Site-Specific Sampling and Analysis Plan Addendum
Surface Soil Delineation Sampling
Acid Area 1

Former Plum Brook Ordnance Works, Sandusky, Ohio

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List of Acronyms

AA1	Acid Area 1
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOD	U.S. Department of Defense
EPA	U.S. Environmental Protection Agency
FS	feasibility study
IDW	investigation-derived waste
IT	IT Corporation
Jacobs	Jacobs Engineering Group, Inc.
mg/kg	milligrams per kilogram
NASA	National Aeronautics and Space Administration
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyl
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RBDL	risk-based delineation level
RI	remedial investigation
SCR	site characterization report
Shaw	Shaw Environmental, Inc.
SSAP	site-specific sampling and analysis plan
SWSAP	sitewide sampling and analysis plan
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
VAAP	Volunteer Army Ammunition Plant

1.0 Project Description

The U.S. Army is conducting studies of the environmental impact of suspected hazardous waste sites at previously owned U.S. Department of Defense (DOD) properties. The former Plum Brook Ordnance Works (PBOW) is located in Sandusky, Erie County, Ohio (Figure 1-1). PBOW is being investigated under the Defense Environmental Restoration Program for Formerly Used Defense Sites. The investigation is being managed and technically overseen by the Nashville District of the U.S. Army Corps of Engineers (USACE). This 9,000-acre facility was used for the manufacture of explosives during World War II. The site is currently controlled and maintained by the National Aeronautics and Space Administration (NASA) and is operated as the Plum Brook Station of the John Glenn Research Center at Lewis Field.

This site-specific sampling and analysis plan (SSAP) addendum has been prepared by Shaw Environmental, Inc. (Shaw) for fieldwork to be carried out in support of the feasibility study (FS) for Acid Area 1 (AA1). Shaw was contracted to complete the FS subsequent to conclusion of the remedial investigation (RI) conducted by another contractor. Review of the RI indicated data gaps associated with the delineation of the extent of polychlorinated biphenyl (PCB) contamination. The results of the analytical data to be collected as described in this SSAP are supplemental to those collected and reported in the site characterization report (SCR) (Jacobs Engineering Group, Inc. [Jacobs], 2009).

AA1 is located in the north-central portion of PBOW, approximately 600 feet south of Maintenance Road between Taylor and Ransom Roads. This SSAP was developed in accordance with the PBOW sitewide sampling and analysis plan (SWSAP) (Shaw, 2008a) and the sitewide quality assurance project plan (QAPP) (Shaw, 2008b) to ensure that work performed at the subject site will be of the quality required to satisfy the overall and site-specific project objectives. A sitewide accident prevention plan/safety and health plan (Shaw, 2008c) has also been prepared for investigations at PBOW to help provide a safe work environment.

1.1 Plum Brook Ordnance Works Facility History

The PBOW site was built in early 1941 and manufactured 2,4,6-trinitrotoluene (TNT), dinitrotoluene, and pentolite. Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and dinitrotoluene processing lines began. Decontamination was completed during the last quarter of 1945, under the supervision of the Army Ordnance Department. The War Assets Administration accepted custody of the property (3,230 acres) except for the retained area, which is known as

the magazine area (2,800 acres), in 1946. The Department of the Army reacquired the 3,230 acres in 1954 and performed cleanup efforts during the 1950s through 1963. Two property use agreements were entered into by the National Advisory Committee of Aeronautics, the predecessor of NASA, and the Army in 1956 and 1958, respectively. In 1963, accountability and custody of the entire PBOW property (6,030 acres) was transferred to NASA by the Department of the Army. NASA has operated and maintained the PBOW site since 1963, and it is currently the NASA John Glenn Research Center, Plum Brook Station. Figure 1-2 shows the various PBOW areas of concern, including AA1.

1.2 Site History

Three acid areas were present at PBOW during TNT manufacturing: AA1, Acid Area 2, and Acid Area 3 (Jacobs, 2009). All three acid areas were used to produce oleum, sulfuric acid, and nitric acid for the manufacture of TNT. Records were not available to describe operations at the PBOW acid areas. However, records are available that describe similar acid production operations from another TNT manufacturing facility, Volunteer Army Ammunition Plant (VAAP), formerly located in Chattanooga, Tennessee. Manufacturing activities at VAAP began during the same time period as PBOW operations but extended into the 1970s. Acid production at all of the World War II-era ammunition plants are reported to have been fairly similar. The following paragraphs summarize acid production at VAAP.

Production of various concentrations of acids for use at the batch TNT processing lines consisted of five main operations:

- Weak nitric acid production
- Strong nitric acid production
- Reprocessing of spent sulfuric acid to produce strong sulfuric acid
- Oleum (sulfuric acid saturated with sulfur trioxide) production
- Mixed acid (strong nitric acid and oleum) production.

Weak nitric acid (60 percent nitric acid) was produced at the Ammonia Oxidation Process Building. Anhydrous ammonia used for the production of weak nitric acid was stored in tanks. Vapor compression to liquefy the ammonia was accomplished by compressors. Weak nitric acid was stored in area tank farms. The acid was then routed to the batch TNT process lines and to the Nitric Acid Concentrator facilities.

At the Nitric Acid Concentrator buildings, strong nitric acid (95 to 98 percent nitric acid) was produced. The process involved mixing weak nitric acid with strong sulfuric acid (93 percent

sulfuric acid) for dehydration of the nitric acid. The resultant strong nitric acid was mixed with oleum (a mixture of sulfuric acid and sulfur trioxide) to produce mixed acid, which was used in the batch TNT nitration process. After the nitric acid and oleum were combined, the mixed acid product was approximately one-half nitric acid and one-half sulfuric acid. This mixed acid was used in lieu of strong nitric acid in the batch process lines because less expensive carbon steel piping could be used to carry it rather than the more costly stainless-steel piping. Until needed, the mixed acid was stored in aboveground storage tanks.

The Sulfuric Acid Concentrator recycled sulfuric acid recovered from the TNT manufacturing process and the nitric acid concentrating process to yield strong sulfuric acid. The strong sulfuric acid was produced at two concentrations, 78 and 93 percent, and used in the production of oleum, the production of strong nitric acid, or sold and shipped off site as “sales acid.”

Oleum was used in the production of mixed acid or routed directly to the batch TNT process lines for use in the nitration process. At the Oleum Plant, sulfur was melted using steam, passed over a series of baffles to remove dirt, and stored in a lined pit. The molten sulfur was pumped into the Oleum Plant, where sulfur dioxide was formed by burning the sulfur. The sulfur dioxide was subsequently oxidized by a vanadium pentoxide catalyst to produce sulfur trioxide. A 40 percent oleum-sulfuric acid solution was produced by absorbing the sulfur trioxide in weak sulfuric acid supplied by the Sulfuric Acid Concentrator operations. Neutralized acid waste was discharged into an acid neutralizing pit, transferred to a holding pond, and eventually discharged into a ditch.

Similar facilities have been identified at PBOW. AA1 consisted of 8 buildings (Buildings 301 through 304, 306 through 308, and 310), 43 aboveground storage tanks, and 2 rail lines. No information was obtained during a records review conducted by IT Corporation (IT) to indicate the type of process conducted at each building; however, five storage areas were identified from the drawings: Oleum Storage (12 tanks), Concentrating Mix Storage (6 tanks), Sulfuric Acid Sales (12 tanks), TNT Residual Acid Storage (5 tanks), and Mixed Storage (8 horizontal tanks) (Figure 1-3). Based on the location of the oleum storage, sulfuric acid sales storage, and mixed storage in close proximity to the rail line, the stored material was likely transferred directly to and from tanker cars or containers on a routine basis. A review of aerial photographs indicated that the aboveground features, including buildings and storage tanks, were dismantled between 1958 and 1968 (Jacobs, 2009).

