Collection Log

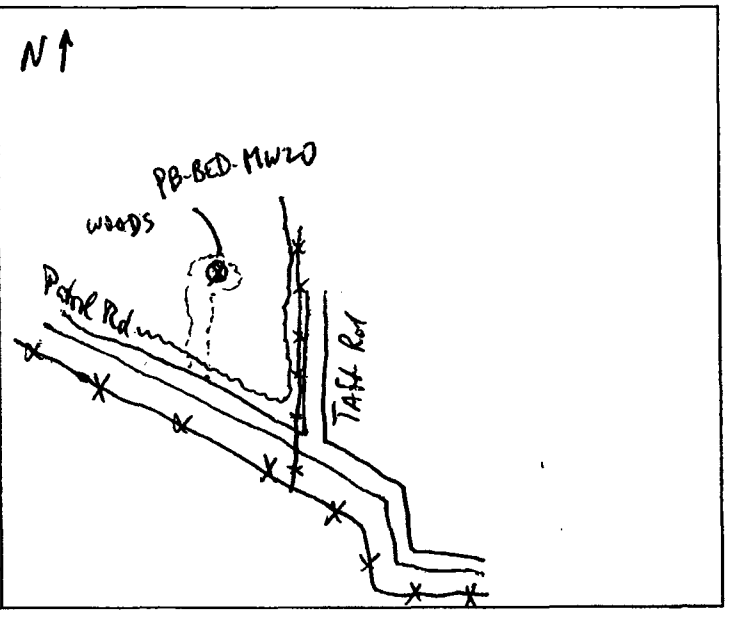
Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW20**	Collection Date:	~~9.17.03~~ 9.18.03
Sample Number:	**DC3001**	Collection Time:	~~0848~~ 0845
Sample Name:	**PBOW-03-PB-BED-MW20-GW-DC3001**	Start Depth:	32
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**REG**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers
ILTERED METALS	1 - 250 mL HDPE
TOTAL METALS	1 - 250 mL HDPE
EXPLOSIVES	1 - 1 L Amb. Glass
VOLATILES	3 - 40 mL Vial
SEMIVOLATILES	2 - 1 L Amb. Glass
TOC	2 - 40 mL Vial
CYANIDE	1 - 1 L HDPE
ALKALINITY	1 - 1 L HDPE
CHLORIDE	
NITRATE	
SULFATE	
TDS	
TSS	
TURBIDITY	
HARDNESS	1 - 250 mL HDPE

Sketch Location



Comments: PID=0.0
All Samples immediately placed on ice

Logged by/Date: [signature] 9.17.03

Reviewed by/Date: David Kessler 9/18/03

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GROUNDWATER PURGE FORM

NOTE: Conductivity reading very high compared to previously sampled wells.

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

Sample Number: **DC3001**

Water Quality Parameter Measurements

Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Conductivity (umhos/cm)	pH (std. units)	Eh (mv)	DO (mg/L)	Turbidity (NTU)
9.17.03 1510	14.30	150	0.0	—	—	—	—	—	—
1515	14.47	300	.75	14.81	49.48	6.44	-15.2	1.47	0
1520	14.45	"	2.25	14.11	49.17	6.42	-15.5	1.19	0
1525	14.47	"	3.75	13.47	49.93	6.38	-26.7	0.78	0.2
1530	14.44	"	5.25	13.46	50.24	6.35	-34.2	0.75	1.8
1535	14.47	"	6.75	13.49	50.18	6.34	-41.7	0.81	2.8
1540	14.46	"	8.25	13.57	50.18	6.33	-41.8	0.88	1.2
1545	14.46	"	7.75	13.61	50.12	6.33	-42.3	0.89	1.3
* 1550	15.19	"	9.25	13.64	50.09	6.33	-42.1	0.95	2.0
- ceased purging in order to check recharge of well.									
- resuming low flow attempt on 9.18.03. Above readings are not to be used for parameter stabalization.									
9.18.03									
0755	14.93	130	0.0	12.92	49.94	6.59	1.6	3.57	9.6
0800	15.01	"	.650	12.69	50.16	6.58	2.3	3.30	5.2
0805	15.01	"	1.300	12.08	50.17	6.50	2.6	2.58	2.4
0810	15.03	"	1.950	11.90	50.00	6.43	0.8	1.46	1.2
0815	15.05	"	2.60	11.89	49.90	6.43	-2.7	0.76	1.3
0820	15.05	"	3.25	11.86	49.86	6.43	-3.5	0.64	1.6
0825	15.06	"	3.90	11.86	49.80	6.43	-5.0	0.56	1.6
0830	15.08	170	4.55	11.89	49.74	6.43	-8.9	0.46	0.9
0835	15.08	"	5.15	11.87	49.72	6.43	-8.7	0.42	0.8
0840	15.09	"	5.75	11.94	49.70	6.43	-9.5	0.39	0
0845	15.10	"	6.35	11.97	49.71	6.43	-9.6	0.38	0
- purge ~~reached~~ completed. Began sampling DC3001.									

9.18.03

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; mL - milliliter; L - Liter

* - Ceased Low Flow Sampling due to water level drop.

~~Purging 3 well volumes~~

GROUNDWATER SAMPLING FORM

Shaw®

Project Number: 843656
Project Name: PBOW
Investigation Site: Backgrd
RFA/COC Number: PB091803STL-K+C

Collection Date: ~~9.17.03~~ 9.18.03
Collection Time: 0845
Sample Filtered (Yes/No): Metals
Weather/Temp: Sunny / Warm

Form Completed By: Z. Parkhan
Sampler(s): Z. Parkhan / D. Kessler
Reviewed By: David Kessler

Sample Name: PBOW-03-PB-BED-MW20-GW-DC3001

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

Well Number: PB-BED-MW20	Outside Casing Dia. (in): 2"	Odor: —
Well Secure (Yes / No):	Depth to Product (ft): NA	Vapor Monitor Type: PID / ~~LEL~~ Vrae
Well Labeled (Yes / No):	Total Well Depth (ft): ~~48~~ 48.6 9.17.03	Vapor Monitor S/N: /
Well Condition: Good	Depth to Water (ft): ~~14.30~~ 9.17.03 14.93 9.18.03	Reading (ppm): LEL = 0 % O_2 = 21.3 %
Top of Screen: 28'	Water Column: ~~34.30~~ 9.17.03 33.67 9.18.03	PID=0.0 C = 0 ppm H_2S = 0 ppm
Screen Height: 20'	Top of Filter Pack: 26	Depth Pump Set: 32'
Casing Type: PVC	Pump Type: Bladder	Pump Settings: 20-psi 10-refill 5-disch.
		Remarks:

MONITORING WELL PURGE CALCULATIONS

Volume of Water in Casing: Gallons/foot = 0.041 x d^2, where d is casing diameter in inches = (0.041 x (2)^2) = ~~.164~~ gal/ft

Well Volume (gallons) = Water Column (ft) x Gal/ft = ~~34.3~~ ft x .164 Gal/ft = 5.63 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 ((8)^2 – (2)^2) = 2.46 gal/ft

Filter Pack Volume (gal) = ((Screen Height + ~~Sand Above Set~~ or Water Column) x gal/ft) x porosity (0.3) = ((Screen Height 20 ft + ~~2.3~~ 12.3 ft) x .164 gal/ft) x 0.3 = ~~.42~~ gallons 1.69

Purge Well Volume: Purge Well Volume = Filter Pack Volume + Well Volume = 1.69 gal + 5.63 gal = 7.32 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.)
7.32	14.64	21.96	29.28	36.6

LOW-FLOW TUBING PURGE CALCULATIONS (3 tubing/pump volumes required for PBOW)

Volume of Water in Tubing: 1/4" ID Tubing = 0.01 Liters/ft. 3/8" ID Tubing = 0.02 Liters/ft. 2" Bladder Pump Volume = 0.3 Liters Tubing Length = 36 ft.

Tubing Volume (Liters) = ([Tubing Liters/ft. x Tubing length] + Pump volume) x 3 = ([0.01 L/ft x 36 ft] + 0.3 L) x 3 = 1.98 L

Total Volume Purged: 1.98 L Liters to gallons = L x 0.26gal/L = 1.98 x 0.26 = .514

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Sample Collection Log

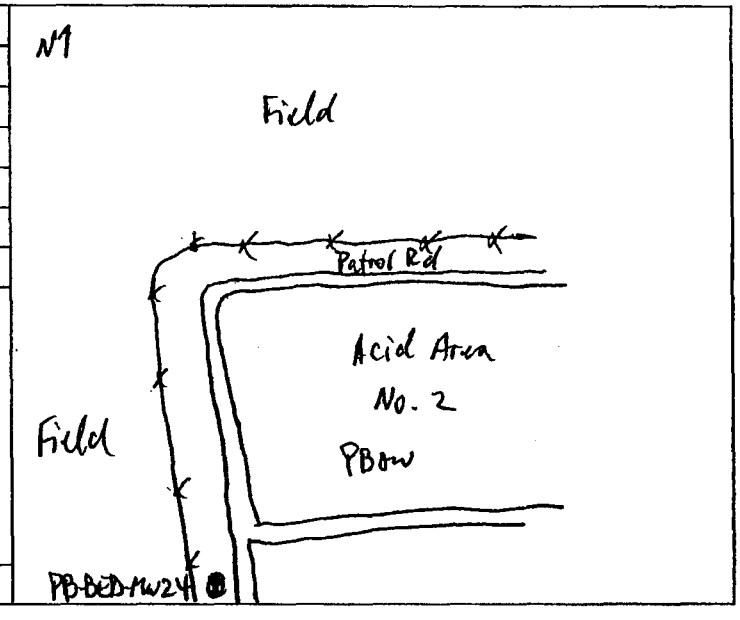
Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW24**	Collection Date:	9.17.03
Sample Number:	**DC3002**	Collection Time:	1320
Sample Name:	**PBOW-03-PB-BED-MW24-GW-DC3002**	Start Depth:	36.50'
Sampling Method:	**Low Flow**	End Depth:	36.61
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**REG**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers
FILTERED METALS	1 - 250 mL HDPE
TOTAL METALS	1 - 250 mL HDPE
EXPLOSIVES	1 - 1 L Amb. Glass
VOLATILES	3 - 40 mL Vial
SEMIVOLATILES	2 - 1 L Amb. Glass
TOC	2 - 40 mL Vial
CYANIDE	1 - 1 L HDPE
ALKALINITY	1 - 1 L HDPE
CHLORIDE	
NITRATE	
SULFATE	
TDS	
TSS	
TURBIDITY	
HARDNESS	1 - 250 mL HDPE

Sketch Location



Comments: PID = 62.9
All samples immediately placed on ice.

Total Purge Vol = 3.25 gal.

Logged by/Date: Zach Parch 9.17.03 Reviewed by/Date: David Kessler 9/17/03

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GROUNDWATER PURGE FORM

Location Code: **PB-BED-MW24**

Sample Number: **DC3002**

(Total volume purged) TVP ≈ 3.25 gal

Water Quality Parameter Measurements									
Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Conductivity (umhos/cm)	pH (std. units)	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1225	28.23	100	0.0	18.20	1.376	6.52	-282.3	2.70	0.1
1230	28.30	"	0.50	17.20	1.371	6.46	-287.2	1.98	0
1235	28.32	250	1.00	14.46	1.349	6.30	-305.6	-0.98	0
1240	"	"	2.25	13.93	1.344	6.24	-313.4	-1.13	0
1245	"	"	3.50	13.71	1.348	6.21	-317.9	-1.99	0.6
1250	"	"	4.75	13.71	1.355	6.21	-324.0	-1.26	0.5
1255	"	"	6.00	13.58	1.382	6.20	-324.1	-0.50	-0.9
1300	"	"	7.25	13.59	1.448	6.20	-324.6	0.12	-2.1
1305	"	"	8.50	13.61	1.521	6.19	-322.7	0.53	-2.8
1310	"	"	9.75	13.72	1.555	6.18	-322.1	0.52	-2.9
1315	"	"	11.00	13.86	1.583	6.19	-322.8	0.58	-3.1
1320	"	"	12.25	13.91	1.606	6.18	-322.0	0.59	-3.3
End 1350				13.00	1.637	6.14	-323.0	4.88	0.0

— purging completed @ 1320. Began sampling DC3002 —

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; mL - milliliter; L - Liter

GROUNDWATER SAMPLING FORM

Shaw®

Project Number:	843656	Collection Date:	9.17.03	Form Completed By:	Z. Larkan
Project Name:	PBOW	Collection Time:	1320	Sampler(s):	Z. Larkan / D. Kessler
Investigation Site:	Background	Sample Filtered (Yes/No):	Metals		
RFA/COC Number:	PB091703STL-K+C	Weather/Temp:	Sunny/warm	Reviewed By:	David Kessler 9/17/03

Sample Name: P B O W - 0 3 - P B - B E D - M W 2 4 - G W - D C 3 0 0 2

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

Well Number:	PB-BED-MW24	Outside Casing Dia. (in):	2"	Odor:	Strong H_2S
Well Secure (Yes/No):		Depth to Product (ft):	NA	Vapor Monitor Type:	PID/~~LEL~~ VRae
Well Labeled (Yes/No):		Total Well Depth (ft):	41.0	Vapor Monitor S/N:	/
Well Condition:	Good	Depth to Water (ft):	28.23	Reading (ppm):	LEL => % O_2 = 20.9%
Top of Screen:	25.5	Water Column:	12.77		PID=62.9 C = 0 ppm H_2S=500 ppm
Screen Height:	15'	Top of Filter Pack:	19	Depth Pump Set:	36.5
Casing Type:	PVC	Pump Type:	Bladder	Pump Settings:	RPM 10.0/5.0 20psi
				Remarks:	

MONITORING WELL PURGE CALCULATIONS

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 + Sand Above Set 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

Low-Flow Sampled

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.)

LOW-FLOW TUBING PURGE CALCULATIONS (3 tubing/pump volumes required for PBOW)

Volume of Water in Tubing: 1/4" ID Tubing = 0.01 Liters/ft. 3/8" ID Tubing = 0.02 Liters/ft. 2" Bladder Pump Volume = 0.3 Liters Tubing Length = 41.5 ft.

Tubing Volume (Liters) = ([Tubing Liters/ft. x Tubing length] + Pump volume) x 3 = ([0.01 L/ft x 41.5 ft] + 0.3 L) x 3 = 2.15 L

Total Volume Purged: 2.15 L Liters to gallons = L x 0.26gal/L = 2.15 x 0.26 = .559

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Sample Collection Log

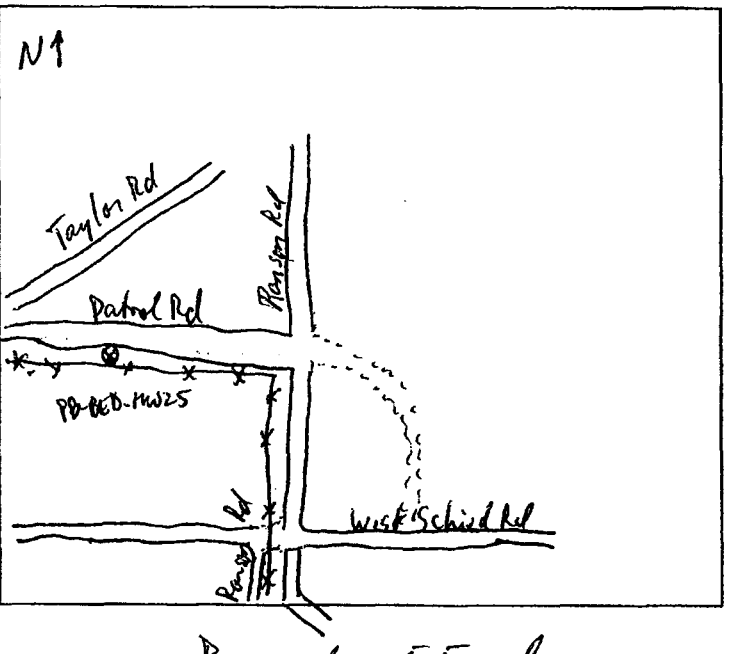
Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW25**	Collection Date:	9.18.03
Sample Number:	**DC3003**	Collection Time:	1220
Sample Name:	**PBOW-03-PB-BED-MW25-GW-DC3003**	Start Depth:	35'
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**REG**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers
FILTERED METALS	1 - 250 mL HDPE
TOTAL METALS	1 - 250 mL HDPE
EXPLOSIVES	1 - 1 L Amb. Glass
VOLATILES	3 - 40 mL Vial
SEMIVOLATILES	2 - 1 L Amb. Glass
TOC	2 - 40 mL Vial
CYANIDE	1 - 1 L HDPE
ALKALINITY	1 - 1 L HDPE
CHLORIDE	
NITRATE	
SULFATE	
TDS	
TSS	
TURBIDITY	
HARDNESS	1 - 250 mL HDPE

Sketch Location



Comments: Removed ~ 5.5 gal

Logged by/Date: [signature] 9.18.03 Reviewed by/Date: David Kessler 9/18/03

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Sample Collection Log

Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW25**	Collection Date:	9.18.03
Sample Number:	**DC3003-MS**	Collection Time:	1220
Sample Name:	**PBOW-03-PB-BED-MW25-GW-DC3003-MS**	Start Depth:	35
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**REG**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers	Sketch Location
FILTERED METALS	1 - 250 mL HDPE	See DC3003
TOTAL METALS	1 - 250 mL HDPE	
EXPLOSIVES	1 - 1 L Amb. Glass	
VOLATILES	3 - 40 mL Vial	
SEMIVOLATILES	2 - 1 L Amb. Glass	
TOC	2 - 40 mL Vial	
CYANIDE	1 - 1 L HDPE	
ALKALINITY	1 - 1 L HDPE	
CHLORIDE		
NITRATE		
SULFATE		
TDS		
TSS		
TURBIDITY		
HARDNESS	1 - 250 mL HDPE	

Comments: See sample# DC3003 for location and purge information

Logged by/Date: [illegible] 9.18.03 Reviewed by/Date: David Kessler 9/18/03

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Sample Collection Log

Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW25**	Collection Date:	9.18.03
Sample Number:	**DC3003-MSD**	Collection Time:	1220
Sample Name:	**PBOW-03-PB-BED-MW25-GW-DC3003-MSD**	Start Depth:	35'
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**REG**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers	Sketch Location
LTERED METALS	1 - 250 mL HDPE	See DC3003
TOTAL METALS	1 - 250 mL HDPE	
EXPLOSIVES	1 - 1 L Amb. Glass	
VOLATILES	3 - 40 mL Vial	
SEMIVOLATILES	2 - 1 L Amb. Glass	
TOC	2 - 40 mL Vial	
CYANIDE	1 - 1 L HDPE	
ALKALINITY	1 - 1 L HDPE	
CHLORIDE		
NITRATE		
SULFATE		
TDS		
TSS		
TURBIDITY		
HARDNESS	1 - 250 mL HDPE	

Comments: See sample# DC3003 for location and purge information

Logged by/Date: [signature] 9.18.03

Reviewed by/Date: David Kessler 9/18/03

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Shaw E & I, Inc.

