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July 31, 2013

U.S. Army Engineer District, Nashville
ATTN: CELRN-EC-E (Ms. Paula Coleman)
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Subject: ***Submittal of the Final Powerhouse No. 2 Ash Pits Baseline Human Health Risk Assessment and Screening-Level Ecological Risk Assessment Addenda for Coal Yard No. 2***
Former Plum Brook Ordnance Works, Sandusky, Ohio
Contract No. W912QR-08-D-0013: Shaw Project Number 132457

Dear Ms. Coleman:

In accordance with the requirements of Delivery Order No. DX02 of Contract No. W912QR-08-D-0013 awarded to Shaw Environmental & Infrastructure, Inc., a CB&I company, we are pleased to submit the Final Addenda to the Powerhouse No. 2 Ash Pits (AP2) Baseline Human Health Risk Assessment and Screening-Level Ecological Risk Assessment for Coal Yard No. 2 at the Former Plum Brook Ordnance Works (PBOW) located in Sandusky, Ohio. This report was prepared consistent with other PBOW risk assessment reports, U.S. Environmental Protection Agency guidance, and the AP2 risk assessment work plan.

Enclosed for your records are four copies of this report. Copies have also been sent to those on the distribution list as indicated for their records. As requested, the document was sent to the Center of Expertise (CX) and the Restoration Advisory Board Co-Chair in electronic format only.

Should you have any questions or require additional information regarding this submittal, please do not hesitate to contact me at (865) 694-7496.

Sincerely,

Steven. T. Downey, PE, PMP
Project Manager

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Shaw Environmental & Infrastructure, Inc.

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Former Plum Brook Ordnance Works, Sandusky, Ohio

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Final
Powerhouse No. 2 Ash Pits
Baseline Human Health Risk Assessment Addendum
For Coal Yard No. 2
FUDS No. G05OH001822

Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared for:

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Shaw Project No. 132457

July 2013

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List of Acronyms

AP2	Powerhouse No. 2 Ash pits
BHHRA	baseline human health risk assessment
BSC	background screening concentration
COPC	chemical of potential concern
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
EPA	U.S. Environmental Protection Agency
FUDS	Formerly Used Defense Sites
GSA	General Services Administration
HQ	hazard quotient
ICI	International Consultants Incorporated
IEUBK	Integrated Exposure Uptake Biokinetic
ILCR	incremental lifetime cancer risk
IT	IT Corporation
MDC	maximum detected concentration
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MK	Morrison Knudsen Corporation
NASA	National Aeronautics and Space Administration
OEPA	Ohio Environmental Protection Agency
PAH	polycyclic aromatic hydrocarbon
PBOW	Plum Brook Ordnance Works
PDT	Project Delivery Team
RBSC	risk-based screening concentration
RSL	regional screening level
Shaw	Shaw Environmental & Infrastructure, Inc.
SI	site inspection
TNT	trinitrotoluene
TNTA	TNT Area A
TNTB	TNT Area B
TNTC	TNT Area C
USACE	U.S. Army Corps of Engineers
WRS	Wilcoxon Rank Sum

Executive Summary

A baseline human health risk assessment (BHHRA) addendum was conducted to evaluate risks associated with exposure to surface soil and subsurface soil at the Coal Yard associated with Powerhouse No. 2, located at the Plum Brook Ordnance Works (PBOW), Sandusky, Ohio. This coal yard site is referred to as "Coal Yard No. 2." This BHHRA is an addendum to the Powerhouse No. 2 Ash Pits BHHRA. The approach used in the BHHRA Addendum is consistent with methodologies described in the U.S. Environmental Protection Agency's primary risk assessment guidance documents, the site-specific work plan, and discussions between the Ohio Environmental Protection Agency, the U.S. Army Corps of Engineers Nashville and Huntington Districts, and Shaw Environmental & Infrastructure, Inc. (a CB&I company).

Site History/Description. The PBOW facility was constructed on property comprising 9,009 acres in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), 2,4-dinitroluene, and pentolite. Production of explosives at PBOW began in December 1941 and continued until 1945. It is estimated that more than 1 billion pounds of nitroaromatic explosives were manufactured during the 4-year operating period. After plant operations ceased, the manufacturing process lines were decontaminated by the Army in late 1945. After the property was certified as decontaminated, 3,230 acres of the property were initially transferred to the Ordnance Department, then to the War Assets Administration. In 1949, PBOW was transferred to the General Services Administration. The Department of the Army reacquired the 3,230 acres in 1954 and performed cleanup efforts from the mid-1950s until 1963.

Accountability and custody for the entire portion of the former PBOW property that had been under the accountability and custody of the Department of the Army were transferred to the National Aeronautics and Space Administration (NASA) on March 15, 1963. NASA performed further decontamination efforts during 1964. NASA has operated and maintained the former PBOW property since 1963, and the facility is currently the NASA Glenn Research Center, Plum Brook Station. NASA operates the property as a space research facility in support of the John Glenn Research Center at Lewis Field, Cleveland, Ohio. Most of the aerospace testing facilities built in the 1960s at the site are currently on standby or inactive status.

Three power stations, Powerhouse No. 1, Powerhouse No. 2, and Powerhouse No. 3, were constructed and utilized to support the TNT manufacturing processes. Coal Yard No. 2 was used as a storage area to provide coal for the Powerhouse No. 2 boilers. The coal was brought into the coal yard via train. The generated steam was used for space heating, driving compressors, and

generating electrical power. Coal Yard No. 2 is located immediately to the northeast of former Powerhouse No. 2. The former coal yard is estimated to have been approximately 200 feet wide by 290 feet in length, or approximately 1.3 acres. Demolition of the former Powerhouse No. 2 building by NASA in the fall of 2010 resulted in some disturbance of surface soil and vegetation, as the area has been filled and graded, primarily in areas outside the footprint of the former coal yard. The site was observed to be covered with bare soil during a site visit on September 1, 2011, but plant shoots were observed to be emerging, suggesting that the site will likely naturally revegetate in the near future.

Approach. The BHHRA Addendum evaluated exposure to chemicals in Coal Yard No. 2 surface soil and subsurface soil. Validated analytical data are from samples collected during 2010, as reported in the site characterization report.

A screening for chemicals of potential concern (COPC) was used to focus the evaluation on those chemicals most likely to present a risk to potentially exposed individuals. This screening included a risk-based screening and, for inorganics, a background screening. The background screening protocol used for Coal Yard No. 2 is based on PBOW Project Delivery Team agreements and differs somewhat from the current Ohio Environmental Protection Agency guidance. Use of this PBOW Project Delivery Team method for the development of background screening concentrations and as part of the COPC screening process ensures consistency between all of the PBOW Formerly Used Defense Sites project sites.

Results/Conclusions. None of the chemicals detected in Coal Yard No. 2 surface soil or subsurface soil were identified as COPCs. The results of the COPC screening indicate that the risks/hazards associated with chemicals detected in Coal Yard No. 2 soils are negligible and/or are related to background soil conditions. Accordingly, a quantitative risk assessment beyond the COPC screening is unnecessary for Coal Yard No. 2 soils.

1.0 Introduction

This baseline human health risk assessment (BHHRA) Addendum evaluates potential human health risks associated with exposure to soil at the Powerhouse No. 2 Coal Yard (Coal Yard No. 2), which is located at the former Plum Brook Ordnance Works (PBOW), Sandusky, Erie County, Ohio. This site is administered as part of Defense Environmental Restoration Program (DERP)-Formerly Used Defense Sites (FUDS) Project No. G05OH001822, Powerhouse No. 2 Ash Pits (AP2). This work is being conducted by Shaw Environmental & Infrastructure, Inc. (Shaw) (a CB&I company) for the U.S. Army Corps of Engineers (USACE) under the DERP-FUDS program, managed by the USACE Huntington District, and technically overseen by the USACE Nashville District. This BHHRA Addendum is consistent with U.S. Environmental Protection Agency (EPA) guidance and with the procedures established in the BHHRA for TNT Area A (TNTA) and TNT Area C (TNTC) soil (IT Corporation [IT], 2001), and, most specifically, the AP2 BHHRA work plan (Shaw, 2010a).

