QUALITY ASSURANCE PROJECT PLAN

FOR THE LIMITED SITE INVESTIGATION

Plum Brook Ordnance Works

Waste Water Treatment Plants 1 & 3

Prepared by:

U.S. ARMY CORPS OF ENGINEERS

LOUISVILLE DISTRICT

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A. Ethics Agreements
B. Quanterra Standard Operating Procedures (SOPs)
C. Laboratory Analysis Criteria
D. Data Validation Checklist
E. Quanterra Reference Data Summary (Method Detection Limits (MDLs) and Method Recovery Limits (MRL) Tables)
F. Comments and Responses

ATTACHED DOCUMENTS

I. Field Sampling Plan (FSP)
II. Data Quality Objectives (DQOs)

ASSOCIATED DOCUMENTS NOT ATTACHED

I. Site Specific Health and Safety Plan dated May 1999

LIST OF ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Standards for Testing Materials
BNA	Base-Neutral-Acid Extractables (Semivolatile Organics)
CELRL	US Army Corps of Engineers, Louisville District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
COC	Chain of Custody
COPC	Contaminant of Potential Concern
CLP	Contract Laboratory Program
CRDL	Contract Required Detection Limits
CRQL	Contract Required Quantitation Limits
CRL	Central Regional Laboratory
D&D	Decontamination and Decommissioning
DCF	Document Control Format
DD	Definitive Data
DERP	Defense Environmental Restoration Program
DNT	Dinitrotoluene
DQO	Data Quality Objective
DoD	Department of Defense
ED-E	Engineering Division, Environmental Branch
EMSL	Environmental Monitoring and Support Laboratory
FSP	Field Sampling Plan
FUDS	Formerly Used Defense Sites
GSA	General Services Administration
IT	International Technology Corporation
LERC	Lewis Research Center
MDL	Minimum Detection Level
MK	Morrison Knudsen K Ferguson
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NASA	National Aeronautics and Space Administration
NIST	National Institute of Standard Technology
NPL	National Priorities List
PA	Preliminary Assessment
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
PCB	Polychlorinated biphenyl
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
OSC	On-Site Coordinator
QA/QC	Quality Assurance/Quality Control
QAMP	Quality Assurance Management Plan
QAPP	Quality Assurance Project Plan
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act

RI/FS	Remedial Investigation/Feasibility Study
RD/RA	Remedial Design/Remedial Action
RPM	Remedial Project Manager
PBRF	Plumb Brook Reactor Facility
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act
SAS	Special Analytical Services
SI	Site Investigation
SMC	Sample Management Coordinator
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOC	Semi Volatile Organic Compound
SW846	Test Methods for Evaluating Solid Waste 1986
TAL	Target Analyte List
TCL	Target Compound List
TIC	Tentatively Identified Compound
TNT	Trinitrotoluene
TOC	Total Organic Carbon
USACE	US Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WWTP	Wastewater Treatment Plant

SECTION 1

PROJECT DESCRIPTION

1.1 Introduction

Department of Defense activity at the former Plum Brook Ordnance Works located near Sandusky, Ohio produced chemical contamination of soil and water that has been documented through several studies of the site. PBOW was operated from 1941 to 1945 as a manufacturing plant for trinitrotoluene , dinitrotoluene , and pentolite. Some of the areas used by the Army were decontaminated in the 1950s and 1960s in accordance with DoD standards at that time; other areas have been decommissioned, but not decontaminated. The site is currently owned by the National Aeronautics and Space Administration and is operated as the Plum Brook Station of the Glenn Research Center. The NASA LERC is located in Cleveland, Ohio.

Due to the environmental impact of the past Army operations the sites of two facilities that operated at the PBOW: the Wastewater Treatment Plants Nos. 1 and 3 (WWTP 1 and WWTP 3) are being evaluated by the U.S. Army under the Defense Environmental Restoration Program, Formerly Used Defense Sites funding. This work is being completed and technically overseen by the U.S. Army Corps of Engineers, Louisville District Engineering Division, Environmental Branch.

1.2 Site Description

In the early 1940s the U.S. Army contracted with Trojan Powder Company to manufacture 2,4,6-TNT, dinitrotoluene and pentolite at PBOW. Production began on 16 December 1941 and continued through late 1945, ceasing two weeks after V-J Day (2 September 1945). After operations ceased, the area was turned over to Army Ordnance Department and renamed Plum Brook Depot and used for ammunition storage.

PBOW was placed in standby status from 1945 to 1946. During this time, decontamination and decommissioning procedures were performed on many structures associated with the manufacturing process. These procedures included the removal and relocation of all explosives to burn grounds for destruction by open burning. Where possible, remaining structures and buildings were burned in place. Drain lines and steam lines were flushed and dismantled.

In December 1945, custody of PBOW was transferred from Trojan Powder Company to U.S. Army Ordnance Department, with the U.S. Army Corps of Engineers assuming custodial responsibilities from 1 January through 30 June 1946. In August 1946, PBOW was transferred to the War Assets Administration.

In 1956 the National Advisory Committee for Aeronautics began leasing sections of PBOW from the War Assets Administration. An agreement was made in 1956 to lease 500 acres of in

the northern portion of PBOW to construct and operate the Plum Brook Reactor Facility. In 1958 NACA changed its name to National Aeronautics and Space Administration. By 1963, approximately 6,400 acres of PBOW had been acquired by NASA for various aerospace research activities. An additional 2,000 acres were acquired to serve as a buffer zone between the facility and the adjacent community. Research and test activities were conducted by NASA at PBS throughout the 1960s and early 1970s.

The wastewater treatment plants were used during plant operation to alleviate the volume of effluent flowing to the waste water ponds. They consisted of a Neutral Storage Tank, an Equalization Tank, a Condensate Storage Tank, the Evaporator Building, Incinerator, and Caustic Storage, Raw Waste and Thick Liquor storage tanks. The plants received waste water from the settling basins at TNT Areas 1 and 3, neutralized it through a chemical depuration process, and disposed of it in open ditches surrounding the area or thickened it by evaporation and incinerated the resultant thick liquor. Ash from the incinerator was disposed of in ash pits.

There is no much background information for WWTP 1. Morrison Knudsen took one sample in the area that did not show any significant contamination (MK, 1994). Other than that, the available studies do not address the site. An inspection of available photographs of the site shows the buildings and structures of the site more or less undisturbed until 1956. In 1969 the buildings have disappeared and from then on the pictures show an empty space at the site, with no signs of any other activity having taken place. A recent visual inspection shows the site covered with normal wild vegetation (grass and brushes), with no indication of any negative environmental impact. The remnants of some concrete slabs were still visible.

The WWTP 3 site was investigated by SAIC in 1991, Morrison Knudsen in 1993, and IT in1997. According to these investigations the site was used by NASA as a dump for demolition debris. SAIC reports dead wood, cement, asphalt, floor tiles, and scrap pipe at the site. SAIC also cites reports of disposal pits excavated in the area for waste materials (specifically fire brick and an empty 500 gallon gasoline tank). SAIC also identifies this site as the place of a lime sludge disposal by NASA. The lime sludge proceeded from cooling water pre-treatment and the volume deposited or its chemical characteristics were unknown to SAIC. MK calls the area the Waste Disposal Area 2A and reports that it is covered with steel and concrete debris. MK took three surface soil samples in the area that tested slightly above residential cleanup levels for polychlorinated biphenyls, and semi volatile organic compounds. IT found the site in 1997 a rugged open field with increasing density of young trees and brush toward Pipe Creek. Considerable amounts of demolition debris and some smashed drums were observed. A warning sign at the entrance of the site indicated possible asbestos contamination. IT collected 20 screening soil samples and 10 confirmation samples in the area. The testing results indicated no apparent soil contamination with respect to nitroaromatic compounds. Metals and SVOC were detected at varying levels above risk based concentrations.

In this case, again, the historic photographs of the site show the structures in 1956 but those were gone by 1969. After that, the photographs show no further activity, the dumping of construction debris that took place being barely discernible.

1.2.1 Facility/Site Size and Borders

The plants occupied an area of approximately 2 acres each. The Wastewater Treatment Plant No. 1 was located northwest of the intersection of Taylor Road and Maintenance Area Road. The Wastewater Treatment Plant No. 2 was located southwest of the intersection of Pipe creek and the railroad track that runs parallel to and 500 ft. south of Maintenance Area Road.

1.2.2 Topography

Wastewater Treatment Plant #1 is essentially flat with a slight topographic gradient to the north-northeast and to the west draining towards ditches that ultimately discharge on Plum brook. The local relief is low, moderately sloping to nearly level.

Wastewater Treatment Plant #3 is essentially flat with a slight topographic gradient to the east draining toward Pipe creek that runs north some 400 feet away from the site.

1.2.3 Local Geology

Based on the Site Wide Ground Study (IT Corporation, 1997-1998), three formations, all of the Devonian Age, underlie the PBOW site. The Delaware Limestone is the lowermost formation. It is characterized as a hard, dense, finely crystalline limestone and dolomite. Dissolution of this unit has been described which has produced solution channels along bedding planes and joints, and even producing caverns in some areas. The unit is typically buff colored and usually described as fossiliferous. In the vicinity of PBOW, benzene, toluene, ethyl benzene, and xylene (BTEX) and hydrogen sulfide are common in area quarries. Overlying the Delaware Limestone is the Olentangy Formation. Two members of the Olentangy Formation have been characterized at the PBOW site, the Plumbrook Shale and the overlying Prout Limestone. The Plum Brook Shale is interpreted to consist of approximately 35 feet of bluish-gray, soft, fossiliferous shale containing thin layers of dark, hard, fossiliferous limestone. The Prout Limestone has been interpreted to be a unit approximately 15 feet thick which outcrops occasionally in a 1,000 to 2,000 foot-wide, northeast striking band across the middle portion of the PBOW. It has been described as a dark-gray to blue, very hard, silicious, fossiliferous limestone or dolomitic mudstone. The uppermost formation at the PBOW site is the Ohio Shale. Only one member of the Ohio Shale is present in the PBOW area- the Huron Shale. This unit has been described as black, thinly bedded, with pyrite and abundant carbonaceous matter with some large pyrite/carbonate concretions up to 6 feet in diameter.

The bedrock overburden in Erie County is predominantly glacial till, glacial outwash or glacial lacustrine (lake) deposits. In the vicinity of PBOW, the soil

has been interpreted to be lacustrine. In many areas, the overburden also consists of highly weathered bedrock. The thickness of the overburden ranges from approximately 5 feet or less for most of PBOW to greater than 25 feet. The overburden is thickest on the northern portion of the site.

1.2.4 Hydrogeology

Based on the Site Wide Groundwater Study (IT Corporation 1997-1998), potable groundwater is encountered in the bedrock units underlying the PBOW site. Generally this groundwater flows northward toward Lake Erie. Based on the hydrogeologic information given in the Groundwater Resources of Erie County, 1986, the PBOW site includes 3 distinct hydrogeologic regimes. Groundwater yields from these regimes range from limited, to the northeast and south, to more than 500 gallons per minute (gpm), to the northwest.

The WWTP 1 site is located in an area designated as having water yields that seldom exceed three gallons per minute. This area is characterized by water found in thin, discontinuous sand and gravel deposits interbedded in fine, sandy clay. Water may also originate from the underlying shale. The shale in the area is described as impervious. (ODNR, 1986) A drawing indicates the depth to shale in the area near Maintenance Road is about eight feet. (E. B. Badger, 1941)

The WWTP 3 site is located in an area designated as having water yields of 100 to 500 gallons per minute. This area is characterized by water found in cavernous limestone and dolomite at depths of less than 200 feet (ODNR, 1986).

1.3 Past Data Collection Activities

A number of environmental investigations have been conducted at the PBOW; however, none were performed specifically for the Waste Water Treatment Plants 1 & 3. The investigations for the PBOW are listed in the References section of this document.

1.4 Current Status

The former PBOW is currently owned by NASA, that uses it as a training and research center (the Glenn Research Center at Plum Brook Station). The specific sites of the WWTPs are at present vacant lots. No activity is being carried on at these sites. The site of WWTP 3 has been used as a construction debris dump.

1.5 Project Objectives

The purpose of this investigation is to gather sufficient information to determine if environmental contamination at the site merits further study or other actions. Objectives of the investigation will be as follows:

- Verify the existence of contamination in the area. Data quality must be sufficient to be able to compare with U.S. Environmental Protection Agency (USEPA) Region 9 PRG criteria.

- Collect sufficient data on potentially contaminated media to support a recommendation for further study, action, or coordinate with the OEPA to proceed toward a No Further Action (NFA) closure of the site.

The investigation will integrate existing data with information gathered through direct field investigations.

The field investigation will include surface soil sampling, field screening, and chemical laboratory analysis for evaluation of the site in accordance with the attached FSP.

If SI data suggests that sufficient site characterization information has been collected to determine that no further action is required at the site, a Decision Document to that effect will be prepared in coordination with Ohio EPA. If, on the other hand, the SI data shows a need for further investigation or other action, work plans for the next action will be developed and submitted to OEPA.

1.5.1 Specific Objectives and Associated Tasks

The Field investigation for this limited SI will include:

A visual survey to assess and document site conditions. Samples may be collected at any location that the visual inspection of the site may show to be of particular significance;

Soil sampling for the WWTP 1 site at the area of the neutralization tank, the area of the incinerator building, the area of the evaporator building, the area of the raw waste holding tank, the area of the equalization tank, the area of the caustic house, the area of the condensate tank, and each one of the areas of the thick liquor tanks;

Field screening for VOCs with a Photo Ionization Detector (PID);

Collection of sediment samples in the southern bank of the ditch that runs north of the site and two in the eastern bank of the ditch that runs west of the WWTP 1 site;

Collection of soil samples to test for asbestos: in the area of the incinerator building, in the area of the evaporator building, and in the area of the caustic house;

Soil sampling for the WWTP 3 site at the area of the neutralization tank, the area of the incinerator building, the area of the evaporator building, the area of the raw

waste holding tank, the area of the equalization tank, the area of the caustic house, the area of the condensate tank, and each one of the areas of the thick liquor tanks.

Collection of sediment samples in the western bank of Pipe creek;

Collection of soil samples to test for asbestos: in the area of the incinerator building, in the area of the evaporator building, and in the area of the caustic house;

Surface water samples will not be collected at this stage of the investigation.

1.5.2 Project Target Parameters and Intended Data Usage

The list of target parameters includes Nitroaromatics, VOCs, SVOCs, PCBs, and metals as detailed in the attached FSP. These parameters will be identified based on analytical results using USEPA SW-846 methodology. This data will be used to evaluate the potential for contamination at the site by comparing results to the Region 9 PRGs screening criteria.

1.5.3 Quality Objectives and Criteria for Measurement Data

The Data Quality Objectives (DQO) Process is a series of planning steps based on the Scientific Method that is designed to ensure that the type, quality, and quantity of environmental data used in decision making are appropriate for the intended application. Quality objectives and criteria for this project were evaluated through the Data Quality Objectives Process described in the EPA QA/G-4 (September 94) document. The DQO for this site are attached to this QAPP.

1.6 Sample Rationale

The sample rationale for sample locations (in respective media) is fully described in detail in Section 4.0 of the Field Sampling Plan.

1.6.1 Sample Network by Task and Matrix

Sample matrices, analytical parameters and frequencies of sample collection can be found in Section 4.0 of the Field Sampling Plan.

1.6.2 Site Maps of sampling Locations

The sample location plan is presented in the Field Sampling Plan, which is attached to this QAPP. It is possible, however, that depending on the nature of encountered field conditions some of these locations will be changed. The

Technical Team Leader, whose responsibilities are described in Section 2 of this QAPP, will be responsible for making such decisions.

1.6.2 Rationale of Selected Sampling Locations

The attached Field Sampling Plan and DQO provide the rationale used to select sampling locations and depths. Sampling will be performed at locations most likely to contain the highest levels of contamination.

1.7 Project Schedule

1.7.1 Anticipated Date of Associated Mobilization

The earliest date for which samples are planned to be collected is 7 June 1999.

1.7.2 Task Bar Chart and Associated Time Frames

The dates of projected milestones are indicated in the SI Schedule.