Sample Collection Log

Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW25**	Collection Date:	9.18.03
Sample Number:	**DC3006**	Collection Time:	1220
Sample Name:	**PBOW-03-PB-BED-MW25-GW-DC3006**	Start Depth:	35'
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**FD**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers
FILTERED METALS	1 - 250 mL HDPE
TOTAL METALS	1 - 250 mL HDPE
EXPLOSIVES	1 - 1 L Amb. Glass
VOLATILES	3 - 40 mL Vial
SEMIVOLATILES	2 - 1 L Amb. Glass

Sketch Location

Comments: See sample # DC3003 for location and purge information.

Logged by/Date: [signature] 9.18.03

Reviewed by/Date: David Kessler 9/18/03

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Shaw E & I, Inc.

Sample Collection Log

Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW25**	Collection Date:	9/18/03
Sample Number:	**DC3007**	Collection Time:	1220
Sample Name:	**PBOW-03-PB-BED-MW25-GW-DC3007**	Start Depth:	35'
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**FS**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers	Sketch Location
'LTERED METALS	1 - 250 mL HDPE	
TOTAL METALS	1 - 250 mL HDPE	
EXPLOSIVES	1 - 1 L Amb. Glass	
VOLATILES	3 - 40 mL Vial	
SEMIVOLATILES	2 - 1 L Amb. Glass	

Comments: See sample # DC3003 for location and purge information.

.ogged by/Date: Zach Park / 9.18.03 Reviewed by/Date: David Kessler 9/18/03

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GROUNDWATER PURGE FORM

TPV = 5.5 gal

Location Code: **PB-BED-MW25**

Sample Number: **DC3003**

Water Quality Parameter Measurements									
Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Conductivity (umhos/cm)	pH (std. units)	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1130	16.02	350	0.0	14.96	2.298	7.26	-120.6	2.19	0
1135	16.13	"	1.75	14.52	2.645	7.14	-123.6	1.36	0
1140	16.08	"	3.50	14.10	2.360	7.08	-193.2	0.74	0
1145	16.18	"	5.25	14.07	2.086	7.06	-229.2	0.58	0
1150	16.11	"	7.00	14.03	1.756	7.03	-258.9	0.34	0
1155	16.16	275	8.75	14.08	1.715	7.00	-277.5	0.27	0
1200	16.10	320	10.125	13.71	1.718	6.98	-286.6	0.25	0
1205	16.15	"	11.725	13.74	1.710	6.97	-296.7	0.24	0
1210	16.11	"	13.325	13.60	1.709	6.97	-296.3	0.23	0
1215	16.16	"	14.925	13.82	1.703	6.98	-296.1	0.23	0
1220	16.10	"		13.91	1.707	6.98	-296.2	0.22	0
purging completed. Began sampling DC3003/MS/MSD/DC3006/DC3007									

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; mL - milliliter; L - Liter

GROUNDWATER SAMPLING FORM

Shaw®

Project Number:	843656	Collection Date:	9.18.03	Form Completed By:	Z. Parham
Project Name:	PBOW	Collection Time:	1220	Sampler(s):	Z. Parham / D. Kessler
Investigation Site:	Background	Sample Filtered (Yes/No):	Metals		
RFA/COC Number:	PB091803STL-Krc PB091803ACC	Weather/Temp:	Sunny / Mild	Reviewed By:	David Kessler

Sample Name: P B O W - 0 3 - P B - B E D - M W 2 5 - G W - D C 3 0 0 3

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

Well Number: PBOW-PB-BED-MW25	Outside Casing Dia. (in): 2"	Odor:
Well Secure (Yes / No):	Depth to Product (ft): NA	Vapor Monitor Type: PID / LEL Vhae
Well Labeled (Yes / No):	Total Well Depth (ft): 40.60	Vapor Monitor S/N: 0.31
Well Condition: Good	Depth to Water (ft): 15.98	Reading (ppm): LEL = 0 % O_2 = 20.7 %
Top of Screen: 30'	Water Column:	C = 0 ppm H_2S = 0 ppm
Screen Height: 10'	Top of Filter Pack: 25	Depth Pump Set: 35'
Casing Type: PVC	Pump Type: Bladder	Pump Settings: IST = 20 refill = 10 discharge = 5
		Remarks:

MONITORING WELL PURGE CALCULATIONS

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 diameter in inches & d is casing dia. in inches = 0.041 x ((_____)^2 – (_____)^2) = _____ gal/ft

Filter Pack Volume (gal) = ((Screen Height + Sand Above Set 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.)

Low Flow

LOW-FLOW TUBING PURGE CALCULATIONS (3 tubing/pump volumes required for PBOW)

Volume of Water in Tubing: 1/4" ID Tubing = 0.01 Liters/ft. 3/8" ID Tubing = 0.02 Liters/ft. 2" Bladder Pump Volume = 0.3 Liters Tubing Length = 40 ft.

Tubing Volume (Liters) = ([Tubing Liters/ft. x Tubing length] + Pump volume) x 3 = ([0.01 L/ft x 40 ft] + 0.3 L) x 3 = 2.1 L

Total Volume Purged: 2.1 L Liters to gallons = L x 0.26gal/L = 2.1 x 0.26 = .546

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Sample Collection Log

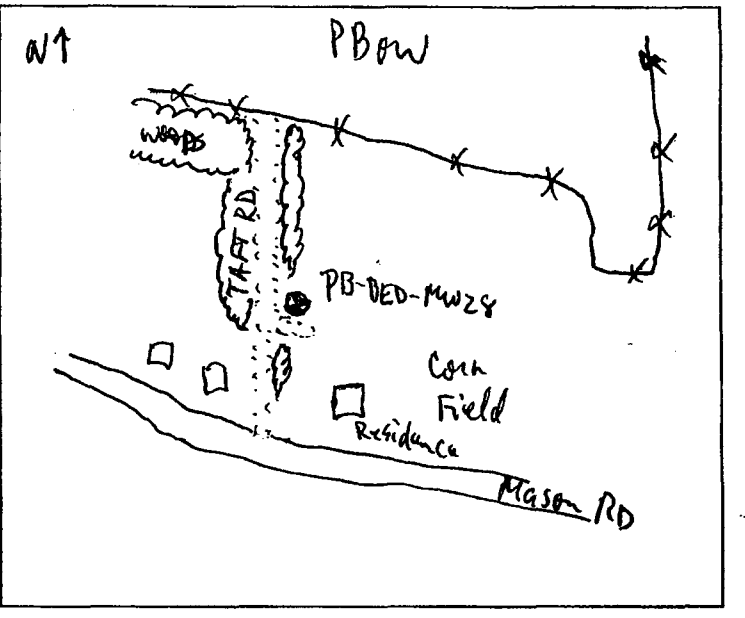
Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW28**	Collection Date:	9 ~~8~~ 17.03
Sample Number:	**DC3004**	Collection Time:	0915
Sample Name:	**PBOW-03-PB-BED-MW28-GW-DC3004**	Start Depth:	34.15' toc
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**REG**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers
LTERED METALS	1 - 250 mL HDPE
TOTAL METALS	1 - 250 mL HDPE
EXPLOSIVES	1 - 1 L Amb. Glass
VOLATILES	3 - 40 mL Vial
SEMIVOLATILES	2 - 1 L Amb. Glass
TOC	2 - 40 mL Vial
CYANIDE	1 - 1 L HDPE
ALKALINITY	1 - 1 L HDPE
CHLORIDE	
NITRATE	
SULFATE	
TDS	
TSS	
TURBIDITY	
HARDNESS	1 - 250 mL HDPE

Sketch Location



Comments: PID=0.0 Removed 1.50 gal
Samples immediately placed on ice.

Logged by/Date: [signature] / 9/17/03 Reviewed by/Date: David Kessler 9/17/03

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GROUNDWATER PURGE FORM

Location Code: **PB-BED-MW28**

Sample Number: **DC3004**

Water Quality Parameter Measurements									
Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Conductivity (umhos/cm)	pH (std. units)	Eh (mv)	DO (mg/L)	Turbidity (NTU)
0827	8.87	180	0.0	—	—	—	—	—	—
0832	9.06	"	0.55	15.12	.806	7.71	151.4	5.53	0.7
0837	9.10	200	1.10	14.38	1.405	7.39	23.2	1.57	1.4
0842	9.15	"	2.1	13.98	1.415	7.37	-40.1	0.69	1.1
0847	"	"	3.1	13.75	1.411	7.39	-76.9	0.41	1.2
0852	"	"	4.1	13.76	1.409	7.40	-89.3	0.33	0.8
0857	"	150	5.1	13.76	1.407	7.41	-90.1	0.30	1.4
0902	"	150	5.85	13.78	1.405	7.42	-90.6	0.29	0.7
0907	"	"	6.60	13.79	1.405	7.42	-90.2	0.29	1.0
0912	"	"	7.35	13.78	1.403	7.43	-90.1	0.28	0.3
~~1100~~	~~9.11~~	—	—	13.88	1.408	7.50	-95.2	0.21	0.0

Flow rate drop.

Purging completed. Began sampling DC3004 @ 0915

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; mL - milliliter; L - Liter

GROUNDWATER SAMPLING FORM

Shaw®

Project Number:	843656	Collection Date:	9.17.03	Form Completed By:	Zach Parham
Project Name:	PBOW	Collection Time:	0915	Sampler(s):	Z. Parham / D. Kessler
Investigation Site:	Background	Sample Filtered (Yes/No):	Metals		
RFA/COC Number:	PB091703STL-K+C	Weather/Temp:	Sunny / Mild	Reviewed By:	David Kessler

Sample Name: P B O W - 0 3 - P B - B E D - M W 2 8 - G W - D C 3 0 0 4

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

Well Number:	PB-BED-MW28	Outside Casing Dia. (in):	2"	Odor:	
Well Secure (Yes / No):	Yes	Depth to Product (ft):	NA	Vapor Monitor Type:	PID ~~LEL~~ Vhae
Well Labeled (Yes / No):	Yes	Total Well Depth (ft):	41.90	Vapor Monitor S/N:	84611 / 02282
Well Condition:	Good	Depth to Water (ft):	8.87	Reading (ppm):	LEL = 0 % O_2 = 20.9%
Top of Screen:	26.65	Water Column:	33.09		C = 0 ppm H_2S= 0 ppm
Screen Height:	15	Top of Filter Pack:	17.5	Depth Pump Set:	34.15
Casing Type:	2" PVC	Pump Type:	Bladder	Pump Settings:	20psi 10-refill 5-discharge
				Remarks:	

MONITORING WELL PURGE CALCULATIONS

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 + Sand Above Set on 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

Low-Flow

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.)

LOW-FLOW TUBING PURGE CALCULATIONS (3 tubing/pump volumes required for PBOW)

Volume of Water in Tubing: 1/4" ID Tubing = 0.01 Liters/ft. 3/8" ID Tubing = 0.02 Liters/ft. 2" Bladder Pump Volume = 0.3 Liters Tubing Length = 38.15 ft.

Tubing Volume (Liters) = ([Tubing Liters/ft. x Tubing length] + Pump volume) x 3 = ([0.01 L/ft x 38.15 ft] + 0.3 L) x 3 = 2.04 L

Total Volume Purged: 2.04 L Liters to gallons = L x 0.26gal/L = 2.04 x 0.26 = .531

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Sample Collection Log

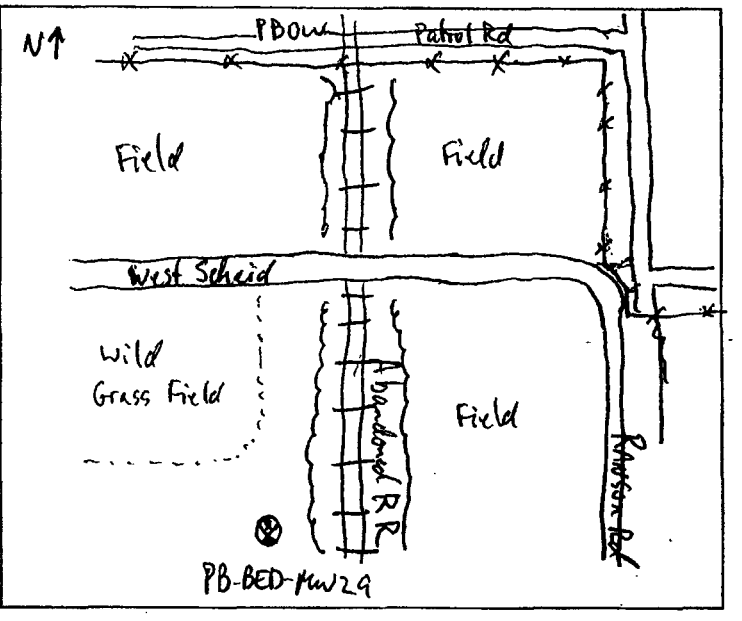
Plum Brook Ordnance Works

Project No: 843656 Project Manager: S. Downey

Location Code:	**PB-BED-MW29**	Collection Date:	9/16/03
Sample Number:	**DC3005**	Collection Time:	1520
Sample Name:	**PBOW-03-PB-BED-MW29-GW-DC3005**	Start Depth:	32'
Sampling Method:	**Low Flow**	End Depth:	—
Sample Type:	**GW**	Sample Matrix:	**WATER**
Sample Purpose:	**REG**	Sample Team:	**Kessler/Parham**

Analytical Suite	Containers
LTERED METALS	1 - 250 mL HDPE
TOTAL METALS	1 - 250 mL HDPE
EXPLOSIVES	1 - 1 L Amb. Glass
VOLATILES	3 - 40 mL Vial
SEMIVOLATILES	2 - 1 L Amb. Glass
TOC	2 - 40 mL Vial
CYANIDE	1 - 1 L HDPE
ALKALINITY	1 - 1 L HDPE
CHLORIDE	
NITRATE	
SULFATE	
TDS	
TSS	
TURBIDITY	
HARDNESS	1 - 250 mL HDPE

Sketch Location



Comments:

Logged by/Date: [signature]

Reviewed by/Date: David Kessler 9/16/03

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GROUNDWATER PURGE FORM

Pump at 32 ft, static 3.86', TD = 37.90'

Location Code: **PB-BED-MW29**

Sample Number: **DC3005**

Water Quality Parameter Measurements									
Time	DTW (ft. BTOC)	Purge Rate (mL/min)	Cumulative Volume Purged (L)	Temp. (degree C)	Conductivity (umhos/cm)	pH (std. units)	Eh (mv)	DO (mg/L)	Turbidity (NTU)
1403	3.86	200	0.0	—	—	—	—	—	—
1408	4.03	"	1.0	14.04	9.88	6.64	-0.9	1.07	72.5
1413	3.99	"	2.0	14.32	9.97	6.63	-8.9	0.73	45.0
1418	"	"	3.0	14.40	9.96	6.63	-6.8	0.63	39.5
1423	4.03	"	4.0	14.48	10.18	6.63	-3.6	0.51	30.8
1428	4.09	"	5.0	14.48	10.24	6.64	-1.5	0.47	26.4
1433	4.05	"	6.0	14.48	10.27	6.65	1.5	0.41	23.0
1438	4.03	"	7.0	14.85	10.29	6.65	3.4	0.40	22.9
1443	4.03	"	8.0	14.87	10.27	6.65	4.7	0.39	15.9
1448	4.10	"	9.0	15.18	10.28	6.66	6.3	0.37	15.1
1453	4.09	"	10.0	15.17	10.24	6.65	6.7	0.37	10.1
1458	4.11	"	11.0	15.34	10.26	6.65	6.9	0.33	10.9
1503	4.11	150	12.0	15.43	10.31	6.66	7.2	0.28	29.3
1508	4.11	"	12.75	15.99	10.32	6.66	6.9	0.24	29.8
1513	4.10	"	13.50	16.01	10.33	6.66	6.9	0.23	25.7
1518	4.10	"	14.25	15.80	10.30	6.66	6.5	0.22	25.0

Purge completed at 1518. Began sampling DC3005 at 1520.