Previous investigations at AA1 include a site investigation conducted in 1998 by IT (IT, 1998), an RI (site characterization) conducted by Jacobs in 2007 and 2008, (Jacobs, 2009), a baseline human health risk assessment (Jacobs, 2010a), and a screening-level ecological risk assessment (Jacobs, 2010b).

Based on the results of the risk assessments, PCBs (Aroclor 1254 and Aroclor 1260) in soils are the major risk constituents at AA1 and were detected in more than 80 percent of surface soil samples (Jacobs, 2010a,b). These samples were generally collected within the footprints of former buildings/structures or immediately outside of the footprints of existing buildings. The highest concentrations were identified within the footprint of the former storage tanks. Figure 1-3 presents historic sample locations and identifies locations that were equal to or exceeded the risk-based delineation levels (RBDL) for PCBs.

The source(s) of PCB contamination at AA1 are not apparent. Based on information obtained during interviews with former employees at VAAP, waste oils were typically used around building foundations and tank cradles to suppress vegetation. Such waste oil may have contained PCBs, as these were previously included in many lubricants such as coolants, hydraulic fluids, and cutting oils. It appears that this same practice of applying waste oils around buildings, tank cradles, and other structures may have been practiced at PBOW. In addition, PCBs were an established part of many paints by the 1950s, and its inclusion in paint was not banned until 1978 (Environmental Protection, 2000). Chlorinated rubber paint was the most common paint to contain PCBs and had excellent water and chemical resistance, elasticity, and durability. Since chlorinated rubber alone made paint too brittle for long-term performance, a plasticizer was added. Until the ban on the manufacture of PCBs, Aroclor 1254 was the plasticizer of choice when chemical resistance was desired. PCBs significantly enhance the chemical resistance of the chlorinated rubber. Alternatively, the PCBs found in AA1 soils may have originated from leaky transformers, spills, or equipment that leaked lubricants (especially hydraulic fluid).

The purpose of this current delineation sampling effort is to more adequately determine the extent of PCB contamination previously identified at AA1 in support of the FS. This sampling effort includes only the collection of surface soil samples. This is consistent with the findings of the SCR (Jacobs, 2009), where only 2 of 22 subsurface soil samples (3 to 5 feet below ground surface) exceeded PCB RBDLs. In both of these subsurface soil samples, the PCB concentrations were higher in the corresponding surface soil samples than in the subsurface samples; note that most of the surface soil samples yielded detectable levels of PCBs that exceeded the RBDLs. Therefore, PCB contamination is limited to surface soil, which is

consistent with the limited mobility of PCBs in soils. Although the subsurface soil sampling was adequate to verify the relative absence of PCBs in the subsurface, the spatial distribution of surface soil samples and associated PCB contamination requires further delineation.

2.0 Scope of Work and Data Quality Objectives

2.1 Scope of Work

Activities covered by this SSAP addendum consist of the following tasks:

- Surface soil delineation sampling
- Laboratory analysis of surface soil samples
- Management and disposal of investigation-derived waste (IDW)
- Preparation and submittal of a geographic information system deliverable
- Preparation of an electronic data deliverable.

The above activities, analytical data, and evaluations will be presented in the AA1 FS report.

2.2 Site-Specific Data Quality Objectives

2.2.1 Overview

The data quality objectives process followed during the project planning stages of the delineation sampling addendum evaluated data requirements to support the decision-making process and select the best action to satisfy these requirements. Incorporated components of the data quality objectives process, described in U.S. Environmental Protection Agency (EPA) guidance (EPA, 2006), are discussed in detail in Section 3.3 of the SWSAP. Determining factors for procedures necessary to satisfy investigative objectives and to establish the basis of future actions at PBOW are presented on Figure 3-1 of the SWSAP (Shaw, 2008a). The data uses and needs for this investigation are summarized in Table 2-1.

2.2.2 Problem Statements

Contamination at the site originated from waste oils used for vegetation suppression, paints, leaky transformers and equipment, and spills of PCB-containing oils.

Site-related contaminants were primarily PCBs. The focus of this SSAP addendum is on delineation soil sampling for PCBs previously identified in the AA1 area.

This delineation soil sampling in support of the AA1 FS is being conducted at the site to allow further evaluation of the extent of PCB contamination beyond what could be performed using the existing RI data alone. Review of available information regarding historical operations has been used to develop a preliminary conceptual site model for the site, summarized in Section 2.2.3.

At this stage of the investigation, the following problem statement relates to PCB concentrations and potential risks to human and ecological receptors:

- What is the extent and degree of PCB contamination in surface soil (0 to 1 foot below ground surface)?

The planned investigation for this site addresses this problem statement through the selection of sample locations designed to evaluate specific contaminant sources and release points (biased sampling) and to delineate PCB contamination above RBDLs identified in the SCR.

2.2.3 Conceptual Site Model

Four factors considered in defining the CSM for the FS are as follows:

- Potential contaminant sources
- Migration pathways
- Potential human health and ecological receptors
- Types of contaminant of an affected medium.

The source(s) of PCB contamination at AA1 are described in Section 1.2. The migration pathways for potential contaminants would primarily be associated with runoff to creeks associated with precipitation events. PCBs are known to strongly sorb to soil particles, and it is expected that leaching to groundwater would not be a major pathway for off-site transport. This interpretation is supported by the relative lack of PCB detections in subsurface soil. Regardless, the overburden/shale groundwater in the AA1 area is not of sufficient yield to be a usable groundwater source (Jacobs, 2009), and groundwater is an incomplete pathway.

AA1 covers approximately 17 acres and is currently an open field, with tall grass and frequent low shrubs. Small wooded areas have developed throughout the site and tend to be thickest in the northeastern portion (Jacobs, 2009). The assumption for future land use is unrestricted. Plum Brook Station employees and contractors may have casual contact with the soil in AA1 during routine utility servicing or maintenance activities. Hunters may also have casual contact with the soil, as NASA does open the area to hunting during certain times of the year. Hunters may be exposed to potential contaminants in soil and potentially exposed via ingestion of venison from deer that have grazed in these areas. As described in the baseline human health risk assessment (Jacobs, 2010a), exposure of hunters to contaminants in soil is limited and does not result in substantial risk. The possibility of trespassers being exposed to the AA1 soil is not regarded as plausible because of the security fence and NASA security force. Potential ecological receptors at the AA1 are wildlife communities and plant communities. Note that groundwater in the

vicinity of the site is not used as a potable source. Based on an evaluation of existing data, chemicals of concern are PCBs. Based on the SCR results, the contaminants of concern are generally restricted to surface soil.

2.2.4 Goals of the Delineation Sampling

Historical data and data collected during the planned investigation will be evaluated to meet the following goals and address the problem statement presented in Section 2.2.2.

- Evaluate and use existing data appropriate to the area of concern.
- Define the physical features and characteristics of the area of concern.
- Determine the nature and extent of the associated contamination.
- Obtain site data of quality, quantity, and distribution appropriate for delineation of the PCB contamination in support of the FS.

2.2.5 Information Inputs

The locations and analytical suites for planned samples of environmental media were selected based on available historical information and existing data. Data obtained during the planned sampling will be used to delineate the extent of PCB contamination. The field effort is planned to include at least two rounds of sampling to eliminate the need for further investigation. Samples will be collected at locations selected in a biased manner to delineate known PCB contamination identified in the RI.

In addition to this SSAP, the SWSAP and QAPP have been prepared to ensure that data collected during this investigation are of the appropriate type and quality to support their intended uses (Shaw, 2008a,b). Samples collected during implementation of the sampling effort will meet the recommended method guidance found in *Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods* (EPA, 1996) and its subsequent updates. The analytical laboratory will be accredited under the Environmental Laboratory Accreditation Program for all analyses performed and compliant with *Quality Systems Manual for Environmental Laboratories*, Version 4.2 (DOD, 2010). All other requested analyses will conform to their specified method(s). In general, this sampling plan has been developed to ensure that the data obtained satisfy the following requirements:

- Data will be of sufficient quality to be legally defensible under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

- Data will have reporting limits based on the Limit of Detection as defined in the DOD *Quality Systems Manual for Environmental Laboratories*, Version 4.2. that can support the preparation of future CERCLA reports for the site. Data will be usable for the intended evaluations.

