Work Plans
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works (PBOW)
Sandusky, Ohio

Volume One

Site-Wide Safety and Health Plan (SHP)
Quality Assurance Project Plan (QAPP)
Site-Wide Sampling and Analysis Plan (SAP)

Submitted To:

U.S.Army Corps of Engineers
Nashville District
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

IT Project Number 766952

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

September 1996

Sitewide Safety and Health Plan
Site Investigations and Groundwater Investigation
at the Former Plum Brook Ordnance Works
Sandusky, Ohio

Submitted to:

Commander
U.S. Army Corps of Engineers
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I have read and approve this site safety and health plan with respect to project hazards, regulatory requirements, and IT procedures.

Don Burton, PE
Program Manager

Date 12/11/96

Melissa G. Smith, CIH
Health and Safety Manager

Date 12/11/96

Site Safety and Health Plan
Acknowledgement Form

I have been informed of, and will abide by the procedures set forth, in this safety and health plan and its amendments for the activities at the former Plum Brook Ordnance Works, Sandusky, Ohio.

Printed Name	Signature	Representing	Date
EDWARD KANEVSKY	Edward Kanevsky	IT	4-27-98
DUANE NIELSEN	[illegible]	IT	4-27-98
John Vogeding	John Vogeding	IT	4-27-98
David Stineman	[illegible]	IT	4-27-98
Scott Geyer	[illegible]	Belasco	4-27-98
Ray Cord	Ray Cord	Belasco	4-27-98
Randy Dameron	[illegible]	IT	10-20-98
Charles G. Hagegeorge	Charles G. Hagegeorge	IT	10-20-98
GREG SMITH	Greg Smith	MHS	10-20-98
Chris Kincaid	Chris Kincaid	MHS	10-20-98
Mike Gunderson	[illegible]	IT	10-20-98
Mike Spangberg	[illegible]	IT	10-20-98
Maureen McMyler	Maureen McMyler	IT	10-20-98
TIM MATHES	[illegible]	IT	10-21-98
Todd N Thompson	[illegible]	ON SITE	10 21 98
Bryan Grace	[illegible]	IT	10/26/98

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List of Acronyms

AIDS	Acquired Immune Deficiency Syndrome
ANSI	American National Standards Institute
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
dBA	decibels
°C	degrees Celsius
°F	degrees Fahrenheit
DNT	dinitrotoluene
DOL	U.S. Department of Labor
EPA	U.S. Environmental Protection Agency
EZ	exclusion zone
GFCI	ground fault circuit interrupter
H&S	health and safety
HBV	hepatitis B virus
HEPA	high-efficiency particulate air
HIV	human immunodeficiency virus
IDW	investigation-derived waste
IT	IT Corporation
kV	kilovolt
mm	millimeter
NASA	National Aeronautics and Space Administration
NIOSH	National Institute of Occupational Safety and Health
NRR	noise reduction rating
OSHA	Occupational Safety and Health Administration
PBS	Plum Brook Station
PBOW	Plum Brook Ordnance Works
PE	professional engineer
PEL	permissible exposure limit
PID	photoionization detector
PM	project manager
PPE	personal protective equipment
ppm	parts per million

List of Acronyms *(Continued)*

psig	pound per square inch gage
QAPP	quality assurance project plan
SAP	sampling and analysis plan
SEIR	Supervisor's Employee Injury Report
SSHO	site safety and health officer
SHP	safety and health plan
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1.0 Introduction

1.1 Objectives

The Nashville District, U.S. Army Corps of Engineers (USACE)-Nashville has retained IT Corporation (IT) to conduct a site investigation at the former Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio. This site safety and health plan (SHP) is being prepared in support of the activities and will be used in conjunction with the sampling and analysis plan (SAP) and quality assurance project plan (QAPP).

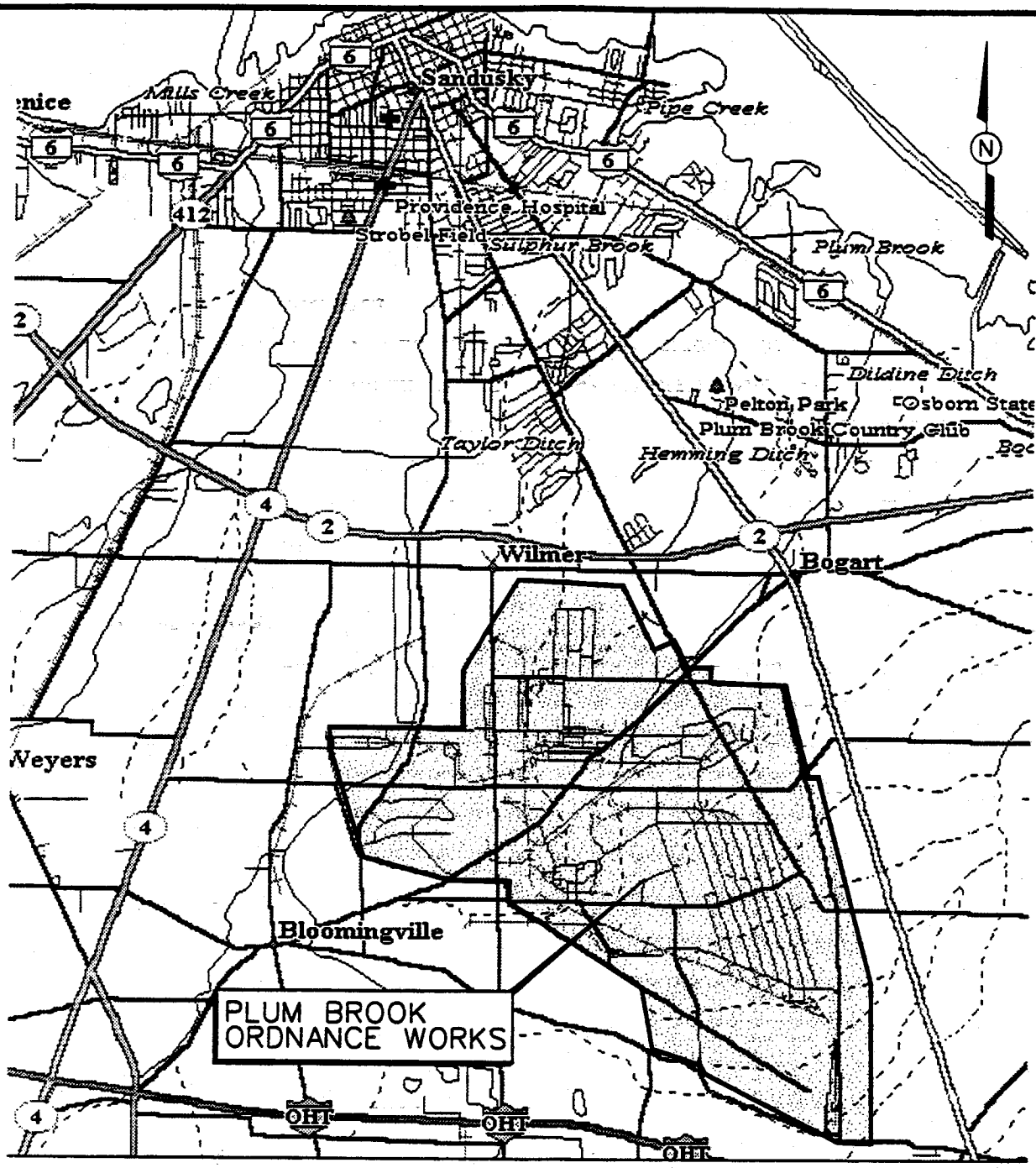
This SHP establishes the work practices necessary to ensure the protection of IT personnel during field activities.

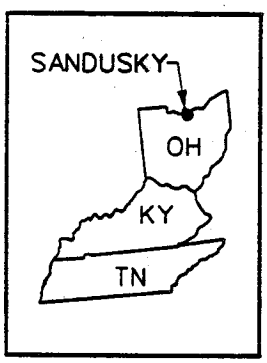
The objective of this plan is to provide a mechanism for the establishment of safe working conditions at the site. The safety organization and health and safety (H&S) procedures have been established following an analysis of potential hazards at the site. Specific hazard control methodologies have been evaluated and selected in an effort to minimize the potential of accident or injury.

All site operations will be performed in accordance with applicable state, local, and IT corporate regulations and procedures, Occupational Safety and Health Administration (OSHA) requirements, and USACE guidelines contained within EM385-1-1. All IT employees and IT subcontractors must comply with the requirements of this plan.

1.2 Facility and Location Description

The former PBOW is located approximately 4 miles south of Sandusky, Ohio and is specifically located in the Perkins, Milan, Huron, and Oxford Townships. The site is bounded on the north by Bogart Road, on the south by Mason Road, on the east by U.S. Highway 250, and on the west by County Road 43 (Figure 1-1). The former PBOW site is consisted of approximately 9,000 acres and lies in an area that is primarily rural and agricultural with low population density. The National Aeronautics and Space Administration (NASA) currently owns 6,400 acres of the original site.





NOT TO SCALE

FIGURE 1-1
VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 6-11-96	DATE LAST REV.:	DRAFT. CHCK. BY: CET	INITIATOR: G. YU	DWG. NO.: 766952ES.005
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON	PROJ. NO.: 766952

766952ES.005 14:16:12 JUL. 1, 1996 KHB

Previous activities conducted at the site in the early 1940s included manufacturing trinitrotoluene (TNT), dinitrotoluene (DNT), pentolite, nitric acid, and sulfuric acid. In 1945, manufacturing operations ceased and decontamination of TNT, acid, pentolite, and DNT manufacturing lines was completed. NASA acquired PBOW in 1963 and is presently using the site to conduct space research. Over the years, several thousand acres of the original PBOW have been sold off by NASA. The details of these sales are listed in the site management plan and can be found at the NASA Plum Brook Station (PBS).

Specific site descriptions will be included in site-specific SHP prepared for each site and will be attached to this SHP as addendum.

1.3 Policy Statement

It is IT's policy to provide a safe and healthful work environment for all its employees. IT considers no phase of operations or administration to be of greater importance than injury and illness prevention. Safety takes precedence over expediency or shortcuts. IT believes every accident and every injury is preventable, and will take every reasonable step to reduce the possibility of injury, illness, or accident.

This SHP prescribes the procedures that must be followed during the activities at PBOW. Operational changes that could affect the H&S of personnel, the community, or the environment will not be made without the prior approval of the USACE, the IT project manager (PM), and the IT H&S manager.

The provisions of this plan are mandatory for all IT personnel and subcontractors assigned to the project. IT requires all visitors to the work site to abide by the requirements of the plan.

1.4 References

This SHP complies with applicable OSHA and U.S. Environmental Protection Agency (EPA) regulations. This plan follows the guidelines established in the following:

- *Standard Operating Safety Guidelines* (EPA, November 1984)
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (National Institute of Occupational Safety and Health [NIOSH] 86-116)

- Title 29 of the Code of Federal Regulations (CFR), Part 1910, including Part 1910.120, U.S. Department of Labor (DOL)/OSHA

- Title 29 of the CFR, Part 1926, including Part 1926.65, DOL/OSHA.

The contents of this plan are consistent with the IT H&S policies and procedures.

2.0 Responsibilities

2.1 All Personnel

Each person is responsible for his safety and that of his coworkers, for completing tasks in a safe manner, and reporting any unsafe acts or conditions to his supervisor. All personnel are responsible for continuous adherence to these H&S procedures during the performance of their work. No person may work in a manner that conflicts with the safety and environmental precautions expressed in this SHP. After due warnings, IT will dismiss from the site any person who violates safety procedures. IT's employees are subject to progressive discipline and may be terminated for blatant or continued violations. All on-site personnel will be trained in accordance with 29 CFR 1910.120, 29 CFR 1926.65, and this document.

2.2 Project Manager: Don Burton

The PM, Don Burton, is ultimately responsible for ensuring that all project activities are completed in accordance with requirements set forth in this plan. The PM must coordinate at least one on-site safety review during the project. He is responsible for ensuring all accidents and incidents on the project are reported and thoroughly investigated. The PM must approve in writing any addenda or modifications of the SHP.

2.3 Health & Safety Manager: Melissa G. Smith

The H&S manager for this project, Melissa G. Smith, is responsible for developing and coordinating the SHP and addenda as required. This plan complies with 29 CFR 1910.120 and 29 CFR 1926.65 in all respects and includes medical surveillance and training requirements, hazard assessment, personal protective equipment (PPE) specifications, field implementation procedures, and audits. The H&S manager is the contact for regulatory agencies on matters of safety and health. Other H&S manager responsibilities include:

- Administering general H&S program
- Determining the level of personnel protection required
- Updating equipment or procedures based on information obtained during site operations
- Establishing air monitoring parameters based on expected contaminants
- Establishing employee exposure monitoring notification programs

- Investigating significant accidents and illnesses and implementing corrective action plans
- Performing regular site inspections
- Developing site-specific employee/community emergency response plans as required based on expected hazards.

2.4 Site Safety and Health Officer: George Yu

The site safety and health officer (SSHO) has the ultimate responsibility to stop any operation that threatens the health and safety of the team or surrounding populace, or that causes significant adverse impact to the environment. Other responsibilities include, but are not limited to:

- Implementing all safety procedures and operations on site
- Observing work crew members for symptoms of on-site exposure or stress
- Upgrading or downgrading, in coordination with the H&S manager and the PM, the levels of personal protection based upon site observations and monitoring results
- Informing the project H&S manager of significant changes in the site environment that require equipment or procedure changes
- Arranging for the availability of first aid and on-site emergency medical care, as necessary
- Determining evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation
- Ensuring that all site personnel and visitors have received the proper training and medical clearance prior to entering the site (refer to Chapter 6.0 of this plan)
- Establishing exclusion, contamination reduction, and support zones (refer to Chapter 7.0 of this plan)
- Presenting tailgate safety meetings and maintaining attendance logs and records
- Ensuring that the respiratory protection program is implemented (refer to Chapter 5.0 of this plan)

- Ensuring that decontamination procedures meet established criteria
- Ensuring that there are qualified first-aid persons on site who are trained in universal precautions and the use of PPE (refer to Chapter 12.0 of this plan).

2.5 Heavy Equipment Operators

Heavy equipment operators shall be responsible for the safe operation and maintenance of the equipment they operate and other equipment and supplies associated with heavy equipment operations. Operators shall possess appropriate and current licenses/certifications/permits required by local, state, or federal authorities or required by their contract for each project. Heavy equipment operators are responsible for complying with the controls requirements of the Chapter 4.0 subsection entitled "Heavy Equipment Operating Safety."

2.6 Drill Rig Operators

Operators of drill rig equipment shall be responsible for the safe operation and maintenance of the equipment they operate. Operators shall possess appropriate and current licenses/certifications or permits required by local, state, or federal authorities or required by their contract for each project. Drilling operators are responsible for complying with the controls requirements of the Chapter 4.0 subsection entitled "Drilling Equipment Operations."

2.7 Subcontractors

On-site subcontractors and their personnel are responsible for understanding and complying with all site requirements. Subcontractors are required to read and acknowledge the subcontractor certification (Appendix A) and follow all of the provisions set forth in this SHP.

2.8 On-Site Personnel and Visitors

All on-site personnel and visitors are required to comply with the provisions of this SHP and all applicable federal, state, local, and USACE regulations. Each person is responsible for his/her own safety and health and for completing tasks in a safe manner. All on-site personnel will report any unsafe acts or conditions to his/her supervisor or the IT representative. Personnel will monitor themselves and their fellow employees for signs and symptoms of heat/cold stress and chemical exposure.

2.9 Occupational Physician

The occupational physician for this project, Dr. David Barnes, is board-certified in occupational medicine with more than 20 years of experience. Dr. Barnes is the Medical Director of Environmental Medical Resources, a consulting service for IT.

3.0 Job Hazard Analysis

3.1 Scope of Work

IT will conduct the site investigation at several sites at PBOW, which will include the following activities:

Reservoir No. 2 Burning Ground

- Geophysical survey
- Soil boring
- Surface/subsurface sampling
- Land survey
- Disposal of investigation-derived waste (IDW)

Additional Burn Ground

- Geophysical survey
- Soil boring
- Surface/subsurface sampling
- Land survey
- Disposal of IDW

Wastewater Disposal Plant No. 2

- Soil boring
- Soil screening
- Land survey
- Disposal of IDW

Powerhouse No. 2 Ash Pit

- Soil boring
- Surface/subsurface sampling
- Land survey
- Disposal of IDW

Sitewide Groundwater Investigation

- Monitoring well installation
- Slug testing
- Groundwater sampling
- Land survey
- Disposal of IDW.

Decontamination of sampling equipment will be conducted using Alconox.

3.2 Job Hazard Analysis by Task

The job hazard analysis identifies potential safety, health, and environmental hazards and provides for the protection of personnel, the community, and the environment. Because of the complexity and constant change of investigation/projects, supervisors must continually inspect the work site to identify hazards that may harm site personnel, the community, or the environment. The PM, site coordinator, and SSHO must be aware of these changing conditions and discuss them with the H&S manager. The H&S manager will write addenda to modify job hazard analyses as necessary. Detailed activity hazard analyses by task are provided in Table 3-1.

3.3 Physical Hazards

The primary physical hazards for this project are associated with the use of drilling equipment and supporting vehicles; operation of heavy equipment; and the collection of soil and water samples.

The potential physical hazards of the work site are as follows:

- Drilling hazards
- Heavy equipment hazards
- Drum handling hazards
- High-pressure water jetting operations
- Sampling hazards.

3.3.1 Drilling Hazards

Physical hazards specific to drilling are listed in the following paragraphs.

Slips. Slips are toothed wedges positioned between the drill pipe and the master bushing/rotary table to suspend the drill string in the well bore when it is not supported by the hoist. Most accidents associated with slip operations are related to manual materials handling; strained backs and shoulders are common.

Tongs. Tongs are large, counter-weighted wrenches used to break out the torqued couplings on drill pipe. Both sets of tongs have safety lines; when breakout force is put on the tongs, the tongs or the safety lines could break and injure an employee standing close to them. Another likely accident can occur when the driller actuates the wrong tong lever and an

Table 3-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Staging equipment	Slip, trip, and fall hazards	• Determine best access route before transporting equipment. • Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards. • Look before you step; ensure safe and secure footing.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment.
	Falling objects	• Stay alert and clear of materials suspended overhead; wear hard hat and steel-toed boots.
	Flying debris, dirt, dust, etc.	• Wear safety glasses/goggles; ensure that eye wash is in proper working condition
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Bees, spiders, and snakes	• Inspect work area carefully and avoid placing hands and feet into concealed areas.
	Fire	• Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow.
	Hazard communication	• Label all containers as to contents and dispose of properly. • Ensure MSDSs are available for hazardous chemicals used on site.
	Noise	• Sound levels above 85 dBA mandates hearing protection.

Table 3-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Surveying	Slip, Trip, Fall	• Site workers will be required to wear hard hat, safety glasses with side shields, work gloves, and steel-toe boots when working in the field. • Provide adequate lighting in all work areas. • Whenever possible, avoid routing cords and hoses across walking pathways. • Flag or cover inconspicuous holes to protect against falls. • Work areas will be kept clean and orderly. • Garbage and trash will be disposed of daily in approved refuse containers. • Tools and accessories will be properly maintained and stored. • Work areas and floors will be kept free of dirt, grease, and slippery materials.
	Traffic Accidents	• Place physical barrier (i.e., barricades, fencing) around work areas regularly occupied by pedestrians. • If working adjacent to roadways, have workers wear fluorescent orange vests. • Use warning signs or lights to alert oncoming traffic. • Assign flag person(s) if necessary to direct local traffic. • Set up temporary parking locations outside the immediate work area. • Motor vehicle operators shall obey all posted traffic signs, signals, and speed limits. • Pedestrians have the right-of-way. • Wear seat belts when vehicles are in motion.
Drilling and Installation of Monitoring Wells	Faulty or damaged equipment being utilized to perform work	• All machinery or mechanized equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. • Equipment will be inspected before being put to use and at the beginning of each shift. • Faulty/unsafe equipment will be tagged and if possible locked out.
	Uneven terrain, poor ground support, inadequate clearances, contact with utilities	• Inspections or determinations of road conditions and structures shall be made in advance to ensure that clearances and load capacities are safe for the passage or placing of any machinery or equipment. • All mobile equipment and areas in which they are operated shall be adequately illuminated. • Aboveground and belowground utilities will be located prior to staging equipment. • Whenever the equipment is parked, the parking brake shall be set. • Equipment parked on inclines will have the wheels chocked. • Inspect brakes and tire pressure on drill rig before staging for work. • Obtain trenching/drilling permit prior to operation.

Table 3-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Drilling and Installation of Monitoring Wells (continued)	Inexperienced operator	• Machinery and mechanized equipment shall be operated only be designated personnel. • Heavy equipment operators shall inform their supervisor(s) of any prescribed medication that they are taking that would impair their judgment.
	Jacks/outriggers	• Ensure proper footing and cribbing.
	Falling objects	• Remove unsecured tools and materials before raising or lowering the derrick. • Stay alert and clear of materials suspended overhead.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert at all times!
	Fire	• Mechanized equipment shall be shut down prior to and during fueling operations. • Have fire extinguishers inspected and readily available.
	Fall hazards	• Personnel are not allowed to work off of machinery or use them as ladders. • Use safety belts and lifeline when working above 6 feet
	Noise	• Hearing protection is mandatory above 85 dBA.
	Contact with rotating or reciprocating machine parts	• Machine guards, use long-handled shovels to remove auger cuttings. • Safe lockout procedures for maintenance work.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Slip, trip, and fall hazards	• Good housekeeping, keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards.
	Contact with potentially contaminated materials	• Real time air monitoring will take place. If necessary, proper personal protective clothing and equipment will be utilized.
Groundwater Sampling	Cross-contamination and contact with potentially contaminated materials	• Sampling technicians will wear proper protective clothing and equipment to safeguard against potential contamination.

Table 3-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Groundwater Sampling (continued)		• Only essential personnel will be in the work area. • Initial real-time air monitoring will take place before and during sampling activities. • All personnel will follow good hygiene practices. • Proper decontamination procedures will be followed. • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations.
	Cut hazards	• Use care when handling glassware. • Wear adequate hand protection.
	Hazard communication	• Label all containers as to contents.
	Strains/sprains	• Use the proper tool for the job being performed. • Get assistance if needed. • Avoid twisting/turning while pulling on tools, moving equipment, etc.
	Spills/residual materials	• Absorbent material and containers will be kept available where leaks or spills may occur.
	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Unattended worker	• "Buddy System" - visual contact will be maintained with the sampling technician during sampling activities.
Heavy equipment operation	Faulty or damaged equipment being utilized to perform work	• All machinery or mechanized equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. • Equipment will be inspected before being put to use and at the beginning of each shift. • Faulty/unsafe equipment will be tagged and if possible locked out.
	Uneven terrain, poor ground support, inadequate clearances, contact with utilities	• Inspections or determinations of road conditions and structures shall be made in advance to assure that clearances and load capacities are safe for the passage or placing of any machinery or equipment. • All mobile equipment and areas in which they are operated shall be adequately illuminated. • Aboveground and belowground utilities will be located prior to staging equipment. • Whenever the equipment is parked, the parking brake shall be set. • Equipment parked on inclines will have the wheels chocked. • Inspect brakes and tire pressure on drill rig before staging for work. • Obtain trenching/drilling permit prior to operation.

Table 3-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Heavy equipment operation (continued)	Inexperienced operator	• Machinery and mechanized equipment shall be operated only by designated personnel. • Heavy equipment operators shall inform their supervisor(s) of any prescribed medication that they are taking that would impair their judgment.
	Fire	• Mechanized equipment shall be shut down prior to and during fueling operations. • Have fire extinguishers inspected and readily available.
	Fall hazards	• Personnel are not allowed to work off of machinery or use them as ladders. • Use safety belts and lifeline when working above 6 feet
	Noise	• Hearing protection is mandatory above 85 dBA.
	Vehicle traffic	• Site workers shall establish hand signals when verbal communication becomes difficult. • Seats should be provided for each occupant of the equipment. • Equipment operated on the highway shall be equipped with headlights, taillights, brake lights, back-up lights, and turn signals visible from the front and rear. • Never walk or work directly in back of or to the side of heavy equipment without the operator's knowledge. • Assign flag person(s) if necessary to direct traffic.
	Cold Stress	• Provide insulating clothing to workers when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.
Soil boring and surface/subsurface sampling	Cross-contamination and contact with potentially contaminated materials	• Sampling technicians will wear proper protective clothing and equipment to safeguard against potential contamination. • Only essential personnel will be in the work area. • Initial real-time air monitoring will take place before and during sampling activities. • All personnel will follow good hygiene practices. • Proper decontamination procedures will be followed. • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations.

Table 3-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Soil boring and surface/subsurface sampling (continued)	Cut hazards	• Use care when handling glassware. • Wear adequate hand protection.
	Slip, trip, fall	• Site workers will be required to wear hard hat, safety glasses with side shields, work gloves, and steel-toe/shank boots when working in the field. • Whenever possible, avoid routing cords and hoses across walking pathways. • Flag or cover inconspicuous holes to protect against falls.
	Bees, spiders, and snakes	• Workers shall inspect the work area carefully and avoid placing hands and feet into concealed areas. • Evaluate need for sensitive workers to have prescribed antibiotic or medicine to combat onset of symptoms.
	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Cold Stress	• Provide insulating clothing to workers when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.
	Lighting strikes	• Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Limit the body surface area that is in contact with the ground (i.e., kneeling on one knee is better than laying on the ground). • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Keep all body parts in contact with the ground as close as possible. • Remain 6 feet away from tree trunk if seeking shelter beneath tree(s). • If in a group, keep 6 feet of distance between people.

Table 3-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Soil boring and surface/subsurface sampling (continued)	Thunderstorms, tornados	• Listen to radio or TV announcements for pending weather information. • Cease field activities during thunderstorms or tornado warnings. • Seek shelter. Do not try to outrun a tornado.
Moving and shipping collected samples	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Cut hazards	• Wear adequate hand protection. Use care when handling glassware.
	Hazard communication	• Label all containers as to contents and associated
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Cut hazards	• Wear adequate hand protection. Use care when handling glassware.
	Hazard communication	• Label all containers as to contents and associated hazards.
Material storage	Flammable and combustible liquids	• Store in NO SMOKING AREA. • Fire extinguisher readily available. • Transfer only when properly grounded and bonded.
Disposal of IDW (Forklift Operation)	Personnel injury, property damage, and/or equipment damage	• Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their Supervisor of any prescribed medication that they are taking that would impair their judgement.

unsecured tong swings across the rig floor at uncontrolled velocity. A common accident attributable to tongs can occur when an employee has his hand or finger in the wrong place as he attempts to swing and latch the tong onto the drill pipe, resulting in crushing injuries or amputation of the fingers.

Elevators. Elevators are a set of clamps affixed to the bails on the swivel below the traveling block. They are used to clamp each side of a drill pipe and hold the pipe as it is pulled from the well bore. Accidents and injuries can occur during the latching and unlatching tasks; fingers and hands can get caught and crushed in the elevator latch mechanism. If the pipe is overhead when the latching mechanism fails, then the pipe may fall on employees working on the drill floor.

Cat Lines. Cat lines are used on drilling rigs to hoist material. Accidents that occur during cat line operations may injure the employee doing the rigging, as well as injure the operator. Minimal hoisting control causes sudden and erratic load movements, which may result in hand and foot injuries.

Working Surfaces. The rig floor is the working surface for most tasks performed in well drilling operations. The surface is frequently wet from circulating fluid and/or water used to wash it down. Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls.

Derrick Operations. The derrick man on a well drilling operation performs his tasks from various elevated work platforms in the mast. He is exposed to falls when not utilizing fall protection equipment while climbing the derrick ladder, while working with the pipe stands, and while moving from the ladder to his platform station.

Utility Hazards. There are no overhead or underground utilities at the site.

Materials Handling. The most common type of accident that occurs in material handling operations is the "caught between" situation when a load is being handled and a finger or toe gets caught between two objects. Rolling stock can shift and/or fall from a pipe rack or truck bed. Rig accidents can occur as a result of improperly placing the rig on uneven or unstable terrain, or failing to adequately secure the rig prior to the start of operations.

3.3.2 High-Pressure Water Jetting Operation Hazards

The use of high-pressure water jetting equipment (1,000 pounds per square inch gage [psig]) for decontamination may result in lacerations from accidental water spray, and slips, trips, and falls. Accidents can occur as a result of improper operation of the high-pressure water jetting equipment, failing to adequately isolate the worker area from other activities, use of faulty or damaged equipment, and improper use of adequate PPE.

3.3.3 Sampling Hazards

Field sampling operations consist of the collection of subsurface soil, surface water, and sediment samples for subsequent analysis. The physical hazards of this operation are primarily associated with the sample collection methods and procedures utilized.

The primary hazards associated with these specific sampling procedures are not potentially serious; however, other operations in the area, or the conditions under which samples must be collected, may present certain chemical and physical hazards. The hazards of these types of sampling procedures are generally limited to strains/sprains and potential eye hazards resulting from sampling activities.

3.4 Chemical Hazards

The primary contaminants of concern at Plum Brook are constituents of the TNT manufacturing process: toluene, TNT and DNT. Hydrochloric acid and methanol will be used in small quantities as preservatives. These chemicals will already be in sample jars and a workers' potential for direct contact is unlikely.

The analytical results from previous investigations indicate the following contaminants may be present at the site:

- Nitroaromatics and Nitramines:
  - Trinitrotoluene
  - Nitrobenzene
  - Dinitrotoluene
  - Nitrotoluene
  - Dinitrobenzene

- Priority Pollutant Metals:
  - Antimony
  - Arsenic
  - Beryllium
  - Cadmium
  - Manganese
  - Mercury
  - Nickel
  - Selenium

- Chromium
- Copper
- Lead
- Silver
- Thallium
- Zinc

- Polychlorinated biphenyls:
  - Aroclor 1242
  - Aroclor 1250.

3.5 Noise

Noise exposure at or above the OSHA action level (85 decibels [dBA]) is likely during some activities. Exposure to noise levels in excess of 90 dBA, the OSHA permissible exposure limit (PEL) for noise, is likely during heavy equipment operation. Sound level monitoring will not be conducted during these activities as previous noise monitoring during similar operations revealed noise levels at or above 85 dBA near the motor side of the operating equipment. A hearing conservation program shall be required for heavy equipment operators.

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication, thereby increasing the risk of accidents on site.

3.6 Anticipated Biological Hazards

3.6.1 Snakes

Workers at the site have potential for encountering poisonous snakes such as water moccasins, rattlesnakes, and copperheads. All personnel shall be cautioned to be alert to the presence of snakes. If a snake bite occurss attempts should be made to kill the snake for positive identification. The victim should be transported to the nearest hospital within 30 minutes. First aid consists of applying a pressure bandage; omit cutting and sucking (unless medical care cannot be obtained within 30 minutes). Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation; and effects from local release of substances by enzymatic actions. Other noticeable effects of snake bites include swelling, edema and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

3.6.2 Insects

All IT personnel and subcontractors should be aware of the potential presence of deer ticks in wooded areas during the months of April through October. Precautionary methods include familiarity with the signs/symptoms and potential health hazards of Lyme disease, and the proper implementation of appropriate work practices.

During the months of April through October, particular caution must be exercised to prevent being bitten by ticks and potentially contracting Lyme disease, Rocky Mountain Fever, and other tick-borne diseases. Specific precautions include:

- Wear hooded coveralls to cover your body as much as possible. Light color clothing makes spotting of ticks easier.
- Try to eliminate possible paths by which the deer tick may reach unprotected skin. For example, tuck bottoms of pants into socks or boots and sleeves into gloves. (Duct tape may be utilized to help seal cuffs and ankles.) If heavy concentrations of ticks or insects are anticipated or encountered, Tyvek coveralls may be utilized.
- Conduct periodic and frequent (e.g., hourly) surveys of your clothing for the presence of ticks. Remove any ticks/insects that become attached to clothing.
- Use insect/tick repellents. Apply repellents in accordance with manufacturers' recommendations. These repellents are readily available and include such brands as Deep Woods OFF and Maximum Strength OFF. Check the ingredients of the repellent. IT field personnel should check with the PM to ensure use of insect repellents will not interfere with sample collection procedures.

3.6.3 Poisonous Plants

If work sites are located in areas where poisonous plants such as poison ivy, poison sumac, and poison oak may be encountered, personnel should wear long pants, long sleeves, and gloves to minimize the possibility of exposure. In some areas, the use of a Tyvek or other protective suit may be advisable.

3.7 Cold Stress

Cold and/or wet environmental conditions can place workers at risk of a cold-related illness. Hypothermia can occur whenever temperatures are below 45 degrees Fahrenheit (°F), and is most common during wet, windy conditions, with temperatures between 40 to 30°F. The principal cause of hypothermia in these conditions is loss of insulating properties of clothing due to moisture, coupled with heat loss due to wind and evaporation of moisture on the skin.

Frostbite, the other illness associated with cold exposure, is the freezing of body tissue, which ranges from superficial freezing of surface skin layers to deep freezing of underlying tissue. Frostbite will occur only when ambient temperatures are below 32°F. The risk of frostbite increases as the temperature drops and wind speed increases.

3.8 Heat Stress

Wearing PPE puts site personnel at considerable risk of heat stress. Heat stress effects range from transient heat fatigue to serious illness and death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is one of the most common and potentially serious illnesses during drilling operations, preventive measures and alertness to the symptoms are vital.

Heat stress monitoring shall commence when personnel are wearing PPE, including Tyvek coveralls, and the ambient temperature exceeds 70°F. If impermeable garments are not worn, heat stress monitoring shall commence at 85°F. The protocols of heat stress monitoring and symptoms of heat stress are discussed in Section 4.4.

4.0 Safety Program and Procedures

The following work practices will be observed during all site activities.

4.1 General Practices

- At least one copy of this plan shall be available at the project site, in a location readily available to all personnel, including visitors.

- Ensure that no one is required to lift more than 60 pounds.

- Legible and understandable precautionary labels that comply with the hazard communication standard shall be affixed prominently to all containers of contaminated scrap, waste, debris, and clothing.

- No food or beverages shall be present or consumed in the work areas.

- No tobacco products shall be present or used in the work areas.

- Cosmetics shall not be applied within the work areas.

- All crew personnel on site shall use the buddy system (working in pairs or teams). If protective equipment or noise levels impair communications, then prearranged hand signals shall be used for communication. Visual contact shall be maintained between crew members at all times, and crew members must observe each other for signs of toxic exposure. Indication of adverse effects include, but are not limited to:

  - Changes in complexion and skin coloration
  - Changes in coordination
  - Changes in demeanor
  - Excessive salivation and pupillary response
  - Changes in speech pattern.

- Employees shall inform their partners or fellow team members of nonvisible effects of overexposure to toxic materials. The symptoms of such overexposure may include:

  - Headaches
  - Dizziness
  - Nausea
  - Blurred vision
  - Cramps
  - Irritation of eyes, skin, or respiratory tract.

- Visitors to the site shall abide by the following:

  - "Visitor" means persons not involved in routine site work activities.

  - All visitors shall be instructed to stay outside the work area and remain within the support area during the extent of their stay. Visitors shall be cautioned to avoid skin contact with contaminated or potentially contaminated surfaces.

4.2 Operating Procedures

4.2.1 Drilling Equipment Operations

Specific elements of this section may not be applicable, depending on the type of drilling equipment used and/or for the anticipated scope of this project. Prior to the start of site work, the drilling subcontractor will inspect all drilling equipment in the presence of the site supervisor.

4.2.1.1 General Drilling Practices

- The departing driller shall inform the oncoming driller of any special hazards or ongoing work that may affect the safety of the crew.

- Fire-fighting equipment shall not be tampered with and shall not be removed for other than the intended fire-fighting purposes or for servicing.

- If lubrication fittings are not accessible with guards in place, machinery shall be stopped for oil and greasing.

- Rigging material equipment for material handling shall be checked prior to use on each shift and as often as necessary to ensure it is safe. Defective rigging shall be removed from service.

- The area around the derrick ladder shall be kept clear to provide unimpeded access to the ladder.

- Work areas and walkways shall not be obstructed.

- The rotary table of the rig floor shall be kept free of obstructions and free of undue accumulation of oil, water, ice, or circulating fluids.

4.2.1.2 Overhead Electrical Clearances

Nominal System Voltage	Minimum Required Clearance
0-50 kilovolts (kV)	10 feet
51-100 kV	12 feet
101-200 kV	15 feet
201-300 kV	20 feet
301-500 kV	25 feet
501-750 kV	35 feet
751-1000 kV	45 feet

When the drill rig is in transit, with the boom lowered and no lead, the equipment clearance must be at least 4 feet for voltages less than 50 kV, 10 feet for voltages of 50 kV to 345 kV, and 16 feet for voltages above 345 kV.

4.2.1.3 Hoisting Operations

- The derrick must not be raised until the rig has been blocked, leveled, and chocked.
- Drillers shall never engage the rotary clutch without watching the rotary table and ensuring it is clear of personnel and equipment.
- Unless the draw works is equipped with an automatic feed control, the brake shall not be left unattended without first being tied down.
- Drill pipe or casing shall not be picked up suddenly.
- Drill pipe shall not be hoisted until the driller is sure that the pipe is latched in the elevator, or the derrick man has signaled that he may safely hoist the pipe.
- During instances of unusual loading of the derrick or mast, such as when making an unusually hard pull, only the driller should be on the rig floor and no one shall be on the rig or derrick.
- The brakes on the draw works of every drilling rig shall be tested by each driller, when he comes on shift, to determine whether they are in good order. The brakes shall be thoroughly inspected by a competent individual each week.
- A hoisting line with a load imposed shall not be permitted to be in direct contact with any derrick member or stationary equipment, unless it has been specifically designed for line contact.

- Workers shall never stand near the well bore whenever any wire line device is being run.

- Hoisting control stations shall be kept clean and controls labeled as to their functions.

4.2.1.4 Riding Hoisting Equipment

Under no circumstances will personnel be permitted to ride the traveling block or elevators, nor will the cat line be used as a personnel carrier.

4.2.1.5 Cat Line Operations

- Only experienced workers will be allowed to operate the cat head controls. The kill switch must be clearly labeled and operational prior to operation of the cat line.

- The cat head area must be kept free of obstructions and entanglements.

- The operator shall not use more wraps than necessary to pick up the load. More than one layer of wrapping is not permitted.

- Personnel shall not stand near, step over, or go under a cable or cat line that is under tension.

- Employees rigging loads on cat lines shall:

  - Keep out from under the load.

  - Keep fingers and feet where they will not be crushed.

  - Be sure to signal clearly when the load is being picked up.

  - Use standard visual signals only and not depend on shouting to coworkers.

  - Make sure the load is properly rigged, because a sudden jerk in the cat line will shift or drop the load.

4.2.1.6 Pipe Handling

- Pipe shall be loaded and unloaded layer by layer, with the bottom layer pinned or blocked securely on all four corners. Each successive layer should be effectively blocked or chocked.

- Workers shall not be permitted on top of the load during loading, unloading, or transferring of pipe or rolling stock.

- Employees shall be instructed never to try to stop rolling pipe or casing; they should be instructed to stand clear of rolling pipe.

- Slip handles shall be used to lift and move slips. Employees should not be permitted to kick slips into position.

- When pipe is being hoisted, personnel shall not stand where the bottom end of the pipe could whip and strike them.

- Pipe stored in racks, catwalks, or on flatbed trucks shall be chocked to prevent rolling.

4.2.1.7 Derrick Operations

- The derrick climber shall be used whenever climbing the derrick. Personnel on the derrick should be tied off, or otherwise protected from falling when working in an unguarded elevated position.

- All stands of pipe and drill collars racked in a derrick shall be secured with rope or otherwise adequately secured.

- Tools, derrick parts, or materials of any kind shall not be thrown from the derrick.

- The elevators must be properly clamped onto all pipe joints prior to the driller engaging the load.

4.2.1.8 Making and Breaking Joints

- Tongs shall be used for the initial making up and breaking of the joint. The rotary table should not be used for the initial breaking of a joint.

- Employees making or breaking joints shall not be permitted to stand within the arc of the tong handles when the tong pull line is under tension. Employees should handle the tongs only by the appropriate handles.

- Employees shall be trained in the safe use of spinning chains. Spinning chains should not be handled near the rotary table while it is in motion.

4.2.2 Drum Handling Safety

Operations shall be organized to minimize the amount of drum or container movement. Employers shall be warned of the potential hazards associated with the contents of the drums or containers during tailgate safety meetings prior to the beginning of disposition operations. Ignition sources during transfer operations shall be minimized by using proper equipment and procedures. Standing upon or working from drums or containers is prohibited.

4.2.3 Heavy Equipment Operating Safety

The physical hazards and control methods shown in Table 3-1 shall be reviewed for each task and communicated to all affected personnel. As new hazards are discovered, the hazards will be promptly communicated to site personnel. Prior to the start of site work, the heavy equipment operators will inspect all equipment in the presence of the site supervisor.

All heavy equipment will be used in the manner it was intended. Drivers will operate all equipment in accordance with the manufacturers instructions and within the safe operating parameters as defined by the manufacturer.

Ground personnel should always make eye contact and wait for a signal to proceed before passing close to or in front of operating equipment or moving vehicles. Where possible, heavy equipment in stationary operation should be barricaded (with hazard tape) at a sufficient distance for ground personnel to avoid swinging cabs, counter weights, and brooms. When ground personnel are working in the vicinity of heavy equipment, they should inform the flagman of their presence.

All drivers and operators will be expected to adhere to the speed limits, signs, and road markings.

All heavy equipment will carry a multipurpose dry chemical fire extinguisher (at least 5 pounds).

Backhoes and other noncrane heavy equipment will be used to "pull" (lift) equipment only when this is within the normal design parameter of the equipment. If a piece of equipment such as a trackhoe is used to make a lift, it will have a lifting eye mounted on or near the bucket. This lifting eye must be standard equipment for the make and the model of equipment.

During trenching, IT Procedure HS307 on excavation and trenching must be followed. This procedure complies with OSHA regulations 1926.650 through 1926.652. Any excavation greater than 5 feet deep into which persons must enter must be shored, sloped, or otherwise made safe for entry. The shoring or sloping system must be designed by a registered professional engineer (PE) licensed in the state in which the excavation will take place. The design must be present at the site, and the system must be installed as designed.

All excavation shall be performed from a stable ground position. Daily inspections of the excavation shall be made by a competent person who has received training in excavation safety. The inspector shall determine the likelihood of a cave-in, and remedial action such as sloping or shoring shall be taken if the walls appear to be unstable.

All spoil shall be located at least 2 feet from the edge of the excavation to prevent it from falling back into the excavation. The excavation shall be guarded on all sides by barricades or caution tape at least 2 feet from the edge.

All project personnel shall participate in the daily tailgate safety meetings and be instructed on the following requirements:

- Before excavating, the existence and location of underground pipe, electrical equipment, and gas lines will be determined. This will be done, if possible, by contacting the appropriate utility company and/or client representative to mark the location of the lines. If the client's knowledge of the area is incomplete, an appropriate device, such as a cable avoiding tool, will be used to locate the service line.

- Operations must be suspended and the area vented if the airborne volatile organic compound (VOC) concentration reaches 25 parts per million (ppm) continuously using the HNu photoionization detector (PID).

- A VOC reading of the general work area will be made regularly.

- If excavating equipment is located in the vicinity of overhead power lines, a distance of 15 feet must be maintained between the lines and any point on the equipment. If the lines have appreciable sag, or if windy conditions exist, this distance shall be 20 feet.

4.2.4 High-Pressure Water Jetting Operation Safety

Job Setup. All machinery and mechanized equipment shall be operated only by personnel who have been trained in accordance with the original manufacturer's instructional training program, and have been qualified through demonstrating the knowledge, experience, and ability to perform the assigned task.

The jetting operator shall be responsible for the safe operation of the high-pressure water jetting equipment. To ensure the safety of the operator and nearby workers, and to ensure that proper equipment selection is followed, the manufacturer's checklist shall be completed prior to starting work.

The work area should be isolated with use of suitable barriers (i.e., rope, safety tape, barrels, etc.) to warn personnel they are entering a hazardous area. The perimeter should be outside the effective range of the jet whenever possible. The work area must be as clean as feasible to prevent slip, trip, and fall hazards.

High-Pressure Water Jetting Operations

- The equipment must be operated within the limitations specified by the manufacturer.
- The system shall incorporate at least one fluid shut-off or dump service. The orifice operator must always be able to shut down the water jet by releasing pressure on the trigger, switch, or foot valve pedal.
- Hoses shall be arranged so that a tripping hazard does not occur.
- The hoses shall be checked for evidence of damage, wear, or imperfections.
- Any electrical equipment in the immediate area of the operation that presents a hazard to the operator shall be de-energized, shielded, or otherwise made safe. Ground fault circuit interrupters (GFCI) shall be used for any necessary power hook-ups.
- Only approved safety cans shall be used to store fuel. Do not refuel equipment while it is operating.
- Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.

- The minimum PPE shall be worn during jetting operations including hard hats, impact-resistant safety glasses, and safety shoes. In addition, the jetting gun operator will wear metatarsal guards for the legs and feet, hearing protection (if appropriate), and liquid-resistant clothing.

- The jet operator shall not be distracted until the jet has stopped.

- When pressurizing the system, increase pressure slowly on the system while it is being inspected for leaks or faulty components, or both. Repair or replace components only when equipment is properly locked out and tagged.

- During jetting operations, a minimum of two persons, one at the orifice or gun and one accessible to the pump, shall be employed at all times.

- The operator and other team members shall be capable of performing the required operations safely. All shall be capable of speaking and reading the instructions and warnings in the language of their place of work.

Shotgunning

- The person operating the nozzle shall have direct control of the dump system.

- The pressurized system shall never be left unattended.

- When more than one shotgunning operation is being performed within the same area, install a physical barrier or maintain adequate spacing between operators to prevent the possibility of injury from the pressure water.

- Never manually hold objects to be cleaned.

- The point where the hose connects to the gun shall be shrouded by a protective device such as a heavy duty hose, shoulder guard, etc., to prevent injury to the operator should the hose, pipe, or fitting rupture.

- When used, the minimum length of the shotgun lance extension shall be 4 feet (1.2 millimeters [mm]) from the triggering device to the nozzle.

- Use steel-braided hoses on air-operated, fail-safe systems to keep the system from being activated by someone stepping on the hose or running over it.

Moleing or Flex Lancing

- The operator shall have direct control of the dump system.

- A positive method shall be used to prevent the nozzle from reversing direction inside the item being cleaned. Safety guards for this purpose shall be used.

- During manual operations, the entrance to a line or pipe shall not be cleaned with a nozzle containing back jets without adequate shielding.

- The clearance between the outside diameter of the hose, lance, and nozzle assembly and the inside wall of the item being cleaned shall be sufficient to allow adequate washout of water and debris.

- During manual operation, insert the nozzle into the tube prior to pressurizing. Conversely, depressurize the system before removing the nozzle from the tube.

- Hoses shall be conspicuously marked no closer than 24 inches (600 mm) from the nozzle to warn the operator of the nozzle location.

- Where the length of the nozzle and rigid coupling is less than the inside diameter of the pipe, a length of rigid pipe of not less than the diameter of the pipe being cleaned shall be fitted directly behind the nozzle, or a suitable safety shield shall be provided to protect the operator. This is to prevent the nozzle from turning around 180° and doubling back towards the operator. Specific safety guards shall be used for this purpose.

Rigid Lancing

- The operator inserting the nozzle shall have direct control of the dump system.

- The clearance between the outside diameter of the lance and nozzle and the inside wall of the item being cleaned shall be sufficient to allow adequate washout of water and debris.

- When under manual operation, the nozzle shall be inserted into the tube prior to pressurizing. Conversely, the system shall be depressurized before removal of the nozzle from the tube, unless proper shielding is provided.

- When lancing tubes with a rigid lance, a guard shall be installed around the lance to prevent a lance nozzle from being inadvertently withdrawn and causing injury.

- Any water additive (chemical, detergent, or solid particle) shall be used in accordance with the manufacturer's recommendations.

4.2.5 Lifting Safety

Back strain or injury may be prevented by using proper lifting techniques. The fundamentals of proper lifting include:

- Consider the size, shape, and weight of the object to be lifted. Two persons must lift an object if it cannot be lifted safely alone (e.g., greater than 60 pounds).

- The hands and the object should be free of dirt or grease that could prevent a firm grip.

- Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, rough or slippery surfaces.

- Fingers must be kept away from points which could crush or pinch them, especially when putting an object down.

- Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear.

- The load should be kept as low as possible, close to the body with the knees bent.

- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.

4.2.6 Confined-Space Entry

Confined-space entry will not be performed during activities at the sites. If confined-space entry must be performed, an SHP addenda shall be prepared and approved prior to work start.

4.3 Cold Stress Prevention

Most cold-related worker fatalities have resulted from failure to escape low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is a fall in the deep core temperature of the body.

Site workers should be protected from exposure to cold so that the deep core temperature does not fall below 36 degrees Celsius (°C). Lower body temperatures will very likely result in reduced mental alertness, reductioo in rational decision making, or loss of consciousness with the threat of fatal consequences. To prevent such occurrence, the following measures will be implemented:

- Site workers must wear warm clothing such as mittens, heavy socks, etc., when the air temperature is below 45°F. Protective clothing, such as Tyvek or other disposable coveralls, may be used to shield employees from the wind.

- Insulated suits, such as whole body thermal underwear
- Wool socks or polypropylene socks to keep moisture off the feet
- Insulated gloves
- Insulated boots
- Insulated head cover such as hard cat, winter liner, or knit cap
- Insulated jacket, with wind and water resistant outer layer.

- At air temperatures below 35°F, the following work practices must be implemented:

  - If the clothing of a site worker might become wet on the job site, the outer layer of clothing must be water impermeable.

  - If a site worker's underclothing becomes wet in any way, the worker must change into dry clothing immediately. If the clothing becomes wet from sweating (and the employee is not uncomfortable), the employee may finish the task at hand prior to changing into dry clothing.

  - Site workers must have a warm (65°F or above) break area.

  - Hot liquids such as soups or warm, sweet drinks must be provided in the break area. The intake of coffee and tea should be limited, due to their circulatory and diuretic effects.

  - The buddy system must be practiced at all times on site. Any site worker observed with severe shivering must leave the work area immediately.

  - Site workers should dress in layers, with thinner lighter clothing worn next to the body.

  - Site workers should avoid overdressing when going into warm areas or when performing strenuous activities.

4.4 Heat Stress Prevention

One or more of the following control measures shall be used to help control heat stress and are mandatory if any site worker has a heart rate (measure immediately prior to rest period) in excess of 110 beats per minute:

- To Monitor: Measure the heart rate by counting the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

Heat Stroke. Heat stroke is the most serious form of heat stress and should always be treated as a medical emergency. The body's temperature regulation system fails, and the body temperature rapidly rises to critical levels. Immediate action must be taken to cool the body before serious death or injury occurs. Signs and symptoms of heat stroke include:

- Red, hot, usually dry skin
- Lack of, or reduced perspiration
- Nausea
- Dizziness and confusion
- Strong, rapid pulse and confusion
- Coma.

4.5 Hearing Conservation

All on-site IT and subcontractor personnel shall wear hearing protection with a noise reduction rating (NRR) of at least 20 when noise levels exceed 85 dBA. All site personnel who may be exposed to noise shall also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss. Noise monitoring is discussed in Section 8.3.