Abbreviations: BTOC - Below top of casing; DTW - Depth to water; mL - milliliter; L - Liter

APPENDIX B

DATA VALIDATION SUMMARY

Data Validation Summary Report
Quarterly Groundwater Sampling - September 2003
Plum Brook Ordnance Works

1.0 Introduction

Level III data validation was performed on environmental samples collected from Plum Brook Ordnance September 2003 sampling event. The analytical data consisted of one sample delivery group (SDG), PB044, which was analyzed by Severn Trent Laboratories. The following samples were validated for this investigation.

SDG Number	Sample Number
PB044	DC3000, DC3001, DC3002, DC3003, DC3004, DC3005, DC3006

The parameters for which the data were analyzed and validated are identified below:

Parameter (Method)
Volatiles by SW846 5030/8260B
Semivolatiles by SW846 3510C/8270C
Nitroaromatic and Nitramine Explosives by SW846 8330
Total and Dissolved Metals by SW846 3005A/6010B/7470A
Wet Chemistry - Chloride, Cyanide, Hardness, Nitrate, Sulfate, Alkalinity, Total dissolved solids (TDS), Total organic carbon (TOC), Total suspended solids (TSS), and turbidity

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* (July 2002) and *USEPA Contract Laboratory Program National Functional Guidelines For Organic Review* (October 1999) for all areas except blanks. *Region III Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (April 1993) and *Region III 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 (SOPs) 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 spectrometer (GC/MS) calibration areas, and is due to the fact that the analytical methods are "performance-based," and allow 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. For those analytical methods not addressed by the CLP and Region III guidelines, the validation was based on the method requirements (i.e., SW846, Code of Federal Regulations [CFR], SOPs) 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. No data were rejected.

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 Volatiles by 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.

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

SDG	Samples Affected	Analyte	Blank	Validation Qualifier
PB044	DC3001	Chloromethane, Toluene	TB	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.

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

4.2 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 with the exception of reanalysis of DC3005. The original analysis of DC3005 with method blank surrogates problems was chosen over the reanalysis of DC3005, which was extracted outside of hold time. It was determined that the method blank surrogate recovery problems were an isolated occurrence and likely attributed to laboratory error.

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

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

Surrogate Recoveries. All surrogate recoveries were within acceptable QC limits with the exceptions of the following:

SDG	Samples Affected	Compound(s)	Validation Qualifier
PB044	Method blank for DC3005	All acid compounds	UJ

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 with exceptions of the following:

SDG	Samples Affected	Compound(s)	Validation Qualifier
PB044	DC3005	Phenol, 2-Chlorophenol	UJ

Field Duplicates. Original and field duplicate results were reviewed to evaluate the precision and accuracy of field activities. All QC criteria (30%) 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 Nitroaromatics and Nitramines by HPLC SW846 8330

Overall, the data are of good quality and are usable as reported by the laboratory. 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 blanks was applied to all sample results. All were found to be acceptable.

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

Column Agreement. All positive hits were detected on both columns. All detections were in agreement. No data were qualified.

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.

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

4.4 Total and Dissolved Metals by SW846 6010B/7470A

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.

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
PB044 (dissolved)	DC3000, DC3001, DC3002, DC3003, DC3005, DC3006	Aluminum	ICB/CCB	B
	DC3000, DC3001, DC3004, DC3005, DC3006	Thallium	MB/ICB/CCB	B
	DC3002, DC3003, DC3004	Zinc	ICB/CCB	B

SDG	Samples Affected	Analyte	Blank	Validation Qualifier
PB044 (total)	DC3000, DC3001, DC3002, DC3003, DC3006	Aluminum	ICB/CCB	B
	DC3000, DC3001, DC3002, DC3003, DC3004, DC3005, DC3006	Thallium	MB/ICB/CCB	B
	DC3004	Zinc	ICB/CCB	B

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.

Interference Check Sample (ICS). All ICS % recoveries were within QC limits.

ICP Serial Dilutions. Serial dilution 10% D criteria were met with the following exception(s):

SDG	Samples Affected	Compound(s)	Validation Qualifier
PB044 (total & dissolved)	All Samples	Potassium	J

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

SDG	Samples Affected	Compound(s)	Validation Qualifier
PB044 (total)	DC3003 (original), DC3003 (FD)	Thallium	B

* Thallium results were "B" qualified due to method and CCB blank contaminants.

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.

4.5 Wet Chemistry (Chloride, Cyanide, Hardness, Nitrate, Sulfate, Total Alkalinity, TDS, TOC, TSS, and Turbidity)

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. 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 trip and method blanks was applied to all sample results. All were found to be acceptable.

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

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

SDG	Samples Affected	Compound(s)	Validation Qualifier
PB044	DC3000, DC3002, DC3003	Cyanide, Total	UJ

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

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.

ATTACHMENT A

Validation Qualifier Definitions

Qualifier	Definition
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.
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.

Validation Reason Codes

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.

APPENDIX C

CHEMICAL ANALYTICAL DATA SUMMARY

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25			PB-BED-MW25		
SAMPLE_NO			DC3000			DC3001			DC3002			DC3003			DC3006		
SAMPLE_DATE			18-Sep-03			18-Sep-03			17-Sep-03			18-Sep-03			18-Sep-03		
SAMPLE_PURPOSE			REG			REG			REG			REG			FD		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual
Cyanide																	
Cyanide, total	ug/L	N	10	U	UJ	10	U	U	10	U	UJ	10	U	UJ			
Explosives																	
Amino-2,6-dinitrotoluene, 4-	ug/L	N	0.2	U	U	0.19	J	J	0.2	U	U	0.2	U	U	0.2	U	U
Amino-4,6-dinitrotoluene, 2-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Dinitrobenzene, 1,3-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Dinitrotoluene, 2,4-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Dinitrotoluene, 2,6-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
HMX	ug/L	N	0.5	U	U	0.5	U	U	0.5	U	U	0.5	U	U	0.5	U	U
Nitrobenzene	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Nitrotoluene, 2-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Nitrotoluene, 3-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Nitrotoluene, 4-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
RDX	ug/L	N	0.5	U	U	0.5	U	U	0.5	U	U	0.5	U	U	0.5	U	U
Tetryl	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Trinitrobenzene, 1,3,5-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Trinitrotoluene, 2,4,6-	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
General Chemistry																	
Alkalinity	ug/L	N	355000			248000			846000			313000					
Chloride	ug/L	N	1000000			19100000			98000			257000					
Hardness	ug/L	N	710000			9690000			761000			700000					
Nitrate	ug/L	N	100	U	U	100	U	U	100	U	U	100	U	U			
Sulfate	ug/L	N	23300			5000	U	U	24600			264000					
Total dissolved solids	ug/L	N	1880000			42700000			988000			1100000					
Total organic carbon	ug/L	N	1200			1000	U	U	1900			2800					
Total suspended solids	ug/L	N	7000			112000			4000	U	U	5000					
Turbidity	NTU	N	78.5			6.2			138			22.9					
Metals																	
Aluminum	ug/L	N	101	B	B	115	B	B	78	B	B	86.5	B	B	88.6	B	B
Aluminum	ug/L	Y	75	B	B	91.4	B	B	69.9	B	B	61.8	B	B	72.8	B	B
Antimony	ug/L	N	60	U	U	60	U	U	60	U	U	60	U	U	60	U	U
Antimony	ug/L	Y	60	U	U	60	U	U	60	U	U	60	U	U	60	U	U
Arsenic	ug/L	N	10	U	U	3.3	B	J	10	U	U	10	U	U	10	U	U
Arsenic	ug/L	Y	10	U	U	4.8	B	J	10	U	U	10	U	U	10	U	U
Barium	ug/L	N	292			25200			690			177	B	J	172	B	J

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25			PB-BED-MW25		
SAMPLE_NO			DC3000			DC3001			DC3002			DC3003			DC3006		
SAMPLE_DATE			18-Sep-03			18-Sep-03			17-Sep-03			18-Sep-03			18-Sep-03		
SAMPLE_PURPOSE			REG			REG			REG			REG			FD		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual
Barium	ug/L	Y	292			25700			689			177	B	J	174	B	J
Beryllium	ug/L	N	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Beryllium	ug/L	Y	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Cadmium	ug/L	N	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Cadmium	ug/L	Y	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Calcium	ug/L	N	131000			2180000			168000			159000			156000		
Calcium	ug/L	Y	131000			2270000			169000			158000			157000		
Chromium	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Chromium	ug/L	Y	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Cobalt	ug/L	N	50	U	U	8.6	B	J	50	U	U	50	U	U	50	U	U
Cobalt	ug/L	Y	50	U	U	23.8	B	J	3.7	B	J	50	U	U	50	U	U
Copper	ug/L	N	25	U	U	25	U	U	25	U	U	25	U	U	25	U	U
Copper	ug/L	Y	25	U	U	25	U	U	25	U	U	25	U	U	25	U	U
Iron	ug/L	N	218			4120			100	U	U	156			142		
Iron	ug/L	Y	195			3800			100	U	U	92.7	B	J	99.1	B	J
Lead	ug/L	N	11	G U	U	119	G U	U	13	G U	U	12	G U	U	13	G U	U
Lead	ug/L	Y	11	G U	U	122	G U	U	13	G U	U	13	G U	U	13	G U	U
Magnesium	ug/L	N	81900			1040000			80600			62000			60600		
Magnesium	ug/L	Y	81900			1070000			79900			61400			60500		
Manganese	ug/L	N	63.8			192			27.4			72.9			70.9		
Manganese	ug/L	Y	64			220			35			71.5			71.2		
Mercury	ug/L	N	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Mercury	ug/L	Y	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U	0.2	U	U
Nickel	ug/L	N	40	U	U	4	B	J	40	U	U	40	U	U	40	U	U
Nickel	ug/L	Y	40	U	U	6	B	J	40	U	U	40	U	U	40	U	U
Potassium	ug/L	N	42700		J	104000		J	24100		J	12100		J	11800		J
Potassium	ug/L	Y	42100		J	105000		J	23200		J	11900		J	11500		J
Selenium	ug/L	N	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Selenium	ug/L	Y	5	U	U	5	U	U	5	U	U	5	U	U	5	U	U
Silver	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Silver	ug/L	Y	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Sodium	ug/L	N	471000			8540000			80400			120000			116000		
Sodium	ug/L	Y	472000			8710000			79600			118000			115000		
Thallium	ug/L	N	3.8	B J	B	4.6	B J	B	3.8	B J	B	3.1	B J	B	8.3	B J	B
Thallium	ug/L	Y	4.7	B J	B	4.1	B J	B	10	U	U	10	U	U	6.9	B J	B

Plum Brook C[illegible]nance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25			PB-BED-MW25		
SAMPLE_NO			DC3000			DC3001			DC3002			DC3003			DC3006		
SAMPLE_DATE			18-Sep-03			18-Sep-03			17-Sep-03			18-Sep-03			18-Sep-03		
SAMPLE_PURPOSE			REG			REG			REG			REG			FD		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual
Vanadium	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Vanadium	ug/L	Y	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Zinc	ug/L	N	20	U	U	5.7	B	J	20	U	U	4.8	B	J	20	U	U
Zinc	ug/L	Y	20	U	U	6.4	B	J	2.9	B	B	2.6	B	B	20	U	U
Semivolatiles																	
Acenaphthene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Acenaphthylene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Anthracene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(a)anthracene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(a)pyrene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(b)fluoranthene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(ghi)perylene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(k)fluoranthene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Bis(2-chloroethoxy)methane	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Bis(2-chloroethyl)ether	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Bis(2-chloroisopropyl)ether	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Bis(2-ethylhexyl)phthalate	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Bromophenyl phenyl ether, 4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Butyl benzyl phthalate	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Carbazole	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Chloro-3-methylphenol, 4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Chloroaniline, 4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Chloronaphthalene, 2-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Chlorophenol, 2-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Chlorophenyl phenyl ether, 4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Chrysene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dibenz(a,h)anthracene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dibenzofuran	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dichlorobenzene, 1,2-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dichlorobenzene, 1,3-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dichlorobenzene, 1,4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dichlorobenzidine, 3,3'-	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Dichlorophenol, 2,4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Diethyl phthalate	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dimethyl phthalate	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25			PB-BED-MW25		
SAMPLE_NO			DC3000			DC3001			DC3002			DC3003			DC3006		
SAMPLE_DATE			18-Sep-03			18-Sep-03			17-Sep-03			18-Sep-03			18-Sep-03		
SAMPLE_PURPOSE			REG			REG			REG			REG			FD		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual
Dimethylphenol, 2,4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Di-n-butyl phthalate	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dinitro-2-methylphenol, 4,6-	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Dinitrophenol, 2,4-	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Dinitrotoluene, 2,4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Dinitrotoluene, 2,6-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Di-n-octyl phthalate	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Fluoranthene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Fluorene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Hexachlorobenzene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Hexachlorobutadiene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Hexachlorocyclopentadiene	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Hexachloroethane	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Indeno(1,2,3-cd)pyrene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Isophorone	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Methylnaphthalene, 2-	ug/L	N	10	U	U	10	U	U	4	J	J	10	U	U	10	U	U
Methylphenol, 2-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Methylphenol, 4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Naphthalene	ug/L	N	10	U	U	10	U	U	3.5	J	J	10	U	U	10	U	U
Nitroaniline, 2-	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Nitroaniline, 3-	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Nitroaniline, 4-	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Nitrobenzene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Nitrophenol, 2-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Nitrophenol, 4-	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
n-Nitroso-di-n-propylamine	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
n-Nitrosodiphenylamine	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Pentachlorophenol	ug/L	N	50	U	U	50	U	U	50	U	U	50	U	U	50	U	U
Phenanthrene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Phenol	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Pyrene	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Trichlorobenzene, 1,2,4-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Trichlorophenol, 2,4,5-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U
Trichlorophenol, 2,4,6-	ug/L	N	10	U	U	10	U	U	10	U	U	10	U	U	10	U	U

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25			PB-BED-MW25		
SAMPLE_NO			DC3000			DC3001			DC3002			DC3003			DC3006		
SAMPLE_DATE			18-Sep-03			18-Sep-03			17-Sep-03			18-Sep-03			18-Sep-03		
SAMPLE_PURPOSE			REG			REG			REG			REG			FD		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual
Volatiles																	
Acetone	ug/L	N	10	U	U	20	U	U	200	U	U	10	U	U	10	U	U
Benzene	ug/L	N	1	U	U	1.4	J	J	32			1	U	U	1	U	U
Bromodichloromethane	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Bromoform	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Bromomethane	ug/L	N	2	U	U	4	U	U	40	U	U	2	U	U	2	U	U
Butanone, 2-	ug/L	N	5	U	U	10	U	U	100	U	U	5	U	U	5	U	U
Carbon disulfide	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	0.11	J	J
Carbon tetrachloride	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Chlorobenzene	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Chloroethane	ug/L	N	2	U	U	4	U	U	40	U	U	2	U	U	2	U	U
Chloroform	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Chloromethane	ug/L	N	2	U	U	0.47	J	B	40	U	U	2	U	U	2	U	U
Dibromochloromethane	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Dichloroethane, 1,1-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Dichloroethane, 1,2-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Dichloroethene, 1,1-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Dichloroethene, 1,2-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Dichloropropane, 1,2-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Dichloropropene, cis-1,3-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Dichloropropene, trans-1,3-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Ethylbenzene	ug/L	N	1	U	U	2	U	U	13	J	J	1	U	U	1	U	U
Hexanone, 2-	ug/L	N	5	U	U	10	U	U	100	U	U	5	U	U	5	U	U
Methyl-2-pentanone, 4-	ug/L	N	5	U	U	10	U	U	100	U	U	5	U	U	5	U	U
Methylene chloride	ug/L	N	2	U	U	4	U	U	40	U	U	2	U	U	2	U	U
Styrene	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Tetrachloroethane, 1,1,2,2-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Tetrachloroethene	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Toluene	ug/L	N	1	U	U	0.45	J	B	37			1	U	U	1	U	U
Trichloroethane, 1,1,1-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Trichloroethane, 1,1,2-	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Trichloroethene	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Vinyl chloride	ug/L	N	1	U	U	2	U	U	20	U	U	1	U	U	1	U	U
Xylenes, total	ug/L	N	1	U	U	2	U	U	67			1	U	U	1	U	U