- Sampling locations, depths, and quantities will be sufficient to delineate PCB contamination in soil.

The following inputs will be required to make informed decisions regarding the requirements listed above:

- Soil samples will be collected from the AA1 area for laboratory analysis of PCBs.

- Laboratory data packages will include signed chain-of-custody forms, Form I documents, method blanks, laboratory control sample/laboratory control sample duplicate forms, matrix spike/matrix spike duplicate forms, initial and continuing calibrations, prep logs, analysis logs, all chromatograms and quantitation reports, standard preparation logs, and any other raw data as applicable.

- The laboratory will provide a Staged Electronic Data Deliverable in Hypertext Markup Language format along with a ShawView electronic deliverable.

- Digital geospatial will conform to the Federal Geographic Data Committee Standard STD-001-1998.

Data collection methods and analytical procedures are intended to provide results of sufficient quality to satisfactorily determine the spatial distribution of contaminants at the site.

2.2.6 Boundaries of the Site

The site boundary for AA1 is shown on Figure 1-2. Should this delineation sampling determine that any soil contamination associated with AA1 extend beyond this boundary, the investigation boundaries will be modified as needed.

2.2.7 Decision Rules

Analytical results from the planned sampling effort in conjunction with existing data will be evaluated to determine if the extent of PCB contamination has been defined. Confirmation of contamination during the delineation sampling will be based upon a comparison of detected contaminants in samples from this investigation to RBDLs (EPA, 2010). Definitive data will be used to determine whether the criteria are exceeded in the soil samples. The RBDLs to be used in this investigation are as follows:

- Aroclor 1254 – 1 milligram per kilogram (mg/kg)
- Aroclor 1260 – 1 mg/kg
- Total PCBs – 2 mg/kg.

The following decision rules apply to the complete delineation sampling effort:

- If, after completion of the sampling activities, results indicate that contamination is adequately delineated, then additional sampling will not be recommended. Results will be reported in the FS report.

- If, after completion of the sampling activities, results indicate that contamination is not adequately delineated, then additional sampling may be recommended.

Based on the results from the RI, the AA1 site consists of multiple source areas, namely the former storage tank areas and building areas. Only RI samples collected from within the footprint of these features or within approximately 15 feet of them exceeded the RBDLs. This delineation sampling effort focuses on delineating the contamination already shown to exist at these sources. As discussed in Section 1.2, waste oils that contained PCBs may have been routinely used for weed suppression around the storage tank and building areas and/or the PCBs in soil could result from the flaking or leaching of PCB-containing paints that may have been used on these structures. The results of the RI appear to be consistent with the application of PCB-containing materials within/along the former storage areas and around the building perimeters or the flaking/leaching of PCB-containing paints. Therefore, a gradation is expected: As one moves further from a given former storage tank (or building) footprint, it is anticipated that the soil will contain correspondingly lower levels of PCBs. It is expected that most, if not all, of the PCB results for the delineation samples will be less than the RBDLs. In such cases, a delineation limit between the existing exceedance and the adequately "clean" delineation sample will be estimated in the FS report. If the PCB concentration of a delineation sample exceeds the RBDL, essentially one of three determinations will be made:

1. The exceedance is marginal and the delineation sampling location is assumed to approximate the delineation of contamination based on a full examination of the data

2. The concentration of the delineation sample appreciably exceeds the RBDL and further delineation will be recommended

3. The concentration of the delineation sample appreciably exceeds the RBDL, but a full examination of the data (including those of other AA1 source areas) reveals that a reasonable assumption of the extent of delineation sufficient for the FS can be made, potentially with the aid of statistical analysis.

2.2.8 Performance or Acceptance Criteria (Decision Errors)

The primary sources of decision errors, errors that might lead to a wrong decision, include sample density and sampling and/or analytical methods.

Sample Density. Sample locations, the spacing between the individual samples, and sample depths are important in obtaining data which represent the true distribution of contaminants with sufficient accuracy to achieve project objectives. Potential errors have been minimized by 1) identifying historical and environmental data and 2) selecting additional sample locations which are biased toward suspected contaminant sources.

Sampling and/or Analytical Methods. Sampling and/or analytical methods may be sources of error if proper sample collection procedures are not followed, if the analytical reporting limits exceed target goals, or if the analytical methods have an unacceptably high margin of error. To limit errors in sample collection procedures, sample collection procedures have been provided in the SWSAP (Shaw, 2008a).

Soil samples will be collected and analyzed to meet the objectives of the FS. Quality assurance (QA)/quality control (QC) samples will be collected for all sample types, as described in Chapter 3.0. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the FS, data analyzed at this level of quality are appropriate for all phases of the FS.

3.0 Field Activities

Soil delineation activities will be conducted in a manner consistent with work conducted previously at the PBOW facility. Soil samples initially will be collected from 48 new locations (around former tanks and building foundations) to aid in the lateral delineation of PCB contamination in soil at the site. Upon review of the analytical results of the 48 soil samples, up to 24 additional samples may be collected to address any data gaps identified. Initial proposed locations have been selected using data and knowledge from the previous investigations. The field activities to be executed under this SSAP addendum are discussed in the following sections. Table 3-1 summarizes the samples and analytical parameters.

3.1 Sample Location Land Surveying

Prior to the collection of surface soil samples, Shaw will secure the services of an Ohio-registered professional land surveyor to determine the coordinates and elevations of new locations. The existing locations were previously surveyed. Survey coordinates for proposed locations were derived by Shaw from geo-referenced site figures. Both the existing and proposed new sample locations are shown on Figure 3-1. Post-sampling surveying will be completed on any additional sampling points required to fully delineate the PCB contamination and for any sample points moved due to surface obstruction or other site conditions (e.g., refusal during sampling).

Horizontal coordinates of the previous soil sample collection localities will be to the closest 0.1 foot and referenced to the State Plane Coordinate System. Vertical coordinates (ground elevation) will be to the nearest 0.01 foot and referenced to the 1929 National Geodetic Vertical Datum. All survey data will be tabulated. Loop closure for survey accuracy for PBOW is Third Order, Class II as specified in the Standards and Specifications for Geodetic Control Networks, which correlates to 1 part in 5000 (1:5000). Modern survey equipment typically achieves loop closures of 1 part in 40,000 on a routine basis. Critical reference points, landmarks, and sample locations will be plotted on appropriate map figures with a scale large enough to show their locations relative to other structures at the site.

3.2 Surface Soil Sampling

Surface soil samples will be collected using a stainless-steel hand auger, hand trowel, or direct-push drilling rig from the uppermost 1 foot. The locations are shown on Figure 3-1. All soil samples will be collected from the existing ground surface, as no fill material was encountered or identified in the previous investigation (Jacobs, 2009). A total of 48 field samples will be collected initially, and up to 24 additional soil samples may be collected to fill potential data

gaps. A qualified geologist or geotechnical engineer will be on site for all sampling operations. Prior to collecting the samples, surface debris (e.g., rocks, vegetation) will be removed from the immediate sample area. The remaining soil will be transferred from the sample collection instrument to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample container(s). Upon filling a sample container, the jar will be placed on ice. Any remaining soil will be returned to the soil boring location.