Whenever possible, equipment that does not generate excessive noise levels will be selected for this project. If the use of noisy equipment is unavoidable, barriers or increased distance will be used to minimize worker exposure to noise, wherever possible.

4.6 Sanitation

4.6.1 Potable Water

The following rules apply for all project field operations:

- An adequate supply of potable water will be provided at each work site.

- Portable containers used to dispense drinking water shall be capable of being tightly closed, and shall be equipped with a tap dispenser. Water shall not be drunk directly from the container.

- Containers used for drinking water shall be clearly marked and not used for any other purpose.

- Disposable cups will be supplied; both a sanitary container for unused cups and a receptacle for disposing of used cups shall be provided.

4.6.2 Nonpotable Water

Outlets for nonpotable water shall be identified to clearly indicate that the water is unsafe and is not to be used for drinking, washing, or cooking purposes. There shall be no cross connection (open or potential) between potable and nonpotable water systems. Nonpotable and potable water systems shall be separated so as to minimize confusion and possible cross contamination.

4.6.3 Toilet Facilities

Toilet facilities shall be available for employees. If permanent toilet facilities are not available (i.e., the work site is more than 500 feet from a building with an accessible toilet), then a portable chemical toilet(s) will be provided.

4.6.4 Trash Collection

Trash collected from the contamination reduction zone (CRZ) will be separated as routine hazardous waste. Trash collected in the support and break areas will be disposed of as nonhazardous waste. Labeled trash receptacles will be set up in the CRZ and in the support zone.

5.0 Personal Protective Equipment

The PPE outlined in this chapter has been selected according to the site characterization and analysis, job tasks, site hazards, intended use, and duration of potential employee exposures. Maintenance and storage of PPE, decontamination, donning and doffing procedures, inspection and monitoring of effectiveness, and PPE limitations are outlined in this chapter.

5.1 Respiratory Program

A comprehensive respiratory protection program has been established by IT and is required in all locations where use of such equipment is intended to lessen the potential for adverse health affects to any employee.

As part of the respiratory training program, each employee is instructed in the following elements:

- Nature of the respiratory hazard on the work site and the appraisal of potential consequences if the respiratory protection is not utilized
- Use and proper fitting of the respirator
- Cleaning, disinfecting, inspection, maintenance, and storage of the respirator
- Proper selection, capabilities, and limitations.

Routinely used respiratory equipment will be inspected, cleaned, and disinfected daily to help assure proper hygienic practices. An inspection of these breathing devices will include the following:

- Examine the head straps for breaks, loss of elasticity, broken or malfunctioning buckles and other attachments.
- Examine the face piece for excessive dirt, cracks, tears, distortion, holes, or inflexibility.
- Examine the exhalation and inhalation valves for any foreign material, cracks, tears, or distortion in the valve. Additional checks will be made to inspect for proper insertion, defective valve covers, or improper installation.
- Examine the air purifying elements for incorrect cartridge, expired shelf life of the cartridge, cracks or dents in the cartridge or cartridge-holder.

- Examine for proper insertion of the cartridges into the face-piece and a check of the gaskets inside the cartridge holder.

- Examine air cylinders for adequate air volume. Only Grade D air will be utilized for breathing air.

When Level C protection is required, respirator cartridges will be changed daily or if increased breathing resistance is detected. All respirators will be inspected prior to each day's use. If broken or malfunctioning parts are found during the cleaning process, these parts will be replaced or new respiratory equipment will be issued to the user.

The respiratory protective equipment will be stored in an area protected from any mechanical damage. These devices will also be stored in a location that provides protection against dust, heat, excessive moisture, or damage by chemical contact. The storage area for the respirators should be in a readily accessible location.

- Only employees who have been trained to wear and maintain respirators properly will be allowed to use respiratory protection.

- Selection of respirators, as well as any decisions regarding upgrading or down-grading of respiratory protection, will be made by the H&S manager or designee.

- Positive and negative pressure checks will be performed each time the respirator is donned.

- Only employees who have been fit tested within the last 12 months will be allowed to work in atmospheres where respirators are required.

- Respirator users will be instructed in the proper use and limitations of respirators.

- If an employee has difficulty in breathing during the fit test or during use, he will be evaluated medically to determine if he can wear a respirator safely while performing assigned tasks.

- No employee will be assigned to tasks requiring the use of respirators if, based upon the most recent examination, a physician determines that the health or safety of the employee will be impaired by respirator use.

- Contact lenses will not be worn while using any type of respiratory protection.

- Air-supplied respirators will be assembled according to manufacturer's specifications. Hose length, couplings, valves, regulators, manifolds, and all accessories will meet American National Standards Institute (ANSI) and the manufacturer's requirements.

- Respirators will be cleaned and sanitized daily after use.

- Respirators will be stored in a convenient, clean, and sanitary location on site.

- Respirators will be inspected during cleaning. Worn or deteriorated parts will be replaced.

- Facial hair that might interfere with a good face-piece seal or proper operation of the respirator is prohibited.

- The IT PM will review the respiratory protection program daily to ensure employees are properly wearing and maintaining their respirators and that the respiratory protection is adequately protecting the employees.

- The H&S manager and the PM will evaluate the respiratory protection program monthly to ensure the continuing effectiveness.

- Respirators used for emergency response will be inspected weekly by the SSHO.

5.2 Levels of Protection

The level of protection used in the exclusion zone (EZ) is based on site-specific information. Specific levels of protection will be changed whenever site conditions change. Levels of protection can either be increased to the next higher level or decreased to the next lower level. If the site superintendent requests a change in levels of protection, he must contact the IT H&S manager and PM. If the need arises to protect safety and health,the site superintendent can upgrade protection levels without input from the H&S manager or PM. He will then review his decision with the H&S manager, SSHO, and PM. Levels of protection will not be downgraded without prior approval from the H&S manager.

5.2.1 Level A Protection

Level A protection is not required.

5.2.2 Level B Protection

Level B protection is not required.

5.2.3 Level C Protection

Level C protection will not be used unless air monitoring data indicate the need for upgrade; however, the equipment shall be readily available on site. The following equipment will be used for Level C protection:

- National Institute of Occupational Safety and Health (NIOSH)/Mine Safety and Health Agency-approved full face, air purifying respirators equipped with organic vapor cartridge in combination with high-efficiency particulate air (HEPA) filter
- Hooded, polyethylene-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Note: In addition to Level C PPE, the operator shall wear metatarsal guards for the legs and feet during high-pressure water jetting operations.

5.2.4 Level D-Modified Protection

The following equipment will be used for Level D-Modified protection:

- Permeable Tyvek, Kleenguard, or its equivalent
- Latex boot covers
- Nitrile, heavy work, or latex gloves
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Note: In addition to modifying Level D PPE, the operator shall wear metatarsal guards for the legs and feet during high-pressure water jetting operations.

5.2.5 Level D Protection

The minimal level of protection that will be required of IT personnel at the site will be Level D. The following equipment will be used for Level D protection:

- Coveralls or work clothing
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

5.2.6 Selection of PPE

The selection of the PPE has been done after a thorough evaluation of the hazards involved during each sampling task. The initial levels of PPE are as follows:

Task	Initial Level of PPE
Staging equipment	Level D
Surveying	Level D
Drilling and installation of monitoring wells	Modified Level D*
Groundwater sampling	Modified Level D*
Soil boring and sampling	Modified Level D*
Excavation/trenching	Modified Level D*
High-pressure water jetting operations	Modified Level D*
Disposal of IDW	Level D

*Initial level will be raised to Level C or higher if air monitoring results in worker's breathing zone are above action levels stated in Chapter 8.0.

5.3 Using PPE

All persons entering the EZ will don the required PPE according to established procedures in this plan to minimize exposure potential. When leaving the EZ, PPE will be removed according to the established procedures to minimize the spread of contamination.

5.3.1 Donning Procedures for Level C PPE

- Put on boots and boot covers and tape the coveralls.
- Put on gloves.
- Tape the coveralls over the gloves at the wrist.
- Don respirator and check for secure fit.
- Put hood or head covering over the respirator.
- Put on remaining protective equipment, i.e., hard hat, safety glasses, etc.

One person will remain outside the work area to check that each person entering has the proper protective equipment. No persons will be allowed to enter an EZ improperly attired.

5.3.2 Doffing Procedures for Level C PPE

Whenever a person leaves the work site, the following proper decontamination sequence will be followed:

- Upon entering the CRZ, rinse contaminated mud and debris from boots or remove boot covers.
- Clean reusable protective equipment.
- Remove protective garments and equipment. All disposable clothing should be placed in plastic bags and labeled as contaminated waste.
- Remove respirator.
- Proceed to the clean area and dress.
- Clean respirator and prepare for next use.

All disposable equipment, garments, and PPE will be bagged in two 6-mil plastic bags and properly labeled for disposal.

6.0 Site Control

6.1 Authorization to Enter

Access to work areas where intrusive activities are conducted is regulated and limited to authorized personnel. Only persons who have completed the following training and medical requirements will be allowed to enter in this work zone:

- Completion of 40 hours of hazardous waste operations training as defined under 29 CFR 1910.120 or 29 CFR 1926.65
- Completion of the 40-hour hazardous waste operations training within the past 12 months or completion of an 8-hour hazardous waste operations refresher
- Certification by a physician of fitness for hazardous waste operations within the last 12 months.

Personnel not meeting these requirements may enter the designated support zone only. The SSHO will maintain a list of persons authorized to enter contaminated work areas, and only personnel on the authorized persons list will be allowed within the work zone.

6.2 Site-Specific Orientation

No person shall be allowed on any field site without first being given a site-specific H&S orientation. This orientation will provide training on the potential H&S hazards and procedures specific to the site, and will discuss the provisions of this SSHP. All personnel will acknowledge their attendance by signing the SSHP Acknowledgement Form. IT subcontractors must also acknowledge and sign the form in Appendix A, Subcontractor Certification.

6.3 Documentation of Certificates

Personnel entering the site to work will have satisfied the medical and training requirements of 29 CFR 1910.120. The project file will contain copies of certificates documenting status for all on-site personnel. Personnel not entering the work zone need not meet the requirements in Section 6.1. The PM will accommodate requests from representatives of regulatory agencies to review documentation. All visitors must present documentation of current training and medical status before being granted authorization to enter the work zone.

6.4 Entry Log

The PM shall keep a daily roster of all on-site personnel and record the time of entry into and exit from the work zone for each person.

7.0 Decontamination

The project areas will be divided into three work zones: the EZ, a CRZ, and a support zone. The PM will be responsible for designation of the work zones. The EZ will be in an approximate 20-foot radius around the drill rig or heavy equipment operation and will be marked with barrier tape or other means to warn personnel of the hazards.

Only IT personnel and authorized visitors who have met the requirements of Section 6.1 and who are wearing the required PPE will be allowed within this zone.

Immediately adjacent to the EZ, a decontamination area for equipment and personnel will be established. This area will also be delineated witt traffic cones and/or barrier tape. Each side of the decontamination zone will be posted.

The remainder of the IT project area will be designated as the support zone. No special markings or warning labels are required for this area.

7.1 Personnel Decontamination

All personnel working in the EZ must undergo personnel decontamination prior to entering the support zone. The personnel decontamination area shall consist of the following stations.

Station 1. Personnel leaving the EZ will remove the gross contamination from their outer clothing and boots.

Station 2. Equipment for this station may include plastic-lined waste receptacle, chair, clean damp cloths or paper towels, and plastic bags. At Station 2, personnel will remove their Tyvek coveralls and gloves and deposit them in the lined waste receptacles. Personnel will wipe their respirators (if used), hard hats, and boots with clean, damp cloths and then remove those items. Those items are then hand carried to the next station.

Station 3. Equipment for this station may include a wash basin with soap and water and respirator sanitation station. At this station, personnel will thoroughly wash their hands and face before leaving the decontamination zone. Respirators will be sanitized and then placed in a clean plastic ziplock bag.

7.2 Equipment Decontamination

Any heavy equipment that has entered the EZ shall be decontaminated prior to leaving the decontamination zone using methods specified in design package drawings.

7.3 PPE Decontamination

Where and whenever possible, single-use, external protective clothing shall be used for work within the EZ or CRZ. This protective clothing shall be disposed of in marked containers. Depending upon subsequent analysis, this protective clothing may require disposal as hazardous waste.

Reusable protective clothing will be rinsed at the site with detergent and water. The rinsate will be collected for possibledisposal as hazardous waste. A Material Safety Data Sheet must be present on site for any hazardous chemicals used during decontamination procedures (see Appendix B).

Respiratory protective equipment will be wiped with a damp cloth while in the CRZ and bagged. After the respirator has been removed from the CRZ, it will be thoroughly cleaned with soap and water. The respirator face piece will be cleaned at the end of each work shift.

8.0 Site Monitoring

8.1 Air Monitoring

The primary contaminants of concern at Plum Brook are constituents of the former TNT manufacturing process: toluene, TNT, and DNT.

Measurements of airborne VOCs will be conducted in the breathing zone of employees in each work area and their respective support zones by using an HNu PID with an 10.2 electron volt lamp to assess potential employee exposures to VOCs. All air monitoring activities shall be documented on the IT Real Time Air Monitoring Log or Field Activity Daily Log form.

The action level for airborne contaminants is provided in Table 8-1.

All real-time air monitoring results will be provided to the USACE as these results become available.

8.1.1 Air Monitoring Frequency

Air monitoring frequency and location is provided in Table 8-2.

8.1.2 Air Monitoring Equipment

An HNu Model PI-101 PID or equivalent will be available for on-site utilization. All equipment shall be maintained in such quantity and condition to adequately monitor and assess all site operations.

8.1.3 Monitoring Equipment Maintenance and Calibration

All IT HNu PIDs will be calibrated in accordance with IT Procedures 9521.1 through 9521.3 in Appendix C. Preventive maintenance and repairs will be conducted in accordance with the respective manufacturer's procedures.

All direct reading instrumentation calibrations should be conducted under the approximate environmental conditions the instrument will be used. All air monitoring equipment calibrations and maintenance activities shall be documented on the IT Real Time Instrument Calibration Log or Field Activity Daily Log. All completed H&S documentation/forms shall be maintained by the SSHO for review by the H&S manager.

Table 8-1

Action Levels
Former Plum Brook Ordnance Works
Sandusky, Ohio

When in Level C PPE

Analyte	Action Level	Required Action[a]
Volatile organic hydrocarbons	≥ 25 ppm above background in breathing zone (BZ)	Stop work

When in Level D Modified/D PPE

Analyte	Action Level	Required Action[b]
Volatile organic hydrocarbons	≥ 5 ppm above background in BZ	Upgrade to Level C PPE.

When in Support Zone

Analyte	Action Level	Required Action
Volatile organic hydrocarbons	≥ 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.

[a]Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.
[b]Contact with the H&S manager must be made prior to continuance of work. The H&S manager may then initiate perimeter/integrated air sampling along with additional engineering controls.

No one is permitted to downgrade levels of PPE without authorization from the H&S manager.

Table 8-2

Air Monitoring Frequency and Location
Former Plum Brook Ordnance Works
Sandusky, Ohio

Work Activity	Instrument	Frequency	Location
Staging equipment	HNu	Initially for area	Breathing zone (BZ) of employees
Drilling and installation of monitoring wells	HNu	Initially, then periodically (wiih each 5- to 10-foot depth)	BZ of employees Support zone
Sampling (groundwater and soil)	HNu	Initially, then periodically	BZ of employees Support zone
Excavation/trenching	HNu	Initially, then periodically	BZ of employees Support zone

If an instrument is found to be inoperative or suspected of giving erroneous readings, the SSHO shall be responsible for immediately removing the instrument from service and obtaining a replacement unit. The specific IT or subcontractor operation for which this equipment is essential shall cease until an appropriate replacement unit is obtained. The SSHO shall be responsible for ensuring a replacement unit is obtained and/or repairs are initiated on the defective equipment.

When applicable, only manufacturer-trained and/or authorized IT personnel will be allowed to perform instrument repairs or preventive maintenance.

8.2 Other Hazardous Conditions

The SSHO will take affirmative action to limit exposures. If unknown chemicals or contamination are encountered, operations will cease until the situation is evaluated. The SSHO will contact the H&S manager to evaluate any potentially hazardous situations, or any situation with elevated contamination levels. Operations will only be resumed if they can be accomplished in a safe manner.

8.3 Noise Monitoring

Noise monitoring will not be conducted because previous noise monitoring during similar drilling and heavy equipment operations has characterized noise levels greater than 85 dBA within a 5-foot radius around the rear end (motor side) of heavy equipment and drill rigs. Hearing protection is mandatory for all employees in or when working near/adjacent to operating heavy equipment or drill rig. Noise monitoring will occur when new heavy equipment is brought on site and when new tasks are started that have not previously had their noise levels characterized.

8.4 Monitoring Records

The PM shall ensure that site monitoring records are complete and incorporated into the project file. Any personnel or area air monitoring results will be incorporated into the IT H&S files. The host H&S manager will be responsible for establishing, maintaining, and forwarding to other IT offices (as necessary) all required monitoring information as described below for placement in individual employee files:

- Employee name, social security number, and payroll number
- The date, time, pertinent task information, and exposure information

- Weather conditions (wind direction, precipitation, temperature, etc.)
- Description of the analytical methods, equipment used, equipment identification number, and calibration data
- Type of PPE worn
- Engineering controls used to reduce exposure.

8.5 Notification

Within 5 working days after receipt of monitoring results, the project H&S staff and the host office H&S staff will ensure that each employee is informed in writing of the results which represent that employee's exposure. Monitoring results representative of an employee's exposure shall be reported to the affected employee on the IT Employee Notification of Industrial Hygiene Monitoring Results Form.

Whenever the results indicate that the representative employee exposure exceeds the PEL, the Employee Notification of Industrial Hygiene Monitoring Results Form shall state that the PEL was exceeded, and shall provide a description of the corrective action taken to reduce exposure to a level below the PEL.

IT will provide industrial hygiene monitoring results to subcontractor companies, if the exposure of subcontractor employees to airborne contaminants is elevated. Notification of subcontractor personnel of industrial hygiene monitoring results is the responsibility of the subcontractor.

9.0 Employee Training

9.1 General

All on-site project personnel shall have completed at least 40 hours of hazardous waste operations training, as required by 29 CFR 1910.120 and 29 CFR 1926.65. In addition, all field employees shall have received a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Those personnel who completed the 40-hour training more than 12 months prior to the start of the project shall have completed an 8-hour refresher course within the past 12 months. Supervisors shall have completed an additional 8 hours of relevant H&S training. Subcontractor personnel must meet these training requirements. Documentation of IT and subcontractor training shall be maintained with the project files.

9.1.1 Site-Specific Orientation

All personnel, before performing any work at the site, are required by the NASA PBS to go through a safety orientation, which will include a short briefing at the guard house, and a 10-minute orientation video. In addition, all on-site project personnel will be given a site-specific H&S orientation. This orientation will provide training on the potential H&S hazards and procedures specific to the site, and will discuss the provisions of this SHP. All personnel will acknowledge their attendance by signing the SHP Acknowledgement Form. Additionally, subcontractors must acknowledge the Subcontractor Certification Form in Appendix A.

9.1.2 Tailgate Safety Meetings

The SSHO shall conduct a tailgate safety meeting at the beginning of each shift or whenever new employees arrive at the job site once the job commences. The topics discussed at the tailgate safety meeting will include H&S considerations for the day's activities, necessary protective equipment, potential for encounters with biological hazards, problems encountered, and new operations. Attendance records and meeting notes will be maintained with the project files.

9.2 Site Workers' Basic Course

The following is a list of the topics covered in IT's 40-hour training course:

- General site safety
- Physical hazards (fall protection, noise, heat stress, cold stress)

- Names and titles of key personnel responsible for site H&S
- Safety, health, and other hazards typically present at hazardous waste sites
- Use of PPE
- Work practices by which employees can minimize risks from hazards
- Safe use of engineering controls and equipment on site
- Medical surveillance requirements including recognition of symptoms and signs that might indicate overexposure to hazards
- Worker right-to-know (Hazard Communication OSHA 1910.1200)
- Routes of exposure to contaminants
- Engineering controls and safe work practices
- Components of the site H&S program
- Decontamination practices for personnel and equipment
- Confined-space entry procedures
- Emergency response plan.

9.3 Supervisors' Course

Management and supervisors must receive an additional 8 hours of training presented by the IT Training Department that includes:

- General site safety and health programs
- PPE programs
- Air monitoring techniques.

9.4 First-Aid and Cardiopulmonary Resuscitation

At least two employees current in first aid/cardiopulmonary resuscitation (CPR) will be assigned to the work crew and will be on the site whenever operations are ongoing. First aid and CPR training courses are offered to all IT employees. Annual refresher training in CPR and triannual refresher training in first aid is required to maintain the currency of the certificate.

9.5 Instructors

The IT Training Department, headquartered in Torrance, California, teaches the 40-hour hazardous waste operations classes using certified environmental trainers. When training needs exceed the capacity of the training division, IT uses outside institutions. IT is recognized by EPA and listed in the Federal Register (53 FR 3982). Only similarly recognized outside training institutions may be used with prior approval of the IT Training Department.

10.0 Medical Surveillance Program

10.1 Physical Examinations

All on-site project personnel shall within the past 12 months have completed a comprehensive medical examination that meets the requirements of OSHA regulations 29 CFR 1910.120 and 29 CFR 1926.65. The annual medical includes the following elements:

- Medical and occupational history questionnaire
- Physical examination
- Complete blood count, with differential
- Liver enzyme profile
- Chest X-ray, once every 3 years, for nonasbestos workers
- Pulmonary function test
- Audiogram
- Electrocardiogram for persons older than 35 years of age, or if indicated during the physical examination
- Drug screening
- Visual acuity
- Follow-up examinations, at the discretion of the examining physician or the corporate medical director.

All employee medical clearance forms are maintained by the H&S group within the worker's home profit center, or for subcontractors at the subcontractor's office. The examining physician provides the employee with a letter summarizing his findings and recommendations. Each employee also has the right to inspect and copy medical records.

The examining physician provides the employer with a letter confirming the worker's fitness for work and ability to wear a respirator. A copy of this letter for all project workers will be kept on site during all project site work.

Subcontractors will verify on the certification form that all their employees have successfully completed a physical examination by a qualified physician. The physical examinations shall meet the requirements of 29 CFR 1910.120, 29 CFR 1910.134, HS100, and HS101. Subcontractors must submit a completed Subcontractor Certification Form (Appendix A) and supply copies of the medical examination certificate for each on-site employee.

10.1.1 Preplacement Examination

All employees will receive a preplacement medical examination prior to assignment to field operations.

10.1.2 Annual Examination

Each year subsequent to the placement examination, all employees and subcontractors must undergo an annual examination similar in scope to the placement examination. IT employees hired prior to 1985 are not required to submit to drug screening. Chest x-rays are taken every third year. The medical and occupational history is updated with each examination.

10.1.3 Exit Examination

IT employees receive an exit examination upon leaving the company if they have not been examined within the previous 6 months. The exit examination consists of the annual examination without drug screen. The employee's immediate supervisor is to notify the home office H&S assistant within a reasonable time before the termination to allow for the necessary arrangements.

10.2 First-Aid and Medical Treatment

All persons on site must report any near-miss incident, accident, injury, or illness to their immediate supervisor. First aid will be provided by the designated site first aider. Injuries and illnesses requiring medical treatment will be accompanied by an Authorization for Treatment form. The employee's supervisor will complete the Supervisor's Employee Injury Report (SEIR) (Appendix D) and conduct an accident investigation as soon as emergency conditions no longer exist and first aid and/or medical treatment has been rendered. The results of the investigation should be reported on the accident/injury investigation report. The SEIR must be completed and submitted to the H&S manager within 24 hours of the incident. The accident/injury investigation report must be submitted within 72 hours of the incident.

If first-aid treatment is required, first-aid kits are available at the CRZ and in all IT vehicles. If treatment beyond first aid is required, the injured should be transported to the medical

facility shown in Appendix E. If the injured is not ambulatory or shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedics should be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service examine and transport the worker. In case of any emergency, the IT field supervisor needs to contact the PBS Communications Center located in the front gate for assistance using the portable station radio provided by the PBS.

10.3 Medical Restriction

When a medical care provider identifies a need to restrict work activity, the employee's home office H&S assistant will communicate the restriction to the employee, his supervisor, and the H&S manager. The terms of the restriction will be discussed with the employee and his supervisor. Every attempt will be made to keep the employee working, while not violating the terms of the medical restriction.

10.4 Medical Records

Medical and personal exposure monitoring records will be maintained according to the requirements of 29 CFR 1910.20 and HS103, and shall be kept for 30 years after employment. Employee confidentiality shall be maintained. Employees and their authorized representatives have access to these records through the H&S assistant.

11.0 Emergency Procedures

11.1 General

This SHP has been developed to allow site activities to be conducted without adversely impacting the safety of the workers, the community, and the environment. Procedures included in this section address the action required in the event extraordinary conditions occur at the site.

11.2 First Aid

If first aid and/or CPR is administered by site personnel, the SSHO must ensure full compliance with the requirements of Chapter 12.0, Bloodborne Pathogen Exposure Control Plan. First-aid kits shall be maintained at the control access point between the decontamination and support zones and in all support vehicles. If the victim cannot be safely moved from the contaminated area, first aid necessary to stabilize the victim for safe transport shall be administered at the accident location. Appropriate decontamination of all clothing and equipment shall be followed upon leaving the contaminated area. The SSHO is responsible for administering first aid.

11.3 Emergency Response

11.3.1 Pre-Emergency Planning

During the site-specific orientation and at the daily tailgate safety meetings, all employees will be trained in and reminded of the provisions of this emergency response plan, the communication systems and evacuation routes. This plan will be reviewed and revised, if necessary, on a regular basis. This will ensure that the plan is adequate and consistent with prevailing site conditions.

11.3.2 Project Manager's Responsibilities

The PM has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area. The PM is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. In the absence of the PM, the site superintendent shall assume the responsibilities of the PM. All project personnel are responsible for assisting the PM in responding to emergency situations within the capabilities of their skills, equipment, and training.

11.3.3 Evacuation Signal

Vehicle or portable air horns will be used for evacuation signals with one long, continuous blast: emergency evacuation of the site.

11.3.4 Emergency Equipment/Facilities

All individuals shall be familiar with the site and be able to identify the locations of the following emergency equipment:

- "IT-approved" first-aid kits
- Fire extinguishers (minimum of 20-pound A:B:C)
- Emergency eye wash/portable shower that complies with ANSI Z-358.1
- Cellular telephone
- PPE.

11.3.5 Medical Emergencies

First aid should be administered by the SSHO while awaiting an ambulance or paramedics. In the event of serious injury on site, all activities will be immediately suspended and resources will be diverted until it can be ensured that response procedures are adequate and that proper assistance has been provided to ambulance or paramedics responsible for treating the injury.

All injuries and illnesses must be immediately reported to the PM or the SSHO, who will then notify appropriate off-site personnel and organizations as necessary.

For ambulance, fire, or police contacts, give the name of the road and the nearest intersection to the Communication Center (Front Gate). Notify the IT PM, the USACE representative, and the IT H&S manager after primary emergency contacts have been made.

Attending emergency physicians should be given the telephone number of the IT medical director to obtain immediate access to an employee's medical records and for consultation purposes.

11.3.6 Emergency Contact/Notification Listing

In case of any emergency, the PBS Communication Center will be contacted for appropriate services. The PBS Communication Center will coordinate station access and response.

Local, State, and National emergency numbers as follows:

Police Department	(419) 627-5863
Fire Department	(419) 627-5837
Ambulance	911
Hospital	(419) 621-7000
National Response Center	(800) 424-8802
Poison Control Center	(800) 542-4225
Ohio EPA Emergency Spill Number	(800) 282-9378

11.3.7 Key Project and IT Personnel

Project Manager	Don Burton, PE	(423) 690-3211
H&S Manager	Melissa Smith, CIH	(423) 690-3211
SSHO	George Yu	(423) 690-3211

11.3.8 Directions to the Nearest Hospital

The nearest hospital is located at:

Providence Hospital
1912 Hayes Avenue
Sandusky, Ohio 44870

Directions to the Providence Hospital:

Exit from the front gate of Plum Brook Station; turn right to Taylor Road; go approximately 1/4 mile; turn left to Botay Road; at the stop sign make a left turn to Bogart Road (County Road No. 10); take Bogart Road all the way to State Road No. 4; (Wright Brothers Memorial Highway); make a right turn at State Road No. 4; the Providence Hospital will be on the right side.

Estimated travel time to the hospital from PBS is between 15 and 30 minutes, depending on traffic conditions.

See Appendix E, Site and Hospital Location Map.

11.4 General Emergency Procedures

- If a member of the field crew experiences any adverse effects or symptoms of exposure while on the scene, the entire field crew shall immediately halt work and act according to the instructions provided by the SSHO.

- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated shall result in the evacuation of the field team and re-evaluation of the hazard and the level of protection required.

- If an accident occurs, the site supervisor must immediately complete the SEIR (Appendix B). If necessary, follow-up action shall be taken to correct the situation that caused the accident.

11.4.1 Personal Injury

The SSHO is trained in American Red Cross first-aid procedures and shall administer appropriate first-aid treatment, including CPR, in emergency situations. If the injury to the worker is of chemical nature, the following first-aid procedures will be instituted as soon as possible:

- ***Eye Exposure*** - If contaminated material gets into the eyes, the eyes will be flushed immediately at the eyewash station using copious amounts of water while lifting up the lower and upper eyelids.

- ***Skin Exposure*** - If contaminated sludge or corrosive liquid material gets on the skin, the affected area will be washed with soap or mild detergent.

- ***Inhalation*** - If an individual inhales a volume of toxic or corrosive vapors, the employee will be removed to fresh air at once. If breathing has stopped, artificial respiration will be performed on the affected individual until medical attention can arrive on scene and transport the patient to the nearest medical facility.

- ***Ingestion*** - In the event a person ingests a toxic liquid or solid material, medical attention will be obtained at once.

The following general emergency procedures shall be carried out in the event of injury:

- Notify the SSHO of the incident.

- Administer first aid.

- Call for ambulance transport, or transport victim to nearest hospital or emergency medical center, as appropriate.

- Notify the IT PM, the USACE representative, and the IT H&S manager of the incident and describe the emergency response actions taken.

11.4.2 Fire or Explosion

In the event of a fire of explosion:

1. Immediately evacuate injured personnel and leave the area.
2. Administer first aid, as appropriate.
3. Notify emergency services through the PBS Communication Center.
4. Notify the IT PM, the USACE representative, and the IT H&S manager.

11.5 Evacuation Routes and Procedures

Evacuation routes and procedures will be developed by IT upon arrival at the site in coordination with the NASA PBS personnel.

12.0 Bloodborne Pathogen Exposure Control Plan

This exposure control plan presents H&S guidelines for voluntary first aid and CPR care providers. To meet the requirements of OSHA 29 CFR 1910.151 and EM 385-1-1, during day shift operations, at least one person on site will be adequately trained in first aid and CPR, and in the requirements of the Bloodborne Pathogens Standard as listed in 29 CFR 1910.1030, IT Procedure HS512, and the contents of this plan.

12.1 Definition

Bloodborne pathogens are those agents (i.e., bacteria, virus, fungi) found in blood components, certain body fluids, and other materials, objects, or surfaces that have had contact with blood that are capable of causing human disease or death to unprotected people who come into contact with blood or blood-affected items. Diseases caused by bloodborne pathogens include, but are not limited to, hepatitis B virus (HBV), human immunodeficiency virus (HIV), hepatitis C, malaria, and syphilis. The most significant and of greatest concern are HBV and HIV.

12.1.1 Hepatitis B Virus

HBV is the major bloodborne pathogen hazard that first aid/CPR care providers are most likely to encounter. The HBV can remain infectious for up to 10 days even in dried blood. The virus adversely affects 8,000 to 10,000 workers annually, resulting in approximately 200 deaths each year.

Hepatitis Exposure Symptoms. Hepatitis means "inflammation of the liver" causing severe liver damage or cirrhosis. Exposure symptoms include fever, fatigue, nausea, vomiting, muscle aches, loss of appetite, and jaundice (yellowing of the eyes or skin). Hepatitis diagnosis is difficult because some symptoms are similar to the flu and may remain mild for an extended period of time.

Presently, no cure exists for hepatitis, but it can be prevented with a vaccination.

12.1.2 Human Immunodeficiency Virus

HIV attacks and deteriorates the body's immune system and eventually weakens it to the point that infection sets in causing the disease Acquired Immune Deficiency Syndrome (AIDS). HIV is primarily transmitted through sexual contact, but may also be transmitted

through contact with blood and body fluids. HIV is not transmitted by touching or working with people who are HIV-positive.

Human Immunodeficiency Virus Exposure Symptoms. HIV leads to AIDS-related illnesses that eventually cause neurological problems, cancer, pneumonia, and death. People can carry the virus for many years without experiencing any symptoms. Upon development, symptoms may include weight loss, skin lesions, dry cough, fever, fatigue, diarrhea, or swelling of the lymph glands.

Presently, no cure exists for HIV or AIDS, and no vaccination is currently available.

12.2 Exposure Determination

The purpose of the guidelines in this plan are designed to limit occupational exposure of site workers to infectious blood materials that could result in disease or possibly death. The contents of this plan are intended to protect the IT employees trained in first aid and CPR who are responsible for administering medical assistance to site workers.

Means of Transmission. The major activity that may expose any of these IT employees to bloodborne pathogens is their response and care to on-site personal injuries or decontamination of equipment/surfaces contaminated by blood or other potentially infectious materials during the incident.

These IT employees could be subject to bloodborne pathogens during rendering of first aid or CPR by accidental exposure due to:

- Punctures through the skin with a contaminated sharp object (i.e., scissors)
- Contact or absorption of blood or blood-contaminated objects through open or broken skin (i.e., cuts, scratches, rashes)
- Blood splashes to their eyes, nose, or mouth, or other mucous membranes.

Workers can reduce their risk of contacting HBV or HIV by implementing the recommended work practices (outlined in this plan) before, during, and after responding to emergency medical incidents involving personal injuries.

12.3 Measures for Prevention

The establishment of work practice controls is an integral part of an effective exposure control plan in preventing accidental infection of employees. These work practices are designed to protect employees from reasonably foreseeable occupational exposures to bloodborne pathogens from blood and other potentially infectious material. The work practice controls outlined in this section are applicable to the administration of first aid in emergency situations and subsequent cleanup only.

12.3.1 Universal Precautions

Universal precautions is an approach to infection control that operates on the assumption that all human blood and bodily fluids are to be treated as if they are known to be contaminated with HIV, HBV, or other infectious diseases. Universal precautions shall be implemented whenever there exists a foreseeable potential for contact with blood or bodily fluids.

12.3.2 Engineering Controls

Due to the remote location of the work site, the nature of work in outdoor locations with potential exposure to airborne chemical contaminants, and the potential for exposure being limited to emergency situations, the implementation of engineering controls is not feasible. Exposure control shall be accomplished through implementation of work practice controls and use of PPE.

12.3.3 Work Practice Controls

Work practice controls shall be instituted whenever foreseeable potential contact with, or exposure to, blood and bodily fluid exists. Examples of situations in which these controls are to be implemented include, but are not limited to, accidents or injuries in which administration of first aid is required, application of bandages to minor cuts and abrasions of another person, and contact with sores, wounds, or broken skin.

Following are specific work practice controls that shall be implemented:

- Open wounds or cuts will be promptly bandaged.
- Hands and face will be washed as soon as possible after administering first aid or CPR. If wash facilities are not readily available, stock disposable one-time use towelettes.
- No eating, drinking, or smoking is allowed in any work area where a potential exists for occupational exposure to bloodborne pathogens.

- Nondisposable equipment or materials that have or may have blood or infectious fluid contact must be washed immediately after their use. (A 1-to-10 solution of bleach and water is recommended for proper decontamination.)

- Any clothing that comes into contact with blood or infectious fluids shall be removed as soon as possible after administering first aid or CPR.

- No personal clothing that comes into contact with blood or infectious fluids shall be laundered off site.

- First-aid kits on site will be equipped with a pair of surgical gloves and CPR mouth pieces.

Minimization of Contact. Direct contact with blood and bodily fluids should be kept to an absolute minimum, as required in a particular situation. In situations where direct contact is likely, PPE shall be worn to help prevent infection.

Based upon professional judgment, an employee may choose to temporarily forego the use of PPE if he determines that the use of the PPE will further jeopardize his well-being or that of the injured worker. This limited application must be carefully evaluated by the employee.

If this situation does occur, IT is obligated to investigate and document the circumstances in an effort to provide alternative means to avoid further occurrence.

12.3.4 Personal Protective Equipment

The following are specific PPE items that shall be implemented:

- Always use CPR mouthpieces or ventilation devices.

- Inspect PPE prior to use to ensure it is in good working order and without flaws.

- Do not reuse gloves once removed.

- After use, remove gloves from top to bottom inside-out, not allowing unprotected skin to contact the exterior of the gloves.

12.3.5 Waste Handling

Disposable items that have or may have blood contact must be bagged separately from other trash. These wastes must be placed in leak-proof containers or bags and labeled.

A collection container for contaminated articles will be available on site. Wastes used in medical emergency treatment (i.e., gloves, towels, gauze) shall be disposed in the infectious waste container(s). The container will be replaced as needed and will not be overfilled.

12.3.6 Waste Disposal

The waste will remain on site in approved container(s) until an approved disposal facility capable of receiving medical wastes is identified. Disposal of the infectious waste container(s) shall be in accordance with applicable local, state, and federal regulations.

12.4 Medical Requirements

The medical requirements of the exposure control plan include provision of a hepatitis B vaccination to all exposed employees, and postexposure procedures and evaluation.

12.4.1 Hepatitis B Vaccination

All potentially exposed employees will have made available to them at no cost a hepatitis B vaccination. The employee will also receive training as to the vaccine's efficacy, safety, benefits, and consequences prior to administration. The vaccination series shall be initiated within 24 hours of providing first aid/CPR in an incident and shall be administered under the supervision of a licensed physician. Employees may at their own discretion decline the vaccination, in which case documentation of declination will be completed and employees may be assigned immediately. If an employee covered by this exposure plan decides to accept the vaccination at a later date, the vaccination will be offered at that time at no cost to the employee.

12.4.2 Postexposure Procedures and Evaluation

Subsequent to all reported exposure incidents, a confidential medical evaluation and follow-up shall be made available to each employee exposed in the incidents.

Documentation Procedures. Documentation of the exposure incident shall be recorded as soon as possible, and shall include the route(s) of exposure, the circumstances surrounding the incident, and the identification of the source individual. Additionally, each incident shall be placed on the "first aid incident list" attached to the location OSHA Log of Occupational Injuries and Illnesses.

Blood Testing

Source Individuals. As soon as feasible, the source individual in an exposure incident will be asked to consent to a blood test to determine HBV and HIV infectivity. Where applicable laws require employee consent, documented consent shall be obtained prior to testing. If an employee refuses the blood test, documentation of the refusal will be made. Documentation of the test results shall be made available to the exposed employee(s). All results should be kept confidential, because criminal and civil penalties may be charged against persons negligently or willfully releasing such information, depending on local laws.

Exposed Employees. Exposed employees will be asked to consent to a blood test for HBV and HIV serological status. If consent to HIV testing is denied, the blood sample will be preserved for 90 days; within this time, the employee may elect to consent to the HIV test.

12.4.3 Postexposure Medical Evaluations

Exposed employees shall receive a health care professional's written opinion for postexposure evaluations. The written opinion shall include the results of the evaluation and any medical conditions resulting from the exposure incident that require further medical treatment.

12.5 Hazard Communication

12.5.1 Warning Labels

Containers used for disposal of blood contaminated supplies and waste will be labeled in accordance with the word "biohazard."

12.5.2 Warning Signs

There are no designated areas for medical treatment on site, because first aid will be provided on an emergency basis only; therefore, warning signs are not applicable. In cases of potential exposure, observers and nonessential personnel should be verbally warned to keep a safe distance from injured personnel.

12.5.3 Employee Training Program

All associates who are first aid/CPR trained and may provide assistance shall be trained in the requirements for voluntary providers as described in HS512, this SHP and its addenda, and the general provisions of HS512.

12.6 Record Keeping

12.6.1 Training Records

All employees selected to attend the training program that covers the contents of this plan shall sign the Acknowledgment Form and the Training Attendance Form.

The training record will contain the date, training outline, name and qualifications of the trainer, and names and job titles of attendees.

At the completion of the training program, all participants must take and pass the training quiz.

The training records will be maintained by the IT Training Department for at least 3 years from the training date.

12.6.2 Medical Records

Medical records necessary for IT employees must include documentation of HBV vaccination status, medical follow-up, postexposure testing, and a medical professional's written evaluation.

Confidentiality. The employee medical records will be forwarded to Washington Occupational Health Associates Consulting Services for inclusions in the employee's medical file.

Maintenance and Transfer of Records. IT shall maintain the employee medical records for the duration of the employee's employment plus 30 years thereafter.

If, for whatever reason, IT no longer does business and no successor exists, IT will notify the director of NIOSH in writing 3 months prior to the disposal of records. If so directed, the records shall be transferred to the director of NIOSH.

12.6.3 Incident Recording

An incident that occurs as a result of rendering emergency medical care will be recorded on the OSHA 200 log as OSHA defines work-related injuries and illnesses. All injuries involving the release of blood or bodily fluids must be immediately reported to the H&S department to ensure proper reporting and follow-up. Within two working days of any reportable incident, an Accident Report (ENG Form 3394) will be completed in accordance

with AR 385-40 and Supplement 1 to the same regulation, and forwarded to the USACE Occupational Safety and Health Office at the address listed below. An incident follow-up report will be completed within one week of the incident.

U.S. Army Corps of Engineers
Nashville District
Safety and Occupational Health Office
CEORN-SO (Attn: Emmett E. Forte)
P.O. Box 1070
Nashville, TN 37202-1070

Should OSHA inspect the site, contact the Site Manager for direction.

APPENDIX A

SUBCONTRACTOR CERTIFICATION

SUBCONTRACTOR CERTIFICATION

I, _____ as an agent of _____,
do hereby certify that the following employees have successfully completed a 40-hour training course which complies with the provisions of 29 CFR 1910.120/29 CFR 1926.65, and respiratory protection training which complies with 29 CFR 1910.134. Each employee has successfully completed a medical examination which complies with the above regulations.

Individual copies of certification of successful completion of the required training and medical examinations are attached for each employee.

_____ _____

Signature Date

APPENDIX B

MATERIAL SAFETY DATA SHEETS

I-CHEM

MATERIAL SAFETY DATA SHEET

CORPORATE OFFICE
23787-F Eichler Street
Hayward, CA 94545-2724
(510) 782-3905
Fax: (510) 782-3219

2 Boulden Circle, Suite 8
New Castle, DE 19720-2064
(302) 322-3808

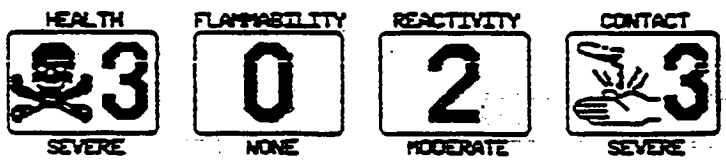
J.T.BAKER INC., 222 Red School Lane, Phillipsburg, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

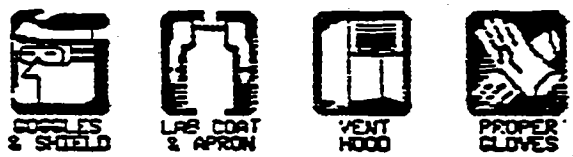
Product Name: Hydrochloric Acid
Common Synonyms: Muriatic Acid; Chlorohydric Acid; Hydrogen Chloride, Aqueous
Chemical Family: Inorganic Acids
Formula: HCl
Formula Wt.: 36.46
CAS No.: 7647-01-0
NIOSH/RTECS No.: MW4025000
Product Use: Laboratory Reagent
Product Codes: 9538,9535,4800,9542,9534,9549,9529,9547,9546,6900,9536,9540 9539,9548,5367,9544,5800,5214,5575,9543,9530,9537,5537

PRECAUTIONARY LABELING

BAKER SAF-T-DATA* System



Laboratory Protective Equipment



U.S. Precautionary Labeling

POISON! DANGER!
CAUSES SEVERE BURNS. MAY BE FATAL IF SWALLOWED OR INHALED.
Do not get in eyes, on skin, on clothing. Do not breathe vapor. Causes damag to Respiratory system (lungs), eyes and skin. Keep in tightly closed container. Loosen closure cautiously. Use with adequate ventilation. Wash thoroughly after handling. In case of spill neutralize with soda ash or lime and place in dry container.

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Continued on Page: 2

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Closed Cup): N/A NFPA 704M Rating: 3-0-0

Autoignition Temperature: N/A

Flammable Limits: Upper - N/A Lower - N/A

Fire Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Us water to keep fire-exposed containers cool. Do not get water inside containers.

Unusual Fire & Explosion Hazards
May emit hydrogen gas upon contact with metal.

Toxic Gases Produced
hydrogen chloride, hydrogen

Explosion Data-Sensitivity to Mechanical Impact
None identified.

Explosion Data-Sensitivity to Static Discharge
None identified.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA): 7 mg/m³ (5 ppm)

TLV (Ceiling) is for Hydrogen chloride.

Short-Term Exposure Limit (STEL): Not Established

Permissible Exposure Limit (PEL): 7 mg/m³ (5 ppm)

PEL (Ceiling) is for Hydrogen chloride.

Toxicity of components

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SECTION V - HEALTH HAZARD DATA (CONTINUED)

Emergency and First Aid Procedures

INGESTION: CALL A PHYSICIAN. If swallowed, do NOT induce vomiting. I conscious, give water, milk, or milk of magnesia.

INHALATION: If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

SKIN CONTACT: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use.

EYE CONTACT: In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

SARA/TITLE III HAZARD CATEGORIES and LISTS

Acute: Yes Chronic: Yes Flammability: No Pressure: No Reactivity: No

Extremely Hazardous Substance:	Yes	Contains Hydrogen Chloride (RQ = 1 LB, T = 500 LBS)
CERCLA Hazardous Substance:	Yes	Contains Hydrochloric Acid (RQ = 5000 LB
SARA 313 Toxic Chemicals:	Yes	Contains Hydrochloric Acid
Generic Class:		C16
TSCA Inventory:	Yes	

SECTION VI - REACTIVITY DATA

Stability: Stable Hazardous Polymerization: Will not occur

Conditions to Avoid: heat, moisture

Incompatibles: most common metals, water, amines, metal oxides, acetic anhydride, propiolactone, vinyl acetate, mercuric sulfate, calcium phosphide, formaldehyde, alkalies, carbonates, strong bases, sulfuric acid, chlorosulfonic acid

Decomposition Products: hydrogen chloride, hydrogen, chlorine

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I-CHEM MATERIAL SAFETY DATA SHEET

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.)

Proper Shipping Name: Hydrochloric acid, solution
Hazard Class: 8
UN/NA: UN1789 Reportable Quantity: 5000 LBS. Packaging Group: II
Labels: CORROSIVE
Regulatory References: 49CFR 172.101

International (I.M.O.)

Proper Shipping Name: Hydrochloric acid, solution
Hazard Class: 8 I.M.O. Page: 8183
UN: UN1789 Marine Pollutants: No Packaging Group: II
Labels: CORROSIVE
Regulatory References: 49CFR 172.102; Part 176; IMO

AIR (I.C.A.O.)

Proper Shipping Name: Hydrochloric acid, solution
Hazard Class: 8
UN: UN1789 Packaging Group: II
Labels: CORROSIVE
Regulatory References: 49CFR 172.101; 173.6; Part 175; ICAO/IATA=== We belie the transportation data and references contained here to be factual and the opinion of qualified experts. T data is meant as a guide to the overall classificatio of the product and is not package size specific, nor should it be taken as a warranty or representation fo which the company assumes legal responsibility.=== Th information is offered solely for your consideration, investigation, and verification. Any use of the information must be determined by the user to be in accordance with applicable Federal, State, and Local laws and regulations. See shipper requirements 43CFR 172.3 and employee training 49CFR 173.1.

U.S. Customs Harmonization Number: 28061000000

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J.T.BAKER INC. 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865
M A T E R I A L S A F E T Y D A T A S H E E T
24-HOUR EMERGENCY TELEPHONE -- (908) 859-2151
CHEMTREC # (800) 424-9300 -- NATIONAL RESPONSE CENTER # (800) 424-8802

J.T.BAKER INC., 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: METHANOL
COMMON SYNONYMS: METHYL ALCOHOL; WOOD ALCOHOL; CARBINOL; METHYLOL; WOOD SPIRIT
CHEMICAL FAMILY: ALCOHOLS
FORMULA: CH3OH
FORMULA WT.: 32.04
CAS NO.: 67-56-1
NIOSH/RTECS NO.: PC1400000
PRODUCT USE: LABORATORY REAGENT
PRODUCT CODES: 9049,9063,9076,9091,5370,9074,6808,9127,9098,5807,9073,9071 5811,5217,9075,9090,9093,P704,9069,5536,9263,9070,9077,9072 9068

PRECAUTIONARY LABELING

BAKER SAF-T-DATA™ SYSTEM

HEALTH	-	3	SEVERE (POISON)
FLAMMABILITY	-	3	SEVERE (FLAMMABLE)
REACTIVITY	-	1	SLIGHT
CONTACT	-	1	SLIGHT

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

U.S. PRECAUTIONARY LABELING

POISON DANGER
FLAMMABLE. HARMFUL IF INHALED. CANNOT BE MADE NON-POISONOUS. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED.
KEEP AWAY FROM HEAT, SPARKS, FLAME. DO NOT GET IN EYES, ON SKIN, ON CLOTHING. AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THORCUGHLY AFTER HANDLING. IN CASE OF FIRE, USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE. FLUSH SPILL AREA WITH WATER SPRAY.

CONTINUED ON PAGE: 2

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP): 12 C (54 F) NFPA 704M RATING: 1-3-0

AUTOIGNITION TEMPERATURE: 463 C (867 F)

FLAMMABLE LIMITS: UPPER - 36.0 % LOWER - 6.0 %

FIRE EXTINGUISHING MEDIA
USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE. (WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE. BURNS WITH A CLEAR, ALMOST INVISIBLE FLAME.

TOXIC GASES PRODUCED
CARBON MONOXIDE, CARBON DIOXIDE, FORMALDEHYDE

EXPLOSION DATA-SENSITIVITY TO MECHANICAL IMPACT
NONE IDENTIFIED.

EXPLOSION DATA-SENSITIVITY TO STATIC DISCHARGE
NONE IDENTIFIED.

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 260 MG/M3 (200 PPM)

THE TLV LISTED DENOTES TLV (SKIN).

SHORT-TERM EXPOSURE LIMIT (STEL): 310 MG/M3 (250 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 260 MG/M3 (200 PPM)

CONTINUED ON PAGE: 4

SECTION V - HEALTH HAZARD DATA (CONTINUED)

EMERGENCY AND FIRST AID PROCEDURES

INGESTION: CALL A PHYSICIAN. IF SWALLOWED, IF CONSCIOUS, GIVE LARGE AMOUNTS OF WATER. INDUCE VOMITING.

INHALATION: IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

SKIN CONTACT: IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE RE-USE.