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			PB-BED-MW28			PB-BED-MW29		
SAMPLE_NO			DC3004			DC3005		
SAMPLE_DATE			17-Sep-03			16-Sep-03		
SAMPLE_PURPOSE			REG			REG		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual
Cyanide								
Cyanide, total	ug/L	N	10	U	U	10	U	U
Explosives								
Amino-2,6-dinitrotoluene, 4-	ug/L	N	0.2	U	U	0.2	U	U
Amino-4,6-dinitrotoluene, 2-	ug/L	N	0.2	U	U	0.2	U	U
Dinitrobenzene, 1,3-	ug/L	N	0.2	U	U	0.2	U	U
Dinitrotoluene, 2,4-	ug/L	N	0.2	U	U	0.2	U	U
Dinitrotoluene, 2,6-	ug/L	N	0.2	U	U	0.2	U	U
HMX	ug/L	N	0.5	U	U	0.5	U	U
Nitrobenzene	ug/L	N	0.2	U	U	0.2	U	U
Nitrotoluene, 2-	ug/L	N	0.2	U	U	0.2	U	U
Nitrotoluene, 3-	ug/L	N	0.2	U	U	0.2	U	U
Nitrotoluene, 4-	ug/L	N	0.2	U	U	0.2	U	U
RDX	ug/L	N	0.5	U	U	0.5	U	U
Tetryl	ug/L	N	0.2	U	U	0.2	U	U
Trinitrobenzene, 1,3,5-	ug/L	N	0.2	U	U	0.2	U	U
Trinitrotoluene, 2,4,6-	ug/L	N	0.2	U	U	0.2	U	U
General Chemistry								
Alkalinity	ug/L	N	474000			443000		
Chloride	ug/L	N	171000			3540000		
Hardness	ug/L	N	99500			1750000		
Nitrate	ug/L	N	100	U	U	390		
Sulfate	ug/L	N	35200			5700		
Total dissolved solids	ug/L	N	833000			6580000		
Total organic carbon	ug/L	N	5900			2600		
Total suspended solids	ug/L	N	4000	U	U	46000		
Turbidity	NTU	N	3.3			14.7		
Metals								
Aluminum	ug/L	N	147	B	J	309		
Aluminum	ug/L	Y	152	B	J	83.1	B	B
Antimony	ug/L	N	60	U	U	60	U	U
Antimony	ug/L	Y	60	U	U	60	U	U
Arsenic	ug/L	N	7.4	B	J	10	U	U
Arsenic	ug/L	Y	6.9	B	J	2.6	B	J
Barium	ug/L	N	374			11300		

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			PB-BED-MW28			PB-BED-MW29		
SAMPLE_NO			DC3004			DC3005		
SAMPLE_DATE			17-Sep-03			16-Sep-03		
SAMPLE_PURPOSE			REG			REG		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual
Barium	ug/L	Y	371			10500		
Beryllium	ug/L	N	5	U	U	5	U	U
Beryllium	ug/L	Y	5	U	U	5	U	U
Cadmium	ug/L	N	5	U	U	5	U	U
Cadmium	ug/L	Y	5	U	U	5	U	U
Calcium	ug/L	N	20800			316000		
Calcium	ug/L	Y	20300			316000		
Chromium	ug/L	N	10	U	U	10	U	U
Chromium	ug/L	Y	10	U	U	10	U	U
Cobalt	ug/L	N	50	U	U	3.9	B	J
Cobalt	ug/L	Y	50	U	U	6.1	B	J
Copper	ug/L	N	25	U	U	25	U	U
Copper	ug/L	Y	25	U	U	25	U	U
Iron	ug/L	N	235			932		
Iron	ug/L	Y	242			350		
Lead	ug/L	N	4	G U	U	24	G U	U
Lead	ug/L	Y	4	G U	U	23	G U	U
Magnesium	ug/L	N	8320			217000		
Magnesium	ug/L	Y	8120			219000		
Manganese	ug/L	N	20.3			62.7		
Manganese	ug/L	Y	15.8			55.1		
Mercury	ug/L	N	0.2	U	U	0.2	U	U
Mercury	ug/L	Y	0.2	U	U	0.2	U	U
Nickel	ug/L	N	40	U	U	40	U	U
Nickel	ug/L	Y	40	U	U	40	U	U
Potassium	ug/L	N	7240		J	75800		J
Potassium	ug/L	Y	7140		J	76500		J
Selenium	ug/L	N	5	U	U	5	U	U
Selenium	ug/L	Y	5	U	U	5	U	U
Silver	ug/L	N	10	U	U	10	U	U
Silver	ug/L	Y	10	U	U	10	U	U
Sodium	ug/L	N	290000			1390000		
Sodium	ug/L	Y	289000			1390000		
Thallium	ug/L	N	4.2	B J	B	5.1	B J	B
Thallium	ug/L	Y	4.1	B J	B	6.2	B J	B

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			PB-BED-MW28			PB-BED-MW29		
SAMPLE_NO			DC3004			DC3005		
SAMPLE_DATE			17-Sep-03			16-Sep-03		
SAMPLE_PURPOSE			REG			REG		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual
Vanadium	ug/L	N	50	U	U	50	U	U
Vanadium	ug/L	Y	50	U	U	50	U	U
Zinc	ug/L	N	2.5	B	B	6.9	B	J
Zinc	ug/L	Y	3.8	B	B	8.5	B	J
Semivolatiles								
Acenaphthene	ug/L	N	10	U	U	10	U	U
Acenaphthylene	ug/L	N	10	U	U	10	U	U
Anthracene	ug/L	N	10	U	U	10	U	U
Benzo(a)anthracene	ug/L	N	10	U	U	10	U	U
Benzo(a)pyrene	ug/L	N	10	U	U	10	U	U
Benzo(b)fluoranthene	ug/L	N	10	U	U	10	U	U
Benzo(ghi)perylene	ug/L	N	10	U	U	10	U	U
Benzo(k)fluoranthene	ug/L	N	10	U	U	10	U	U
Bis(2-chloroethoxy)methane	ug/L	N	10	U	U	10	U	U
Bis(2-chloroethyl)ether	ug/L	N	10	U	U	10	U	U
Bis(2-chloroisopropyl)ether	ug/L	N	10	U	U	10	U	U
Bis(2-ethylhexyl)phthalate	ug/L	N	10	U	U	10	U	U
Bromophenyl phenyl ether, 4-	ug/L	N	10	U	U	10	U	U
Butyl benzyl phthalate	ug/L	N	10	U	U	10	U	U
Carbazole	ug/L	N	10	U	U	10	U	U
Chloro-3-methylphenol, 4-	ug/L	N	10	U	U	10	U	UJ
Chloroaniline, 4-	ug/L	N	10	U	U	10	U	U
Chloronaphthalene, 2-	ug/L	N	10	U	U	10	U	U
Chlorophenol, 2-	ug/L	N	10	U	U	10	U	UJ
Chlorophenyl phenyl ether, 4-	ug/L	N	10	U	U	10	U	U
Chrysene	ug/L	N	10	U	U	10	U	U
Dibenz(a,h)anthracene	ug/L	N	10	U	U	10	U	U
Dibenzofuran	ug/L	N	10	U	U	10	U	U
Dichlorobenzene, 1,2-	ug/L	N	10	U	U	10	U	U
Dichlorobenzene, 1,3-	ug/L	N	10	U	U	10	U	U
Dichlorobenzene, 1,4-	ug/L	N	10	U	U	10	U	U
Dichlorobenzidine, 3,3'-	ug/L	N	50	U	U	50	U	U
Dichlorophenol, 2,4-	ug/L	N	10	U	U	10	U	UJ
Diethyl phthalate	ug/L	N	10	U	U	10	U	U
Dimethyl phthalate	ug/L	N	10	U	U	10	U	U

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			PB-BED-MW28			PB-BED-MW29		
SAMPLE_NO			DC3004			DC3005		
SAMPLE_DATE			17-Sep-03			16-Sep-03		
SAMPLE_PURPOSE			REG			REG		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual
Dimethylphenol, 2,4-	ug/L	N	10	U	U	10	U	UJ
Di-n-butyl phthalate	ug/L	N	10	U	U	10	U	U
Dinitro-2-methylphenol, 4,6-	ug/L	N	50	U	U	50	U	UJ
Dinitrophenol, 2,4-	ug/L	N	50	U	U	50	U	UJ
Dinitrotoluene, 2,4-	ug/L	N	10	U	U	10	U	U
Dinitrotoluene, 2,6-	ug/L	N	10	U	U	10	U	U
Di-n-octyl phthalate	ug/L	N	10	U	U	10	U	U
Fluoranthene	ug/L	N	10	U	U	10	U	U
Fluorene	ug/L	N	10	U	U	10	U	U
Hexachlorobenzene	ug/L	N	10	U	U	10	U	U
Hexachlorobutadiene	ug/L	N	10	U	U	10	U	U
Hexachlorocyclopentadiene	ug/L	N	50	U	U	50	U	U
Hexachloroethane	ug/L	N	10	U	U	10	U	U
Indeno(1,2,3-cd)pyrene	ug/L	N	10	U	U	10	U	U
Isophorone	ug/L	N	10	U	U	10	U	U
Methylnaphthalene, 2-	ug/L	N	10	U	U	10	U	U
Methylphenol, 2-	ug/L	N	10	U	U	10	U	UJ
Methylphenol, 4-	ug/L	N	10	U	U	10	U	UJ
Naphthalene	ug/L	N	10	U	U	10	U	U
Nitroaniline, 2-	ug/L	N	50	U	U	50	U	U
Nitroaniline, 3-	ug/L	N	50	U	U	50	U	U
Nitroaniline, 4-	ug/L	N	50	U	U	50	U	U
Nitrobenzene	ug/L	N	10	U	U	10	U	U
Nitrophenol, 2-	ug/L	N	10	U	U	10	U	UJ
Nitrophenol, 4-	ug/L	N	50	U	U	50	U	UJ
n-Nitroso-di-n-propylamine	ug/L	N	10	U	U	10	U	U
n-Nitrosodiphenylamine	ug/L	N	10	U	U	10	U	U
Pentachlorophenol	ug/L	N	50	U	U	50	U	UJ
Phenanthrene	ug/L	N	10	U	U	10	U	U
Phenol	ug/L	N	10	U	U	10	U	UJ
Pyrene	ug/L	N	10	U	U	10	U	U
Trichlorobenzene, 1,2,4-	ug/L	N	10	U	U	10	U	U
Trichlorophenol, 2,4,5-	ug/L	N	10	U	U	10	U	UJ
Trichlorophenol, 2,4,6-	ug/L	N	10	U	U	10	U	UJ

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Data Summary

LOCATION_CODE			PB-BED-MW28			PB-BED-MW29		
SAMPLE_NO			DC3004			DC3005		
SAMPLE_DATE			17-Sep-03			16-Sep-03		
SAMPLE_PURPOSE			REG			REG		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual
Volatiles								
Acetone	ug/L	N	50	U	U	17		
Benzene	ug/L	N	2.4	J	J	1	U	U
Bromodichloromethane	ug/L	N	5	U	U	1	U	U
Bromoform	ug/L	N	5	U	U	1	U	U
Bromomethane	ug/L	N	10	U	U	2	U	U
Butanone, 2-	ug/L	N	25	U	U	5	U	U
Carbon disulfide	ug/L	N	5	U	U	0.44	J	J
Carbon tetrachloride	ug/L	N	5	U	U	1	U	U
Chlorobenzene	ug/L	N	5	U	U	1	U	U
Chloroethane	ug/L	N	10	U	U	2	U	U
Chloroform	ug/L	N	5	U	U	0.25	J	J
Chloromethane	ug/L	N	10	U	U	2	U	U
Dibromochloromethane	ug/L	N	5	U	U	1	U	U
Dichloroethane, 1,1-	ug/L	N	5	U	U	1	U	U
Dichloroethane, 1,2-	ug/L	N	5	U	U	1	U	U
Dichloroethene, 1,1-	ug/L	N	5	U	U	1	U	U
Dichloroethene, 1,2-	ug/L	N	5	U	U	1	U	U
Dichloropropane, 1,2-	ug/L	N	5	U	U	1	U	U
Dichloropropene, cis-1,3-	ug/L	N	5	U	U	1	U	U
Dichloropropene, trans-1,3-	ug/L	N	5	U	U	1	U	U
Ethylbenzene	ug/L	N	5	U	U	0.86	J	J
Hexanone, 2-	ug/L	N	25	U	U	5	U	U
Methyl-2-pentanone, 4-	ug/L	N	25	U	U	5	U	U
Methylene chloride	ug/L	N	10	U	U	2	U	U
Styrene	ug/L	N	5	U	U	1	U	U
Tetrachloroethane, 1,1,2,2-	ug/L	N	5	U	U	1	U	U
Tetrachloroethene	ug/L	N	5	U	U	1	U	U
Toluene	ug/L	N	1.7	J	J	0.12	J	J
Trichloroethane, 1,1,1-	ug/L	N	5	U	U	1	U	U
Trichloroethane, 1,1,2-	ug/L	N	5	U	U	1	U	U
Trichloroethene	ug/L	N	0.59	J	J	1	U	U
Vinyl chloride	ug/L	N	5	U	U	1	U	U
Xylenes, total	ug/L	N	5	U	U	5.5		

Laboratory Qualifier Definitions (Qual)

B (inorganic) - Analyte detected below the reporting limit. Estimated value

G - Reporting limit is elevated because of matrix interferences

J - Analyte detected below the reporting limit. Estimated value

J - (inorganic) Analyte found in the associated method blank.

U - Not detected

Validation Qualifier Definitions (Val Qual)

B - The analyte was not detected above the value found in an associated blank.

J - The analyte was positively identified; the concentration is estimated.

U - Not detected. The analyte was not detected above the reporting limit.

UJ - Not detected. The associated reporting limit may be inaccurate or imprecise.