A qualified geologist or geotechnical engineer will be on site for all excavation, drilling, and sampling operations. Soil samples will be documented by sample collection logs and analysis request/chain-of-custody record forms (Figures 4-7 and 6-2 of the SWSAP [Shaw, 2008a]), following field custody procedures specified in Section 5.1 of the QAPP (Shaw, 2008b). Any changes from this SSAP or the SWSAP will be recorded in chronological order in the variance log shown as Figure 9-1 of the SWSAP (Shaw, 2008a). Daily field notes will be kept on a field activity daily log and will include sufficient information to reconstruct the progress of the sampling activities in chronological order. After completion of database entry, all field forms and documents will be archived in the project central files at the Shaw office in Knoxville, Tennessee.

3.3 Utility Clearances

Prior to beginning sampling activities, the site will be marked for underground utilities by personnel from NASA, Plum Brook Station Health and Safety Division, or other appropriate departments. In addition to verifying that all utilities companies have been contacted, utilities have been identified, and sample locations are away from known utilities, Shaw will complete a utility mark-out form (HS308) verifying proper actions have been taken to avoid contact with known underground utilities.

3.4 Site Access and Safety Communication

All personnel will meet each morning at the NASA Plum Brook Station or other “headquarters” type area for the morning tailgate safety/job safety analysis meeting, equipment calibration, gathering of needed material, and replenishing of water. At the end of each day, IDW generated during fieldwork will be moved to the identified Shaw IDW storage area. Names of all personnel, including any subcontracted personnel, will be provided by Shaw to Mr. Robert Lallier, NASA Environmental Coordinator, at least 72 hours in advance so that site access can be arranged. All personnel entering the NASA (former PBOW) facility will be appropriately trained and instructed by Plum Brook Station concerning site safety issues. All Shaw personnel and any subcontracted personnel participating in this sampling activity will be U.S. citizens.

4.0 Sample Analysis and Decontamination Procedures

4.1 Sample Number System

The sample numbering system to be used during this investigation will conform to the USACE Nashville District's numbering convention. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number will consist of a group of letters and numbers separated by hyphens. The sample media and numbering system are described as follows.

Project Code	Year	Sample Type[a]	Site Identification[b]	Location (Well ID)	Sample Number	Depth[c]
PBOW	11	XX	XXXX	XXXX	XXXX	(XXXX)

[a]Sample type:
SS – surface soil sample
MS – matrix spike
MD – matrix spike duplicate

[b]Site:
Acid Area 1 – AA1

[c]Depth: Required for soil samples.

In addition, field QC is identified by the sample purpose, field duplicates, and field splits use the same sample numbering convention shown above. The sample purpose is recorded on the sample collection log and in the ShawView™ PBOW database. The sample purpose is suppressed when creating chains of custody and bottle labels. Thus, field QC sample collection remains blind to the subcontract laboratories. See the sitewide QAPP (Shaw, 2008b) for a detailed discussion of field QC.

The complete sample number will be recorded by the Shaw field geologist/geotechnical engineer in the field activity daily log and/or in the boring log and as appropriate in the sample collection log.

4.2 Analytical Program

The analytical program has been designed to acquire sufficient and defensible data to determine the nature and extent of contamination at the site in support of the FS. Table 4-1 summarizes the analytical parameters required and associated laboratory methods to be used during this investigation.

A DOD Environmental Laboratory Accreditation Program-accredited laboratory will analyze samples for PCBs by SW-846 8082A. All applicable analyses will meet the recommended method guidance found in *Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods* (EPA, 1996) and its subsequent updates The analytical laboratory will comply with *Quality Systems Manual for Environmental Laboratories*, Version 4.2 (DOD, 2010). Project-specific reporting limits are included in Tables 7-1 through 7-4 of the QAPP (Shaw, 2008b). All other requested analyses will conform to their specified method(s).

In addition to laboratory QC samples, the following types of field QC samples will be collected: field duplicates, field splits, equipment rinsates, and a source water sample. Definitions of both field and laboratory QA/QC can be found in the QAPP (Shaw, 2008b).

4.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SWSAP (Shaw, 2008a) and will be followed during soil delineation activities. The Shaw field coordinator will contact Plum Brook Station for access to a potable water source for decontamination use. The following list summarizes decontamination procedures for equipment that may come in contact with samples for chemical analysis (stainless-steel homogenization bowls, mixing spoons, etc.):

- Remove excess soil from the equipment and return soil to the soil boring.
- Pre-wash sampling equipment in potable water (no detergent) using a brush.
- Wash and scrub using a brush and nonphosphate detergent.
- Rinse with potable water.
- Rinse with American Society for Testing and Materials Type II water.
- Rinse with hexane (required when sampling for PCBs).
- Final rinse with American Society for Testing and Materials Type II water; the volume of water used will be at least five times greater than the volume of hexane used.
- Air dry.
- Wrap in aluminum foil.

Decontamination wash water and rinse water will be managed for disposal as described in Section 6.1.

5.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as precleaned, and made of materials recommended by EPA in Title 40, Code of Federal Regulations, Part 136 and SW-846 (EPA, 1996). Sample containers and preservatives/preservation methods are summarized in Table 5-1. Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated based on the date and time of sample collection.

Samples for chemical analysis will be placed in coolers immediately following collection and packed to minimize container breakage by using styrofoam peanuts or bubble wrap to fill void spaces in the cooler; vermiculite will not be used. Coolers will be taped, marked, and sealed, and custody will be maintained as described in Chapter 6.0 of the SWSAP. Samples will be cooled immediately after collection to a temperature of less than 6 degrees Celsius and maintained at that temperature by means of double-bagged ice until the cooler is received at the laboratory. Coolers will be shipped to the laboratory by a next-day delivery service. The temperature of each cooler will be taken with an infrared thermometer upon receipt. Notification of shipment, including airbill number, will be telephoned, faxed, or emailed to the laboratory on the day of sample collection. If this is not possible, the laboratory will be notified the following morning.

For regular and field duplicate samples submitted for PCB analyses, a completed analytical request/chain-of-custody record will be secured and included with each shipment of coolers to the following address:

ATTN: Sue Bell
Accutest Southeast
4405 Vineland Road
Suite C-15
Orlando, FL 32811
P:407-425-6700
F:407-425-0707

For split samples submitted for PCB analyses, a completed analytical request/chain-of-custody record will be secured and included with each shipment of coolers to the following address:

ATTN: Denise Pohl
Test America
4101 Shuffel Drive NW
North Canton, OH 44720
P:330-966-9789
F:330-497-0772

6.0 Investigation-Derived Waste Management Plan

Anticipated IDW during field activities includes decontamination fluids and disposable personal protective equipment (PPE). Detailed procedures for IDW management are provided in Chapter 8.0 of the SWSAP (Shaw, 2008a). The following is a brief summary of the procedures for handling IDW.

6.1 Decontamination Fluid

Limited quantities of decontamination fluid, including wash water, nonphosphate soapy water, and final rinse water, will be kept in plastic tubs during the decontamination process and placed in 55-gallon drums upon completion of field sampling. Decontamination fluid containing small quantities of solvents such as hexane will be collected in metal pans for evaporation.

6.2 Sampling Equipment and Personal Protective Equipment

Limited quantities of PPE and sampling equipment, including Tyvek® suits, latex/nitrile gloves, and plastic, will be generated during sampling. All sampling equipment and PPE will be double-bagged and disposed of in on-site Shaw-contracted dumpsters. If any of the sampling equipment and PPE appears to be grossly contaminated, it will be decontaminated prior to disposal.

6.3 Investigation-Derived Waste Sampling

All decontamination fluid will be sampled at the completion of fieldwork. Table 4-1 summarizes the analytical parameters and methods for the IDW samples. Five-day turnaround time will be used unless otherwise directed by the Shaw Project Manager.

When the analytical results are received, Shaw personnel will evaluate the results and make a determination of off-site disposal methods. Possible disposal facilities will be identified by Shaw; however, selection of the facility or facilities to receive the IDW will be the responsibility of USACE.