EYE CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ACUTE: YES CHRONIC: YES FLAMMABILITY: YES PRESSURE: NO REACTIVITY: NO

EXTREMELY HAZARDOUS SUBSTANCE:	NO	
CERCLA HAZARDOUS SUBSTANCE:	YES	CONTAINS METHANOL (RQ = 5000 LBS)
SARA 313 TOXIC CHEMICALS:	YES	CONTAINS METHANOL
GENERIC CLASS:		C05
TSCA INVENTORY:	YES	

SECTION VI - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS, STRONG ACIDS, ZINC, ALUMINUM, MAGNESIUM

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE, FORMALDEHYDE

CONTINUED ON PAGE: 6

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME: METHYL ALCOHOL
HAZARD CLASS: FLAMMABLE LIQUID
UN/NA: UN1230 REPORTABLE QUANTITY: 5000 LBS.
LABELS: FLAMMABLE LIQUID
REGULATORY REFERENCES: 49CFR 172.101; 173.119

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME: METHANOL
HAZARD CLASS: 3.2, 6.1 I.M.O. PAGE: 3251
UN: UN1230 MARINE POLLUTANTS: NO PACKAGING GROUP: II
LABELS: FLAMMABLE LIQUID, POISON
REGULATORY REFERENCES: 49CFR 172.102; PART 176; IMO

AIR (I.C.A.O.)

PROPER SHIPPING NAME: METHANOL
HAZARD CLASS: 3.2, 6.1
UN: UN1230 PACKAGING GROUP: II
LABELS: FLAMMABLE LIQUID, POISON
REGULATORY REFERENCES: 49CFR 172.101; 173.6; PART 175; ICAO/IATA=== WE BELIEVE THE TRANSPORTATION DATA AND REFERENCES CONTAINED HEREIN TO BE FACTUAL AND THE OPINION OF QUALIFIED EXPERTS. THE DATA IS MEANT AS A GUIDE TO THE OVERALL CLASSIFICATION OF THE PRODUCT AND IS NOT PACKAGE SIZE SPECIFIC, NOR SHOULD IT BE TAKEN AS A WARRANTY OR REPRESENTATION FOR WHICH THE COMPANY ASSUMES LEGAL RESPONSIBILITY.=== THE INFORMATION IS OFFERED SOLELY FOR YOUR CONSIDERATION, INVESTIGATION, AND VERIFICATION. ANY USE OF THE INFORMATION MUST BE DETERMINED BY THE USER TO BE IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND REGULATIONS. SEE SHIPPER REQUIREMENTS 49CFR 172.3 AND EMPLOYEE TRAINING 49CFR 173.1.

U.S. CUSTOMS HARMONIZATION NUMBER: 29051100009

CONTINUED ON PAGE: 8

MALLINCKRODT

Material Safety Data Sheet

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Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

Emergency Telephone Number: 314-982-5001

NITRIC ACID, 70%

PRODUCT IDENTIFICATION:

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 70%

Formula CAS No.: 7697-37-2

Molecular Weight: 63.00

Chemical Formula: HNO_3

Hazardous Ingredients: Nitric acid

PRECAUTIONARY MEASURES

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE.

Do not get in eyes, on skin, or on clothing.
Avoid breathing mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep from contact with clothing and other combustible materials.
Do not store near combustible materials.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING!
Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Oxidizer

SECTION 1 Physical Data

Appearance: Clear, colorless to slightly yellow liquid.

Odor: Suffocating acrid.

Solubility: Infinite in water.

Boiling Point: 122°C (252°F)

Melting Point: -34°C (-29°F)

Specific Gravity: 1.41

Vapor Density (Air=1): 2-3 approximately

Vapor Pressure (mm Hg): 62 @ 20°C (68°F)

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.

Explosion:
Reacts explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc.

Fire Extinguishing Media:
If involved in a fire, use water spray.

Special Information:
Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Certain may burst when heated.

Hazardous Decomposition Products:
When heated to decomposition, emits toxic nitrogen oxides f and hydrogen nitrate. Will react with water or steam to prod heat and toxic and corrosive fumes.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
A dangerously powerful oxidizing agent, concentrated nitric a is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.

SECTION 4 Leak/Spill Disposal Information

Isolate or enclose the area of the leak or spill. Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic or corrosive fluids or vapors.
Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). Sewer with excess water.
Larger spills and lot sizes: Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite) and dispose in a RCRA-approved waste facility or sewer the neutralized slurry with excess water if local ordinances allow. Provide forced ventilation to dissipate fumes.

Reportable Quantity (RQ)(CWA/CERCLA): 1000 lbs.

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0 Other: Oxidizer

MALLINCKRODT

Material Safety Data Sheet

Mallinckrodt, Inc. Science Products Division, P.O. Box M Paris, KY 40361

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Emergency Telephone Number: 314-982-5000

Addendum to Material Safety Data Sheet

REGULATORY STATUS

This Addendum Must Not Be Detached from the MSDS

Identifies SARA 313 substance(s)

Any copying or redistribution of the MSDS must include a copy of this addendum

(Chem.Key: NITRA)

Hazard Categories for SARA Section 311/312 Reporting

Acute	Chronic	Fire	Pressure	Reactive
X	X			X

Product or Components of Product:	SARA EHS Sect. 302 RQ (lbs.)	SARA EHS Sect. 302 TPQ (lbs.)	SARA Section 313 Chemicals Name List	SARA Section 313 Chemicals Chemical Category	CERCLA Sec.103 RQ (lbs.)	RCRA Sec. 261.33
NITRIC ACID, 70% (7697-37-2)	1000	1,000	Yes	No	1000	No

SARA Section 302 EHS RQ: Reportable Quantity of Extremely Hazardous Substance, listed at 40 CFR 355.
SARA Section 302 EHS TPQ: Threshold Planning Quantity of Extremely Hazardous Substance. An asterisk (*) following a Threshold Planning Quantity signifies that if the material is a solid and has a particle size equal to or larger than 100 micrometers, the Threshold Planning Quantity = 10,000 LBS.
SARA Section 313 Chemicals: Toxic Substances subject to annual release reporting requirements listed at 40 CFR 372.65.
CERCLA Sec. 103: Comprehensive Environmental Response, Compensation and Liability Act (Superfund). Releases to air, land or water of these hazardous substances which exceed the Reportable Quantity (RQ) must be reported to the National Response Center, (800-424-8802); Listed at 40 CFR 302.4
RCRA: Resource Conservation and Reclamation Act. Commercial chemical product wastes designated as acute hazards and toxic under 40 CFR 261.33

APPENDIX C

IT PROCEDURES 9521.1 - 9521.3

IT CORPORATION

STANDARD PROCEDURE

PROCEDURE NO. 9521.1

DATE October 29, 1979

SUPERSEDES ----

APPROVED David R. Smith

David R. Smith

SUBJECT:

GasTech GX-3 Maintenance

1. Purpose: To prescribe routine inspection and preventive maintenance for the GX-3 combustible gas/oxygen indicators.

2. Reference: Instruction Manual, 0102-072977-1-10, Model GX-3 Combination Combustible Gas/Oxygen Indicator and Alarm.

3. Attachments:

   A. Inventory list, GX-3 Combustible gas/oxygen indicator; instrument diagram, GX-3

   B. Operational tests.

4. Office of Primary Responsibility:

   Corporate Director of Occupational Safety and Health

5. Discussion:

   Reliable measurements of potentially hazardous atmospheres encountered by field personnel demand optimum performance from operations test instruments. These instruments are sensitive and can get out of calibration easily. In consequence, conscientious attention to proper accomplishment of necessary inspections and scheduled maintenance is mandatory. Periodic inspections and maintenance checks are prescribed in this directive.

6. Action: Before any instrument is issued to field personnel the following procedures will be accomplished:

   A. Daily Inspection

      1. The instrument shall be inspected to ensure that all items listed on the inventory list on Attachment A are with the instrument.

      2. The instrument shall be given the operations tests in Attachment B to verify proper operation.

B. Monthly Maintenance

1. The instrument shall be given the maintenance prescribed in Attachment B at no less a frequency than once a month.

2. An inspection report tag shall be attached to the instrument upon completion of monthly maintenance.

C. Special Precautions

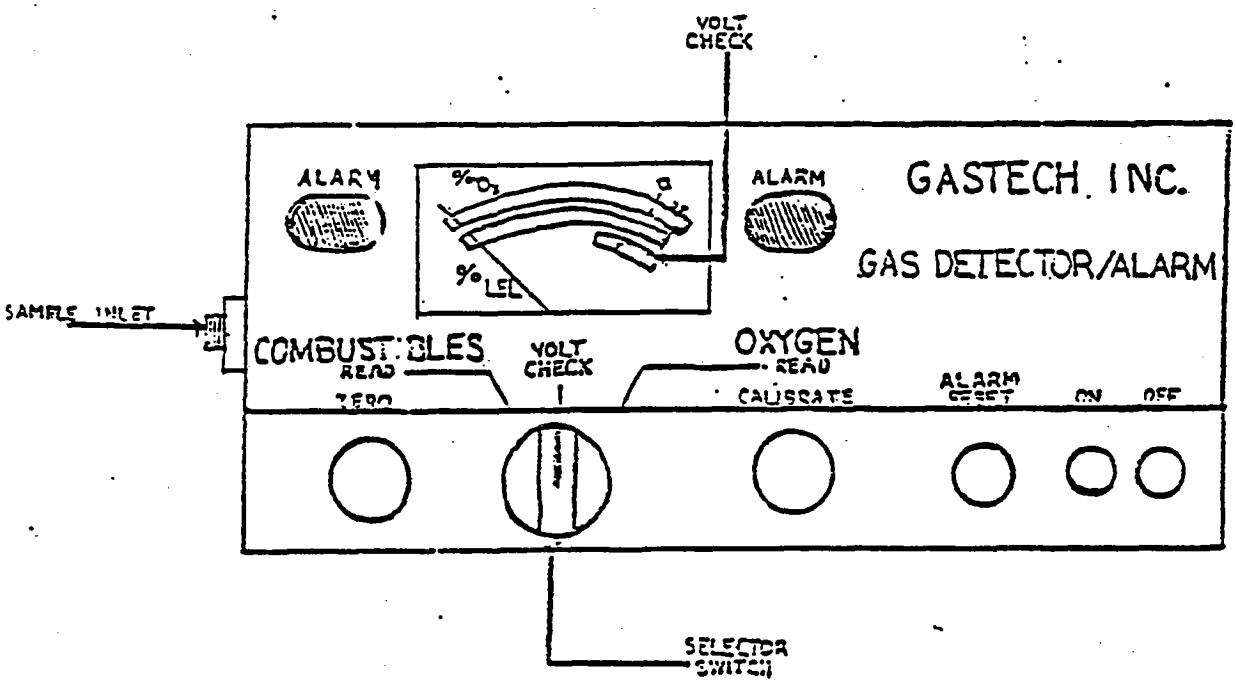
Instruments used in sampling heated spaces such as hot tanks or sampling spaces containing leaded products require additional precautionary checks. These are set forth in Attachment B. A most important consideration is the need for more frequent calibration of instruments using a known concentration of calibration gas to ensure reliability of measurements.

7. Exceptions: All instruments that are assigned to an individual Foreman or Supervisor shall be returned by them each week to the storeroom for inspection, maintenance, and calibration.

GasTech GX-3 Inventory List

1. GX-3 complete with carrying case.
2. Instruction Manual.
3. Probe with cotton filter, 10" fiberglass.
4. Hose, 3', complete with couplings.
5. Hose, 6', complete with couplings.

Instrument Diagram



1. Operational Tests - each instrument shall be inspected to verify normal operation by the following means:

   A. Check battery voltage. Turn instrument on and move selector switch to "volt check" position. Needle should rise to the black band near top of scale. Batteries should be replaced if the needle lies below the "V" on the volt check scale (see attachment A).

   B. Verify pump operation. With instrument turned on, verify pump operation by holding finger over sample inlet. Pump should slow down or stop.

      If pump does not slow appreciably, there is leakage at pump valves or elsewhere in system, and reliable gas indication may be impossible.

   C. Inspect Sampling System

      (1) Probe. Inspect 10" flexible plastic tube for general cleanliness, and remove all liquid and residue before issuing. Inspect filter unit and clean wire screen as necessary. Replace cotton plug if soiled.

      (2) Hoses. Inspect both 3' and 6' hose for damage to rubber surfaces, fittings, or teflon lining. Inspect "O" rings. Replace or repair as necessary.

      (3) Leak Test. Assemble sample system and attach to instrument. With instrument turned on, hold finger over hose inlet. Pump should stop or slow noticeably if there is no leak. Disassemble sample system and place it back in pouch in carrying case.

   D. Check Oxygen Alarm Setting. With instrument turned on, check oxygen alarm setting by moving selector switch to "Oxygen Read" position. Needle should rise to upper portion of scale. Lift and engage "calibrate" knob and rotate counterclockwise to move the needle to 20% oxygen. The oxygen alarm light will glow and an audible alarm will sound if the instrument is properly set at 20% oxygen. Do not issue the instrument unless the oxygen alarm is properly set at 20% oxygen. Return the needle position to 21% oxygen and press "Reset" button to reset alarm circuit.

   E. Check Combustibles Alarm Setting. Check combustibles alarm setting by turning selector switch to "combustibles" position. Meter should read close to zero. Lift and engage "zero" knob clockwise to move the needle to 10% LEL. The combustibles alarm light will glow and an audible alarm will sound if the instrument is properly set at 10% LEL. Return the needle to zero by rotating the zero knob counterclockwise.

2. Monthly Maintenance

   A. Thoroughly clean external surfaces of instrument and carrying case using a mild detergent and water solution.

   B. Calibrate instrument with a known concentration of methane gas using the GasTech Calibration Test Kit No. 81-0202, as per manufacturer's instructions.

   C. Perform all operations checks described in 1. above.

   D. Attach an inspection report tag indicating the date of inspection and the inspector's name.

3. Special Precautions. In addition to normal daily instrument inspection and monthly calibration checks, the following precautionary maintenance checks may be necessary for special operations:

   A. Heated Samples. Sampling spaces such as hot tanks that are warmer than the instrument may result in condensation of water vapor as the sample passes through the cool sample line. This condensation can block the flow system, corrode the flame arrestor and cause pump valve sticking. Instruments that have been used for such sampling should be inspected for evidence of water vapor condensation.

   B. Filament Poisoning. Sampling spaces that have contained leaded products such as leaded gasoline, or silicone vapors, may result in desensitization of the catalytic surface of the platinum filament.

      Instruments that have been used for such sampling should be calibrated more frequently using a known concentration of methane gas to ensure reliability of measurements.

IT CORPORATION

STANDARD PROCEDURE

PROCEDURE NO. ITC PRO 9521.2

DATE July 27, 1987

SUPERSEDES

APPROVED D R Smith
David R. Smith

SUBJECT:

Use, Calibration, and Maintenance of The HNU P1-101

I. PURPOSE

To provide direction for the use, calibration, limitations, and maintenance of the HNU.

II. REFERENCES

A. HNU Systems, Inc., Instruction Manual for Model PI 101 Photoionization Analyzer, 1975

B. E&E FIT Operation and Field Manual: HNU System PI 101 Photoionization Detector and Century Systems (Foxboro) Model OVA-128 Organic Vapor Analyzer

III. RESPONSIBILITIES

A. Corporate Director -- Health & Safety

1. Maintain this procedure, and

2. Specify training of IT employees as appropriate on the use, calibration, limitations, and maintenance of the HNU.

B. Each IT Location shall

1. Ensure that employees using the HNU are trained in use, limitations, calibration, maintenance, and interpretation of readings,

2. Implement the procedures outlined herein,

3. Maintain records of employee training and instrument calibration, and

4. Maintain HNU inventory control and accountability.

IV. DISCUSSION

A. Instrument Maintenance and Calibration

It is the responsibility of the instrument user to ensure that the instrument is calibrated and operating properly. When the instrument is scheduled for or requires maintenance, these functions should be conducted only by qualified individuals. If possible, maintenance responsibilities should be restricted to one or two individuals, who will also bear responsibilities for logging the equipment in and out.

Each regional office will be responsible for developing a documentation format which should include instrument user, dates of use, instrument identification number, and projects the instrument will be used on.

Documentation of maintenance and calibration functions will be discussed in the appropriate attachment.

B. Operator Qualifications

The HNU, although a relatively simple instrument to use, can be incorrectly operated if the user is not thoroughly familiar with the instrument's operation. An appropriate training and certification procedure should be developed and incorporated into each region's training procedures. All users should complete the training and be certified for HNU operation prior to using the instrument in the field.

V. PROCEDURES

A. Start-up/Shut Down Procedures

1. Start-up Procedures

a. Attach the probe to the read out unit. Match the alignment key, then twist the connector clockwise until a distinct locking is felt.

b. Turn the FUNCTION switch to the battery check position. Check to ensure that the indicator reads within or beyond the green battery arc on the scale plate. If the indicator is below the green arc, or if the red LED comes on the battery must be charged prior to using.

c. To zero the instrument, turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15-20 seconds to ensure that the zero adjustment is stable. If not, then readjust.

d. Check to see that the SPAN POTENTIOMETER is set at the appropriate setting for the probe being used.

e. Set the FUNCTION switch to the desired ppm range.

f. Listen for the fan operation to verify fan function.

g. Check instrument with an organic point source such as a magic marker prior to survey to verify instrument function.

2. Shut Down Procedures

a. Turn FUNCTION Switch to OFF.

b. Disconnect the probe connector.

c. Place the instrument on the charger.

B. Maintenance and Calibration Schedule

Function	Frequency
Routine Calibration	Prior to each use*
Factory Check-out & Calibration	Yearly or when malfunctioning
Wipe Down Read-Out Unit	After each use
Clean UV Light Source Window	Every month or as use and site conditions dictate
Clean the Ionization Chamber	Monthly
Recharge Battery	After each use

* It is recommended that for activities where the HNU-PI-101 is in the field for extended periods of time that calibration gas be brought into the field to check calibration. However, if necessary a single calibration conducted prior to an activity will be considered acceptable for periods up to one week.

C. Calibration Procedure 1

1. Run through start-up procedures as set forth in V.A.

2. Fill a sampling bag with HNU calibration gas (Analyzed).

3. Allow sample bag contents to be drawn into the probe and check response in ppm.

4. If the reading deviates ± 15% from the concentration of the calibration gas, the instrument requires maintenance.

5. Each region should develop a mechanism for the documentation of calibration results. This documentation should include:

   a. Date inspected

   b. Person who calibrated the instrument

   c. The instrument number (Serial # or EPA ID#)

   d. The results of the calibration (ppm, probe ev, span pot setting)

   e. Identification of the calibration gas (source, type, concentration, lot #).

D. Calibration Procedure 2 - (For HNU Calibration Canisters Equipped with a Regulator)

1. Run through start-up procedures as set forth in V.A.

2. Connect a sampling hose to the regulator outlet and the other end to the sampling probe of the HNU.

3. Crack the regulator valve.

4. Take reading after 5-10 seconds.

5. If the reading deviates ± 15% from the concentration of the calibration gas, the instrument requires maintenance.

6. Calibration documentation should be as above.

E. Cleaning the UV Light Source Window

1. Turn the FUNCTION switch to the OFF position and disconnect the sensor/probe from the Read Out/Control unit.

2. Remove the exhaust screw located near the base of the probe. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.

3. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing, taking care that the lamp does not fall out of the lamp housing.

4. Tilt the lamp housing with one hand over the opening such that the lamp slides out of the housing into your hand.

5. The lamp window may now be cleaned with any of the following compounds using lense paper:

   a. HNU Cleaning Compound-All lamps except the 11.7 eV

b. Carbon tetrachloride-All lamps except the 11.7 eV

c. Methanol-All lamps

6. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the housing making sure the contacts are properly aligned.

7. Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws only enough to seal the O-ring. Do Not Overtighten.

8. Line up the pins on the base of the lamp housing with pins inside the probe shell, and slide the housing assembly into the shell. It will only fit one way.

F. Cleaning the Ionization Chamber

1. Turn the FUNCTION switch to the OFF position and disconnect the sensor/probe from the Read Out/Control unit.

2. Remove the exhaust screws located near the base of the probes. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.

3. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing, taking care that the lamp does not fall out of the lamp housing.

4. The ion chamber may now be cleaned according to the following sequence:

   a. acetone rinse with agitation (10 min.)

   b. dry (preferably with oven at 100°C)

   c. methanol rinse with agitation (10 min.)

   d. dry (preferably with oven at 100°C)

5. Place the ion chamber on top of the housing making sure the contacts are properly aligned.

6. Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws only enough to seal the O-ring. Do Not Overtighten.

7. Line up the pins on the base of the lamp housing with pins inside the probe shell, and slide the housing assembly into the shell. It will only fit one way.

G. Trouble Shooting

1. No meter response in any switch position (including BATT CHK)

   a. Broken meter movement

      Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero.

   b. Electrical connection to meter is broken

      Check all wires leading to meter and clean the contacts of quick-disconnects.

   c. Battery is completely dead

      Disconnect battery and check voltage with volt-ohm meter.

   d. If none of the above solves the problem, consult the factory.

2. Meter responds in BATT CHK position, but reads zero or near zero for all others.

   a. Power supply defective

      Check power supply voltages per Figure 11 of the HNU owners manual. If any voltage is out of specification, consult the factory.

   b. Input transistor or amplifier has failed

      (1) Rotate zero control; meter should reflect up/down as control is turned.

      (2) Open probe. Both transistors should be fully seated in sockets.

   c. Input signal connection broken in probe or readout.

      (1) Check input connector on printed circuit board. The input connector should be firmly pressed down.

      (2) Check components on back side of printed circuit board. All connections should be solid, and no wires should touch any other object.

      (3) Check all wires in readout for solid connections.

3. Instrument responds correctly in BATT CHK, and STBY, but not in measuring mode.

Check to see that light source is on.

a. Check high voltage power supply.

b. Open end of probe, remove lamp and check high voltage on lamp contact ring.

c. If High voltage is present at all above points, light source has most likely failed. Consult the factory.

4. Instrument responds correctly in all positions, but signal is lower than expected.

a. Check span setting for correct value.

b. Clean window of light source.

c. Double check preparation of standards.

d. Check power supply 180 V output.

e. Check for proper fan operation. Check fan voltage.

5. Instrument responds in all switcn positions, but is noisy (erratic meter movement)

a. Open circuit in feedback circuit. Consult the factory.

b. Open circuit in cable shield or probe shield. Consult the factory.

6. Instrument response is slow and/or irreproducible.

a. Fan operating improperly. Check fan voltage.

b. Check calibration and operation. See sections 2 and 3.

IT CORPORATION

STANDARD PROCEDURE

PROCEDURE NO. ITC PRO 9521.3

DATE July 27, 1987

SUPERSEDES

APPROVED DRSmith

David R. Smith

SUBJECT:

Use, Calibration, and Maintenance of The OVA-128

I. PURPOSE

To provide direction for the use, calibration, limitations, and maintenance of the OVA.

II. REFERENCES

A. Region II FIT "Proposed Guidelines for the Organic Vapor Analyzer"

B. E&E FIT "FIT Operation and Field Manual: HNU Systems PI 101 Photoionization Detector and Century Systems (Foxboro) Model OVA-128 "Organic Vapor Analyzer"

C. Century Systems (Foxboro). "Service Procedures: Organic Vapor Analyzer; 128GC".

III. RESPONSIBILITIES

A. Corporate Director -- Health & Safety

1. Maintain this procedure, and

2. Specify training of IT employees as appropriate on the use, calibration, limitations, and maintenance of the OVA.

B. Each IT Location shall

1. Ensure that employees using the OVA are trained in use, limitations, calibration, maintenance, and interpretation of readings,

2. Implement the procedures outlined herein,

3. Maintain records of employee training and instrument calibration, and

4. Maintain OVA inventory control and accountability.

IV. DISCUSSION

A. Instrument Maintenance and Calibration

It is preferable to minimize the number of people responsible for maintenance and calibration of the OVA. If possible, one or two individuals should be given this responsibility. These individual(s) will also be responsible for logging the equipment in and out.

Each regional office will be responsible for developing a documentation format which should include instrument user, dates of use, instrument identification number, and projects the instrument will be used on.

Documentation of maintenance and calibration procedures will be discussed in the appropriate attachment.

B. Operator Qualifications

The OVA, although a relatively simple instrument to use, can be incorrectly operated if the user is not thoroughly familiar with the instrument's operation. An appropriate training and certification procedure should be developed and incorporated into each region's training procedures. A user should complete the training and be certified for OVA use prior to taking the instrument into the field.

V. PROCEDURES

A. Start-up/Shut Down Procedures

1. Start-up Procedures

   a. Connect the probe/read out connectors to the side-pack assembly.

   b. Check battery condition and hydrogen supply.

   c. For measurements taken as methane equivalent, check that the GAS SELECT Dial is set at 300.

   d. Turn the electronics on by moving the INSR switch to the ON position and allow five (5) minutes for warm-up.

   e. Set CALIBRATE switch to x10, use CALIBRATE knob to set indicator at 0.

   f. Open the H_2 tank valve all the way and the H_2 supply valve all the way. Check that the hydrogen supply gauge reads between 8.0 and 12.0 psig.

g. Turn the PUMP switch ON and check the flow system according to the procedures in Attachment 4.

h. Check that BACKFLUSH and INJECT valves are in the UP position.

i. To light the flame, depress the igniter switch until a meter deflection is observed. The igniter switch may be depressed for up to 5 seconds. Do not depress for longer than five (5) seconds, as it may burn out the igniter coil. If the instrument does not light, allow the instrument to run several minutes and repeat ignition attempt.

j. Confirm OVA operational state by sniffing an organic source, such as a magic marker.

k. Establish a background level in a clean area or by using the charcoal scrubber (depress the sample inject valve) and recording measurements referenced to background.

l. Set the alarm level, if desired.

2. Shut Down Procedures

a. Close H_2 supply valve and H_2 tank valve (Do Not Overtignten Valves).

b. Turn INSTR switch to OFF.

c. Wait until H_2 supply gauge indicates system is purged of H_2, then switch off pump.

d. Put instrument on electrical charger at completion of day's activities.

B. Maintenance and Calibration Schedule

Function	Frequency
Check Particle Filters	Weekly or as needed
Check Quad Rings	Monthly or as needed
Clean Burner Chamber	Monthly or as needed
Secondary Calibration Check	Prior to project start-up
Primary Calibration Check	Monthly or if secondary check is off by more than ± 10%
Check Pumping System	Prior to project start-up
Replace Charcoal	120 hours of use or when background readings are higher with the inject valve down than with the inject valve up in a clean environment.
Factory Service	At least annually

Instruments which are not in service for extended periods of time are not held to the above schedule. However, they must be given a complete check-out prior to their first use addressing the above maintenance items.

C. Calibration Procedure 1

1. Remove instrument guts from the instrument shell.

2. Turn on Electronics and Zero Instrument on x-10 scale. Gas select dial to 300.

3. Turn on Pump and Hydrogen. Ignite Flame. Go to Survey Mode.

4. Introduce a Methane Standard near 100 ppm.

5. Adjust R-32 Trimpot on Circuit Board to make meter read to standard.

6. Turn off hydrogen flame and adjust meter needle to read 40 ppm (calibrate @ x 10) using the calibration adjust knob.

7. Switch to X100 Scale. The meter should indicate 0.4 on the 1-10 meter markings. (0.4 x 100 = 40 ppm), if the reading is off, adjust with R33 Trimpot.

8. Return to X10 Scale and adjust meter needle to 40 ppm with calibration adjust knob if necessary.

9. At the X10 Scale adjust meter to read 0.4 on the 1-10 meter markings using the calibration adjust. Switch to X1 scale. The meter should read 4 ppm. If the reading is off, adjust using the R-31 Trimpot.

D. Calibration Procedure 2

1. Fill an air sampling bag with 100 ppm (certified) methane calibration gas.

2. Connect the outlet of the air sampling bag to the air sampling line of the OVA.

3. Record the reading obtained off the meter onto the calibration record.

E. Documentation

Each regional shall develop a system whereby the following calibration information is recorded.

1. Instrument calibrated (I.D. or Serial #)
2. Date of calibration
3. Method of calibration
4. Results of the calibration
5. Identification of person who calibrated the instrument
6. Identification of the calibration gas (source, type, concentration, lot #)

F. Pump System Check-Out

1. With Pump On, hold unit upright and observe flow gauge.

2. Ball level significantly below a reading of 2 is low flow.

3. Check connections at the sample hose.

4. Clean or replace particle filters if flow is impaired or it is time for scheduled service.

5. Reassemble and retest flow.

6. If flow still low, replace pump diaphragm and valves.

7. If flow normal, plug air intake. Pump should slow and stop.

8. If no noticeable change in pump, tighten fittings and retest.

9. If still no change, replace pump diaphragm and valves.

10. Document this function in the maintenance records developed for your region.

G. Burner Chamber Cleaning

1. Remove plastic exhaust port cover.

2. Unscrew exhaust port.

3. Use wire brush to clean burner tip and electrode. Use wood stick to clean Teflon.

4. Brush inside of exhaust port.

5. Blow out chamber with a gentle air flow.

6. Reassemble and test unit.

7. Document this function in the maintenance records developed for your region.

H. Quad Ring Service

1. Remove OVA guts from protective shell.

2. Remove clip ring from bottom of valve.

3. Unscrew nut from top of valve.

4. Gently pull valve shaft upward and free of housing.

5. Observe rings for signs of damage. Replace if necessary.

6. Lightly grease rings with silicone grease.

7. Reassemble valve. Do not pinch rings during shaft insertion.

8. Document this function in the maintenance records developed for your region.

I. Trouble Shooting

Indication	Possible Causes
High Background Reading (More Than 10 ppm)	Contaminated Hydrogen Contaminated Sample Line
Continual Flameout Dirty Burner Chamber Dirty Air Filters	Hydrogen Leak
Low Air Flow Pump Malfunction Line Obstruction	Dirty Air Filter
Flame Will Not Light Ignitor Broken Hydrogen Leak Dirty Burner Chamber Air Flow Restricted	Low Battery
No Power to Pump Short Circuit	Low Battery
Hydrogen Leak (Instrument Not in Use)	Leak in Regulator Leak in Valves

J. Shipping

Since the OVA-128 contains hydrogen, it is subject to shipping restrictions.

1. As Personal Luggage

   The OVA-128 can be taken on a plane as luggage as a permit has been issued from the Department of Transportation to the manufacturer (Foxboro).

2. Federal Express

   The following labels must be affixed to both sides of the OVA case when snipping OVA by Federal Express.

   Danger - Peligro
   Flammable Gas
   Inside Container Complies with DOT regulations
   Hydrogen UN #1049
   Name and Address of Recipient

A hazardous air bill must be filled out. The following information is requested.

Proper Shipping Name	Hydrogen
Classification	Flammable Gas
ID# UN 1049	
Net Quantity 75 Cubic Centimeters	

In addition, the shipping's certification must be signed and marked Cargo Aircraft Only.

K. Hydrogen Recharging

1. High-grade hydrogen (99.9996) is required.

2. Connect the fill hose to the REFILL FITTING on the side Pack Assembly, with the FILL/BLEED valve in the OFF position.

3. Open H_2 supply bottle valve.

4. Place FILL/BLEED Valve on fill hose in BLEED position momentarily to purge any air out of the system.

5. Crack the instrument TANK and SUPPLY VALVE.

6. Open REFILL Valve on instrument.

7. Place FILL/BLEED Valve in FILL position until the instrument PRESSURE GAUGE equalize with the H_2 SUPPLY BOTTLE PRESSURE GAUGE.

8. Shut REFILL Valve, FILL/BLEED Valve, and H_2 SUPPLY BOTTLE Valve, in quick succession.

9. Turn FILL/BLEED Valve to BLEED until hose pressure equalizes to atmospheric pressure.

10. Turn FILL/BLEED Valve to FILL position, then to the BLEED position, then to OFF.

11. Close TANK and SUPPLY VALVE on instrument.

12. Disconnect the FILL HOSE and replace protective nut on the REFILL FITTING.

L. Particle Filter Servicing

There are two points in the air sampling line of the OVA where filters have been placed to keep particulates from entering the

instrument. The location of these filters are indicated on the attached figure. The first filter is located in the probe assembly, and the second filter (primary filter) is located on the side pack assembly. Cleaning procedures are as follows:

1. Detach the probe assembly from the readout assembly.

2. Disassemble the probe (the components unscrew).

3. The particle filter located within the probe can be cleaned by blowing air through the filter.

4. Reassemble the probe.

5. The primary filter, located behind the sample inlet connector on the side pack assembly is accessed by removing the sample inlet connector with a thin-walled 7/16" socket wrench. Remove the filter and clean as above.

6. Reassemble the sample inlet fitting and filter to the side pack assembly.

7. Check sample flow rate.

INDUSTRIAL HYGIENE SAMPLING WORKSHEET

Client: _____ Date: _____ Job No: _____

Location: _____ Temp: _____ Pres: _____

Employee/SSN: _____ %RH: _____ Rotameter: _____

Job Title: _____ Sampled by: _____

Contaminants: _____

Sample No.	Collector	Pump	flowrate	on	off	time (min)	Vol (L)	Conditions

Operation Sampled: _____

Analytical method: _____ Interferences Present: _____

Ventilation, personal protective equipment, observations: _____

INDUSTRIAL HYGIENE INSTRUMENT SURVEY AND CALIBRATION LOG

Project Name:	Project No.:
Survey/Operation Description:	
Survey Location:	

CALIBRATION		INSTRUMENT		CALIBRATION		INSTRUMENT RESPONSE		
DATE	TIME	NAME	ID No.	GAS	SPAN	METER	SPAN	COMMENTS

FIELD DATA/INSTRUMENT READINGS				FIELD DATA/INSTRUMENT READINGS			
DATE	TIME	READING	LOCATION/COMMENTS	DATE	TIME	READING	LOCATION/COMMENTS

Surveyor's Name:	Signature/Date:

APPENDIX D

SUPERVISOR'S EMPLOYEE INJURY REPORT

INTERNATIONAL TECHNOLOGY CORPORATION

SUPERVISOR'S EMPLOYEE INJURY REPORT

This is an official document to be initiated by the employee's supervisor. Please answer all questions completely. This report must be forwarded to the employee's Regional Health and Safety office within 24 hours of the injury.

Injured's Name _____ Sex ____ S.S. No. _____ Birthdate _____

Home Address _____ City _____ State _____ Zip _____ Phone _____

Job title _____ Employee's P.C. _____ Hire date _____ Hourly wage _____

SUPERVISOR

Date of incident _____ Time _____ Time reported _____ To whom? _____

Client name _____ Client address _____ Time shift began _____

Exact location of incident _____ Did employee leave work? ☐ No ☐ Yes When _____

Has employee returned to work? ☐ No ☐ Yes When _____ Did employee miss a regularly scheduled shift? ☐ No ☐ Yes

Doctor/Hospital name _____ Address _____

Witness name(s) _____ Statements attached? ☐ No ☐ Yes

Nature of injury _____ Exact body part _____

Medical attention: ☐ None ☐ First aid on site ☐ Doctor's office ☐ Hospital ER ☐ Hospitalized

Job assignment at time of incident _____ Job: _____ Phase: _____ Task: _____ Subtask: _____

Describe incident _____

What unsafe physical condition or unsafe act caused the incident? _____

What corrective action has been taken to prevent recurrence? _____

Supervisor/Foreman _____ (Print) _____ Signature _____ Date

MANAGER

Comments on incident and corrective action _____

Manager's name _____ (Print) _____ Signature _____ Date

HEALTH AND SAFETY

Concur with action taken? ☐ No ☐ Yes Remarks _____

OSHA Classification:

☐ Incident only ☐ First aid ☐ No lost workdays ☐ Lost workdays ☐ Restricted activity ☐ Fatality

Days away from work _____ Days restricted work _____ Total days charged _____

☐ State jurisdiction ☐ Federal L&H ☐ Date ER submitted _____ Which claims office _____

Coding: A. Injury type or illness _____ B. Injured body parts _____ C. Activity at time of accident _____ D. Injury cause code _____

E. Agent code _____ F. Safety rule violated code _____ G. Accident prevention code _____

Name _____ (Print) _____ Signature _____ Date

ITC FORM 9300.1-1 (07/86)
Refer to ITC PRO 9300.1 for reporting procedures

White: Corporate Health and Safety Yellow: Regional Health and Safety Pink: Profit/Cost Center

80A-9-85

(For Safety Staff only)	REPORT NO	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT (For Use of this Form See Attached Instructions and USACE Suppl to AR 385-40)	REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)

1 ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE	MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER		☐	

2 PERSONAL DATA

a NAME (Last,First,MI)	b AGE	c. SEX ☐ MALE ☐ FEMALE	d SOCIAL SECURITY NUMBER	e. GRADE

f JOB SERIES/TITLE	g DUTY STATUS AT TIME OF ACCIDENT	h EMPLOYMENT STATUS AT TIME OF ACCIDENT
	☐ ON DUTY ☐ TDY ☐ OFF DUTY	☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER ☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL ☐ TEMPORARY ☐ STUDENT ☐ OTHER (Specify)

3 GENERAL INFORMATION

a. DATE OF ACCIDENT (month/day/year)	b. TIME OF ACCIDENT (Military time))	c EXACT LOCATION OF ACCIDENT	d CONTRACTOR'S NAME (1) PRIME (2) SUBCONTRACTOR
/ /			

e CONTRACT NUMBER	f. TYPE OF CONTRACT	g HAZARDOUS/TOXIC WASTE ACTIVITY
☐ CIVIL WORKS ☐ MILITARY ☐ OTHER (Specify)	☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER (Specify)	☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER (Specify)

4 CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see instructions)*

a CONSTRUCTION ACTIVITY	(CODE)	b TYPE OF CONSTRUCTION EQUIPMENT	(CODE)

INJURY / ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see instructions)*

a. SEVERITY OF ILLNESS / INJURY	(CODE)	b. ESTIMATED DAYS LOST	c. ESTIMATED DAYS HOSPITALIZED	d. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED	(CODE)	g TYPE AND SOURCE OF INJURY/ILLNESS	(CODE)
PRIMARY		TYPE	
SECONDARY		SOURCE	
f. NATURE OF ILLNESS / INJURY			

6 PUBLIC FATALITY *(Fill in line and corresponding code number in box - see instructions)*

a ACTIVITY AT TIME OF ACCIDENT	(CODE)	b PERSONAL FLOATATION DEVICE USED?
		☐ YES ☐ NO ☐ N/A

7 MOTOR VEHICLE ACCIDENT

a TYPE OF VEHICLE	b TYPE OF COLLISION	c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
☐ PICKUP/VAN ☐ AUTOMOBILE ☐ TRUCK ☐ OTHER (Specify)	☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END ☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER (Specify)	(1) FRONT SEAT			
		(2) REAR SEAT			

8 PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	b OWNERSHIP	c. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9 VESSEL / FLOATING PLANT ACCIDENT *(Fill in line and corresponding code number in box from list - see instructions)*

a TYPE OF VESSEL/FLOATING PLANT	(CODE)	b TYPE OF COLLISON/MISHAP	(CODE)

10 ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

11 **CAUSAL FACTOR(S)** *(Read Instruction Before Completing)*

a *(Explain YES answers in item 13)*

	YES	NO
DESIGN Was design of facility,workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES Were operating procedures a factor?	☐	☐
JOB PRACTICES Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS. Did any human factors such as, size or strength of person, etc.,contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐

a *(CONTINUED)*

	YES	NO
CHEMICAL AND PHYSICAL AGENT FACTORS Did exposure to chemical agents, such as dust,fumes,mists,vapors or physical agents, such as, noise,radiation,etc.,contribute to accident?	☐	☐
OFFICE FACTORS Did office setting such as, lifting office furniture,carrying,stooping,etc.,contribute to the accident?	☐	☐
SUPPORT FACTORS Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL. In your opinion,was drugs or alcohol a factor to the accident?	☐	☐

b WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES *(If yes, attach a copy)* ☐ NO

12 **TRAINING**

a WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING	c DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	/ / *(Month) (Day) (Year)*

13 **FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES** *(See instruction for definition of direct and indirect causes) (Use additional paper, if necessary)*

a DIRECT CAUSE

b INDIRECT CAUSE(S)

14 **ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).**

DESCRIBE FULLY

15 **DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.**

a BEGINNING *(Month/Day/Year)* / /	b ANTICIPATED COMPLETION *(Month/Day/Year)* / /		
c SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT CORPS CONTRACTOR	d DATE *(Mo/Da/Yr)* / / / /	e ORGANIZATION IDENTIFIER *(Div. Br. Sect)*	f. OFFICE SYMBOL

16 **MANAGEMENT REVIEW** *(1st).*

a ☐ CONCUR b ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17 **MANAGEMENT REVIEW** *(2nd - Chief Operations, Construction, Engineering, etc.)*

a ☐ CONCUR b ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18 **SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW**

a ☐ CONCUR b ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19 **COMMAND APPROVAL**

COMMENTS

COMMANDER SIGNATURE	DATE

☆ U S G P O 1989- 626-113

GENERAL. Complete a separate report for each person who was *injured, caused,* or *contributed* to the accident (excluding uninjured personnel and witnesses). Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs (OWCP) shall be at the descretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es). If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16. and 17.

INSTRUCTIONS FOR SECTION 1 — ACCIDENT CLASSIFICATION. *(Mark All Boxes That Are Applicable.)*

a. GOVERNMENT. Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.

(1) INJURY/ILLNESS/FATALITY — Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 (injury), CA-2 (illness), or CA-6 (fatality) to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.

(2) PROPERTY DAMAGE — Mark the appropriate box if accident resulted in any damage of $1000 or more to government property (including motor vehicles).

(3) VEHICLE INVOLVED — Mark if accident involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY — Mark if the accident involved an in-house USACE diving activity.

b. CONTRACTOR.

(1) INJURY/ILLNESS/FATALITY — Mark if accident resulted in any contractor lost-time injury/illness or fatality.

(2) PROPERTY DAMAGE — Mark the appropriate box if accident resulted in any damage of $1000 or more to contractor property (including motor vehicles).

(3) VEHICLE INVOLVED — Mark if accident involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY — Mark if the accident involved a USACE Contractor diving activity.

c. PUBLIC.

(1) INJURY/ILLNESS/FATALITY — Mark if accident resulted in public fatality or permanent total disability. (The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander).

(2) VOID SPACE — Make no entry.

(3) VEHICLE INVOLVED — Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, *regardless* of whether "INJURY/ILLNESS/FATALITY" is marked.

(4) VOID SPACE — Make no entry.

INSTRUCTIONS FOR SECTION 2 — PERSONAL DATA

a. NAME — (MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS). Enter last name, first name, middle initial of person involved.

b. AGE — Enter age.

c. SEX — Mark appropriate box.

d. SOCIAL SECURITY NUMBER — (FOR GOVERNMENT PERSONNEL ONLY) Enter the social security number (or other personal identification number if no social security number issued).

e. GRADE — (FOR GOVERNMENT PERSONNEL ONLY) Enter pay grade. Example: O-6; E-7; WG-8; WS-12; GS-11; etc.

f. JOB SERIES/TITLE — For *government civilian employees* enter the pay plan, full series number, and job title, e.g. GS-0810/Civil Engineer. For *military personnel* enter the primary military occupational specialty (PMOS), e.g., 15A30 or 11G50. For *contractor employees* enter the job title assigned to the injured person, e.g. carpenter, laborer, surveyor, etc.,

g. DUTY STATUS — Mark the appropriate box.

(1) ON DUTY — Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.

(2) TDY - Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.

(3) OFF DUTY - Person was not on official business at time of accident

h. EMPLOYMENT STATUS — (FOR GOVERNMENT PERSONNEL ONLY) Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3 — GENERAL INFORMATION

a. DATE OF ACCIDENT — Enter the month, day, and year of accident.

b. TIME OF ACCIDENT — Enter the local time of accident in military time. Example: 1430 hrs (not 2:30 p.m.).

c. EXACT LOCATION OF ACCIDENT — Enter facts needed to locate the accident scene. (installation/project name, building number, street, direction and distance from closest landmark, etc.,).

d. CONTRACTOR NAME

(1) PRIME — Enter the exact name (title of firm) of the prime contractor.

(2) SUBCONTRACTOR — Enter the name of any subcontractor involved in the accident.

e. CONTRACT NUMBER — Mark the appropriate box to identify if contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.

f. TYPE OF CONTRACT — Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.

g. HAZARDOUS/TOXIC WASTE ACTIVITY (HTW) — Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program (IRP) HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site (FUDS) activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4 — CONSTRUCTION ACTIVITIES

a. CONSTRUCTION ACTIVITY — Select the *most appropriate* construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

1. MOBILIZATION
2. SITE PREPARATION
3. EXCAVATION/TRENCHING
4. GRADING (EARTHWORK)
5. PIPING/UTILITIES
6. FOUNDATION
7. FORMING
8. CONCRETE PLACEMENT
9. STEEL ERECTION
10. ROOFING
11. FRAMING
12. MASONRY
13. CARPENTRY
14. ELECTRICAL
15. SCAFFOLDING/ACCESS
16. MECHANICAL
17. PAINTING
18. EQUIPMENT/MAINTENANCE
19. TUNNELING
20. WAREHOUSING/STORAGE
21. PAVING
22. FENCING
23. SIGNING
24. LANDSCAPING/IRRIGATION
25. INSULATION
26. DEMOLITION

b. TYPE OF CONSTRUCTION EQUIPMENT—Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

1. GRADER
2. DRAGLINE
3. CRANE (ON VESSEL/BARGE)
4. CRANE (TRACKED)
5. CRANE (RUBBER TIRE)
6. CRANE (VEHICLE MOUNTED)
7. CRANE (TOWER)
8. SHOVEL
9. SCRAPER
10. PUMP TRUCK (CONCRETE)
11. TRUCK (CONCRETE/TRANSIT MIXER)
12. DUMP TRUCK (HIGHWAY)
13. DUMP TRUCK (OFF HIGHWAY)
14. TRUCK (OTHER)
15. FORKLIFT
16. BACKHOE
17. FRONT-END LOADER
18. PILE DRIVER
19. TRACTOR (UTILITY)
20. MANLIFT
21. DOZER
22. DRILL RIG
23. COMPACTOR/VIBRATORY ROLLER
24. OTHER

INSTRUCTIONS FOR SECTION 5—INJURY/ILLNESS INFORMATION

a. SEVERITY OF INJURY / ILLNESS - Reference para 2-10 of USACE Suppl 1 to AR 385-40 and enter code and description from list below.

NOI NO INJURY
FAT FATALITY
PTL PERMANENT TOTAL DISABILITY
PPR PERMANENT PARTIAL DISABILITY
LWD LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
NLW RECORDABLE CASE WITHOUT LOST WORKDAYS
RFA RECORDABLE FIRST AID CASE
NRI NON-RECORDABLE INJURY

b. ESTIMATED DAYS LOST—Enter the estimated number of workdays the person will lose from work.

c. ESTIMATED DAYS HOSPITALIZED—Enter the estimated number of workdays the person will be hospitalized.

d. ESTIMATED DAYS RESTRICTED DUTY—Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

e. BODY PART AFFECTED—Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	CODE	BODY PART NAME
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH
	CN	NOSE
	CR	THROAT, OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EB	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER
HEAD, EXTERNAL	H1	EYE EXTERNAL
	H2	BOTH EYES EXTERNAL
	H3	EAR EXTERNAL
	H4	BOTH EARS EXTERNAL
	HC	CHIN
	HF	FACE
	HK	NECK/THROAT
	HM	MOUTH/LIPS
	HN	NOSE
	HS	SCALP
KNEE	KB	BOTH KNEES
	KS	KNEE
LEG, HIP, ANKLE, BUTTOCK	LB	BOTH LEGS/HIPS/ ANKLES/BUTTOCKS
	LS	SINGLE LEG/HIP ANKLE/BUTTOCK
HAND	MB	BOTH HANDS
	MS	SINGLE HAND
FOOT	PB	BOTH FEET
	PS	SINGLE FOOT
TRUNK, BONES	R1	SINGLE COLLAR BONE
	R2	BOTH COLLAR BONES
	R3	SHOULDER BLADE
	R4	BOTH SHOULDER BLADES
	RB	RIB
	RS	STERNUM (BREAST BONE)
	RV	VERTEBRAE (SPINE; DISC)
	RZ	TRUNK BONES OTHER
SHOULDER	SB	BOTH SHOULDERS
	SS	SINGLE SHOULDER
THUMB	TB	BOTH THUMBS
	TS	SINGLE THUMB
TRUNK, INTERNAL ORGANS	V1	LUNG, SINGLE
	V2	LUNGS, BOTH
	V3	KIDNEY, SINGLE
	V4	KIDNEYS, BOTH
	VH	HEART
	VL	LIVER
	VR	REPRODUCTIVE ORGANS
	VS	STOMACH
	VV	INTESTINES
	VZ	TRUNK, INTERNAL; OTHER

f. NATURE OF INJURY/ILLNESS - Select the most appropriate nature of injury / illness from the list below. This nature of injury / illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury / illness name on the line and place the corresponding CODE letters in the box provided.

CODE	SOURCE OF INJURY NAME
0200	ENVIRONMENTAL CONDITION
0210	TEMPERATURE EXTREME (INDOOR)
0220	WEATHER (ICE, RAIN, HEAT, ETC.)
0230	FIRE, FLAME, SMOKE (NOT TOBACCO)
0240	NOISE
0250	RADIATION
0260	LIGHT
0270	VENTILATION
0271	TOBACCO SMOKE
0280	STRESS (EMOTIONAL)
0290	CONFINED SPACE
0300	MACHINE OR TOOL
0310	HAND TOOL (POWERED: SAW, GRINDER, ETC.)
0320	HAND TOOL (NONPOWERED)
0330	MECHANICAL POWER TRANSMISSION APPARATUS
0340	GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK)
0350	VIDEO DISPLAY TERMINAL
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL
0370	HEATING EQUIPMENT
0380	WELDING EQUIPMENT
0400	VEHICLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE
0421	DRIVER OF GOVERNMENT VEHICLE
0422	PASSENGER OF GOVERNMENT VEHICLE
0430	COMMON CARRIER (AIRLINE, BUS, ETC.)
0440	AIRCRAFT (NOT COMMERCIAL)
0450	BOAT, SHIP, BARGE
0500	MATERIAL HANDLING EQUIPMENT
0510	EARTHMOVER (TRACTOR, BACKHOE, ETC.)
0520	CONVEYOR (FOR MATERIAL AND EQUIPMENT)
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST
0540	HOIST, SLING CHAIN, JACK
0550	CRANE
0551	FORKLIFT
0560	HANDTRUCK, DOLLY
0600	DUST, VAPOR, ETC.
0610	DUST (SILICA, COAL, ETC.)
0620	FIBERS
0621	ASBESTOS
0630	GASES
0631	CARBON MONOXIDE
0640	MIST, STEAM, VAPOR, FUME
0641	WELDING FUMES
0650	PARTICLES (UNIDENTIFIED)
0700	CHEMICAL, PLASTIC, ETC.
0711	DRY CHEMICAL—CORROSIVE
0712	DRY CHEMICAL—TOXIC
0713	DRY CHEMICAL—EXPLOSIVE
0714	DRY CHEMICAL—FLAMMABLE
0721	LIQUID CHEMICAL—CORROSIVE
0722	LIQUID CHEMICAL—TOXIC
0723	LIQUID CHEMICAL—EXPLOSIVE
0724	LIQUID CHEMICAL—FLAMMABLE
0730	PLASTIC
0740	WATER
0750	MEDICINE
0800	INANIMATE OBJECT
0810	BOX, BARREL, ETC.
0820	PAPER
0830	METAL ITEM, MINERAL
0831	NEEDLE
0840	GLASS
0850	SCRAP, TRASH
0860	WOOD
0870	FOOD
0880	CLOTHING, APPAREL, SHOES
0900	ANIMATE OBJECT
0911	DOG
0912	OTHER ANIMAL
0920	PLANT
0930	INSECT
0940	HUMAN (VIOLENCE)
0950	HUMAN (COMMUNICABLE DISEASE)
0960	BACTERIA, VIRUS (NOT HUMAN CONTACT)

CODE	SOURCE OF INJURY NAME
1000	PERSONAL PROTECTIVE EQUIPMENT
1010	PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES
1020	RESPIRATOR, MASK
1021	DIVING EQUIPMENT
1030	SAFETY BELT, HARNESS
1040	PARACHUTE

INSTRUCTIONS FOR SECTION 6 — PUBLIC FATALITY

a. ACTIVITY AT TIME OF ACCIDENT—Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the *most* appropriate primary activity area (water related, non-water related or other activity), the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

1. Sailing
2. Boating—powered
3. Boating—unpowered
4. Water skiing
5. Fishing from boat
6. Fishing from bank dock or pier
7. Fishing while wading
8. Swimming/supervised area
9. Swimming/designated area
10. Swimming/other area
11. Underwater activities (skin diving, scuba, etc.)
12. Wading
13. Attempted rescue
14. Hunting from boat
15. Other

NON-WATER RELATED RECREATION

16. Hiking and walking
17. Climbing (general)
18. Camping/picnicking authorized area
19. Camping/picnicking unauthorized area
20. Guided tours
21. Hunting
22. Playground equipment
23. Sports/summer (baseball, football, etc.)
24. Sports/winter (skiing, sledding, snowmobiling etc.)
25. Cycling (bicycle, motorcycle, scooter)
26. Gliding
27. Parachuting
28. Other non-water related

OTHER ACTIVITIES

29. Unlawful acts (fights, riots, vandalism, etc.)
30. Food preparation/serving
31. Food consumption
32. Housekeeping
33. Sleeping
34. Pedestrian struck by vehicle
35. Pedestrian other acts
36. Suicide
37. "Other" activities

b. PERSONAL FLOTATION DEVICE USED—If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7—MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE—Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

b. TYPE OF COLLISION—Mark appropriate box.

c. SEAT BELT—Mark appropriate box.