APPENDIX D

DETECTED HITS SUMMARY EXCLUDING "B" QUALIFIERS

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Detected Hits Summary

LOCATION_CODE			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25			PB-BED-MW25		
SAMPLE_NO			DC3000			DC3001			DC3002			DC3003			DC3006		
SAMPLE_DATE			18-Sep-03			18-Sep-03			17-Sep-03			18-Sep-03			18-Sep-03		
SAMPLE_PURPOSE			REG			REG			REG			REG			FD		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual
Explosives																	
Amino-2,6-dinitrotoluene, 4-	ug/L	N	-	-	-	0.19	J	J	-	-	-	-	-	-	-	-	-
General Chemistry																	
Alkalinity	mg/L	N	355			248			846			313					
Chloride	mg/L	N	1000			19100			98			257					
Hardness	mg/L	N	710			9690			761			700					
Nitrate	mg/L	N	-	-	-	-	-	-	-	-	-	-	-				
Sulfate	mg/L	N	23.3			-	-	-	24.6			264					
Total dissolved solids	mg/L	N	1880			42700			988			1100					
Total organic carbon	mg/L	N	1.2			-	-	-	1.9			2.8					
Total suspended solids	mg/L	N	7			112			-	-	-	5					
Turbidity	NTU	N	78.5			6.2			138			22.9					
Metals																	
Aluminum	ug/L	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aluminum	ug/L	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	ug/L	N	-	-	-	3.3	B	J	-	-	-	-	-	-	-	-	-
Arsenic	ug/L	Y	-	-	-	4.8	B	J	-	-	-	-	-	-	-	-	-
Barium	ug/L	N	292			25200			690			177	B	J	172	B	J
Barium	ug/L	Y	292			25700			689			177	B	J	174	B	J
Calcium	ug/L	N	131000			2180000			168000			159000			156000		
Calcium	ug/L	Y	131000			2270000			169000			158000			157000		
Cobalt	ug/L	N	-	-	-	8.6	B	J	-	-	-	-	-	-	-	-	-
Cobalt	ug/L	Y	-	-	-	23.8	B	J	3.7	B	J	-	-	-	-	-	-
Iron	ug/L	N	218			4120			-	-	-	156			142		
Iron	ug/L	Y	195			3800			-	-	-	92.7	B	J	99.1	B	J
Magnesium	ug/L	N	81900			1040000			80600			62000			60600		
Magnesium	ug/L	Y	81900			1070000			79900			61400			60500		
Manganese	ug/L	N	63.8			192			27.4			72.9			70.9		
Manganese	ug/L	Y	64			220			35			71.5			71.2		
Nickel	ug/L	N	-	-	-	4	B	J	-	-	-	-	-	-	-	-	-
Nickel	ug/L	Y	-	-	-	6	B	J	-	-	-	-	-	-	-	-	-
Potassium	ug/L	N	42700		J	104000		J	24100		J	12100		J	11800		J
Potassium	ug/L	Y	42100		J	105000		J	23200		J	11900		J	11500		J
Sodium	ug/L	N	471000			8540000			80400			120000			116000		
Sodium	ug/L	Y	472000			8710000			79600			118000			115000		

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Detected Hits Summary

LOCATION_CODE			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25			PB-BED-MW25		
SAMPLE_NO			DC3000			DC3001			DC3002			DC3003			DC3006		
SAMPLE_DATE			18-Sep-03			18-Sep-03			17-Sep-03			18-Sep-03			18-Sep-03		
SAMPLE_PURPOSE			REG			REG			REG			REG			FD		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual
Thallium	ug/L	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	ug/L	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	ug/L	N	-	-	-	5.7	B	J	-	-	-	4.8	B	J	-	-	-
Zinc	ug/L	Y	-	-	-	6.4	B	J	-	-	-	-	-	-	-	-	-
Semivolatiles																	
Methylnaphthalene, 2-	ug/L	N	-	-	-	-	-		4	J	J	-	-	-	-	-	-
Naphthalene	ug/L	N	-	-	-	-	-		3.5	J	J	-	-	-	-	-	-
Volatiles																	
Acetone	ug/L	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	ug/L	N	-	-	-	1.4	J	J	32		-	-	-	-	-	-	-
Carbon disulfide	ug/L	N	-	-	-	-	-	-	-	-	-	-	-		0.11	J	J
Chloroform	ug/L	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloromethane	ug/L	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	ug/L	N	-	-	-	-	-		13	J	J	-	-	-	-	-	-
Toluene	ug/L	N	-	-	-	-	-		37		-	-	-	-	-	-	-
Trichloroethene	ug/L	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes, total	ug/L	N	-	-	-	-	-		67		-	-	-	-	-	-	-

Plum Brook C. ..ance Works
Quarterly Groundwater Monitoring
Detected Hits Summary

LOCATION_CODE			PB-BED-MW28			PB-BED-MW29		
SAMPLE_NO			DC3004			DC3005		
SAMPLE_DATE			17-Sep-03			16-Sep-03		
SAMPLE_PURPOSE			REG			REG		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual
Explosives								
Amino-2,6-dinitrotoluene, 4-	ug/L	N	-	-	-	-	-	-
General Chemistry								
Alkalinity	mg/L	N	474			443		
Chloride	mg/L	N	171			3540		
Hardness	mg/L	N	99.5			1750		
Nitrate	mg/L	N	-	-	-	0.39		
Sulfate	mg/L	N	35.2			5.7		
Total dissolved solids	mg/L	N	833			6580		
Total organic carbon	mg/L	N	5.9			2.6		
Total suspended solids	mg/L	N	-	-	-	46		
Turbidity	NTU	N	3.3			14.7		
Metals								
Aluminum	ug/L	N	147	B	J	309		
Aluminum	ug/L	Y	152	B	J	-	-	-
Arsenic	ug/L	N	7.4	B	J	-	-	-
Arsenic	ug/L	Y	6.9	B	J	2.6	B	J
Barium	ug/L	N	374			11300		
Barium	ug/L	Y	371			10500		
Calcium	ug/L	N	20800			316000		
Calcium	ug/L	Y	20300			316000		
Cobalt	ug/L	N	-	-	-	3.9	B	J
Cobalt	ug/L	Y	-	-	-	6.1	B	J
Iron	ug/L	N	235			932		
Iron	ug/L	Y	242			350		
Magnesium	ug/L	N	8320			217000		
Magnesium	ug/L	Y	8120			219000		
Manganese	ug/L	N	20.3			62.7		
Manganese	ug/L	Y	15.8			55.1		
Nickel	ug/L	N	-	-	-	-	-	-
Nickel	ug/L	Y	-	-	-	-	-	-
Potassium	ug/L	N	7240		J	75800		J
Potassium	ug/L	Y	7140		J	76500		J
Sodium	ug/L	N	290000			1390000		
Sodium	ug/L	Y	289000			1390000		

Plum Brook Ordnance Works
Quarterly Groundwater Monitoring
Detected Hits Summary

LOCATION_CODE			PB-BED-MW28			PB-BED-MW29		
SAMPLE_NO			DC3004			DC3005		
SAMPLE_DATE			17-Sep-03			16-Sep-03		
SAMPLE_PURPOSE			REG			REG		
Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual
Thallium	ug/L	N	-	-	-	-	-	-
Thallium	ug/L	Y	-	-	-	-	-	-
Zinc	ug/L	N	-	-	-	6.9	B	J
Zinc	ug/L	Y	-	-	-	8.5	B	J
Semivolatiles								
Methylnaphthalene, 2-	ug/L	N	-	-	-	-	-	-
Naphthalene	ug/L	N	-	-	-	-	-	-
Volatiles								
Acetone	ug/L	N	-	-	-	17		
Benzene	ug/L	N	2.4	J	J	-	-	-
Carbon disulfide	ug/L	N	-	-	-	0.44	J	J
Chloroform	ug/L	N	-	-	-	0.25	J	J
Chloromethane	ug/L	N	-	-	-	-	-	-
Ethylbenzene	ug/L	N	-	-	-	0.86	J	J
Toluene	ug/L	N	1.7	J	J	0.12	J	J
Trichloroethene	ug/L	N	0.59	J	J	-	-	-
Xylenes, total	ug/L	N	-	-	-	5.5		

Laboratory Qualifier Definitions (Qual)
B (inorganic) - Analyte detected below the reporting limit. Estimated value
J - Analyte detected below the reporting limit. Estimated value

Validation Qualifier Definitions (Val Qual)
J - Estimated value

APPENDIX E

DATA QUALITY EVALUATION

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List of Acronyms

AR/COC	analysis request/chain of custody
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
DI	deionized
DQE	data quality evaluation
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
LCS	laboratory control sample
MB	material blank or method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
PQL	practical quanitation limit
PBOW	Plum Brook Ordnance Works
QA/QC	quality assurance/quality control
SAP	sampling and analysis plan
RL	reporting limit
RPD	relative percent difference
RRF	relative response factor
SOP	standard operating procedures
STL	Severn Trent Laboratory
TDS	total dissolved solids
TOC	total organic compounds
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

E.1.0 Introduction

This appendix of the Seventh 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.

Shaw Environmental, Inc. (Formerly IT Corporation) conducted field-sampling activities at PBOW in September 2003. Severn Trent Laboratories (STL) in Knoxville, Tennessee, and Canton, Ohio, analyzed the project samples. Accutest Laboratories of Orlando, Florida, analyzed the field split samples. All data analyzed were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following Unites States Environmental Protection Agency (USEPA) guidelines in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, (EPA, 1999) and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, (EPA, 2002). The criteria for blank evaluation were based on those detailed in *Region III Modifications to National Functional Guidelines for Organic Data Review* (EPA, 1994b) and *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* (EPA, 1993). Since these documents specify procedures for Contract Laboratory Program (CLP) data, they are used as guidelines only. Where applicable, method and laboratory quality assurance and quality control requirements supercede these guidelines. 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 site-wide sampling and analysis plan (SAP). The results of this review are presented in the following sections, with all analytical outliers or nonconformances discussed where they occurred.

E.2.0 Field Sampling and QC Activities

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

All project and field duplicate samples collected were submitted to STL. Sample shipments from the field were performed under custody and documented using standard Shaw 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 sample delivery group for each sample collected. Table E-2 summarizes the detected compounds in the method blank and trip blanks associated with the PBOW samples.

E.2.1 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. Three trip blank samples were collected. Two trip blanks contained target analytes and one sample was qualified.

The data validator applied the 5X-10X rule to the samples for the analytes detected. The 10 times limit is applicable only for common laboratory contaminants such as acetone, methylene chloride, and 2-butanone. The following samples were qualified "B" by the data validator, indicating that sample results are indicative of blank contamination:

Lot Number	Sample Affected	Blank Contaminant	Validation Qualifier
PB044	DC3001	Chloromethane, Toluene	B

E.2.2 Field Duplicates

Field duplicate samples are collected and submitted to the laboratory for analysis along with their corresponding original samples. The data generated from the analysis of field duplicate samples are used to evaluate the precision of the sample collection and analysis procedures. 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," blank-contaminated "B," 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 (MDL), the RPD is reported, but should be considered an estimated value.

The acceptance criterion of 30 percent RPD was used to evaluate these sample results. Thallium was qualified "J." In most cases, original and field duplicate data compared well as demonstrated by the RPDs calculated. The instances where they do not compare well involve estimated or blank-contaminated data. 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.2.3 Field Split Samples

Split samples were collected in conjunction with field duplicate samples and sent to Accutest Laboratories. The split samples were submitted to the laboratory for the same analysis as their corresponding field duplicates and original field samples. The split samples are used to determine if data results are reproducible when analyzed by two different laboratories. Results are also evaluated to determine if a contracted laboratory's preparation and analysis procedures are in control and meet the approved method criteria.

Field split samples were collected at a frequency of approximately one for every ten regular samples. One split sample was collected during this sampling event.

Table E-3 compares the original and field split 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 split samples. The analytes compare well when both labs reported above their reporting limits and there was no blank contamination.

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, matrix spikes/matrix spike duplicates (MS/MSD), surrogates, and internal standards. The following SW-846 and USEPA methods were used to analyze PBOW samples:

Parameter	Method
Volatiles	SW-846 5030/8260B
Semivolatiles	SW-846 3520/8270C
Nitroaromatic Compounds	SW-846 8330
Metals	SW-846 3005A/6010B/7470A
Gasoline Range Organics	SW-846 5030/8015B
Diesel Range Organics	SW-846 8015B
Turbidity	EPA 180.1
Alkalinity	EPA 310.1
Total Organic Carbon (TOC)	SW-846 9060
Hardness	EPA 130.2
Total Dissolved Solids (TDS)	EPA 160.1
Total Suspended Solids (TSS)	EPA 160.2
Chloride	EPA 325.2
Total Cyanide	SW-846 9012A
Nitrate	EPA 353.2
Sulfate	EPA 375.4

Appendix C contains validated analytical data summaries for the samples collected during this field investigation. The validator used the QA/QC criteria defined in the SAP to evaluate the data for all parameters for which criteria were provided. If acceptance criteria were not provided in the SAP, the validator used the laboratory-derived acceptance criteria or analytical method criteria to qualify data. 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. The 10 times limit is applicable only for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, and certain phthalates.

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
PB044	DC3000, DC3001, DC3002, DC3003, DC3005, DC3006	Aluminum (dissolved)	Calibration	B
PB044	DC3000, DC3001, DC3004, DC3005, DC3006	Thallium (dissolved)	Method/Calibration	B
PB044	DC3002, DC3003, DC3004	Zinc (dissolved)	Calibration	B
PB044	DC3000, DC3001, DC3002, DC3003, DC3006	Aluminum (total)	Calibration	B
PB044	DC3000, DC3001, DC3002, DC3004, DC3003, DC3005, DC3006	Thallium (total)	Method/Calibration	B
PB044	DC3004	Zinc (total)	Calibration	B

B - blank contamination

E.3.1.2 Matrix Spikes and Laboratory Control Spikes

Two types of spikes were generally performed for all analyses: 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 for 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. An MS and MSD were assigned in the field to sample DC3003. This sample 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 a few exceptions. Cyanide recovery was low in the MSD of DC3003. It was detected at 60 percent. The lower lab limit is 77 percent. As a result the RPD between the MS and MSD was 28 percent. The acceptable limit is 20 percent. Cyanide results should be considered biased low. The following samples were qualified:

Lot Number	Sample Number Affected	Analyte(s)	Validation Qualifier
Wet Chemistry			
PB044	DC3000, DC3002, DC3003	Cyanide	UJ

UJ - nondetect, estimated

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. An LCS is prepared for each analytical "batch" for each parameter and matrix analyzed. All LCS recoveries met the established QC criteria with the following exceptions. Phenol and 2-chlorophenol recoveries

were low in the semivolatile LCS. Phenol recovery was 57 percent. The lower acceptable limit is 62 percent. 2-Chlorophenol recovery was 58 percent. The lower acceptable limit is 63 percent. Phenol and 2-chlorophenol results should be considered biased low in the associated batch. The following sample was qualified:

Lot Number	Sample Number Affected	Analyte(s)	Validation Qualifier
Semivolatiles			
PB044	DC3005	Phenol and 2-chlorophenol	UJ

UJ - nondetect, estimated

E.3.1.3 Calibration

All analytes showed acceptable performance in the calibration standards. No data were qualified.

E.3.1.4 Column Agreement

For high performance liquid chromatography (HPLC) analyses, sample results are confirmed using two dissimilar columns. In order for an analyte to be reported, it must be detected on both columns. Results differing by greater than 40 percent are qualified estimated, "J." All detections were in agreement. No data were qualified.

E.3.2 Reporting Limits

Limits have been established to describe project sensitivity requirements. 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). Practical quantitation limits (PQL) or method quantitation limits (MQL) 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 MDLs. The PQL/MQL calculation adjusts the limit by a predetermined mathematical factor for the analysis of actual environmental sample matrices (i.e., soil, groundwater, etc.). Method reporting limits (MRL) are based on the project action or decision levels.
These limits are generally defined as follows:

- ***MDL.*** The minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the concentration is greater than zero.

- ***MQL/PQL.*** The lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. It is set at the lowest standard used for the calibration curve.

- ***MRL.*** A threshold value below which the laboratory reports a result as non-detected. Ideally, the MRL will be established anywhere between the MDL and 1/2 the project action levels.

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. If project action levels are near or below the MDL, it is unlikely the sensitivity of the method will be achievable. A compromise must be reached. The PQL/MQL 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.

Most samples were handled and analyzed as expected without significant changes to the anticipated project MQLs. Six samples had elevated MQLs due to dilutions. Seven samples had elevated MQLs due to matrix interference.

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. One sample was re-extracted outside of the holding time for surrogate recovery problems. The original analysis results were used instead of the re-extraction. All other holding time criteria were acceptable for the samples collected.

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-5 summarizes all compounds requiring qualifier application due to anomalies discovered during data validation. Table E-4 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:

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

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 groundwater 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 performing field audits.

The samples were collected using Shaw SOPs and were fully documented through the use of standard Shaw 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 expected under optimum conditions. No data points were qualified "R," rejected, in the validation process because of QC criteria as described in the previous sections of this report. Completeness 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 monitoring wells were sampled resulting in approximately 1111 targeted analytical records, including duplicate and split records. No data points were rejected due to anomalies discovered during the validation process. Using the above calculation, greater than 100% 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 USEPA 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 Shaw at PBOW.

E.5.0 References

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

U.S Environmental Protection Agency (USEPA), 2002, ***USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review***, February.

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

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

Table E-1

Sample Cross-reference
Groundwater Wells
Former Plum Brook Ordnance Works
Sandusky, Ohio

Sample Type	Sample Location	Sample Number	Sample Date	Sample Purpose	Lot Number
GW	IT-BG8-BEDGW-001	DC3000	18-Sep-03	REG	PB044
GW	PB-BED-MW20	DC3001	18-Sep-03	REG	PB044
GW	PB-BED-MW24	DC3002	17-Sep-03	REG	PB044
GW	PB-BED-MW25	DC3003	18-Sep-03	REG	PB044
GW	PB-BED-MW25	DC3003-MS	18-Sep-03	MS	PB044
GW	PB-BED-MW25	DC3003-MSD	18-Sep-03	MSD	PB044
GW	PB-BED-MW25	DC3006	18-Sep-03	FD	PB044
GW	PB-BED-MW25	DC3007	18-Sep-03	FS	F19588
GW	PB-BED-MW28	DC3004	17-Sep-03	REG	PB044
GW	PB-BED-MW29	DC3005	16-Sep-03	REG	PB044

FD - Field duplicate sample.
FS - Field split sample.
GW - Groundwater.
MS - Matrix spike sample.
MSD - Matrix spike duplicate sample.
REG - Regular sample.