7.0 References

Environmental Protection, 2000, ***Painting the PCB Picture,*** Volume 11, Number 10, October.

IT Corporation (IT), 1998, ***Site Investigation of Acid Areas, Plum Brook Ordnance Works, Sandusky, Ohio,*** December.

Jacobs Engineering Group, Inc. (Jacobs), 2010a, ***Final Baseline Human Health Risk Assessment, Acid Area 1***, July.

Jacobs Engineering Group, Inc. (Jacobs), 2010b, ***Final Screening Level Ecological Risk Assessment, Acid Area 1***, July.

Jacobs Engineering Group, Inc. (Jacobs), 2009, ***Final Site Characterization Report, Remedial Investigation Part 1 at Acid Area 1***, July.

Shaw Environmental, Inc. (Shaw), 2008a, ***Site-Wide Sampling and Analysis Plan, Plum Brook Ordnance Works, Sandusky, Ohio,*** July.

Shaw Environmental, Inc. (Shaw), 2008b, ***Site-Wide Quality Assurance Project Plan, Plum Brook Ordnance Works, Sandusky, Ohio,*** July.

Shaw Environmental, Inc. (Shaw), 2008c, ***Final Site-Wide Accident Prevention Plan and Site-Wide Safety and Health Plan Appendix, Former Plum Brook Ordnance Works, Sandusky, Ohio***, September.

U.S. Department of Defense (DOD), 2010, ***Quality Systems Manual for Environmental Laboratories***, Final Version 4.2, October.

U.S. Environmental Protection Agency (EPA), 2010, ***Regional Screening Level Table***, November, on-line at www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/ Generic_Tables/index.htm.

U.S. Environmental Protection Agency (EPA), 2006, ***Guidance on Systematic Planning Using the Data Quality Objectives Process***, EAP QC/G-4, February, EPA/240/B-6/001.

U.S. Environmental Protection Agency (EPA), 1996, ***Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods***, EPA Publications SW-0846, Third Edition, Update III, (http://www.epa.gov/sw-846/sw846.htm).

TABLES

Table 2-1

Summary of Data Quality Objectives
Acid Area 1
Former Plum Brook Ordnance Works, Sandusky, Ohio

Potential Data Users	Available Data	Conceptual Model	Media of Concern	Data Uses and Objectives	Data Types	Analytical Level
EPA OEPA DOD USACE NASA Shaw Other Contractors Possible Future Land Users	Previous environmental investigations show varying degrees of contamination in the soil. - potential COCs include PCBs - VOCs, SVOCs and metals are not considered COCs.	Contaminant Source Waste oils for vegetation suppression (hydraulic fluids, lubricants, coolants, cutting oils, etc.) and paints. Leaky transformers, spills, and equipment that leaked lubricants. Past DOD operations. Migration Pathways Soil, sediment, and surface water Potential receptors Wildlife, human Potential Contaminants of Concern PCBs	Soil	Determine if there are hazardous substances present that constitute an unacceptable risk to human health and the environment. Address data gaps in delineation of soil contamination at existing sample locations collected during the RI.	Soil PCBs	Definitive data for all sample analyses.[a]

DNT - Dinitrotoluene.
DOD - U.S. Department of Defense.
EPA - U.S. Environmental Protection Agency.
OEPA - Ohio Environmental Protection Agency.
USACE - U.S. Army Corps of Engineers.
COC - Chemicals of concern.
VOC - Volatile organic compound.
NASA - National Aeronautics and Space Administration.
PAH - Polyaromatic hydrocarbon.
TNT - Trinitrotoluene.
PCB - Polychlorinated biphenyl.
Shaw - Shaw Environmental, Inc.
RI - Remedial investigation.
SVOC - Semivolatile organic compound.

[a] The laboratory will provide data packages consisting of all laboratory receipt documentation, sample prep and run log documentation, calibrations forms, QC forms, Form I documents, and all raw data generated in support of the analysis of PBOW samples.

Table 3-1

Summary of Analytical Samples
Acid Area 1
Former Plum Brook Ordnance Works, Sandusky, Ohio

Surface Soil Samples						
Parameters	**Field samples**	**QA/QC Samples**	**Rinsates**	**Source Water**	**Trip Blanks**	**Matrix Spike/Duplicate***
PCBs	72	7 / 7	1	1	NA	4 / 4

PCB - Polychlorinated biphenyl.

NA - Not applicable. (There are no VOC analyses; therefore, no trip blanks are required.)

* - One matrix spike/matrix spike duplicate shall be analyzed for each batch of 20 samples.

QA - Field duplicates.

QC - Field splits.

Rinsates - Equipment rinsates.

Table 4-1

Summary of Analytical Parameters and Methods
Acid Area 1
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Matrix	Analytical Parameters[a]	Analytical Method[b]
Surface Soils	PCBs	SW-846 3550C/8082A
Water IDW	PCBs	SW-846 3540C/8082A
	TCL Volatile Organic Compounds	SW-846 8260B
	TCL Semivolatile Organic Compounds	SW-846 3510C/8270D
	Nitroaromatic Compounds	SW-846 8330A
	TAL Metals	SW-846 3010A/6010C/7470A
	Ignitability	SW-846 1010A
	pH	SW-846 9045D
	Corrosivity	SW-846 1110A
	Reactive Cyanide	7.3.3/7.3.4
	Reactive Sulfide	7.3.3/7.3.4

[a]Target analyte list (TAL) and target compound list (TCL) are used to designate parameter lists with no requirements for Contract Laboratory Program (CLP) method quality control or data reporting packages.

[b]Analyses found in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* EPA Publication, Third Edition and *Methods for Chemical Analysis of Water and Wastes* , EPA-600/4-79-020, March 1983 and subsequent revisions.

IDW - Investigation-derived waste.

PCB - Polychlorinated biphenyl.

Table 5-1

Analytical Methods, Containers, Preservatives, and Holding Times
Acid Area 1
Former Plum Brook Ordnance Works, Sandusky, Ohio

Matrix	Parameter	Analytical Method	Sample Container*	Preservation Requirements	Holding Time
Surface Soils	PCBs	SW-846 3550C/8082A	(1) 8 oz CWM glass with Teflon-lined lid	Cool to 4°C	14 days extraction/40 days
Water IDW	TCL VOCs	SW-846 8260B	(3) 40 ml VOA vial	Cool to 4°C, HCL to pH <2	14 days
	TCL SVOCs	SW-846 3510CC/8270D	(2) 1 L amber glass	Cool to 4°C	7 days extraction/40 days
	Nitroaromatics	SW-846 8330A	(2) 1 L amber glass	Cool to 4°C	7 days extraction/40 days
	TAL Metals	SW-846 3010A/6010C/7470A	(1) 500 mL HDPE	Cool to 4°C, HNO_3 to pH <2	6 months (28 days for Hg)
	Ignitability	SW-846 1010A	(1) 1 L Amber	Cool to 4°C	ASAP
	pH	SW-846 9045D			
	Corrosivity	SW-846 1110A			
	Reactive Cyanide	7.3.3/7.3.4			
	Reactive Sulfide	7.3.3/7.3.4			

°C - Degrees Celsius.
CWM - Clear widemouth.
HNO_3 - Nitric acid.
HCl - Hydrochloric acid.
HDPE - High-density polyethylene.
oz - Ounces.
L - Liter.
mL - Milliliter.
* - Number of containers required in ( ).

PCB - Polychlorinated biphenyl.
SVOC - Semivolatile organic compound.
TAL - Target analyte list.
TCL - Target compound list.
VOC - Volatile organic compound.
IDW - Investigation-derived waste.
VOA - Volatile organic analysis.
Hg - Mercury.
ASAP - As soon as possible.