INSTRUCTIONS FOR SECTION 8—PROPERTY/ MATERIAL INVOLVED

a. NAME OF ITEM—Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number (NSN) whenever applicable.

b. OWNERSHIP—Enter ownership for each item listed. (Enter one of the following: *USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE)*

c. $ AMOUNT OF DAMAGE—Enter the total estimated dollar amount of damage (parts and labor), if any.

* The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
*TRAUMATIC INJURY OR DISABILITY	TA	AMPUTATION
	TB	BACK STRAIN.
	TC	CONTUSION. BRUISE. ABRASION
	TD	DISLOCATION
	TF	FRACTURE
	TH	HERNIA
	TK	CONCUSSION
	TL	LACERATION. CUT
	TP	PUNCTURE
	TS	STRAIN. MULTIPLE
	TU	BURN. SCALD. SUNBURN
	TI	TRAUMATIC SKIN DISEASES/ CONDITIONS INCLUDING DERMATITIS
	TR	TRAUMATIC RESPIRATORY DISEASE
	TQ	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL/ INFECTIVE/PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER. STRESS: NERVOUS CONDITION
	T8	TRAUMATIC INJURY — OTHER (EXCEPT DISEASE. ILLNESS)

**A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins. poisons. fumes. etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes. an occupational illness/disease or disability is any reported condition which doses not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
**NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	R9	RESPIRATORY DISEASE. OTHER
VIROLOGICAL. INFECTIVE & PARASITIC DISEASES	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC — OTHER
DISABILITY. OCCUPATIONAL	DA	ARTHRITIS. BURSITIS
	DB	BACK STRAIN. BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION: STROKE
	DD	ENDEMIC DISEASE (OTHER THAN CODE TYPES R&S)
	DE	EFFECT OF ENVIRONMENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER. EMOTIONAL STRESS NERVOUS CONDITION
	DR	RADIATION
	DS	STRAIN. MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY. OTHER
SKIN DISEASE OR CONDITION	SB	BIOLOGICAL
	SC	CHEMICAL
	S9	DERMATITIS. UNCLASSIFIED

g. TYPE AND SOURCE OF INJURY/ILLNESS (CAUSE) - Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident (see example 1, below). Examples

(1) An employee tripped on carpet and struck his head on a desk.
TYPE: 210 (fell on same level) SOURCE: 0110 (walking/working surface)

NOTE. This example would NOT be coded 120 (struck against) and 0140 (furniture).

(2) A Park Ranger contracted dermatitis from contact with poison ivy/ oak.
TYPE: 510 (contact) SOURCE: 0920 (plant)

(3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.
TYPE: 410 (punctured by) SOURCE: 0830 (metal)

(4) An employee was driving a government vehicle when it was struck by another vehicle..
TYPE: 800 (traveling in) SOURCE: 0421 (government-owned vehicle, as driver)

NOTE: The Type Code 800. "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality. but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	TYPE OF INJURY NAME
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL. SLIPPED. TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED. TRIPPED (NO FALL)
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED. LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH (INJURED PERSON MOVING)
0520	CONTACTED BY (OBJECT WAS MOVING)
	EXERTED
0610	LIFTED. STRAINED BY (SINGLE ACTION)
0620	STRESSED BY (REPEATED ACTION)
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN

CODE	SOURCE OF INJURY NAME
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE (FLOOR. STREET. SIDEWALKS. ETC)
0120	STAIRS. STEPS
0130	LADDER
0140	FURNITURE. FURNISHINGS. OFFICE EQUIPMENT
0150	BOILER. PRESSURE VESSEL
0160	EQUIPMENT LAYOUT (ERGONOMIC)
0170	WINDOWS. DOORS
0180	ELECTRICITY

INSTRUCTIONS FOR SECTION 9—VESSEL/ FLOATING PLANT ACCIDENT

a. TYPE OF VESSEL/FLOATING PLANT—Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel/ floating plant.

VESSEL/FLOATING PLANTS

1. ROW BOAT
2. SAIL BOAT
3. MOTOR BOAT
4. BARGE
5. DREDGE/HOPPER
6. DREDGE/SIDE CASTING
7. DREDGE/DIPPER
8. DREDGE/CLAMSHELL, BUCKET
9. DREDGE/PIPE LINE
10. DREDGE/DUST PAN
11. TUG BOAT
12. OTHER

b. COLLISION/MISHAP—Select from the list below the object(s) that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

1. COLLISION W/OTHER VESSEL
2. UPPER GUIDE WALL
3. UPPER LOCK GATES
4. LOCK WALL
5. LOWER LOCK GATES
6. LOWER GUIDE WALL
7. HAULAGE UNIT
8. BREAKING TOW
9. TOW BREAKING UP
10. SWEPT DOWN ON DAM
11. BUOY/DOLPHIN/CELL
12. WHARF OR DOCK
13. OTHER

INSTRUCTIONS FOR SECTION 10—ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT—Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11—CAUSAL FACTORS

a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

(1) DESIGN—Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?

(2) INSPECTION/MAINTENANCE—Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?

(3) PERSON'S PHYSICAL CONDITION—Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?

(4) OPERATING PROCEDURES—Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?

(5) JOB PRACTICES—Were any of the provisions of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?

(6) HUMAN FACTORS—Was the person under undue stress (either internal or external to the job)? Did the task tend toward overloading the capabilities of the person: i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

(7) ENVIRONMENTAL FACTORS—Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

(8) CHEMICAL AND PHYSICAL AGENT FACTORS—Did exposure to chemical agents (either single shift exposure or long-term exposure) such as dusts, fibers (asbestos, etc.), silica, gases (carbon monoxide, chlorine, etc..), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, by-products of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?

(9) OFFICE FACTORS—Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

(10) SUPPORT FACTORS—Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc?

(11) PERSONAL PROTECTIVE EQUIPMENT—Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc.) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?

(12) DRUGS/ALCOHOL—Is there any reason to believe the person's mental or physical capabilities, judgement, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

b. WRITTEN JOB/ACTIVITY HAZARD ANALYSIS—Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. *If one was performed, attach a copy of the analysis to the report.*

INSTRUCTIONS FOR SECTION 12—TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?—For the purpose of this section "trained" means the person has been provided the necessary information (either formal and/or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.

b. TYPE OF TRAINING—Mark the appropriate box that best indicates the type of training: (classroom or on-the-job) that the injured person received before the accident happened.

c. DATE OF MOST RECENT TRAINING—Enter the month, day, and year of the last *formal* training completed that covered the activity-task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13—CAUSES

a. DIRECT CAUSES—The direct cause is that single factor which most directly lead to the accident. See examples below.

b. INDIRECT CAUSES—Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.
Direct cause: failure to provide fall protection at elevation.
Indirect causes: failure to enforce USACE safety requirements: improper training/motivation of employee (possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. (note USACE vehicle was in proper/safe working condition).
Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.
Indirect cause: Failure of employee to pay attention to driving (defensive driving).

INSTRUCTIONS FOR SECTION 14—ACTION TO ELIMINATE CAUSE(S)

DESCRIPTION—Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15—DATES FOR ACTION

a. BEGIN DATE—Enter the date when the corrective action(s) identified in Section 14 will begin.

b. COMPLETE DATE—Enter the date when the corrective action(s) identified in Section 14 will be completed.

c. TITLE AND SIGNATURE—Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE Supervisor shall also sign the report. Upon entering the information required in 15.d, 15.e and 15.f below, the responsible USACE supervisor shall forward the report for management review as indicated in Section 16.

d. DATE SIGNED—Enter the month, day, and year that the report was signed by the responsible supervisor.

e. ORGANIZATION NAME—For GOVERNMENT employee accidents enter the USACE organization name (Division, Branch, Section, etc.) of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15.c. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

f. OFFICE SYMBOL—Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15.e.

INSTRUCTIONS FOR SECTION 16—MANAGEMENT REVIEW (1st)

1ST REVIEW—Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15.c shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief (2nd review) for review and comment.

INSTRUCTIONS FOR SECTION 17—MANAGEMENT REVIEW (2nd)

2ND REVIEW—The FOA Staff Chief (i.e., FOA Chief of Construction, Operations, Engineering, Planning, etc.) shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18—SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW—The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc. are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19—COMMAND APPROVAL

4TH REVIEW—The FOA Commander shall (to include the person designated Acting Commander in his absence) review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.

Bureau of Labor Statistics
Log and Summary of Occupational Injuries and Illnesses

U.S. Department of Labor

For Calendar Year 19 _____ Page ____ of ____

Form Approved O.M.B. No. 44R 1453

NOTE: This form is required by Public Law 91-596 and must be kept in the establishment for 5 years. Failure to maintain and post can result in the issuance of citations and assessment of penalties. *(See posting requirements on the other side of form.)*

RECORDABLE CASES: You are required to record information about every occupational death, every nonfatal occupational illness, and those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid). *(See definitions on the other side of form.)*

Company Name

Establishment Name

Establishment Address

Case or File Number	Date of Injury or Onset of Illness	Employee's Name	Occupation	Department	Description of Injury or Illness	Extent of and Outcome of INJURY: Fatalities	Nonfatal Injuries: Injury Related	Injuries With Lost Workdays				Injuries Without Lost Workdays	Type, Extent of, and Outcome of ILLNESS: Type of Illness							Fatalities	Nonfatal Illnesses				Illnesses Without Lost Workdays
													CHECK Only One Column for Each Illness *(See other side of form for terminations or permanent transfers.)*								Illnesses With Lost Workdays				
Enter a nondupli-cating number which will facilitate com-parisons with supple-mentary records.	Enter Mo./day.	Enter first name or initial, middle initial, last name.	Enter regular job title, not activity employee was per-forming when injured or at onset of illness. In the absence of a formal title, enter a brief description of the employee's duties.	Enter department in which the employee is regularly employed or a description of normal workplace to which employee is assigned, even though temporarily working in another depart-ment at the time of injury or illness.	Enter a brief description of the injury or illness and indicate the part or parts of body affected. Typical entries for this column might be Amputation of 1st joint right forefinger, Strain of lower back, Contact dermatitis on both hands, Electrocution-body.	Enter DATE of death.	Enter a CHECK if injury involves days away from work, or days of restricted work activity, or both	Enter a CHECK if injury involves days away from work.	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in col-umns 1 or 2 but the injury is recordable as defined above	Occupational skin diseases or disorders	Dust diseases of the lungs	Respiratory conditions due to toxic agents	Poisoning (systemic ef-fects of toxic materials)	Disorders due to physical agents	Disorders associated with repeated trauma	All other occupa-tional illnesses	Enter DATE of death.	Enter a CHECK if illness involves days away from work, or days of restricted work activity, or both.	Enter a CHECK if illness involves days away from work.	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in col-umns 8 or 9.
						Mo./day/yr.	(1)	(2)	(3)	(4)	(5)	(6)	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(8)	(9)	(10)	(11)	(12)	(13)
(A)	(B)	(C)	(D)	(E)	(F)								(7)												
					Page totals ⟶																				
					TOTALS (subtract last page totals from all other totals) ⟶																				

INJURIES

ILLNESSES

Certification of Annual Summary Totals By _____ Title _____ Date _____

OSHA No. 200

FOLD

OSHA No 200

POST ONLY THIS PORTION OF THE LAST PAGE NO LATER THAN FEBRUARY 1.

I. Log and Summary of Occupational Injuries and Illnesses

Each employer who is subject to the recordkeeping requirements of the Occupational Safety and Health Act of 1970 must maintain for each establishment a log of all recordable occupational injuries and illnesses. This form (OSHA No. 200) may be used for that purpose. A substitute for the OSHA No. 200 is acceptable if it is as detailed, easily readable, and understandable as the OSHA No. 200.

Enter each recordable case on the log within six (6) workdays after learning of its occurrence. Although other records must be maintained at the establishment to which they refer, it is possible to prepare and maintain the log at another location, using data processing equipment if desired. If the log is prepared elsewhere, a copy updated to within 45 calendar days must be present at all times in the establishment.

Logs must be maintained and retained for five (5) years following the end of the calendar year to which they relate. Logs must be available (normally at the establishment) for inspection and copying by representatives of the Department of Labor, or the Department of Health, Education and Welfare, or States accorded jurisdiction under the Act.

II. Changes in Extent of or Outcome of Injury or Illness

If, during the 5-year period the log must be retained, there is a change in an extent and outcome of an injury or illness which affects entries in columns 1, 2, 6, 8, 9, or 13, the first entry should be lined out and a new entry made. For example, if an injured employee at first required only medical treatment but later lost workdays away from work, the check in column 6 should be lined out, and checks entered in columns 2 and 3 and the number of lost workdays entered in column 4.

In another example, if an employee with an occupational illness lost workdays, returned to work, and then died of the illness, the entries in columns 9 and 10 should be lined out and the date of death entered in column 8.

The entire entry for an injury or illness should be lined out if later found to be nonrecordable. For example: an injury or illness which is later determined not to be work related, or which was initially thought to involve medical treatment but later was determined to have involved only first aid.

III. Posting Requirements

A copy of the totals and information following the fold line of the last page for the year must be posted at each establishment in the place or places where notices to employees are customarily posted. This copy must be posted no later than *February 1 and must remain in place until March 1.*

Even though there were no injuries or illnesses during the year, zeros must be entered on the totals line, and the form posted.

The person responsible for the *annual summary totals* shall certify that the totals are true and complete by signing at the bottom of the form.

IV. Instructions for Completing Log and Summary of Occupational Injuries and Illnesses

Column A — CASE OR FILE NUMBER. Self-explanatory.

Column B — DATE OF INJURY OR ONSET OF ILLNESS.
For occupational injuries, enter the date of the work accident which resulted in injury. For occupational illnesses, enter the date of initial *diagnosis* of illness, or, if absence from work occurred before diagnosis, enter the first day of the absence attributable to the illness which was later diagnosed or recognized.

Columns C through F — Self-explanatory.

Columns 1 and 8 — INJURY OR ILLNESS RELATED DEATHS.
Self-explanatory.

Columns 2 and 9 — INJURIES OR ILLNESSES WITH LOST WORKDAYS.
Self-explanatory.

Any injury which involves days away from work, or days of restricted work activity, or both must be recorded since it always involves one or more of the criteria for recordability.

Columns 3 and 10 — INJURIES OR ILLNESSES INVOLVING DAYS AWAY FROM WORK. Self-explanatory.

Columns 4 and 11 — LOST WORKDAYS—DAYS AWAY FROM WORK.
Enter the number of workdays (consecutive or not) on which the employee would have worked but could not because of occupational injury or illness. The number of lost workdays should not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.
NOTE: For employees not having a regularly scheduled shift, such as certain truck drivers, construction workers, farm labor, casual labor, part-time employees, etc., it may be necessary to estimate the number of lost workdays. Estimates of lost workdays shall be based on prior work history of the employee AND days worked by employees, not ill or injured, working in the department and/or occupation of the ill or injured employee.

Columns 5 and 12 — LOST WORKDAYS—DAYS OF RESTRICTED WORK ACTIVITY.
Enter the number of workdays (consecutive or not) on which because of injury or illness:
(1) the employee was assigned to another job on a temporary basis, or
(2) the employee worked at a permanent job less than full time, or
(3) the employee worked at a permanently assigned job but could not perform all duties normally connected with it.

The number of lost workdays should not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work.

Columns 6 and 13 — INJURIES OR ILLNESSES WITHOUT LOST WORKDAYS. Self explanatory.

Columns 7a through 7g — TYPE OF ILLNESS.
Enter a check in only *one* column for each illness.

TERMINATION OR PERMANENT TRANSFER—Place an asterisk to the right of the entry in columns 7a through 7g (type of illness) which represented a termination of employment or permanent transfer.

V. Totals

Add number of entries in columns 1 and 8.
Add number of checks in columns 2, 3, 6, 7, 9, 10, and 13.
Add number of days in columns 4, 5, 11, and 12.
Totals are to be generated for each column at the end of each page and at the end of each year. *Only* the yearly totals are required for posting.

If an employee's loss of workdays is continuing at the time the totals are summarized, estimate the number of future workdays the employee will lose and add that estimate to the workdays already lost and include this figure in the annual totals. No further entries are to be made with respect to such cases in the next year's log.

VI. Definitions

OCCUPATIONAL INJURY is any injury such as a cut, fracture, sprain, amputation, etc., which results from a work accident or from an exposure involving a single incident in the work environment.
NOTE: Conditions resulting from animal bites, such as insect or snake bites or from one-time exposure to chemicals, are considered to be injuries.

OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact.

The following listing gives the categories of occupational illnesses and disorders that will be utilized for the purpose of classifying recordable illnesses. For purposes of information, examples of each category are given. These are typical examples, however, and are not to be considered the complete listing of the types of illnesses and disorders that are to be counted under each category.

7a. Occupational Skin Diseases or Disorders
Examples: Contact dermatitis, eczema, or rash caused by primary irritants and sensitizers or poisonous plants; oil acne; chrome ulcers; chemical burns or inflammations; etc.

7b. Dust Diseases of the Lungs (Pneumoconioses)
Examples: Silicosis, asbestosis, coal worker's pneumoconiosis, byssinosis, siderosis, and other pneumoconioses.

7c. Respiratory Conditions Due to Toxic Agents
Examples: Pneumonitis, pharyngitis, rhinitis or acute congestion due to chemicals, dusts, gases, or fumes; farmer's lung; etc.

7d. Poisoning (Systemic Effect of Toxic Materials)
Examples: Poisoning by lead, mercury, cadmium, arsenic, or other metals, poisoning by carbon monoxide, hydrogen sulfide, or other gases; poisoning by benzol, carbon tetrachloride, or other organic solvents; poisoning by insecticide sprays such as parathion, lead arsenate; poisoning by other chemicals such as formaldehyde, plastics, and resins; etc.

7e. Disorders Due to Physical Agents (Other than Toxic Materials)
Examples: Heatstroke, sunstroke, heat exhaustion, and other effects of environmental heat, freezing, frostbite, and effects of exposure to low temperatures; caisson disease; effects of ionizing radiation (isotopes, X-rays, radium); effects of nonionizing radiation (welding flash, ultraviolet rays, microwaves, sunburn); etc.

7f. Disorders Associated With Repeated Trauma
Examples: Noise-induced hearing loss; synovitis, tenosynovitis, and bursitis; Raynaud's phenomena, and other conditions due to repeated motion, vibration, or pressure.

7g. All Other Occupational Illnesses
Examples: Anthrax, brucellosis, infectious hepatitis, malignant and benign tumors, food poisoning, histoplasmosis, coccidioidomycosis, etc.

MEDICAL TREATMENT includes treatment (other than first aid) administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does NOT include first-aid treatment (one-time treatment and subsequent observation of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care) even though provided by a physician or registered professional personnel.

ESTABLISHMENT: A single physical location where business is conducted or where services or industrial operations are performed (for example: a factory, mill, store, hotel, restaurant, movie theater, farm, ranch, bank, sales office, warehouse, or central administrative office). Where distinctly separate activities are performed at a single physical location such as construction activities operated from the same physical location as a lumber yard, each activity shall be treated as a separate establishment.

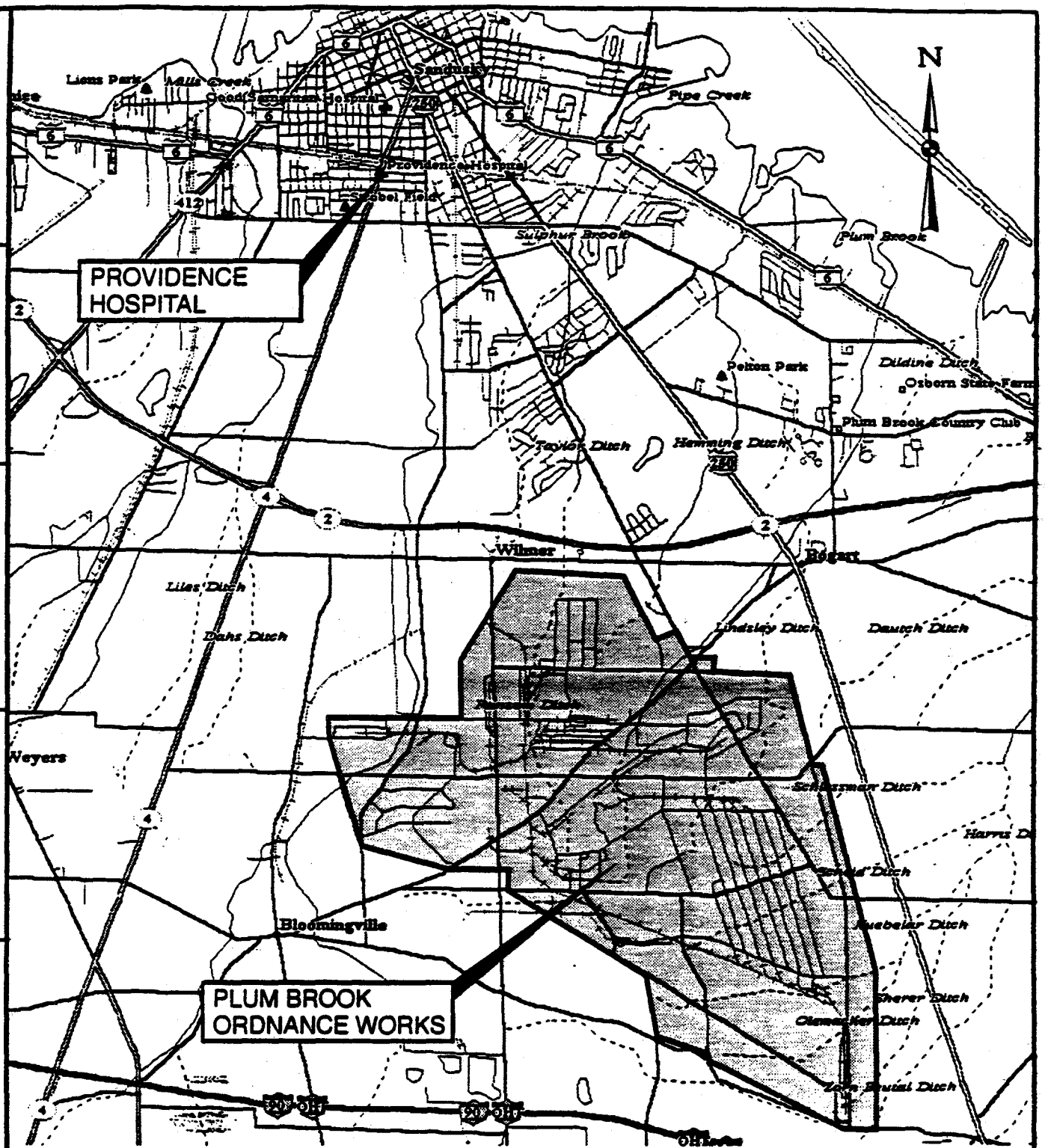
For firms engaged in activities which may be physically dispersed, such as agriculture; construction; transportation; communications; and electric, gas, and sanitary services, records may be maintained at a place to which employees report each day.

Records for personnel who do not primarily report or work at a single establishment, such as traveling salesmen, technicians, engineers, etc., shall be maintained at the location from which they are paid or the base from which personnel operate to carry out their activities.

WORK ENVIRONMENT is comprised of the physical location, equipment, materials processed or used, and the kinds of operations performed in the course of an employee's work, whether on or off the employer's premises.

APPENDIX E

SITE AND HOSPITAL LOCATION MAP



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PROJ. NO.: 764676
INITIATOR: J. LI
PROJ. MGR.: D. BURTON
DRAFT. CHCK. BY: J. HUBBARD
ENGR. CHCK BY: G. YU
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 10/26/95
DRAWN BY: D. HIGGS

EMAP5.CDR 10/26/95 DJH

APPENDIX E

SITE AND HOSPITAL LOCATION MAP

PLUM BROOK ORDNANCE WORKS
HURON COUNTY, OHIO

PROVIDENCE HOSPITAL
1912 HAYES AVE.
SANDUSKY, OHIO 44870

PH. (419) 621-7000

INTERNATIONAL TECHNOLOGY CORPORATION

Direction to the Providence Hospital:

Exit from the front gate of Plum Brook Station; turn right to Taylor Road; go approximately 1/4 mile; turn left to Botay Road; at the stop sign make a left turn to Bogart Road (County Road No. 10); take Bogart Road all the way to State Road No. 4; (Wright Brothers Memorial Highway); make a right turn at State Road No. 4; the Providence Hospital will be on the right side.

Estimated travel time to the hospital from PBS is between 15 and 30 minutes, depending on traffic conditions.

Sitewide Sampling and Analysis Plan
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Submitted to:

Commander
U.S. Army Corps of Engineers
Nashville District
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

IT Project Number 766952

Prepared by:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

September 1996

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List of Acronyms

AOC	area of known contamination
AR/COC	Analysis Request/Chain of Custody Record
ARAR	applicable or relevant and appropriate requirements
ASTM	American Society for Testing and Materials
bgs	below ground surface
BNA	base/neutral and acid extractables
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
°C	degrees Celsius
DERP	Defense Environmental Restoration Program
DM	Dames & Moore
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DQO	data quality objective
EA	Environmental Assessment
Eh	oxidation-reduction potential
EM	electromagnetic
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FADL	Field Activity Daily Log
ft/day	feet per day
gpm	gallons per minute
GPR	ground penetrating radar
GSA	General Services Administration
HA	health advisory
IDW	investigation-derived wastes
IT	IT Corporation
MCL	maximum contaminant level
MCLG	MCL goal
MK	Morrison Knudsen Corporation
MHz	megahertz
mm	millimeter
mS/m	millisiemen per meter
msl	mean sea level

MWI&MP	Monitoring Well Installation and Maintenance Plan
NASA	National Aeronautics and Space Administration
NAVD	North American Vertical Datum
N-S	north to south
NTU	Nephelometric Turbidity Units
OEPA	Ohio Environmental Protection Agency
OHARNG	Ohio Air Reserve National Guard
OVA	organic vapor analysis
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
PCB	polychlorinated biphenyls
PID	photoionization detector
PM	project manager
PMP	project management plan
PPE	personal protective equipment
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
RBC	risk-based concentrations
RCRA	Resource Conservation and Recovery Act
S/N	signal-to-noise
SAP	Sampling and Analysis Plan
SHP	Safety and Health Plan
SI	site investigation
SOP	standard operating procedure
SOW	statement of work
SPCS	State Plane Coordinate Systems
SVOC	semivolatile organic compound
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers

USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
VOC	volatile organic compound

1.0 Project Description

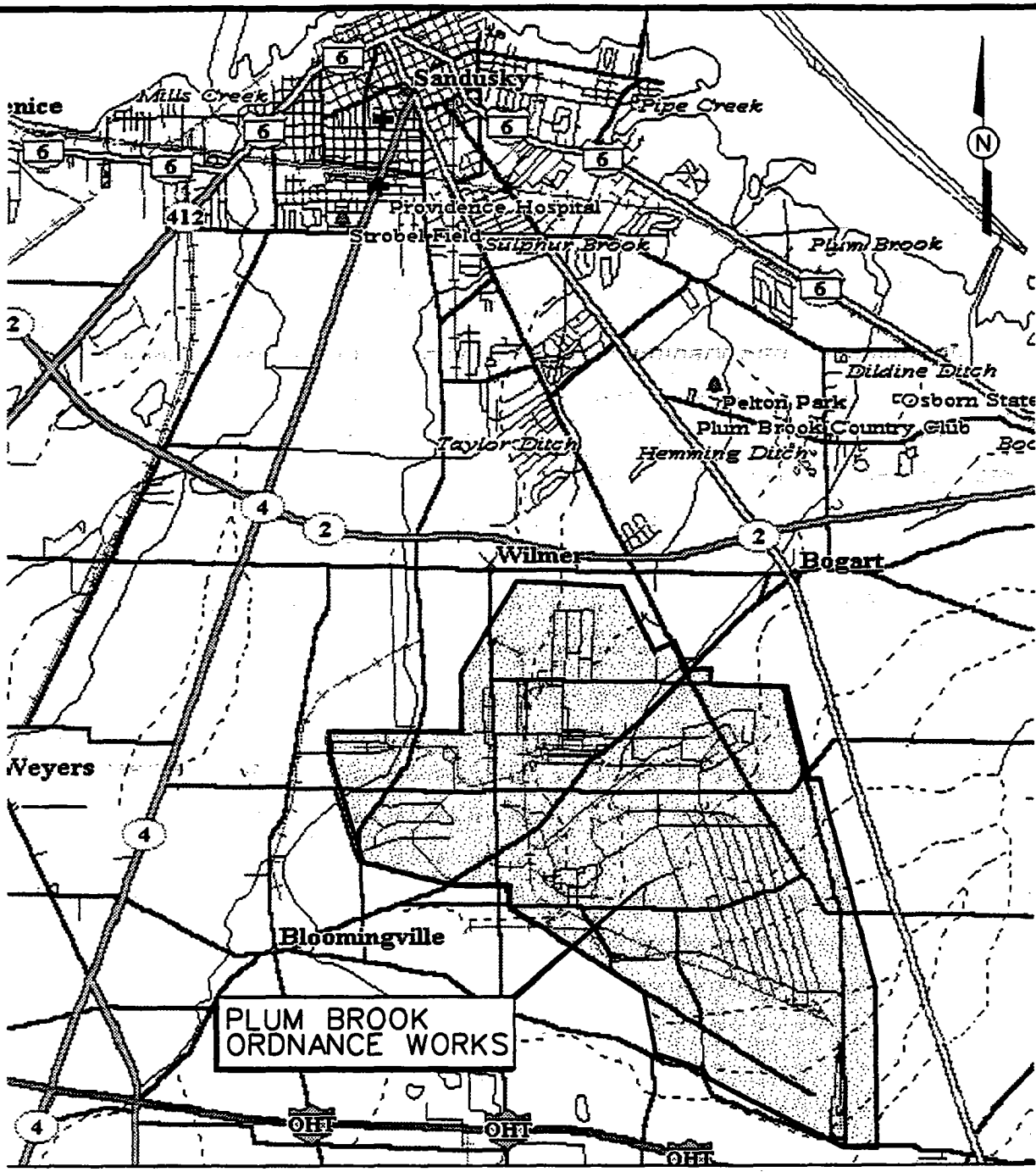
1.1 Introduction

The U.S. Army is conducting studies of the environmental impact of suspected hazardous waste sites at previously owned U.S. Department of Defense (DOD) properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW) site, located in Sandusky, Erie County, Ohio, is a formerly used defense site under DERP, currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. Work contracted to IT Corporation (IT) includes providing engineering services to conduct site investigations (SI) and groundwater investigation at PBOW. Figure 1-1 shows the geographic location of the PBOW.

This Sitewide Sampling and Analysis Plan (SAP) has been prepared as a leading document for the work to be carried out in support of all SIs and groundwater investigation at PBOW. This SAP is intended to be used by IT project team members as the guide and reference source for the specific investigations at PBOW regarding various issues such as data acquisition and management, data quality objectives (DQO), investigative methodologies, laboratory quality assurance (QA), and nonconformances and corrective actions. The SAP contains plans and general procedures for all work to be performed at the former PBOW sites and details specific to each of the investigations are included in site-specific attachments (Attachments I through V) to this document. A Sitewide Safety and Health Plan (SHP) has been prepared to provide guidance and procedures for issues regarding the safety and health of project personnel and the environment. A Quality Assurance Project Plan (QAPP) has been prepared to provide assurance that work to be performed at PBOW will be of the quality required to satisfy the project objectives and is responsive to the applicable regulatory requirements. A project management plan (PMP) has also been prepared for the purpose of identifying authorities and responsibilities among project team members to ensure implementation and management of the project.

1.2 Site History and Contaminants

The 9,009-acre PBOW site was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. It is estimated that more than one billion pounds of explosives were manufactured during the 4-year operating period.



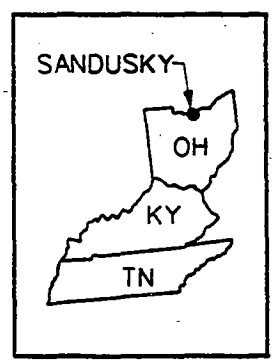


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FIGURE 1-1
VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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

The National Aeronautics and Space Administration (NASA) acquired the PBOW in 1963 and is presently utilizing the site. On April 18, 1978, NASA declared approximately 2,152 acres of land as excess. The Perkins Township Board of Education acquired 46 acres of the excess and uses its area as a bus transportation center. GSA retains the remaining acreage and currently has a use agreement with the Ohio National Guard for 604 acres of the land. NASA presently controls about 6,400 acres (Figure 1-2) and is using its site to conduct space research as a satellite operation (Plum Brook Station [PBS]) of NASA's Lewis Research Center located in Cleveland, Ohio. The details of these land transactions are listed in the site management plan archived at the PBS.

1.3 Summary of Existing Site Data

PBOW is located approximately 4 miles south of Sandusky, Ohio and is specifically located in the Perkins and Oxford Townships. The site is bounded on the north by Bogart Road, on the south by Mason Road, on the east by U.S. Highway 250, and on the west by County Road 43. The former PBOW site consists of 9,009 acres and lies in an area that is primarily rural and agricultural with low population density.

There are approximately 106 permanent buildings and structures and 99 munitions bunkers located in the southeast portion of the site. These bunkers were constructed during the PBOW operation and some are currently used by NASA PBS for the storage of materials, equipment, and records. Electric power is provided to the facility by the Ohio Edison Company. Potable water is supplied by the City of Sandusky. NASA PBS has five wastewater treatment systems, three of which are currently operating.

1.3.1 Physical Setting

1.3.1.1 Climate

The climate in northern Ohio is continental in nature but shows strong influence from Lake Erie. The weather changes frequently due to warm and cold air fronts moving through this area. Summer in Sandusky is warm and humid with high temperatures rarely exceeding 100

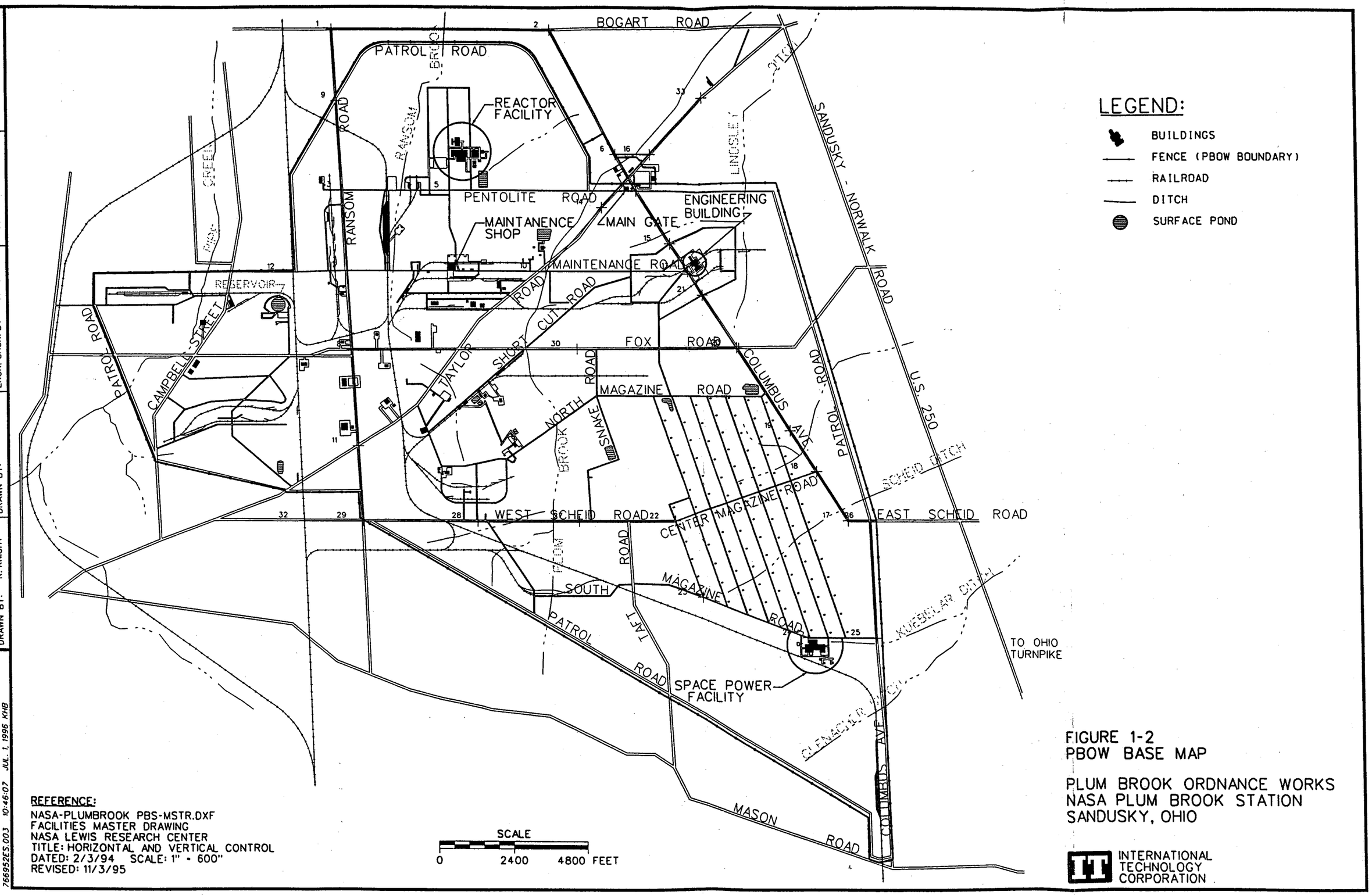


FIGURE 1-2
PBOW BASE MAP

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

degrees Fahrenheit (°F). Winters are cold and windy. On an average, the temperature first falls to below freezing in October and the last freezing temperature occurs in April. Mean annual precipitation is calculated to be 33.9 inches based on data from 1951 to 1980. The wind direction is southwest 55 percent of the time.

1.3.1.2 Topography

The Sandusky area is located on a flat topography modified by glacial processes. The ground surface slopes gradually northward toward Lake Erie at an average slope of less than 6 percent. Elevations at the PBOW site range from 675 feet above mean sea level (msl) at the southwest edge of the site to 625 feet msl in the northern portion of the property at Bogart Road.

1.3.1.3 Regional Geology

From west to east across Ohio, the bedrock units are present as subcrops beneath glacial deposits consisting of Paleozoic sedimentary rocks that range from Ordovician to Permian age. Ordovician bedrock in Ohio is mostly calcareous shale, argillaceous, cherty limestone, and fine clastic rocks. Silurian bedrock in Ohio consists of carbonated rocks (limestone and dolomite) with evaporates and dolomite that grades into shale in the upper part of the Siurian sequence. The Lower and Middle Devonian rocks are predominantly limestone, while the upper Devonian consists of the Ohio and Olentangy shales. According to Ohio Geological Survey open-file map, the PBOW site is underlain from west to east by Devonian formation including Delaware limestone, Plum Brook shale, Prout limestone, and Ohio shale. The limestones are massive with calcareous shale partings and are moderately porous with high secondary permeability near the soil/rock interface, while the shale deposits are low in porosity. Depth to bedrock varies considerably on site. A monitoring well installed near the reactor facility encountered limestone bedrock at a depth of 25 feet below ground surface (bgs). Another well installed in the vicinity of red water pond in the western portion of the site encountered limestone at a depth of 19 feet bgs. Shale bedrock in the southern portion of the site has been encountered during drilling at depths of 2 to 12 feet.

The regional structure in northwestern Ohio is mainly due to the Findley Arch. PBOW is on the southeast side of the arch with bedrock dipping to the southeast at about 5 to 10 feet per mile.

1.3.1.4 Soil

The surficial and near surface deposits were produced by glacial processes. The dominant soil materials were deposited as glacial till, outwash, and lacustrine deposits.

The U.S. Department of Agriculture Soil Conservation Service Soil Survey (1971) identifies the majority of soils at the site as being from the Arkport-Galen association. Arkport soils consist of gently sloping to moderately sloping, well-drained soils formed in the sandy material deposited at the edge of a glacial lake. Arkport soils are generally loamy find sand and fine sand. Galen soils are mostly level and moderately well-drained formed as small sandy deposits on outwash plains and deltas. Galen soils have a fine sand or sandy loam surface layer, a subsurface of fine sand and loamy fine sand that is underlain by silt or clay. The southern portion of the site has soils in the Prout association. Prout soils are moderately deep to deep, nearly level to gently sloping, somewhat poorly drained soils that have a subsoil of heavy silt loam to silty clay loam. These soils are commonly found on highlands.

1.3.1.5 Surface Drainage

Numerous surface ponds and streams lie in the area surrounding PBOW. Lake Erie and Sandusky Bay are the largest surface water bodies near PBOW. Eleven streams, six of which originate within the PBOW site boundaries, flow northerly or northeasterly into Lake Erie. Plum Brook and Pipe Creek originate south of the site and flow independently into Lake Erie, east and west of the Sandusky airport, respectively. Kuebeler Ditch, Ohlemacher Ditch, Scherer Ditch, and Zorn Beutal Ditch originate at the southwest edge of the property and connect into Harris Ditch south of Fox Road. In addition, 17 isolated ponds and reservoirs and three red water ponds are located on site. Water levels in these ponds remain high during dry season indicating contribution from shallow groundwater.

1.3.1.6 Groundwater

Groundwater in the PBOW area receives its recharge mainly from precipitation. The underlying limestone beds are the principal aquifer. Well yields from limestone aquifer generally range from 5 to about 25 gallons per minute (gpm). Water in the limestone beds occurs principally in joints and bedding plans or in solutionally enlarged openings. U.S. Geological Survey (USGS) (1992) conducted a hydrogeological study of the glacial deposits in Sandusky in 1990 and reported a horizontal hydraulic conductivity of 0.046 foot per day (ft/day) and a vertical hydraulic conductivity of 1.2 ft/day. Regional groundwater flow is in the direction of Lake Erie. Locally, groundwater flow regime may be different due to local topography.

1.3.2 Previous Environmental Studies

A number of environmental investigations have been completed at the PBOW site. The purpose of these investigations were to address environmental contamination related to past DOD operations. The following section briefly summaries the findings of these investigations.

Ohio Environmental Protection Agency (OEPA) Preliminary Site Assessment. According to the site inspection report by Morrison Knudsen Corporation (MK), OEPA conducted a preliminary assessment of PBS in 1983 in response to a 1981 spill of about 170 gallons of polychlorinated biphenyls (PCB) at Building 9206 and reported red water discharge from the red water ponds. Soil samples were found to contain PCBs at concentrations up to 2,400 parts per million (ppm). Monitoring wells were installed to detect groundwater contamination around the building. After several years of monitoring which showed no evidence of groundwater contamination, the groundwater monitoring was discontinued in 1990.

Ohio Air Reserve National Guard Environmental Assessment. In the 1980's, the Ohio Air Reserve National Guard (OHARNG) conducted an Environmental Assessment (EA) of the western portion of the site. However, the results of this EA are not currently available.

IT Contamination Evaluation. In 1989, IT conducted a Contamination Evaluation under contract to USACE. The evaluation consisted of a record review, site visit, and field sampling and analysis. The areas investigated include waste disposal area No. 1 (also known as Pentolite Road red water ponds), Waste Disposal Area No. 2 (also known as west area red water ponds), Scheid Road Burning Grounds (also known as Snake Road burn ground), and Rubbish Burning Grounds (also known as Taylor Road burn ground). Four groundwater monitoring wells were installed and sampled. In addition, 21 soil samples and 4 surface water samples were also collected and analyzed. Samples were analyzed for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), nitroaromatic compounds, nitrates, sulfates, pH, and metals. The results of this contamination evaluation indicated no soil or groundwater contamination by VOCs at any locations sampled, limited soil and groundwater contamination from SVOCs at the Waste Disposal Area No. 1 and the Scheid Road Burning Grounds. Elevated metals, sulfates, and nitrates in soils at Waste Disposal Area No. 1, and elevated metals in groundwater at the Waste Disposal Area No. 2 were also detected.

H^+GLC Snake Road Burn Ground Investigation. In 1992, H^+GLC conducted a SI of the Snake Road burn ground and the adjacent burn grounds used by NASA. The purpose of the investigation was to characterize possible groundwater and surface water contamination due to the use of this area as an uncontrolled burn ground. Groundwater monitoring wells and soil borings were installed in this area to allow collection of characteristic samples. Based on the results of the investigation, H^+GLC recommended no further site characterization or remediation of the site.

Morrison Knudsen Corporation Site Inspection. In 1994, MK completed an SI of the PBS for NASA PBS in order to perform a hazard ranking for the site. The MK investigation included review of existing environmental data, collection and analysis of surface soil, sediment, surface water, and groundwater samples. All samples were analyzed for organic and inorganic compounds. In addition, a small number of samples from various site media also were collected and analyzed for radioactivity. The results of the MK investigation identified limited contamination in multiple areas of the PBOW site, some of which were previously used during PBOW operation. However, the Hazard Ranking Score for the overall site was below Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) action levels.

Dames & Moore Sitewide Groundwater Investigation. Dames & Moore (DM) conducted a sitewide groundwater investigation in 1994 (DM, 1996) under contract to Nashville USACE to evaluate groundwater flow conditions in both the overburden and bedrock aquifers and to investigate baseline groundwater quality of the bedrock aquifer. Eleven shallow monitoring wells and eight deep (bedrock) wells were installed and sampled. All samples were analyzed for explosives, nitrates, and total and dissolved metals. Samples from bedrock wells were also analyzed for VOCs and base/neutral and acid extractables (BNA). The results of the DM investigation indicate that significant levels of explosive residues are present in the groundwater in the overburden aquifer in the vicinity of both former red water pond areas. Low levels of explosives and several VOCs and BNAs were also detected in several bedrock wells. Groundwater flow in both aquifers is toward the north in the direction of Lake Erie and the overburden aquifer shows a significant vertical flow component.

2.0 Project Organization and Responsibility

The project team will be IT and IT's approved subcontractors.

The IT team has identified key management and technical personnel who will participate in this project. The program manager, Don C. Burton, professional engineer will have the authority and responsibility for contract management. The project manager (PM), Mikael Spangberg, will be responsible for overall project execution and allocation of resources necessary to implement the work plan and SHP. The principal investigator, George H. Yu, registered professional geologist, will coordinate multidisciplinary investigation efforts and ensure efficient and effective information transfer among team members and be responsible for the technical quality of the project. Melissa G. Smith, certified industrial hygienist, will serve as the safety and health officer and be responsible for safety and health issues encountered during the execution of the field work. Kim Arrant, the analytical coordinator, will coordinate field sampling needs and serve as liaison between the project team and the analytical laboratory. Other key IT associates are identified within the organization and will serve in their respective roles for the completion of this investigation effort.

IT services to be used for this work are primarily located in Knoxville, Tennessee and are:

- Project Management
- Engineer
- Health and Safety
- QA/quality control (QC)
- Contract Administration
- Data Management
- Hazard Evaluation.

Guidance will be provided to individuals, and their activities will be coordinated by the PM to ensure that overall project goals and objectives are met. Additional IT technical staff will be available throughout the course of the project. The PM will determine needs as they arise and obtain the appropriate resources accordingly. Figure 2-1 presents the project organization chart.