TASKS	Jan-99	Feb-99	Mar-99	Apr-99	May-99	Jun-99	Jul-99	Aug-99	Sept-99
Research/Planning	19-	28							
Site Visit			16-17						
Document Prep.			22		28				
DQO				13					
QAPP					24				
SSHP					20				
SAP				21					
Field Investigation						10			
Data Validation							30		
SI Report Prep.								6	
Review SI Report								30	
Submit SI Report									29

SECTION 2

PROJECT ORGANIZATION AND RESPONSIBILITY

The USACE has overall responsibility for all phases of the SI. The Louisville District will perform the field investigation and prepare the SI report. The various quality assurance and management responsibilities of key project personnel are defined below.

2.1 Project Organization Chart

Shelton M. Poole, CHMM, RPIH — Health and Safety Manager (HSM)

Mr. Poole has the responsibility for ensuring that the provisions of the Health and Safety Plan (HASP) are adequate and implemented in the field. Changing field conditions may require decisions to be made concerning the adequacy of the protection programs. Mr. Poole meets the additional training requirements specified by OSHA in 29 CFR 1910.120. The HSM is also responsible for briefing personnel on a regular basis in order to ensure the effectiveness of the HASP.

David Brancato, Ph.D., RPIH — Risk Assessor

Dr. Brancato is experienced in risk assessment methodologies. He also has the responsibility for ensuring that the provisions of the HASP are adequate and implemented in the field in the stead of Mr. Poole. He has had the additional training requirements specified by OSHA in 29CFR1910.120. He will serve as an alternative to Mr. Poole.

Samir A. Mansy, Ph.D. — Quality Assurance Manager

Dr. Mansy served as the Chief of the Quality Assurance Section at Great Lakes and Ohio River Division Laboratory, Cincinnati, Ohio. He is currently the Data Quality Assurance Manager in Louisville District, Environmental Engineering Branch. He is experienced in data review, validation, and troubleshooting. Dr. Mansy provides an independent review of the analytical data based on SW846 and National Functional Guidelines.

Albert J. Reyes, PE — Project Engineer and Team Leader

Mr. Reyes has served as a Project Engineer for Environmental Projects with the Louisville District since 1992. Mr. Reyes has extensive experience in all the aspects of contracting and execution of all type of Environmental Projects including preparation of Groundwater Treatment Plans, Testing and removal of Underground Storage Tanks, Preliminary Assessments, Site Investigations, Remedial Investigations and Feasibility Studies, and Remedial Design and Remedial Action. Mr. Reyes will serve as Project Engineer and Team Leader.

2.2 Management Responsibilities

Rick Meadows Project Manager

The Project Manager, Rick Meadows, Huntington District, has the overall responsibility for all phases of the PBOW projects.

Doug Meadors Technical Team Leader

Mr. Meadors serves as the Technical Team Leader. He is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements. The Technical Team Leader's primary function is to ensure the successful achievement of technical, financial, and scheduling objectives. The Technical Team Leader will:

- Define project objectives and develop a detailed work plan schedule;
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Acquire and apply technical resources as needed to ensure performance within budget and schedule constraints;
- Orient appropriate personnel concerning the project's special considerations;
- Monitor and direct field work;
- Develop and meet ongoing project requirements, including mechanisms to review and evaluate each task project;
- Review the work performed on each task to ensure its quality, responsiveness and timeliness;
- Review and analyze overall task performance with respect to planned requirements and authorizations;
- Approve all reports (deliverables) before their submission to Ohio EPA;
- Ultimately be responsible for the preparation of reports; and
- Represent the project team at meetings.

2.3 Quality Assurance Responsibilities

QA Manager

The QA Manager will remain independent of direct job involvement and day-to-day operations, and have direct access to corporate executive staff as necessary, to resolve any QA dispute. Dr. Mansy is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations, U.S. Army Corps of Engineers, and Ohio EPA requirements. Specific functions and duties include:

- Providing QA audit on various phases of the field operations;
- Reviewing and approving of QA plans and procedures;
- Providing QA technical assistance to project staff;
- Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Project Scientist and to the Technical Team Leader;
- Data validation including tentatively identified compounds;
- Review and approval of field and laboratory procedure; and
- Performance and system Audits of the Laboratory.

All samples will be analyzed by Quanterra Environmental Services, North Canton, Ohio, with the exception of Atterburg Limits and grain size analysis, which will be subcontracted to an approved laboratory. Data validation will be done by an independent contractor. Validation will be conducted randomly on 10% of the sample results.

2.4 Field Responsibilities

Technical Team Leader

The technical team leader for this project will monitor and direct fieldwork. The technical team leader will be responsible for determining whether locations to be sampled will be changed.

USACE Field Technical Staff

The technical staff (team members) for this project will be drawn from USACE pool of Louisville District, Environmental Engineering Branch resources. The technical team staff will be utilized to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

2.5 Laboratory Responsibilities

Quanterra Laboratory Project Manager

The Quanaterra Project Manager, Debora Hula, will report directly to the USACE Quality Assurance Manager, Dr. Samir Mansy, and will be responsible for the following:

- Ensuring all resources of the laboratory are available on an as-required basis;
- Over viewing of final analytical reports; and
- Approving final analytical reports prior to submission to Louisville District.

Quanterra Operations Manager

The Quanterra Operation Manager will report to the Quanterra Project Manager and will be responsible for:

- Coordinating laboratory analyses;
- Supervising in-house chain-of-custody;
- Scheduling sample analysis;
- Overseeing data review; and
- Overseeing preparation of analytical reports.

Quanterra Quality Assurance Officer

Ms. Opal Davis-Johnson is the Quanterra QA Officer, and has the overall responsibility for data after it leaves the laboratory. The Quanterra QA Officer will be independent of the laboratory but will communicate data issues through the Quanterra Project Manager. In addition, the Quanterra QA Officer will:

- Provide overview of laboratory quality assurance;
- Review QA/QC documentation;
- Conduct random audits of detailed data;
- Determine whether to implement laboratory corrective actions, if required;
- Define appropriate laboratory QA procedures;

- Prepare laboratory Standard Operating Procedures; and
- Sign the title page of the QAPP.

Quanterra Sample Custodian

The Quanterra sample custodian, Lois Ezzo, will report to the Quanterra Operations Manager and the Laboratory Supervisor. Responsibilities of the sample custodian will include:

- Receiving and inspecting the incoming sample containers;
- Recording the condition of the incoming sample containers;
- Signing appropriate documents;
- Verifying chain-of-custody and its correctness;
- Notifying Laboratory Manager and Laboratory Supervisor of sample receipt and inspection;
- Assigning a unique identification number and customer number, and entering each into the sample receiving log;
- With the help of the Laboratory Manager, initiating transfer of the samples to appropriate lab sections; and
- Controlling and monitoring access/storage of samples and extracts.

Final responsibility for project quality rests with the USACE Project Manager. Independent quality assurance will be provided by the Quanterra Project Manager and QA Officer prior to release of all data to the USACE Project Engineer.

Quanterra Technical Staff

The Quanterra technical staff will be responsible for sample analysis and identification of corrective actions. The staff will report directly to the Quanterra Operations Manager. Members of the technical staff have signed Ethics Agreements, which state: they will abide by the high standards of integrity; they shall report actual data; and they will report to the officials of any accidental or intentional non-authentic data. Copies of the agreements are included in Appendix A.

SECTION 3

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for this project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results that are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventative maintenance of field equipment, and corrective action are described in other sections of this QAPP.

3.1 Precision

3.1.1 Definition

Precision is a measure of the degree to which two or more measurements are in agreement.

3.1.2 Field Precision Objectives

Field precision is assessed through the collection and measurement of field duplicates at a rate of 1 duplicate per 10 analytical samples.

3.1.3 Laboratory Precision Objectives

Precision in the laboratory is assessed through the calculation of relative percent difference (RPD) and relative standard deviations (RSD) for three or more samples. The equations to be used for precision in this project can be found in section 12 of this QAPP. Precision control limits are included in the provided SOPs.

3.2 Accuracy

3.2.1 Definition

Accuracy is the degree of agreement between an observed value and an accepted reference value.

3.2.2 Field Accuracy Objectives

Accuracy in the field is assessed through the use of field and trip blanks and through the adherence to all sample handling, preservation and holding times.

3.2.3 Laboratory Accuracy Objectives

Laboratory accuracy is assessed through the analysis of matrix spikes (MS) or standard reference materials (SRM) and the determination of percent recoveries. The equation to be used for accuracy in this project can be found in section 12 of this QAPP. Accuracy control limits are included in the provided SOPs.

3.3 Completeness

3.3.1 Definition

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

3.3.2 Field Completeness Objectives

Field completeness is a measure of the amount of valid measurements obtained from all the measurements obtained from all the measurements taken in the project. The equation for completeness is presented in section 12 of the QAPP. Field completeness for this project will be greater than 90 percent.

3.3.3 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in section 12 of this QAPP. Laboratory completeness for this project will be greater than 95 percent.

3.4 Representativeness

3.4.1 Definition

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

3.4.2 Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the field sampling plan (FSP) is followed and that proper sampling techniques are used.

3.4.3 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times and analyzing and assessing field duplicated samples. The sampling network is designed to provide data representative of facility conditions. During development of this network, consideration is given to past waste disposal practices, existing analytical data, physical setting and processes, and constraints inherent to the FUDS program. The rationale of the sampling network is discussed in detail in the Field Sampling Plan (FSP).

3.5 Comparability

3.5.1 Definition

Comparability is an expression of the confidence with which one data set can be compared with another. Comparability is also dependent on similar QA objectives.

3.5.2 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the FSP is followed and that proper sampling techniques are used.

3.5.3 Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented in the QAPP. Comparability is also dependent on similar QA objectives.

3.6 Level of Quality Control Effort

Field blank, trip blank, method blank, duplicate, standard reference materials (SRM) and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs.

Field and trip blanks consisting of distilled water will be submitted to the analytical laboratories to provide the means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination at the facility, which may cause samples contamination. Trip blanks are used to assess the potential for contamination of samples due to contamination migration during sample shipping and storage. Trip blanks pertain to volatile organic samples only. Trip blanks prepared prior to the sampling event in the actual sample containers and are kept with the investigative samples throughout the sampling event. They are then packaged for shipment with other samples and sent for analysis. There should be one trip blank included in each sample shipping container. At no time after their preparation are the sample containers opened before they reach the laboratory.

Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures. Duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spikes provide information about the effect of sample matrix on the digestion and measurement methodology. All matrix spikes are performed in duplicate and are subsequently referred to as MS/MSD samples. One matrix spike/matrix spike duplicate will be collected for every 20 or fewer investigative samples. MS/MSD samples are designated/ collected for organic analyses only.

MS/MSD samples are investigative samples. Soil MS/MSD samples require no extra volume for VOCs or extractable organics. However, aqueous MS/MSD samples must be collected at triple the volume for VOCs and double the volume for extractable organics. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix (i.e., water, soil).

The number of duplicate and field blank samples to be collected is listed in the FSP. Sampling procedures are also specified in the FSP.

SECTION 4

SAMPLING PROCEDURES

The sampling procedures to be used in this site investigation will be consistent, and are presented in Section 4.0 and 5.0 of the Field Sampling Plan.

SECTION 5

CUSTODY PROCEDURES

Proper sample collection and analysis requires the maintenance of strict chain-of-custody (CoC) procedures. These procedures include tracking and documentation during sample collection, shipment, and laboratory processing.

A sample is considered to be in an individual's custody if it is:

- In the physical possession or view of the individual party.
- Secured to prevent tampering.
- Placed in a restricted area by the responsible party.

5.1 Field Custody Procedures

All samples will be accompanied by a CoC form. When possession of samples is transferred, the individual relinquishing the samples and the individual receiving the samples will sign, date, and note the time of transfer on the CoC document. This record will represent the official documentation for all transfers of sample custody until samples arrive at Quanterra Laboratories, North Canton, Ohio. Samples will be shipped via overnight service by the courier. This will minimize the time interval from sampling to analysis, and will help ensure that all constituent holding times are met. Notification of sample shipment to the laboratory will be performed by the field team leader.
Contact information for Quanterra Laboratories is listed below.

Quanterra Laboratory	Phone: (330) 497-9396
4101 Shuffel Drive NW	Fax: (330) 497-0772
North Canton, OH 44720	

5.2 Laboratory Custody Procedures

Laboratory custody procedures for sample receiving and log-in, sample storing and numbering, tracking during sample preparation and analysis, and storage of data are described in the Quanterra Standard Operating Procedures in Appendix B.

Examples of laboratory chain of custody traffic reports along with instructions for completion are also included.

5.3 Final Evidence Files

The final evidence file will be the central repository for all documents, which constitute evidence relevant to sampling and analysis activities as described in this QAPP. The USACE is the custodian of the evidence file and maintains the content of evidence files for the site, including all relevant records, reports, logs, field notebooks, subcontractor reports, and data reviews. The final evidence file shall be maintained in a secured, limited access area and under custody of the USACE Technical Team Leader.

The final evidence file will typically include:

- field logbooks;

- field data and data deliverables;

- drawings;

- soil boring logs;

- laboratory data deliverables;

- data validation reports;

- data assessment reports;

- all custody documentation (tags, forms, and air bills).

SECTION 6

CALIBRATION PROCEDURES AND FREQUENCY

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

6.1 Field Instrument Calibration

Organic Vapor Photoionization detector (PID)

Organic vapor photoionization detector (PID) instruments will be rented from Hazco Services Inc., a reputable instrument rental, sales, and repair company. The rental agreement will include provision for a cylinder of span gas and any other materials needed for proper calibration of the instrument. The instrument manufacturer's operation manual will be used as a checklist during field operations.

The instruments will be obtained from the following location:

Hazco Services Inc.
6501 Centerville Business Parkway
Dayton, OH 45459
(937) 824-4400

6.2 Laboratory Instrument Calibration

Calibration procedures for a scientific laboratory instrument will consist of an initial calibration (2, 3, 5, or 6 points, depending on the method), initial calibration verification and continuing calibration verification. For a description of the calibration procedures for a specific laboratory instrument, refer to the applicable SOPs in Appendix B of this QAPP. The SOP for each analysis performed in the laboratory describes the calibration procedures, their frequency, acceptance criteria and the conditions that will require recalibration. In all cases, the initial calibration will be verified using an independently prepared calibration verification solution (CRI-brand as second source).

The laboratory maintains a sample logbook for each instrument, which will contain the following information: instrument identification, date of calibration, analyst, calibration solutions run, and the samples associated with these calibrations.

Organic Analyses

Prior to calibration, the instrument(s) used for Gas Chromatographic/Mass Spectrometer (GC/MS) analyses are tuned by analysis of p-bromofluorobenzene (BFB) for volatile analyses and decafluorotriphenyl phosphine (DFTPP) for semivolatile analyses. Once the tuning criteria

for these reference compounds are met, the instrument should be initially calibrated by using a five-point calibration curve. The instrument tune will be verified for every 12 hours of operation.

The calibration standards will be USEPA- or NBS-traceable and are spiked with internal standards and surrogate compounds. Calibration and continuing calibration verification at midpoint and at MRL (Method Reporting Limit) levels will be performed at approved intervals as specified by the manufacturer or the analytical method (whichever is more frequent). Calibration standards used as reference standards will be traceable to the source.

Metals Analysis

The Atomic Absorption Spectrophotometer (AAS) and Inductively Coupled Plasma Emission Spectrophotometer (ICP) instruments are calibrated by use of a blank and a one-point standard prepared by dilution of certified stock solutions. An analysis blank is prepared with one calibration standard at the MRL for the metal. The other standards bracket the concentration range of the samples. Calibration standards will contain acids at the same concentration as the digestates.

A continuing calibration standard, prepared from a different stock solution than that used for preparation of the calibration standards, is prepared and analyzed after ten samples or every two hours of continuous operation. The value of the continuing calibration standard concentration must agree with ± 10 percent of the initial value or the appropriate corrective action is taken which may include recalibrating the instrument and reanalyzing the previous ten samples.