FIGURES

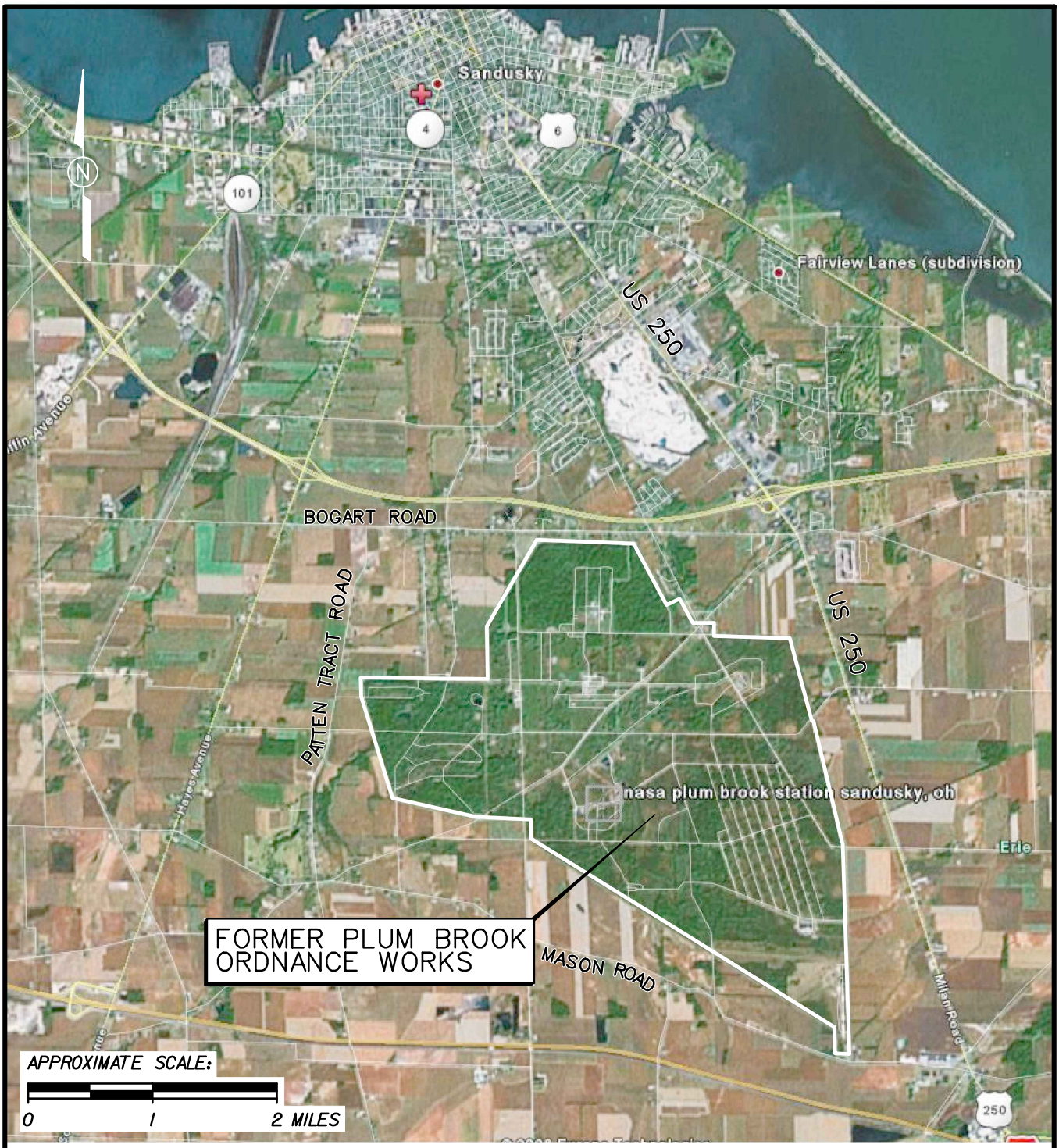

FIGURE 1-1
PBOW VICINITY MAP

ACID AREA 1 SSAP

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

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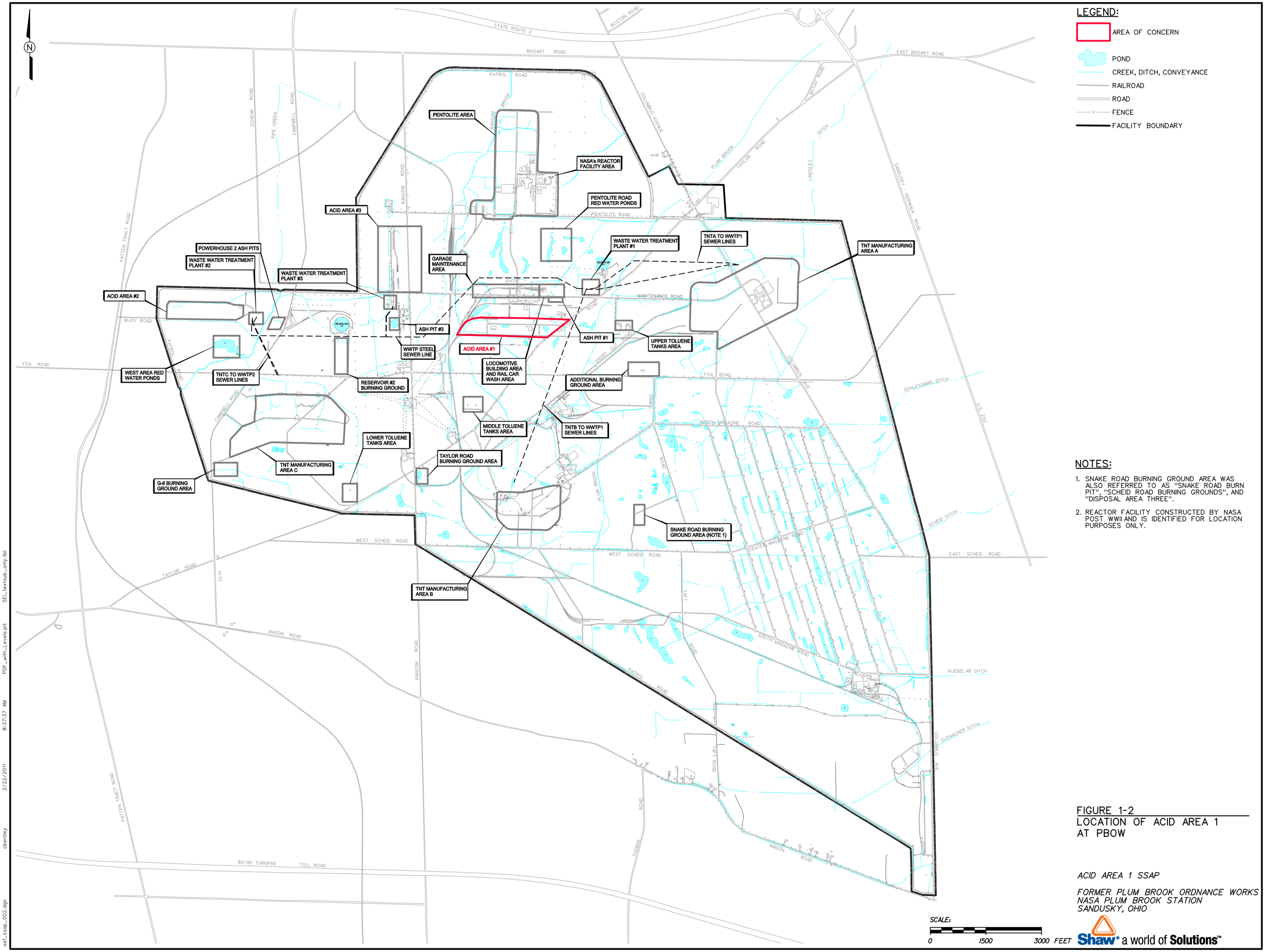

LEGEND:

- AREA OF CONCERN
- 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.