1.1 Facility Location and Description

PBOW is located approximately 4 miles south of Sandusky, Ohio, and 59 miles west of Cleveland (Figure 1-1). Although located primarily in Perkins and Oxford Townships, the eastern edge of the facility extends into Huron and Milan Townships. PBOW is bounded on the north by Bogart Road, on the south by Mason Road, on the west by Patten Tract Road, and on the east by U.S. Highway 250. The areas surrounding PBOW are mostly agricultural and residential. The facility is currently surrounded by a chain-link fence, and the perimeter is regularly patrolled. Access by authorized personnel is limited to established checkpoints. Public access is restricted. Hunting is allowed by permit on portions of PBOW during the annual deer hunting season.

1.2 Facility History and Background

The PBOW facility was constructed on property comprising 9,009 acres in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), 2,4-dinitroluene (DNT), and pentolite (International Consultants Incorporated [ICI], 1995). Production of explosives at PBOW began in December 1941 and continued until 1945. It is estimated that more than 1 billion pounds of nitroaromatic explosives were manufactured during the 4-year operating period. The three explosive manufacturing areas were designated TNTA, TNT Area B (TNTB), and TNTC. Twelve process lines were used in the manufacture of TNT: four lines at TNTA, three lines at TNTB, and five lines at TNTC.

After plant operations ceased, the manufacturing process lines were decontaminated by the Army in late 1945. During decontamination, all structures, equipment, and manufacturing debris were either removed and salvaged or removed and burned. After the property was certified as decontaminated, 3,230 acres of the property were initially transferred to the Ordnance Department, then to the War Assets Administration. In 1949, PBOW was transferred to the General Services Administration (GSA). This transfer did not include the 2,800-acre Plum Brook Depot area, which is also known as the Magazine Area. The Department of the Army reacquired the 3,230 acres in 1954. In 1955, the Army completed further decontamination of the manufacturing process lines. This effort included removal of contaminated surface and subsurface soil around the building and wooden and ceramic waste disposal lines containing TNT. Thousands of pounds of TNT were discovered in catch basins; this TNT was removed and burned at the burning grounds. The Army continued cleanup efforts until 1963.

Two property use agreements were entered into by the Army and the National Advisory Committee of Aeronautics, the predecessor of the National Aeronautics and Space Administration (NASA), in 1956 and 1958, respectively. Accountability and custody for the entire portion of the former PBOW property (6,030 acres) that had been under the accountability and custody of the Department of the Army were transferred to NASA on March 15, 1963. NASA performed further decontamination efforts during 1964. The NASA decontamination process included removing contaminated surface soil above the drain tiles, flumes, etc.; destruction of all buildings by fire; then removal of all soil, debris, sumps, and above-grade portions of concrete foundations. Portions of the concrete foundations located below grade were left buried, and some that had been previously slightly above grade were covered with fill material. All materials, including the soil in those areas, were flashed; the area was then rough-graded. The decontamination process was also to have included the burning of excavated nitroaromatic-filled flumes (Dames & Moore, Inc., 1997).

NASA has operated and maintained the former PBOW property since 1963, and the facility is currently the NASA Glenn Research Center, Plum Brook Station. NASA operates the property as a space research facility in support of the John H. Glenn Research Center at Lewis Field, Cleveland, Ohio. Most of the aerospace testing facilities built in the 1960s at the site are currently on standby or inactive status. On April 18, 1978, NASA declared approximately 2,152 acres of PBOW as excess. This excess included former buffer areas that had not been used by the Army and thus were not subject to decontamination efforts. The Perkins Township Board of Education acquired 46 acres of the excess acreage and uses this area as a bus transportation area. The GSA retains ownership of the remaining excess acreage and currently has a use agreement

with the Ohio National Guard for 604 acres of this land. The details of land transactions are listed in the site management plan (ICI, 1995).

1.3 Coal Yard No. 2 Site History

Three power stations, Powerhouse No. 1, Powerhouse No. 2, and Powerhouse No. 3, were constructed and utilized to support the TNT manufacturing processes. Each power station consisted of a main powerhouse, a coal storage area (coal yard), and two aboveground fuel storage tanks. The fuel storage tanks were surrounded by a berm to contain any potential spills or leaks. Each powerhouse building consisted of a boiler house, compressor room, electrical room, filter room, and locker room. Each building also contained two to four large coal-burning boilers, a turboelectric generator, a feed water treatment system, and several steam-driven or electric air compressors. The generated steam was used for space heating, driving compressors, and generating electrical power. The coal yards were used as storage areas to provide coal for the powerhouse boilers. The coal was brought into the yards via train. Figure 1-2 shows the location of Coal Yard No. 2 and other investigative sites on PBOW property.

Coal Yard No. 2 is located immediately to the northeast of Powerhouse No. 2. The former coal yard is estimated to have been approximately 200 feet wide by 290 feet in length, or approximately 1.3 acres. Demolition of the former Powerhouse No. 2 building by NASA in fall of 2010 resulted in some disturbance of surface soil and vegetation, and the area has been filled and regraded, primarily in areas outside of the footprint of the former coal yard. The site was observed to be covered with bare soil during a site visit on September 1, 2011, but plant shoots were observed to be emerging, suggesting that the site will likely naturally revegetate in the near future. Small amounts of coal were observed on the ground surface of Coal Yard No. 2 in isolated areas during previous site walks.

The vicinity of Coal Yard No. 2 was first investigated by Morrison Knudsen Corporation (MK) in 1993 during a site inspection (SI), when the coal yard was mistaken as a former burning ground and called “Burn Ground 1” (MK, 1994). Two surface soil samples were collected with a hand auger from the first 2 feet of soil and analyzed for nitroaromatics, volatile organic compounds, semivolatile organic compounds, and inorganics. The MK study concluded that all detected organic and inorganic constituents were below quantitation limits or otherwise at low concentrations.

1.4 Protocol for the Baseline Human Health Risk Assessment

The BHHRA Addendum was performed consistent with the AP2 BHHRA work plan (Shaw, 2010a). The AP2 BHHRA work plan was developed consistent with previous PBOW BHHRAs

and is based on EPA, USACE, and Ohio Environmental Protection Agency (OEPA) guidance, including, but not limited to, the following:

- OEPA, 2009a, ***Use of U.S. EPA's Regional Screening Levels as Screening Values in Human Health Risk Assessments***, Technical Decision Compendium, Division of Emergency and Remedial Response, August.

- OEPA, 2009b***, Human Health Cumulative Carcinogenic Risk and Non-carcinogenic Hazard Goals for the DERR Remedial Response Program***, Technical Decision Compendium, Division of Emergency and Remedial Response, August.

- USACE, 1999, ***Risk Assessment Handbook, Volume I: Human Health Evaluation***, Engineer Manual EM 200-1-4.

- EPA, 1989, ***Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)***, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., EPA/540/1-89/002.

- EPA, 1991, ***Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance, Standard Default Exposure Factors***, Interim Final, Office of Solid Waste and Emergency Response, OSWER Directive: 9285.6-03.

- EPA, 1992, ***Guidance on Risk Characterization for Risk Managers and Risk Assessors***, Memorandum from F. Henry Habicht II, Deputy Administrator, to Assistant Administrators, Regional Administrators, February.

- EPA, 1997, ***Exposure Factors Handbook***, Office of Research and Development, National Center for Environmental Assessment, Washington, D.C., EPA/600/P-95/002Fa, August.

- EPA, 2002, ***Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites***, Office of Solid Waste and Emergency Response, Washington, D.C., 9355.4-24, December.

- EPA, 2004a, ***Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part E - Supplemental Guidance for Dermal Risk Assessment)***, Final, Office of Superfund Remediation and Technology Innovation, Washington, D.C., EPA/540/R-99/005, July.

2.0 Data Evaluation

Data evaluation consists of a description of the appropriate data sources for Coal Yard No. 2 soil, a discussion of data quality, a description of the methodology used for identification of the chemicals of potential concern (COPC), and a summary of the COPCs.