For the ICP, linearity near the reporting limit will be verified with a standard prepared at a concentration at the reporting limit (MRL >3MDL). This standard must be run at the beginning and end of each sample analysis run or a minimum of twice per 8-hour period.

SECTION 7

ANALYTICAL PROCEDURES

Samples will be analyzed by Quanterra Laboratories, North Canton, Ohio.

7.1 Field Analytical Procedures

During soil sampling, a headspace portion will be placed in a clean glass container (no more than half full), and sealed with aluminum foil or a plastic bag. PID readings will be taken from the headspace container. The operation manual for the PID instrument will be consulted prior to taking the PID readings for each sampling event.

7.2 Laboratory Analytical Procedures

The laboratory named above will implement the project required Standard Operating Procedures (SOPs). These laboratory SOPs for sample preparation, cleanup, and analysis are based on the latest SW-846 Revision. These SOPs provide sufficient detail and are applicable to this investigation.

The site samples for VOC analysis (VOA) shall be screened in the laboratory, as described in the VOA SOP, and shall be analyzed either as low- or medium-level concentration samples, or as a series of dilutions in order to cover the expected concentration range of the site-specific compounds of interest.

The site soil sample extracts requiring pesticide/PCB and/or SVOC analysis (acid/base/neutral analysis or ABNs) shall be subject to gel permeation chromatography cleanup and/or other column chromatography cleanup as necessary.

The laboratory of record has prepared tables that summarize the analyte groups of interest, appropriate laboratory SOP numbers and EPA reference method for the organic and inorganic analytes to be evaluated in this investigation. The Quanterra SOPs to be used in this investigation are contained in Appendix B of this QAPP.

7.3 List of project target compounds and laboratory detection limits

A complete listing of project target compounds can be found in the Field Sampling Plan. Current laboratory determined detection limits for each analyte group are presented in an attachment provided by the laboratory of record. The method detection limits shown have been experimentally determined using the procedure found in 40CFR, Part 136, Appendix B, or equivalent statistical approach. The latest MDLs at the time of sample analysis will be used.

SECTION 8

INTERNAL QUALITY CONTROL CHECKS

8.1 Field Quality Control Checks

The only field measurement planned for this site investigation is monitoring VOCs as measured with the PID. There is no reference standard for PID monitoring since the instrument cannot distinguish between individual compounds. Calibration of the field instrument can be accomplished with the span gas cylinder provided by the equipment supplier.

8.2 Laboratory Quality Control Checks

The laboratory identified in Section 7 of this QAPP has a QC program, which ensures the reliability and validity of the analyses, performed at the laboratory. All analytical procedures are documented in writing as SOPs. Each SOP includes a QC section, which addresses the minimum QC requirements for the procedure. The internal quality control checks might differ slightly for each individual procedure, but in general the QC requirements include the following:

- Field /Trip blanks
- Method blanks
- Reagent/preparation blanks (applicable to inorganic analysis)
- Instrument blanks
- Matrix spikes/matrix spike duplicates
- Surrogate spikes
- Analytical spikes (Graphite furnace)
- Field duplicates
- Laboratory duplicates
- Laboratory control standards
- Internal standard areas for GC/MS analysis; control limits
- Mass tuning for GC/MS analysis
- Endrin/DDT degradation checks for GC/EC analysis
- Second dissimilar column confirmation for GC/EC analysis

For a description of the specific QC requirements of this site investigation and the frequency of audit, refer to the laboratory SOPs contained in Appendix B. Quality Control (QC) criteria are also included in the SOPs.

All data obtained will be properly recorded. The data package will include a full deliverable package capable of allowing the recipient to reconstruct QC information and compare it to QC criteria. Any samples analyzed which do not conform to QC criteria will be reanalyzed by the laboratory if sufficient volume is available. It is expected that sufficient volumes/weights of samples will be collected to allow for reanalysis when necessary.

SECTION 9

DATA REDUCTION, VALIDATION AND REPORTING

All data generated through field activities or by the laboratory operation shall be reduced and validated prior to reporting. No data shall be disseminated by the laboratory until it has been subjected to the procedures summarized below.

9.1 Data Reduction

9.1.1 Field data reduction procedures

Only direct reading instrumentation will be employed in the field. The use of PID instruments will generate measurements directly read from the meters following calibration per manufacturer's recommendations as outlined in Section 6 of this QAPP. These measurements will be used for screening. No data from photoionizable species sensing is anticipated to be reported as interval/ratio data for this SI. The presence of photoionizable species will be noted in the field log. It is planned to report the data from field sensing for photoionizable species in air as nominal /ordinal data.

9.1.2 Laboratory data reduction procedures

Laboratory data reduction procedures will be followed according to the following protocol: All raw analytical data will be recorded in numerically identified laboratory notebooks (paper or electronic form). These notebooks will be issued only by the Laboratory QA Manager. Data are recorded in this notebook along with other pertinent information, such as the sample identification number and the sample tag number. Other details will also be recorded in the lab notebook, such as the analytical method used (SOP#), name of analyst, the date of analysis, matrix sampled, reagent concentrations, instrument settings, and the raw data. Each page of the notebook shall be signed and dated by the analyst. Copies of the strip chart printouts (such as gas chromatograms) will be maintained on file. Periodic review of these notebooks by the lab QA Manager takes place at the opening and closing of laboratory logs, at a minimum. Records of notebook entry inspections are maintained by the QA Manager.

All calculations are checked by the Organic, and Inorganic including Metal Section Supervisor at the conclusion of each operating day. Errors are noted, corrections are made, but the original notations are crossed out legibly. Analytical results for soil samples shall be calculated and reported on a dry weight basis.

Quality control data (e.g. laboratory duplicates, surrogates, matrix spikes, and matrix spike duplicates) will be compared to the method acceptance criteria. In Level 1 review, the analyst reviews all of the data and QC. This is followed by Level 2 review, in which a senior analyst reviews 100% of QC and 10% of the raw data. Data considered to be acceptable will be entered into the laboratory computer system. The computer system compares QC data to internally generated limits (LCS< MS/MSD, and surrogate) and method criteria. The data are logged into the project database format. Unacceptable data shall be appropriately qualified in the project report. Case narratives will be prepared which will include information concerning data that fell outside acceptance limits, and any other anomalous conditions encountered during sample analysis. After the Lab Project Manager approves these data, they are considered ready for third party data validation.

9.2 Data Validation

Data validation procedures shall be performed for both field and laboratory operations as described below:

9.2.1 Procedures Used to Evaluate Field Data

It is planned to report the data from field sensing for photoionizable species in air as nominal /ordinal data. Hence, the presence or absence of photoionizable species will be noted. There is no applicable validation procedure.

9.2.2 Procedures to Validate Laboratory Data

USEPA Contract Laboratory Program National Functional Guidelines (NFG) for Organic and Inorganic Data Review, February 1994, procedures will be modified to include SW-846 criteria summarized in Appendix C, Laboratory Analysis Criteria. The modified NFG will be followed to validate laboratory data in conjunction with the Data Validation Checklist found at Appendix D.

The validation assessment will be accomplished by the joint efforts of the Data Reviewer and Project Manager. The data assessment by the Project Manager will be based on the criteria that the sample was properly collected and handled according to the field Sampling Plan and Section 5 of this QAPP.

The validation firm reviewer will conduct a systematic review of the data for compliance with the established QC criteria based on the spike, duplicate and blank results provided by the laboratory. All technical holding times shall be reviewed, the GC/MS instrument performance check sample results shall be evaluated, results of initial and continuing calibration will be reviewed and evaluated by trained reviewers independent of the

laboratory. Also, results of all blanks, surrogate spikes, matrix spikes/matrix spike duplicates, laboratory control samples, internal standards, target compound identification and quantitation, tentatively identified compounds, system performance checks shall be performed for volatile organic compounds by the validator. Additionally, documents of method detection limits study will be provided to the validator. The study results shall also be validated. Ten percent (10%) of the data shall be validated.

The Data Review will identify any out-of-control data points and data omissions and interact with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analysis may be made by the Project Engineer/Project Scientist based on the extent of the deficiencies and their importance in the overall context of the project.

All data generated for the site will be computerized in a format organized to facilitate data review and evaluation. The computerized data set will include the data flags provided by Quanterra in accordance with the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (February 1994) and Inorganic Analyses (February 1994), as well as additional comments of the Data Reviewer. The laboratory-provided data flags will include such items as:

1) concentration below required detection limit;
2) estimated concentration due to poor spike recovery; and
3) concentration of chemical also found in laboratory blank.

The Data Reviewer comments will indicate that the data are:

1) useable as a quantitative concentration;
2) useable with caution as an estimated concentration; or
3) unusable due to out-of-control QC results.

All CLP forms summarizing this information will be checked as well. The overall completeness of the data package will also be evaluated by the Data Validator. Completeness checks will be administered on all data to determine whether deliverables specified in the SI Work Plan and QAPP are present. At a minimum, deliverables will include sample chain-of-custody forms, analytical results, QC summaries, and supporting raw data from instrument printouts. The reviewer will determine whether all required items are present and will request copies of missing deliverables.

9.3 Data Reporting

Data reporting procedures shall be carried out for field and laboratory operations as indicated below:

9.3.1 Field Data Reporting

It is planned to report the data from field sensing for photoionizable species in air as nominal ordinal data. Hence, the presence or absence of photoionizable species will be noted.

9.3.2 Laboratory Data Reporting

The Laboratory Project Manager must perform a final review of the report summaries and case narratives to determine whether the report meets project requirements. In addition to the record of chain-of-custody, the report format shall consist of the following:

1. Case Narrative:

- Date of Issuance
- Laboratory analysis performed
- Any deviations from intended analytical strategy
- Laboratory batch number
- Numbers of samples and respective matrices
- Quality control procedures utilized and also references to the acceptance criteria
- Laboratory report contents
- Project name and number
- Condition of samples 'as received'
- Discussion of whether or not sample holding times were met
- Discussion of technical problems or other observations which may have created analytical difficulties
- Discussion of any laboratory quality control checks which failed to meet project criteria
- Tables summarizing QC checks for MRLs (true values, found values, and % recoveries) in CLP form
- Signature of the laboratory QA Manager

2. Chemistry Data Package

- Case narrative for each package/analytical group
- Summary page indicating dates of analyses for samples and laboratory quality control checks
- Cross-referencing of laboratory samples to project sample identification numbers
- Data qualifiers to be used should be adequately described
- Sample preparation and analyses for samples
- Sample results
- Raw data for sample results and laboratory quality control samples
- Results of calibration checks and GC/MS tuning results
- Matrix spike and matrix spike duplicate recoveries, laboratory control samples, method blank results, calibration check compounds, and system performance check compound results
- Labeled and dated chromatograms/spectra of sample results and laboratory quality control checks

- Results of tentatively identified compounds

The Data package will be a "CLP-like" format consisting of all the information presented in a CLP data package.

SECTION 10

PERFORMANCE AND SYSTEMS AUDITS

Performance and system audits of laboratory activities will be conducted to verify that analyses are performed in accordance with the procedures established in the FSP and QAPP. The audits of laboratory activities include two independent processes: internal and external audits.

10.1 Laboratory Performance and Systems Audits

The Quanterra Analytical Services laboratories are audited on a regular basis by the USACE. The USACE Center of Expertise in Omaha, Nebraska, is responsible for the system audits of the laboratories on an annual basis, and conducts performance audits.

The system audits include examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain of custody procedure, sample preparation and analysis, instrument operating records, etc. The performance audits will consist of sending performance evaluation (PE) samples to laboratories for on-going assessment of laboratory precision and accuracy. The analytical results of the analysis of PE samples are evaluated by the USACE Center of Expertise to ensure the laboratories maintain acceptable performance levels.

10.1.1 Internal laboratory Audits

10.1.1.1 Internal Lab Audit Responsibilities

The internal laboratory audit will be conducted by the Quanterra QA Officer.

10.1.1.2 Internal Lab Audit Frequency

The internal lab system audits will be done on an annual basis while the internal lab performance audits will be conducted on a quarterly basis.

10.1.1.3 Internal Lab Audit Procedures

The internal lab system audits will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, instrument operating records, etc. The performance audits will involve preparing blind QC samples and submitting them along with project samples to the laboratory for analysis throughout the project. The Quanterra QA Officer will evaluate the analytical results of these blind performance samples to ensure the laboratory maintains acceptable QC performance. The laboratory audit checklist has been submitted.

10.1.2 External Laboratory Audits

10.1.2.1 External Lab Audit Responsibilities

An external audit may be conducted by the Corps of Engineers.

10.1.2.2 External Lab Audit Frequency

An external lab audit may be conducted at least once prior to the initiation of the sampling and/or during analysis activities. These audits may or may not be announced and are at the discretion of the USACE, Louisville District.

10.1.2.3 Overview of the External Lab Audit Process

External lab audits will include (but not be limited to) review of laboratory analytical procedures, laboratory on-site audits, and/or submission of performance evaluation samples to the laboratory for analysis.

SECTION 11

PREVENTATIVE MAINTENANCE

11.1 Field Instrument Preventative Maintenance

Photoionization detectors will be used in the field for this project. The specific preventative maintenance procedures to be followed for the field equipment for this limited SI are those recommended by the manufacturer. The instruments will be checked and calibrated daily for use. Batteries will be kept on-site to reduce downtime. Backup instruments and equipment will be available on-site or within 1-day shipment to avoid delays in the field schedule.

11.2 Laboratory Instrument Preventative Maintenance

As part of their QA/QC Program, a routine preventative maintenance program is conducted by a service contractor on a limited basis to minimize the occurrence of instrument failure and other system malfunctions. Quanterra Laboratories personnel perform routine scheduled maintenance, and repair or coordinate with the vendor for the repair of all instruments. All laboratory instruments are maintained in accordance with manufacturer's specifications and the requirements of the specific method employed. This maintenance is carried out on a regular, scheduled basis, and is documented in the laboratory instrument service logbook for each instrument. Emergency repair or scheduled manufacturer's maintenance is provided under a repair and maintenance contract with factory representatives.

SECTION 12

SPECIFIC ROUTINE PROCEDURES

USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

12.1 Accuracy Assessment

In order to assure the accuracy of the analytical procedures, an environmental sample will be randomly selected from each sample shipment received at the laboratory, and spiked with a known amount of the analyte or analytes to be evaluated. In general, a sample spike will be included in every set of 20 samples tested on each instrument. The spike sample will be then analyzed. The increase in concentration of the analyte observed in the spike sample, due to the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the unspiked sample determines the percent recovery. Control charts will be plotted periodically for each commonly analyzed compound and kept on method-specific, matrix-specific, and analyte-specific bases. The percent recovery for a spiked sample is calculated according to the following formula:

$$\%R = \frac{Amount\ in\ Spiked\ Sample - Amount\ in\ Sample}{Known\ Amount\ Sampled} \times 100$$

12.2 Precision Assessment

Spiked samples are prepared by choosing a sample at random from each sample shipment received at the laboratory, dividing the sample into equal aliquots, and then spiking each of the aliquots with a known amount of analyte. The duplicate samples will be then included in the analytical sample set. The splitting of the sample allows the analyst to determine the precision of the preparation and analytical techniques associated with the duplicate sample. The relative percent difference (RPD) between the spike and duplicate spike will be calculated and plotted. The RPD is calculated according to the following formula:

$$RPD = \frac{|Amount\ in\ Spike\ \#1 - Amount\ in\ Spike\ \#2|}{\frac{Amount\ in\ Spike\ \#1 + Amount\ in\ Spike\ \#2}{2}} \times 100$$

Control Charts for recoveries (%), and RPDs will be submitted with the data packages to the U.S. Army Corps of Engineers, Louisville District.

12.3 Completeness Assessment

Completeness is the ratio of the number of valid sample results to the total number of samples analyzed with a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$Completeness = \frac{(number\ of\ valid\ measurements)}{(number\ of\ measurements\ planned)} \times 100$$

SECTION 13

CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving and implementing measures to encounter unacceptable procedures or out of quality control performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All corrective action proposed and implemented will be documented in the regular quality assurance reports to management. Corrective action should only be implemented after approval by the Project Scientist, or his designee. If immediate corrective action is required, approvals secured by telephone from the Project Scientist should be documented in an additional memorandum.