SCALE:

0 1500 3000 FEET

FIGURE 1-2
LOCATION OF ACID AREA 1 AT PBOW

ACID AREA 1 SSAP

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

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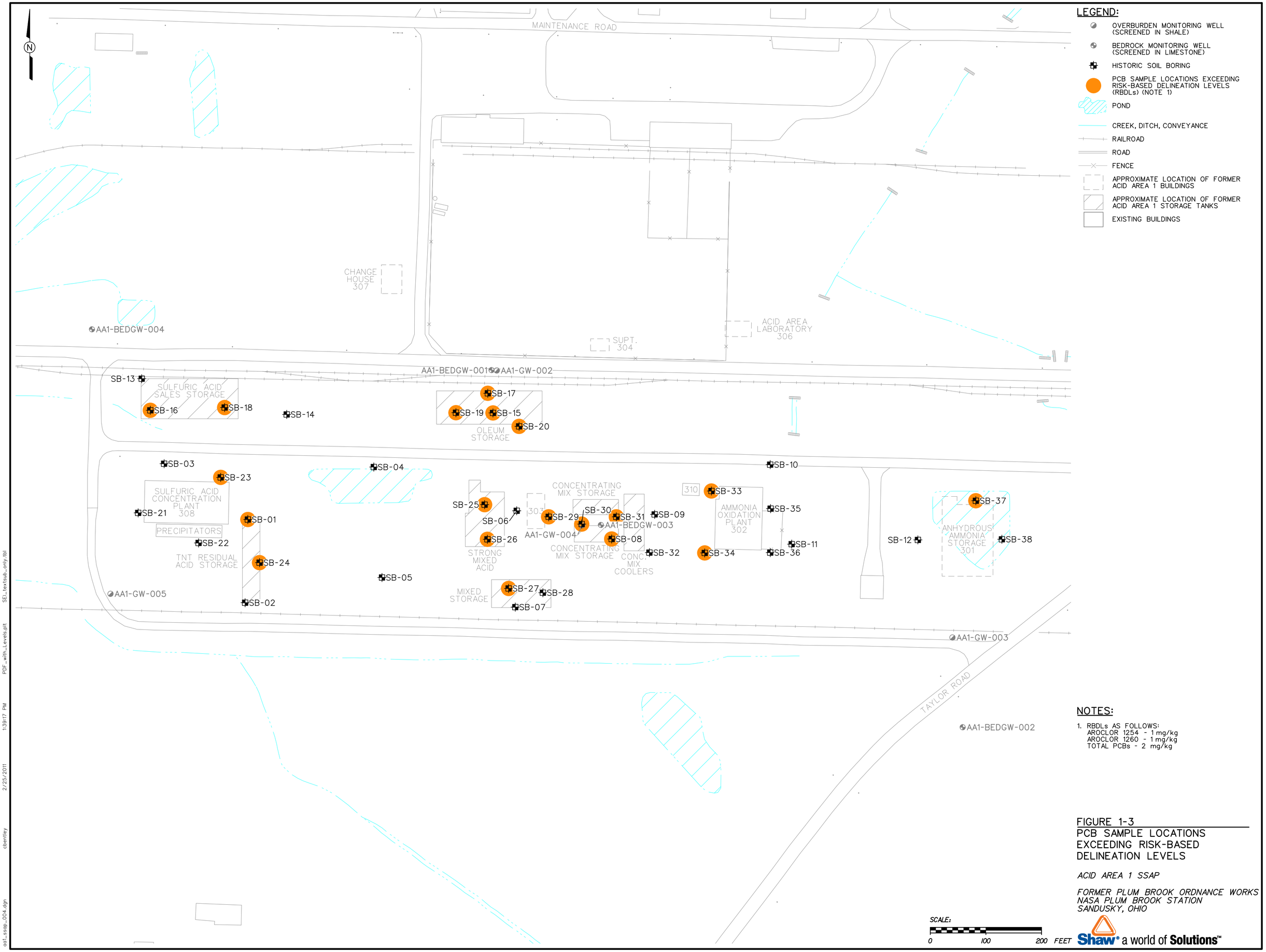

FIGURE 1-3
PCB SAMPLE LOCATIONS EXCEEDING RISK-BASED DELINEATION LEVELS

ACID AREA 1 SSAP

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

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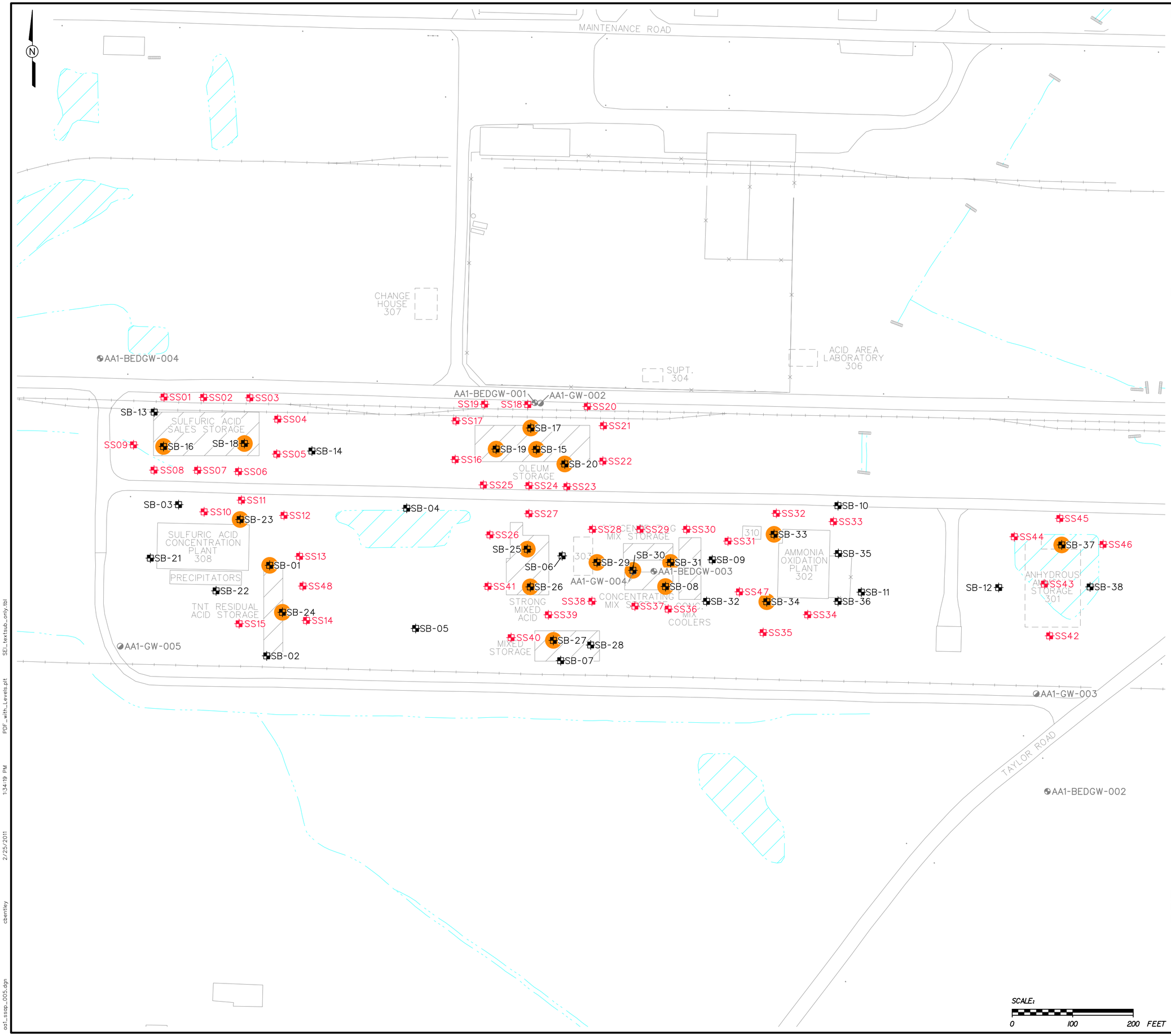