2.1 Data Sources

All soil samples from which the validated analytical data used in the BHHRA Addendum were derived are presented in Table 2-1. The sample summary table identifies each sample used in the BHHRA Addendum and the associated analytical suite, which are those collected as part of the remedial investigation in 2011 and described in the Coal Yard No. 2 site characterization report (Shaw, 2012). The results from the SI samples described in Section 1.3 were not used in the BHRRA because of uncertainty as to the sample locations, the age of the sample results (20 years), and the observation that the analytes detected in these SI samples were each reported at concentrations less than concentrations observed in the samples collected for this remedial investigation . All Coal Yard No. 2 sampling locations are shown on Figure 1-3.

2.2 Organization of the Analytical Data

Prior to initiation of BHHRA calculations, a database of chemicals present in site soil samples was compiled. This database includes all chemicals detected as described in the site characterization report. The surface soil and subsurface soil are considered separate media. Surface and subsurface soil data are typically combined to assess exposures under the construction worker, future groundskeeper, and hypothetical future residential site-use scenarios, which would likely occur after surface and subsurface soil had been excavated and/or mixed, assuming that COPCs are identified for surface and/or subsurface soil in the BHHRA Addendum. Combined surface and subsurface soil data are generally termed “total soil” in the BHHRA. If a chemical is either a surface soil COPC or a subsurface soil COPC (or both), then that chemical is a total soil COPC.

Generally, surface soil is defined as samples collected from within the interval of 0 to 1 foot below ground surface, and subsurface soil is defined as samples collected from depths greater than 1 foot below ground surface per the work plan (Shaw, 2011). All Coal Yard No. 2 surface soil samples were collected within the 0-to-1-foot interval and subsurface soil samples were collected from either the 3-to-5-foot or 8-to-10-foot interval.

2.3 Evaluation of Data Quality

The quality of the analytical data was evaluated to select data for inclusion in the BHHRA Addendum. Data quality is expressed by the assignment of qualifier codes during the analytical laboratory quality control process or during third-party data evaluation. Some of the more common qualifiers and their meanings are as follows (EPA, 1989):

U - Chemical was analyzed for but not detected; the associated value is the sample quantitation limit.

J - Value is estimated, usually below the reporting limit.

N - The analysis indicates an analyte for which there is presumptive evidence to make a tentative identification.

NJ - The analysis indicates a "tentatively identified analyte," and the reported value represents its approximate concentration.

UJ - The analyte was not detected above the reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R - Quality control indicates that the data are unusable (chemical may or may not be present).

B - The concentration in the sample is not sufficiently higher than the concentration in the blank, using the 5-times, 10-times rule, which states that a chemical is considered a nondetect unless its concentration exceeds 5 times the blank concentration. For common laboratory contaminants (acetone, 2-butanone [methyl ethyl ketone], methylene chloride, toluene, and the phthalate esters), the sample concentration must exceed 10 times the blank concentration to be considered a detection.

"J," "N," and "NJ" qualified data are treated in the BHHRA Addendum as detected concentrations; "R" data and "B" qualified chemical data are not used. "U" qualified data (nondetects) are treated in the BHHRA Addendum as nondetections. The use of data with other, less common qualifiers is evaluated on a case-by-case basis. Generally, data for which the identity of the chemical is unclear are not used in the BHHRA. If confidence is reasonably high that the chemical is present but the actual concentration is somewhat in question, the data generally are used in the BHHRA.

Some chemicals may be analyzed under two different analytical programs. For example, the DNT isomers are analyzed by EPA Method 8330 for nitroaromatics as well as EPA Method

8270C for semivolatile organic compounds. As appropriate, risks associated with the reported values from both analyses are typically considered in the risk characterization and discussed as appropriate in the uncertainty analysis, together with potential issues such as the relative sensitivities (i.e., differences in respective reporting limits) of the methods.

2.4 Identification of Chemicals of Potential Concern

A screening process is used to identify COPCs, which are the detected chemical analytes carried through the full risk assessment process. The objectives of COPC screening are to focus the risk assessment on those chemicals that may contribute significantly to overall risk and to remove from quantification those chemicals whose contribution is clearly inconsequential. COPC screening includes a risk-based screen which also considers status as a human nutrient (Section 2.4.1), a frequency-of-detection evaluation (Section 2.4.2), and a background screen (Section 2.4.3).

2.4.1 Risk-Based Screening

In the risk-based screen, the maximum detected concentration (MDC) of a chemical in a given medium is compared to the appropriate risk-based screening concentration (RBSC) for that chemical and medium. This is performed for each chemical in each medium. The units of the MDC and RBSC are the same for each chemical in a given medium. For Coal Yard No. 2, only soil is evaluated; therefore, all MDCs and RBSCs are in units of milligrams per kilogram (mg/kg).

If the MDC of a chemical is less than or equal to its RBSC, then the chemical is not considered further in the BHHRA for this medium because it is very unlikely that chemical concentrations at or below the RBSC would contribute substantially to risk. Where no COPCs for an environmental medium are identified, that medium is not quantitatively evaluated in the BHHRA. An analyte may be identified as a COPC if its MDC exceeds its RBSC. As indicated in Section 2.4, actual status as a COPC also depends on a chemical's frequency of detection (Section 2.4.2), concentration with respect to background (Section 2.4.3), and potential status as a nutrient. RBSCs for both surface and subsurface soil are derived from EPA regional screening level (RSL) "residential soil" values (EPA, 2012a). This is a change in the source of the RBSCs for PBOW BHHRA work plans begun prior to March 2009 based on discussion between USACE and OEPA (2009c), and this change is consistent with current OEPA (2009a) guidelines. Previously, the RBSCs were derived from the EPA (2004b) Region 9 preliminary remediation goals.

RSL values are based on a concentration equal to either an incremental lifetime cancer risk (ILCR) of 1E-6 or a noncancer hazard quotient (HQ) of 1, the threshold at (or below) which adverse noncancer effects are regarded as unlikely to occur. For the BHHRA, the noncancer values listed in the RSL tables are multiplied by a factor of 0.1 to provide additional protection for simultaneous exposure to multiple chemicals (OEPA, 2009a; EPA, 2012b). This results in RBSC values associated with an HQ of 0.1. For cancer risk, the RSL values based on an ILCR of 1E-6 were used directly as RBSCs in the BHHRA Addendum. The National Oil and Hazardous Substances Pollution Contingency Plan under the Comprehensive Environmental Response, Compensation, and Liability Act identifies acceptable exposure levels that are generally associated with concentration levels that represent an excess upper bound lifetime cancer risk to an individual of 1E-6 to 1E-4 (EPA, 1990). Cancer risks associated with RSL values represent the lower end of this range. OEPA recognizes an overall cancer risk of 1E-5, which represents the logarithmic midpoint of the EPA risk management range, as a remedial goal (OEPA, 2009b). The RBSC for a chemical that elicits both cancer and noncancer health effects is selected based on either a cancer risk of 1E-6 or an HQ of 0.1, whichever associated concentration is lower.

The screening of lead in soil is a special case. Lead exposure and risk is evaluated separately from other chemicals using the EPA (2004c) Integrated Exposure Uptake Biokinetic (IEUBK) model. This IEUBK model includes cumulative lead exposure from multiple media, primarily soil and drinking water exposure. The residential RSL for lead in soil is 400 mg/kg, which is used in the BHHRA as the RBSC. The selection of the action level for lead in drinking water (EPA, 2012c) as the drinking water RSL is based partly on the IEUBK model. Section 5.2 of the RSL user's guide (EPA, 2012b) states that if the average tap water concentration exceeds 15 micrograms per liter (µg/L) and the average soil concentration exceeds 250 mg/kg, then more than the IEUBK target (EPA, 2004c) of 5 percent of the population of exposed children may exceed 10 micrograms per deciliter of lead in blood. It is possible that the residential soil RSL of 400 mg/kg, which is selected as the soil RBSC, may not be protective of an average soil concentration of 250 mg/kg within a given data set. Therefore, the following conditions were placed on the screening of lead: 1) If either the soil RBSC or the drinking water action level for lead is exceeded, then the IEUBK blood-lead model is run using both average soil and groundwater concentrations, and 2) if the average soil concentration exceeds 250 mg/kg, then the IEUBK model is run, even if neither the soil RBSC nor the drinking water action level is exceeded, using average concentrations of lead in both soil and groundwater. Although groundwater is not evaluated specifically in this BHHRA Addendum, the average lead concentration in AP2 overburden/shale (2.5 µg/L) is less than 15 µg/L, and lead was not detected in AP2 bedrock groundwater (Shaw, 2010b).