For noncompliance problems during laboratory analysis, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem will be responsible for notifying the Project Manager, who in turn will notify the USACE Quality Assurance Manager. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established quality control procedures in the QAPP or Field Sampling Plan will be identified and corrected in accordance with the QAPP. The USACE Quality Assurance Manager, or his designee, will issue a nonconformance report for each nonconformance condition.

No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by stop-work order by the Quality Assurance Manager.

13.1 Field Corrective Action

Corrective action in the field may be necessary when the sample network is changed (i.e. more/less samples, sampling locations other than those specified in the QAPP), sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the Project Scientist or designee. The Project Scientist will be responsible for assessing the suspected problems and making decisions based on the potential for the situation to impact the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, a nonconformance report will be initiated by the Project Scientist.

The Project Scientist will be responsible for ensuring that corrective action for nonconformances are initiated by:

- evaluating all reported nonconformances;
- controlling additional work on nonconforming items;
- determining disposition or action to be taken; and
- ensuring nonconformance reports are included in the final site documentation in project files.

If appropriate, the SI Project Scientist will ensure that additional work that is dependent on the nonconforming activity is not performed until the corrective actions are completed. Corrective action for field measurements may include:

- Repeat the measurement to check the error;
- Check the batteries;
- Re-Calibration:
- Check the calibration;
- Replace the instrument or measurement devices; and
- Stop work (if necessary).

The Field Team Leader or his designee is responsible for all site activities. In this role, the Field Team Leader is required to adjust the site programs to accommodate site specific needs. When it becomes necessary to modify a program, the responsible person notifies the Field Team Leader of the anticipated change and implements the necessary changes after obtaining the approval of the Field Team Leader. The Field Team Leader must approve the change in writing or verbally prior to field implementation, if feasible. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and action taken.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected due to unapproved or improper use of approved methods. The Quality Assurance Officer will identify deficiencies and recommended corrective action to the Project Manager. Implementation of corrective actions will be performed by the Field Operations Manager and field team. Corrective action will be documented in quality assurance reports to the entire project management.

Corrective actions will be implemented and documented in the field record book. Staff members will not initiate corrective action without prior communication of findings

through the proper channels. If corrective actions are not sufficient, work may be stopped by the USACE QA Manager.

13.2 Laboratory Corrective Action

Corrective action in the laboratory may occur prior to, during, and after initial analysis. A number of conditions such as broken sample containers, multiple phases, low/high pH readings, potentially high concentration samples, may be identified during sample log-in or just prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the laboratory Quality Control Coordinator to approve the implementation of corrective action. The submitted SOPs specify conditions during or after analysis that may automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, automatic reinjection/reanalysis when certain quality control criteria are not met, etc. A summary of method-specific corrective actions is found in this QAPP.

Corrective action is implemented at several different levels. The laboratories are required to have a written SOP specifying corrective action to be taken when an analytical error is discovered or the analytical system is determined to be out of compliance. The SOP requires documentation of the corrective action and notification by the analyst about the errors and corrective procedures. The USACE may request corrective action for any contractual nonconformance identified by audits or data validation. The USACE may also request corrective action by the laboratories for any nonconformances identified in the data validation process or, for minor problems, the lab may be contacted directly. Corrective actions may include:

- Re-analyzing the samples, if holding time criteria permits;
- Resampling and analyzing, and/or;
- Evaluation and amending sampling procedures and/or
- Evaluation and amending analytical procedures; and/or
- Accepting data and acknowledging the level of uncertainty.

If resampling is deemed necessary due to laboratory problems, the Project Manager must identify the necessary approach for the additional sampling effort.

Corrective actions are required whenever an out-of-compliance event or potential is noted. The investigative action taken is somewhat dependent on the analysis and the event.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy;
- Blanks contain target analytes above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- There are unusual changes in detection limits;
- Deficiencies are detected by the QA department during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department.

These corrective actions are performed prior to release of the data from the laboratory. The corrective actions will be documented in both the laboratory's corrective action log (signed by analyst, section leader and quality control coordinator), and the narrative data report sent from the laboratory to the data validator. If corrective action does not rectify the situation, the laboratory will contact the Corps of Engineers QA Manager.

13.3 Corrective Action During Data Validation and Data Assessment

The USACE may identify the need for corrective action during either data validation or data assessment. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the required quality assurance objectives (e.g. the holding time for samples is not exceeded, etc.). When the USACE data assessor identifies a corrective action situation, the Project Manager will be responsible for approving the implementation of corrective action, including resampling, during data assessment. All corrective actions of this type will be documented by the QA Manager.

SECTION 14

QUALITY ASSURANCE REPORTS TO MANAGEMENT

The Project Manager will be responsible for deliverables associated with the tasks identified in the Work Plan. The Quality Assurance Officer will be responsible for reporting on the accuracy, precision, and completeness of the data as well as the results of the performance and system audits, and any corrective action needed or taken during the project.

14.1 Contents of Project QA Reports

The QA reports will contain on a routine basis all results of field and laboratory audits, all information generated during the past month reflecting on the achievement of specific data quality objectives, and a summary of corrective action that was implemented, and its immediate results on the project. The status of the project with respect to the Project Schedule included in the QAPP will be determined. Whenever necessary, updates on training provided, changes in key personnel, anticipated problems in the field or lab for the upcoming month that could bear on data quality, along with proposed solutions, will be reported. Detailed references to QAPP modifications will also be highlighted. All QA reports will be prepared in written, final format by the Project Manager or his designee. In the event of an emergency, or in case it is essential to implement corrective action immediately, QA reports can be made by telephone to the appropriate individuals, as identified in the Project Organization or Corrective Action sections of this QAPP. However, these events, and their resolution will be addressed in the final QA report.

14.2 Frequency of QA Reports

Based on the duration of this investigation, only one QA Report will be prepared. The QA Report will be prepared at the end of the project. The frequency of any emergency reports that must be delivered verbally cannot be estimated at the present time.

14.3 Individuals Receiving/Reviewing QA Reports

All individuals identified in the Project Organization chart will receive copies of the QA report.

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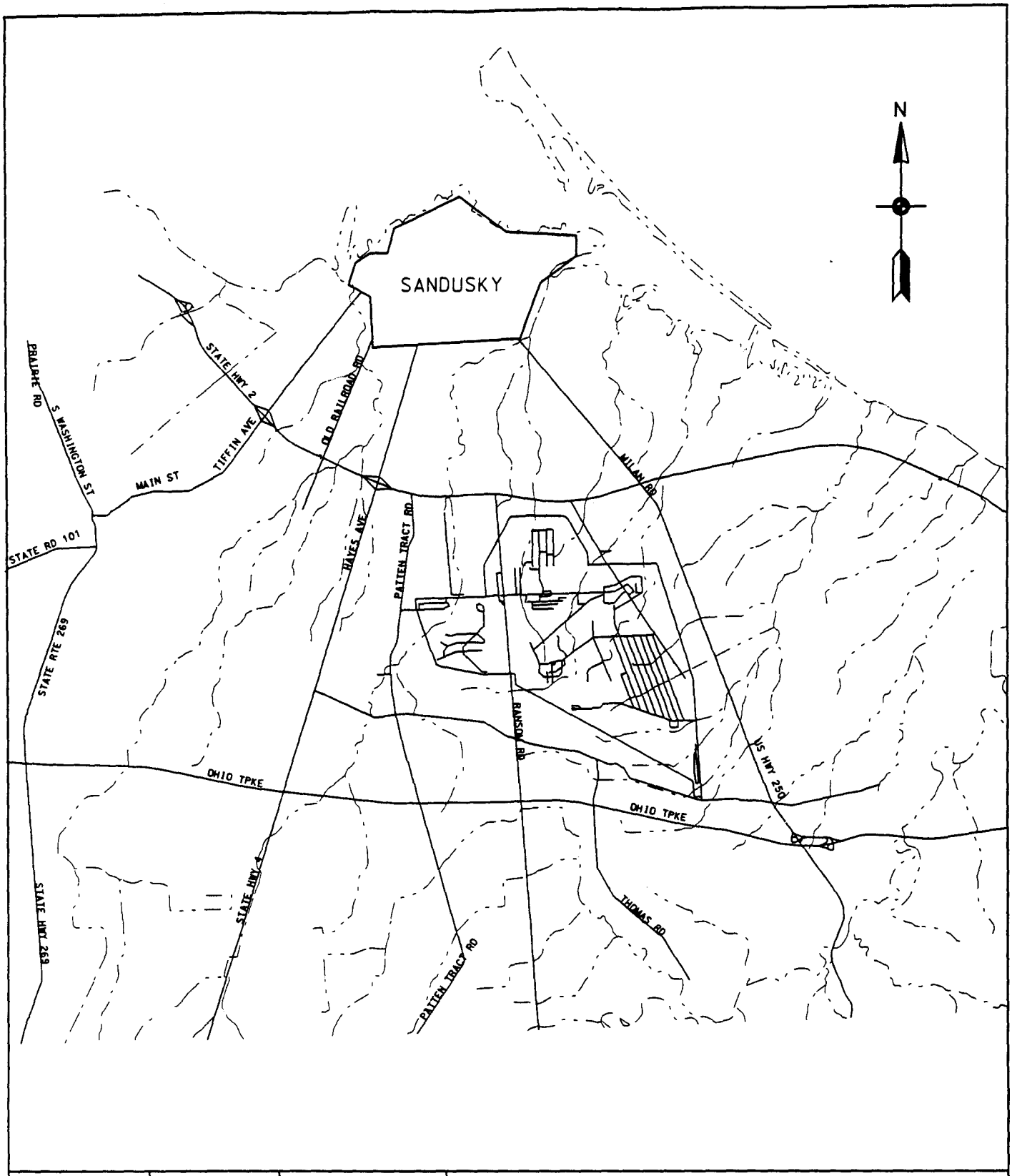
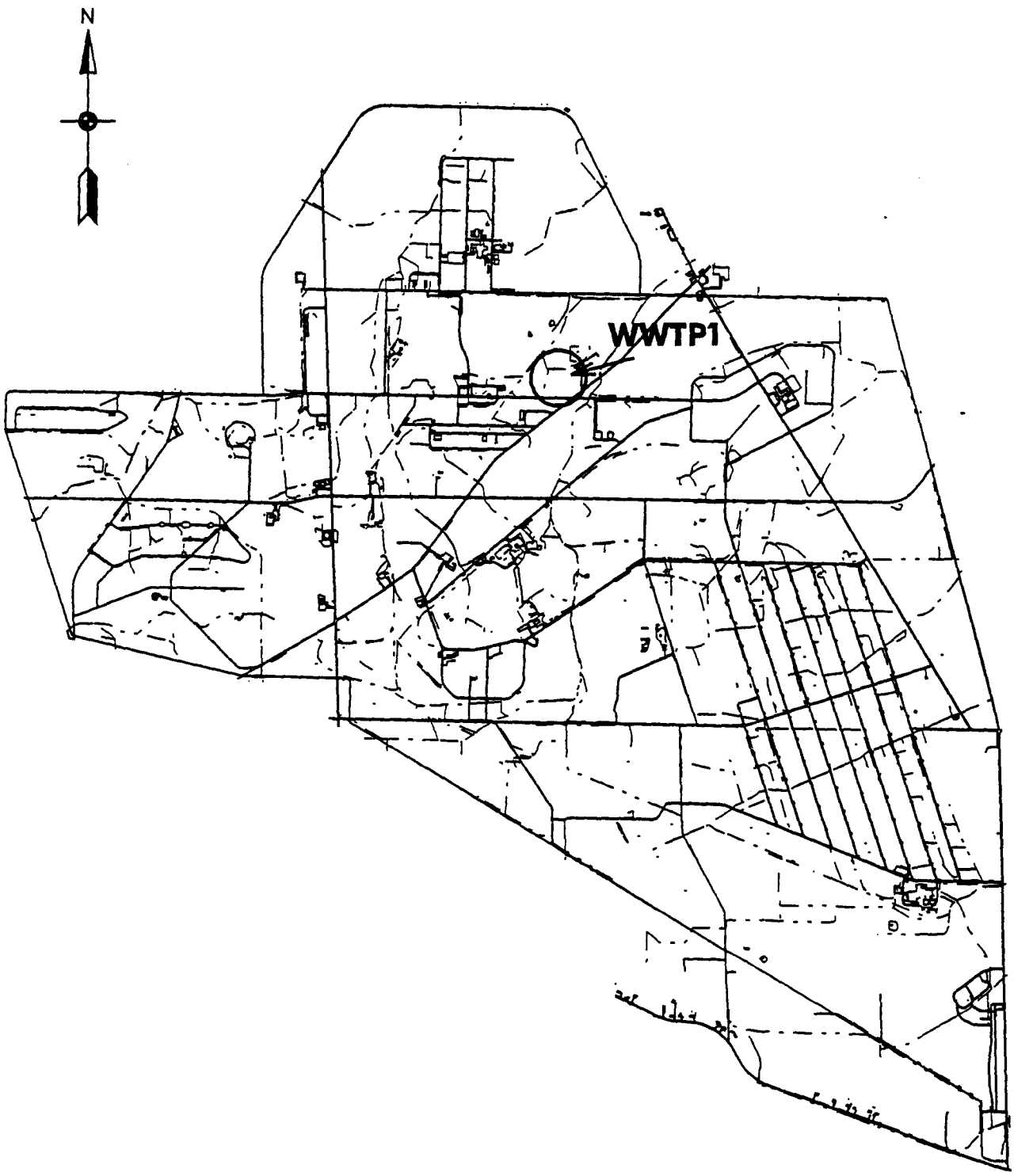


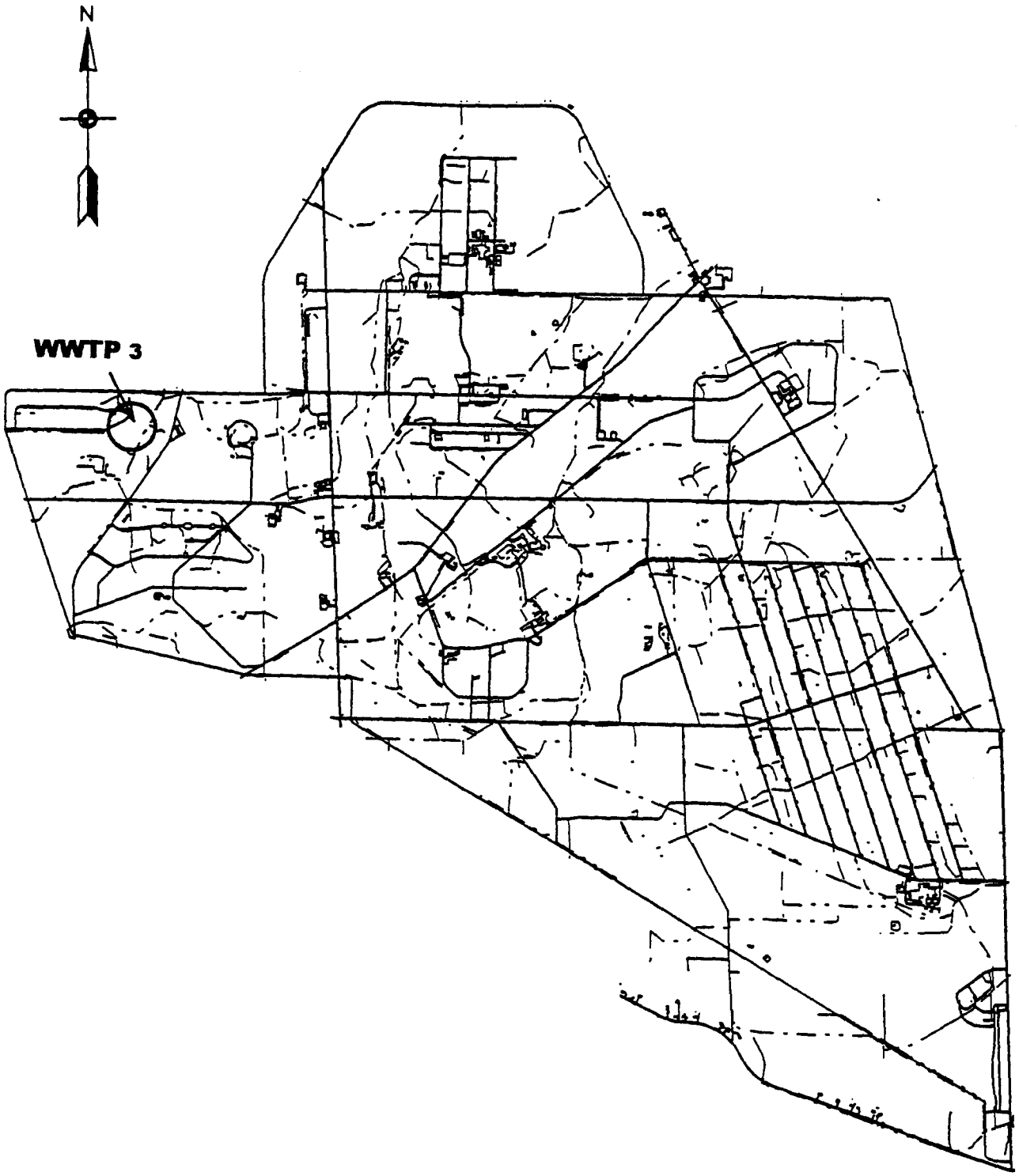
Design By:	Drawn By:	Checked By:	US Army Corps of Engineers	WASTE WATER TREATMENT PLANT #1 & #3 REGIONAL MAP FORMER PLUM BROOK ORDNANCE WORKS SANDUSKY, OHIO LIMITED SITE INVESTIGATION, 1999		
Reviewed By:	Approved By:					
Date:	Scale:		Drawing Code:		Sheet Ref. No.	FIG 1.1