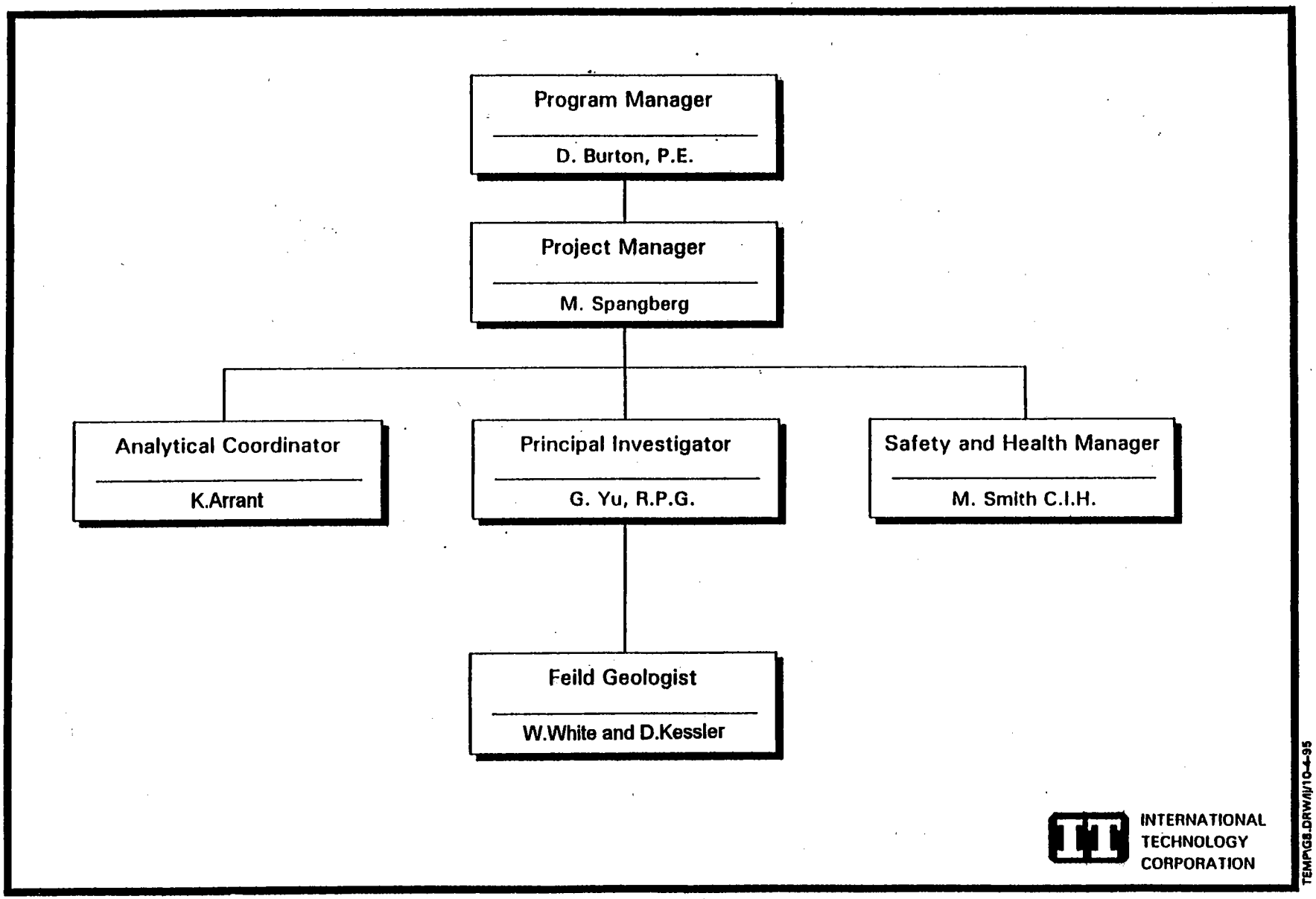


Figure 2-1 IT Project Organization Chart for PBOW Investigations

3.0 Scopes and Objectives

3.1 Scope

As specified in the statement of work (SOW) (USACE, 1996), the scope within which this SAP has been prepared includes the SI of Reservoir No. 2 Burning Ground, SI of the Additional Burn Ground, SI of Waste Water Disposal Plant No. 2, SI of Power House No. 2 Ash Pit, and the sitewide Groundwater Investigation. Each investigation consists of the following subtasks: preparation and completion of site-specific work plans, completion of various field activities, evaluation of analytical results from samples collected during field investigation, and preparation and submittal of investigation reports of activities, conclusions, and recommendations for further actions. Figure 3-1 presents the areas of concerns at the PBOW site. Among them, the Reservoir No. 2 Burning Ground, the additional burn ground, the Wastewater Disposal Plant No. 2, and the Power House No. 2 Ash Pit are covered by this SAP.

3.2 Objectives

The purpose of these investigations are to collect information on contamination of site soils (SI) and groundwater (groundwater investigation) resulting from past activities that can be used to make initial management decisions and for developing more detailed and comprehensive sampling regiments should further investigations be determined to be necessary. The specific objectives of each investigation are summarized as follows:

- ***SI of Powerhouse No. 2 Ash Pit.*** Determine if site soils at the former Powerhouse No. 2 Ash Pit are contaminated, and, if so, whether or not this contamination poses a threat to human health or the environment.

- ***SI of Reservoir No. 2 Burning Ground.*** Determine the location of the Reservoir No. 2 Burning Ground; determine the existence and nature of contamination in site soils; determine if contamination poses a threat to human health or the environment; and determine if further investigation or clean-up of the site will be required.

- ***SI of the Additional Burn Ground.*** Delineate the lateral extent of the Additional Burn Ground; confirm the existence and nature of contamination in shallow soils at the site; and determine whether further investigation of the site will be required, and, if so, the media that will require investigation.

- ***SI of Wastewater Disposal Plant No. 2.*** Determine whether or not site soils in the vicinity of Wastewater Disposal Plant No. 2 are contaminated, and, if

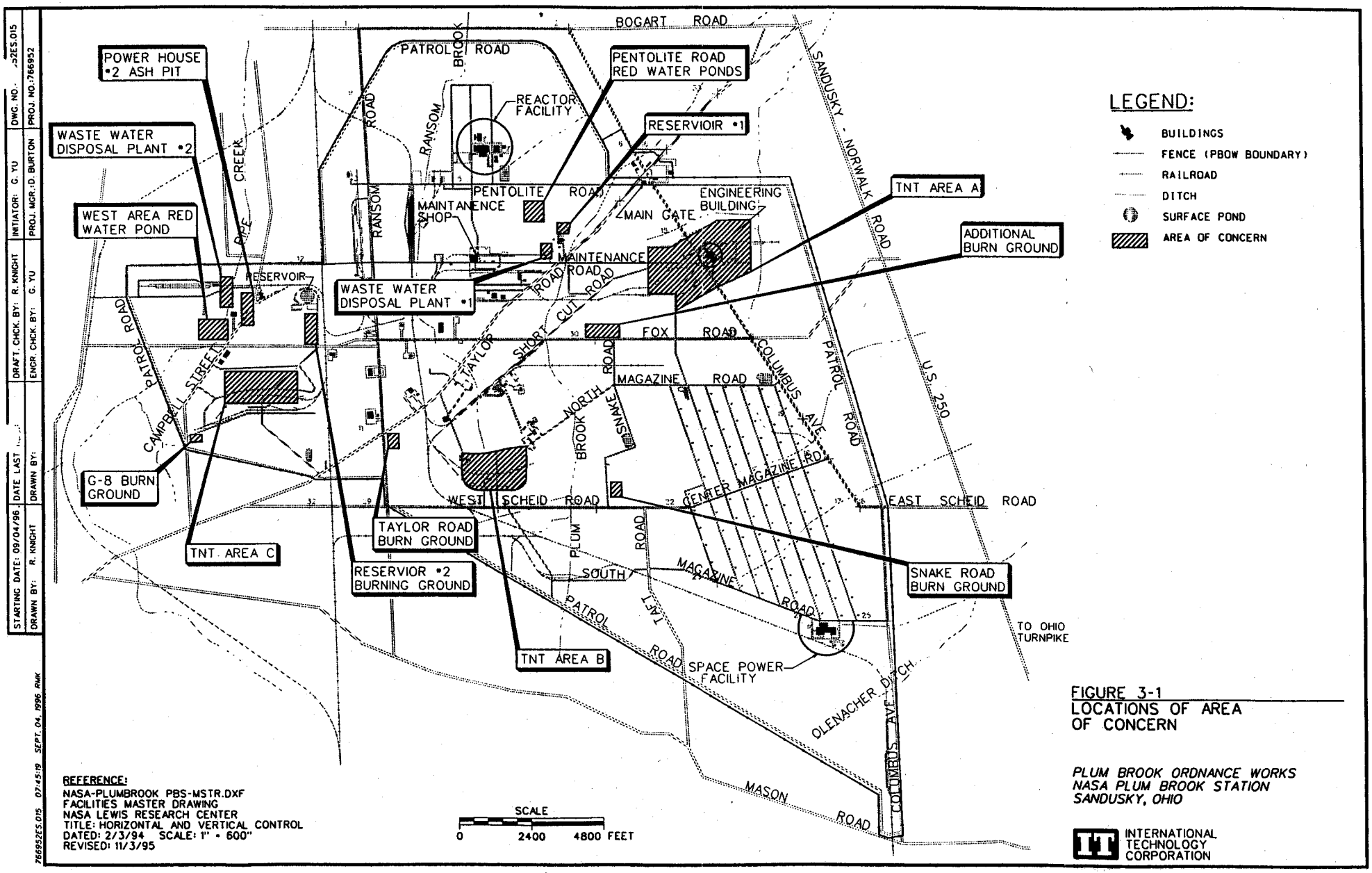


FIGURE 3-1
LOCATIONS OF AREA OF CONCERN

so, whether or not this contamination poses a threat to human health or the environment.

- ***Groundwater Investigation.*** Acquire data of sitewide groundwater levels and contaminants to add to an existing database, and fill existing gaps in groundwater levels and contamination in the western portion of PBOW.

3.3 Data Quality Objectives

3.3.1 Overview

As defined in the U.S. Environmental Protection Agency (EPA) guidance document entitled *Data Quality Objectives Process For Superfund* (EPA/-540/G-93/071) (EPA, 1993), DQOs are qualitative and quantitative statements that specify the quality of the data required to support decisions during all phases of environmental investigation and design. DQOs are applicable to all data collection activities, and the level of detail and data quality needed will vary based on the intended uses of the data.

The DQO process helps define the purpose for which environmental data will be used and sets guidelines for designing a data collection program that will meet regulatory objectives. The process also provides a logical, objective, and quantitative framework for finding an appropriate balance between the time and resources that will be utilized to generate the data and the quality of that data.

This section summarizes the DQO process that will be implemented during the design and planning phase of investigations at PBOW. The DQO process is followed to ensure that the type, quantity, and quality of the site environmental data used in decision making are appropriate for the intended application.

3.3.2 Initial DQO Assumptions

Two assumptions are made to justify the DQO process and these assumptions will be tested at several points during the process:

- There is a regulatory program decision to be made, and environmental data will be required for the decision. Regulatory and program decisions are decisions to take an action, such as to: develop or revise a standard or regulation; study a problem further; or implement a corrective action program.

- The DQO process is being initiated because there is an expectation that existing environmental data will not provide the information required and that new environmental data will be needed for the decision.

3.3.2.1 Consideration of ARARs

An important aspect of the CERCLA/Superfund Amendment and Reauthorization Act is the concept of applicable or relevant and appropriate requirements (ARAR), which applies to the response of released hazardous substances, pollutants, or contaminants into the environment. The definition of ARAR is divided into two distinct categories; those requirements that specifically address the CERCLA site are called "applicable," and those that do not specifically address the CERCLA site but address conditions that are sufficiently similar to those encountered at the site are considered "relevant and appropriate." The requirements include: cleanup standards, standards of control and other substantive requirements, and criteria or limitations promulgated under federal, state, or facility environmental laws.

Requirements are further defined by the chemical, location, or specific actions to be taken depending on the hazardous substances present at the site, the site characteristics, and actions selected for remedy. Chemical-specific ARARs are health- or risk-based concentration (RBC) limits set for specific substances, pollutants, or contaminants. Location-specific ARARs address restrictions upon the concentrations of hazardous substances or the conduct of activities solely based on the CERCLA site's location within an environmentally regulated region. Such regions may include a 100-year floodplain or a region with an endangered species. ARARs that relate to a method of remedial response are termed action-specific.

Consideration of ARARs is made according to 40 Code of Federal Regulations 300.430. ARARs are identified and utilized by taking into account the following:

- Contaminants suspected to be at the site
- Chemical analyses to be performed
- Types of media to be sampled
- Geology and other site characteristics
- Use of the resource/media
- Level of exposure and risk
- Potential transport mechanisms
- Purpose of the application of the potential ARARs
- Remedial alternatives that will be considered for the site.

The ARARs considered for the former PBOW include maximum contaminant levels and National Pollution Discharge Elimination System requirements. Additionally, analytical data will also be evaluated using Ohio state regulatory requirements as appropriate.

3.3.2.2 Data Collection

Developing DQOs should be the first step in initiating any significant environmental data collection program. The DQO process provides a quantitative basis for designing rigorous, defensible, and cost-effective investigations. Decision making is driven by risks to public health and the fact that the level of uncertainty in decisions will be affected by the type and quality of data collected.

3.3.3 DQO Planning Process

The DQO process consists of seven steps, summarized as follows:

- ***Step 1 - State the Problem.*** Summary of the contaminant problem requiring the collection of new environmental data and identification of the available resources for problem resolution.

- ***Step 2 - Identify the Decision.*** Identification of the decision requiring new environmental data to address the contamination problem.

- ***Step 3 - Identify Inputs to the Decision.*** Identification of information needed to support the decision and determination of which inputs require new environmental measurements.

- ***Step 4 - Define the Study Boundaries.*** Definition of spatial and temporal aspects of the environmental media that must be represented by the data to support the decision.

- ***Step 5 - Develop a Decision Rule.*** Development of a logical "if... then..." statement defining the conditions which would require the decision maker to select among alternative actions.

- ***Step 6 - Specify Limits on Decision Errors.*** Determination of acceptable limits for decision errors, which are subsequently used to establish performance goals to limit uncertainties in the collected data.

- ***Step 7 - Optimize the Design for Obtaining Data.*** Identification of the most resource-effective sampling and analysis design for generating data to satisfy the DQOs.

The following sections describe the purpose and activities associated with each of the seven steps of the DQO process.

3.3.3.1 Step 1 - State the Problem

This step is designed to clearly define the problem which necessitates the collection of new environmental data so that the focus of the investigation will be clear and unambiguous. Activities associated with this step are the (1) identification of members of the planning team and the primary decision maker, (2) development of a concise statement or description of the problem, and (3) determining the available resources and deadlines for the study. The results of these activities are then carried forward to Step 2 of the DQO process.

3.3.3.2 Step 2 - Identify the Decision

This step defines the decision that will be resolved utilizing the data collected to address the problem as defined in Step 1. The specific activities associated with this step are (1) a statement of the decision, (2) categorization of multiple decisions, when applicable, and (3) a statement of the actions or decisions that are likely to result from resolution of the decision. The results of this step are then carried forward to Step 3.

3.3.3.3 Step 3 - Identify Inputs to the Decision

This step is designed to identify the information required for resolution of the decision, including a determination of what environmental measurements are necessary to support the decision. Specific activities associated with this step are (1) determining the required information for resolving the decision, (2) defining the sources of each needed piece of information, (3) determining what information is needed to establish action levels for the investigation, and (4) confirmation that appropriate field sampling techniques and analytical methods exist to obtain the required data.

3.3.3.4 Step 4 - Define the Study Boundaries

This step specifies the spatial and temporal circumstances that are impacted by the decision. The specific activities associated with this step include (1) definition of the location or geographic area within which the decisions will apply, (2) determination of the characteristics that define the population of interest, (3) the division of the population into strata that have relatively homogeneous characteristics (when appropriate), (4) definition of the scale of the decision making, (5) determination of the appropriate time for data collection, (6) determination of the time frame to which investigation data apply, and (7) determination of any practical constraints on data collection.

3.3.3.5 Step 5 - Develop a Decision Rule

Step 5 integrates the results or outputs of the previous steps into a single statement that describes the logical basis for selection of alternative actions. Specific activities associated with this step include (1) specifying the parameter that characterizes the population of interest, (2) specifying the investigation's action levels, and (3) integrating the results of the previous steps into an "if... then..." decision rule that clearly defines how the selection decisions regarding different alternative actions will be made.

3.3.3.6 Step 6 - Specify Limits on Decision Errors

This step defines the acceptable limits on decision errors, which are then used to establish appropriate performance goals for limiting the uncertainty in the data. Specific activities associated with Step 6 include (1) determining the possible ranges of the parameters of interest, (2) defining the two types of decision errors (false positive and false negative errors) and the potential consequence of each, (3) specifying a range of possible parameter values where the consequences are relatively minor, (4) assigning probability values to points above and below the action level that reflect the acceptable probability for the occurrence of decision errors, and (5) verifying that the limits on decision errors accurately reflect the relative consequences for each type of decision error.

3.3.3.7 Step 7 - Optimize the Design for Obtaining Data

The final step of the DQO process determines the most resource-effective sampling and analysis design for generating data that satisfy the DQOs. This step utilizes statistical methods to develop alternative sampling designs and evaluate their effectiveness at satisfying the DQOs; in order to optimize the design, it may be necessary to work through this step repeatedly after revisiting the first six steps of the DQO process. Specific activities associated with Step 7 include (1) reviewing the DQO process results and available environmental data, (2) translating the results obtained from the DQO process into a statistical hypothesis, (3) developing general sampling and analysis design alternatives, (4) formulation of mathematical expressions required to solve design problems for each alternative, (5) selection of the optimal sample size that satisfies the DQOs for each alternative, (6) selection of the most resource-effective design that satisfies the DQOs, and (7) documenting the operational details and theoretical assumptions of the selected design in the SAP.

3.3.3.8 Key Activities

Although the DQO process consists of many activities within the seven steps, there are several key activities that lead to the establishment of effective data collection:

- Understanding the context or statement of the problem
- Converging on a statement of the question
- Defining an array of possible useful answers
- Selecting the measure that will estimate the answers
- Arriving at a decision rule
- Setting error tolerance
- Optimizing the design.

This structure establishes activities to be performed and personnel required at each point in the process. The product (output) of each step serves as the starting information (input) for the next step. Activities in each step are narrowly defined to keep all interested parties focused. The specified outputs of each step are documented in a paper trail in order to provide all participants with an understanding and clear record of the step-wise process.

3.3.4 Site Investigation and Groundwater Investigation DQOs

3.3.4.1 Overview of Site-Specific DQOs

The DQO process is followed to evaluate data requirements and to support the decision making process associated with the SIs and groundwater investigation at the PBOW. This plan incorporates the components of the DQO process which has been described previously. Table 3-1 provides a summary of the factors used to establish the sampling and analysis program necessary to meet the objectives of the investigations, which also will serve as the basis for future actions at these sites. The decision making process of the SI and groundwater investigation is presented in Figure 3-2.

3.3.4.2 Data Users and Available Data

The intended data users and available data related to the PBOW investigations have been considered in order to formulate the site-specific conceptual models for each site. The data users of information generated during the investigations include the EPA, the OEPA, the USACE, NASA PBS, and IT (or other support contractors). This work plan along with its attachments have been designed to give the regulatory agencies sufficient detail to reach a determination as to the adequacy of the plan. These investigations also have been designed to provide the USACE with the level of defensible data required to determine the existence and

Table 3-1

Summary of Data Quality Objectives
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Potential Data User	Available Data	Conceptual Model	Media of Concern	Data Uses and Objectives	Data Types	Analytical Level	Data Quantity
Reservior No. 2 Burning Ground							
EPA OEPA DOD USACE NASA IT Corporation Other Contractors Possible Future Land Users	Former burn pit for TNT product No previous environmental investigations	Contaminated sources: Burning TNT product on site Migration pathways: Soil, sediment, surface water, and groundwater Potential receptors: Wildlife, human Potential Contaminants of Concern: VOCs, SVOCs, metals, Cyanide, explisoves	Soils	Delineate location of the burning ground Determine the existence and nature of soil contamination Determine environmental risks and the necessity of futher investigation	Soils: Metals Explosives VOCs SVOCs Cyanide Geophysical data	Definitive[a] Data	24 + QA
Additional Burn Ground							
EPA OEPA DOD USACE NASA IT Corporation Other Contractors Possible Future Land Users	Former burn pit for TNT and TNT-contaminated materials Previous environmental investigation of limited scale detected soil contamination	Contaminated sources: Burning TNT product on site Migration pathways: Soil, sediment, surface water, and groundwater Potential receptors: Wildlife, human Potential Contaminants of Concern: VOCs, SVOCs, metals, Cyanide, explisoves	Soils	Delineate location of the burn pit Confirm the existence and nature of soil contamination Determine environmental risks and the necessity of futher investigation	Soils: Metals Explosives VOCs SVOCs Cyanide Geophysical data	Definitive[a] Data	24 + QA
Wastewater Disposal Plant No. 2							
EPA OEPA DOD USACE NASA IT Corporation Other Contractors Possible Future Land Users	Former waste disposal area received discharge from TNT Area C Previous investigation detected soil contamination within the disposal plant area	Contaminated sources: Burning TNT product on site Migration pathways: Soil, sediment, surface water, and groundwater Potential receptors: Wildlife, human Potential Contaminants of Concern: VOCs, SVOCs, metals, Cyanide, explisoves	Soils	Determine site soil contamination in the vicinity of the disposal area Determine environmental risks associated with soil contamination	Soils: Metals Explosives VOCs SVOCs Cyanide	Definitive[a] Data	20 samples screening 10 + QA Confirmation

Table 3-1

Summary of Data Quality Objectives
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Potential Data User	Available Data	Conceptual Model	Media of Concern	Data Uses and Objectives	Data Types	Analytical Level	Data Quantity
Powerhouse No. 2 Ash Pit							
EPA OEPA DOD USACE NASA IT Corporation Other Contractors Possible Future Land Users	Former surface impoundment for ash storage No previous environmental investigations	Contaminated sources: Ash storage Migration pathways: Soil, sediment, surface water, and groundwater Potential receptors: Wildlife, human Potential Contaminants of Concern: VOCs, SVOCs, Metals, Cyanide, Explosives	Soils	Determine the existence and nature of soil contamination Determine environmental risks associated with soil contamination	Soils: Metals Explosives VOCs SVOCs Cyanide	Definitive[a] Data	24 + QA
Groundwater Investigation							
EPA OEPA DOD USACE NASA IT Corporation Other Contractors Possible Future Land Users	Detection of several organic compounds and metals in selected monitoring wells Sitewide groundwater investigation (95)[b]	Contaminated sources: TNT areas, Burning pits, Wastewater Ponds, Migration pathways: Soil, sediment, surface water, and groundwater Potential Receptors: Wildlife, human Potential Contaminants of Concern: VOCs, SVOCs, Metals, Cyanide, Explosives	Groundwater	Acquire groundwater level and contamination data from selected wells Fill in groundwater data gaps in western portion of the PBOW	Groundwater: Total metals Dissolved metals VOCs, SVOCs Cyanide Explosives	Definitive[a] Data	32 + QA

[a] Definitive data as defined in EPA/540/G-93/071 *Data Quality Objectives Process For Superfund* (EPA, 1993)
[b] Draft Report Sitewide Groundwater Investigation, PBOW, May 1995, Dames & Moore

Objectives: **Determine the existence and nature of soil contamination**
Determine environmental risks related to soil contamination
Fill in data gaps in groundwater levels and quality
Determine the necessity of further studies

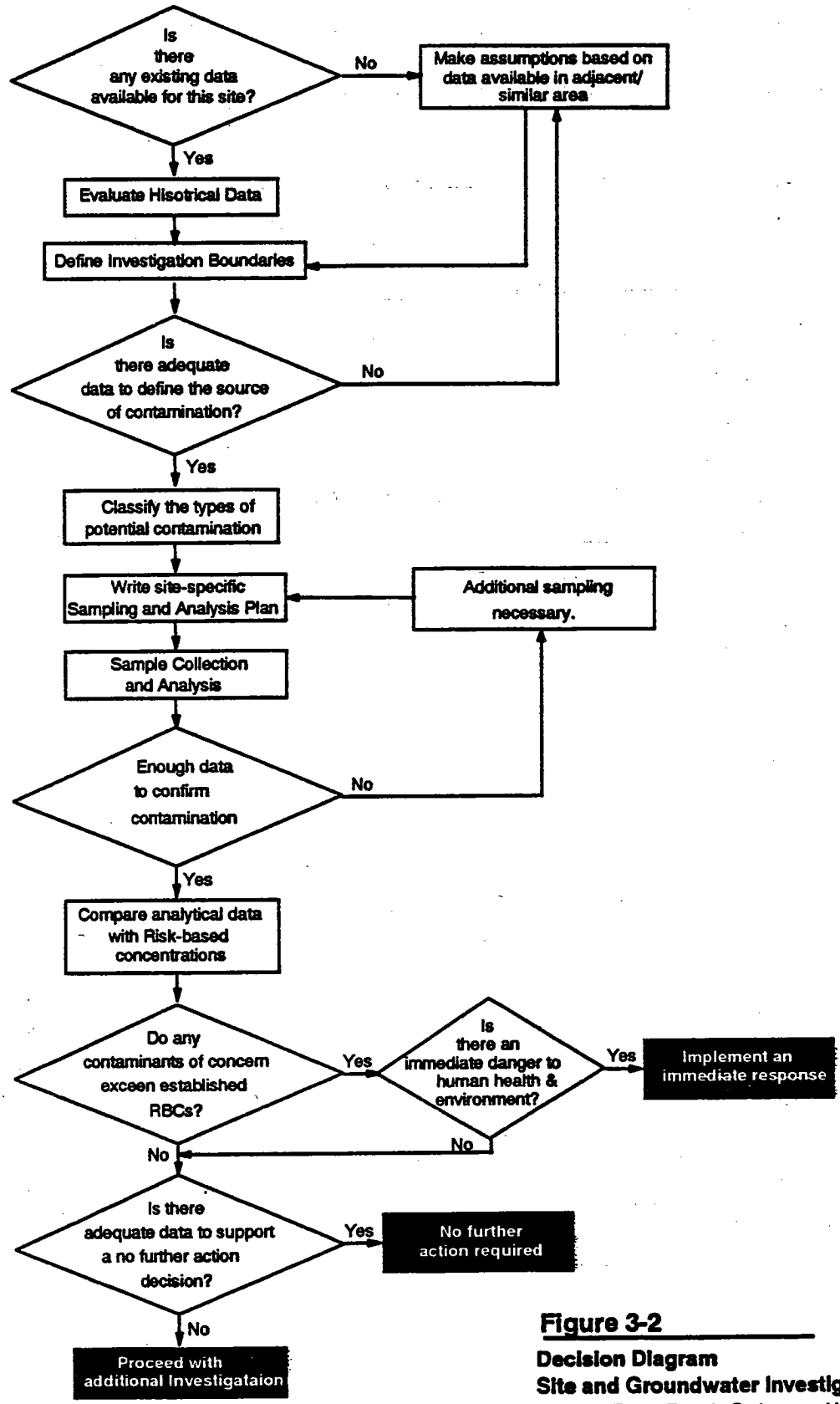


Figure 3-2

Decision Diagram
Site and Groundwater Investigations
Former Plum Brook Ordnance Works
Sandusky, Ohio

INTERNATIONAL TECHNOLOGY CORPORATION

fig3-2.dwg/pbow/pc/7/2/98

nature of site contamination and to assess potential risks to human health and the environment.

Available data regarding past and present uses of the sites under investigation were presented in Section 1.2 of this plan. For more detailed historical information, the reader is referred to the Site Inspection Report (MK, 1994) and Record Review Report (DM, 1995).

3.3.4.3 Conceptual Model

Four factors have been considered in developing the conceptual models for the PBOW site:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Potential contaminants of concern.

Table 3-1 presents the conceptual model developed for PBOW sites.

3.3.4.4 Decision-Making Progress, Data Uses, and Needs

The site-specific decisions regarding the SIs and groundwater investigation include:

- Determine the existence and nature of site contamination
- Determine the risk of site contamination to human health and the environment
- Determine the sampling media if future comprehensive investigation is warranted.

The formal decision making process is presented in Figure 3-2. Data obtained during the investigations will be used to make management decisions on the status of site contamination, impacted media, and future actions in PBOW sites including the Powerhouse No. 2 Ash Pit, Reservoir No. 2 Burning Ground, Additional Burn Ground, Wastewater Disposal Plant No. 2, and site groundwater.

3.3.4.4.1 Risk Evaluation Needs

A determination of contamination will be based on a comparison of detected contaminants against RBC as developed by EPA (EPA Region III, 1995) or other applicable criteria.

Soils analytical data were evaluated using RBCs from the Region III EPA table (EPA, 1995). RBCs are media-specific contaminant levels used to reduce the list of detected chemicals to

screen down to those warranting further consideration. The RBCs are calculated using toxicity data and standard risk-assessment exposure scenarios to produce concentrations at fixed levels of risk. The RBCs correspond to either a hazard quotient of 1 or a lifetime cancer risk of 10^{-6}, whichever occurs at a lower concentration. The cancer risk of 10^{-6} reflects the lower end of the target risk range as defined in the National Contingency Plan (EPA, 1990). Chemicals present in environmental media at concentrations below the RBCs will not contribute significantly to total site risk.

Groundwater analytical data will be screened using the EPA Region III tap water RBCs and the EPA Drinking Water Regulations and Health Advisories maximum contaminant levels (MCL) (EPA, 1996). MCLs are the maximum permissible level of a contaminant in water that is delivered to any user of a public water system. MCLs from the EPA drinking water regulations will be used preferentially to evaluate each detected constituent; if an MCL has not been developed for a detected constituent, either the available MCL goal (MCLG) or the lifetime health advisory (HA) will be used. An MCLG is a nonenforceable concentration of a drinking water contaminant that is protective of adverse human health effects and allows an adequate margin of safety. A lifetime HA is the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects over a lifetime of exposure, with a margin of safety.

EPA definitive data will be used to achieve detection limits sufficient to determine whether the established RBCs or other criteria have been exceeded in the sampled media.

3.3.4.4.2 Data Quality, Types, and Quantity

Environmental media will be sampled and analyzed in order to meet the objectives of the investigations. QA/QC samples will be collected for all sample matrices according to procedures described in the next chapter. All samples will be analyzed using EPA-approved methods and will comply with EPA definitive data requirements.

3.3.4.4.3 Precision, Accuracy, and Completeness

The assessment procedures for accuracy, precision, and completeness are presented in Section 12.0 of the QAPP.

4.0 Investigation Methodologies

This chapter describes the methodologies and procedures to be followed for performance of proposed tasks necessary for conducting site investigations and groundwater investigation at the former PBOW. The investigations will include one or more of the following main tasks:

- Installing soil borings with soil sampling
- Installing groundwater monitoring wells with groundwater sampling
- Conducting geophysical surveys
- Collecting groundwater samples from existing monitoring wells
- Testing for field permeability
- Conducting land surveys.

The rationale for these activities for each investigation is provided in site-specific attachments of this SAP. The tasks associated with each investigation along with the number of samples to be collected are summarized in Table 4-1.

4.1 Geophysical Surveys

Geophysical surveys using magnetometry, electromagnetic (EM) induction, and ground penetrating radar (GPR) techniques will be conducted at selected sites. The objectives of each investigation and survey design are discussed in detail in the site-specific SAPs. The following sections describe the generalized geophysical survey procedures to be used including review of existing data, survey control, equipment calibration, data validation, data processing and interpretation, and file tracking procedures.

4.1.1 Geophysics Equipment

Magnetic surveys will be conducted using a Geometrics G-858G magnetic gradiometer (G-858G) for field data acquisition and an EDA OmniPlus magnetometer, or equivalent, to be used as a magnetic base station. EM surveys will be conducted using a frequency-domain Geonics EM-31 terrain conductivity meter (EM-31) coupled to an Omnidata DL720 digital data logger. GPR surveys will be conducted using a Geophysical Survey Systems Inc. System-10, or equivalent, coupled to either 300- or 500-megahertz (MHz) antennae, depending on site conditions and signal attenuation. Subsurface utilities, if suspected in the survey areas, will be verified using a Schoenstedt MAC-51B magnetic/utility locator (MAC-51B), or equivalent.

Table 4-1

Summary of Investigation Tasks and Field Samples
Former Plum Brook Ordnance Works (PBOW)
Sandusky, Ohio
IT Project Number 766952

SITE	PBOW Site-Wide	Reservoir Number 2 Burning Ground	Additional Burn Ground	Waste Water Disposal Plant Number 2	Power House Number 2 Ash Pit	Groundwater Investigation
TASK	Project Work Plans	Site Investigation	Site Investigation	Site Investigation	Site Investigation	Groundwater Investigation
SUBTASK						
Work Plans	Field sampling Plan (FSP) Safety & Health Plan (SHP) Project Management Plan Quality Assurance Project Plan (QAPP)	SAP/SHP Attachment	SAP/SHP Attachment	SAP/SHP Attachment	SAP/SHP Attachment	SAP/SHP Attachment
Geophysical Survey		Geophysical Survey 250' x 250' approx. EM-31, magnetic, GPR	Geophysical Survey 500' x 500' approx. EM-31, magnetic, GPR			
Soil Boring		8 soil boring locations 8 surfacial samples 16 subsurface samples (VOCs, SVOCs, metals, cyanide explosives, pesticides/PCBs)	12 soil boring locations 12 surfacial samples 12 subsurface samples (VOCs, SVOCs, metals, cyanide explosives, pesticides/PCBs)	10 boring locations 20 field screening soil samples 10 confirmation samples (VOCs, SVOCs, metals, cyanide explosives, pesticides/PCBs)	12 soil boring locations 12 surfacial samples 12 subsurface samples (VOCs, SVOCs, metals, cyanide pesticides/PCBs)	
Groundwater Sampling Well Installation						Install 4 new monitoring wells Development and slug testing Purging 28 existing wells 32 groundwater samples (VOCs, SVOCs, total and dissolved metals cyanide, explosives, pesticides/PCBs)
Analytical Survey IDW Report		Analytical work Land survey IDW Report	Analytical work Land survey IDW Report	Analytical work Land survey IDW Report	Analytical work Land survey IDW Report	Analytical work Land survey IDW Report

4.1.2 Review of Existing Data and Survey Control

The following issues or concerns will be evaluated prior to conducting the survey:

- Review existing site surface and subsurface information (e.g., aerial photographs, utility maps, boring logs, etc.).
- Evaluate the potential influence of cultural features (e.g., overhead and subsurface utilities, fences, buildings, etc.).

Following evaluation of existing data and a visual inspection of the site, geophysical reconnaissance scans will be conducted with the EM-31 and magnetic gradiometer to determine the precise boundary of the survey area. The results of the reconnaissance scans will be recorded on the Field Activity Daily Log (FADL) (Figure 4-1). At a minimum, each geophysical survey base grid will be staked at all corners. A licensed land surveyor will later survey the corner stakes of the site which will be referenced to the State Plane Coordinate System. Using the base grid as a reference, the geophysics crew will mark control points on 10-foot centers throughout the site using surveyor's paint and/or pinflags. To the extent possible, the grid will be oriented in the north to south (N-S) direction. Vegetation will be cleared as necessary through the heavy foliage portions of the site, and surface metallic debris will be removed prior to geophysical data acquisition.

The geophysics crew will generate a site map in the field showing the geophysical survey area and obvious surface cultural features that could potentially affect the data (e.g., structures, fences, surface metallic objects, or overhead utilities).

4.1.3 Magnetic Surveys

Magnetic surveys will be conducted to locate buried ferrous metallic fragments possibly associated with the burning grounds.

A magnetic survey measures variations in the earth's magnetic field. Anomalies in the earth's magnetic field are caused by induced or remnant magnetism resulting from ferromagnetic material, such as metallic pipelines, drums, and tanks. Thus, a magnetic survey is an effective tool for delineating waste burial sites and individual metallic objects.

Surveys utilizing magnetic gradiometers, such as the Geometrics G-858G, measure the intensity of the earth's magnetic field in two sensors located at different heights. To determine the vertical magnetic gradient, the upper sensor reading is subtracted from the

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG

DAILY LOG			
DATE			
NO.			
SHEET		OF	

PROJECT NAME	PROJECT NO.
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
IT PERSONNEL ON SITE:	
SIGNATURE	DATE:

3374-7-86

FIGURE 4 - 1

lower sensor reading, and the result is then divided by the distance between the sensors. The vertical magnetic gradient allows for better definition of shallower anomalies.

Magnetic Survey Field Procedures. A field instrument base station will be established at a fixed location clear of cultural interference (e.g., surface or subsurface metallic debris, fences, utilities, or pipelines). The field instrument base station will be used to collect baseline magnetic gradiometer data and will be revisited periodically during the surveys to verify proper instrument operation. Instrument operation shall be in accordance with the manufacturer's operating instructions.

After establishing the field instrument base station, a battery check will be performed on the magnetic gradiometer (G-858G), the instrument's cesium vapor cells will be allowed to stabilize (approximately 15 minutes), and approximately 60 readings of total magnetic field strength will be recorded and stored in the internal memory of the unit. These data will provide a quantitative record of instrument variation or drift during the survey period. The field instrument base station will be reoccupied throughout the day, at approximately 2 to 3-hour intervals, where 60 additional readings of total magnetic field strength will be collected and compared with the initial base station data set to determine if instrument drift has occurred during the survey period. The acceptable "drift" range in magnetic gradiometer data as determined by analysis of the field base station data is plus or minus 10 nanoTeslas per meter of the measured total magnetic field strengths.

A magnetic base station (EDA OmniPlus) will be established at a fixed location off site and away from the field instrument base station. The magnetic base station will be located in an area clear of cultural interference capable of producing magnetic anomalies. Instrument operation shall be in accordance with the manufacturer's operating instructions. Following a battery check, the magnetic base station will be time-synchronized with the magnetic gradiometer (G-858G) and programmed to measure the intensity of the earth's magnetic field at 10-second intervals during the magnetic survey. These data will later be used to de-drift G-858G survey data for variations in the earth's magnetic field.

Magnetic gradiometer data will be collected at 0.1-second intervals (approximate 0.5- to 1.0-foot intervals) along N-S oriented survey lines spaced 5 feet apart. The magnetic gradiometer data will be stored in the internal memory of the G-858G, along with corresponding line and station numbers and the time of acquisition.

Magnetic gradiometer base station and field data will be downloaded to a laptop computer as the survey progresses, de-drifted using the magnetic base station data, and reviewed in the field using the Magmap® program to assess data quality. The data will be backed up on 3.5-inch floppy disks. Magnetic gradiometer field data files and corresponding base station files will be recorded on the Field Data File Tracking Form (Figure 4-2); Magnetic gradiometer base station data will be evaluated and recorded on the Gradiometer Base Station Summary Form (Figure 4-3); Magnetic base station data will be processed and recorded on the Magnetic Base Station Processing Form (Figure 4-4).

Color-enhanced contour maps of G-858G total magnetic field and vertical magnetic gradient data will be generated in the field using the GEOSOFT® geophysical mapping system. The contour maps will be color-enhanced to facilitate recognition and interpretation of subtle anomalies. Geometry and data edits will be recorded on the Geophysical Data Editing Form (Figure 4-5), and select parameters and final processed file names will be recorded on the GEOSOFT Data Processing Form (Figure 4-6).

Anomalies observed in the magnetic data will be correlated with anomalies seen in the EM-31 data to aid in interpretation of source materials. The anomalies will be field-checked immediately following the survey to differentiate between those caused by surface and subsurface sources. The contour maps will be used to illustrate each site and the locations of any buried ferrous metallic fragments potentially representing the burning ground. Anomalies verified as being caused by subsurface objects thought to represent the target burning ground will be recorded on the field interpretation map and marked in the field for further characterization with GPR.

4.1.4 Electromagnetic Surveys

EM surveys will be conducted to locate any buried metallic fragments and/or areas of anomalous soil conductivity potentially representing the burning ground.

EM surveys that utilize the EM-31 terrain conductivity meter measure the electrical conductivity of subsurface material. Instrument performance involves the induction of an electrical current into the subsurface. An alternating current passing through a transmitter coil produces a primary, time-varying magnetic field in the subsurface. The primary magnetic field produces small eddy currents in the subsurface. These eddy currents produce a secondary magnetic field. The instrument's receiver coil detects both the primary and secondary fields.

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD DATA FILE TRACKING FORM

Project Name: _____ Project No: _____ Sheet ___ of ___

Site Name: _____ Processed by: _____

Data Type: _____ Date: _____

Date	Field Data Files	Base Station Files	Base Station Files	Comments

IR/6-93/EES/geopfrm.tm

FIGURE 4 - 2

INTERNATIONAL TECHNOLOGY CORPORATION

Gradiometer Base Station Summary Form

Project Name: _____ Project Number: _____ Sheet___of___

Site Name: _____ Processed by: _____

Instrument Type: _____

Date	Base Station File	Average TMF Lower Sensor (nT)	Average TMF Upper Sensor (nT)	Average Gradient (nT/m)

KN/1992/WP1992.FM5/08-29-95(2:17pm)/DO/NE

FIGURE 4 - 3

INTERNATIONAL TECHNOLOGY CORPORATION

Magnetic Base Station Processing Form

Project Name:_____ Project Number:_____ Sheet___of___

Site Name: _____ Processed by:_____

Instrument Type:_____ De-Drift Software:_____ Date_____

Field Data File	Summary of Corrections Made	Julian Date	Time Range (Hrs.)	Corrected Field Data File (.NEW)	XY Data File (.DAT)	Plot file (.PLT)	Data Editor

KN/1992/WP1992.FM6/02-23-96(10:49am)/DO/NE

FIGURE 4 - 4

INTERNATIONAL TECHNOLOGY CORPORATION

Geophysical Data Editing Form

Project Name: _____ Project Number: _____ Sheet___of___
Site Name: _____ Processed by: _____
Instrument Type: _____ Date: _____

Field Data File	Line Number	Station Range	Summary of Corrections Made	Corrected Field Data File (.NEW)	Output Geosoft Format Data File (.XYZ)	Data Editor

KN/1992/WP1992.FM7/02-27-96(3:55pm)/DO/NE

FIGURE 4 - 5

INTERNATIONAL TECHNOLOGY CORPORATION

GEOSOFT DATA PROCESSING FORM

Project Name: _____ Project Number: _____ Sheet ___ of ___
Site Name: _____ Processed by: _____
Data Type: _____ Date: _____

INPUT FILE	(.dat)					Comments:
XYZLINE	(.xyz)					Comments:
XYZMERGE	(.xyz)					Comments:
XYZSTAT	(LZ-HZ)					LZ=Low Z Value HZ=High Z Value
MAPSET	(.mdf)					Scale:
BIGRID ☐ RANGRID ☐ KRIGRID ☐	(.con) (.grd)					Comments:
GRIDHANN ☐ GRIDFILT ☐	(.con) (.grd)					Number of Passes:
GRIDZONE	(.zon) (CI.EF.M)					Color Table: CI=Contour Interval EF=Expansion Factor M=Mean
STAKPLOT	(.con) (.plt)					Comments:
CONTUR	(.con) (.plt) (CI)					Comments: CI=Contour Interval
MAPPLOT	(.con) (.plt)					Comments:
PLMERGE	input (.plt) output (.plt)					Comments:

FIGURE 4 - 6

Changes in magnitude and phase of these magnetic fields depend on the conductivity of the medium and are linearly related to the ground conductivity.

The EM-31 is designed to measure both the 90°F out-of-phase (quadrature) and the in-phase components. The quadrature component is directly related to the conductivity of subsurface materials, whereas the in-phase component is generally more sensitive to buried metals.

EM Survey Field Procedures. The field instrument base station (same as for the G-858G magnetic gradiometer) will be used as a calibration point for the EM-31 and also to establish a baseline system response for verifying proper instrument operation during the surveys. Instrument operation shall be in accordance with the manufacturer's operating instructions.

After establishing the field instrument base station, an EM-31 battery check will be performed, the instrument will be calibrated, and the in-phase component will be zeroed. Approximately 20 readings of conductivity and in-phase component will then be recorded in the digital data logger. These data will provide a quantitative record of instrument variation or drift during the survey period. The field instrument base station will be reoccupied throughout the day, at approximately 2 to 3 hour intervals, where 20 additional conductivity and in-phase components will be collected and compared with the initial base station data set to determine if instrument drift has occurred during the survey period. The acceptable "drift" range in conductivity data as determined by analysis of EM-31 base station data is plus or minus 5 percent (e.g., 1 millisiemen per meter [mS/m] in materials of average 20 mS/m conductivity) of the measured conductivity.

EM-31 survey data will be collected at 5-foot intervals along N-S and east to west oriented survey lines spaced 10 feet apart. EM-31 base station and field survey data will be stored in separate files in a digital data logger programmed with appropriate line and station numbers.

EM-31 base station and field data will be downloaded to a laptop computer as the survey progresses and line profiles will be reviewed in the field using the DAT-31® program to assess data quality. The data will be backed up on 3.5-inch floppy disks. EM-31 field data files and corresponding base station files will be recorded on the Field Data File Tracking Form; EM-31 base station data will be evaluated and recorded on the Geonics EM-31 Base Station Summary Form (Figure 4-7).

INTERNATIONAL TECHNOLOGY CORPORATION

Geonics EM-31 Base Station Summary Form

Project Name:_____ Project Number:_____ Sheet___of___.
Site Name:_____ Processed by:_____

Date	Base Station File	Average Conductivity (mS/M)	Average In-phase Component (ppt)	Corresponding Data File(s)

KN/1992/WP1992.FM1/07-26-95(10:20am)/DO/NE

FIGURE 4 - 7

Color-enhanced contour maps of EM-31 conductivity and in-phase component data will be generated in the field using the GEOSOFT® geophysical mapping system. The contour maps will be color-enhanced to facilitate recognition and interpretation of subtle anomalies. Geometry and data edits will be recorded on the Geophysical Data Editing Form, and select parameters and final processed file names will be recorded on the GEOSOFT Data Processing Form.

Anomalies observed in the EM-31 data will be correlated with anomalies seen in the magnetic data to aid in interpretation of source materials. The anomalies will be field-checked immediately following the survey to differentiate between those caused by surface and subsurface sources. The contour maps will be used to illustrate each site and the locations of any buried metallic fragments and/or areas of anomalous soil conductivity potentially representing the burning ground. Anomalies verified as being caused by subsurface objects thought to represent the target burning ground will be recorded on the field interpretation map and marked in the field for further characterization with GPR.

4.1.5 Ground Penetrating Radar Surveys

GPR surveys will be conducted to further characterize source materials responsible for observed EM-31 and magnetic anomalies.

GPR involves a system that transmits electromagnetic pulses into the ground from an antenna near the surface. These pulses are reflected from various subsurface interfaces back to a receiver. As the antenna is hand-towed along a survey line, the GPR signals are either simultaneously processed and displayed on a graphic recorder or recorded and later processed and displayed. The displayed data are a continuous profile along the survey line, depicting time versus distance.

GPR depth of penetration is highly site specific and depends on the near-surface soil conductivity. Highly-conductive soils, such as clays, can reduce signal penetration to less than 1 foot, whereas less conductive materials, such as poorly-graded sands or limestone bedrock, may allow depth of penetration in excess of 50 feet.

GPR Survey Field Procedures. Instrument operation shall be in accordance with the manufacturer's operating instructions. Prior to collecting survey data, the GPR will be field-checked at a GPR/utility locator base station. This base station will be established where subsurface utilities and their depth bgs are known. Initially, several test GPR profiles will be

acquired with the 300- and 500-MHz antennae along lines perpendicular to the known orientation of the buried utility at the GPR/utility locator base station. GPR profile data representing both antennae will be recorded as the antenna is towed across the survey line. The electromagnetic signal velocity may then be calculated and used to determine approximate depths of other anomalies located in similar subsurface conditions. If no known calibration object is available, approximate signal velocities may be obtained from published tables by selecting a velocity for the type of soil that most closely resembles the site soil conditions.

The GPR signal will be gained by applying specific multipliers relative to depth to the amplitudes of the signal to maximize the signal-to-noise (S/N) ratio. This procedure is done to account for the rapid loss of energy of the electromagnetic waves as they travel through the subsurface. Time range and filter/gain settings will be set and recorded for each antenna.

All GPR system parameters will be recorded digitally in the GPR profile header at the time of data acquisition and selected parameters will be recorded on the GPR Data Acquisition Form (Figure 4-8); Survey line information will be recorded on the GPR Data Tracking Form (Figure 4-9). Based on the system response at the field survey locations, an antenna will be chosen and GPR parameters specific to the antenna (chosen at the base station) will be recalled and used during data acquisition, unless site-specific conditions indicate modifications should be made to the previously chosen parameters. At the start and end of each work period, the GPR system configuration used for field data acquisition will be field-checked at the GPR/utility locator base station and test data will be reviewed and compared with previous base station profile data to verify proper system operation.

GPR profile data will be collected along perpendicular survey lines centered on EM-31 and magnetic anomalies and extend to background subsurface conditions. Control points will be marked with surveyor's paint at 5-foot increments along the survey lines and the line locations will be recorded on the field interpretation map. GPR profile data will be collected semicontinuously (24 scans per second) as the antenna is towed across the survey lines. A marker switch on the antenna unit will be used to mark control points on the GPR records. The GPR data will be field-reviewed in real time on a color monitor and stored to 8-millimeter (mm) digital tape. GPR data processing will be performed, as necessary, using GRADIX® processing and interpretation software by Interpex. Processing will be conducted to enhance features of interest and maximize the S/N. Specific processing parameters will be recorded on the GPR Data Processing Form (Figure 4-10).

INTERNATIONAL TECHNOLOGY CORPORATION

GPR Data Acquisition Form

Project Name: _____ Project Number: _____ Sheet ___ of ____

Site Name: _____ Acquired by: _____

System Type: _____ Date: _____

File No.	Line No.	Sta. Range	Direction	Antenna	Range	TICS	Tape No.	Comments

FIGURE 4 - 8

INTERNATIONAL TECHNOLOGY CORPORATION

GPR Data Tracking Form

Project Name:_____ Project Number:_____ Sheet____ of_____
Site Name:_____ Processed by:_____
Tape Name: _____ Date:_____

File	Line Number	Station Range	File Name	File	Line Number	Station Range	File Name
1				26			
2				27			
3				28			
4				29			
5				30			
6				31			
7				32			
8				33			
9				34			
10				35			
11				36			
12				37			
13				38			
14				39			
15				40			
16				41			
17				42			
18				43			
19				44			
20				45			
21				46			
22				47			
23				48			
24				49			
25				50			

FIGURE 4 - 9

INTERNATIONAL TECHNOLOGY CORPORATION

GPR Data Processing Form

Project Name: _____ Project Number: _____ Sheet ____ of _____

Site Name: _____ Date: _____

Date Acquired	Tape No.	File No.	Line No.	Sta. Range	Reverse (Y/N)	Header Mod (Y/N)	Horizontal Filter	Vertical Filter	Final Gain	Final GPR Profile Name

FIGURE 4 - 10

GPR records will be evaluated to determine the depth penetration at each site and to determine the lateral extent and approximate depth bgs of anomaly source materials. The interpreted locations of source materials will be placed on the geophysical interpretation map and marked in the field, as required.

4.1.6 Subsurface Utility Verification

In areas of the site where EM-31 or magnetic anomalies potentially representing pipelines/-utilities are observed in the contoured data, the lines will be verified with the utility locator and checked against the blue prints if available from the engineering building at PBS. Verification is necessary since the anomalous response caused by subsurface utilities may sometimes be mistaken for a linear trench containing metallic debris.

The utility locator is an electromagnetic instrument designed to locate and delineate underground pipelines, cables, and utilities. Instrument performance involves transmitting a radio frequency signal that induces a secondary field in a buried conductor. This secondary field is sensed and indicated by an audible response.

Utility Verification Field Procedures. The utility locator will be field-checked at the start of each work period at the GPR/utility locator base station. Instrument operation shall be in accordance with the manufacturer's operating instructions. Battery checks will be conducted on both the transmitter and receiver units to ensure an adequate signal is being transmitted and received over the known pipeline. The battery checks and pipeline location test will be repeated at the end of each work period to verify proper instrument response. All testing results will be documented on the FADL.

Each subsurface utility will be verified by first locating the transmitter over the suspected area of the utility and circling the transmitter with the receiver at a radius of about 40 feet. When a strong receiver response occurs, the transmitter will be moved to that location and the circling process will be repeated with the receiver to accurately locate the subsurface utility. The location of all utilities will be marked in the field with surveyor's paint and recorded on the field interpretation map.

4.2 Soil Gas Survey

Soil gas survey will not be included in these investigations.

4.3 Groundwater

Groundwater investigation will be conducted at PBOW to acquire information regarding groundwater level, groundwater flow, and contamination in relation to known or suspected contaminated areas. The groundwater investigation consists of installation of new monitoring wells and collection of groundwater samples from both new and existing wells.

4.3.1 Monitoring Well Installation

New monitoring wells will be installed above the soil and bedrock interface as part of the groundwater investigation. Borings for the installation of the wells will be advanced in the residual soils using hollow-stem auger drill method or other appropriate drilling method. The rationale for the well placement, as well as anticipated depths and screen depths, are given in the site-specific attachments.