For Coal Yard No. 2 soil, the MDCs for lead in surface soil (13.2 mg/kg) and subsurface soil (15.3 mg/kg) are both less than the RBSC (400 mg/kg) and the criterion for average concentration (250 mg/kg).

The evaluation of essential nutrients is a special form of risk-based screening applied to certain ubiquitous elements that are generally considered to be required human nutrients. Essential nutrients such as calcium, chloride, iodine, magnesium, phosphorous, potassium, and sodium are generally considered innocuous at levels found in environmental media. No RSLs are listed for these nutrients. Should any of these chemicals be identified as site related, an exposure analysis is performed whereby a daily dose of chemical from ingestion of the medium in question is calculated. The dose is compared with levels known or expected to be safe or toxic, and/or with recommended daily allowances, depending on the availability of data.

2.4.2 Frequency of Detection

When confidence is high that a given chemical is present, the data generally are used in the BHHRA. For most chemicals, their detection is presumptive evidence of their presence. As suggested by EPA (1989), chemicals that are reported infrequently may be artifacts in the data that do not reflect the actual presence of the chemical in question. For the BHHRA, chemicals that are reported only at low concentrations in less than 5 percent of the samples from a given medium are excluded from further consideration, unless the presence of a given chemical is expected based on historical information about the site. Chemicals detected infrequently at high concentrations may identify the existence of contaminant plumes or limited "hot spots" and are retained as COPCs.

2.4.3 Comparison to Background

A number of the chemicals detected in PBOW soils may have MDCs that exceed RBSCs but are part of normal background concentrations. Such chemicals may include inorganics and polycyclic aromatic hydrocarbons (PAH), a class of organic compounds which form from natural or anthropogenic combustion of organic matter, including fossil fuels, and are generally ubiquitous in the environment. Airborne PAHs associated with non-U.S. Department of Defense sources may be deposited on soil.

Concentrations of inorganic chemicals in site environmental media may be compared to those of PBOW background using a two-step approach: 1) background screening and 2) statistical data set testing. This second step (Section 2.4.3.2) is initiated only in cases where the concentration used for background screening is exceeded (Section 2.4.3.1) and is performed after the risk

characterization. The results of the statistical data testing are discussed in the uncertainty analysis.

Inorganics and organics are treated similarly from a quantitative perspective. However, all organics not eliminated on the basis of RBSC exceedance (Section 2.4.1) or infrequent detection (Section 2.4.2) are carried through the risk calculation process (exposure assessment, toxicity assessment, and risk characterization). As presented in Section 2.4.3.3, organic compounds are quantitatively eliminated as background related only through the uncertainty analysis if applicable.

2.4.3.1 Background Screening of Inorganics

Background screening is applied to each inorganic with an MDC in soil exceeding the RBSC and that cannot be characterized as an infrequently detected analyte. In background screening, the MDC is compared to the PBOW chemical-specific background screening concentration (BSC). The background data set and derivation of soil BSCs for all PBOW soil investigations are described in IT (1998) (Table 2-2). The background screening protocol used for Coal Yard No. 2 is based on PBOW Project Delivery Team (PDT) agreements (PBOW PDT, 2000) and differs somewhat from the current OEPA (2009d) guidance. Use of this PBOW PDT method for the development of BSCs and as part of the COPC screening process ensures consistency between all of the PBOW FUDS project sites. Summary tables of the background soil data set for soil are provided as Table 2-2. The background soil samples were collected from near the property boundary, away from any potential source areas. Briefly, BSCs were calculated for use at PBOW based on concentrations found in these background soil samples. Each BSC is either the MDC or the calculated 95th percent upper tolerance limit of the background data set, whichever value is lower (IT, 1998; PBOW PDT, 2000).

The background screening consists of comparing the MDC of the site soil data set to the BSC. The chemical may be regarded as a COPC if its MDC exceeds the BSC for that chemical or if no BSC can be determined due to a lack of detections in the background data set. COPCs are fully evaluated in the exposure assessment, toxicity assessment, and risk characterization. An inorganic analyte is not regarded as a COPC if its MDC is equal to or less than the BSC.

2.4.3.2 Statistical Data Set Testing of Inorganics

Statistical testing is performed to compare data sets of site inorganics data against the appropriate PBOW background data sets. The background data set for soil is described in Section 2.4.3.1 and presented in the site investigation for the acid areas (IT, 1998). The method for statistical comparison of the site data sets to the background data sets, described in Appendix M of Shaw

(2005), is the Wilcoxon Rank Sum (WRS) statistical test (also known as the Mann-Whitney U test). WRS testing is performed for inorganics having MDCs that exceed the respective BSCs and are identified as COPCs based on RBSC comparison (Section 2.4.1) and frequency of detection (Section 2.4.2). All COPCs are carried through the risk characterization process; thus, statistical testing results are not used to screen out any chemicals. WRS testing is used only to evaluate inorganic COPCs and is not used to evaluate non-COPC inorganics.

2.4.3.3 Treatment of Organic Compounds

Certain organic compounds (e.g., PAHs) in site media may be attributable to background conditions. However, no organic compounds are summarily screened out. Instead, all detected organic compounds are carried through the risk assessment process (i.e., exposure assessment, toxicity assessment, risk characterization) unless screened out on the basis of comparison to RBSCs (Section 2.4.1) or characterized as infrequently detected (Section 2.4.2). Background contributions of organics are discussed in the uncertainties analysis, as applicable.

2.5 Data Evaluation Summary

Data summary tables are provided for Coal Yard No. 2 surface soil in Table 2-3 and for Coal Yard No. 2 subsurface soil in Table 2-4. These tables provide the following information for each detected chemical as applicable:

- Chemical name
- Frequency of detection
- Range of detected concentrations
- Range of reporting limits
- Arithmetic mean of site concentrations
- Appropriate BSC
- Appropriate RBSC
- Selection/exclusion of chemical as a COPC
- 95th percent upper confidence limit on the arithmetic mean (for COPCs only)
- Exposure point concentration (for COPCs only).

As shown in Tables 2-3 and 2-4, none of the chemicals detected in Coal Yard No. 2 surface soil or subsurface soil are COPCs. RBSCs are used to screen for human health risks at an ILCR of 1E-6 and an HQ of 0.1. Chemicals with ILCRs and HQs less than these respective levels are identified in the work plan (Shaw, 2010a) as having insignificant contributions to risk/hazard. This indicates that the cancer risks and noncancer hazards associated with exposure to Coal Yard No. 2 soils are negligible and/or are not greater than those associated with background soils. Therefore, a quantitative risk assessment (exposure assessment, toxicity assessment, and risk characterization [EPA, 1989]) is not necessary and was not performed.

3.0 Summary and Conclusions

3.1 Summary

The BHHRA Addendum was conducted to evaluate cancer risk and noncancer hazards associated with Coal Yard No. 2 surface soil and subsurface soil. A COPC identification process, which includes both risk-based screening and background screening components, was performed to identify chemicals detected in Coal Yard No. 2 soil that may contribute appreciably to risk or hazard. The chemicals detected in surface and subsurface soil were screened against the respective residential exposure-based RBSCs, and inorganics in soil were also screened against BSCs. COPCs for the various media are typically identified based on this screening.

3.2 Conclusions

None of the chemicals detected in Coal Yard No. 2 surface soil or subsurface soil were identified as COPCs. The results of the COPC screening indicate that the risks/hazards associated with chemicals detected in Coal Yard No. 2 soils are negligible and/or are related to background soil conditions. Accordingly, a quantitative risk assessment beyond the COPC screening is unnecessary for Coal Yard No. 2 soils.