File Name:
Plot Date:



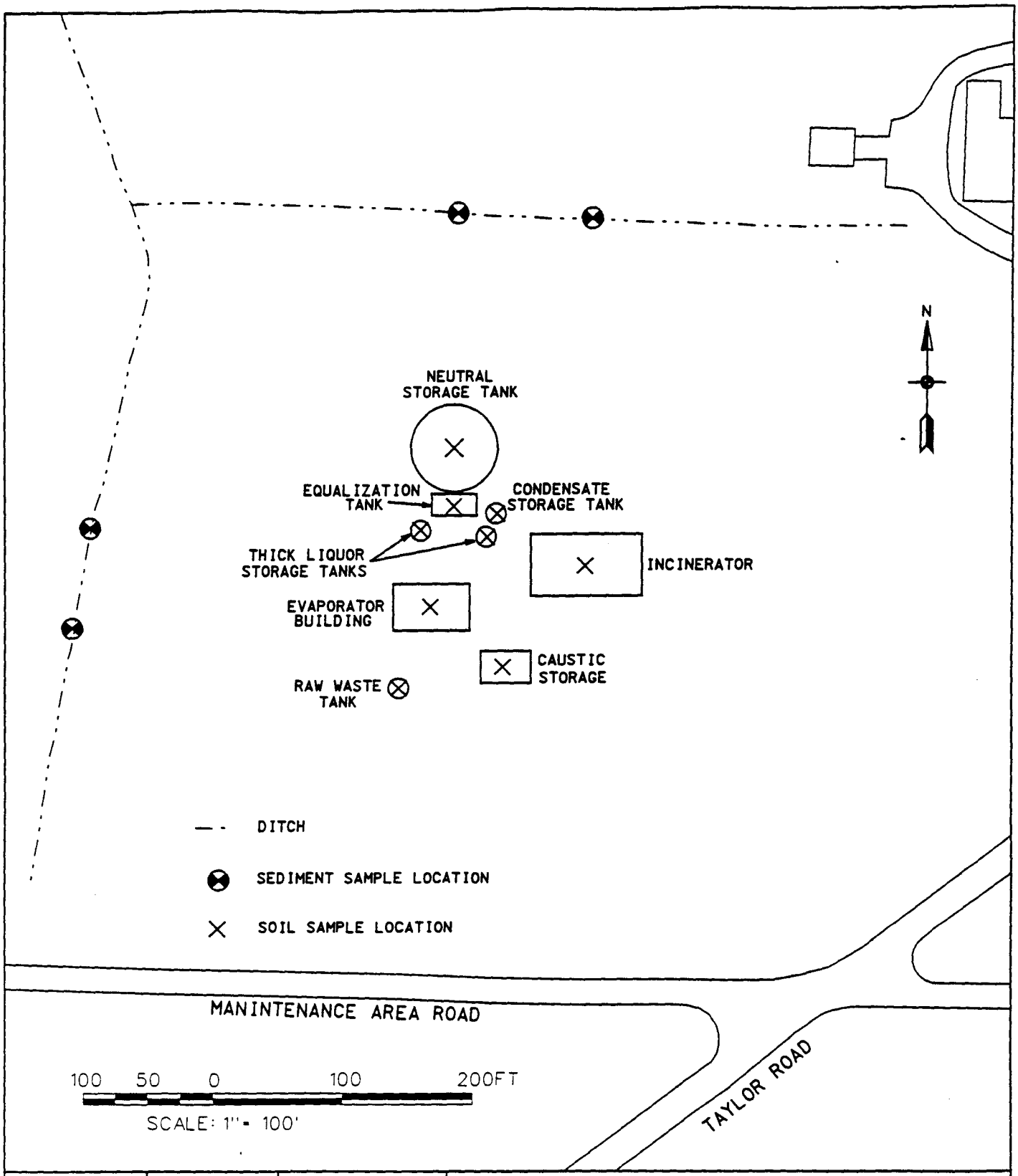
Design By:	Drawn By:	Checked By:	US Army Corps of Engineers	WASTE WATER TREATMENT PLANT #1 SITE LOCATION MAP FORMER PLUM BROOK ORDNANCE WORKS SANDUSKY, OHIO LIMITED SITE INVESTIGATION, 1999	
Reviewed By:	Approved By:				
Date:	Scale:	Drawing Code:	Sheet Ref. No.	FIG 1.2	

File Name:
Plot Date:



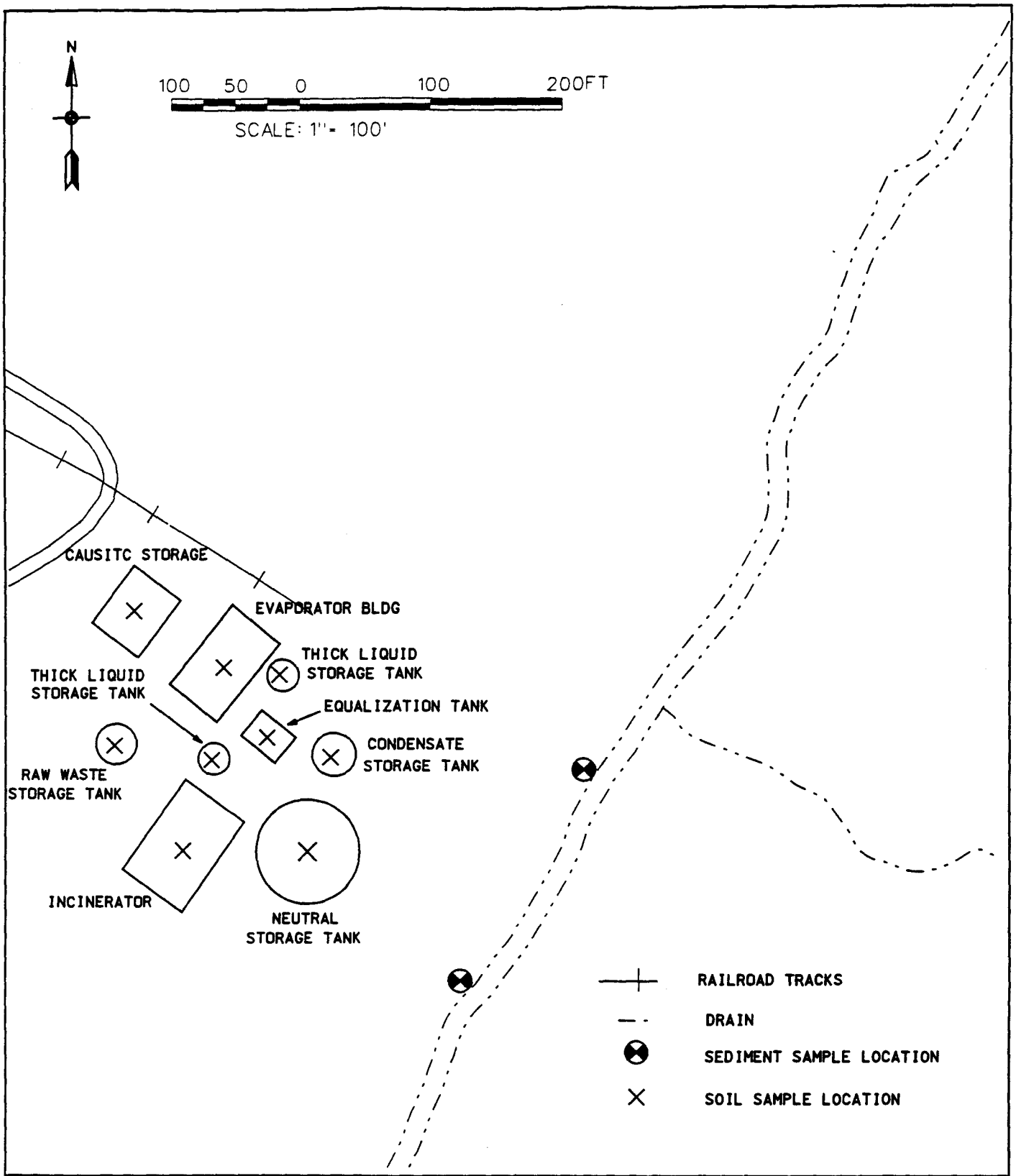
Design By:	Drawn By:	Checked By:	US Army Corps of Engineers	WASTE WATER TREATMENT PLANT #3 SITE LOCATION MAP FORMER PLUM BROOK ORDNANCE WORKS SANDUSKY, OHIO LIMITED SITE INVESTIGATION, 1999	
Reviewed By:	Approved By:				
Date:	Scale:		Drawing Code:	Sheet Ref. No.	FIG 1.3

File Name:
Plot Date:



Design By:	Drawn By:	Checked By:	US Army Corps of Engineers	WASTE WATER TREATMENT PLANT #1 SAMPLING MAP FORMER PLUM BROOK ORDNANCE WORKS SANDUSKY, OHIO LIMITED SITE INVESTIGATION, 1999	
Reviewed By:	Approved By:				
Date: 10 MAY 99	Scale: 1" = 100'	Drawing Code:	Sheet Ref. No.	FIG 4.1	

File Name:
Plot Date:



Design By:	Drawn By:	Checked By:	US Army Corps of Engineers	WASTE WATER TREATMENT PLANT #3 SAMPLING MAP FORMER PLUM BROOK ORDNANCE WORKS SANDUSKY, OHIO LIMITED SITE INVESTIGATION, 1999		
Reviewed By:	Approved By:					
Date: 10 MAY 99	Scale: 1" = 100'		Drawing Code:		Sheet Ref. No.	FIG 4.2

File Name:
Plot Date:

This section not reproduced in this Wastewater Treatment Plants 1 & 3 submission. This section was provided in the submission of the Former Plum Brook Ordnance Works, Pentolite Area.

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Comment Responses

Document: **Quality Assurance Project Plan (QAPP), Limited Site Inspection for the Waste Water Treatment Plants 1 and 3.**
Name: **Ronald E. Nabors, Ohio EPA**

1. General Comment: The Ohio EPA, DERR, would prefer to receive the Quality Assurance Project Plan under separate cover and have it referenced in all site investigation Work Plan submittals.

   Response: We apologize for not obtaining an OEPA, DERR preferred format to develop the Quality Assurance Project Plan (QAPP). We have prepared QAPP documents for projects in Illinois, Michigan and Ohio. The QAPP and associated FSP and DQO attachments were assembled for the Former Plum Brook Ordnance Works using the EPA Region 5 model QAPP, the format we typically use. We apologize for this inconvenience. If our office executes future phases of work for this Formerly Used Defense Site, we will incorporate the OEPA, DERR preferred format in preparing documents.

U.S. ARMY CORPS
OF ENGINEERS
LOUISVILLE DISTRICT

Field Sampling Plan

Limited Site Investigation of the former

Plum Brook Ordnance Works

Waste Water Treatment Plants No. 1 and 3

Sandusky, Ohio

DERP-FUDS HTRW Project No. G05OH001807

July 2000

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1.0 PROJECT DESCRIPTION

1.1 Introduction

Located near Sandusky Ohio, the former Plum Brook Ordnance Works (PBOW) was operated from 1941 to 1945 by Army as a manufacturing plant for trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Contamination detected at the site by previous studies has been related to those activities and is being addressed by the Department of Defense (DOD) under the framework of the Defense Environmental Restoration Program (DERP), Formerly Used Defense Sites (FUDS). A limited Site Investigation (SI) of two sites of the former PBOW will be conducted under this project to evaluate the potential for contamination of the sites that may be traced to DOD activities.

This project is one of several limited SI projects simultaneously undertaken by the US Army Corps of Engineers to be executed by the Louisville District (CELRL) under the direction of the Huntington District (CELRH).

1.2 History and Usage

1.2.1 Installation

Based on the Archives Search Report (USACE, 1993), the original PBS site was established in 1941 and referred to as Plum Brook Ordnance Works (PBOW). The installation was established for the purpose of manufacturing trinitrotoluene (TNT), dinitrotoluene (DNT), pentolite, and nitric and sulfuric acids. Built by E.B. Badger and Sons Company, the facility was operated under contract by the Trojan Powder Company. Production of explosives ceased two weeks after V-J Day, having manufactured in excess of one billion pounds of explosives during the four-year operating period.

Decontamination of TNT, acid, pentolite and DNT manufacturing lines was completed during the last quarter of 1945. On 17 December 1945, the physical custody of the plant was transferred from Trojan to the Ordnance Department. The U.S. Army Corps of Engineers assumed responsibility for maintenance and custodial duties until September 1946 when the property was transferred to the War Assets Administration (predecessor to the Government Services Administration), after it was certified by the U.S. Army to be decontaminated.

NASA acquired the PBOW in 1963 and is presently using the site, now referred to as PBS.

The PBS site currently lies in an area that is primarily rural and agricultural with a low population density. The NASA Glenn Research Center occupies a majority of the former ordnance works. The Department of the Army maintains a reserve center on the westernmost portion of the facility. The remainder of the former installation is in private ownership with the vast majority being cultivated. A tract on the northern boundary is owned by the Perkins Board of Education and is utilized as a bus maintenance facility

1.2.2 Site Specific

The wastewater treatment plants were used during plant operation to reduce the volume of wastewater flowing to the waste water ponds. They consisted of a Neutral Storage Tank, an Equalization Tank, a Condensate Storage Tank, the Evaporator Building, Incinerator, and Caustic Storage, Raw Waste and Thick Liquor storage tanks occupying an area of approximately 2 acres. The plants received waste water from the settling tanks at TNT Areas 1 and 3, neutralized it through a chemical depuration process, and disposed of it in open ditches surrounding the area or thickened it by evaporation and incinerated the resultant thick liquor. Ash from the incinerator was disposed in ash pits.

There is very little background information for WWTP1. Morrison Knudsen took one sample in the area that did not show any significant contamination.