For all monitoring wells, samples will be collected continuously with a stainless-steel continuous core sampler during drilling, to provide a detailed lithologic log. Selected samples will be collected for grain-size analysis and to determine Unified Soil Classification System (USCS) soil classification in accordance with the American Society for Testing and Materials (ASTM) methods.

An IT geologist will supervise the drilling of each borehole and will maintain a record of the drilling and soil conditions encountered. The geologist will maintain continuous, legible, and detailed drilling logs (Figure 4-11) from examining drill cuttings, recording samples/cores, and noting first-encountered and static groundwater levels for each borehole. Daily field notes will be kept in a bound logbook and will include sufficient information to reconstruct the progress of drilling operations, problems encountered, well installation procedures, etc. After completion of database entry, all field forms and documents will be archived in the project files at the IT offices in Knoxville.

After completion of the borings, well installations will be performed in conformance with USACE engineer manual EM-1110-1-4000 (USACE, 1994) requirements. Representative samples of graded filter pack material will be evaluated and the filter sand will be selected before drilling. The well will be constructed by placing a 1-foot layer of sand in the borehole below the screen and bringing the filter pack to 3 feet above the top of screen. Screen lengths for the wells are specified in the site-specific attachment. A 3- to 5-foot-thick bentonite pellet seal will be placed above the sand pack, depth permitting, and the remaining annular space between the top of the seal and the elevation of the local frost line (42 feet

HTRW DRILLING LOG

HTRW DRILLING LOG	DISTRICT	HOLE NUMBER
1 COMPANY NAME	2. DRILL SUBCONTRACTOR	SHEET SHEETS OF
3 PROJECT	4 LOCATION	
5 NAME OF DRILLER	6 MANUFACTURER'S DESIGNATION OF DRILL	
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8 HOLE LOCATION	
	9 SURFACE ELEVATION	
	10. DATE STARTED	11 DATE COMPLETED
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16 DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14 TOTAL DEPTH OF HOLE	17 OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19 TOTAL NUMBER OF CORE BOXES

20 SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21 TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR

LOCATION SKETCH/COMMENTS SCALE:

PROJECT	HOLE NO

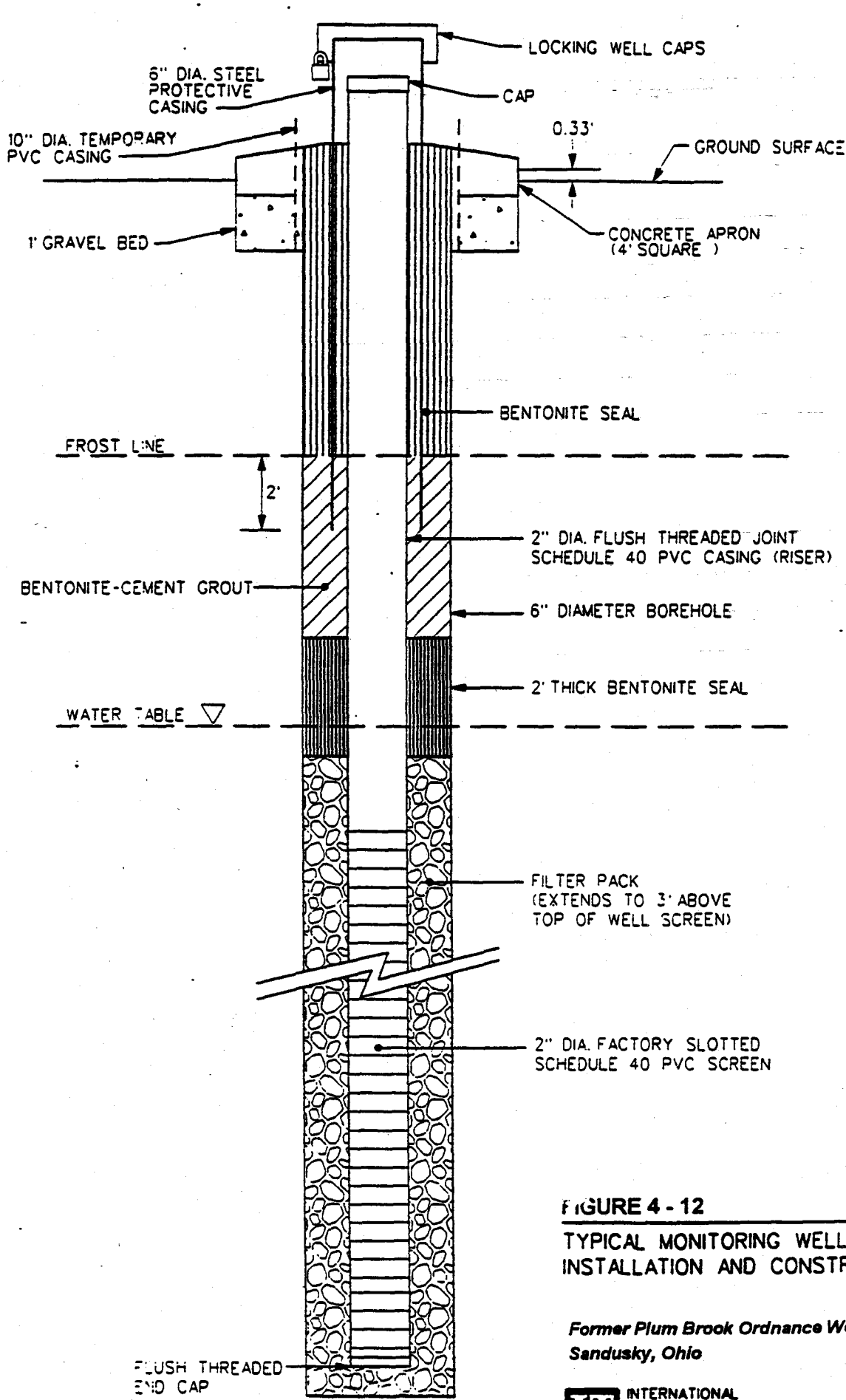
ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

Figure 4-2. HTRW Drilling Log

below ground surface, Sandusky City Engineering Office, 419-627-7829) will be grouted continuously. The type of grout to be used will be bentonite-cement slurry grout with about 5 percent bentonite powder and 95 percent Type 1 portland cement, mixed with 5 to 7 gallons of clean water. Bentonite pellet will then be placed from the frost line to the ground surface. If shallow water table is encountered, grouting to the local frost line may not be possible. In each case, bentonite pellet will be placed from the top of the filter pack up to the ground surface to ensure an adequate seal.

Surface protection will consist of a 6-inch-diameter steel surface casing extending approximately 5 feet into the ground (2 feet below the frost line), where possible, and approximately 2.5 feet above the ground (a maximum of 0.2 foot above the top of the polyvinyl chloride (PVC) well casing) with a lockable cap set into and surrounded by a concrete pad 4 feet square and approximately 4 inches thick. To prevent the well casing from frost heave damage, the concrete pad will be constructed as shown in Figure 4-12 and follow procedures below. Initially, a pit 4 by 4 feet around the protective casing will be dug to a depth of about 1 foot and 4 inches. A 2-foot-long, 8- or 10-inch-diameter PVC pipe will then be placed temporarily around the 6-inch steel casing; the annulus between the 8- or 10-inch PVC casing and the 6-inch steel casing and that between the steel casing and the 2-inch riser will be filled with bentonite pellets. Bentonite will be hydrated up to 1 hour using distilled water to form a "bentonite plug." Then, a 1-foot-thick gravel base will be laid in the pit. After the 8- or 10-inch temporary PVC casing is removed, concrete will be poured on top of the gravel base. The pad will be sloped a minimum of 2 inches from the surface casing to the edge of the pad to provide positive drainage. Four 3-inch-diameter steel posts extending 3 feet above the pad will be driven 3 feet into the ground at equal spacing around the surface casing outside of the perimeter of the concrete pad. An internal drainage hole will be drilled through the steel casing just above the mortar collar. Completed wells will be surveyed by a licensed land surveyor and a permanent metal tag will be attached to the steel casing. The stamped metal tag will indicate the Nashville COE District, well identification, date of installation, and elevations of top and bottom casing.

A well installation diagram illustrating the depth of the boring, screen location, sand filter pack material, seals, grout, and height aboveground surface will be submitted to USACE, and will be included in the investigation report. The well installation diagram and boring logs will also be filed with Ohio Department of Natural Resources.



NOT TO SCALE

FIGURE 4 - 12

TYPICAL MONITORING WELL INSTALLATION AND CONSTRUCTION

Former Plum Brook Ordnance Works
Sandusky, Ohio

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: 762430ES.004 | PROJ. NO.:
INITIATOR: G.YU | PROJ. MGR.: D.BURTON
DRAFT. CHCK. BY: D.AGUILAR | ENGR. CHCK BY: G.YU
DATE LAST REV.: | DRAWN BY:
STARTING DATE: 05/16/95 | DRAWN BY D.AGUILAR

762430ES.004 15:45 Sep 20, 1995 KLW

4.3.2 Monitoring Well Development

After each well has been constructed, but no sooner than 48 hours nor later than 7 days after the grouting and concrete apron have been placed, each well will be developed as required by the SOW. Wells will be developed by pumping or bailing without using acids, flocculents, disinfectants, or dispersing agents. All purged water will be drummed at the well site. Well development will be completed by bailing, pumping, and surging. During development, the pump inlet will be moved through the entire screened interval or the bailer will be lifted from different depths in the well. The development procedure will continue until the following conditions are met:

- Water is clear to the unaided eye and free of sand
- Turbidity measurement will be taken during and at the end of well development
- Thickness of the accumulated sediment in the well is less than 5 percent of the length of the well screen
- Temperature, pH, and specific conductance values stabilize to within $\pm 0.5°C$, ± 0.2 pH units, and less than 10 percent variation, respectively, for three consecutive readings
- A volume of water equal to five times standing water in the well including the well casing and screen, and the saturated annular space assuming 30 percent porosity has been removed.

Water shall not be added to the well once the well has been grouted and sealed. If heavy or caked sediments must be removed by washing, the water will be from a potable water source and a sample will be submitted for analysis.

If after 6 hours of well development the groundwater is not clear and free of sand, the USACE will be contacted for consultation and further instructions. After final development of each well, approximately 1 liter of water from the well will be collected in a clear glass jar, labeled, and photographed (35-mm color print). The photograph will be submitted as part of the well development log. The photograph will be a suitably back-lit close-up to show the clarity of the water. The development water sample will be archived until receipt of developed prints.

4.3.2.1 Well Redevelopment

If one of the following conditions are found to be exhibited at a well to be sampled, the well may be redeveloped according to the same procedures set forth in Section 4.3.2:

- Sediment accumulation in the well covers more than 5 percent of the total length of the well screen
- Turbidity of groundwater is greater than 20 Nephelometric Turbidity Units (NTU) after the well has been purged prior to sampling
- Recharge has declined through time; slow recharge is defined as a condition where upon removal of fluids from a well, the water level has not reached static level within 24 hours.

If after two episodes of redevelopment the well still does not meet the requirements set forth in Section 4.3.2, the well shall be deemed nonfunctional and may be scheduled for replacement or abandonment.

4.3.2.2 Development Records

The following records will be kept on a Well Development Log (Figure 4-13):

- Project name and location
- Well designation and location
- Date and time of well installation
- Date and time of well development
- Static water level from top of well casing before and 24 hours after well development
- Quantity of fluid in well prior to development:
  - Standing in well
  - Contained in saturated annulus based on an assumed 30 percent porosity
- Field measurement of pH, conductivity, and temperature before, twice during, and after development
- Field measurement of turbidity (NTU) twice during development
- Depth from top of well casing to bottom of well

WELL DEVELOPMENT LOG

WELL No.: | **PAGE:** of

Project Name: | *Site:*

Project No.: | *Client/Project:*

Contractor: | *Dev. Contr.:* | *Csg Dia.:*

Date/Time Start: / / | *Date/Time End:* / / | *Dev. Rig(Y/N):*

Development Method:

Equipment:

Pre-Dev. SWL: | **Maximum drawdown during pumping:** at gpm.

Range and Average discharge rate: gpm. | **Documented by:**

Total quantity of material bailed: | **Assisted by:**

Total quantity of water discharged by pumping:

Disposition of discharge water:

TIME *military*	WATER LEVEL *(btoc)*	VOLUME REMOVED *(gal)*	TURB. *(NTU)*	CLARITY COLOR	TEMP *deg C*	pH	COND. *umhos/cm)*	REMARKS

COMMENTS:

FIELD FORM

WLDEVLG

FIGURE 4 - 13

- Screen length
- Depth from top of well casing to top of sediment inside well, before and after development
- Physical character of removed water, including changes in clarity, color, particulate, and odor
- Type and size/capacity of pump and/or bailer used
- Description of surge technique
- Measured height of well casing above ground surface at time of development
- Typical pumping rate and estimated well yield
- Quantity of water/fluid removed during development, both incremental and total.
- Disposal of development water.

4.3.3 Water Level Monitoring

The depth to water will be measured prior to purging to the nearest 0.01 foot from the highest point on the riser (inner casing), or from a marking on the riser from which the elevation has been surveyed. Water level measurement will be documented in Groundwater Level Measurement Form as shown in Figure 4-14.

4.3.4 Groundwater Sampling

Groundwater samples will be collected from existing and newly installed monitoring wells. Proposed and existing groundwater monitoring well locations are shown in the figures presented in the site-specific attachments. The analyses to be performed on samples collected from each of the wells are identified in tables located in these attachments.

Groundwater sampling will be conducted from the areas assumed to be least contaminated to the areas assumed to be most contaminated. All sampling and purging equipment (pumps, tapes, discharge piping) will be decontaminated before use and before each successive use in accordance with the decontamination procedures in Chapter 5.0. Collection of groundwater samples will be documented in Groundwater Sampling Log as shown in Figure 4-15.

GROUND WATER LEVEL MEASUREMENTS

PROJECT No.: _____ FIELD CREW MEMBERS: _____

PROJECT NAME: _____ POINT OF REFERENCE: _____

WELL NUMBER	DATE	TIME	DEPTH TO WATER	INITIALS	COMMENTS

FIELD FORM REVISION DATE: 12/07/90 WATLEVEL.WK1

FIGURE 4 - 14

FIGURE 4-15

GROUNDWATER SAMPLING FORM

INTERNATIONAL TECHNOLOGY CORPORATION

Project Number: _____
Project Name: _____
Investigation Site: _____
RFA/COC Number: _____

Collection Date: _____
Collection Time: _____
Sample Filtered (Yes / No): _____
Weather/Temp: _____

Form Completed By: _____
Sampler(s): _____
Reviewed By: _____

Sample Number: P B O W – __ __ – __ __ – __ __ __ – __ __ __ __ __ __ __ – __ __ __ __ – (__ - __ __ __)

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

Well Number: _____
Well Secure (Yes / No): _____
Well Labeled (Yes / No): _____
Well Condition: _____
Screen Height: _____
Casing Type: _____

Outside Casing Dia. (in): _____
Depth to Product (ft): _____
Total Well Depth (ft): _____
Depth to Water (ft): _____
Water Column (ft): _____
Elev. Ref. for Water Level: _____

Odor: _____
Vapor Monitor Type: _____
- Vapor Monitor S/N: _____
- Reading (ppm): _____
Remarks: _____

MONITORING WELL PURGE CALCULATIONS AND PURGE RECORD

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

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

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

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

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

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

Purge Cycle	Time (24 hr)	Depth to Water	Conductivity	pH	Eh	Temperature	Turbidity	Diss. O_2	Purge Volume
Units:		Feet	umhos/cm	Standard Units	ppm	°F	NTU	ppm	gallons
Purge Vol 1									
Purge Vol 2									
Purge Vol 3									
Purge Vol 4									
Purge Vol 5									
SAMPLE									

SAMPLE ANALYTICAL INFORMATION

Requested Analysis	Method	Requested Analysis	Method	Requested Analysis	Method

Groundwater Sampling Equipment. The equipment required for groundwater sampling includes:

- Water level indicator
- Low-flow submersible pump with Teflon®-lined tubing
- Teflon or stainless-steel bailer of appropriate size for the monitoring well fitted with a bottom-emptying device
- Nylon rope
- Eh, dissolved oxygen, pH, temperature, turbidity, and conductivity meters
- Appropriate sample bottles and temperature-controlled container
- Plastic sheeting
- 5-gallon buckets with lids
- Photoionization detector (PID)
- Pump and/or stainless-steel and/or PVC bailers for purging.

Groundwater Sampling Procedure. Sampling of newly installed monitoring wells will take place no sooner than 14 days after well development has been completed. All equipment used to purge wells and collect samples will be protected from ground surface contact and contamination by use of clean plastic sheeting. The following procedures will be followed when collecting groundwater samples from all monitoring wells:

- The well will be checked for proper identification and structural integrity.
- After unlocking the well and removing the well cap, a PID will be used to measure the concentration or organic vapors at the top of casing and in the breathing zone. If readings are above background, safety precautions outlined in the SHP and SSHP will be followed.
- The depth to water will be measured using a decontaminated water level indicator, then the volume of water in the well casing and screen, and the volume present in the saturated annulus (filter pack) will be calculated.
- Where recharge rates permit, the well will be purged by an appropriate submersible sampling pump to remove three to five times the volume of the standing water in the well casing and saturated annulus. A bailer will be used if well

yield rates prohibit use of a pump. Review of permeability testing at wells installed by IT during the 1989 contamination evaluation indicate that all wells to be sampled will recharge rapidly enough to be purged.

- During purging, field measurements of pH, Eh, temperature, turbidity, and conductivity will be performed preferably after each well volume.

- Where possible, groundwater samples will be collected using a submersible sampling pump and in-line sampling. Where the use of in-line sampling is not possible, a bottom-emptying Teflon bailer will be used. Decontamination procedures are given in Chapter 5.0.

- At the time of sampling, after collection of the sample for chemical analysis, a second sample will be collected for field measurements of temperature, pH, Eh, dissolved oxygen, turbidity, and conductivity. Detailed procedures for these measurements are presented in site-specific attachments.

- Sample containers will be labeled with appropriate identifying information (location, date, time, condition, added preservatives, etc.). The preprinted labels will be provided by the field sampling crew leader. Each sample will be logged in a field notebook at the time of collection. Sample containers of appropriate volume and composition will be prepared in advance to ensure the collection of sufficient volumes for all specified analyses.

- The samples will be collected in the order of priority as VOC, SVOC, nitroaromatics, metals, total cyanide, and pesticides/PCBs.

- Samples for volatile analysis will be collected in screw-cap, septum-top glass vials and filled so that there are no air bubbles present to allow volatilization.

- Samples for metals analysis and/or nitroaromatics (as described in the site-specific addenda) will be collected in two separate containers; one will be filtered and the other will not be filtered. Samples will be filtered according to the following procedures:

  - The water sample will be filtered at the well site with portable sample filtering equipment or at the field office to remove any remaining suspended formation particles.

  - A Millipore filtration apparatus (or comparable equipment) equipped with a 0.45-micron filter will be used. The filtering apparatus will be cleaned following procedures set forth in 5.2 before filtering each sample.

- All sample containers will be transferred to a cooler chest (kept at 4 degrees Celsius (°C)] and delivered to the laboratory in sufficient time so that specified holding times are not exceeded.

4.3.5 Field Hydraulic Conductivity Testing

Field hydraulic conductivity will be evaluated at newly installed wells at the former PBOW by performing slug tests after well development. These wells will be specified in the site-specific attachments. To avoid altering the groundwater chemistry at the site by the introduction of water, water will be instantaneously removed (slug out) from each well to decrease the hydraulic head. The head recovery rate will be recorded, and these data will then be evaluated by the appropriate method to determine in situ hydraulic conductivity. Pressure transducers and electronic data loggers will be used to record water level changes in the well during the test. Test data will be downloaded to a laptop computer and preprocessed by the IT hydrogeologist before departure from the site to ensure complete and usable data are collected. One test will be performed in each new well unless unusable data are obtained. Slug test data will be analyzed for aquifer parameters using a computer software AQTESOLV. Permeability testing procedures will be detailed in site-specific Attachment V.

4.4 Surface and Subsurface Soil Sampling

Surface Soil Samples for Screening. Surface soil samples for screening refer to the collection of native soil samples from above the 0.5-foot depth. Samples collected for field screening purposes will be collected at the appropriate depth using a stainless-steel split-spoon sampler. If the soil is too hard to use a hand sampler, a power auger will be used in conjunction with the split-spoon sampler.

Samples will be collected as directed by the IT geologist based on observed contamination and or lithologic characteristics. This strategy will be followed to the maximum depth of each boring.

Before collecting a surface sample, debris such as rocks and twigs will be cleared from the immediate area. After the split-core sample is collected, the soil will be homogenized as thoroughly as possible in a stainless-steel bowl (samples for VOC analysis will not be homogenized) using a stainless-steel spoon. The sample will then be placed in a labeled 4-ounce amber bottle for field screening.

A Boring Log (Figure 4-11) and a Sample Collection Log (Figure 4-16) will be hand completed in a neat and legible printing for each field screening sampling. All equipment used for collection, transferral, and homogenization will be properly decontaminated between uses, as described in Chapter 5.0. The boring logs will be included in the investigation report.

FIGURE 4-16

SAMPLE COLLECTION LOG

USE THIS FORM FOR ALL SAMPLE COLLECTION EXCEPT GROUNDWATER

INTERNATIONAL TECHNOLOGY CORPORATION

Project Number: _____

Project Name: _____

Collection Date: _____

Investigation Site: _____

Collection Time: _____

RFA/COC Number: _____

Sample Number: P B O W — __ __ — __ __ — __ __ __ — __ __ __ __ __ __ __ — __ __ __ __ — (__ - __ . __)

WATER SAMPLES (not groundwater):

For use with surface water samples, field blanks, equipment rinsates, etc.

Type of Water Body: _____

Sample Filtered (Yes / No): _____

Depth of Take Below Surface (ft): _____

Eh (mV): _____

pH (SU): _____

Conductivity (μmhos/cm): _____

Dissolved Oxygen (mg/L): _____

Temperature (°C): _____

Turbidity (NTU): _____

SAMPLE ANALYTICAL PARAMETER	ANALYTICAL METOD

SEDIMENT SAMPLES:

Depth of Water Above Sample (ft): _____

Depth of Take (ft): _____

SOIL SAMPLES:

Depth of Take (ft): _____

START	END
inches	inches
inches	inches
inches	inches
inches	inches

Headspace Reading: _____

Purpose (chemical / geotechnical): _____

Composite Sample (Yes / No): _____

Form Prepared By: _____

Sample Collected By: _____

Form Checked By: _____

Remarks/Comments: _____

SAMPLE LOCATION SKETCH:

Soil Boring Samples for Confirmation Analyses. Subsurface soil samples refer to confirmation samples collected below 1 foot.

Soil borings will be advanced using the hollow-stem auger method or by stainless-steel hand bucket auger, stainless-steel split-core sampler, or Little Beaver. If the hollow-stem auger method is used, this will be in accordance with the ASTM D-1586-84 and logged in accordance with ASTM D-2488-93 using the USCS. During advancement of the boreholes, a 1-1/2- to 5-foot-long steel split-barrel sampler will be used to collect soil samples. Soil samples will be continuously collected from 6 inches below the surface to the total depth of the boring. The entire length of the sample collected from the sampler will be field screened for the presence of organic vapors using an organic vapor analyzer (OVA), such as an HNu, and the soil will be visually classified. The depth interval and reading in units of ppm will be recorded for any portion of the sample where organic vapors are detected. Samples will be placed in the appropriate sample containers, labeled for proper identification, and packed in a cooler with ice pending the completion of the hole. Soil samples will be submitted for laboratory analysis based on the results of the field screening for organic vapors, visual evidence of contamination or alteration, predefined depth ranges for samples or other criteria as determined by the on-site geologist based on the conditions encountered. The criteria for sample selection will be documented on the FADL.

The field geologist will maintain a detailed boring log (Figure 4-11) during the drilling of each borehole. The log will serve as a record of sample collection, sample location and depth, and drilling procedures.

All soil cuttings generated during the drilling of soil borings will be handled in accordance with the investigation-derived waste (IDW) management plan in Chapter 8.0. The minimum number of samples selected and the specific laboratory analyses to be performed for each site are included in the site-specific attachments (I through V).

Soil Samples for Geotechnical Analyses. Selected soil samples may be collected for geotechnical analysis. All soil and sediment samples collected and submitted to the laboratory for chemical analysis will also undergo a moisture content analysis (ASTM D2216). In addition to this analysis, certain samples will be submitted for geotechnical analyses that may include one or more of the following:

- Sieve analysis (grain size with hydrometer) - ASTM D422
- Atterberg limits - ASTM D4318
- USCS classification - ASTM D2487.

The number of samples to be submitted for geotechnical analysis are summarized in the site-specific attachments.

4.5 Sediment Sampling

Sediment sampling is not included in this investigation effort at PBOW.

4.6 Surface Water Sampling

Surface water sampling is not included in this investigation effort at PBOW.

4.7 Other Matrices

No other matrices other than those described in Sections 4.3 and 4.4 will be sampled during this investigation effort at PBOW.

4.8 Land Surveying

Generally, land survey requirements for the investigations at PBOW will include the following:

- Establish grid corners of geophysical survey locations.
- Locate soil boring and monitoring wells sampling positions.
- Locate and establish elevation of installed monitoring wells and actual drilling sites of soil borings.

All elevation will be referenced to the 1988 North American Vertical Datum (NAVD). All horizontal coordinates will be referenced to the State Plane Coordinate Systems (SPCS), or if SPCS is unavailable, to an existing local grid coordinate system such as the one used by the NASA PBS. Elevation and coordinates will be surveyed to the closest 0.1 foot.

4.8.1 Control Monuments

Existing permanent control monuments will be used for each site. If existing permanent control monuments are unavailable, new control monuments will be provided after consultation with the USACE. Each new control monument will be located horizontally to the nearest 0.1 foot and referenced to the previously established site coordinate system. The elevation of

each monument will be measured to the nearest 0.1 foot and referenced to the 1988 NAVD. Each monument will consist of a standard 4-inch-diameter brass or aluminum monument embedded permanently in concrete. The identification, elevation, and coordinates will be inscribed on the monument. Control monument data will be included with other surveying data in the final report.

4.8.2 Monitoring Wells

Horizontal coordinates for all new monitoring wells will be measured to the nearest 0.1 foot and referenced to the SPCS. Elevations will be measured at the top of the well casing to the nearest 0.01 foot. All elevation measurements will be referenced to the 1988 NAVD. The measurement point on the top of the well casing will be clearly and permanently marked for future water level measurements. The unique monitoring well identification number will be permanently marked on the protective cover.

4.8.3 Geophysical Survey Grids

Geophysical survey grids will be surveyed at each of the four boundary corners. Grids within the survey boundary will not be surveyed. Survey of geophysical grids will be conducted concurrently with other land survey activities in order to locate the geophysical survey areas on the site map. Land survey prior to geophysical survey will not be required.

4.8.4 Soil Boring Locations

Each soil screening sampling location and soil boring will be established in the field by the site geologist/coordinator. Each location, once sampled, will be clearly marked with a stake, pin, or similar item until it can be surveyed. The sample location identifier will be written in waterproof ink on each marker.

Soil boring locations (samples below the 1-foot depth), once grouted and properly marked, will be surveyed for horizontal coordinates to the nearest 0.1 foot and referenced to the SPCS. Surface elevations of soil borings will be measured to the nearest 0.1 foot referenced to the 1988 NAVD.

5.0 Prevention of Cross Contamination

Drilling and sampling equipment decontamination will be performed to maintain integrity of the soil and groundwater samples collected. A temporary decontamination pad will be built and used for drilling equipment. The station will be lined with three layers of at least 6-milliliter-thick Visqueen®, and will be bermed on all sides. In addition to the berms, the decontamination pad will be constructed so that the drill rigs can be driven onto the Visqueen for decontamination and so that all decontamination water can be collected and placed in 55-gallon drums. Sampling and other portable equipment may be decontaminated at a fixed decontamination station. General procedures for decontamination of nonsampling and sampling equipment are described in the following sections.

5.1 Nonsampling Equipment

All equipment that may contact the interior of a hole or that may contact other equipment that will enter the hole (including, but not limited to, drill rods, bits, and tools) shall be thoroughly cleaned at the decontamination pad by using steam or high pressure hot water from a steam-cleaner prior to setting up on the first hole, between each hole, and following drilling of the final hole. No tools or drilling equipment may contact the ground or become contaminated after cleaning until used in drilling. If this situation occurs, contaminated items shall again be cleaned before use in the manner specified previously. At the drill site, cleaned equipment shall be kept off the ground by storing on cleaned metal racks (not wooded pallets) or on polyethylene-covered pallets. The drilling rig shall be cleaned between drilling each monitoring well and between mobilization from site to site.

5.2 Sampling Equipment

The following decontamination procedures will be used for all sampling equipment before site entry, between borings, and before site departure:

- Steam-rinse with potable water (metal soil sampling tools only)
- Wash and scrub using a brush with nonphosphate detergent
- Rinse with potable water
- Rinse with 10 percent nitric acid (glass and Teflon only)
- Rinse with deionized water (ASTM Type II water).

- Rinse with methanol. Follow with a hexane rinse if soil samples and sediment samples will be analyzed for pesticides/PCBs.

- Final rinse with deionized water. The volume of water used will be at least five times greater than the volume of methanol and hexane used.

- Air dry.

- Wrap in aluminum foil.

5.3 Decontamination Supplies

The following decontamination supplies are anticipated during field operations:

- Laboratory-grade nonphosphate detergent
- ASTM Type II water
- 10 percent nitric acid rinse solution
- Methanol
- Hexane (If testing for PCBs, pesticides, or fuels)
- Plastic sheeting
- Aluminum foil
- Spray bottles
- Stainless-steel sprayers
- Potable water - available at PBOW site.

6.0 Sample Chain of Custody/Documentation

6.1 Field Activity Daily Log

Field data collection activities will be recorded on the FADL as shown in Figure 4-1. Entries will be described at an appropriate level of detail so that the situation can be reconstructed without relying on memory. All log sheets will be kept in the project files. Project files will be turned over to the USACE at the completion of the project contract.

Entries on the logs will contain a variety of information. Specifically, this information will include:

- Project identification
- Field activity subject
- General work activity
- Unusual events
- Visitors on site
- Subcontractor progress or problems
- Communication with the client or others
- Weather condition
- IT personnel on site
- Sample number and time of day for each sample collected for analysis
- Listing by sample number of samples collected during the day, sorted by COC number (compiled at the end of the day); cross-reference between QA/QC samples and field samples
- Record of telephone call informing the laboratory of sample shipment
- Accomplishment of decontamination of drilling equipment and sampling equipment
- Accomplishment of required calibration checks

- Disposition of decontamination fluids
- Variances from project plans and procedures (details will be recorded in the variance log)
- Accomplishment of tailgate safety meetings
- Review of project procedures with site personnel
- Photographs taken and identification numbers
- Air monitoring readings, as appropriate.

6.2 Photographs

Color photographs (35-mm color print) will be taken of well development and soil sampling activities. The photograph number and roll number will be logged on the FADL to identify which sampling site is depicted in the photograph. Each film roll will be identified by taking a photograph of an information sign on the first frame. The job and film roll number will be written on each sign to identify the pictures contained on the roll; for example:

PBOW
Site Location
Roll Number 1
Frame Number 1 of 36
August 05, 1996 - (photographer's name)

Color print will be identified with the project number, date taken, and a brief description. Negatives and color prints will be kept in project central files.

6.3 Sample Numbering System

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

Project Code	Year	Sample Type[a]	Site[b] Identification	Location (Well ID)	Sample Number	Depth[c]
PBOW	96	XX	XXX	XXXX	XXXX	(XXXX)

[a]Sample type:

SO - soil sample
GW - groundwater sample
FD - field duplicate
MS - matrix spike
MD - matrix spike duplicate
SS - soil screening sample
FB - field blank
FS - field split
ER - equipment rinsite

[b]Site Identification:

TNTA - TNT Area A
TNTB - TNT Area B
TNTC - TNT Area C
PH2 - Powerhouse No.2 Ash Pit
2BG - Reservoir No.2 Burning Ground
ABG - Additional Burning Ground
WP2 - Waste Water Disposal Plant No.
WARWP - West Area Red Water Pond

[c]Depth: only required for soil samples.

PBOW-96-S0-ABG-0003-0129-(0'-0.5') signifies that this soil sample is collected at a depth between 0 and 0.5 foot bgs from soil boring 0003 with a laboratory number 0129 at Additional Burning Ground site at PBOW. "PBOW-96-GW-TNTC-BEDMW13-0235" indicates that this groundwater sample is collected from monitoring well BED-MW13 in TNT Area C with a laboratory number 0235. The complete sample number will be recorded by the IT field geologist or sampler in the FADL and/or in the Boring Log or in the Sample Collection Log as appropri ate.

6.4 Sample Documentation

6.4.1 Sample Labels

All physical samples for laboratory analysis obtained at the sites will be placed in an appropriate sample container for shipment to the laboratory. Each sample container will be

identified with a separate identification label (Figure 6-1). The following information will be included on the label:

- Project identification
- Sample identification
- Sample location
- Date of collection
- Time of collection
- Required analytical methods
- Sampler's initial.

6.4.2 Sample Logbook

A sample logbook will be used by the IT field geologist or sample technician to keep track of sample collection, designation, and packing and shipping information for all samples. Upon completion of the field work, the sample logbook will be kept in the project files for future reference.

6.4.3 Field Custody Procedures

Field custody procedural activity includes:

- Before sampling begins, the field coordinator will instruct site personnel in the COC procedures, as necessary.

- The quantity and types of samples and sample locations have been determined and are outlined in the SAP.

- The field coordinator determines whether proper custody procedures and report forms were used during the field work and documents results on the FADLs.

- The field coordinator has overall responsibility for the care and custody of the samples collected until they are transferred or properly dispatched to the laboratory. Each individual who collects a sample is responsible for sample custody until transferred to someone else via the analysis request/chain of custody (AR/COC).

- COC records initiated in the field shall be placed in a plastic bag and placed on top of the samples in the shipping container used for sample transport from the field to the laboratory.

- Additional samples that will be collected are classified as environmental or low-concentration samples.

- Shipping containers shall be secured using filament-reinforced strapping tape and custody seals to ensure that samples have not been disturbed during transport.

IT Corporation Project Number 766952 Plum Brook Ordnance Works	
Sample Number: Location: Sample Date:	Time:
Analysis:	
Preservation: Require 4C:	Filtered:
Sampler:	

FIGURE 6 - 1

The custody seals shall be placed on each container so that they cannot be opened without breaking the seal.

- Shipment information is recorded for shipment of samples at the end of the shift, day, or collection period on the FADL.

The AR/COC form (Figure 6-2), along with any instructions for filling the form, will be furnished by the laboratory that will analyze the samples.

Field custody procedures include:

- Before sampling begins, the principal investigator or the field coordinator will instruct site personnel in the AR/COC procedures, as necessary.
- The quantity, types, and identification of samples will be reviewed.
- Sampling locations will be finalized and annotated on a site map.
- The field coordinator has overall responsibility for the care and custody of the samples collected until they are transferred or properly dispatched to the laboratory. Each individual who collects a sample is responsible for sample custody until the sample is transferred to someone else via the AR/COC record form.
- Shipment information is recorded for shipment of samples at the end of the shift, day, or collection period on the FADL.

6.4.4 Transfer of Custody and Shipment

Transfer of custody and shipping procedures include:

- An AR/COC will be initiated in the field for each sample or group of samples up to ten. A copy of this record will accompany each sample shipment.
- The custody of individual sample containers will be documented by recording each container's identification on an appropriate AR/COC.
- Each time responsibility for custody of the sample changes, the new custodian will sign the AR/COC and note the date.
- The analyses to be performed for each sample will be recorded on an AR/COC.
- The waybill number will be recorded on the AR/COC when a commercial carrier is used.

INTERNAT. .AL
TECHNOLOGY
CORPORATION

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

Reference Document No: 5450/81

Project Number:

Project Name:

Sample Team:

Turnaround Time:

Samples Shipment Date:

Lab Destination:

Lab Contact:

Project Contact:

Carrier/Waybill No.:

Bill To:

Report To:

Sample No	Sample Date	Sample Time	Container	Preservative	Requested Testing Program	Fil	CID	Condition On Receipt

Special Instructions:

Possible Hazard Indentification:
Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐

Sample Disposal:
Return to Client ☐ Disposal by Lab ☐ Archive (mos.)

1. Relinquished By (Signature/Affiliation)	Date: Time:	1. Received By (Signature/Affiliation)	Date: Time:
2. Relinquished By (Signature/Affiliation)	Date: Time:	2. Received By (Signature/Affiliation)	Date: Time:
3. Relinquished By (Signature/Affiliation)	Date: Time:	3. Received By (Signature/Affiliation)	Date: Time:

Comments:

FIGURE 6 - 2

- If the laboratory sample custodian judges sample custody to be invalid (e.g., samples arrive damaged or custody seals have been broken), a nonconformance report will be initiated. The IT PM will be advised immediately and the samples will not be analyzed unless the IT PM so authorizes. The IT PM, the laboratory coordinator, and quality assurance officer (QAO) will be notified. The IT PM will make a decision as to the fate of the sample(s) in question on a case-by-case basis. The sample(s) will either be processed "as is" with custody failure noted along with the analytical data, or rejected with sampling rescheduled if necessary. The IT PM and QAO will sign-off the nonconformance report, noting the reason for disposition. Any problem with a sample will be noted in the appropriate data report.

- Upon sample destruction or disposal, the custodian responsible for the disposal will complete the AR/COC, file a copy, and send a copy to the IT PM or to his designated representative for record keeping.

6.4.5 Laboratory Receipt and Entry of Samples

Upon receipt at the laboratory, each sample is removed from the shipping container and the sample identification of the sample bottles is compared to the information contained in the COC documents. If discrepancies exist, appropriate notes (signed and dated) are made on the AR/COC and the shipping and receiving supervisor is notified; this supervisor in turn determines if a nonconformance report needs to be initiated.

Upon receipt of samples, the following items are checked against the AR/COC or the accompanying forms:

- The seals and tapes on the sample containers and cooler are unbroken and uncut.

- The sample containers in the cooler are intact and temperature of samples required to be preserved by cooling.

- The identification on the sample bottles corresponds to the entries on accompanying forms.

- The number of sample containers received (i.e., bottles) is equal to the number of samples listed on the COC record or accompanying forms.

Laboratory identification numbers are stamped on stickers and securely wrapped about each sample. If samples are to be shipped from one laboratory to another, proper COC and packaging procedures will be maintained.

Individual SOPs addressing sample receiving, tracking, storage, and security have been provided by Quanterra Environmental Services and are included as an appendix in the QAPP.

7.0 Sample Preservation, Packing, and Shipping

Samples will be collected in appropriate containers and preserved according to the procedures summarized in Table 5-1 of the QAPP. Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that it is received by the laboratory.

Unless prior arrangements are made, the sample containers will be shipped to the site with necessary preservatives added, except for the bottles to be used for dissolved metals analysis. Samples for dissolved metals analysis will be preserved after the water has been filtered.

Samples for geotechnical analysis need not be chemically preserved; however, the samples will be properly sealed to prevent moisture loss and will be packaged so that the material is adequately preserved in its natural state. Samples will be placed in sample containers that will be sealed with three wraps of electrical-type or duct tape around the lid lip.

Preservative and proper transferring equipment (pipettes) will be obtained from the laboratory that will perform the analysis. If field filtration equipment is unavailable or not working properly, the samples may be shipped to the laboratory unfiltered and unpreserved provided that arrangements have been made with the laboratory. However, complete documentation will be required on the Sampling Collection and/or Variance Log if unfiltered and/or unpreserved samples are sent to the laboratory.

Samples will be placed in coolers as soon as possible after collection and will be packaged so as to minimize the possibility of container breakage by using vermiculite or Styrofoam™ peanuts to fill void spaces in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4°C and maintained at that temperature by means of blue ice or packaged ice from the time the shipping carton is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by a next-day delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of sample collection. If this is not possible, the laboratory will be notified the following morning.

Completed AR/COC records will be included with each shipment of coolers. The AR/COC will be sealed in a plastic bag and taped to the inside lid of the cooler. The cooler drain will be taped shut and a completed shipping label will be taped to the top of the cooler. This Side

Up labels will be placed on four sides of the cooler and fragile labels will be placed on two sides of the cooler.

8.0 Investigation-Derived Waste Management Plan

The following sections describe procedures for the handling, temporary storage, and disposal of IDW. Management of IDW follows options from published EPA guidance documents, specifically, EPA's fact sheet, *Guide to Management of Investigation-Derived Waste*, January 1992, Publication 9345.3-03FS. The following procedures are established for IDWs generated primarily from CERCLA investigations because the guidance states that it is permissible to handle a material as nonhazardous with regard to the Resource Conservation and Recovery Act (RCRA) until it is proven to be a RCRA hazardous material. The status of IDW should be determined, as it relates to RCRA, and established before placement of the material.

IDW materials include cuttings from soil borings and monitoring well installations; decontamination fluids; purge water, soil, and other materials from the collection of samples; and disposable or contaminated personal protective equipment (PPE).

On-site disposal of an IDW, either in an area of known contamination (AOC) or within its point of origin, will be the preferred method of disposal for an IDW.

8.1 Minimization of Investigation-Derived Waste

Advance planning should be used to minimize the quantities of IDW generated. Boring sizes shall be as small as possible to accomplish the task. Excess soil and sediment from hand augering and similar applications to collect samples should be returned immediately to the location from which it was obtained. When this procedure is not possible, soils should be containerized and stored until disposal. The IDW is not suspected to pose any immediate threat to human health or the environment.

8.2 Surface Soil

Surface soil is the excess soil generated from the collection of surface soil samples and sediment samples. Because surface soil and sediment samples are considered to be at sampling depths less than 1-foot, grouting of the abandoned borehole is not normally necessary. Excess soil cuttings from each specific surface soil or sediment sample location will be disposed of from the point of origin, specifically in the borehole.

8.3 Drilling Cuttings from Borings

Drill cuttings are generated from borings for subsurface soil sample collection and from borings for monitoring well installations.

Drill cuttings generated from soil borings not converted to monitoring wells will be placed on plastic sheeting at the boring location. Upon completion of the soil boring and sample collection, the cuttings will be used to backfill the boring from where it was generated. Following backfill, the boring will be monitored to place additional backfill material to compensate for any settling that may occur. Excess soil will be spread out at the site.

Drill cuttings generated from monitoring well borings will be collected and placed in 55-gal. drums. One composite sample will be collected from all drums for each monitoring well and analyzed for full toxicity characteristic leaching procedures, except for herbicides and pesticides, for determination of disposal method. After validation of select samples is completed, all analytical results will be summarized in a letter report for review. If the well cuttings are determined to be nonhazardous, the cuttings will be disposed of in the following order:

- The drill cuttings will be placed on site at the specific boring location or point of origin.
- The drill cuttings will be transferred to a designated soils holding area and disposed of on site. Should a nonhazardous waste classification form be required for transportation purposes or otherwise, IT or its subcontractors will assist in preparing the form, but will not be responsible for signature as the waste generator.

Should the analytical results indicate the presence of contamination, the following disposal options may be implemented if the well drilling cuttings are determined to be hazardous:

- Consolidate in a pit (within the AOC)
- Containerize and allow the USACE to handle disposal
- Store for future disposal
- Treat consistent with the final remedy.

8.4 Purged Groundwater

Water generated from well development and purging activities will be collected and containerized from each individual well. The volume of development water and purge water will be measured and documented. The containers will be clearly labeled as to the contents, the

location at which the aqueous liquids were generated, and date. Never shall a container be labeled as containing hazardous material until a determination is made as to whether the material is hazardous. The analytical results, using methods outlined in Chapter 6.0, of discrete groundwater samples will serve as the basis for disposal of the purged groundwater generated. After the validation of select samples is completed, all analytical results will be summarized in a letter report for review. If the purged groundwater is determined appropriate for disposal, they will be disposed of in the designated IDW disposal area located south of Pentolite Road, adjacend to the Pentolite Road Red Water Ponds.

8.5 Decontamination Fluids

Decontamination fluids, wash water containing nonphosphate soaps and rinse water, will be collected and discharged. Subject to EPA approval, decontamination fluids will be discharged on site within an AOC.

Decontamination fluids, used in the final rinse of sampling equipment and containing solvents such as methanol and hexane, will be collected and segregated from other decontamination fluids. Because of the small quantity generated, these fluids will be collected in bright metal pans for evaporation.

8.6 Personal Protective Equipment/Disposable Equipment

PPE includes all gloves, Tyvek suits, and other disposable equipment that cannot be adequately decontaminated to permit safe re-use. This material will be collected in double plastic-bagged liners and disposed of in an approved industrial waste bin for subsequent disposal.

8.7 Field Screening Laboratory Waste

Laboratory wastes, generated from field screening of chemicals of concern in soils, will be collected and containerized for subsequent disposal either back on the site, the originating site, or, if so determined, as a hazardous waste.

8.8 Temporary Storage of IDW

IDW can be stored temporarily in a designated area. Drums will be staged on pallets and covered with a tarp. The staging area will have a plastic sheeting floor with built up sides so as to prevent the release to the environment any drum contents in the event of a drum failure or spill.

9.0 Variances, Nonconformances, and Corrective Action Procedures

9.1 Variances

Changes (variances) to this plan including site-specific addenda may be initiated either in the field or in the office as may be necessary. All variances will be noted on the FADL (Figure 4-1) and will be recorded on a Variance Log as shown in Figure 9-1. Variances will be approved by the QAO and the PM prior to implementation of the change. Variances that affect the project scope, cost, or schedule must be approved by USACE before being implemented.

9.2 Nonconformance and Corrective Action Procedures

Nonconforming equipment, items, activities, conditions, and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported in a timely manner. A nonconformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item unacceptable or indeterminate. The originator (any IT employee) of a Nonconformance Report (Figure 9-2) will describe the finding on the form provided for this purpose and will notify the PM and QAO. Each nonconformance will be reviewed and a disposition given for the item, activity, or condition. The disposition of a nonconformance will be documented and approved by the IT organization responsible for the issuance of the nonconformance. The QAO will concur with the disposition of the nonconformance.

The laboratory coordinator is responsible for assessment of QC sample information. If data fall outside accepted limits, the QA/QC coordinator will immediately notify the laboratory PM and the responsible group leader. If the situation is not corrected and an out-of-control condition occurs or is expected to occur, the QAO will notify the PM. The PM and group leaders are responsible for identifying the source of the nonconformance and initiating corrective action. Completion of corrective action should be evidenced by data returning to prescribed acceptable limits. The procedures for laboratory nonconformances are discussed in more detail in Section 13.0 of the QAPP.

The modification, repair, rework, or replacement of nonconforming equipment, items, or activities will require the reverification of acceptability. In certain instances, as determined by the PM or QAO, these actions may require that corrective action be completed and verified before site work continues.

INTERNATIONAL TECHNOLOGY CORPORATION

VARIANCE NO._____

VARIANCE LOG

PROJECT NO. 766952

PAGE ___ OF ___

PROJECT NAME Plum Brook Ordnance Works

DATE: _____

VARIANCE (INCLUDE JUSTIFICATION)

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: _____ Date: _____

Approved By: _____ Date: _____
Project Manager

_____ Date: _____
Quality Assurance Officer

_____ Date: _____

FIGURE 9 - 1

IT CORPORATION

NONCONFORMANCE REPORT

PROJECT NO. 766952

PROJECT NAME Plum Brook Ordnance Works

NR NO _____

PAGE 1 OF

DATE: _____

NONCONFORMANCE:

IDENTIFIED BY: _____ DATE: _____

CORRECTIVE ACTION REQUIRED:

TO BE PERFORMED BY: _____ DATE: _____

MUST CORRECTION BE VERIFIED? YES NO

TO BE VERIFIED BY: _____ PREPARED BY: _____ DATE: _____

CORRECTIVE ACTION TAKEN:

PERFORMED BY: _____ DATE: _____

VERIFIED BY: _____ DATE: _____

CC:

Approved By: _____ Date: _____

Approved By: _____ Date: _____

FIGURE 9 - 2

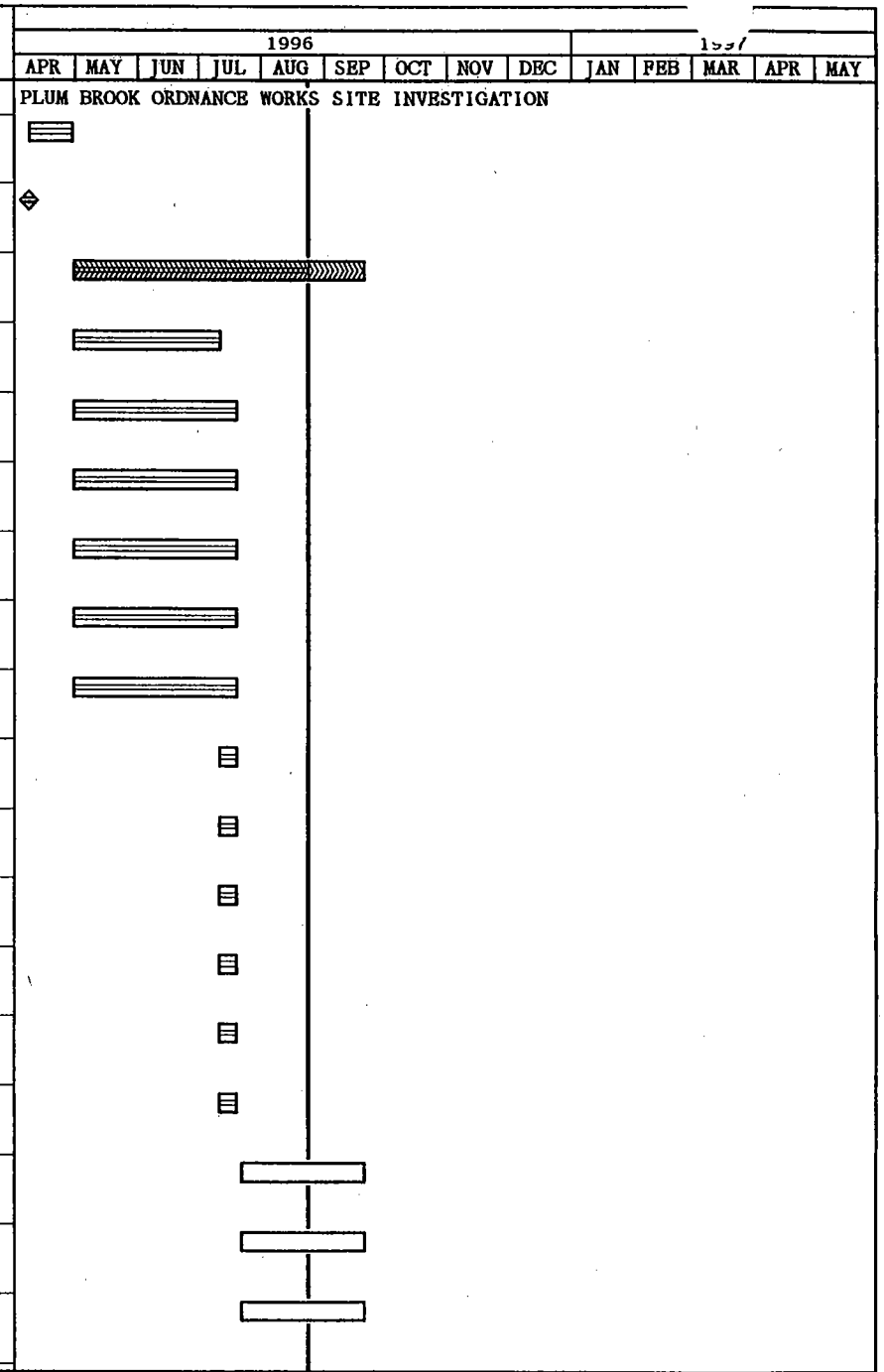
The equipment, item, or activity that has the deficiency may be temporarily stopped while the nonconformance is being investigated. If, in the opinion of the PM and the QAO, the nonconformance does not significantly affect the technical quality or use of the work, the work may continue pending resolution of the nonconformance. The basis for such decisions will be documented on the Nonconformance Report and submitted to the QAO for review and approval. The documentation will state that the decision was made prior to continuing with the work. The records of nonconformance and their dispositions will be kept in the project central files.