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TABLES

Table 2-1

Soil SampleSummary
Baseline Human Health Risk Assessment Addendum for Coal Yard No. 2
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Location	Sample Number	Sample Purpose	Sample Date	Depth of Sample (ft bgs)			Analysis
CY2-SB01	CY0015	REG	10/27/2011	0.5	-	1	Explosives, Gen Chem, Metals, SVOC
CY2-SB01	CY0016	FD	10/27/2011	0.5	-	1	Explosives, Gen Chem, Metals, SVOC
CY2-SB01	CY0016	FS	10/27/2011	0.5	-	1	PCB [a]
CY2-SB01	CY0018	REG	10/27/2011	3	-	5	Explosives, Gen Chem, Metals, SVOC
CY2-SB01	CY0019	REG	10/27/2011	8	-	10	Explosives, Gen Chem, Metals, Pest, PCB, SVOC
CY2-SB02	CY0020	REG	10/27/2011	0.5	-	1	Explosives, Gen Chem, Metals, Pest, PCB, SVOC
CY2-SB02	CY0021	REG	10/27/2011	3	-	5	Explosives, Gen Chem, Metals, Pest, PCB, SVOC
CY2-SB02	CY0022	REG	10/27/2011	8	-	10	Explosives, Gen Chem, Metals, SVOC
CY2-SB02	CY0023	FD	10/27/2011	8	-	10	Explosives, Gen Chem, Metals, SVOC
CY2-SB03	CY0025	REG	10/26/2011	0.5	-	1	Explosives, Gen Chem, Metals, Pest, PCB, SVOC
CY2-SB03	CY0026	REG	10/26/2011	3	-	5	Explosives, Gen Chem, Metals, Pest, PCB, SVOC
CY2-SB03	CY0027	REG	10/26/2011	8	-	10	Explosives, Gen Chem, Metals, SVOC
CY2-SB04	CY0028	REG	10/26/2011	0	-	1	Explosives, Gen Chem, Metals, Pest, PCB, SVOC
CY2-SB04	CY0029	REG	10/26/2011	3	-	5	Explosives, Gen Chem, Metals, Pest, PCB, SVOC
CY2-SB04	CY0030	REG	10/26/2011	8	-	10	Explosives, Gen Chem, Metals, SVOC

[a] The field split sample PCB results were used for surface soil location CY2-SB01 because PCBs were inadvertently not analyzed in the original sample as the result of a paperwork error.

ft bgs - feet below ground surface
FD - Field duplicate; averaged with regular sample.
Exp - Explosives.
PCB - Polychlorinated biphenyls.
REG - Regular sample.
SVOC - Semivolatile organic compounds.

Table 2-2

Background Screening Concentrations of Inorganics in Soil
Baseline Human Health Risk Assessment for Coal Yard No. 2
Former Plum Brook Ordnance Works, Sandusky, Ohio

Chemical Name (mg/kg)	Frequency of Detection	Range of Detected Concentrations	Range of Reporting Limits [a]	Statistical Distribution	Arithmetic Mean	95% UTL [b]	Background Screening Concentration [c]
Aluminum	12 / 12	3520 - 15500	22.6 - 26.5	L	8.43E+03	2.69E+04	15500
Antimony	9 / 25	5.9 - 9.3	5.4 - 8.0	NP	4.68E+00	NA	9.30
Arsenic	23 / 26	2.1 - 36.5	1.1 - 24.7	L	1.08E+01	7.10E+01	36.5
Barium	9 / 12	35.6 - 826	22.6 - 26.5	L	1.16E+02	1.30E+03	826
Beryllium	6 / 25	0.57 - 1	0.57 - 1.2	L	5.65E-01	1.17E+00	1.00
Cadmium	0 / 25	NA	0.57 1.2	L	4.49E-01	NA	NA
Calcium	12 / 12	735 - 52300	566 - 663	L	1.13E+04	2.18E+05	52300
Chromium	25 / 26	4.4 - 29	1.1 - 12.3	NP	1.34E+01	NA	29.0
Cobalt	9 / 12	9.6 - 116	5.7 - 61.7	L	2.26E+01	2.48E+02	116
Copper	23 / 26	2.3 - 56.2	2.2 - 3.3	L	1.70E+01	1.47E+02	56.2
Iron	12 / 12	5880 - 234000	11.3 - 123	L	4.01E+04	3.58E+05	234000
Lead	26 / 26	1.9 - 48.6	0.34 - 7.4	L	1.28E+01	5.13E+01	48.6
Magnesium	12 / 12	629 - 10400	566 - 663	L	3.26E+03	3.08E+04	10400
Manganese	26 / 26	21 - 13300	1.7 - 18.5	L	7.29E+02	3.51E+03	3506
Mercury	2 / 26	0.085 - 0.085	0.037 - 0.3	L	9.06E-02	5.60E-01	0.085
Nickel	26 / 26	5.4 - 55.1	4.5 - 5.3	L	2.28E+01	7.79E+01	55.1
Potassium	11 / 12	579 - 3390	566 - 663	L	1.24E+03	6.08E+03	3390
Selenium	5 / 25	0.61 - 2	0.57 - 4.9	NP	1.55E+00	NA	2.00
Silver	2 / 26	1.1 - 11.1	1.1 - 1.3	NP	1.00E+00	NA	11.1
Sodium	0 / 12	NA	566 - 663	L	3.03E+02	NA	NA
Thallium	2 / 25	1.2 - 1.3	1.1 - 6.1	NP	1.91E+00	NA	1.30
Vanadium	11 / 12	9 - 40.9	5.7 - 61.7	L	2.48E+01	8.31E+01	40.9
Zinc	26 / 26	6.6 - 655	0.57 - 12.3	L	7.30E+01	3.22E+02	322

L - Lognormal; mg/kg - milligrams per kilogram; NP - nonparametric; NA - not applicable; not available.

[a] A single background sample had to be diluted such that the reporting limits of this sample (BCG-SB01, 6990) were elevated 10 or 20 times higher than they would have been if not diluted. This affects the maximum reporting limit shown for arsenic, chromium, cobalt, iron, lead, manganese, and vanadium. Reporting limits for these analytes in all other samples were much lower, approximately by an order of magnitude or more in each case.

[b] 95% UTL - 95% upper tolerance limit calculated as described in IT Corporation (IT), 1998, *Site Investigation of Acid Areas, Plum Brook Ordnance Works, Sandusky, Ohio* , August.

[c] The maximum detected concentration is used as the background screening criterion for nonparametric data sets; for normal or lognormal data sets, the 95% UTL or the maximum detected concentration, whichever is less, is used. This approach was agreed upon for all future risk assessments by the Plum Brook Ordnance Works Project Delivery Team (PDT) during the May 10, 2000 PDT meeting.

Note: Detection limits from sample 6990 were deleted when calculating results for antimony, beryllium, cadmium, selenium, and thallium. The detection limits were elevated by dilution factors which greatly exceed any detected concentration and would bias results unrealistically high.

Source: IT, 2001, *TNT Areas A and C Remedial Investigation, Volume 2 Baseline Human Health Risk Assessment* , Final, Former Plum Brook Ordnance Works, Sandusky, Ohio,November, and reports referenced therein, including IT (1998).