The WWTP3 site was investigated by the Science Applications International Corporation (SAIC) in 1991, Morrison Knudsen in 1993, and the International Technology Corporation (IT) in1997. According to these investigations the site was used by NASA as a dump for demolition debris. SAIC reported dead wood, cement, asphalt, floor tiles, and scrap pipe at the site. SAIC also cited reports of disposal pits excavated in the area for waste materials (specifically fire brick and an empty 500 gallon gasoline tank). SAIC also identified this site as the place for disposal of lime sludge by NASA. The lime sludge was generated from cooling water pre-treatment. The volume of sludges deposited or its chemical characteristics were unknown to SAIC. If the lime sludge resulted from residual material from a water softening process, it would not be expected to contain hazardous ingredients. Morrison Knudsen (MK) identified the area as the Waste Disposal Area 2A and reported that it was covered with steel and concrete debris. MK

took three surface soil samples in the area that tested slightly above Region 9 residential cleanup levels for polychlorinated biphenyls (PCBs), and semi volatile organic compounds (SVOCs). According to the IT investigator, the site in 1997 was a rugged open field with increasing density of young trees and brushes towards the east. Considerable amounts of demolition debris and some smashed drums were observed. A warning sign at the entrance of the site indicated possible asbestos contamination. IT collected 20 screening soil samples and 10 confirmation samples in the area. The testing results indicated no apparent soil contamination with respect to nitroaromatic compounds. Metals and SVOCs were detected at varying levels of contamination.

1.3 Location

The plants occupied an area of approximately 2 acres each. The Wastewater Treatment Plant No. 1 was located northwest of the intersection of Taylor Road and Maintenance Area Road. Plum Brook is 500 feet away to the southeast. The Wastewater Treatment Plant No. 2 was located southwest of the intersection of Pipe creek and the railroad track that runs parallel to and 500 ft. south of Maintenance Area Road (Figures 1.1, 1.2 and 1.3).

1.4 Climate

The climate for Erie County is continental with cold and cloudy winters and warm humid summers. The county's first freezing temperature is typically in October, and it's last freezing temperature is typically in April. Average annual precipitation for Sandusky from 1961 to 1990 was 34.05 inches. Within that time period February had the lowest mean monthly rainfall average with 1.65 inches, whereas July had a high of 3.70 inches. The weather changes every few days as cold fronts move through the region. Wind is from the southwest 55 percent of the time.

1.5 Topography.

1.5.1 WWTP 1

The site is essentially flat with a slight topographic gradient to the north-northeast and to the west draining towards ditches that ultimately discharge on Plum brook. The local relief is low, moderately sloping to nearly level.

1.5.2 WWTP 3

The site is essentially flat with a slight topographic gradient to the east draining toward Pipe creek that runs north some 400 feet away from the site.

1.6 Geology

Based on the Site Wide Ground Study (IT Corporation, 1997-1998), three formations, all of the Devonian Age, underlie the PBOW site. The Delaware Limestone is the lowermost formation. It is characterized as a hard, dense, finely crystalline limestone and dolomite. Dissolution of this unit has been described which has produced solution channels along bedding planes and joints, and even producing caverns in some areas. The unit is typically buff colored and usually described as fossiliferous. In the vicinity of PBOW, benzene, toluene, ethyl benzene, and xylene (BTEX) and hydrogen sulfide are common in area quarries. Overlying the Delaware Limestone is the Olentangy Formation. Two members of the Olentangy Formation have been characterized at the PBOW site, the Plumbrook Shale and the overlying Prout Limestone. The Plum Brook Shale is interpreted to consist of approximately 35 feet of bluish-gray, soft, fossiliferous shale containing thin layers of dark, hard, fossiliferous limestone. The Prout Limestone has been interpreted to be a unit approximately 15 feet thick which outcrops occasionally in a 1,000 to 2,000 foot-wide, northeast striking band across the middle portion of the PBOW. It has been described as a dark-gray to blue, very hard, silicious, fossiliferous limestone or dolomitic mudstone. The uppermost formation at the PBOW site is the Ohio Shale. Only one member of the Ohio Shale is present in the PBOW area- the Huron Shale. This unit has been described as black, thinly bedded, with pyrite and abundant carbonaceous matter with some large pyrite/carbonate concretions up to 6 feet in diameter.

The bedrock overburden in Erie County is predominantly glacial till, glacial outwash or glacial lacustrine (lake) deposits. In the vicinity of PBOW, the soil has been interpreted to be lacustrine. In many areas, the overburden also consists of highly weathered bedrock. The thickness of the overburden ranges from approximately 5 feet or less for most of PBOW to greater than 25 feet. The overburden is thickest on the northern portion of the site.

1.7 Hydrogeology

Based on the Site Wide Groundwater Study (IT Corporation 1997-1998), potable groundwater is encountered in the bedrock units underlying the PBOW site. Generally this groundwater flows northward toward Lake Erie. Based on

the hydrogeologic information given in the Groundwater Resources of Erie County, 1986, the PBOW site includes 3 distinct hydrogeologic regimes. Groundwater yields from these regimes range from limited, to the northeast and south, to more than 500 gallons per minute (gpm), to the northwest.

The WWTP 1 site is located in an area designated as having water yields that seldom exceed three gallons per minute. This area is characterized by water found in thin, discontinuous sand and gravel deposits interbedded in fine, sandy clay. Water may also originate from the underlying shale. The shale in the area is described as impervious. (ODNR, 1986) A drawing indicates the depth to shale in the area near Maintenance Road is about eight feet. (E. B. Badger, 1941)

The WWTP 3 site is located in an area designated as having water yields of 100 to 500 gallons per minute. This area is characterized by water found in cavernous limestone and dolomite at depths of less than 200 feet (ODNR, 1986).

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 General.

This work is being pursued by the United States Army Corps of Engineers (USACE) as part of the Defense Environmental Restoration Program (DERP)/ Formally Used Defense Sites (FUDS). The primary responsibility for the project lies with the Huntington District (CELRH) that acts as the administrator of the funds and performs the overall management functions. CELRH has contracted the Louisville District (CELRL) to execute the design and field work for the project. Several institutions and individuals will coordinate efforts to carry on the project. Their names and functions are listed below.

2.2 Team Members.

Project Manager: Rick Meadows, CELRH-DL-M
Technical Team Leader: Doug Meadors, CELRL-ED-EE
Project Engineer: Albert J. Reyes, CELRL-ED-EE
Health & Safety Manager: Shelton Poole, CELRL-ED-EB
Risk Assessor: David Brancato, CELRL-ED-EE
Quality Assurance Manager: Samir Mansy, CELRL-ED-EB

3.0 SCOPE AND OBJECTIVES

3.1 General

The purpose of this limited SI is to evaluate the potential for contamination of the site due to past Army activities. Historical information was utilized to identify environmental media and locations most likely to be affected. Field sampling and chemical laboratory analysis will be performed to evaluate the suspect media. Results of the laboratory analysis will be compared to risk based, media specific screening criteria. USEPA Region 9 Preliminary Remediation Goals will be used for the screening criteria. Comparison to background values, if warranted by the analytical results, is out of the scope of this project.

The Field investigation for this limited SI will include:

- A visual survey to assess and document site conditions
- Surface soil sampling
- Sediment sampling

Target parameters include nitroaromatics, Volatile Organic Compounds (VOCs),), Semi Volatile Organic Compounds (SVOCs), Polychlorinated Biphenyls (PCBs) and Target Analyte List (TAL) metals. These parameters will be identified based on analytical results using USEPA SW-846 methodology. Asbestos is also included, and will be identified by point count methodology. This data will be used to evaluate the potential for contamination at the site by comparing results to the Region 9 PRG screening criteria.

Additional data will be gathered to help assess the physical characteristics of the site and potential migration characteristics of COC. This includes pH, total organic carbon (TOC), and soil grain size distribution and soil plasticity.

4.0 SAMPLING DESIGN AND RATIONALE

4.1 Identification of Mission Related Contaminants

The objective of this SI is to determine contamination associated with Army use of the sites. The Army Contractor used the sites in the 1940s for the operation of the wastewater treatment plants. Mission Related Contaminants associated with the products handled in the wastewater treatment plants

include nitroaromatics and heavy metals. Contaminants associated with the operation of the plants are those normally associated with industrial processes: VOCs, SVOCs, and PCBs. In addition, asbestos contamination of soils is suspected as a result of the demolition of buildings that probably included asbestos containing materials. Following this criteria all samples will be tested for nitroaromatics and metals, and at those locations where a building site is suspected, samples will be also be tested for VOCs, SVOCs, PCBs and asbestos.

4.2 Nature and Location of Samples

Soil samples will be collected in the areas occupied by the wastewater plants in and around the place where the treatment buildings and tanks were located.

Each one of the plants operated an incinerator and there are indications that the ashes produced by the incinerators were disposed in ash pits around the sites, but those pits could not be located through the review of the existing aerial photography and literature for the sites. During the preliminary visual inspection an effort will be made to detect traces of ashes and samples will be taken at the sites where the ashes are detected.

All buildings demolished at the sites probably included asbestos containing materials. Soil samples collected at the former location of the buildings will be tested for asbestos.

Sediment samples will be collected from the ditches surrounding the sites. Surface water samples will not be collected at this stage of the investigation.

4.3 Number of Samples

4.3.1 WWTP 1

Nine soil sampling points are planned for the WWTP 1 site. One in the area of the neutralization tank, one in the area of the incinerator building, one in the area of the evaporator building, one in the area of the raw waste holding tank, one in the area of the equalization tank, one in the area of the caustic house, one in the area of the condensate tank, and one in each one of the areas of the thick liquor tanks. Proposed sampling locations are depicted in Figure 4.1. At each sampling point, five samples will be collected and field screened for VOCs with a Photo Ionization Detector (PID). The sample point giving the highest PID reading will be sampled for all the parameters presented in this FSP.

Two sediment samples will be collected in the southern bank of the ditch that runs north of the site and two in the eastern bank of the ditch that runs west of the site. In addition to those, samples will be collected at any location where visual inspection reveals potential from mission related contamination.

Additionally, six soil samples will be collected to test for asbestos: two in the area of the incinerator building, two in the area of the evaporator building, and two in the area of the caustic house.

4.3.2 WWTP 3

Nine soil sampling points are planned for the WWTP3 site. One in the area of the neutralization tank, one in the area of the incinerator building, one in the area of the evaporator building, one in the area of the raw waste holding tank, one in the area of the equalization tank, one in the area of the caustic house, one in the area of the condensate tank, and one in each one of the areas of the thick liquor tanks. Proposed sampling locations are depicted in Figure 4.2. At each sampling point, five samples will be collected and field screened for VOCs with a Photo Ionization Detector (PID). The sample point giving the highest PID reading will be sampled for all the parameters presented in this FSP.

Two sediment samples will be collected in the western bank of Pipe creek. In addition to those, samples will be collected at any location where visual inspection reveals potential from mission related contamination.

Additionally, six soil samples will be collected to test for asbestos: two in the area of the incinerator building, two in the area of the evaporator building, and two in the area of the caustic house.

4.4 Testing Parameters

Samples collected will be analyzed nitroaromatics, metals, VOCs, SVOCs, and PCBs. In addition, to aid in assessing the potential for migration through the soil column, one sample will be tested for total organic carbon (TOC), pH, and geotechnical parameters.

5.0 FIELD ACTIVITIES AND SAMPLING PROCEDURES

5.1 Visual Inspections

A visual inspection of the site will be performed before actual sampling takes place. The inspection will consist of a thorough walkover of the site to familiarize the working team with the site and locate visual signs of contamination and potential migration pathways. Modifications to the planned sampling may result from this action.

5.2 Sample Documentation

Logbooks with sequentially numbered pages will be kept at the site during all field activities and will be assigned to each sample team. These logs will be updated continuously and will constitute master field investigation documents. Information to be recorded in the logs includes, but is not limited to the following:

- Project Identification.
- General work activity, work dates, and general time of occurrence.
- Unusual events.
- Communication with the facility representative.
- Visitors on site.
- Sample number and time of day for each sample collected for analysis.
- Record of telephone calls to laboratory informing it of sample shipment.
- Variances from project plans and procedures.
- Photographs taken and identification numbers (including location, spatial orientation, and a brief description of the photograph subject).

5.3 Photographs

Color photographs will be taken of sampling areas to record significant field observations or to record site conditions in the case of visual inspections. Prints will be identified with the project number, date and time taken, and a brief description of the subject, location, and orientation of the photograph.

5.4 Surface and Subsurface Soil Sampling

Surface soil sampling will be performed using a stainless steel hand auger. The area around the boring location will be cleared of any debris (twigs, rocks, litter). A piece of plastic sheeting will be placed on the ground around the sample boring location to prevent cross contamination. Samples will not come into direct contact with this plastic sheeting. Hand augers will be decontaminated prior to being used. The boring will be advanced by turning the hand auger's crossbar at the same time the operator presses the auger into the ground. Sampling will be continuous throughout the boring. Samples will be collected at 1 foot depths. Any variances in sampling due to field conditions or findings will be properly documented. All borings will be documented with a boring log and soils will be classified using the USCS. Once the proper depth is obtained the auger is removed from the borehole and the sample is taken from the sampling section (void) of the auger. For field screening, the sample will be placed in a zipped plastic bag. The field screening sample will be allowed to stand and volatilize for approximately 10 minutes in a warm area. The bag will then be pierced and a reading of VOC will be recorded. For samples destined for laboratory testing, first a VOC portion will be placed in a laboratory pre-cleaned glass sample jar with Teflon lined lids, labeled, sealed and immediately placed on ice. The remains of the sample will be placed in a stainless steel bowl and will be thoroughly mixed and homogenized before placing samples in the appropriate container. All soil sample containers will be clearly identified on the labels and put on ice for preservation. The proper volume of sample will be taken to insure that all internal laboratory quality control samples (i.e., Matrix Spike/Matrix Spike Duplicates (MS/MSDs), spikes, lab duplicates) can be performed by the laboratory. Sample collection information will be recorded in a field logbook. All sampling equipment will be appropriately decontaminated prior to each individual sampling episode to prevent down-hole and cross-hole contamination and prior to leaving the investigative area.

5.5 Sediment Sampling

The sampling sequence will begin at downstream locations and progress upstream to prevent cross-contamination from one location to another. Sediment samples will be collected by using a stainless steel scoop. If access is limited or the depth of sediment is to great a clamp and pole will be used to extend the reach of the sampler. Effort will be made to obtain sediment samples beneath the water sediment interface. Any excess water collected during sediment samples will be decanted from the sediment. Sediment samples will be collected facing upstream. All samples requiring preservation will be preserved in the field with the appropriate preservatives. Sediment samples will be placed in a stainless steel bowl and homogenized, before placing samples in containers. All samples will be clearly identified on the

sample labels and put on ice for preservation. The proper volume of sample will be taken to insure that all internal laboratory quality control samples (i.e., MS/MSDs, spikes, lab duplicates) can be performed by the laboratory. Sample collection information will be recorded in a field logbook. All sampling equipment will be decontaminated prior to each individual sampling episode to prevent cross contamination and prior to leaving the investigative area.

5.6 Asbestos Sampling

The location where asbestos samples will be collected will be manually cleaned of grass and debris and a superficial soil sample will be taken with a spoon and placed in a laboratory supplied soil bottle.

5.7 Field Quality Control Sampling

The following field quality control samples will be collected to monitor sampling precision, cross contamination, and decontamination procedures:

- Duplicates - Duplicate samples will be collected at the same time as the original sample and in the same analytical sequence. One field duplicate will be collected for every 10 primary samples. Duplicate samples will be used to monitor sampling precision in the field. Duplicate analysis will be performed for VOCs, SVOC ,metals , and TOC analyses.

- Rinsate - Rinsate samples will be collected by rinsing sampling equipment (i.e., hand augers, stainless steel scoops) with deionized water after decontamination has been performed. The water being used to rinse the equipment will be collected in the appropriate sample container. One rinsate will be collected for every 20 investigative samples. These samples will monitor field-sampling procedures for decontamination completeness. SVOC, metals, and TOC analyses will be performed on rinsates.

- Field Blanks - Field blanks will be collected from the deionized water used in the field for sampling procedures. One field blank will be collected for every 20 primary samples. These samples will monitor field-sampling procedures for the introduction of contamination. Field blanks will be analyzed for SVOCs, nitroaromatics, PCBs, and metals.

- Temperature Blanks – The laboratory of record will provide prefilled sample bottles. This sample will be clearly identified as a temperature blank. This sample will be added in every cooler prepared for shipment to the analytical laboratory to monitor temperature of the samples while in transit from the field to the laboratory.