In addition, the PM will notify the USACE PM within 48 hours of significant nonconformances that could impact the schedule or the SOW and will indicate the corrective action taken or planned.

10.0 Project Schedule

Project schedule is provided herewith.

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	REM DUR
Records Review & Site Visit	8APR96A	29APR96A	0
Notice to Proceed	8APR96A		0
WORK PLANS	30APR96A	20SEP96	20
Generic Work Plans-Draft	30APR96A	11JUL96A	0
Reservoir # 2 Burning Ground SSWP-Draft	30APR96A	19JUL96A	0
Additional Burning Ground SSWP-Draft	30APR96A	19JUL96A	0
Waste Water Disposal Plant # 2 SSWP-Draft	30APR96A	19JUL96A	0
Powerhouse # 2 SSWP-Draft	30APR96A	19JUL96A	0
Groundwater Investigation SSWP-Draft	30APR96A	19JUL96A	0
Review Draft	11JUL96A	19JUL96A	0
Review Draft	11JUL96A	19JUL96A	0
Review Draft	11JUL96A	19JUL96A	0
Review Draft	11JUL96A	19JUL96A	0
Review Draft	11JUL96A	19JUL96A	0
Review Draft	11JUL96A	19JUL96A	0
Generic Work Plans-Final	22JUL96A	20SEP96	20
Reservoir # 2 Burning Ground SSWP-Final	22JUL96A	20SEP96	20
Additional Burning Ground SSWP-Final	22JUL96A	20SEP96	20



Plot Date 18SEP96
Data Date 24AUG96
Project Start 5JAN96
Project Finish 15MAY97

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

BOOK PB61

Sheet 1 of 3

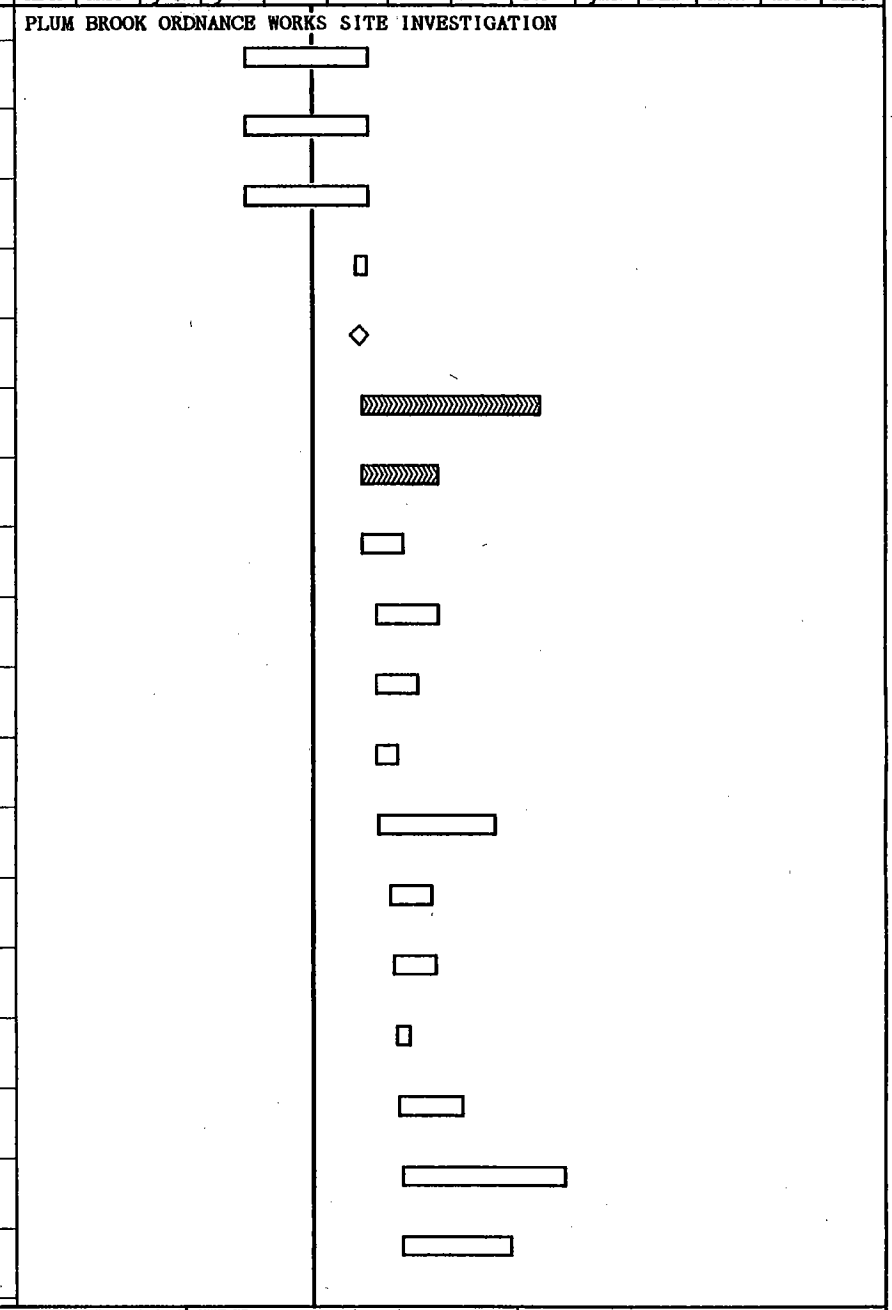
USACE - NASHVILLE DISTRICT
PBOW SITE INVESTIGATION
PROJECT SCHEDULE

CONSTRAINT
HANDCOCK

SCHEDULE REVISIONS

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	REM DUR
Waste Water Disposal Plant # 2 SSWP-Final	22JUL96A	20SEP96	20
Powerhouse # 2 SSWP-Final	22JUL96A	20SEP96	20
Groundwater Investigation SSWP-Final	22JUL96A	20SEP96	20
Kickoff and Coordination Meeting	14SEP96	19SEP96	5
Begin Field Work	16SEP96		0
FIELD WORK	17SEP96	13DEC96	76
Geophysics	17SEP96	24OCT96	33
Geophysics - Reservoir # 2 Burning Ground	17SEP96	7OCT96	18
Geophysics - Additional Burning Ground	24SEP96	24OCT96	27
Drill & Install Monitoring Wells	24SEP96	14OCT96	18
Soil Sampling - Waste Water Disposal Plant 2	24SEP96	4OCT96	10
Analytical Work - Waste Water Disposal Plant # 2	25SEP96	21NOV96	42
Monitoring Well Development	1OCT96	21OCT96	18
In-Situ Permeability Tests	30CT96	23OCT96	18
Soil Sampling - Powerhouse # 2 Ash Pit	4OCT96	10OCT96	6
Groundwater Sampling	5OCT96	5NOV96	27
Analytical Work - Groundwater Investigation	7OCT96	25DEC96	58
Analytical Work - Powerhouse # 2 Ash Pit	7OCT96	29NOV96	40



Plot Date 18SEP96
Data Date 24AUG96
Project Start 5JAN96
Project Finish 15MAY97

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

BOOK PRES

Sheet 8 of 8

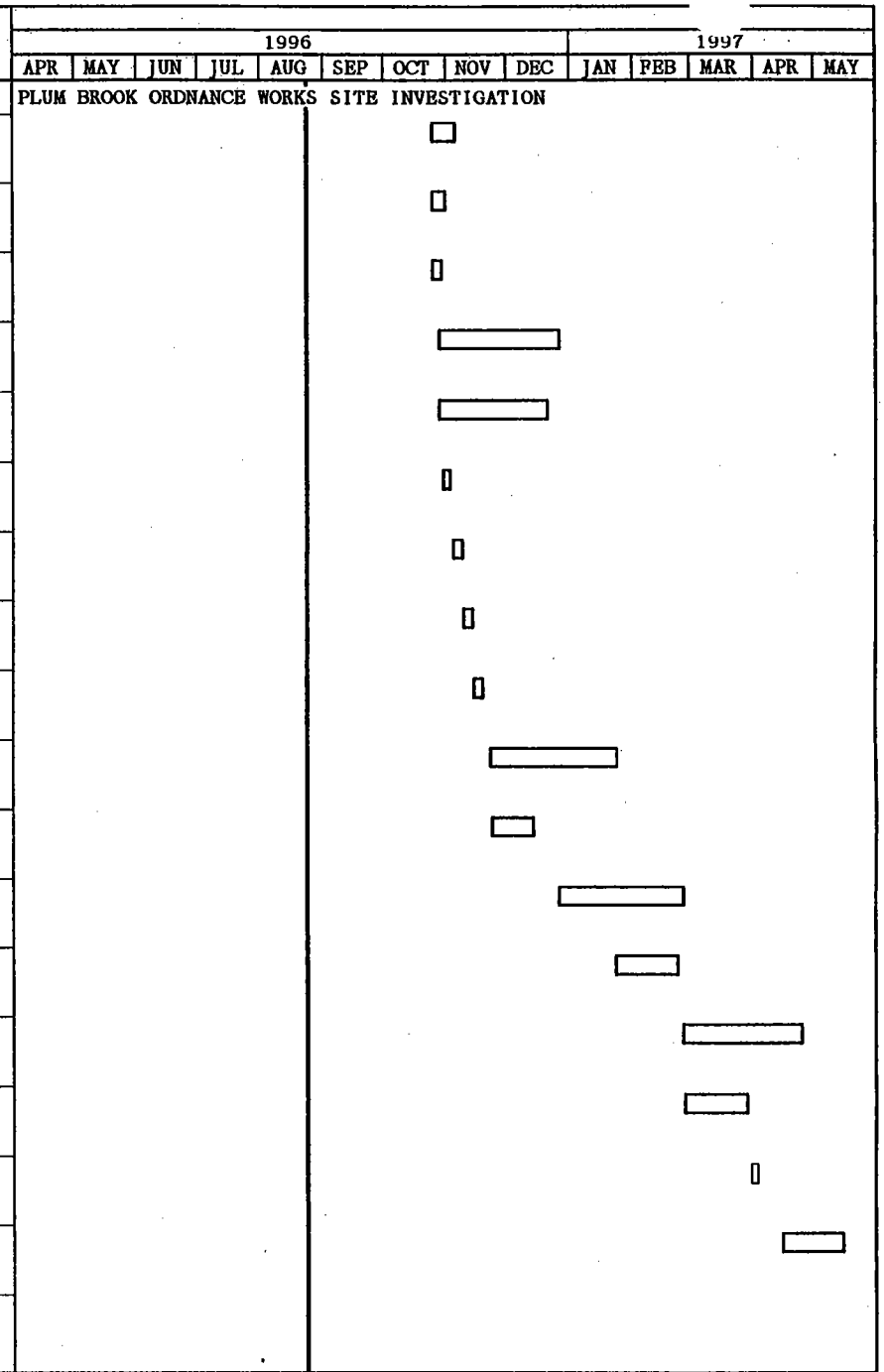
USACE - NASHVILLE DISTRICT
PBOW SITE INVESTIGATION
PROJECT SCHEDULE

CONSTRAINT
MANDOCK

SCHEDULE REVISIONS

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	REM DUR
Soil Sampling - Reservoir # 2 Burning Ground	25OCT96	5NOV96	10
Soil Sampling - Additional Burning Ground	25OCT96	31OCT96	6
Land Survey - Reservoir # 2 Burning Ground	25OCT96	29OCT96	4
Analytical Work - Reservoir # 2 Burning Ground	28OCT96	26DEC96	44
Analytical Work - Additional Burning Ground	28OCT96	20DEC96	40
Land Survey - Additional Burning Ground	30OCT96	2NOV96	4
Land Survey - Waste Water Disposal Plant # 2	4NOV96	8NOV96	5
Land Survey - Powerhouse # 2 Ash Pit	9NOV96	13NOV96	4
Land Survey - Groundwater Investigation	14NOV96	18NOV96	4
Draft SI Report	22NOV96	23JAN97	45
Management of IDW	23NOV96	13DEC96	18
Draft Groundwater Report	26DEC96	25FEB97	44
Review	23JAN97	22FEB97	31
Final SI Report	25FEB97	24APR97	43
Review	26FEB97	28MAR97	31
Draft Reports Meeting	31MAR97	2APR97	3
Final Groundwater Report	15APR97	15MAY97	23



Plot Date 16SEP96
Data Date 24AUG96
Project Start 5JAN96
Project Finish 15MAY97

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Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

NCCB P261

Sheet 3 of 3

USACE - NASHVILLE DISTRICT
PBOW SITE INVESTIGATION
PROJECT SCHEDULE

CONSTRAINT
MUSTOCK

SCHEDULE REVISIONS

Date	Revision	Checked	Approved

11.0 References

Dames & Moore, 1996, ***Site-Wide Groundwater Investigation Draft Report, Plum Brook Ordnance Works, Sandusky, Ohio***, May 1996.

Dames & Moore, 1995, ***Records Review Report, Plum Brook Ordnance Works, Sandusky, Ohio***, April 27, 1995.

H+GCL, 1992, ***Phase I Site Characterization of Disposal Area Three, Plum Brook Station, Ohio***, June 1992.

IT Corporation (IT), 1991, ***Engineering Report for the Contamination Evaluation at the Former Plum Brook Ordnance Works, Sandusky, Ohio***, January 1991.

Morrison Knudsen Corporation, 1994, ***Site Inspection Report, Plum Brook Station, Sandusky, Ohio***, January 1994.

U.S. Army Corps of Engineers (USACE), 1996, ***Statement of Work, Plum Brook Ordnance Works***, February 1996

U.S. Army Corps of Engineers (USACE), 1994, ***Monitoring Well Design, Installation and Documentation at Hazardous and/or Toxic Waste Sites***, EM-1110-1-4000.

U.S. Department of Agriculture (USDA), 1971, ***Soil Survey, Erie County, Ohio***, Soil Conservation Service, February 1971.

U.S. Environmental Protection Agency (EPA), 1996, ***Drinking Water Regulations and Health Advisories***, Office of Water, Washington, DC, February 1996.

U.S. Environmental Protection Agency (EPA), 1995, ***Risk-Based Concentration Table, July-December 1995***, Roy L. Smith, EPA Region III, October 20, 1995.

U.S. Environmental Protection Agency (EPA), 1993, ***Data Quality Objectives Process for Superfund***, EPA/-540/G-93/071.

U.S. Environmental Protection Agency (EPA), 1992, ***Guide to Management of Investigation-Derived Waste***, January 1992.

U.S. Environmental Protection Agency (EPA), 1990, "National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule," ***Federal Register***, 55(4b):8666-8865.

U. S. Geological Survey (USGS), 1992, ***Hydraulic Properties of Three Types of Glacial Deposits in Ohio***, Water-Resources Investigation Report 92-4135.

Quality Assurance Project Plan
Site Investigations and Groundwater Investigation
at the Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared for:

Commander
U.S. Army Corps of Engineers
Nashville District
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

IT Project Number 766952

Prepared by:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

September 1996

Quality Assurance Project Plan
Site Investigations and Groundwater Investigation at the Former Plum Brook Ordnance Works Sandusky, Ohio

Approved by: _____ Date: 12/11/96
IT Program Manager

Approved by: _____ Date: 12/11/96
IT Quality Assurance Officer

Approved by: _____ Date: _____
Project Manager
USACE Nashville District

Approved by: _____ Date: _____
Analytical Laboratory Director

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List of Acronyms

AA	atomic absorption
AR/COC	analysis request/chain of custody
ASTM	American Society for Testing and Materials
CLP	Contract Laboratory Program
DNT	dinitrotoluene
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FADL	Field Activity Daily Log
GC/MS	gas chromatography/mass spectrometry
GSA	General Services Administration
HSO	health and safety officer
ICP	inductively coupled plasma spectroscopy
IT	IT Corporation
LCS	laboratory control sample
MS/MSD	matrix spike/matrix spike duplicate
NASA	National Aeronautics and Space Administration
NIST	National Institute of Science and Technology
OEPA	Ohio Environmental Protection Agency
%R	percent recovery
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyls
PE	performance evaluation
PM	project manager
POC	point-of-contact
QA	quality assurance
QAM	quality assurance manual
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
RPD	relative percent difference
SAP	sampling and analysis plan
SI	site investigation
SOP	standard operating procedure

List of Acronyms *(Continued)*

SOW	statement of work
SRM	standard reference material
SHP	safety and health plan
STEP	Solutions to Environmental Problems, Inc.
SVOC	semivolatile organic compound
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
VOA	volatile organic analytes
VOC	volatile organic compound

1.0 Project Description

This quality assurance project plan (QAPP) describes the methods and procedures that will be used by IT Corporation (IT) at the former Plum Brook Ordnance Works (PBOW) site investigations and groundwater investigation to ensure quality, precision, accuracy, and completeness of the data collection during the investigations. The field investigations covered by this document include site investigation (SI) of Powerhouse No. 2 Ash Pit, SI of Reservoir No. Burning Ground; SI of the Additional Burning Ground; SI of Wastewater Disposal Plant No. 2; and the sitewide Groundwater Investigation. This QAPP will be used in conjunction with the sitewide sampling and analysis plan (SAP) and the sitewide safety and health plan (SHP) during the investigations. These activities will be conducted under Contract DACA62-94-D-0030 with the Nashville District, U.S. Army Corps of Engineers (USACE) so that they satisfy the project objectives and comply with U.S. Environmental Protection Agency (EPA) and Ohio EPA (OEPA) requirements.

This QAPP has been prepared to provide assurance that the work to be performed will be of the quality required to satisfy the project objectives and is responsive to the applicable requirements of the EPA, the OEPA, and the Department of the Army.

1.1 Site Description

The 9,009-acre PBOW site was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. It is estimated that more than one billion pounds of explosives were manufactured during the 4-year operating period.

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

National Aeronautics and Space Administration (NASA) acquired the PBOW in 1963 and is presently utilizing the site. On April 18, 1978, NASA declared approximately 2,152 acres of land as excess. The Perkins Township Board of Education acquired 46 acres of the excess and uses its area as a bus transportation center. GSA retains the remaining acreage and currently has

a use agreement with the Ohio National Guard for 604 acres of the land. NASA presently controls about 6,400 acres and is using its site to conduct space research as a satellite operation of NASA's Lewis Research Center in Cleveland, Ohio. The details of these land transactions are listed in the site management plan and can be found at the NASA Plum Brook Station.

A specific site description will be included in the site-specific SAP to be prepared for each site and will be attached to the sitewide SAP as addenda.

1.2 Project Objectives

The purpose of these investigations are to collect information on contamination of site soils (site investigations) and groundwater (groundwater investigation) resulting from past activities that can be used to make initial management decisions and for developing more detailed and comprehensive sampling regiments should they be determined to be necessary. The specific objectives of each investigation are summarized as follows:

- ***SI of Powerhouse No. 2 Ash Pit.*** Determine if site soils at the former Powerhouse No. 2 Ash Pit are contaminated, and, if so, whether or not this contamination poses a threat to human health or the environment.

- ***SI of Reservoir No. 2 Burning Ground.*** Determine the location of the Reservoir No. 2 Burning Ground; determine the existence and nature of contamination in site soils; determine if contamination poses a threat to human health or the environment; and determine if further investigation or cleanup of the site will be required.

- ***SI of the Additional Burning Ground.*** Delineate the lateral extent of the Additional Burn Ground; confirm the existence and nature of contamination in shallow soils at the site; and determine whether further investigation of the site will be required, and, if so, the media that will require investigation.

- ***SI of Wastewater Disposal Plant No. 2.*** Determine whether or not site soils in the vicinity of Wastewater Disposal Plant No. 2 are contaminated, and, if so, whether or not this contamination poses a threat to human health or the environment.

- ***Sitewide Groundwater Investigation.*** Obtain data of groundwater levels and contaminants to add to an existing database, and fill existing data gaps in groundwater levels and contamination in the western portion of PBOW.

a use agreement with the Ohio National Guard for 604 acres of the land. NASA presently controls about 6,400 acres and is using its site to conduct space research as a satellite operation of NASA's Lewis Research Center in Cleveland, Ohio. The details of these land transactions are listed in the site management plan and can be found at the NASA Plum Brook Station.

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- ***SI of the Additional Burning Ground.*** Delineate the lateral extent of the Additional Burn Ground; confirm the existence and nature of contamination in shallow soils at the site; and determine whether further investigation of the site will be required, and, if so, the media that will require investigation.

- ***SI of Wastewater Disposal Plant No. 2.*** Determine whether or not site soils in the vicinity of Wastewater Disposal Plant No. 2 are contaminated, and, if so, whether or not this contamination poses a threat to human health or the environment.

- ***Sitewide Groundwater Investigation.*** Obtain data of groundwater levels and contaminants to add to an existing database, and fill existing data gaps in groundwater levels and contamination in the western portion of PBOW.

1.3 Target Compounds

The targeted compounds for the site investigations are based on the possible contamination present in surface soil, subsurface soil, and sediment. The contaminants may include volatile organic compounds (VOC), semivolatile organic compounds (SVOC), nitroaromatics, cyanide, and metals.

Analytical parameters and methods to be used during this investigation are presented in Table 1-1.

1.4 Sample Program and Rationale

The sampling program and rationale for sample selection are presented in the SAP, Sections 4.4 and 4.5.

Data collected as outlined in the SAP and in this document, in conjunction with data from previous investigations, will be used in the decision-making process to determine the necessity of further action at each site. The investigative approach is discussed in detail in Chapter 4.0 of the sitewide SAP and also in respective sections of site-specific SAPs.

1.5 Schedule

Schedules for each site-specific investigation will be given in the final sitewide SAP.

Table 1-1

Summary of Chemical Analysis and Methodologies for Soil and Groundwater Samples Site Investigations and Groundwater Investigation Former Plum Brook Ordnance Works Sandusky, Ohio

Matrix	Analytical Parameters	Analytical Method
Soil	TCL Volatile Organic Compounds	SW-846 8260A[a]
	TCL Semivolatile Organic Compounds	SW-846 3520B/3541/8270B[a]
	TAL Metals	SW-846 3050A/6010A[b] for Ag, Al, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Tl, V, Zn 7471A[a] for Hg 7060A[b] for As 7740[b] for Se
	TCL Pesticides/PCBs	SW-846 3520B/8081[a]
	Nitroaromatic Compounds	SW-846/8330[c] (as modified)
	Total Cyanide	SW-846 9013/9010A
Groundwater	TCL Volatile Organic Compounds	SW-846 8260A[a]
	TCL Semivolatile Organic Compounds	SW-846 8260A[a]
	TCL Pesticides/PCBs	SW-846 3520B/8081[a]
	TAL Metals (Total and Dissolved)	SW-846 3010A/6010A[b] for Al, Sb, Ba, Be, Cd, Ca, Cs, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Ag, Na, Tl, V, Zn 3020A/7060A[a] for As 3020A/7740[c] for Se 7470[a] for Hg
	Nitroaromatic Compounds (Total and Dissolved, as necessary)	SW-846 Modified 8330
	Total Cyanide	SW-846 9010A[a]

[a]U.S. Environmental Protection Agency (EPA), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Third Edition, Update II, September 1994.
[b]U.S. Environmental Protection Agency (EPA), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Third Edition, Update I, July 1992.
[c]U.S. Environmental Protection Agency (EPA), *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Third Edition, Revision 1, December 1990.
TCL - Target compound list.
TAL - Target analyte list.

2.0 Project Organization

All project personnel, including field, laboratory, and subcontractor personnel are subject to the requirements of this QAPP. The key positions are described in the following sections. Figure 2-1 of the sitewide SAP shows the key project personnel and their reporting relationships.

2.1 USACE Nashville District Project Manager

The USACE Nashville District project manager (PM) will be an appointed representative of the USACE and will serve as the primary contact for the federal and state oversight agencies, as well as for the IT PM. The USACE Nashville District PM will facilitate the project from beginning to end, providing the necessary interface with the regulatory agencies and all contractors selected to support the project efforts. The USACE PM will also be responsible for the following:

- Scheduling of the site investigation activities
- Seeking the appropriate regulatory authorizations
- Seeking the required permits or certification necessary to complete site investigation
- Providing the necessary interface with the regulatory agencies as required
- Obtaining the authorization to proceed with the activities at the site
- Quality assurance review of IT's work plans.
- Ultimately, for meeting the project's objectives.

2.2 IT Project Manager

The IT PM will serve as the central point of contact for government agencies, subcontractors, and other concerned parties. The IT PM will be responsible for management of the activities, ensuring compliance with the statement of work (SOW), QAPP, SHP, and SAP. Specifically, the duties of the IT PM will be as follows:

- Assigning duties to the project staff and orienting the staff to the needs and requirements of the project
- Obtaining required approvals for proposed variances to the supplemental investigation SAP, QAPP, and SHP
- Supervising the performance of the project staff

- Evaluating training needs of the project staff
- Providing budget and schedule control
- Reviewing subcontractor work and approving subcontractor invoices
- Establishing a project record system
- Ensuring that major project deliverables are reviewed for technical accuracy and completeness including data validity before their release
- Ensuring that the requirements of the QAPP are satisfied
- Regularly communicating the project status, progress, and any problems to the USACE project coordinator.

2.3 Quality Assurance Officer

The IT quality assurance officer (QAO) will be an independent representative reporting to the PM and/or upper management, responsible for ensuring compliance with the QAPP and other work-related documents. The specific duties of the QAO are as follows:

- Administering the overall QAPP
- Performing independent quality assurance (QA) audits
- Serving as the official contact for all project QA matters
- Identifying and responding to QA/quality control (QC) needs, resolving problems, and answering requests for assistance or guidance
- Reviewing, evaluating, and approving quality related changes to the QAPP, SAP, or SHP
- Preparing and submitting QA/QC reports to the PM
- Verifying that appropriate corrective actions are taken for all nonconformances
- Actively tracking the progress of quality tasks in this QAPP and consulting periodically with the PM
- Other duties and responsibilities as assigned by the PM.

2.4 Health and Safety Officer

The health and safety officer (HSO) will ensure that site activities comply with the requirements of the SHP. The HSO will have the authority to stop work, if necessary, and to implement corrective actions if SHP requirements are not satisfied.

2.5 Analytical Services QA/QC Director

Laboratory services for this supplemental investigation will be provided by Quanterra Environmental Services, Knoxville, Tennessee.

The Quanterra QA/QC director will have the following responsibilities:

- Performing audits of the laboratory to verify compliance with the QAPP
- Verifying completion of corrective actions cited in previous audits
- Acting as the point-of-contact (POC) for proposed changes in the laboratory QAPP and initiating changes in the program
- Discussing with laboratory QC coordinators and managers any unresolved nonconformances.

2.6 Laboratory QC Coordinator

The Quanterra Laboratory QC coordinator will be responsible for implementing the requirements of this QAPP. The laboratory coordinator's responsibilities will include (as appropriate):

- Providing orientation and necessary training to laboratory personnel on the requirements of this QAPP
- Assisting the project staff in implementing sampling and testing programs
- Serving as liaison between the laboratory staff, the PM, task managers, and other project personnel
- Serving as the POC for laboratory staff reporting nonconformances and changes in laboratory activities
- Notifying the laboratory, QA personnel, the PM, and affected task managers of specific laboratory nonconformances and changes
- Maintaining laboratory data and checkprints while sampling is in progress
- Preparing and submitting QA/QC reports to the laboratory manager

- Releasing test data and results
- Calibrating laboratory equipment
- Storing and controlling samples submitted for analysis or archiving.

2.7 Data Validation Services

All data will be subjected to a third-party validation process. The validation procedure will include the review and evaluation of the following QA/QC elements:

- Chain(s) of custody
- Initial and continuing calibration
- Detection limits
- Analyte(s) identification
- Analyte(s) quantification
- QC blanks (trip, method, rinsate, etc.)
- Matrix spike recoveries.

The validation will be conducted by Solutions to Environmental Problems, Inc. (STEP), an independent subcontractor. Validation will involve data flagging, evaluation of blank data, evaluation of duplicates, and statistical evaluation of the data. The validation process references the EPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (February 1993, EPA-540/R-94/012) and *Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Data Review* (February 1994, EPA-540/R-94/013). For parameters not specifically addressed by the EPA's CLP or validation guidelines, evaluation procedures similar to these references and the laboratory's submitted standard operating procedures (SOP) are followed.

The third-party validation procedure, when performed in conjunction with the internal review of all sample documentation (location, date and time collected, batch, etc.), the sampling design approach, and accuracy and precision evaluation, provides all the necessary qualifications for the establishment of definitive data.

2.8 Subcontractor Activities

The selection of qualified subcontractors will be in accordance with the IT procurement and QA procedures. Subcontractors such as drillers, geophysical specialists, surveyors, and environmental monitoring specialists must meet predetermined qualifications developed by the PM that are defined in the procurement bid packages. Each subcontractor bid submittal is

reviewed by technical personnel, purchasing, and QA personnel to verify that the bidders are qualified and can satisfy bid requirements. Before starting work, IT will perform a quality check to determine if the subcontractor has fulfilled the procurement requirements necessary to begin activities. Subcontractors involved in environmental measurements will be monitored by the field coordinator to verify the use of calibrated equipment and qualified operators.

All subcontractors will be required to follow the procedures of the QAPP. Ongoing observation and monitoring of subcontractor performance during the field investigation will be the responsibility of the PM or the field coordinator. Periodic QC inspections of each subcontractor may be performed. Inspection will include (as appropriate):

- Type and conditions of equipment
- Calibration procedures
- Personnel qualifications
- Documentation.

2.9 Qualifications and Training of Personnel

Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. In addition to education and experience, specific training may be required to qualify individuals to perform certain activities. Training will be documented on the appropriate form and placed in the project file as a record. Project personnel will receive an orientation to the SAP, the SHP, and the QAPP as appropriate to their responsibilities before participation in project activities. Training of field personnel will be provided by the field coordinator, the QA officer, or by a qualified designee. This orientation will be documented.

3.0 Quality Assurance Objectives for Measurement of Data

3.1 Data Quality Indicators

This QAPP facilitates implementation of the requirements of the SOW for the site investigations and groundwater investigation of the former PBOW and applicable regulatory requirements principally to provide an internal means for control and review so that the environmentally related measurements and data collected by IT and its subcontractors are scientifically sound, defensible, and of known acceptable documented quality.

The procedures to be used for assessing the quality of the measurement data are as follows:

- ***Accuracy and Precision*** is the agreement between a measurement and the true value and the degree of variability in the agreement, respectively.

  To determine the precision of the method and/or laboratory analyst, a routine program of replicate analyses is performed. The results of the replicate analyses are used to calculate the relative percent difference (RPD), which is the governing QC parameter for precision:

  For replicate results $R_1 + R_2$

$$RPD = \frac{\frac{|R_1 - R_2|}{R_1 + R_2}}{2} \times 100\% \qquad \text{Eq.3-1}$$

  To determine the accuracy, the evaluation is applied over the entire range of spiking concentrations. To determine the accuracy of an analytical method and/or the laboratory analyst, a periodic program of sample spiking is conducted (minimum 1 spike and 1 spike duplicate per 20 samples). The results of sample spiking are used to calculate the QC parameter for accuracy evaluation, the percent recovery (%R).

$$\%R = \frac{|S_1 - S_2|}{T_1} \times 100\% \qquad \text{Eq. 3-2}$$

  where:

  S_1 = Observed spiked sample concentration
  S_2 = Sample concentration
  T_1 = True concentration of the spike.

Accuracy and precision of data collected in the investigation will depend on the measurement standards used and their meticulous, competent use by qualified personnel.

- ***Completeness*** is the adequacy in quantity of valid measurements to prevent misinterpretation and to answer important questions. For this project the data completeness objective is 90 percent.

- ***Representativeness*** is the extent to which discrete measurements accurately describe the greater picture they are intended to represent.

  For this project, good representativeness will be achieved through careful, informed selection of sampling sites, drilling sites, drilling depths, and analytical parameters; and through the proper collection and handling of samples to avoid interferences and to minimize contamination and loss.

- ***Comparability*** is the extent to which comparisons among different measurements of the same quantity or quality will yield valid conclusions. For this project, comparability among measurements will be achieved through the use of standard procedures, standard field data sheets, and uniform concentration units.

- ***Quantitation Limits*** are the extent to which the equipment, laboratory or field, or analytical process can provide accurate, minimum data measurements of a reliable quality for specific constituents in replicate field samples. It is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the value is above zero. The actual reporting limit for a given analysis will vary depending on instrument sensitivity, matrix effects, and dryness calculations.

- ***Traceability*** is the extent to which data can be substantiated by hard-copy documentation. Traceability documentation exists in two essential forms: one that links quantitation to authoritative standards and a second that explicitly describes the history of each sample from collection to analysis.

Typical quantitation limits applicable to this project are presented in each EPA-approved analytical method (see Section 7.0). The QA objectives for laboratory QC data are designed to screen out data of unacceptable precision or accuracy and to provide data that will meet the data quality goals for this project.

3.2 Project QA Objectives

Several procedures will be used for demonstrating the precision and accuracy objectives of this project. Sampling and analytical activities will be conducted following standard reference procedures whenever possible. All reference materials used as calibration standards or surrogate

compounds will be of the highest purity commercially available, typically greater than 99 percent. Each instrument used for the analysis will be calibrated daily before sample analyses to demonstrate accurate analytical performance levels. Absolute instrument responses will be within the ranges specified in the laboratory-specific SOP, typically within 10 percent of the most recent calibration of the instrument. Data precision and accuracy will be assessed by evaluating the results from the analysis of internal standards, laboratory blanks, calibration check standards, reagent blanks, method blanks, field and trip blanks, duplicate samples, and matrix or surrogate spiked samples. Sections 4.0 and 9.0 of this QAPP describe both the field and laboratory QC sample types which will be used to evaluate the precision and accuracy of the sampling and analytical activities associated with this project.

3.3 Analytical Support Levels

The analytical options available to support data collection activities are presented in two general levels: screening data, with definitive confirmation, and definitive data. These two data categories are associated with specific QA and QC elements, and may be generated using a wide range of analytical methods. The particular type of data to be generated depends on the qualitative and quantitative data quality objective (DQO) developed for the project. Definitive data will be required for this investigation.

Definition of Definitive Data. Definitive data are generated using rigorous analytical methods, such as approved EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data (e.g., chromatograms, spectra, digital values, etc.) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined.

Definitive Data QA/QC Elements

- Sample documentation (location, date and time collected, etc.)
- Chain of custody
- Sampling design approach (systematic, simple or stratified random, judgmental, etc.)
- Initial and continuing calibration

- Determination and documentation of detection limits
- Analyte(s) identification
- Analyte(s) quantification
- QC blanks (trip, method, rinsate)
- Matrix spike recoveries
- Performance evaluation (PE) samples (when specified)
- Analytical error determination (measures precision of analytical method): an appropriate number of replicate aliquots, as determined by the QAPP, are taken from at least one thoroughly homogenized sample and analyzed. From these samples, standard laboratory QC parameters such as variance, mean, and coefficient of variation should be calculated and compared to method-specific performance requirements defined in the QAPP.
- Total measurement error determination (measures overall precision of measurement system from sample acquisition through analysis): an appropriate number of collocated samples as determined by the QAPP are independently collected from the same location and analyzed following standard operating procedures. Based on these analytical results, standard laboratory QC parameters such as variance, mean, and coefficient of variation should be calculated and compared to establish measurement error goals. This procedure may be required for each matrix under investigation, and may be repeated for a given matrix at more than one location at the site.

Data Quality, Types, and Quantity. Soil and sediment will be sampled and analyzed to meet the objectives of the site investigation. QA/QC samples will be collected for all sample types according to the proportionality described in Section 4.0. All samples will be analyzed using EPA-approved methods and will comply with EPA-definitive data criteria.

3.4 Laboratory QC Criteria

The primary analytical QA objective is to produce an analytical database during the data collection phase of the project that can be used to assess all site activities relative to the contracted DQOs, as well as other project-specific criteria established for the project. The specific project QC criteria for laboratory analyses are as stated in each of the individual methods.

4.0 Sampling Procedures

The site investigation SAP documents the scope and rationale of the sampling activities to be conducted at the former PBOW sites. The on-site activities will include soil, sediment, and groundwater sampling.

The following considerations form the basis for the site-specific sampling program:

- Selection of sampling points
- Frequency of sampling
- Methods of sampling to be used
- Media to be sampled
- Number of samples to be collected
- Volume of samples to be collected
- Types and kinds of analyses to be performed in the field
- Types and kinds of analyses to be performed at the laboratories
- Sample turnaround time
- Procedures and precautions to be followed during sampling
- Methods of preservation and shipment.

Sampling will be conducted frequently enough to satisfy program objectives. The methods used during sampling will preserve the integrity of the material parameters. Field procedures for sample collection and analysis are presented in the SAP.

Any sample obtained during the field sampling should be representative of the sample location and free of contaminants from sources other than the immediate environment being sampled. The equipment and techniques that will be employed to obtain representative samples will be in accordance with procedures specified in this QAPP and the SAP.

The equipment and sample collection, preparation, and shipment techniques that will be used will be in accordance with EPA protocols. The rationale for the specific sampling program(s) are presented in the SAP.

The SAP presents sampling location design considerations; the numbers and types of samples to be collected; sampling equipment, procedures, and sample containers; methods of sample preservation; decontamination procedures; shipping and packaging methods; and a sampling schedule. Analytical tests that will be performed are also listed. Precleaned containers, certified to meet all EPA protocols, will be purchased from a contractor for use on this project.

4.1 Prevention of Cross Contamination

All sampling equipment that will be in contact with the soil will be decontaminated before use, between each sampling point, and before leaving the site. Each decontamination activity will be recorded on the Field Activity Daily Log (FADL), as shown on Figure 4-1 of the SAP. Detailed procedures for decontamination of sampling equipment and disposal of decontamination byproducts are provided in the SAP.

4.2 Decontamination Requirements

The decontamination procedures to be used during the investigation and subsequent monitoring activities are described in the following sections. Documentation for all decontamination will be recorded in the FADLs.

4.2.1 Nonsampling Equipment

All drilling equipment, centering guides, backhoes, dredges, augers, and other nonsampling equipment will be decontaminated with high-pressure steam, scrubbed with a laboratory-grade nonphosphate detergent, rinsed with potable water from a source with known quality, and, if appropriate, covered with plastic sheeting to protect it from the elements.

4.2.2 Sampling Equipment

All equipment used in sample collection will be decontaminated before sampling begins and between samples. The decontamination procedure to be employed depends on the analyses to be performed and the media being collected.

The procedures to be used are as follows:

- ***Inorganic Sampling:***
  - Wash and scrub with detergent (laboratory grade).
  - Rinse with tap water.
  - Rinse with American Society for Testing and Materials (ASTM) Type II water.
  - Air dry.
  - Protect from fugitive dust or vapors by wrapping with plastic sheeting.

- ***Organic Sampling:***

  - Wash and scrub with detergent (laboratory grade).
  - Rinse with tap water.
  - Rinse with ASTM Type II water.
  - Rinse with methanol.
  - Air dry.
  - Wrap in aluminum foil.

Note: Detergents may be phosphatic only if phosphate is not a target analyte. ASTM Type II water as defined by Section D 1193-77 (reapproved 1983), must be used.

Solvents (methanol, hexane) used must be pesticide grade or better. Paint or coatings (such as rust) must be removed from any part of the equipment that may contact the sample.

4.3 Sample Identification

Samples will be put into sample containers that have been precleaned and treated with a preservative by the laboratory. The labels on the containers will state the type of preservative, if any, and the sample type and analysis for which the container is intended. As samples are collected and sealed in containers, the containers will be marked.

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

Project Code	Year	Sample Type[a]	Site Identification[b]	Location (Well ID)	Sample Number	Depth[c]
PBOW	96	XX	XX	XXXX	XXXX	(XXXX)

[a]Sample type:

SO - soil sample
GW - groundwater sample
FD - field duplicate
MS - matrix spike
MD - matrix spike duplicate
SS - soil screening sample
FB - field blank
FS - field split
ER - equipment rinsate
TB - trip blank

[b]Site:

2BG - Reservoir No. 2 Burning Ground
ABG - Additional Burning Ground
WP2 - Wastewater Disposal Plant No. 2
PH2 - Powerhouse No. 2 Ash Pit

[c]Depth: Only required for soil samples.

The complete sample number will be recorded by an IT field geologist in the FADL and/or in the boring log in the sample collection log as appropriate.

4.4 Sample Turnaround Time

Sample analyses are based upon information received through previous investigations and will be consistent with the sample holding times required for the EPA analytical methods used for the generation of definitive data. The standard turnaround for sample analyses is 21 calendar days for hard copy and electronic delivery of the data.

4.5 Field Documentation

An integral part of the QAPP for the sampling activities will be maintaining a FADL. All information pertinent to field activities will be recorded on the FADLs. Entries on the logs will include, as a minimum:

- The names and affiliations of all personnel on site
- A general description of the day's field activities showing the sequence of events
- Documentation of weather conditions
- Readings from personnel safety instruments
- References to appropriate field data forms for details of each activity performed.

Appropriate field-generated data forms will be prepared based on the requirements presented in the SAP. Data to be recorded will include information such as the monitored location (e.g., boring, well, depth, sampling location, elevation, and field coordinates) and applicable sample analyses to be conducted. All handwritten documents must be recorded in such a manner as to be completely legible. Errors are not to be obliterated, but crossed out with a single line, dated, and initialed.

Documents used to direct field activities will be controlled to ensure that they are correct and available to field personnel when the activities are conducted. Documents reporting data or results will be considered valid records only if stamped, initialed, or signed and dated by authorized personnel or otherwise authenticated.

4.6 Corrections to Documentation

All original data recorded in field log books, FADLs, sample labels, and analysis request/chain-of-custody (AR/COC) records will be written with permanent ink. None of the accountable serialized documents will be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a line through the error, entering the correct information, and initialing and dating the change. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry. All subsequent corrections will be initialed and dated.

4.7 Variance System

Procedures that properly address all specific conditions encountered during a field program cannot be prepared. Variances from approved operating procedures presented herein will be documented on a variance log (Figure 9-1 of the SAP). Approval of the variance is required by the PM and QAO before work proceeds. The field coordinator will initiate and chronologically maintain the variances generated during the field work. Variances affecting project scope, costs, or schedule must be forwarded to the USACE PM within 48 hours of occurrence. Any variance from the SAP and SHP must be signed off by the HSO. Approval by the PM can be initiated on a verbal basis via telephone with follow-up sign-off. Verbal approval will also be documented using a record-of-telephone-call memorandum. In no case will any subcontractor initiate a variance. If a variance is proposed by the client, it will be so recorded. Copies of the variance log will be kept on site until the field work is complete and originals will be sent to the project files.

4.8 Nonconformances and Corrective Action Procedures

Nonconforming equipment, items, activities, conditions, and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported in a timely manner. A nonconformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item unacceptable or indeterminate. The originator of a nonconformance report will describe the finding on the form provided for this purpose and will notify the PM and QAO. Each nonconformance will be reviewed and a disposition given for the item, activity, or condition. The disposition of a nonconformance will be documented and approved by the organization responsible for the issuance of the nonconformance, the QAO will review for his or her concurrence with the disposition of the nonconformance. The nonconformance report is shown in Figure 9-2 of the SAP (IT, this volume).

The laboratory coordinator is responsible for the assessment of QC sample information. If data fall outside of the accepted limits, the QA/QC coordinator will immediately notify the laboratory PM and the responsible group leader. If the situation is not corrected, and an out-of-control situation occurs or is expected to occur, then the QAO will notify the PM. The PM and group leaders are responsible for identifying the source of the nonconformance and initiating corrective action. Completion of the corrective action should be evidenced by data returning to prescribed acceptable limits.

The modification, repair, rework, or replacement of nonconforming equipment, items, or activities will require the reverification of acceptability. In certain instances, as determined by

the PM or QAO, these actions may require that corrective action be completed and verified before site work continues.

The equipment, item, or activity that has the deficiency may be temporarily stopped while the nonconformance is being investigated. If, in the opinion of the PM and the QAO, the nonconformance does not significantly affect the technical quality or use of the work, then the work may continue pending resolution of the nonconformance. The basis for such decisions will be documented on the nonconformance report and submitted to the QAO for review and approval. The documentation will include a statement that the decision was made prior to continuing the field work. The records of nonconformances and their dispositions will be kept in the project files.

In addition, the PM will notify the USACE Nashville District Project Coordinator within 48 hours of significant nonconformances that could impact the schedule or the SOW and will indicate the corrective action taken or planned.

4.9 Field Quality Control Samples

QC samples will be collected and analyzed by the laboratory for the purposes of assessing the quality of the project sampling and analytical efforts. The data obtained from the analysis of QC samples will be assessed with respect to all project DQOs before determining the usefulness of the project sample data for each site.

QC samples will be collected during field sampling activities to provide a measure of QA for the project samples. The samples that will be collected include field duplicates, MS/MSDs, and split samples. Table 4-1 includes a summary of the QC samples and frequency associated with each analytical parameter.

4.9.1 Trip Blanks

Trip blanks will consist of a pair of "clean," volatile organic analysis (VOA) vials filled with ASTM Type II water. These vials are transported from the laboratory where they are prepared, to the project site and returned to the laboratory for storage and subsequent analysis along with the project samples. The trip blank data are used to demonstrate that the samples requiring volatile analysis are not exposed to fugitive contamination during storage and transport to their final laboratory destination. Trip blanks are analyzed for volatile organics. A trip blank will accompany each cooler of liquid volatile samples submitted to the laboratory.

Table 4-1
Soil and Groundwater Sample and QA/QC Sample Quantities
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Site	Analytical Parameters	Number of Field Samples	Field Duplicates	Matrix Spike	Matrix Spike Duplicate	Field Blank	Equipment Rinsate	Trip Blank
Reservoir #2 Burning Ground (Soil samples Only)	TCL VOCs	24	3	1	1	2	3	4
	TCL SVOCs	24	3	1	1	2	3	
	TAL Total Metals	24	3	1	1	2	3	
	Pesticides/PCBs	24	3	1	1	2	3	
	Total Cyanide	24	3	1	1	2	3	
	Nitroaromatics	24	3	1	1	2	3	
Additional Burn Ground (Soil Samples only)	TCL VOCs	24	2	1	1	2	3	4
	TCL SVOCs	24	2	1	1	2	3	
	TAL Total Metals	24	2	1	1	2	3	
	Pesticides/PCBs	24	2	1	1	2	3	
	Total Cyanide	24	2	1	1	2	3	
	Nitroaromatics	24	2	1	1	2	3	
Waste Water Disposal Plant #2 (Soil Samples Only, Excluding 20 Screening Soil Samples)	TCL VOCs	10	1	1	1	2	2	2
	TCL SVOCs	10	1	1	1	2	2	
	TAL Total Metals	10	1	1	1	2	2	
	Pesticides/PCBs	10	1	1	1	2	2	
	Total Cyanide	10	1	1	1	2	2	
	Nitroaromatics	10	1	1	1	2	2	
Power House #2 Ash Pit (Soil Samples only)	TCL VOCs	24	2	1	1	2	3	4
	TCL SVOCs	24	2	1	1	2	3	
	TAL Total Metals	24	2	1	1	2	3	
	Pesticides/PCBs	24	2	1	1	2	3	
	Total Cyanide	24	2	1	1	2	3	
Groundwater Investigation (Groundwater Samples Only)	TCL VOCs	32	3	2	2	2	8	12
	TCL SVOCs	32	3	2	2	2	8	
	TAL Total Metals	32	3	2	2	2	8	
	TAL Dissolved Metals	32	3	2	2	2	8	
	Pesticides/PCBs	32	3	2	2	2	8	
	Total Cyanide	32	3	2	2	2	8	
	Nitroaromatics	32	3	2	2	2	8	

4.9.2 Equipment Rinsate Samples

Equipment rinsates will be collected during the project and analyzed to verify that the decontamination procedures implemented on reusable sampling equipment or other nonsampling equipment are adequately preventing cross contamination. Equipment rinsates are analyzed for the same analytical parameters as the associated project samples.

4.9.3 Field Blanks

Field blanks are prepared from the clean water used in decontamination procedures and steam cleaning. Analysis of field blanks will ensure that all water sources used during decontamination of sampling equipment are free of the parameters of interest. Only water field blanks are required. At a minimum, one sample from each event and each source of water will be collected and analyzed for all necessary parameters. Field blanks will be collected from the source water (potable) for the steam cleaner and the final decontamination rinse water, thus there will be a minimum of two field blanks:

- A sample of the potable water used for steam cleaning
- A sample of the water used for decontamination.

If more than one lot number of deionized water is used or if potable water is taken from more than one location, then additional field blanks must be taken from each different source.

4.9.4 Field Duplicates

Field duplicate samples collected will be taken at a frequency of one per ten, or fewer, the number of samples collected for laboratory analysis. All media samples will have at least one field duplicate collected. Field duplicate locations will be determined in the field by the supervising geologist or field coordinator. All field procedures for collection of samples will apply to the collection of the duplicate samples. Duplicate samples will be given a unique sample identification.

During the collection of soils for field duplicates it may be necessary to collect several samples from the sample depth to obtain the required volume of soils for duplicate samples. Soil samples to be split for VOC analysis are to be collected from the same sample run, splitting the material between the soil jars. Once the VOC sample has been collected, the remaining sample bottles shall be filled with soils that have been homogenized.

4.9.5 Matrix Spike/Matrix Spike Duplicates

To meet analytical QC requirements, MS/MD samples will be collected for each medium sampled on a 1 per 20 basis. At least one MS/MD pair will be collected for each medium sampled. MS/MD locations will be determined in the field by the supervising geologist or field coordinator. The MS/MD location should be chosen so that high concentrations of contaminants are not expected.

4.9.6 Split Samples

Split samples will be collected at a frequency of one per ten samples collected in laboratory analysis. All media samples will have at least one split sample taken. The split sample locations will be the same as the field duplicate locations to be determined by the supervisory geologist or field coordinator. All field procedures for the collection of samples will apply to the collection of the split samples. Split samples will be given a unique sample identification.
Results from analysis of field and QC samples will be indexed and sent to the QA laboratory for the review and preparation of the Chemical Quality Assurance Report.

The QA laboratory for this investigation is the USACE, Ohio River Division Laboratory (CEORD-PE-GL) located in Cincinnati, Ohio. Split samples collected and submitted for QA analysis will be sent to:

U.S. Army Corps of Engineers
Ohio River Division Laboratory
Mr. John Adams
11275 Sebring Drive
Cincinnati, Ohio 45240-2714
Phone (513) 589-3604.