Table 2-3

Statistical Summary and Selection of Chemicals of Potential Concern in Surface Soil
Baseline Human Health Risk Assessment Addendum for Coal Yard No. 2
Former Plum Brook Ordnance Works, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Detected Concentrations Maximum	VQ	Method Detection Limit Minimum	Method Detection Limit Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg		COPC? [c,d]
Inorganics													
Aluminum	4 / 4	100	6.65E+03		1.13E+04	J	9.10E-01	3.34E+00	8.78E+03	1.55E+04	7700		N (b)
Antimony	1 / 4	25	2.50E-01	J	2.50E-01	J	4.60E-02	2.50E-01	2.28E-01	9.30E+00	3.1		N (b)
Arsenic	4 / 4	100	6.10E+00		1.35E+01		4.60E-02	2.50E-01	1.05E+01	3.65E+01	0.39		N (b)
Barium	4 / 4	100	3.52E+01		6.80E+01		1.90E-01	1.00E+00	5.71E+01	8.26E+02	1500		N (b)
Beryllium	4 / 4	100	2.70E-01		7.70E-01	J	4.60E-03	2.50E-02	4.70E-01	1.00E+00	16		N (b)
Cadmium	1 / 4	25	7.20E-01		7.20E-01		4.60E-03	2.50E-02	1.97E-01	NA	7		N (a)
Calcium	4 / 4	100	1.27E+03		6.28E+03	J	2.30E+00	1.30E+01	3.17E+03	5.23E+04	Nutrient		N (c)
Chromium	4 / 4	100	1.04E+01		2.20E+01		4.60E-02	2.50E-01	1.63E+01	2.90E+01	0.29		N (b)
Cobalt	4 / 4	100	3.50E+00		1.10E+01	J	4.60E-02	2.50E-01	6.50E+00	1.16E+02	2.3		N (b)
Copper	4 / 4	100	1.12E+01		2.44E+01		4.60E-02	2.50E-01	2.04E+01	5.62E+01	310		N (b)
Iron	4 / 4	100	1.64E+04		3.43E+04		1.10E+00	5.80E+00	2.57E+04	2.34E+05	5500		N (b)
Lead	4 / 4	100	7.40E+00		1.32E+01		3.80E-02	5.10E-02	1.03E+01	4.86E+01	400		N (b)
Magnesium	4 / 4	100	1.81E+03		3.69E+03		2.30E+00	1.30E+01	2.76E+03	1.04E+04	Nutrient		N (c)
Manganese	4 / 4	100	8.11E+01		2.24E+02		4.60E-02	2.50E-01	1.32E+02	3.51E+03	180		N (b)
Mercury	4 / 4	100	3.40E-02	J	4.50E-02	J	6.20E-03	6.90E-03	3.93E-02	8.50E-02	2.3		N (b)
Nickel	4 / 4	100	1.07E+01		2.83E+01		4.60E-02	2.50E-01	2.04E+01	5.51E+01	150		N (b)
Potassium	4 / 4	100	4.72E+02		7.07E+02	J	2.30E+00	1.30E+01	6.11E+02	3.39E+03	Nutrient		N (c)
Selenium	3 / 4	75	9.10E-01	J	1.70E+00	J	3.80E-01	4.65E+00	2.09E+00	2.00E+00	39		N (b)
Silver	1 / 4	25	8.80E-02	J	8.80E-02	J	4.60E-02	2.50E-01	1.87E-01	1.11E+01	39		N (b)
Sodium	1 / 4	25	5.26E+01	J	5.26E+01	J	3.90E+01	2.20E+02	1.54E+02	NA	Nutrient		N (c)
Vanadium	4 / 4	100	1.61E+01		3.24E+01		4.60E-02	2.50E-01	2.51E+01	4.09E+01	39		N (b)
Zinc	4 / 4	100	2.42E+01		6.78E+01		4.60E-02	2.50E-01	5.01E+01	3.22E+02	2300		N (b)
Semivolatile Organic Compounds													
Fluoranthene	2 / 4	50	3.10E-02	J	6.47E-02	J	1.90E-02	2.00E-02	3.37E-02		230		N (a)
Methylnaphthalene, 2-	1 / 4	25	4.29E-02	J	4.29E-02	J	1.90E-02	2.00E-02	2.55E-02		23		N (a)
Naphthalene	1 / 4	25	3.21E-02	J	3.21E-02	J	3.10E-02	3.20E-02	3.18E-02		3.6		N (a)
Phenanthrene	1 / 4	25	2.92E-02	J	2.92E-02	J	1.90E-02	2.00E-02	2.21E-02		170	e	N (a)
Pyrene	1 / 4	25	6.34E-02	J	6.34E-02	J	1.90E-02	2.00E-02	3.04E-02		170		N (a)

BSC - Background screening criterion.
COPC - Chemical of potential concern.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.

[a] Value is either the 95th percent upper tolerance limit or the maximum detcted value of the background data set, whichever is less. Source: IT Corporation (IT), 2000, *TNT Areas A and C Remedial Investigation, Volume 2 Baseline Human Health Risk Assessment* , Final, Former Plum Brook Ordnance Works, November, and reports
[b] Risk-Based Screening Concentrations based on USEPA Regional Screening Level Table (November 2012) residential soil values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.
[c] N = Chemical is not chosen as a COPC:
(a) = maximum detected concentration is less than the RBSC.
(b) = maximum detected concentration is less than the BSC.
(c) = essential nutrient.
[d] Y = Chemical is chosen as COPC.
[e] RBSC based on acenapthene.

Table 2-4

Statistical Summary and Selection of Chemicals of Potential Concern in Subsurface Soil
Baseline Human Health Risk Assessment Addendum for Coal Yard No. 2
Former Plum Brook Ordnance Works, Sandusky, Ohio

Chemical	Detection Frequency	Percent Detection	Range of Values, mg/kg: Detected Concentrations Minimum	VQ	Maximum	VQ	Reporting Limits Minimum	Maximum	Mean mg/kg	BSC [a] mg/kg	RBSC [b] mg/kg	COPC? [c,d]
Inorganics												
Aluminum	8 / 8	100	5.14E+03		8.50E+03		1.00E+00	5.40E+00	6.35E+03	1.55E+04	7700	N (b)
Arsenic	8 / 8	100	2.00E+00		1.15E+01		4.50E-02	2.50E-01	5.87E+00	3.65E+01	0.39	N (b)
Barium	8 / 8	100	3.52E+01		7.09E+01		1.80E-01	9.00E-01	5.37E+01	8.26E+02	1500	N (b)
Beryllium	8 / 8	100	3.60E-01	J	4.90E-01		9.65E-03	2.20E-02	4.44E-01	1.00E+00	16	N (b)
Cadmium	6 / 8	75	2.40E-01	J	8.90E-01		5.30E-03	2.50E-02	4.36E-01	NA	7	N (a)
Calcium	8 / 8	100	3.46E+04		6.07E+04		4.90E+00	1.10E+01	4.76E+04	5.23E+04	Nutrient	N (c)
Chromium	8 / 8	100	9.80E+00		1.67E+01		1.10E-01	2.50E-01	1.29E+01	2.90E+01	0.29	N (b)
Cobalt	8 / 8	100	5.50E+00		1.51E+01		5.30E-02	2.50E-01	8.88E+00	1.16E+02	2.3	N (b)
Copper	8 / 8	100	1.88E+01		2.64E+01		1.10E-01	2.50E-01	2.21E+01	5.62E+01	310	N (b)
Iron	8 / 8	100	1.71E+04		2.04E+04		2.25E+00	5.20E+00	1.89E+04	2.34E+05	5500	N (b)
Lead	8 / 8	100	8.30E+00		1.53E+01		4.30E-02	2.20E-01	1.24E+01	4.86E+01	400	N (b)
Magnesium	8 / 8	100	1.41E+04		2.37E+04		4.90E+00	1.10E+01	1.63E+04	1.04E+04	Nutrient	N (c)
Manganese	8 / 8	100	4.32E+02		8.16E+02		1.40E-01	2.50E-01	5.51E+02	3.51E+03	180	N (b)
Mercury	8 / 8	100	1.10E-02	J	4.00E-02	J	6.40E-03	7.70E-03	1.98E-02	8.50E-02	2.3	N (b)
Nickel	8 / 8	100	1.61E+01		4.00E+01		5.30E-02	2.50E-01	2.41E+01	5.51E+01	150	N (b)
Potassium	8 / 8	100	8.48E+02	J	1.45E+03		4.90E+00	1.10E+01	1.19E+03	3.39E+03	Nutrient	N (c)
Selenium	3 / 8	38	4.30E-01	J	1.15E+00	J	2.10E-01	4.90E-01	5.58E-01	2.00E+00	39	N (b)
Silver	5 / 8	63	5.30E-02	J	4.65E-01	J	4.50E-02	2.50E-01	1.74E-01	1.11E+01	39	N (b)
Sodium	4 / 8	50	1.14E+02	J	1.46E+02	J	8.35E+01	1.90E+02	1.53E+02	NA	Nutrient	N (c)
Thallium	1 8	13	3.90E-01	J	3.90E-01	J	1.50E-01	6.70E+00	1.83E+00	1.30E+00	0.078	N (b)
Vanadium	8 / 8	100	1.14E+01		2.49E+01		4.50E-02	2.50E-01	1.58E+01	4.09E+01	39	N (b)
Zinc	8 / 8	100	4.60E+01		6.37E+01		1.10E-01	2.50E-01	5.36E+01	3.22E+02	2300	N (b)
Semivolatile Organic Compounds												
Bis(2-ethylhexyl)phthalate	1 / 8	13	3.21E-01	J	3.21E-01	J	8.10E-02	8.60E-02	1.14E-01		35	N (a)

BSC - Background screening criterion.
COPC - Chemical of potential concern.
J - The compound/analyte was positively identified; the reported result is the estimated concentration of the compound/analyte detected in the sample analyzed.
mg/kg - Milligrams per kilogram.
RBSC - Risk-based screening concentration.
VQ - Validation qualifier.