5.8 Decontamination

Decontamination procedures are implemented to prevent cross contamination, to control potential migration of chemical constituents, and to prevent worker exposure to chemicals or pathogens that may contaminate clothing or protective gear. A decontamination system will be established to wash and rinse all personal equipment and sampling equipment. Several gallons of clean, distilled water will be maintained on site along with plastic buckets, brushes, and soap to decontaminate during the sample collection process.

Personnel performing field activities must decontaminate upon exiting the area. Personal safety and health considerations are presented in the Site-specific Health and Safety plan that was submitted along with this Field Sampling Plan. In addition, all hand tools and equipment will require decontamination prior to removal from the work area. Any materials generated during the site investigation activities (i.e. investigative derived wastes) as a result of decontamination procedures will be stored in labeled drums until final disposal arrangements, consistent with applicable environmental requirements, are made.

Only minor decontamination of site personnel is recommended, incorporating gross decontamination of the soles of work boots and any personal protective equipment used while on site. All discarded materials shall be handled in such a manner as to preclude spreading of contamination, creating a sanitary hazard, or littering the site. In addition, site workers must wash their hands (and face optional, if exposure warrants) with soap and water before eating, drinking, and before leaving the investigative area.

Decontamination procedures involved in this site investigation will generally involve the subsequent cleaning of any sampling equipment associated with soil and sediment collection. Generally accepted measures for ensured data quality and reliability will be employed, specifically involving rinsing of sampling tools and equipment with distilled water and soap (Alconox or other non-phosphate detergent), with a final rinse of deionized water.

This will be accomplished by moving the equipment to a "contained area" and washing all suspect contaminated equipment down with brush scrubbing and the soap solution. Hand tools, trowels, scoops, bowls, bailers, etc. used for sample collection of soils and sediments shall similarly be decontaminated between samples and before leaving the site for the day. Rinsates and decontamination fluids will require containerization in containers approved for liquids, labeled and properly stored, while awaiting approval for disposal. Based on the anticipated levels of contamination on these sites, it is believed that disposal approvals will permit disposal of decontamination fluids through the local sanitary sewer.

Materials used for decontamination will be compatible and safe for the purpose intended and for site workers. Consistent with the Hazardous Communication Standard, 29 CFR 1910.1200, any chemicals brought on site will be accompanied by a Materials Safety Data Sheet (MSDS) and kept with the field team.

6.0 FIELD SAMPLE IDENTIFICATION AND CUSTODY PROCEDURES

A critical aspect of sample collection and analysis protocols is the maintenance of strict chain-of-custody (CoC) procedures. CoC procedures include tracking and documentation during sample collection, shipment, and laboratory processing. A sample is considered to be in an individual 's custody if it is:

- In the physical possession or view of the individual party.
- Secured to prevent tampering.
- Placed in a restricted area by the responsible party.

The sampling team leader is responsible for the custody of the collected samples in the field until they are properly packaged, documented, and released to the courier for shipment to the laboratory. The laboratory is responsible for sample custody thereafter. Custody will be documented by using the CoC record initiated for each day that samples are collected. This record will accompany the samples from the site to the laboratory and will be returned to key project personnel with the final analytical report. All personnel with sample custody responsibilities are required to sign, date, and note the time on the CoC record when relinquishing and receiving samples from their immediate custody. Any discrepancies will be noted at this time. All samples will be shipped via overnight courier to the analytical laboratory. Bills of lading will be used as custody documentation during this time and will be retained as part of the permanent sample custody documentation. All aspects of sample documentation and custody for field and laboratory activities are detailed in the following sections.

6.1 Sample Containers, Preservation and Holding Times

The laboratory will supply sample containers. Containers will be selected to ensure compatibility with the sample matrix, chemical constituents to be analyzed, and to minimize breakage during transportation. Sample bottle size required, preservatives, and holding times are listed in table 6.1. Sample containers, blank labels, preservatives, and packing materials will be supplied by the laboratory. Sample labels will be attached to containers and filled out at the time of sampling. The following information will be recorded on each label:

- sample identification number

- project number
- collectors initials
- date and time of collection
- preservatives added if applicable
- sample type
- depth

Table 6.1. Summary of Sample Containers, Preservation Methods, and Holding Times for Soil Samples

Parameter	Analytical Method	Quantity	Type	Holding Times
Nitroaromatics	EPA 8330	1	4-oz wide mouth	14 days to extract analyze: 28 days
Metals	Trace ICP 6010	1	2 oz wide mouth	6 mo's Hg 28 days
VOCs	EPA 8260B	1	2 oz wide mouth	14 days analyze: 28 days
SVOCs	EPA 8270C	1	4 oz wide mouth	14 days to extract analyze: 28 days
PCBs	EPA 8082	1	4 oz wide mouth	14 days to extract
TOCs	EPA 9060	1	4 oz wide mouth	28 days
pH		1	2 oz wide mouth	Immediate
Asbestos	Point Count	1	4 oz wide mouth	Infinite

Table 6.2. Summary of Sample Containers, Preservation Methods, and Holding Times for Sediment Samples

Parameter	Analytical Method	Quantity	Type	Holding Times
Nitroaromatics	EPA 8330	1	4-oz wide mouth	14 days to extract
Metals	Trace ICP 6010	1	2 oz wide mouth	6 mo's Hg 28 days
SVOCs	EPA 8270C	1	4 oz wide mouth	14 days to extract

Table 6.3. Summary of Sample Containers, Preservation Methods, and Holding Times for Water Samples

Parameter	Analytical Method	Quantity	Type	Preservation Methods	Holding Times
Nitroaromatics	EPA 8330	2	1 liter Amber glass	None	7 days to extract
Metals	Trace ICP 6010	1	1 liter poly	HNO_3	6 mo's Hg 28 days
VOCs	EPA 8260B	3	40 ml VOA	HCl	14 days
SVOCs	EPA 8270C	2	1 liter amber glass	none	7 days to extract
PCBs	EPA 8082	2	1 liter amber glass	none	7 days to extract
TOC	EPA 9060	2	40 ml. VOA	H_2SO_4	28 days

6.2 Sample Identification

Each sample will be assigned a unique identification number that uniquely identify each sample for analysis. The sampling will consist of 13 alphanumeric characters separated in 5 groups, as shown in the example and explained below.

PBOW 99 SS W1 05

Group 1 (5 characters or less): identifies the project
Group 2 (2 digits): identifies the year
Group 3 (2 characters): identifies the type of sample according to the following code:

SS surface soil
SB soil boring (subsurface soil)
SW surface water
WW well water
SD sediment

Group 4 (2 chars): identifies the location of the sample according to a code particular for each project. For this project the code is:

W1 WWTP1
W2 WWTP3

Group 5 (2 digits): sequential number of samples taken at the location.

6.3 Sample Packaging

The following procedures will be performed during sample packaging:

- Number of samples will be verified with field logbook documentation.
- Sample labels will be checked for accuracy and legibility.
- All samples will be wrapped in bubble pack, and placed in a sealed zip-locked bag.
- All coolers will have a temp blank so that the temperature can be monitored.
- Samples will be packaged in a thermally insulated, rigid cooler.
- Packing material will be placed in the coolers to prevent breakage.
- Ice will be placed in the cooler for samples requiring 4°C ± 2° preservation.
- Each cooler will have it's own Chain of Custody (CoC) form reflecting the samples inside.
- The CoC form will be placed in a sealed zip-lock bag, and taped to the inside lid of the cooler.
- The cooler will be closed and sealed with duct tape around both ends, and around the lid.
- Custody seals will be placed in two separate locations on the cooler across the lid and main body of the cooler and signed by the field team leader.
- An addressed courier bill will be placed on the cooler so that shipment of the cooler can take place.

6.4 Custody Transfer and Shipment Procedures

All samples will be accompanied by a CoC form. When the possession of samples is transferred, the individual relinquishing the samples and the individual receiving the samples will sign, date, and note the time of transfer on the CoC document. This record will represent the official documentation for all transfers of sample custody until samples arrive at Quanterra Laboratories, North Canton, Ohio. Samples will be shipped for overnight

service by the courier. This will allow for the least amount of time from sampling and analysis, and will ensure that all holding times are met. Notification of sample shipment to the laboratory will be performed by the Field team leader.

Quanterra Laboratory	Phone (330) 497-9396
4101 Shuffel Drive NW	Fax (330) 497-0772
North Canton, OH 44720	

7.0 DISPOSITION OF FIELD INVESTIGATION DERIVED WASTE (IDW)

Investigation derived waste will be minimal for this field activity. Soil cuttings from all hand-augured borings will be replaced. All personal protective equipment (PPE) (e.g., Tyvek®, nitrile or latex gloves) will be placed in a plastic garbage bag and taken to a PBS dumpster for disposal. All decontamination water will be collected and stored in an appropriate storage container pending analytical results. Should results obtained show insignificant contamination, the water will be placed in a sanitary sewer system at Plum Brook Station. Should significant contamination be revealed, the decontamination water will be disposed of at a licensed disposal facility. IDW will be identified and properly handled while it is being accumulated or stored on site.

IDW shall be contained and handled in compliance with the following requirements:

- IDW shall be stored at the site of generation or consolidated at a central storage location supplied by NASA-PBS, pending analytical results.
- Waste generation will be minimized whenever possible and feasible.
- Storage, label and equipment needs shall be identified in a timely manner for NASA -PBS personnel.
- All IDW, pending analytical results, will be characterized for appropriate disposal at a licensed disposal facility within 45 days of initiating field activities.

8.0 SCHEDULE

8.1 Start Date

The earliest date for which field activities will begin is 7 June 1999.

8.2 Pre-mobilization

The following activities will be completed before field activities begin:

- Site Access - Access has been obtained from NASA by the U.S Army Corps of Engineers to enter Plum Brook Station.

- Security - Access to Plum Brook Station is controlled by the main gate and security office located on Taylor Road. The security procedures for gaining access are vehicle and personnel registration. The Security office will issue vehicle and personnel badges. Only U.S. citizens with picture I.D. can obtain access to the station. All personnel allowed access to Plum Brook Station are required to view a short 10-minute safety and informational video. The security office will also dispense hand radios to all personnel performing fieldwork for safety as well as security reasons.

- Staging and Support Area - NASA has provided the USACE with a staging area within NASA's shipping and receiving building #9209 located south of Maintenance Road in the garage /maintenance area. This area will be used as a staging area for small sampling supplies and sample shipment.

- Site Visit - A site visit will take place prior to any sampling event. This site visit will allow USACE personnel to visually assess sites, and will facilitate optimization of the sampling design and rationale.

8.3 Mobilization

Mobilization includes efforts required by USACE personnel to prepare for the sampling portion of the site investigation. All sampling team members will review the Field Sampling Plan and Quality Assurance Project Plan prepared for the site investigation. All sampling equipment and materials will be inspected for proper decontamination and good working condition. All provisions will be made by USACE to ensure that field supplies are available and appropriate for sampling team members. These supplies include logbooks, sample containers, labels, chain of custody forms, shipping supplies, coolers, and packing materials.

8.4 Demobilization

At the completion of sampling activities USACE personnel will demobilize. Arrangements have been made for the disposal of investigation-derived waste (IDW). Preparation of waste manifests, if necessary will be prepared by USACE personnel for signature by PBS personnel. All sampling equipment and materials will be removed by USACE personnel from the site as well as the staging area provided by NASA. USACE personnel will maintain a clean

and safe work environment at the investigative site as well as the staging areas provided by NASA. All efforts will be made to leave investigative areas in the same condition as they were found.

U.S. ARMY CORPS
OF ENGINEERS
LOUISVILLE DISTRICT

Data Quality Objectives

Limited Site Investigation of the former

Plum Brook Ordnance Works

Waste Water Treatment Plants No. 1 and 3

Sandusky, Ohio

DERP-FUDS HTRW Project No. G05OH001807

July 2000

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1.0 DATA QUALITY OBJECTIVE PROCESS

The purpose of this section is to provide and document the rationale for developing Data Quality Objectives (DQOs) for the Site Investigation (SI) of the Wastewater Treatment Plant 1 and Wastewater Treatment Plant 3 sites, located at the former Plum Brook Ordnance Works (PBOW), Ohio FUDS Site.

The former PBOW was operated from 1941 to 1945 by the Trojan Powder Company under contract to the Army Ordnance Department. The facility manufactured trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Investigation of the PBOW is being addressed by the DOD under the Defense Environmental Restoration Program (DERP), Formerly Used Defense Sites (FUDS) program. This project is being undertaken by the U.S. Army Corps of Engineers Louisville District (CELRL) under direction of the U.S. Army Corps of Engineers Huntington District (CELRH).

The DQO process is a strategic planning approach based on the Scientific Method that is used to prepare for a data collection activity. It provides a systematic procedure for defining the criteria that a data collection design should satisfy, including when to collect samples, where to collect samples, the tolerable level of decision errors for the study, and how many samples to collect.

The DQO process consists of the following seven distinct steps with the following brief descriptions (USEPA 1994):

- **Step 1**: State the Problem – Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.

- **Step 2:** Identify the Decision – Identify what questions the study will attempt to resolve, and what actions may result.

- **Step 3**: Identify the Inputs to the Decision – Identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement.

- **Step 4:** Define the Study Boundaries – Specify the time periods and spatial area to which decisions will apply. Determine when and where the data should be collected.

- **Step 5:** Develop a Decision Rule – Define the statistical parameters of interest, specify the action level, and integrate the previous DQO outputs into a singe statement that describes the logical basis for choosing among alternative actions.

- **Step 6:** Specify Tolerable Limits on Decision Errors – Define the decision maker's tolerable decision error rates based on a consideration of the consequences of making an incorrect decision.

- **Step 7:** Optimize the Design – Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets all DQOs.

The DQO process is iterative by design; the outputs of one step may influence any steps in the process and improve the investigation as knowledge of the site increases.

2.0 Background

2.1 Installation and Site History

Based on the Archives Search Report (USACE, 1993), the site was established in 1941 and referred to as Plum Brook Ordnance Works (PBOW). The installation was established for the purpose of manufacturing trinitrotoluene (TNT), dinitrotoluene (DNT), pentolite, and nitric and sulfuric acids. The E.B. Badger and Sons Company was the facility architect. The facility was operated under contract by the Trojan Powder Company. Production of explosives ceased two weeks after V-J Day, having manufactured in excess of one billion pounds of explosives during the four-year operating period.

Decontamination of TNT, acid, pentolite and DNT manufacturing lines was completed during the last quarter of 1945. On 17 December 1945, the physical custody of the plant was transferred from Trojan to the Ordnance Department. The U.S. Army Corps of Engineers assumed responsibility for maintenance and custodial duties until September 1946 when the property was transferred to the War Assets Administration (predecessor to the Government Services Administration), after it was certified by the U.S. Army to be decontaminated.

NASA acquired the PBOW in 1963 and is presently using the site, now referred to as PBS.

The former PBOW site currently lies in an area that is primarily rural and agricultural with a low population density. The NASA Glenn Research Center occupies a majority of the former ordnance works. The Department of the Army maintains a reserve center on the westernmost portion of the facility. The remainder of the former installation is in private ownership with the vast majority being cultivated. A tract on the northern boundary is owned by the Perkins Board of Education and is utilized as a bus maintenance facility.

The wastewater treatment plants were used during plant operation to alleviate the volume of effluent flowing to the waste water ponds. The plants received waste water from the settling basins at TNT Areas 1 and 3, neutralized it through a chemical depuration process and disposed of it in open ditches surrounding the area. Ash from an incinerator building associated with the process was disposed in ash pits. The nature of the operations suggest the possibility of

contamination from explosive residues in the soil. The contaminants of concern are those normally associated with explosives, nitroaromatics and metals and those associated with manufacturing processes, volatiles, semivolatiles, and PCBs.

There is very little background information for WWTP1. Morrison Knudsen took one sample in the area that did not show any significant contamination.