Table E-2
Summary of Analytes Detected in Blanks
Former Plum Brook Ordnance Works
Sandusky, Ohio

Lot Number	Sample Number	Analysis Date	Sample Purpose	Parameter	Result	Units	Lab Qualifier
PB044	DC5000	19-Sep-03	TB	1,1-Dichloroethene	0.13	ug/L	J
PB044	DC5000	19-Sep-03	TB	Chloromethane	0.25	ug/L	J
PB044	DC5001	22-Sep-03	TB	Chloromethane	0.24	ug/L	J
PB044	DC5001	22-Sep-03	TB	Toluene	0.17	ug/L	J
PB044	F0XHEBW	29-Sep-03	BLK	Thallium	4.3	ug/L	B
PB044	F0XHKBW	29-Sep-03	BLK	Thallium	7.1	ug/L	B

B - Blank contamination.
BLK - Blank sample.
J - Estimated.
TB - Trip blank sample.
ug/L - Micrograms per liter or parts per billion.

Table E-3

Summary of Original, Field Duplicate, and Field Split Results and RPD Calculations
Former Plum Brook Ordnance Works
Sandusky, Ohio

		LOCATION_CODE	PB-BED-MW25		PB-BED-MW25		PB-BED-MW25		Relative Percent Difference between	Relative Percent Difference between
		SAMPLE_NO	DC3003		DC3006		DC3007			
		SAMPLE_DATE	18-Sep-03		18-Sep-03		18-Sep-03			
		SAMPLE_PURPOSE	REG		FD		FS			
Parameter	Units	Filtered	Result	ValQual	Result	ValQual	Result	ValQual	REG and FD	REG and FS
Aluminum	ug/L	N	86.5	B	88.6	B	69	U	2.40	22.51
Aluminum	ug/L	Y	61.8	B	72.8	B	69	U	16.34	11.01
Barium	ug/L	N	177	J	172	J	162	J	2.87	8.85
Barium	ug/L	Y	177	J	174	J	167	J	1.71	5.81
Calcium	ug/L	N	159000		156000		151000	J	1.90	5.16
Calcium	ug/L	Y	158000		157000		152000	J	0.63	3.87
Iron	ug/L	N	156		142		367		9.40	80.69
Iron	ug/L	Y	92.7	J	99.1	J	320		6.67	110.15
Magnesium	ug/L	N	62000		60600		57500		2.28	7.53
Magnesium	ug/L	Y	61400		60500		57800		1.48	6.04
Manganese	ug/L	N	72.9		70.9		65.1		2.78	11.30
Manganese	ug/L	Y	71.5		71.2		64.7		0.42	9.99
Potassium	ug/L	N	12100	J	11800	J	12800	J	2.51	5.62
Potassium	ug/L	Y	11900	J	11500	J	12800	J	3.42	7.29
Sodium	ug/L	N	120000		116000		115000		3.39	4.26
Sodium	ug/L	Y	118000		115000		115000		2.58	2.58
Thallium	ug/L	N	3.1	B	8.3	B	3.3	U	91.23	6.25
Thallium	ug/L	Y	10	U	6.9	B	3.3	U	36.69	100.75
Zinc	ug/L	N	4.8	J	20	U	8	U	122.58	50.00
Zinc	ug/L	Y	2.6	B	20	U	8	U	153.98	101.89
Carbon disulfide	ug/L	N	1	U	0.11	J	2	U	160.36	66.67

RPD > 30%
ug/L - Micrograms per liter.
FD - Field duplicate sample.
FS - Field split sample.
REG - Regular field sample.
N - No.
Y - Yes.
RPD - Relative percent difference.
ValQual - Validation qualifier.

Table E-4

Summary of Data Validation Reason Codes
Plum Brook Ordnance Works
Sandusky, Ohio

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
Former Plum Brook Ordnance Works
Sandusky, Ohio

Lot Number	Sample Number	Analysis	Parameter	VQ	Reason Codes (1,2) R1	R2	R3	R4
F19588	DC3007	Dissolved Metals	Barium	J	13	15		
F19588	DC3007	Dissolved Metals	Calcium	J	13			
F19588	DC3007	Dissolved Metals	Potassium	J	13			
F19588	DC3007	Total Metals	Barium	J	13	15		
F19588	DC3007	Total Metals	Calcium	J	13			
F19588	DC3007	Total Metals	Potassium	J	13			
PB044	DC3000	Cyanide	Cyanide, total	UJ	08A	08B		
PB044	DC3000	Dissolved Metals	Aluminum	B	06B	15		
PB044	DC3000	Dissolved Metals	Potassium	J	13			
PB044	DC3000	Dissolved Metals	Thallium	B	06A	06B	15	
PB044	DC3000	Total Metals	Aluminum	B	06B	15		
PB044	DC3000	Total Metals	Potassium	J	13			
PB044	DC3000	Total Metals	Thallium	B	06A	06B	15	
PB044	DC3001	Dissolved Metals	Aluminum	B	06B	15		
PB044	DC3001	Dissolved Metals	Arsenic	J	15			
PB044	DC3001	Dissolved Metals	Cobalt	J	15			
PB044	DC3001	Dissolved Metals	Nickel	J	15			
PB044	DC3001	Dissolved Metals	Potassium	J	13			
PB044	DC3001	Dissolved Metals	Thallium	B	06A	06B	15	
PB044	DC3001	Dissolved Metals	Zinc	J	15			
PB044	DC3001	Explosives	Amino-2,6-dinitrotoluene, 4-	J	15			
PB044	DC3001	Total Metals	Aluminum	B	06B	15		
PB044	DC3001	Total Metals	Arsenic	J	15			
PB044	DC3001	Total Metals	Cobalt	J	15			
PB044	DC3001	Total Metals	Nickel	J	15			
PB044	DC3001	Total Metals	Potassium	J	13			
PB044	DC3001	Total Metals	Thallium	B	06A	06B	15	
PB044	DC3001	Total Metals	Zinc	J	15			
PB044	DC3001	Volatiles	Benzene	J	15			
PB044	DC3001	Volatiles	Chloromethane	B	06D	15		
PB044	DC3001	Volatiles	Toluene	B	06D	15		
PB044	DC3002	Cyanide	Cyanide, total	UJ	08A	08B		
PB044	DC3002	Dissolved Metals	Aluminum	B	06B	15		
PB044	DC3002	Dissolved Metals	Cobalt	J	15			
PB044	DC3002	Dissolved Metals	Potassium	J	13			
PB044	DC3002	Dissolved Metals	Zinc	B	06B	15		
PB044	DC3002	Semivolatiles	Methylnaphthalene, 2-	J	15			
PB044	DC3002	Semivolatiles	Naphthalene	J	15			
PB044	DC3002	Total Metals	Aluminum	B	06B	15		
PB044	DC3002	Total Metals	Potassium	J	13			
PB044	DC3002	Total Metals	Thallium	B	06A	06B	15	
PB044	DC3002	Volatiles	Ethylbenzene	J	15			
PB044	DC3003	Cyanide	Cyanide, total	UJ	08A	08B		
PB044	DC3003	Dissolved Metals	Aluminum	B	06B	15		

Table E-5

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Former Plum Brook Ordnance Works
Sandusky, Ohio

Lot Number	Sample Number	Analysis	Parameter	VQ	Reason Codes (1,2) R1	R2	R3	R4
PB044	DC3003	Dissolved Metals	Barium	J	15			
PB044	DC3003	Dissolved Metals	Iron	J	15			
PB044	DC3003	Dissolved Metals	Potassium	J	13			
PB044	DC3003	Dissolved Metals	Zinc	B	06B	15		
PB044	DC3003	Total Metals	Aluminum	B	06B	15		
PB044	DC3003	Total Metals	Barium	J	15			
PB044	DC3003	Total Metals	Potassium	J	13			
PB044	DC3003	Total Metals	Thallium	B	06A	06B	17	15
PB044	DC3003	Total Metals	Zinc	J	15			
PB044	DC3004	Dissolved Metals	Aluminum	J	15			
PB044	DC3004	Dissolved Metals	Arsenic	J	15			
PB044	DC3004	Dissolved Metals	Potassium	J	13			
PB044	DC3004	Dissolved Metals	Thallium	B	06A	06B	15	
PB044	DC3004	Dissolved Metals	Zinc	B	06B	15		
PB044	DC3004	Total Metals	Aluminum	J	15			
PB044	DC3004	Total Metals	Arsenic	J	15			
PB044	DC3004	Total Metals	Potassium	J	13			
PB044	DC3004	Total Metals	Thallium	B	06A	06B	15	
PB044	DC3004	Total Metals	Zinc	B	06B	15		
PB044	DC3004	Volatiles	Benzene	J	15			
PB044	DC3004	Volatiles	Toluene	J	15			
PB044	DC3004	Volatiles	Trichloroethene	J	15			
PB044	DC3005	Dissolved Metals	Aluminum	B	06B	15		
PB044	DC3005	Dissolved Metals	Arsenic	J	15			
PB044	DC3005	Dissolved Metals	Cobalt	J	15			
PB044	DC3005	Dissolved Metals	Potassium	J	13			
PB044	DC3005	Dissolved Metals	Thallium	B	06A	06B	15	
PB044	DC3005	Dissolved Metals	Zinc	J	15			
PB044	DC3005	Semivolatiles	Chloro-3-methylphenol, 4-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Chlorophenol, 2-	UJ	07B	11A	19	
PB044	DC3005	Semivolatiles	Dichlorophenol, 2,4-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Dimethylphenol, 2,4-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Dinitro-2-methylphenol, 4,6-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Dinitrophenol, 2,4-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Methylphenol, 2-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Methylphenol, 4-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Nitrophenol, 2-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Nitrophenol, 4-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Pentachlorophenol	UJ	07B	19		
PB044	DC3005	Semivolatiles	Phenol	UJ	07B	11A	19	
PB044	DC3005	Semivolatiles	Trichlorophenol, 2,4,5-	UJ	07B	19		
PB044	DC3005	Semivolatiles	Trichlorophenol, 2,4,6-	UJ	07B	19		
PB044	DC3005	Total Metals	Cobalt	J	15			
PB044	DC3005	Total Metals	Potassium	J	13			

Table E-5

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Former Plum Brook Ordnance Works
Sandusky, Ohio

Lot Number	Sample Number	Analysis	Parameter	VQ	Reason Codes (1,2)			
					R1	R2	R3	R4
PB044	DC3005	Total Metals	Thallium	B	06A	06B	15	
PB044	DC3005	Total Metals	Zinc	J	15			
PB044	DC3005	Volatiles	Carbon disulfide	J	15			
PB044	DC3005	Volatiles	Chloroform	J	15			
PB044	DC3005	Volatiles	Ethylbenzene	J	15			
PB044	DC3005	Volatiles	Toluene	J	15			
PB044	DC3006	Dissolved Metals	Aluminum	B	06B	15		
PB044	DC3006	Dissolved Metals	Barium	J	15			
PB044	DC3006	Dissolved Metals	Iron	J	15			
PB044	DC3006	Dissolved Metals	Potassium	J	13			
PB044	DC3006	Dissolved Metals	Thallium	B	06A	06B	15	
PB044	DC3006	Total Metals	Aluminum	B	06B	15		
PB044	DC3006	Total Metals	Barium	J	15			
PB044	DC3006	Total Metals	Potassium	J	13			
PB044	DC3006	Total Metals	Thallium	B	06A	06B	17	15
PB044	DC3006	Volatiles	Carbon disulfide	J	15			
PB044	DC5000	Volatiles	Chloromethane	J	15			
PB044	DC5000	Volatiles	Dichloroethene, 1,1-	J	15			
PB044	DC5001	Volatiles	Chloromethane	J	15			
PB044	DC5001	Volatiles	Toluene	J	15			

Footnotes:
(1) Table E-4 defines all reason codes.
(2) Reason codes are assigned in order of their importance to the validation qualifiers with R1 being most important.
Definitions:
VQ - Validation qualifier.

Table E-6

Laboratory and Validation Qualifier Definitions
Former Plum Brook Ordnance Works
Sandusky, Ohio

Qualifier	Definition
Laboratory - Organic	
B	The compound was detected in the sample and in an associated method blank.
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.
J	The compound was detected in the sample and in an associated method blank.
G	Elevated reporting limit due to matrix interference.
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.
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.

APPENDIX F

CHAINS-OF-CUSTODY

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Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB09 16 03STL -C

PAGE 1 OF 1

Project Name/No: FBOW/843656
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 days

Sample Shipment Date: 9/16/03
Laboratory Destination: STL-North Canton
Laboratory Contact: Ken Kuzior
Project Contact/Phone: Maureen McMyler/865-690-3211
Carrier Waybill No.: 836531447450

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC3005	WATER	9/16/03 1520	2 - Glass	40 mL	H2SO4	TOC by 9060		
			1 - HDPE	1000 mL	Cool	Alkalinity by 310.1; Chloride by 325.2		
						Nitrate by 353.2; Sulfate by 375.4		
						TDS by 160.1; TSS by 160.2		
						Turbidity by 180.1		
			1 - HDPE	250 mL	HNO3	Hardness by 130.2		

Special Instructions:

Possible Hazard Identification:
Non-haz: X Flammable: ___ Poison B: ___ Unknown: X

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: David Kessler	Date: 9/16/03 Time: 1800	1. Received by: Anne Sanders	Date: 9-17-03 Time: 940
2. Relinquished by:	Date: Time:	2. Received by:	Date: Time:
3. Relinquished by:	Date: Time:	2. Received by:	Date: Time:

Comments:

H3I170121

Shaw™
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB09 16 03STL-K

PAGE 1 OF 1

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Project Name/No: PBOW
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 DAYS

Sample Shipment Date: 9/16/03
Laboratory Destination: STL- Knoxville
Laboratory Contact: Jamie McKinney
Project Contact/Phone: Maureen McMyler/865-690-3211
Carrier Waybill No.: 836531447509

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC 3005	WATER	9/16/03 1520	2 - Amber	1 L	Cool	Explosives by 8830	Custody Seals Intact	
			1 - HDPE pink	250 mL	HNO3	Total TAL Metals by 6010B/7470A	Received Temp. 2°C	
			1 - HDPE pink	250 mL	HNO3	Dissolved TAL Metals by 6010B/7470A	1 COOLER / FEDEX	
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C	T# 836531447509	
			3 - Glass	40 mL	HCL	TCL VOCs by 8260B	ADF 09-17-03	
			1 - HDPE pink	1 L	NaOH	Cyanide by 9010/9012		
	WATER		2 - Amber	1 L	Cool	Explosives by 8830		
			1 - HDPE	250 mL	HNO3	Total TAL Metals by 6010B/7470A		
			1 - HDPE	250 mL	HNO3	Dissolved TAL Metals by 6010B/7470A		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C		
			3 - Glass	40 mL	HCL	TCL VOCs by 8260B		
			1 - HDPE	1 L	NaOH	Cyanide by 9010/9012		
	WATER		3 - Glass	40 mL	HCL	TCL VOCs by 8260B		

Special Instructions:

Possible Hazard Identification:

Non-haz: X Flammable: ___ Poison B: ___ Unknown: ___

Sample Disposal:

Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:

Normal: X Rush: ___

Level of QC Required:

Definitive: X Project Specific: ___

1. Relinquished by: David Kessler Shaw Date: 9/16/03 Time: 1800
1. Received by: Andrew D Flores Date: 09-17-03 Time: 09:15
2. Relinquished by: Date: Time:
2. Received by: Date: Time:
3. Relinquished by: Date: Time:
2. Received by: Date: Time:

Comments:

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB09 17 03STL-C

PAGE 1 OF 1

Project Name/No: PBOW/843656
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 days

Sample Shipment Date: 9/17/03
Laboratory Destination: STL-North Canton
Laboratory Contact: Ken Kuzior
Project Contact/Phone: Maureen McMyler/865-690-3211
Carrier Waybill No.: 839702-140170