[a] Value is either the 95th percent upper tolerance limit or the maximum detcted value of the background data set, whichever is less. Source: IT Corporation (IT), 2000, *TNT Areas A and C Remedial Investigation, Volume 2 Baseline Human Health Risk Assessment* , Final, Former Plum Brook Ordnance Works, November, and reports referenced therein.

[b] Risk-Based Screening Concentrations based on USEPA Regional Screening Level Table (November 2012) residential soil values and are based on a risk level of 1.0E-06 and a hazard index of 0.1.

[c] N = Chemical is not chosen as a COPC:
(a) = maximum detected concentration is less than the RBSC.
(b) = maximum detected concentration is less than the BSC.
(c) = essential nutrient.

[d] Y = Chemical is chosen as COPC.

FIGURES

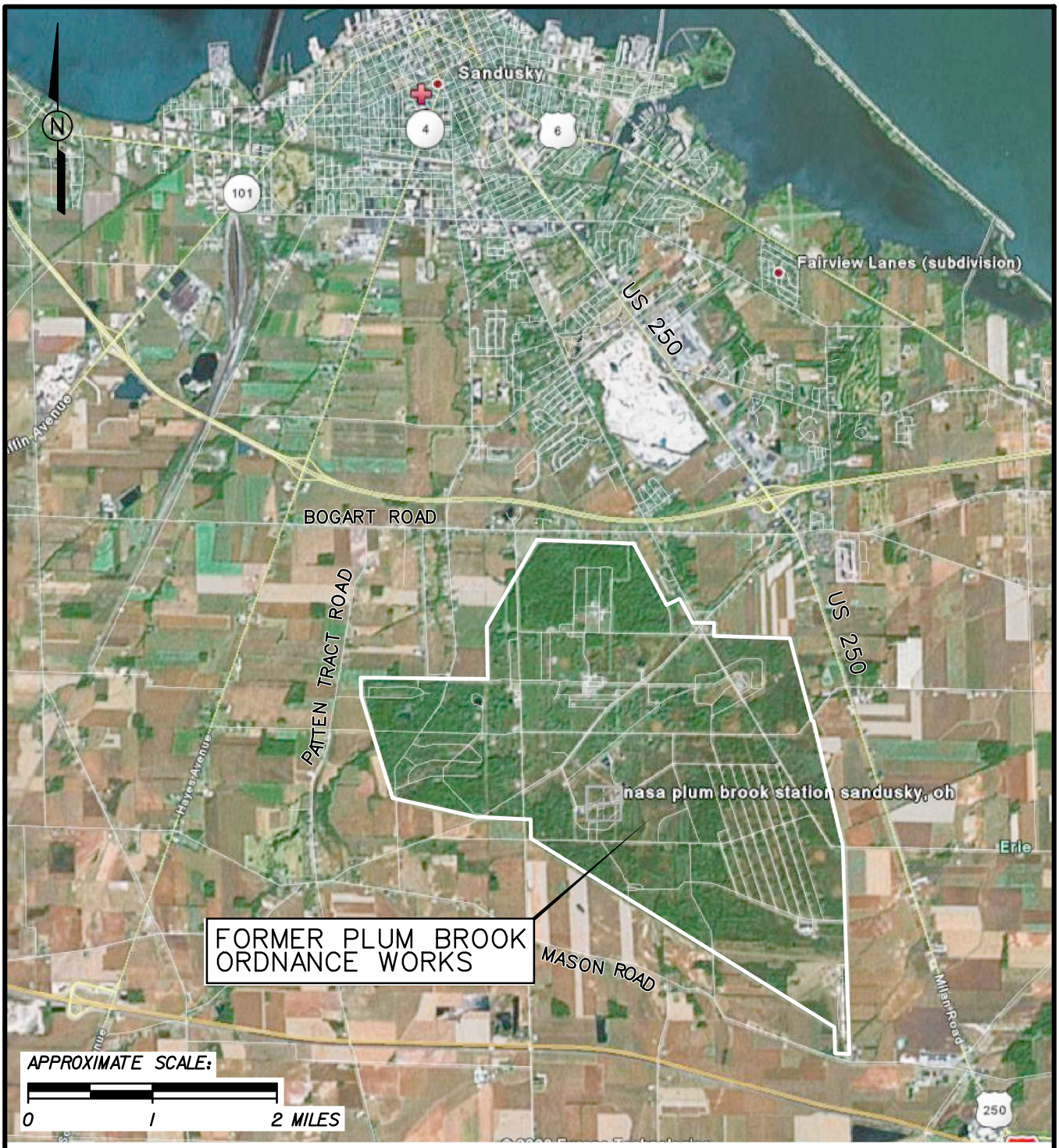

FIGURE 1-1
PBOW VICINITY MAP

POWERHOUSE No. 2 ASH PITS BASELINE HUMAN HEALTH RISK ASSESSMENT ADDENDUM FOR COAL YARD No. 2 FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

Shaw Environmental & Infrastructure, Inc.
(A CB&I Company)

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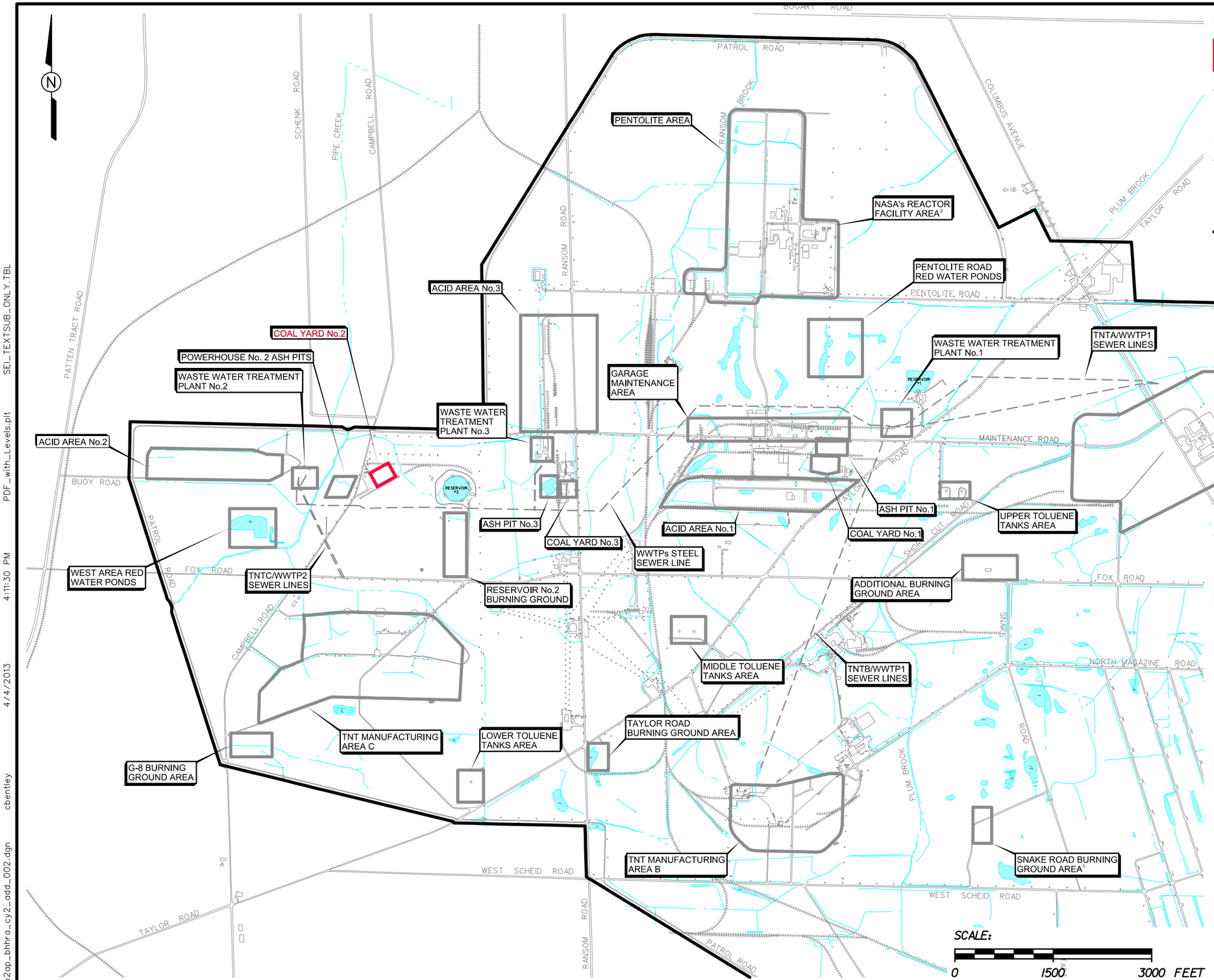