The WWTP3 site was investigated by the Science Applications International Corporation (SAIC) in 1991, Morrison Knudsen in 1993, and the International Technology Corporation (IT) in1997. According to these investigations the site was used by NASA as a dump for demolition debris. SAIC reported dead wood, cement, asphalt, floor tiles, and scrap pipe at the site. SAIC also cited reports of disposal pits excavated in the area for waste materials (specifically fire brick and an empty 500 gallon gasoline tank). SAIC also identified this site as the place for disposal of lime sludge by NASA. The lime sludge was generated from cooling water pre-treatment. The volume of sludges deposited or its chemical characteristics were unknown to SAIC. If the lime sludge resulted from residual material from a water softening process, it would not be expected to contain hazardous ingredients. Morrison Knudsen (MK) identified the area as the Waste Disposal Area 2A and reported that it was covered with steel and concrete debris. MK took three surface soil samples in the area that tested slightly above Region 9 residential cleanup levels for polychlorinated biphenyls (PCBs), and semi volatile organic compounds (SVOCs). According to the IT investigator, the site in 1997 was a rugged open field with increasing density of young trees and brushes towards the east. Considerable amounts of demolition debris and some smashed drums were observed. A warning sign at the entrance of the site indicated possible asbestos contamination. IT collected 20 screening soil samples and 10 confirmation samples in the area. The testing results indicated no apparent soil contamination with respect to nitroaromatic compounds. Metals and SVOCs were detected at varying levels of contamination.

2.2 Topography

WWTP 1

The site is essentially flat with a slight topographic gradient to the north-northeast and to the west draining towards ditches that ultimately discharge on Plum brook. The local relief is low, moderately sloping to nearly level.

WWTP 3

The site is essentially flat with a slight topographic gradient to the east draining toward Pipe creek that runs north some 400 feet away from the site.

2.3 Geology

Based on the Site Wide Ground Study (IT Corporation, 1997-1998), three formations, all of the Devonian Age, underlie the PBOW site. The Delaware Limestone is the lowermost formation. It is characterized as a hard, dense, finely crystalline limestone and dolomite. Dissolution of this unit has been described which has produced solution channels along bedding planes and joints, and even producing caverns in some areas. The unit is typically buff colored and usually

described as fossiliferous. In the vicinity of PBOW, benzene, toluene, ethyl benzene, and xylene (BTEX) and hydrogen sulfide are common in area quarries. Overlying the Delaware Limestone is the Olentangy Formation. Two members of the Olentangy Formation have been characterized at the PBOW site, the Plumbrook Shale and the overlying Prout Limestone. The Plum Brook Shale is interpreted to consist of approximately 35 feet of bluish-gray, soft, fossiliferous shale containing thin layers of dark, hard, fossiliferous limestone. The Prout Limestone has been interpreted to be a unit approximately 15 feet thick which outcrops occasionally in a 1,000 to 2,000 foot-wide, northeast striking band across the middle portion of the PBOW. It has been described as a dark-gray to blue, very hard, silicious, fossiliferous limestone or dolomitic mudstone. The uppermost formation at the PBOW site is the Ohio Shale. Only one member of the Ohio Shale is present in the PBOW area- the Huron Shale. This unit has been described as black, thinly bedded, with pyrite and abundant carbonaceous matter with some large pyrite/carbonate concretions up to 6 feet in diameter.

The bedrock overburden in Erie County is predominantly glacial till, glacial outwash or glacial lacustrine (lake) deposits. In the vicinity of PBOW, the soil has been interpreted to be lacustrine. In many areas, the overburden also consists of highly weathered bedrock. The thickness of the overburden ranges from approximately 5 feet or less for most of PBOW to greater than 25 feet. The overburden is thickest on the northern portion of the site.

2.4 Hydrogeology

Based on the Site Wide Groundwater Study (IT Corporation 1997-1998), potable groundwater is encountered in the bedrock units underlying the PBOW site. Generally this groundwater flows northward toward Lake Erie. Based on the hydrogeologic information given in the Groundwater Resources of Erie County, 1986, the PBOW site includes 3 distinct hydrogeologic regimes. Groundwater yields from these regimes range from limited, to the northeast and south, to more than 500 gallons per minute (gpm), to the northwest.

The WWTP 1 site is located in an area designated as having water yields that seldom exceed three gallons per minute. This area is characterized by water found in thin, discontinuous sand and gravel deposits interbedded in fine, sandy clay. Water may also originate from the underlying shale. The shale in the area is described as impervious. (ODNR, 1986) A drawing indicates the depth to shale in the area near Maintenance Road is about eight feet. (E. B. Badger, 1941)

The WWTP 3 site is located in an area designated as having water yields of 100 to 500 gallons per minute. This area is characterized by water found in cavernous limestone and dolomite at depths of less than 200 feet (ODNR, 1986).

3.0 Data Quality Objectives Process

3.1 Step 1: State the Problem

The purpose of this step is to define the problem so that the focus of the study will be unambiguous. Concisely describe the problem to be studied and review prior studies and existing information to gain a sufficient understanding to define the problem.

3.1.1 *Identification of Planning Team Members*

Project Manager:	Rick Meadows, CELRH-DL-M
Team Leader & Site Manager:	Doug Meadors, CELRL-ED-EE
Project Engineer:	Albert J. Reyes, CELRL-ED-EE
Health & Safety Manager:	Shelton Poole, CELRL-ED-EB
Health & Safety Manager Alternate:	David Brancato, CELRL-ED-EE
Quality Assurance Manager:	Samir Mansy, CELRL-ED-EB

3.1.2 *Description of Problem*

Potential contamination at the Wastewater Treatment Plants 1 & 3 sites was identified in a project summary sheet, as an exhibit to an Inventory Project Report (INPR) prepared by Huntington District, which requested a Limited Site Investigation. The purpose of the Limited SI was to identify any contamination related to the previous Army activities. Soil samples have not been collected in this area.

3.1.2 *Potential Transport Mechanisms*

Potential transport mechanisms at the Wastewater Treatment Plants 1 & 3 sites include:

- Surface water runoff.
- Leaching through the soil column to the subsurface soil and groundwater.

3.1.3 *Resources and Relevant Deadlines for the Site Investigation*

The funding resources for Site Investigations are provided under the DERP-FUDS DOD program. This limited SI must be completed by the end of FY 99 in order to closeout the records for this project in the financial system. The Louisville District Environmental Engineering Branch is slated to provide the necessary labor to complete the investigation. This is slated to be a limited SI since it is the initial investigative work for the Wastewater Treatment Plants 1 & 3 sites.

3.2 *Step 2: Identify the Decision*

The purpose of this step is to define the decision statement that the study will attempt to resolve.

3.2.1 Principal Study Question

Do constituents of concern exist in the environmental media at the Wastewater Treatment Plants 1 & 3 sites at levels that would exceed those found in USEPA Region 9 PRGs?

3.2.2 Alternative Actions that could result from Resolution of the Principle Study Question:

SI report recommendation: Coordinate with federal and state regulatory authorities to proceed toward a no further action (NFA) decision document.
SI report recommendation: Additional site investigation or interim measures.

3.2.3 Decision Statement

The primary decision for the site investigation is to determine whether the COCs present at the Wastewater Treatment Plants 1 & 3 sites are at levels that exceed media specific screening criteria (Region 9 PRGs) and thus would require further action.

3.3 Step 3: Identify Inputs to the Decision

The purpose of this step is to identify the informational inputs that will be required to resolve the decision statement and determine which inputs require environmental measurements.

3.3.1 Information Required to Resolve Decision Statement:

Historical records, interviews, aerial photographs, visual inspections, previous environmental investigations, site topography, geology, site hydrology and hydrogeology will be utilized to make an informed decision about the expected type of COCs. This information will also help position the most likely location of samples within the Wastewater Treatment Plants 1 & 3 sites where contaminated media will be discovered. Transport mechanisms and chemical properties of COCs to evaluate migration pathways. Analytical samples and results from the corresponding environmental media within the Wastewater Treatment Plants 1 & 3 sites to compare to PRGs.

3.3.2 Sources for Information

DERP-FUDS and EPA guidance are the principle tools leading this investigation. CELRH has an extensive administrative record (AR) for the former PBOW. A review of excepts from this AR and other sources including historic aerial photographs, historical topographic quadrangles, published geologic information, and data base searches

revealed useful information about the site. Information regarding the chemical properties and characteristics of COCs can be obtained from the NIOSH *Chemical Guide (NIOSH 1998).* The "References" section of the Quality Assurance Project Plan (QAPP) dated June 1999 for this project contains a complete listing of the reviewed information.

3.3.3 Information Needed to Establish the Action Level and Confirm that Appropriate Measurement Methods Exist to Provide the Necessary Data

The action levels for the contaminants of concern (COCs) will be the USEPA Region 9 screening criteria for the protection of human health. USEPA SW-846 analytical methods were selected for sample analysis to provide Method Detection Limits that are sufficiently low enough to allow comparison with applicable screening criteria. The performance-based methods have inherited quantitative and qualitative QA objectives, internal method requirements, and specific QC limits. These methods along with strict USEPA QA/QC guidance and protocols will provide data that will meet data quality objectives.

3.4 Step 4 – Define Site Investigation Boundaries

This step describes the spatial and temporal boundaries of the site investigation to which decisions will apply. Characteristics of the population to be sampled are defined, and practical considerations for the site investigation are evaluated in this section. Based on the initial results of the site investigation, additional data may be required to further define the investigation boundaries.

3.4.1 Characteristics that Define the Population of Interest

The COC associated with the Wastewater Treatment Plants 1 & 3 sites, that may have been released into the environment include explosives, Target Analyte List (TAL) metals, and Semi-Volatile Organic Compounds (SVOCs). Samples should be collected from the surface soil to characterize the population of COC that may have been released during wastewater treatment operations

3.4.2 Spatial Boundary of the Decision Statement

The site investigation will focus around the emplacement of the suspected location of the Wastewater Treatment Plants 1 & 3 sites. The site investigation will focus on the ash pits and plant buildings identified in historical drawings, aerial photos, and site visits. The approximate size of the area to be investigated is 2.0 acres at each plant. The vertical extent of the site investigation is 2 feet down through the soil column.

3.4.3 Temporal Boundary of Decision Statement

The analytical data obtained from this site investigation will be used as valid indicators of COCs throughout an exposure time frame of 50 years. The sampling for this investigation

should take place in the time frame of early spring through summer. If performed in this time frame, optimum weather conditions for fieldwork should occur.

3.4.4 Scale of Decision Making

The scale of decision making will be based on the concentrations of the possible contaminants identified in the surface water, surface soil, and subsurface soil samples compared to the values for the Region 9 PRGs.

3.4.5 Practical Constraints on Data Collection

Practical constraints on data collection for this site investigation could be scheduling problems, access problems, personal injury during fieldwork, illness, dangerous weather, and/or budget constraints.

3.5 Step 5: Develop a Decision Rule

Define the statistical parameters of interest, specify the action level, and integrate the previous DQO outputs into a single statement that describes the logical basis for choosing among alternative actions.

3.5.1 Specify the Parameter that Characterizes the Population of Interest

The concentration levels of the COCs found will be compared to the levels of the specific screening criteria. Any findings surpassing the criteria levels will become the area of focus for further investigation.

3.5.2 Specify the Action Level for the Site Investigation

The analytical sample results will be compared to the proper screening standard set forth by Region 9 PRGs. The levels of screening are conservative so that the proper protection is met for both human health and the environment.

3.5.3 Decision Rule

If concentration levels of the COCs are higher than that of the criteria levels, then a recommendation for further investigation and/or remediation will be implemented. If the concentration levels are below the criteria, then an approach for a No Further Action (NOFA) will be developed. During the review process data gaps may be uncovered. Such data gaps may require additional media sampling and analytical chemistry effort to proceed to NOFA.

3.6 Step 6: Specify Tolerable Limits on Decision Error

Define the decision maker's tolerable decision error rates based on a consideration of the consequence of making an incorrect decision.

3.6.1 Determine the Possible Range of the Parameter of Interest

Previous samples have not been taken at the former Wastewater Treatment Plants 1 & 3 sites. Therefore, the minimum value used for the parameter of interest is the concentration at the detection limit for each COC. The maximum values are those that exceed the appropriate screening criteria.

3.6.2 Identify the Decision Errors and Choose the Null Hypothesis

A non-statistical sampling plan will be used to position the location of each sample along with the number of samples. This process is being implemented because this is a limited SI. The sampling will be both purposeful and biased to locations that are most likely contaminated. Four steps are used to define where each decision error occurs relative to an action level and establish the decision errors associated with the sampling design.

Definition of Decision Error – As in any statistical test, there are two kinds of error that can occur in implementing the decision rule: the null hypothesis may be rejected when true (Type I error, with probability α), or the fail to reject decision may be made when false (Type II error, with probability β). The number of samples needed to make the decision is driven by the error rate that can be tolerated, as well as by other considerations such as spatial variability of COCs distributions. Because this is a limited SI, probability errors will not be considered herein.

The Null Hypothesis (baseline condition) and the Alternative Hypothesis– The baseline conditions or null hypothesis for the Wastewater Treatment Plants 1 & 3 sites is "COCs detected in the soil or surface water are at concentrations that warrant additional investigation activities". The alternate hypothesis is "COCs detected in the soil or groundwater are at concentrations that do not demand additional investigation activities". In terms of this investigation, the default assumption (null hypothesis) is that the concentrations of COCs at the site are significant enough to require further investigation.

Potential Consequence of Each Decision Error – In the event that the COCs expected do not exceed the criteria levels when actually they do (Type I error), then possible endangerment of human health and the environment could occur. If this takes place, then the Army Corps of Engineers and its sister agencies responsible for protection of human health and the environment would not be meeting their stated mission. If the COCs are detected at a concentration level that exceeds the criteria levels when actually they do not, then the Army will have unnecessary expenses associated with additional investigation activities.

Which Decision Error Has More Severe Consequences Near the Action Level – For the purpose of protecting human health and the environment, the Type I error has more

severe consequences in terms of the stated null hypothesis. The Type I decision error has a more severe consequence near the action level since the risk of jeopardizing human health is likely to outweigh the consequences associated with additional investigation expenditures and schedule delays. In using the data collected, careful review will be made to insure that the Type I error is not likely to occur. If the review warrants, additional investigation will be recommended.

3.7 Step 7: Optimization of the Sampling Design

The purpose of this step is to identify a resource-effective data collection design for generating data that are expected to satisfy DQOs. This SI will be based on surface and subsurface soil samples collected within and below the potential source area (that is, the former Wastewater Treatment Plants 1 & 3 sites themselves). As more information is obtained, the sampling design may be optimized to accomplish the goals of this investigation.

No existing chemical data is available for the Wastewater Treatment Plants 1 & 3 sites. Therefore, the sampling design is based on hypothetical expectations of what may be detected at the site. Alternative sampling plans could require additional samples and funds; however, the scope of this SI is limited in nature.

Surface soil sampling will be performed using a stainless steel hand auger. Hand augers will be decontaminated prior to being used. The boring will be advanced by turning the hand auger's crossbar at the same time the operator presses the auger into the ground. Sampling will be continuous throughout the boring. Samples will be collected at 1 foot depths. Any variances in sampling due to field conditions or findings will be properly documented. Once the proper depth is obtained the auger is removed from the borehole and the sample is taken from the sampling section (void) of the auger. For samples destined for laboratory testing, first a VOC portion will be placed in a laboratory pre-cleaned glass sample jar with Teflon lined lids, labeled, sealed and immediately placed on ice. The remains of the sample will be placed in a stainless steel bowl and will be thoroughly mixed and homogenized before placing samples in the appropriate container. All soil sample containers will be clearly identified on the labels and put on ice for preservation. All sampling equipment will be appropriately decontaminated prior to each individual sampling episode to prevent down-hole and cross-hole contamination and prior to leaving the investigative area.

The sediment sampling sequence will begin at downstream locations and progress upstream to prevent cross-contamination from one location to another. Sediment samples will be collected facing upstream by using a stainless steel scoop. If access is limited or the depth of sediment is to great a clamp and pole will be used to extend the reach of the sampler. Effort will be made to obtain sediment samples beneath the water sediment interface. Any excess water collected during sediment samples will be decanted from the sediment. Sediment samples will be placed in a stainless steel bowl and homogenized, before placing samples in containers. All samples will be clearly identified on the sample labels and put on ice for preservation.

Detailed sampling strategy is in the FSP. Specific sampling locations are presented in Figures 4.1 and 4.2 of the FSP.