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC3004	WATER	9/17/03 0915	2 - Glass	40 mL	H2SO4	TOC by 9060		
			1 - HDPE	1000 mL	Cool	Alkalinity by 310.1; Chloride by 325.2		
						Nitrate by 353.2; Sulfate by 375.4		
						TDS by 160.1; TSS by 160.2		
						Turbidity by 180.1		
			1 - HDPE	250 mL	HNO3	Hardness by 130.2		
DC3002	WATER	9/17/03 1320	2 - Glass	40 mL	H2SO4	TOC by 9060		
			1 - HDPE	1000 mL	Cool	Alkalinity by 310.1; Chloride by 325.2		
						Nitrate by 353.2; Sulfate by 375.4		
						TDS by 160.1; TSS by 160.2		
						Turbidity by 180.1		
			1 - HDPE	250 mL	HNO3	Hardness by 130.2		
~~DC3001~~	~~DKK WATER~~	~~9/17/03~~	~~2 - Glass~~	~~40 mL~~	~~H2SO4~~	~~TOC by 9060~~		
			~~1 - HDPE~~	~~1000 mL~~	~~Cool~~	~~Alkalinity by 310.1; Chloride by 325.2~~		
						~~Nitrate by 353.2; Sulfate by 375.4~~		
						~~TDS by 160.1; TSS by 160.2~~		
						~~Turbidity by 180.1~~		
			~~1 - HDPE~~	~~250 mL~~	~~HNO3~~	~~Hardness by 130.2~~		
~~DKK~~								

Special Instructions:

Possible Hazard Identification:
Non-haz: X Flammable: ___ Poison B: ___ Unknown: ___

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: David Kessler Shaw Date: 9/17/03 Time: 1800
2. Relinquished by: Date: Time:
3. Relinquished by: Date: Time:

1. Received by: Date: 9-18-03 Time: 0950
2. Received by: Date: Time:
2. Received by: Date: Time:

Comments:

H3J180186

Shaw™
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB09 17 03STL-K

PAGE 1 OF 2

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Project Name/No: PBOW
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 DAYS

Sample Shipment Date: 9/17/03
Laboratory Destination: STL- Knoxville
Laboratory Contact: Jamie McKinney
Project Contact/Phone: Maureen McMyler/865-690-3211
Carrier Waybill No.: 836 531447440

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC 3004	WATER	9/17/03 0915	1 - Amber	1 L	Cool	Explosives by 8830	Custody Seals Intact Received Temp. 2°C 1 COOLER EETX ~~TA#8284 1755 3111~~ T#836531447440 ADF 09-18-03	ADF 09-18-03
			1 - HDPE	250 mL	HNO3	Total TAL Metals by 6010B/7470A pH<2		
			1 - HDPE	250 mL	HNO3	Dissolved TAL Metals by 6010B/7470A pH<2		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C		
			3 - Glass	40 mL	HCL	TCL VOCs by 8260B		
			1 - HDPE	1 L	NaOH	Cyanide by 9010/9012 pH>12		
DC 3002	WATER	9/17/03 1320	1 - Amber	1 L	Cool	Explosives by 8830		
			1 - HDPE	250 mL	HNO3	Total TAL Metals by 6010B/7470A pH<2		
			1 - HDPE	250 mL	HNO3	Dissolved TAL Metals by 6010B/7470A pH<2		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C		
			3 - Glass	40 mL	HCL	TCL VOCs by 8260B		
			1 - HDPE	1 L	NaOH	Cyanide by 9010/9012 pH>12		
DC3005	WATER	9/17/03	3 - Glass	40 mL	HCL	TCL VOCs by 8260B		
[illegible]	DCLF 9/17/03 [illegible]	9/17/03	2 - Amber	1 L	Cool	~~Explosives by 8830~~		
			1 - HDPE	250 mL	HNO3	~~Total TAL Metals by 6010B/7470A~~		
			1 - HDPE	250 mL	HNO3	~~Dissolved TAL Metals by 6010B/7470A~~		
			2 - Amber	1 L	Cool	~~TCL SVOCs by 8270C~~		
			3 - Glass	40 mL	HCL	~~TCL VOCs by 8260B~~		
			1-HDPE	1 L	NaOH	Cyanide by 9010/9012		
~~DC5000~~ DCL	1	1						

Special Instructions:

Possible Hazard Identification:

Non-haz: X Flammable: ___ Poison B: ___ Unknown: ___

Sample Disposal:

Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:

Normal: X Rush: ___

Level of QC Required:

Definitive: X Project Specific: ___

1. Relinquished by: David Kessler Shaw	Date: 9/17/03 Time: 1800	1. Received by: Andrew D. Forrer	Date: 09-18-03 Time: 09:20
2. Relinquished by:	Date: Time:	2. Received by:	Date: Time:
3. Relinquished by:	Date: Time:	2. Received by:	Date: Time:

Comments:

Shaw™
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB09 18 03STL-C

PAGE 1 OF 2

Project Name/No: PBOW/843656
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 days

Sample Shipment Date: 9/18/03
Laboratory Destination: STL-North Canton
Laboratory Contact: Ken Kuzior
Project Contact/Phone: Maureen McMyler/865-690-3211
Carrier Waybill No.: 836531447461

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC3001	WATER	9/18/03 0845	2 - Glass	40 mL	H2SO4	TOC by 9060		
			1 - HDPE	1000 mL	Cool	Alkalinity by 310.1; Chloride by 325.2		
						Nitrate by 353.2; Sulfate by 375.4		
						TDS by 160.1; TSS by 160.2		
						Turbidity by 180.1		
			1 - HDPE	250 mL	HNO3	Hardness by 130.2		
DC3003	WATER	9/18/03 1220	2 - Glass	40 mL	H2SO4	TOC by 9060		
			1 - HDPE	1000 mL	Cool	Alkalinity by 310.1; Chloride by 325.2		
						Nitrate by 353.2; Sulfate by 375.4		
						TDS by 160.1; TSS by 160.2		
						Turbidity by 180.1		
			1 - HDPE	250 mL	HNO3	Hardness by 130.2		
DC3003 MS	water	9/18/03 1220	2-Glass	40 ml	H_2SO_4	TOC by 9060		
			1-HDPE	1000 ml	cool	Alk		
						Nitrate		
						TDS		
						Turbidity		
			1-HDPE	250 ml	HNO_3	Hardness		

Special Instructions:

Possible Hazard Identification:
Non-haz: X Flammable: ___ Poison B: ___ Unknown: ___

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: David Kessler Shaw	Date: 9/18/03 Time: 1800	1. Received by: Jerry Miller	Date: 9-19-03 Time: 9:30
2. Relinquished by:	Date: Time:	2. Received by:	Date: Time:
3. Relinquished by:	Date: Time:	2. Received by:	Date: Time:

Comments:

204

Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB09 18 03STL-C

PAGE #2 OF 2

Project Name/No: PBOW/843656
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 days

Sample Shipment Date: 9/18/03
Laboratory Destination: STL-North Canton
Laboratory Contact: Ken Kuzior
Project Contact/Phone: Maureen McMyler/865-690-3211
Carrier Waybill No.: 836531447461

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC3003MSD	WATER	9/18/03 1220	2 - Glass	40 mL	H2SO4	TOC by 9060		
			1 - HDPE	1000 mL	Cool	Alkalinity by 310.1; Chloride by 325.2		
						Nitrate by 353.2; Sulfate by 375.4		
						TDS by 160.1; TSS by 160.2		
						Turbidity by 180.1		
			1 - HDPE	250 mL	HNO3	Hardness by 130.2		
DC 3000	WATER	9/18/03 1550	2 - Glass	40 mL	H2SO4	TOC by 9060		
			1 - HDPE	1000 mL	Cool	Alkalinity by 310.1; Chloride by 325.2		
						Nitrate by 353.2; Sulfate by 375.4		
						TDS by 160.1; TSS by 160.2		
						Turbidity by 180.1		
			1 - HDPE	250 mL	HNO3	Hardness by 130.2		
	DKR							

Special Instructions:

Possible Hazard Identification:
Non-haz: X Flammable: ___ Poison B. ___ Unknown: ___

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: David Kessler Shaw	Date: 9/18/03 Time: 1800	1. Received by: [signature]	Date: 9-19-03 Time: 9:30
2. Relinquished by:	Date: Time:	2. Received by:	Date: Time:
3. Relinquished by:	Date: Time:	2. Received by:	Date: Time:

Comments:

195

H3I190201

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ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB09 18 03STL-K

PAGE 1 OF 2

Project Name/No: PBOW
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 DAYS

Sample Shipment Date: 9/18/03
Laboratory Destination: STL- Knoxville
Laboratory Contact: Jamie McKinney
Project Contact/Phone: Maureen McMyler/865-690-3211
Carrier Waybill No.: 839702140191

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC3001	WATER	9/18/03 0845	2 - Amber	1 L	Cool	Explosives by 8330	Custody Seals Intact Received Temp. 3°C, 2°C, 3°C 3 COOLERS / FEDEX T# 839702140191 MDF 09-19-03	
			1 - HDPE pH<2	250 mL	HNO3	Total TAL Metals by 6010B/7470A		
			1 - HDPE pH<2	250 mL	HNO3	Dissolved TAL Metals by 6010B/7470A		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C		
			3 - Glass	40 mL	HCL	TCL VOCs by 8260B		
			1 - HDPE pH>12	1 L	NaOH	Cyanide by 9010/9012		
DC3003	WATER	9/18/03 1220	2 - Amber	1 L	Cool	Explosives by 8330		
			1 - HDPE pH<2	250 mL	HNO3	Total TAL Metals by 6010B/7470A		
			1 - HDPE pH<2	250 mL	HNO3	Dissolved TAL Metals by 6010B/7470A		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C		
			3 - Glass	40 mL	HCL	TCL VOCs by 8260B		
			1 - HDPE pH>12	1 L	NaOH	Cyanide by 9010/9012		
DC3003 MS	WATER	9/18/03 1220	2 - Amber	1 L	Cool	Explosives by 8330		
			1 - HDPE pH<2	250 mL	HNO3	Total TAL Metals by 6010B/7470A		
			1 - HDPE pH<2	250 mL	HNO3	Dissolved TAL Metals by 6010B/7470A		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C		
			3 - Glass	40 mL	HCL	TCL VOCs by 8260B		
			1 - HDPE pH>12	1 L	NaOH	Cyanide by 9010/9012		
DC5001	WATER	9/18/01	2 - Glass	40 mL	HCL	TCL VOCs by 8260B		

Special Instructions:

Possible Hazard Identification:
Non-haz: X Flammable: ___ Poison B: ___ Unknown: ___

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: David Kesch Shaw	Date: 9/18/03 Time: 1800	1. Received by: Andrew D. Flores	Date: 09-19-03 Time: 09:00
2. Relinquished by:	Date: Time:	2. Received by:	Date: Time:
3. Relinquished by:	Date: Time:	2. Received by:	Date: Time:

Comments:

H3I190201

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Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

REFERENCE COC NO.: PB09 18 03STL-K

PAGE 2 OF 2

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Project Name/No: PBOW
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 DAYS

Sample Shipment Date: 9/18/03
Laboratory Destination: STL- Knoxville
Laboratory Contact: Jamie McKinney
Project Contact/Phone: Maureen McMyler/865-690-3211
Carrier Waybill No.: 839702140191

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC3003MSD	WATER	9/18/03 1220	1 - Amber	1 L	Cool	Explosives by 8330		
			1 - HDPE	250 mL pH<2	HNO3	Total TAL Metals by 6010B/7470A		
			1 - HDPE	250 mL pH<2	HNO3	Dissolved TAL Metals by 6010B/7470A		
			2 - Amber	1 L	Cool	TCL SVOCs by 8270C		
			3 - Glass	40 mL	HCL	TCL VOCs by 8260B		
			1 - HDPE	1 L pH>12	NaOH	Cyanide by 9010/9012		
~~DC3004~~	~~WATER~~		~~3 - Glass~~	~~40 mL~~	~~HCL~~	~~TCL VOCs by 8260B~~		
DC3006	water	9/18/03 1220	1-Amber	1-L	Cool	Explosives		
			1-poly	250 ml pH<2	HNO_3	Total TAL Metals		
			1-poly	250 ml pH<2	HNO_3	Dissolved TAL Metal		
			2-Amber	1-L	Cool	TCL SVOCs		
			3-Glass	40 ml	HCL	TCL VOCS		
-1			1-poly	1 L	NaOH	Cyanide		
DC3000	water	9/18/03 1550	1-Amber	1 L	Cool	Explosives		
			1-poly	250 ml pH<2	HNO_3	Total TAL Metals		
			1-poly	250 ml pH<2	HNO_3	Dissolved TAL Metals		
			2-Amber	1 L	Cool	TCL SVOCs		
			3-Glass	40 ml	HCL	TCL VOCs		
			1-poly	1 L pH>12	NaOH	Cyanide		

Special Instructions:

Possible Hazard Identification:
Non-haz: X Flammable: ___ Poison B: ___ Unknown: ___

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: David Kessler Shaw Date: 9/18/03 Time: 1800
1. Received by: Andrew D. Flores Date: 9-19-03 Time: 09:00
2. Relinquished by: Date: Time:
2. Received by: Date: Time:
3. Relinquished by: Date: Time:
2. Received by: Date: Time:

Comments:

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Shaw
Shaw E & I, Inc.

ANALYSIS REQUEST AND CHAIN-OF-CUSTODY RECORD

F19588

REFERENCE NO.: PB09 18 03ACC

PAGE 1 OF 1

Project Name/No: PBOW
Sample Team Member: David Kessler
Profit Center: Knoxville
Project Manager: Steve Downey
Project No.: 843656
Required Report Date: 21 days

Sample Shipment Date: 9/18/03
Laboratory Destination: Accutest
Laboratory Contact: Sue Bell
Project Contact/Phone: Maureen McMyler/865-560-5271
Carrier Waybill No.: 839702140169

Bill To: Accounting
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Report To: Maureen McMyler
Shaw E & I
312 Directors Drive
Knoxville, TN 37923

Sample Number	Sample Type/ Description	Date/Time Collected	Container Type	Sample Volume	Pre-servative	Requested Testing Program	Condition on Receipt	Disposal Record
DC3007	WATER	9/18/03 1220	1 - Amber	1 L	Cool	Explosives by 8830		
		9/18/03 1220	2 - Amber	1 L	Cool	Semivolatiles by 8270C		
		9/18/03 1220	3 - Vial	40 mL	HCl	Volatiles by 8260B		
		9/18/03 1220	1 - HDPE	250 mL	HNO3	TAL Metals (Total) by 6010B/7471A		
		9/18/03 1220	1 - HDPE	250 mL	HNO3	TAL Metals (Diss) by 6010B/7471A		
2 DC5003 DKK	WATER	—	2 - Vial DKK	40 mL	HCl	Volatiles by 8260B		
	DKK							

Special Instructions:

Possible Hazard Identification:
Non-haz: X Flammable: ___ Poison B: ___ Unknown: ___

Sample Disposal:
Return to Client: ___ Disposal by Lab: X Archive: ___

Turnaround Time:
Normal: X Rush: ___

Level of QC Required:
Definitive: X Project Specific: ___

1. Relinquished by: David Kessler Shaw Date: 9/18/03 Time: 1800
1. Received by: FEDEX Date: Time:
2. Relinquished by: FEDEX Date: Time:
2. Received by: Mina Mohammed Date: 9/19/03 Time: 0900
3. Relinquished by: Date: Time:
2. Received by: Date: Time:

Comments:

2 ∩

APPENDIX G

RESPONSE TO COMMENTS

RESPONSE TO COMMENTS
U.S. ARMY CORPS OF ENGINEERS (CELRN-EC-R-D)
SIXTH QUARTERLY BACKGROUND GROUNDWATER REPORT
FORMER PLUM BROOK ORDNANCE WORKS, SANDUSKY, OHIO
(Dated July 2003)

Reference: Comments forwarded by Linda Ingram (dated September 2003) for the Sixth Quarterly Background Groundwater Report. Comments will be incorporated into the Seventh Quarterly Background Groundwater Report.

Comments by Jim Beaujon (Geologist)

Comment 1: **For the next version of this document, and future documents, it might be helpful to include a time reference in the title (year of the data, quarterly samplings would include the month). Thus a title like *Sixth Quarterly (April 2003) Background Groundwater Sampling Report* would be a more informative title.**

Response 1: Agreed. The date of the sampling will be included in the title.

Comment 2: **Figure 1-1: US Route 250 should be labeled.**

Response 2: U. S. Route 250 will be included on Figure 1-1.

Comment 3: **Page 1-2, paragraph above Section 1.1; page 1-3, 4th bullet; page 2-1, 1st paragraph of Section 2.2; page 2-2, last sentence of paragraph above Section 2.3; page 2-3, 3rd paragraph of Section 2.4; page 3-1, end of 1st paragraph on page; page 3-3, Section 3.4, end of 1st sentence; page 4-1, last sentence of Section 4.1: I found the discussions/references concerning PB-BED-MW27 a bit confusing since PB-BED-MW27 was last sampled during the October 2002 sampling as reported and discussed in the 5th Quarterly Report. I would expect these quarterly reports to focus more on what was sampled for that quarter and thus wouldn't expect to see discussions of PB-BED-MW27 again until the Annual Summary Report that will include the October 2002 sampling event.**

Response 3: Monitoring well PB-BED-MW27 was abandoned in January 2003. The analytical results were presented to provide the reader with the most current information on groundwater quality in the well immediately prior to abandonment. This information will be presented in the Annual Summary Report.