LEGEND:

- OVERBURDEN MONITORING WELL (SCREENED IN SHALE)
- BEDROCK MONITORING WELL (SCREENED IN LIMESTONE)
- HISTORIC SOIL BORING
- PCB SAMPLE LOCATIONS EXCEEDING RISK-BASED DELINEATION LEVELS (RBDLs) (NOTE 1)
- PROPOSED SOIL SAMPLE LOCATION
- POND
- CREEK, DITCH, CONVEYANCE
- RAILROAD
- ROAD
- FENCE
- APPROXIMATE LOCATION OF FORMER ACID AREA 1 BUILDINGS
- APPROXIMATE LOCATION OF FORMER ACID AREA 1 STORAGE TANKS
- EXISTING BUILDINGS

NOTES:

1. RBDLs AS FOLLOWS:
   AROCLOR 1254 - 1 mg/kg
   AROCLOR 1260 - 1 mg/kg
   TOTAL PCBs - 2 mg/kg
2. ALL PROPOSED SOIL SAMPLE LOCATION ID's HAVE THE PREFIX "AA1-" THAT HAS BEEN OMITTED ON THE DRAWING DUE TO SPACE RESTRICTIONS.
3. THE TABLE BELOW LISTS THE PROPOSED SOIL SAMPLE LOCATIONS. COORDINATES ARE OHIO STATE PLANE COORDINATE SYSTEM, 3401 OHIO NORTH, NAD83.

PROPOSED SOIL SAMPLE LOCATIONS		
LOCATION ID	NORTH	EAST
AA1-SS01	623078.42	1917105.60
AA1-SS02	623077.75	1917171.00
AA1-SS03	623077.18	1917247.50
AA1-SS04	623041.83	1917293.48
AA1-SS05	622984.23	1917291.90
AA1-SS06	622955.32	1917228.64
AA1-SS07	622957.50	1917161.02
AA1-SS08	622957.77	1917089.04
AA1-SS09	622999.50	1917055.23
AA1-SS10	622888.77	1917171.93
AA1-SS11	622908.06	1917233.55
AA1-SS12	622882.99	1917303.90
AA1-SS13	622815.35	1917329.53
AA1-SS14	622709.52	1917340.98
AA1-SS15	622704.07	1917229.73
AA1-SS16	622975.28	1917586.74
AA1-SS17	623039.11	1917587.95
AA1-SS18	623065.97	1917706.57
AA1-SS19	623066.55	1917635.21
AA1-SS20	623062.68	1917804.96
AA1-SS21	623031.13	1917831.66
AA1-SS22	622972.59	1917830.60
AA1-SS23	622930.55	1917771.18
AA1-SS24	622932.19	1917708.47
AA1-SS25	622933.28	1917633.21
AA1-SS26	622850.91	1917644.12
AA1-SS27	622885.82	1917708.47
AA1-SS28	622859.96	1917813.36
AA1-SS29	622859.96	1917892.22
AA1-SS30	622859.96	1917968.95
AA1-SS31	622840.45	1918037.28
AA1-SS32	622886.37	1918117.24
AA1-SS33	622872.73	1918211.58
AA1-SS34	622718.91	1918169.04
AA1-SS35	622689.45	1918095.42
AA1-SS36	622728.18	1917938.59
AA1-SS37	622733.09	1917883.51
AA1-SS38	622741.16	1917812.62
AA1-SS39	622718.82	1917740.64
AA1-SS40	622681.16	1917679.02
AA1-SS41	622765.71	1917640.85
AA1-SS42	622683.99	1918568.76
AA1-SS43	622769.64	1918560.03
AA1-SS44	622847.64	1918510.41
AA1-SS45	622877.95	1918585.49
AA1-SS46	622835.09	1918657.10
AA1-SS47	622756.75	1918056.18
AA1-SS48	622766.28	1917335.13

FIGURE 3-1
PROPOSED SOIL SAMPLE LOCATIONS

ACID AREA 1 SSAP

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

SCALE:
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RESPONSES TO COMMENTS

RESPONSE TO COMMENTS
DRAFT SITE-SPECIFIC SAMPLING AND ANALYSIS PLAN ADDENDUM SURFACE SOIL DELINEATION SAMPLING ACID AREA 1
FORMER PLUM BROOK ORDNANCE WORKS, SANDUSKY, OHIO
(Report dated February 2011)

Reference: Comments from Janusz Z. Byczkowski, Ohio EPA, DERR, CO, received April 4, 2011.

Comment 1: Section 1.2, page 2, line 32; Section 1.2, page 3, line 10; and Section 2.2.3, page 7, line 11: This document states a) *"93 percent syllabic acid"*, b) *"production of strong nitric acid or sales acid", and* c) *"exposure to hunters is limited"*. Some statements are unclear (e.g., who is exposed to what?). Also, all ingredients with unusual names should be defined, listed with Chemical Abstract Service numbers, or their names should be corrected. I suggest a revision of this Document following the quality technical reading to correct unclear statements, typos and inappropriate chemical names.

Response 1: a) The reference to "syllabic" acid is a typographical error and will be revised to "sulfuric" acid.
b) This sentence will be revised consistent with the following to indicate that the sulfuric acid was sold and shipped off site "…production of strong nitric acid, or sold and shipped off site as 'sales acid'…".
c) This sentence will be revised consistent with the following "…exposure by hunters to *contaminants in soil* is limited…".

Comment 2: Section 2.2.7, page 9, line 8: This document states *"The RBDLs to be used in this investigation are as follows:*
****Aroclor 1254 – 1 milligram per kilogram (mg/kg)***
****Aroclor 1260 – 1 mg/kg***
****Total PCBs – 2 mg/kg…".***
Please note that the current Regional Screening Levels for these PCBs are 0.22 mg/kg residential soil, and thus, 0.22 mg/kg soil rather than 1.0 mg/kg will be their screening level, based on cancer end point (U.S. EPA, 2010); even though, the TSCA regulations require permanent remediation for soil between a range of 1-10 ppm PCBs for high occupancy and >10-100 ppm for low occupancy.
Reference: U.S. EPA (2010) Pacific Southwest, Region 9 "Regional Screening Levels (Formerly PRGs). Screening Levels for Chemical Contaminants". On-line: http://www.epa.gov/region09/superfund/prg/index.html.

Response 2: Regional Screening Levels were already used, as suggested by the reviewer, in the Baseline Human Health Risk Assessment (BHHRA) (Jacobs, 2010). This screening process identified Aroclor 1254 and Aroclor 1260 as chemicals of potential concern (COPC). Based on the results of the BHHRA, these two

polychlorinated biphenyls have been identified as representing unacceptable human health risks.

As stated in the first sentence of the last paragraph on page 4, the purpose of this field work is to adequately determine the extent of PCB contamination, identified previously, in support of the Acid Area 1 Feasibility Study. It is expected that the results of this study will enable greater accuracy in estimating the areas and volumes of PCB-contaminated soil to be addressed in the FS.

Note that the risk-based values are well within the TSCA 1 to 10 mg/kg PCB soil concentration range for high occupancy. Please also note that the TSCA regulations (40 CFR 761.60) are only relevant to PCB remediation waste, which is defined in 40 CFR 761.3 as including PCBs deposited prior to 1979 only if these exceed 50 mg/kg. Because the highest concentrations of PCBs at Acid Area 1 are less than 50 mg/kg, the TSCA material at Acid Area 1 is not a PCB remediation waste. Thus, even though these TSCA regulations do not apply to Acid Area 1, the RBDLs selected for the Acid Area 1 delineation are well within the TSCA high occupancy range.