LEGEND:

- AREA OF CONCERN
- APPROXIMATE LOCATION OF SEWER LINES
- POND
- CREEK, DITCH, CONVEYANCE
- RAILROAD
- ROAD
- FENCE
- FACILITY BOUNDARY

NOTES:

1. SNAKE ROAD BURNING GROUND AREA WAS ALSO REFERRED TO AS "SNAKE ROAD BURN PIT", "SCHEID ROAD BURNING GROUNDS", AND "DISPOSAL AREA THREE".
2. REACTOR FACILITY CONSTRUCTED BY NASA POST WWII AND IS IDENTIFIED FOR LOCATION PURPOSES ONLY. DEMOLITION COMPLETED IN 2012.

FIGURE 1-2
LOCATION OF COAL YARD No. 2 AT PBOW

POWERHOUSE No. 2 ASH PITS BASELINE HUMAN HEALTH RISK ASSESSMENT ADDENDUM FOR COAL YARD No. 2 FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

Shaw Environmental & Infrastructure, Inc.
(A CB&I Company)

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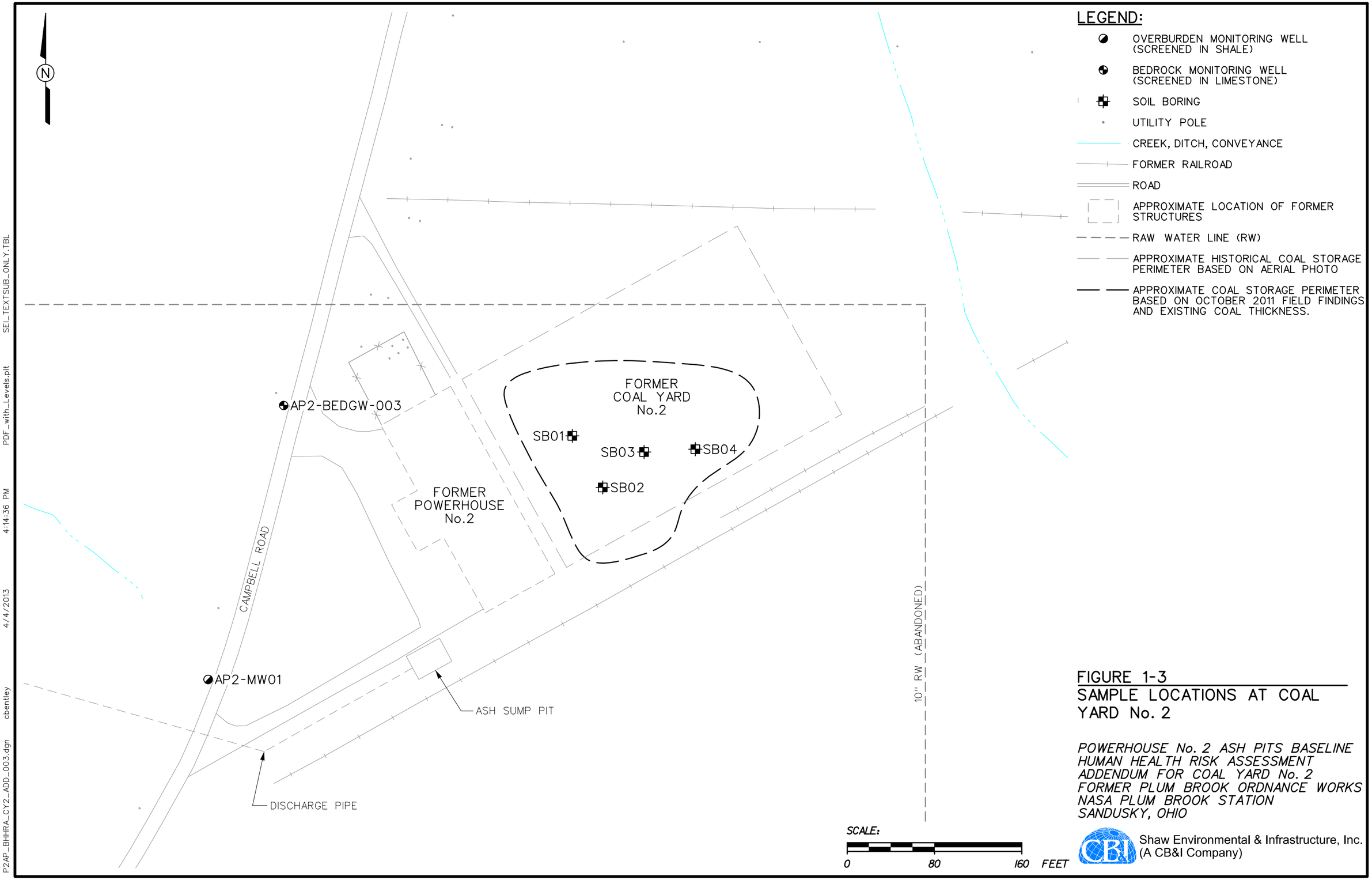

FIGURE 1-3
SAMPLE LOCATIONS AT COAL YARD No. 2

POWERHOUSE No. 2 ASH PITS BASELINE HUMAN HEALTH RISK ASSESSMENT ADDENDUM FOR COAL YARD No. 2 FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

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RESPONSE TO COMMENTS

Responses to Ohio Environmental Protection Agency Comments on the Baseline Human Health Risk Assessment and Screening Level Ecological Risk Assessment for Powerhouse No. 2 Ash Pits Addendum for Coal Yard No. 2 Former Plum Brook Ordnance Works, Sandusky, Ohio, Dated April 11, 2013

Comments by Janusz Byczkowski, Risk Assessor, Ohio Environmental Protection Agency, received May 17, 2013.

BHHRA Comments

Comment 1: **Section ES-1, Line 6.** The BHHRA document states: "*…consistent with methodologies described in the U.S. Environmental Protection Agency's primary risk assessment guidance documents, the site-specific work plan, and discussions and agreements between the Ohio Environmental Protection Agency, the U.S. Army Corps of Engineers Nashville…*"

The issue of determining background and the "agreement" was already discussed in previous reviews. Please note that no legally binding agreement has been made between OEPA and ACE or Shaw Environmental Inc., regarding risk assessment methodology at the NASA Plum Brook Site. Please delete reference to "agreements" with Ohio Environmental Protection Agency.

Response 1: The words "and agreements" will be removed from the indicated text.

BHHRA and SLERA Comments

Comment 2: **BHHRA Table 2-4 and SLERA Table 2-2.** From comparison of maximum detected concentrations of cadmium in soil in BHHRA Table 2-4 versus SLERA Table 2-2 (8.90E-01 vs. 8.10E-01 mg/kg, respectively) it is not clear which numerical value is correct.

Please verify and correct maximum detected concentration of cadmium in soil.

Response 2: The BHHRA and SLERA use different soil datasets to select COPCs/COPECs. The cadmium MDC for the BHHRA in Table 2-4 of 0.89 mg/kg was detected in sample CY0019, which was collected from the 8 to10 feet below ground surface (bgs) interval. Soil at this depth is not included in the SLERA, which only evaluates soil up to 6 feet bgs. Thus, the MDCs in the BHHRA and SLERA are different for chemicals such as cadmium that have higher concentrations in soil samples collected from a depth greater than 6 feet bgs.