Comment 4: **Page 1-3, last sentence of 1st paragraph: Change "chemicals the boundary" to "chemicals beyond the boundary".**

Response 4: The 1st paragraph containing this sentence fragment will be deleted from the 7th Quarterly Report.

Comment 5: **Page 4-2, end of paragraph at top of page, beginning with "During the sixth quarterly sampling event": PB-BED-MW26 was not sampled for anything during the sixth quarterly sampling event, only its water level was measured. This portion of the paragraph should be deleted as its content is not relevant to the sixth quarterly (April 2003) sampling.**

Response 5: Agreed. All information following and including the sentence "During the sixth quarterly....." will be deleted.

Comment 6: **Data tables in appendices: When presenting tables of qualified analytical data it's helpful to provide a footnote explaining what each qualifier indicates. Readers don't always take the time (or know) to read through the Data Validation Summary Report to determine what each qualifier means in this particular presentation.**

Response 6: A validation qualifier summary table will be provided in Appendix C (Chemical Analytical Summary) and Appendix D (Detected Hits Summary Excluding "B" Qualifiers).

RESPONSE TO COMMENTS
HTRW – CENTER OF EXPERTISE
SIXTH QUARTERLY BACKGROUND GROUNDWATER REPORT
FORMER PLUM BROOK ORDNANCE WORKS, SANDUSKY, OHIO
(Dated July 2003)

Comments will be incorporated into the Seventh Quarterly Background Groundwater Report.

Comments by Cheryl Groenjes (Chemist)

Comment 1: **P. 1-1, Sec 1.0, 4th paragraph. Clarify what chemical parameter(s) will be evaluated for a trending pattern.**

Response 1: Trending patterns, if any, of both inorganic and organic parameters in groundwater will be reviewed. The sentence will be clarified to indicate that both inorganic and organic compounds will be evaluated for trends.

Comment 2: **P. 1-2, 1.1.**

a. **(1) Clarify what direction the "bedrock ground water entering the PBOW site" is being evaluated from.**

Response 2a: "In the upgradient direction (west, south and southwest)" will be included in the sentence to clarify the direction from which groundwater is being evaluated.

b. **(3) and (5) are redundant objectives.**

Response 2b: Objectives 3 and 5 will be combined.

c. **(6) Suggest this objective be restated as to confirm or evaluate the validity of the nitroaromatic detections for the 4-02 sampling event (or similar). For as stated, the option that the detections are valid; and that these wells may be impacted/contaminated is missing. Nitoraromatics such as 2,6-DNT, NB, RDX are not considered "natural", suggest this option and term be removed. The steps taken to evaluate the field and lab error sources, as well as the results of this investigation must be discussed at the end of the document.**

Response 2c: Agreed. The objective will be rewritten to state "Evaluate the detection of nitroaromatics reported in April 2002 in background monitoring wells to determine a possible source for this contamination." The steps taken to evaluate the data will be included in the final Groundwater Remedial Investigation Report.

d. **(7) Clarify what purpose the GW quality is being determined 'adequate' for.**

Response 2d: "For establishing background concentrations" will be included in the sentence.

Comment 3 **P. 1-1 through 1-3, 1.0, general.**

a. **With the noted low-level detections of nitroaromatics in three of the five bedrock wells, and evidence of VOCs in 4 of 5 of these "background" wells, it seems the ability of these wells to be considered "background i.e., they represent areas NOT impacted by site activities", comes under question. Further study is recommended on p. 1-3 as including 'downgradient' wells within this 'background' study also. It is unclear how downgradient wells and wells showing low-levels of organic contamination can represent background conditions; or if the term 'background' is being misapplied.**

Response 3a: Part of the purpose of a background report is to determine where background is (areas not impacted by previous site activities) and what the quality of groundwater is in that expected area. Some of the VOCs detected (benzene, toluene, ethylbenzene, xylene,) appear to be common in the groundwater, possibly typical of groundwater from a natural source of hydrocarbons.

Downgradient groundwater well data were presented simply because it was a sampling activity that took place at the same time as the background groundwater sampling. This data is not part of the Background Report. It will be presented later in an Annual Summary report.

b. **Suggest briefly noting whether there is known or suspected impact from offsite activities or naturally occurring sources (crude petroleum) here, leading to assumptions being made about the ground water condition in the area.**

Response 3b: At the end of Section 1.3, a paragraph will be inserted stating "Review of documents and discussions with OEPA personnel indicated that the Columbus and Delaware bedrock units (same bedrock units that one of the PBOW background wells is screened in) contain actively producing petroleum hydrocarbon wells (Shaw, 2003a). Therefore, it is important to note that some VOCs (primarily benzene, toluene, ethylbenzene, and total xylenes) and SVOCs may be naturally occurring in site groundwater."

Comment 4: Figure 2-1.

a. **The figure shows Bedrock flow arrows that are contradictory around MW 24 and 25, and no flow information in the area around MW 26**

and 20. Suggest clarifying these inconsistencies in the text, and including an arrow (if possible) to identify the flow by MWs 25 and 20. Is (OB and BED) GW flow still inconclusive? The noted contradictions in bedrock flow and sporadic organic compound detections noted above make it difficult to discern what is a reasonable representation of 'updgradient'.

Response 4a: The bedrock flow direction arrow near PB-BED-MW25 was incorrect. Correct groundwater flow directions based on May 2002 measurement readings will be included near BED-MW25 and BED-MW20.

Two groundwater units with associated flow directions are interpreted to be present at PBOW. One groundwater unit is from the wells screened in the Delaware Limestone, and the other unit is from the overburden/wells screened in the shale units.

b. Include PB-BED-MW27 on figure. If off scale, include another figure to establish its relationship to the other background wells.

Response 4b: Well PB-BED-MW27 will not be included in following reports because it is not a background well.

Comment 5: **P. 1-3, 1.1, 4th main bullet. PB-BED-MW-27 is noted later as downgradient, clarify here if this well is / is not considered a background well location.**

Response 5: Please see Response 4b.

Comment 6: **P. 1-4, 1.3, first sentence. Clarify which isomer(s) of DNT were manufactured at PBOW.**

Response 6: A total of six DNT isomers were manufactured during the 3-step nitration process of toluene for the production of 2,4,6-TNT. The main DNT isomers produced were 2,4-DNT, 2,6-DNT, and 3,4-DNT; far smaller quantities (total of approximately 5%) of the remaining isomers were produced (2,3-, 2,5-, and 3-5-DNTs). Individual DNT isomers will not be listed because six DNT isomers were produced.

Comment 7: **P. .3-3, 3.4. Suggest clarification of the 1/10 rule being applied to the PRG values when establishing the RBSCs. Include a reference for the EPA-IX PRGs (noted as EPA (2002) here) in section 6.0 for completeness. Suggest checking the Mn level noted in table 4-2**

Response 7: The third sentence of the first paragraph in Section 3.4.1 will be deleted and replaced with statements expressing the following:

RBSCs are derived from Region 9 PRGs, either based on chronic noncancer or cancer effects. For noncancer effects, RBSCs are adjusted to a hazard quotient (HQ) of 0.1; noncancer-based PRGs are based on an HQ of 1. Adjusting the HQ downward accounts for possible additive effects of multiple chemicals during risk-based screening. For cancer-based effects, both RBSCs and PRGs are based on an incremental lifetime cancer risk of 1E-6. Some chemicals exhibit both chronic noncancer and cancer effects. For these chemicals, the RBSC represents either an HQ of 0.1 or an ILCR of 1E-6, whichever results in a lower concentration.

Comment 8: **P. 3-3, 3.4, 3rd paragraph.**

a. **MDC values are noted as the maximum concentration found within an AOC. These values represent the 'worst case' detections in an AOC, and are important in the evaluation of downgradient / impacted wells, but is not supportive to the purpose of a background study. Suggest that separate MDCs be established from data sets representing background/upgradient vs. downgradient locations in addition to the current separation based on various AOCs.**

Response 8a: Separate MDC values for background and various AOCs will be established.

b. **Clarify when and how (statistics to be used) the Background Screening Concentrations will be established. Text here notes that additional wells are needed to support this. However, there is no clear rationale as to what data gaps exist in the current GW model for the site (after six rounds of sampling!), and why and where this data is needed. Suggest more detailed planning be done and documented within project plans/reports to identify clear goals for PBOW, and clarify these omissions in order to avoid gathering unnecessary and/or inappropriate data.**

Response 8b Two additional sampling events for background wells were decided during the September 11, 2002, meeting between the USACE, OEPA, PES, and Shaw. As stated in Section 1.1, the objectives could not be reached by the present groundwater sampling events. Since additional background wells needed to be installed to determine the "reality" of the current background well locations, associated groundwater sampling of 4 additional rounds (new background wells included) should be performed. Background values are estimated to be established after the background sampling event in June 2004. The estimated completion date will be noted in this paragraph.

Comment 9: **4-1 through 4-6, Data summaries are very rote and are limited to a general description of hits with little to no interpretative value. The**

discussion fails to clarify the significance of the detections found or impact this has in reaching stated project objectives. Text should be oriented to support the data presentation found in table 4-1 and as stated in objectives - by evaluating trends at these wells over time. Analytical results should be presented for an individual well noting continuity in results (or lack there of) over the (6) quarterly events taken to date. Interpretation should include an evaluation of data relationships between adjacent wells and related analyses (i.e., filtered and unfiltered metals). Some issues to keep in mind, does data make sense, is it very sporadic in nature or is it fairly consistent, are the unfiltered metals > filtered metals, do the stabilization parameters support the laboratory results, how close are results to the DL/RL of the method, how might this impact the reliability of the data, etc.

Response 9: The purpose of the data summaries is to present the analytical results. Interpretations, evaluations, and comparisons will be performed during the Annual Groundwater report that will also present the background screening value.

Comment 10: **p. 5-1, 5.0 Several objectives noted within section 1.1 are not addressed within this final report i.e., trend analyses, legitimacy of data and evaluation of sources of field/ lab errors from 4-02 sampling event, adequacy of background MWs to support project objectives, calculating background concentration ranges, determining the quality of GW, etc. Recommend that an understanding of current data and how that represents current site GW conditions is necessary BEFORE on can propose 'effective and efficient' future data needs. If not now, define when this will be done.**

Response 10: A 2004 Groundwater Data Summary and Evaluation report will be prepared using groundwater data collected from the background wells following completion of the June 2004 background groundwater sampling. This information will be included in the Planned Activities, Section 5.0.

Comment 11: **References. Add the EPAIX PRG reference.**

Response 11: "U.S. Environmental Protection Agency (EPA), 2002, Region 9 Preliminary Remediation Goals (PRG), 2002 Update, online, 1 October" reference will be added.

Comment 12: **Table 4-1 and 4-2, Suggest water quality parameters be changed to ppm to allow easier review of data. Check the RBSC For Mn.**

Response 12: The water quality parameters will be changed to parts per million. The RBSC value for manganese is 88 μg/L, but will not be shown because RBSC values are not being presented in the 7th Quarterly report.

Comment 13: **Appendix B:**

a. **Actual RSD values for Ical and (%D for continuing cal) should be documented on these forms for those compounds that exceed the calibration criteria. This allows an assessment of the analytical error and bias direction associated with those compounds. This documentation back to the user is critical and is prescribed in both SW-846 800B and in EM 200-1-3, Appendix I.**

Response 13a: Specific RSD values will be discussed in the Data Quality Evaluation.

b. **Suggest that unacceptable surrogate and spike recoveries bias direction (high/low) and value (if possible) be noted to enable an assessment of the FN/FP potential.**

Response 13b: Unacceptable surrogate and spike recovery bias and values will be discussed in the Data Quality Evaluation.

c. **5th quarter, p. 7, 4.4. The blank evaluation for explosives analyses should not employ a 10x rule, for they do not include compounds representing common lab contaminants. Suggest limiting criteria to 5x rule for this analyses.**

Response 13c: Current blank evaluation for explosives employs the 5x rule. The paragraph will be updated to clarify this.

d: **5th quarter, p. 7, 4.4. Unclear why confirmation of results is not evaluated for Explosives. Second column confirmation is mandated by method 8330, and should be evaluated as apart of this review process.**

Response 13d: For explosives analyses by HPLC, sample results are confirmed using two dissimilar columns. In order for an analyte to be reported, it must be detected on both columns. A section will be added to the report that states that the second column confirmation is verified.

RESPONSE TO COMMENTS
HTRW – CENTER OF EXPERTISE
SIXTH QUARTERLY BACKGROUND GROUNDWATER REPORT
FORMER PLUM BROOK ORDNANCE WORKS, SANDUSKY, OHIO
(Dated July 2003)

Comments will be incorporated into the Seventh Quarterly Background Groundwater Report.

Comments by Sam Bass (Geologist)

Comment 1: **Page 1-2, Section 1.1, general comment. There does not appear to be a clear sense of what the data will be used for after the quality of background ground water has been determined. Will site and downgradient ground water quality be compared to background to determine if there are any site-related impacts? Will background ground water quality be used to determine background risk? It is also unclear why the need for downgradient wells are being discussed in a background ground water document. This should be clarified in the report or a reference inserted to point the reader to another part of the document (or another document) where these questions are answered.**

Response 1: As indicated, the background groundwater data will be used to calculate background screening concentrations for comparison to site wells to determine site-related groundwater impacts. A version of this sentence will be included in the 4th paragraph of Section 1.0. For inclusion of downgradient well PB-BED-MW27, see response to Comment No. 3 for USACE, Jim Beaujon.

Comment 2: **Page 1-2, Section 1.1, item 7. This bullet states you will determine if ground water quality of background monitoring wells is adequate. Adequate for what? Include in the report.**

Response 2: Adequate "for establishing background concentrations" will be included in item 6 (former item 7).

Comment 3: **Section 4.2.4, General comment. General water quality parameters and selected metals (e.g., sodium, magnesium, calcium) are one to two orders of magnitude greater in MW20 than any other background well. The chloride concentrations are upwards of 2%. The Data Summary and Evaluation Report should evaluate possible lithologic reasons for these higher concentrations such as the presence of evaporite deposits, or possible storage of road salt or other materials on the surface in the vicinity of the well. The high general chemistry parameters call into**

question the representativeness of MW20 and its potential use as a background well.

Response 3: Agreed. The 2004 Data Summary and Evaluation Report will evaluate the groundwater quality parameters and a decision as to whether this well should be included as a background well will be made before background screening values are calculated.

Comment 4: **Page 4-6, Section 4.2.5. Benzene, total xylenes, and carbon disulfide were also reported in MW25. Include in the summary.**

Response 4: Agreed. Acetone, benzene, total xylenes, and carbon disulfide will be included in the summary.

Comment 5: **Page 5-1, Section 5.0. There appears to be confusion between determining background ground water quality and determining nature and extent of ground water contamination at the site. If additional work is necessary to determine nature and extent, those recommendations should be made in the RI report rather than a report on the background water quality. This reviewer is under the impression that a conscious decision was made to separate the determination of background water quality from nature and extent, hence the separate RI and background sampling reports. The bullets in Section 5 should be reviewed and edited to be consistent with the project objective to keep determination of background concentrations separate from determination of nature and extent of contamination. This would probably lead to the deletion of bullets three and five, or addition of text to those bullets stating those activities would be performed as part of the nature and extent determination for the RI.**

Response 5: In the December quarterly report presenting the October 2003 background groundwater data, all of the bullets will be removed. Only planned activities specifically relating to background groundwater quality will be included as bullets.

Comment 6: **Table 4-1. There is a significant amount of "dead space" along the margins and within this table, resulting in the two most recent sampling rounds being separated from all previous sampling rounds for wells BEDGW-001, MW20, MW24, and MW25. This makes it difficult to directly compare results of time series data for each well, i.e., relative changes in sampling results over time. The table should be reformatted to place all sampling rounds for a given well on one page, so there are eight columns of data rather than the current six.**

Response 6: To allow the font size to be readable and all of the sampling events of a single well on the same page, analytical results will be printed on an 11- by 17-inch page for future reports.

Comment 7: **Figure 2-1. The location and results for PB-BED-MW27 are not shown on Figure 2-1. Even though this well is no longer part of the sampling program, previous results from this well are still significant because of the natural product found in the well. Results should still be included on figures and in the text.**

Response 7: This well will be included with the analytical results on a figure in the 2004 Annual Report.

Comment 8: **Figure 2-1. Include a note on Figure 2-1 explaining that MW26 has not been sampled since January 2002 due to insufficient water column. Also recommend that the water quality parameters be stated in mg/L rather than µg/L since the standards typically used for comparison (secondary drinking water regulations) are given in mg/L.**

Response 8: Agreed. The note will be added to Figure 2-1 and the analytical results for the water quality parameters will be presented in mg/L (ppm).