5.0 Sample Control Procedures

Field personnel will be responsible for the identification, preservation, packaging, handling, shipping, and storage of samples obtained in the field so that all samples can be readily identified and will retain, to the extent possible, in situ characteristics to be determined through testing. All samples collected by field personnel will be documented through the use of AR/COC forms (Figure 6-2 of the SAP).

5.1 Field Custody Procedures

Field custody procedural activity includes:

- Before sampling begins, the field coordinator will instruct site personnel in the COC procedures, as necessary.
- The quantity and types of samples and sample locations have been determined and are outlined in the SAP.
- The field coordinator determines whether proper custody procedures and report forms were used during the field work and documents results on the FADLs.
- The field coordinator has overall responsibility for the care and custody of the samples collected until they are transferred or properly dispatched to the laboratory. Each individual who collects a sample is responsible for sample custody until transferred to someone else via the AR/COC.
- COC records initiated in the field shall be placed in a plastic bag and placed on top of the samples in the shipping container used for sample transport from the field to the laboratory.
- Additional samples that will be collected are classified as environmental or low-concentration samples.
- Shipping containers shall be secured using filament-reinforced strapping tape and custody seals to ensure that samples have not been disturbed during transport. The custody seals shall be placed on each container so that they cannot be opened without breaking the seal.
- Shipment information is recorded for shipment of samples at the end of the shift, day, or collection period on the FADL.

5.2 Sample Labeling

All physical samples for laboratory analysis obtained at the site will be placed in appropriate sample containers for shipment to the laboratory. Sample labels must contain sufficient information to uniquely identify the sample in the absence of other documentation. The following information will be included on the label:

- Project identification
- Sample identification
- Sample location
- Date of collection
- Time of collection
- Required analytical methods
- Sampler's initials.

An example sample label is shown in Figure 6-1 of the SAP.

5.3 Transfer of Custody and Shipment

Transfer of custody and shipping procedures include:

- An AR/COC will be initiated in the field for each sample or group of samples up to ten. A copy of this record will accompany each sample shipment.

- The custody of individual sample containers will be documented by recording each container's identification on an appropriate AR/COC.

- Each time responsibility for custody of the sample changes, the new custodian will sign the AR/COC and note the date.

- The analyses to be performed for each sample will be recorded on an AR/COC.

- The waybill number will be recorded on the AR/COC when a commercial carrier is used.

- If the laboratory sample custodian judges sample custody to be invalid (e.g., samples arrive damaged or custody seals have been broken), a nonconformance report will be initiated. The PM will be advised immediately and the samples will not be analyzed unless the PM so authorizes. The PM, the laboratory coordinator, and QAO will be notified. The PM will make a decision as to the fate of the sample(s) in question on a case-by-case basis. The sample(s) will either be processed "as is" with custody failure noted along with the analytical data, or rejected with sampling rescheduled, if necessary. The PM and QAO will sign-off the nonconformance report, noting the reason for disposition. Any problem with a sample will be noted in the appropriate data report.

- Upon sample destruction or disposal, the custodian responsible for the disposal will complete the AR/COC, file a copy, and send a copy to the PM or to his designated representative for record keeping.

5.4 Preparation, Packaging, Handling, and Shipping

Samples will be placed in containers compatible with the intended analysis and properly preserved. Also, the control of samples must consider the time interval between sample collection and sample analysis (holding time) so that the sample is representative. Table 5-1 presents the requirements for various analytical parameters with respect to the type of container, preservation method, and the maximum holding time.

Samples that are to be shipped off site for chemical analysis will be placed in ice chests containing "blue ice," or in double-bagged ice during shipment. The ice chest will be sealed, addressed, and placarded as appropriate.

As soon as field personnel have consigned samples to a commercial carrier, they shall notify the laboratory by telephone of the shipment. If the samples are transported by field personnel, then the estimated time of arrival at the laboratory should be given to the laboratory. Transportation will be scheduled to enable samples to arrive at the laboratory in time to permit testing within the established holding times.

5.5 Laboratory Receipt and Entry of Samples

Upon receipt at the laboratory, each sample is removed from the shipping container and the sample identification of the sample bottles is compared to the information contained in the COC documents. If discrepancies exist, appropriate notes (signed and dated) are made on the AR/COC and the shipping and receiving supervisor is notified; this supervisor in turn determines if a nonconformance report needs to be initiated.

Upon receipt of samples, the following items are checked against the AR/COC or the accompanying forms:

- The seals and tapes on the sample containers and cooler are unbroken and uncut.
- The sample containers in the cooler are intact and temperature of samples required to be preserved by cooling.
- The identification on the sample bottles corresponds to the entries on accompanying forms.

Table 5-1

Laboratory Sample Containers, Preservatives, and Holding Times
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

(Page 1 of 2)

Matrix	Analytical Parameter	Analytical Method	Container Type & Quantity	Preservative	Holding Time
Water	Volatile Organics	8260A	3 x 40-mL Glass w/ Teflon®-Lined Septum	HCl to pH < 2, Cool to 4°C	14 days from collection
	Explosives	8330	2 x IL Amber Glass w/Teflon	Cool to 4°C	Extract 7 days from collection, analyze 40 days from extraction
	Semivolatile Organics	3520B/8270B	2 x 1-L Amber Glass w/Teflon-Lined Cap	Cool to 4°C	Extract 7 days from collection, analyze 40 days from extraction
	Pesticides/PCBs	3520B/8081	2 x 1-L Amber Glass w/Teflon-Lined Cap	Cool to 4°C	Extract 7 days from collection, analyze 40 days from extraction
	Metals (Filtered)	3010A/6010A 7060A/7470A 7740	1 x 1-L HDPE[a] w/White Poly Cap	HNO_3 to pH < 2 Cool to 4°C preserve following field filtration	180 days from collection (Hg - 28 days) from collection
	Metals (Unfiltered)	3010A/6010A 7060A/7470A 7740	1 x 1-L HDPE w/White Poly Cap	HNO_3 to pH < 2, Cool to 4°C	180 days from collection (Hg - 28 days) from collection
	Total cyanide	9010A	1 x 500 ml HDPE w/White Poly Cap	NaOH to pH < 12, Cool to 4°C	14 days
Soils	Volatile Organics	8260A	2 x 120 mL Wide-Mouth Glass w/ Teflon-Lined Cap	Cool to 4°C	14 days from collection
	Explosives	8330		Cool to 4°C	Extract 14 days from collection, analyze 40 days from extraction
	Semivolatile Organics	3540B/8270B	1 x 250-mL Wide-Mouth Clear Glass w/Teflon-Lined Cap	Cool to 4°C	Extract 14 days from collection, analyze 40 days from extraction
	Pesticides/PCBs	3540B/8081	1 x 250-mL Wide-Couth Clean Glass w/Teflon-Lined Cap	Cool to 4°C	Extraact 14 days from collection, analyze 40 days from extraction

Table 5-1

Laboratory Sample Containers, Preservatives, and Holding Times
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Matrix	Analytical Parameter	Analytical Method	Container Type & Quantity	Preservative	Holding Time
Soils (continued)	Total Cyanide	9013/9010A	1 x 120-mL Wide-Mouth Claer Glass w/Teflon-Lined Cap	Cool to 4°C	14 days
	Metals	3050A/6010A 7060A/7471A 7740	1 x 120-mL Wide-Mouth Clear Glass w/Teflon-Lined Cap	Cool to 4°C	180 days from collection (Hg - 28 days) from collection
	Grain Size and Moisture	ASTM D2216, D421, D422	1 x 500-mL Wide-Mouth Glass w/ Teflon-Lined Cap	---	---
	TCLP[c] VOC	1311/8240	2 x 120-mL Wide-Mouth	Cool to 4°C	14 days TCLP extraction, 14 days analysis
	TCLP SVOC	1311/8270	1 x 500-mL Wide-Mouth	Cool to 4°C	14 days TCLP extraction, 7 days to leachate extraction, 40 days to analysis
	TCLP TAL[d] Metals	1311/6010/7000	1 x 250-mL Wide-Mouth Glass Out of SVOC container	Cool to 4°C	180 days TCLP extraction, 180 days analysis Hg - 28 days TCLP extraction, 28 days analysis

[a]HDPE - High Density Polyethylene
[b]PCB - polychlorinated biphenyls
[c]TCLP - Toxicity Characteristic Leaching Procedure
[d]TAL - Total dissolved metals include Ag, Al, Ba, Be, Ca, Cd, Co, Cr, Fe, K, Mg, Na, Pb, Cu, Ni, Mn, Tl, V, Zn, As, Hg, and Se.

- The number of sample containers received (i.e., bottles) is equal to the number of samples listed on the COC record or accompanying forms.

Laboratory identification numbers are stamped on stickers and securely wrapped about each sample. If samples are to be shipped from one laboratory to another, proper COC and packaging procedures will be maintained.

Individual SOPs addressing sample receiving, tracking, storage, and security have been provided by Quanterra, Inc.

5.6 Preanalysis Storage

Personnel from the appropriate laboratory group receive and log in the samples. These personnel have the responsibility of picking up samples that are specific to their group from shipping and receiving. The samples are then placed into temporary storage until analysis.

Samples are stored as prescribed in the laboratory-specific quality assurance manual (QAM). Methods of storage are generally intended to:

- Retard biological action.
- Retard hydrolysis of chemical compounds and complexes.
- Reduce volatility of constituents.
- Reduce adsorption effects.
- Reduce light exposure.

Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing.

5.7 Postanalysis Storage

Anticipation of reanalysis prescribes proper environmental control. If reanalysis is not anticipated, environmental conditions are not observed, and the samples are stored at room temperature. Postanalysis environmental control of samples shall be specifically addressed in the laboratory-specific QAM. Disposal of samples will be in accordance with federal and state regulations.

5.8 Final Evidence Files

Records are prepared during the performance of the project to furnish documentary evidence of the conduct and quality of work. These records shall be controlled and retained.

5.8.1 Indexing and Filing of Project Records

Indexing and filing of records shall be performed only by designated filing personnel and maintained under the direction of the IT PM. The project record files will be organized by various project file categories.

Project files, including copies of all sampling and analytical data, are stored at the IT-Knoxville facility while the job is active. Once the job is completed and the files have been closed by the IT PM, records are transferred to off-site remote storage. Project files from the IT-Knoxville facility are managed by a local private storage company, Security Business Records Management.

5.8.2 Laboratory Analytical Project Files

Analytical data are stored by Quanterra for a period of 7 years unless specified differently by the client. Data are stored for 2 years at the laboratory facility; at the end of 2 years, records are transferred off site to a commercial records storage facility.

Evidentiary and document control/sample tracking SOPs for the Quanterra, Inc., Knoxville, Tennessee facility are provided in Appendix A.

6.0 Calibration Procedures

6.1 General Calibration Procedures and Frequency

Laboratory equipment will be identified and calibrated in accordance with the requirements of approved calibration procedures/instructions, such as those published by ASTM, EPA, or equipment manufacturers. Measuring equipment, test equipment, and reference standards will be calibrated at prescribed intervals and/or before use. Calibration frequency will be based on the analytical methods employed, the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience as dictated by the laboratory-specific QAM.

In some cases, scheduled periodic calibration will not be performed because the equipment is not continuously in use. Such equipment will be calibrated before use and then at the required frequencies for as long as its use continues.

6.2 Calibration Reference Standards

Two types of reference standards may be used at the laboratories for calibration:

- Physical standards, such as weights for calibration balances and certified thermometers for calibrating working thermometers and ovens are generally used for periodic calibration.

- Chemical standards such as standard reference materials (SRM) provided by the National Institute of Science and Technology (NIST) or the EPA. These may include vendor-certified materials traceable to NIST or EPA SRMs. These are primarily used for operational calibration.

Whenever possible, physical reference standards shall have known relationships to nationally recognized standards (e.g., NIST) or accepted values of natural physical constants. If national standards do not exist, the basis for the reference standard shall be documented.

Physical reference standards shall be used only for calibration and shall be stored separately from equipment used in analyses. In general, physical reference standards shall be at least four to ten times as accurate as the requirements for the equipment that is used to calibrate. In general, physical standards should be recalibrated every 3 years by a certified external agency.

Whenever possible, chemical reference standards shall be directly traceable to NIST SRMs. If SRMs are not available, compounds of vender-certified high purity will be used to prepare calibration standards.

6.3 Calibration Failures

Scheduled periodic calibration of testing equipment will not relieve personnel of the responsibility of employing properly functioning equipment. If an equipment malfunction is suspected, the device will be removed from service, tagged so it is not inadvertently used, and the laboratory coordinator notified, as appropriate, so that recalibration can be performed or substitute equipment can be obtained.

Equipment that can no longer be calibrated or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate that it is out of calibration. Such equipment will be repaired and recalibrated or replaced as appropriate. Any such action should be reported in the appropriate laboratory log.

6.4 Calibration Records

Records will be prepared and maintained for each piece of calibrated measuring and test equipment and each piece of reference equipment to indicate that established calibration procedures have been followed. Records demonstrating accuracy of preparation, stability, and proof of continuity of reference standards will also be maintained. Records for equipment used will be kept in the appropriate project file.

Records for periodically calibrated equipment will include, as a minimum:

- Identification number of equipment and type of equipment, or assigned unique equipment number
- Calibration frequency and acceptable tolerances
- Identification of calibration procedures used
- Date of calibration
- Identity of personnel performing the calibration
- Reference standards used for calibration
- Calibration data

- Certificates or statements of calibration provided by manufacturers and external agencies, and traceability to national standards

- Information regarding calibration acceptance or failure and any repair of failed equipment.

6.5 Operational Calibration

Operational calibration is generally performed as a part of the analytical procedure. Included may be the analysis of a method blank and the preparation of a standard response (standard calibration) curve. Operational calibration is dependent upon the instrumentation within the laboratory.

6.6 Periodic Calibration

Periodic calibration will be performed for equipment such as balances, thermometers, ovens, and furnaces that are required in analytical methods, but which are not routinely calibrated as part of the analytical procedure. Calibration requirements will be determined in the field and the laboratory depending upon the equipment used and its operating function.

7.0 Analytical Procedures

7.1 Analytical Objective

The analytical objective for this site remediation project is to provide data that most accurately reflect the constituents present at each sample location as indicated by the analytical results obtained from samples collected at each location. This objective will be met through the selection of the appropriate sample collection, sample preparation, and analytical methods. The process of selecting the analytical methods and procedures for this or any other project is based on the anticipated sample matrix, composition, required sample volume, and the analytes/compounds of interest.

7.2 Analytical Laboratories

The primary laboratory to be used for this investigation is Quanterra Environmental Services (Quanterra) in Knoxville, Tennessee. Quanterra holds all necessary certifications for the execution of the analytical project.

The laboratories participating in the analytical program will be equipped with the proper analytical instrumentation necessary to complete the desired sample analysis while also meeting the project DQOs. The analysts performing the sample preparation and analysis shall be familiar with the preparation and analytical methodologies selected, proper instrument operation, instrument calibration, QC requirements, and instrument preventive maintenance. The laboratories utilized will provide a well documented analytical data package that meets or exceeds the project required deliverables.

7.3 Analytical Instrumentation

Each instrument used to analyze samples in conjunction with this project will be set up, calibrated according to the procedures specified, and operated according to the selected analytical methodology. Instrument set-up, calibration, and operations will be documented in the run-log. Any deviations from these procedures will be documented in the laboratory case narrative that precedes the analytical data packages of every sample delivery group. QC sample analyses will be performed according to the type and frequencies specified by each method in order to verify instrument performance periodically during routine analyses. All recommended calibration and calibration frequencies specified in the analytical methods will be met by the laboratory performing the analysis.

7.4 Analytical Methods and Procedures

The analytical methods that will be used for this project are listed in Table 1-1. Tables 7-1, 7-2, 7-3, 7-4, and 7-5 list laboratory reporting limits for all compounds and analytes of interest. Detection limits are matrix dependent and may vary from those listed in the tables.

Table 7-1

Target Compound List
Volatile Organic Compounds and Laboratory Reporting Limits for Soil and Groundwater Sample SW-8260A[a]
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Compound	Soils Reporting Limit[b] (µg/kg)	Groundwater Reporting Limit (µg/L)
Acetone	20	20
Benzene	5	5
Bromodichloromethane	5	5
Bromoform	5	5
Bromomethane	10	10
2-Butanone	20	20
Carbon disulfide	5	5
Carbon tetrachloride	5	5
Chlorobenzene	5	5
Chlorodibromomethane	5	5
Chloroethane	10	10
Chloroform	5	5
Chloromethane	10	10
cis-1,3-Dichloropropene	5	5
1,1-Dichloroethane	5	5
1,1-Dichloroethene	5	5
1,2-Dichloroethane	5	5
1,2-Dichloroethene (total)	5	5
1,2-Dichloropropane	5	5
trans-1,3-Dichloropropene	5	5
Ethyl benzene	5	5
2-Hexanone	20	20

Table 7-1

Target Compound List
Volatile Organic Compounds and Laboratory Reporting Limits for Soil and Groundwater Sample SW-8260A[a]
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Compound	Soils Reporting Limit[b] (µg/kg)	Groundwater Reporting Limit (µg/L)
Methylene chloride	5	5
4-Methyl-2-pentanone	20	20
Styrene	5	5
Tetrachloroethene	5	5
1,1,2,2-Tetrachloroethane	5	5
Toluene	5	5
Trichloroethene	5	5
1,1,1-Trichloroethane	5	5
1,1,2-Trichloroethane	5	5
Vinyl chloride	10	10
Xylenes (total)	5	5

[a]U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods*, Third Edition, Update II, September 1994.
[b]Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factors, etc.

Table 7-2

Target Compound List
Semivolatile Organic Compounds and Laboratory Reporting Limits for Soil and Groundwater Sample SW-8270B
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Compound	Soils Reporting Limits[b] (µg/kg)	Groundwater Reporting Limits (µg/L)
Acenaphthene	330	10
Acenaphthylene	330	10
Anthracene	330	10
Benzo(a)anthracene	330	10
Benzo(a)pyrene	330	10
Benzo(b)fluoranthene	330	10
Benzo(g,h,i)perylene	330	10
Benzo(k)fluoranthene	330	10
4-Bromophenyl-phenyl ether	330	10
Butyl benzyl phthalate	330	10
Carbazole	330	10
Chrysene	330	10
bis(2-Chloroethoxy)methane	330	10
bis(2-Chloroethyl)ether	330	10
4-Chloro-3-methylphenol	330	10
4-Chloroaniline	330	10
2-Chloronaphthalene	330	10
2-Chlorophenol	330	10
4-Chlorophenyl-phenyl ether	330	10
Di-n-butyl phthalate	330	10
Di-n-octyl phthalate	330	10
Dibenzo(a,h)anthracene	330	10
Dibenzofuran	330	10

Table 7-2

Target Compound List
Semivolatile Organic Compounds and Laboratory Reporting Limits for Soil and Groundwater Sample SW-8270B
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Compound	Soils Reporting Limits[b] (µg/kg)	Groundwater Reporting Limits (µg/L)
1,2-Dichlorobenzene	330	10
1,3-Dichlorobenzene	330	10
1,4-Dichlorobenzene	330	10
3,3'-Dichlorobenzidine	1600	50
2,4-Dichlorophenol	330	10
Diethyl phthalate	330	10
Dimethyl phthalate	330	10
2,4-Dimethylphenol	330	10
4,6-Dinitro-2-methylphenol	1600	50
2,4-Dintrophenol	1600	50
2,4-Dinitrotoluene	330	10
2,6-Dinitrotoluene	330	10
bis(2-Ethylhexyl)phthalate	330	10
Fluoranthene	330	10
Fluorene	330	10
Hexachlorobenzene	330	10
Hexachlorobutadiene	330	10
Hexachlorocyclopentadiene	1600	50
Hexachloroethane	330	10
Indeno(1,2,3-cd)pyrene	330	10
Isophorone	330	10
2-Methylnaphthalene	330	10
2-Methylphenol	330	10

Table 7-2

Target Compound List
Semivolatile Organic Compounds and Laboratory Reporting Limits for Soil and Groundwater Sample SW-8270B
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Compound	Soils Reporting Limits[b] (µg/kg)	Groundwater Reporting Limits (µg/L)
4-Methylphenol	330	10
Naphthalene	330	10
2-Nitroaniline	1600	50
3-Nitroaniline	1600	50
4-Nitroaniline	1600	50
Nitrobenzene	330	10
2-Nitrophenol	330	10
4-Nitrophenol	1600	50
N-Nitroso-di-n-propylamine	330	10
N-nitrosodiphenylamine	330	10
2,2'-oxybis (1-Chloropropane)	330	10
Pentachlorophenol	1600	50
Phenanthrene	330	10
Phenol	330	10
Pyrene	330	10
1,2,4-Trichlorobenzene	330	10
2,4,5-Trichlorophenol	330	10
2,4,6-Trichlorophenol	330	10

[a]U.S. Environmental Protection Agency, *Test Methods for Evaluating Solid Waste (SW-846), Physical/ Chemical Methods*, Third Edition, Update II, September 1994.
[b]Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factor, etc.

Table 7-3

Target Compound List
Pesticides/PCB Compounds and Laboratory Reporting Limits
for Soil and Groundwater Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio
(Methods W-8080/8081)[a]

Compound	Soil/Sediment Reporting Limit[b] (µg/kg)	Water Reporting Limit (µg/L)
Aldrin	1.7	0.05
Aroclor 1016	33	1
Aroclor 1221	33	1
Aroclor 1232	33	1
Aroclor 1242	33	1
Aroclor 1248	33	1
Aroclor 1254	33	1
Aroclor 1260	33	1
alpha-BHC	1.7	0.05
beta-BHC	1.7	0.05
delta-BHC	1.7	0.05
gamma-BHC (Lindane)	1.7	0.05
Chlordane (Technical)	17	0.5
4,4'-DDD	1.7	0.05
4,4'-DDE	1.7	0.05
4,4'-DDT	1.7	0.05
Dieldrin	1.7	0.05
Endrin	1.7	0.05
Endrin aldehyde	1.7	0.05
Endosulfan I	1.7	0.05
Endosulfan II	1.7	0.05
Heptachlor	1.7	0.05
Heptachlor epoxide	1.7	0.05

Table 7-3

Target Compound List
Pesticides/PCB Compounds and Laboratory Reporting Limits
for Soil and Groundwater Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio
(Methods W-8080/8081)[a]

Compound	Soil/Sediment Reporting Limit[b] (µg/kg)	Water Reporting Limit (µg/L)
Methoxychlor	3.3	0.1
Toxaphene	67	2

[a]U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods, Third Edition, Update II, September 1994.
[b]Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factors, etc.

Table 7-4

Nitroaromatic Compunds and Laboratory Reporting Limits for Soil and Groundwater Sample SW-846[a] 8330 Site Investigations and Groundwater Investigation Former Plum Brook Ordnance Works Sandusky, Ohio

Compound	Soils Reporting Limit[b] (mg/kg)	Groundwater Reporting Limit (µg/L)
4-Amino-2,6-dinitrotoluene	0.25	0.2
1,3-Dinitrobenzene	0.25	0.2
2,4-Dinitrotoluene	0.25	0.2
2,6-Dinitrotoluene	0.25	0.2
HMX	0.50	0.5
Nitrobenzene	0.25	0.2
2-Nitrotoluene	0.25	0.2
3-Nitrotoluene	0.25	0.2
RDX	0.50	0.5
Tetryl	0.65	0.2
1,3,5-Trinitrobenzene	0.25	0.2
2,4,6-Trinitrotoluene	0.25	0.2

[a]U.S. Environmental Protection Agency (EPA), *Test Methods for Evaluating Solid Waste; Physical/Chemical Methods*, Third Edition, Revision 1, December 1990.
[b]Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factor, etc.

Table 7-5

Target Analyte List
Inorganic Compounds and Laboratory Reporting Limits
for Soil and Groundwater Sample SW-846[a], 6010A/7470a/7471A
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Analyte	Soils Reporting Limit[b] (mg/kg)	Groundwater Reporting Limit (mg/L)
Aluminum	20	0.2
Antimony	6.0	0.06
Arsenic	1.0	0.01
Barium	20	0.20
Beryllium	0.5	0.005
Cadmium	0.5	0.005
Calcium	500	5.0
Chromium	1.0	0.01
Cobalt	5.0	0.05
Copper	2.5	0.025
Iron	10	0.1
Lead	0.3	0.003
Magnesium	500	5.0
Manganese	1.5	0.015
Mercury	0.1	0.0002
Nickel	4.0	0.04
Potassium	500	5.0
Selenium	0.5	0.005
Silver	1.0	0.01
Sodium	500	5.0
Thallium	1.0	0.010
Vanadium	5.0	0.05
Zinc	2.0	0.02
Total Cyanide	0.5	0.01

[a]U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste (SW-846), Physical/ Chemical Methods, Third Edition, Update I, July 1992.
[b]Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factor, etc.

8.0 Data Reduction, Validation, and Reporting

8.1 Data Reduction and Verification

Analytical data reduction, validation, and reporting will be performed as follows. Analytical data are generated by the gas chromatography/mass spectrometer (GC/MS) computer software, the GC computer, the inductively coupled plasma (ICP) spectroscopy computer, atomic absorption (AA), ion chromatograph, and associated laboratory instrumentation. Examples of outputs include identifications of compounds, peak height or area, concentrations, retention times, and comparisons to standards. Outputs are in graphic form (chromatograms), bar graph (spectra), and printed tabular form in the standard formats specified for each analysis. These graphical or tabular outputs are used to calculate analyte concentrations using equations identified in the laboratory SOP for each method. If incomplete or incorrect outputs are received, corrective actions are taken according to procedures established for each type of analysis, consistent with manufacturer recommendations.

In the data review process, the data are compared to information such as the sample history, sample preparation, and QC sample data to evaluate the validity of the results. Corrective action is minimized through the development and implementation of routine internal system controls. Analysts are provided with specific criteria that must be met for each procedure, operation, or measurement system.

Laboratory data verification includes dated and signed entries by analysts and group leaders on the worksheets and logbooks used for samples, the use of sample tracking and numbering systems to track the progress of samples through the laboratory, and the use of QC criteria to reject or accept specific data.

Steps and checks used to validate precision and accuracy of the measured parameters and to support the representativeness, comparability, and completeness include:

- Description of the calibration performed
- Description of routine instrument checks (noise levels, drift, linearity, etc.)
- Documentation of the traceability of instrument standards, samples, and data
- Documentation of analytical methodology and QC methodology

- Description of the controls taken to determine and minimize interference contaminants in analytical methods (use of reference blanks and check standards for method accuracy and precision)

- MS recoveries, percent RPDs between the MS and MSD and surrogate recoveries

- Description of routine maintenance performed

- Documentation of sample preservation and transport when shipped elsewhere.

Laboratory validation responsibilities are as follows:

- ***Level 1, Technical Data Review.*** Each laboratory analyst shall review the quality of his/her work based on an established set of guidelines. The review criteria as established in each method, in this instruction, and as stated within the laboratory QAM shall be used. The review shall, at a minimum, ensure that: (1) sample preparation information is correct and complete; (2) analysis information is correct and complete; (3) the appropriate SOPs have been followed; (4) analytical results are correct and complete; (5) QC samples are within established control appropriate QC limits; (6) special sample preparation and analytical requirements have been met; and (7) documentation is complete (any anomalies have been documented and forms complete, holding times documented, etc.). This data review shall be documented by using a checklist form and by signature and date of the reviewer.

- ***Level 2, Technical Review.*** The Level 2 review shall be performed by a supervisor or data review specialist whose function is to provide an independent review of the data package. This review shall also be conducted according to an established set of guidelines and is structured to ensure that: (1) all appropriate laboratory SOPs have been followed; (2) calibration data are scientifically sound, appropriate to the method, and completely documented; (3) QC samples are within established guidelines; (4) qualitative identification of sample components is correct; (5) quantitative results are correct; (6) documentation is complete and accurate (any anomalies have been documented and forms complete, etc.); (7) the data are ready for incorporation into the final report; and (8) the data package is complete and ready for data archive. Level 2 review shall be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from at least 10 percent of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional 10 percent of the sample results shall be checked back to the sample preparatory and analytical bench sheets. This cycle then repeats until either no errors are found in the data set checked or all data has been checked. All errors and corrections noted shall be documented. Level 2 data review shall also be documented on a checklist with the signature and date of the reviewer.

- ***Level 3, Administrative Data Review.*** Level 3 review is performed by the QAO or the program administrator at the laboratory. This review shall be similar to the review as provided in Level 2 except that it shall provide a total overview of the data package to ensure its consistency and compliance with this instruction. All errors noted shall be corrected and documented. Level 3 data review shall also be documented on a checklist with the signature and date of the reviewer.

8.2 Data Reports

The format and content of a data report depend on project needs such as client or contract requirements, government agency reporting formats, and if explanatory text is required. However, the following items are applicable to data presentation and will be included:

- The final data presentation shall be checked in accordance with data verification requirements and approved by the laboratory technical director.
- Data are presented in a tabular format whenever possible.
- Data will be formatted as a Certificate of Analysis.
- Each page of data is identified with the project number and name, date of issue, and (if appropriate) client name.
- Data presentation includes:
  - Sample identification number provided to the laboratory
  - Chemical parameters analyzed, reported values, and units of measurement
  - Detection limit of the analytical procedure if the reported value is less than the detection limit
  - Data for chemical parameters reported with consistent significant figures for samples
  - Results of QC sample analysis
  - Achieved accuracy, precision, and completeness of data, if appropriate
  - Footnotes referenced to specific data if required to explain reported values
  - Analytical methods specifically referenced on all laboratory reports (any method modification will be included in the case narrative)

- Data for field QC samples reported in the same format as action samples (a modified data package consisting of QA/QC summary data sheets will be provided for all internal laboratory QC samples)

- Laboratory data stored so that complete data packages can be subsequently assembled for EPA-designated review.

The PM is responsible for preparing each technical report including the process of data validation.

8.3 Deliverables

The laboratory will provide the raw instrument data analytical results in a format based on the EPA CLP or CLP-like format. These data packages will represent "stand alone" deliverables, which include sample preparation information, instrument data, parameter specific QC documentation and QC data such as method blanks, spikes, duplicates, surrogates, and internal standards, calibration and calibration check performance, and other instrument performance information. Deliverables will also include copies of the AR/COC forms, along with validation narratives from the person(s) performing laboratory data validation.

8.4 Data Validation

All data will be subjected to a third-party validation process. This process will include the review and evaluation of the following QA/QC elements:

- Chain of custody
- Initial and continuing calibrations
- Detection limits
- Analyte(s) identification
- Analyte(s) quantification
- QC blanks (trip, method, rinsate, etc.)
- Matrix spike recoveries.

The validation will involve data qualification or flagging based on the review of the aforementioned elements. The validation process references the *EPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review* (February 1993, EPA-540/R-94/012) and *Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Data Review* (February 1994, EPA-540/R-94/013). For parameters not specifically addressed by the EPA's validation guidelines, evaluation procedures similar to those referenced and the laboratory's SOPs will be followed.

The third-party validation procedure, when performed in conjunction with the internal review of all sample documentation (location, date and time collected, batch, etc.), the sampling design approach, and the accuracy and precision evaluation provide all the necessary qualifications for the generation and verification of definitive data as defined in EPA-540/R-93/071.

9.0 Internal Quality Control Samples

This section addresses the QC samples that are routinely added to the normal laboratory sample stream to demonstrate that the laboratory is operating within prescribed requirements for accuracy and precision. The analytical laboratory will be required to include the following internal checks: instrument or method initial and continuing calibrations using traceable standards, duplicate analyses, surrogate spikes, MS/MSD samples, postdigestion spikes, internal standards (where appropriate), and method blanks. Table 1-1 summarizes the laboratory sample analyses and analytical method requirements for which the previously mentioned items must be maintained for this project. Table 9-1 summarizes laboratory QC samples and frequency of collection and analysis requirements. The analytical QC checks, frequencies, acceptance criteria, and corrective actions for each SW-846 analytical method or parameter are described in detail in the appropriate analytical method. SOPs for these particular methods are found in Appendix A.

9.1 Surrogate Spikes

Analytical procedures which use GC/MS, GC, and HPLC instrumentation require each sample to be spiked with a surrogate standard. The surrogate standard is used to evaluate the efficiency of sample preparation methods through the calculation of percent recoveries measuring the accuracy of the procedure. These standards are spiked into the sample immediately before sample preparation. The surrogate spikes recommended in the SW-846 methods to be used for analysis will be spiked in the appropriate concentrations into the project samples prior to sample preparation. Table 1-1 summarizes the analytical methods to be used in this project. The samples are prepared, analyzed, and the spike recoveries calculated. Following analyses, the surrogate recoveries will be calculated and checked against the acceptance criteria established in the analytical methods and in this QAPP. Surrogate spikes are used for volatile, semivolatile, and pesticide/PCB and explosives analyses only.

9.2 Duplicate Analyses

The intent of requesting a duplicate sample analysis will be to evaluate the variance in the applied analytical method. The collection of a composite sample will compensate for any variability in the sample components while providing adequate volume for the analysis. Duplicate samples may also be requested for samples collected during routine operations associated with project remediation. Duplicate analyses will be requested on the AR/COC submitted to the laboratory with the samples.

Table 9-1

Laboratory Quality Control Samples
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

			Applicability			
Type	Purpose of Sample	Frequency	Inorganic	Organic	Accuracy and Precision Application	Introduced by Field Sampler/Analyst/QC Coordinator
Method Blank (Process Blank)	The analysis is performed using only the reagents and solvents used in the method. Determine cumulative interference. If interference cannot be eliminated, it must be considered when computations are performed.	With each group of samples, or beginning and end of each run. For GC/MS, method is spike with surrogates 1 out of 10.	X	X	Accuracy	Analyst
Reagent Blank	Determines the background of each reagent/solvent to be used in an analyses. Must use identical conditions to actual analyses including detection system. Background must not interfere with intended analyses.	Can be done as part of method blank; determine separately with each new batch of reagent/solvents.	X	X	Accuracy	Analyst
Duplicate	An aliquot of a sample known to analyst. Calculates relative percent difference.	1 out of 20 or at least 1/month/run.	X	X (MSD)	Precision	Analyst
Check Standard	Analysis of standard with concentrations at midpoint or low end of standard curve to verify standard calibration curve.	With each group of samples.	X		Accuracy	Analyst
Surrogate Standards	For GC/MS and GC analysis, the addition of nonpriority pollutants as spikes in standards, method blanks, and samples. Three-point calibration curve. When used daily, determine Means and Warning and Control Limits.	All standards, method blanks, and samples.		X	Accuracy	Analyst

Table 9-1

Laboratory Quality Control Samples
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

			Applicability			
Type	Purpose of Sample	Frequency	Inorganic	Organic	Accuracy and Precision Application	Introduced by Field Sampler/Analyst/QC Coordinator
Standard Reference Materials	Standards prepared by recognized external agency and used to determine performance of entire system, instrumentation, and analysts.	Scheduled periodic basis such as quarter or semiannually	X	X	Accuracy	Analyst or QC Coordinator
Blank Spike (laboratory control sample)	Blank material spiked with parameters of interest. Recovery evaluated for proper execution of technique or analytical method.	1 out of 10 or at least 1/batch with MS/MSD pair.	X	X	Accuracy	Analyst
Analysis Matrix Spike	Sample or extract spiked just prior to analysis. Shows matrix effects during analysis.	As specified in methods, or as needed	X	X	Accuracy	Analyst
Internal Standards	Nonpriority pollutant spiked into sample and method blank after extraction to monitor instrument performance and sensitivity should surrogate standards indicate a problem.	Each sample and standard	GC/MS VOA and Base Neutral/Acid Analysis		Accuracy	Analyst
Initial Calibration	An analytical curve based on absorbance, emission intensity, or other measured characteristics of known standards. Data from subsequent analyses are considered valid as long as they fall within the linear range of the curve.	Instruments should be calibrated at the beginning of the project before any samples are analyzed, after each major disruption in analytical procedures, and whenever action limits are exceeded.	X	X	Accuracy	Analyst

Table 9-1

Laboratory Quality Control Samples
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

			Applicability			
Type	Purpose of Sample	Frequency	Inorganic	Organic	Accuracy and Precision Application	Introduced by Field Sampler/Analyst/QC Coordinator
Continuing Calibration	Validity of the original calibration curve is confirmed.	GC/MS: Calibration should be checked at the beginning of each work shift, at least once every 12 hours (or every 10 to 12 analyses, whichever is more frequent), and after the last sampled analysis of each work shift. GC: Calibration should be checked at the beginning of each shift, every 6 hours (or every 6 samples, whichever is less frequent), and after the last sample analysis of each shift. ICP/AA: All work performed using continuing calibration. Ten percent of the samples or every 2 hours during analysis run, whichever is more frequent.	X	X	Accuracy	Analyst

9.3 Matrix Spikes and Postdigestion Spikes

Spiked samples also will include MS, MSD, and postdigestion spikes. MS spikes will be conducted to evaluate accuracy and matrix recovery of selected compounds or analytes of interest. Post-digestion spikes will be applied to the samples receiving metals analysis. Postdigestion spikes are applied following sample preparation but prior to sample analysis. These spikes indicate any possible sample matrix effects. Specific spiking requirements are specified in the appropriate analytical methods.

9.4 Internal Standards

For volatiles and semivolatiles, internal standards are spiked after sample preparation and extraction. The data obtained from the analysis will not be used to evaluate accuracy, but rather to calculate response factors necessary for the quantitation of all compounds of interest. The recovery standards are used to calculate response factors for the internal standards, while the surrogate spikes are used to calculate response factors for the internal standards and to assess recovery of the internal standards for volatile and semivolatile compounds. The data will be reviewed for conformance with the acceptance criteria specified by the analytical method.

9.5 Method Blanks

A method blank sample will be prepared and analyzed by the laboratory in association with each batch of samples containing project samples. The method blanks will be prepared according to the same preparation methodology used for preparing the project samples. These blanks will consist of those required by the analytical method (method blanks prepared in the laboratory) to demonstrate the absence of fugitive contaminants in the laboratory reagents, materials, and glassware used during sample preparation. The resulting analytical data will be used to qualify the data obtained from project samples should the method blank indicate the presence of fugitive contaminants. Samples associated with this batch method blank will be qualified with a "B" for each analyte detected in the method blank. The method blank sample data will not be used to determine the usefulness or the acceptance of other project data. Use of this data will be restricted to notifying the analytical PM that an observed concentration detected in the project samples may be the result of fugitive contamination present in the laboratory during the preparation and analysis of samples.

9.6 Reagent Blanks

The reagent blank is an aqueous solution that is as free of analyte as possible and contains all the reagents in the same volume as used in the processing of the samples. The reagent blank must be carried through the complete sample preparation procedure and contains the same reagent

concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used for determining possible contamination resulting from the preparation or processing of the sample.

9.7 Check Standard

A check standard is a material of known composition that is analyzed concurrently with test samples to evaluate a measurement process; it is an analytical standard that is analyzed to verify the calibration of the analytical system. One check standard should be analyzed with each analytical batch or every 20 samples, whichever is greater.

9.8 Standard Reference Material

SRM is a sample prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. An independent standard is defined as a standard composed of the analyte(s) of interest from a different source than that used in the preparation of standards for use in the standard curve. A QC reference sample is intended as an independent check of technique, methodology, and standards. This is applicable to all organic and inorganic analyses.

9.9 Blank Spike (Laboratory Control Samples)

A laboratory control sample (LCS) is a blank spiked with the parameters of interest or is a matrix of known parameter concentrations that is carried through the entire analytical procedure being used to analyze project samples. Analysis of this sample with acceptable recoveries demonstrates that the laboratory techniques for this method are in control. Where required, this sample will be analyzed in conjunction with MS/MSD samples. If the MS/MSD pair shows poor recoveries due to interferences of matrix effects, but the LCS is acceptable, strong evidence exists that the method has been performed correctly by the laboratory, but the sample matrix has affected the sample results.

9.10 Analytical Instrument Calibration

The analytical instrumentation used in the laboratory for analysis of project samples will undergo rigorous checks and re-checks of performance. Prior to sample analysis, initial and continuing calibrations will be performed to determine linearity of response versus concentration of known amounts of the analytes of interest. If acceptance criteria, as specified in the appropriate analytical methods for initial and/or continuing calibrations are not met, sample analysis will not proceed until the analytical problem has been corrected and the criteria met. All reported sample results must be bracketed by two successful continuing calibration standards. Linearity checks

will be used to verify that response has not shifted significantly from the most recent calibration. Additionally, internal standards will be analyzed to evaluate instrument and method performance.

10.0 Performance and System Audits

An individual audit plan will be developed to provide a basis for each audit. This plan will identify the audit scope, activities to be audited, audit personnel, any applicable documents, and the schedule. Checklists will be prepared by the auditors and used to conduct all audits. They will be developed to accomplish the necessary reviews and to document the results of the audit.

Audits may involve an on-site visit by the auditor. Items to be examined may, as appropriate, include the availability and implementation of approved work procedures, calibration and operation of equipment; packaging, storage, and shipping of samples obtained; performance documentation; and nonconformance documentation.

The records of operations will be reviewed to verify that laboratory and field-related activities were performed in accordance with appropriate approved procedures. Items reviewed will include, but will not be limited to, the calibration records of equipment, FADLs, AR/COC documentation, and data resulting from field and laboratory operations.

10.1 Audit Schedule and Records

Audits will be conducted as the scheduled activities dictate. Audits will cover both field work as well as other project and laboratory actions. The QAO is responsible for scheduling and performing audits. Within 20 working days of completion of an audit, the QAO and/or his representative will prepare and submit an audit report. The report will be addressed to the PM and copies will be sent to the organization or group audited.

Within 30 working days after receipt of the audit report, the PM will prepare and submit to the QAO, a reply to the audit. This reply will include, as a minimum, a plan for implementing the corrective action to be taken on nonconformances indicated in the audit report, the date by which such corrective action will be completed, and actions taken to prevent reoccurrence. If the corrective action has been completed, supportive documentation should be attached to the reply. The QAO will ascertain (by reaudit or other means) whether appropriate and timely corrective action has been taken. Reaudits will be conducted and reported in the same manner as the original audit.

Records of audits will be maintained in the project files. Audit files will include, as a minimum, the audit report, the reply to audit, and any supporting documents. It is the responsibility of the

PM to conform to the established procedures, particularly with timely replies to audit reports and implementation of such corrective action as may be indicated.

10.2 Performance and System Audits

Audits will be performed to review and evaluate the adequacy of laboratory performance, and to ascertain if the QAPP is being completely and uniformly implemented. The laboratory QC coordinator is responsible for such audits and will perform them according to a schedule planned to coincide with appropriate activities on the project schedule and sampling plans. Such scheduled audits may be supplemented by additional audits for one or more of the following reasons:

- When significant changes are made in the QAPP
- When it is necessary to verify that corrective action has been taken on a nonconformance reported in a previous audit
- When requested by the PM or laboratory manager.

The objectives of performance and systems audits are to verify that the QAPP developed for this project is being implemented according to the specified requirements, to assess the effectiveness of the QAPP, to identify nonconformances, and to verify that identified deficiencies are corrected. Upon discovery of any significant deviation from the QAPP, the PM shall be informed of the nature, extent, and corrective action taken to remedy the deviation.

In addition to these internal audits, surveillance of selected activities may be performed periodically.

10.2.1 Performance Audits

A performance audit can be defined as a review of the existing project and QC data to determine the accuracy of a total measurement system(s) or a component part of the system. The analysis of laboratory PE samples and the participation in scheduled interlaboratory studies may be included as part of the performance audit.

The laboratory will perform monthly internal audits covering all laboratory functions and activities. Performance audit reporting will be summarized in a monthly report to the technical director and the PM.

10.2.2 System Audits

A systems audit consists of an evaluation to determine if the components of a measurement system(s) were properly selected and are being used correctly. A system audit includes a careful evaluation of field and laboratory QC procedures.

System audits will be conducted on a semiannual basis by the QA/QC director. The system audit will be reported in formal audit reports.

10.2.3 Field Audits

Field audits can be performed either by internal personnel or by external personnel. An individual audit plan will provide a basis for each field audit. This plan will identify the audit scope, activities to be audited, audit personnel, any applicable documents, and the audit schedule. Checklists will be prepared by the auditors and used to conduct all audits. They will be developed to accomplish the review of necessary items and to document the results of the audit.

A field operations audit may involve an on-site visit by the auditor. Items to be examined may, as appropriate, include the availability and implementation of approved work procedures; calibration and operation of equipment; packaging, storage, and shipping of samples obtained; documentation procedures and instructions; and nonconformance documentation.

The records of field operations will be reviewed to verify that field-related activities were performed in accordance with appropriate procedures. Items reviewed may include, but are not limited to, the calibration records of field equipment, FADLs, AR/COCs, and data resulting from field operations.

Field audits will be conducted during the field work. Field audit reports will be reported in formal audit reports distributed by the PM.

During an audit and upon its completion, the auditor(s) will discuss the findings with the individuals audited and discuss and agree on corrective actions to be initiated.

Minor administrative findings that can be resolved to the satisfaction of the auditors during an audit are not required to be cited as items requiring corrective action. Findings that are not resolved during the course of the audit and findings affecting the overall quality of the project will be noted on the audit checklists and included in the audit report.

11.0 Preventive Maintenance Procedures

11.1 Field Instruments and Equipment

Periodic preventive maintenance is required for all sensitive equipment. Instrument manuals will be kept on file for reference purposes should equipment need repair. The troubleshooting section of factory manuals may be used in assisting personnel in performing maintenance tasks. The frequency of preventive maintenance for field equipment is usually indicated in each operating instruction manual. Otherwise, the contractor will indicate when routine maintenance checks are necessary so that failures in the field can be minimized.

11.2 Laboratory Instruments

Preventive maintenance is an organized program of actions, such as equipment cleaning, lubricating, reconditioning, adjustment, and/or testing, taken to maintain proper instrument and equipment performance and to prevent instruments and equipment from failing during use. An adequate preventive maintenance program increases reliability of a measurement system.

The implementation of a preventive maintenance program is dependent upon the specific instruments and equipment used within the laboratories.

The laboratory manager is responsible for preparation and documentation of the program. All of the analysts will carry out the program, and the laboratory QC coordinator will review implementation to verify compliance. The laboratory preventive maintenance program will include the following:

- A listing of the instruments and equipment that are included in the program
- The frequency of maintenance considering the manufacturers' recommendations and/or previous experience with the equipment. The listing and maintenance frequency will be provided on a schedule, and the frequency will be stated in terms of monthly, quarterly, etc.
- A list of spare parts maintained by the laboratory for each instrument
- Documentation of external service contracts
- Items to be checked and/or serviced during maintenance and directions for performing maintenance (if external service is not provided, or if not stated in the manufacturers' instrument manuals).

Preventive maintenance records will be stored in the laboratory's central filing system. The master schedule will be kept at the beginning of the maintenance record. Behind the schedule, a separate file will be maintained for each instrument to include:

- Spare parts list
- External service contracts
- Checklist of items to be serviced and directions for maintenance or manufacturers' instrument manuals
- Record/results of periodic maintenance.

12.0 Assessment Procedures for Accuracy, Precision, and Completeness

The QA activities implemented in this study will provide a basis for assessing the accuracy and precision of the analytical measurements. Section 3.0 discusses the QA activities that will generate the accuracy and precision data for each sample type. The generalized form of the equations that will be used to calculate accuracy and precision are as follows:

Accuracy

$$\text{Percent Recovery} = \left[\frac{(X - S)}{T} \right] \times 100 \qquad \text{Eq. 12.1}$$

where:

X = experimentally determined concentration
T = true concentration of the spike
S = sample concentration before spiking

Precision

$$\text{re Percent Difference (RPD)} = \left| \frac{|D_1 - D_2|}{\left(\frac{D_1 + D_2}{2} \right)} \right. \qquad \text{Eq. 12.2}$$

where:

D_1 and D_2 = results of duplicate measurements

or as the standard deviation relative to the average value expressed as:

$$\text{Standard Deviation (\% RSD)} = \left(\frac{\sigma_{(n-1)}}{\overline{X}\ (x_1 .. x_n)} \right. \qquad \text{Eq. 12.3}$$

where:

$\sigma_{(n-1)}$ = sample standard deviation of the sample data
n = number of duplicates
$\overline{X}\ (x_1..x_n)$ = arithmetic mean of the sample data

Completeness. Data completeness is a measure of the extent to which the database resulting from a measurement effort fulfills objectives for the amount of data required. For this remediation project, completeness will be defined as the percentage of valid data obtained from the total project. Completeness is assessed by the following equation:

$$Completeness,\ \% = \left(\frac{D_r}{D_c} \right) \times 100 \qquad \text{Eq. 12.4}$$

where:

D_r = number of samples for which valid results are reported
D_c = number of valid samples that are collected and reach the laboratory for analysis.

The completeness objective will help to evaluate the accuracy and precision of the analytical measurements.

13.0 Corrective Action

The need for corrective action occurs when a circumstance arises that threatens the quality of the data output. For corrective action to be initiated, awareness of a problem must exist. In most instances, the personnel conducting the field work and the laboratory analysis are in the best position to recognize problems that will affect data quality. Awareness on their part can frequently detect minor instrument changes, drifts, or malfunctions, which can then be corrected, thus preventing a major breakdown of the system. If major problems arise, personnel are in the best position to decide upon the proper corrective action and initiate it immediately, thus minimizing data loss. Therefore, the field sampling and laboratory analysis personnel will have a prime responsibility for recognizing the need for a nonconformance. Each nonconformance shall be documented by the personnel identifying or originating it. For this purpose, a variance log, testing procedure record, notice of equipment calibration failure, results of laboratory analysis QA tests, audit report, internal memorandum, or letter shall be used as appropriate. Documentation shall include:

- Identification of the individual(s) identifying or originating the nonconformance
- Description of the nonconformance
- Any required approval signatures
- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted
- Schedule for completing corrective action.

Documentation in the form of a nonconformance report shall be made available to project and laboratory management and the QA/QC coordinator. It is the responsibility of the PM, laboratory analysis coordinator, and/or QA/QC coordinator to notify appropriate personnel of the nonconformance. Samples affected will be listed on the nonconformance report.

Decisions on whether to take corrective action and what action(s) to take will be made by the PM or the QA/QC coordinator. When a corrective action is taken by any of the operations or analytical laboratory personnel, they will be responsible for notifying the QA/QC coordinator so that, if deemed necessary, QA surveillance of the affected sampling or analysis system can be

intensified. Nonconformance and corrective action reports will become part of the final report submittals or the supporting data files.

A second recognition level of the need for corrective action will be determined by the QA/QC coordinator, who will determine the need for corrective action from the results of the audits described in Section 10.0 and from review of the QA data generated during the study. The QA/QC coordinator will be responsible for initiating corrective action by immediately notifying the analytical PM during the sample analysis phase. The appropriate management will then be responsible for instituting corrective action and verifying that the corrective actions produce the desired results.

Ultimately, the personnel performing and checking the sampling and analysis procedures and results must participate in decisions to take corrective actions. To reach the proper decision, each individual must understand the program objectives and data quality required to meet the objectives established in the QAPP. DQOs for this program are presented in Section 3.0. Personnel involved in the project will receive or have available to them an approved copy of this QAPP and will be informed of these objectives. The individuals performing the analyses will have the responsibility to notify the analytical PM whenever a measurement system is not yielding data within these objectives. The analytical PM will then notify the IT PM of the problem.

If a situation arises requiring corrective action, the following closed-loop corrective action system will be used:

- Define the problem.
- Assign responsibility for investigating the problem.
- Investigate and determine the cause of the problem.
- Determine corrective action course to eliminate the problem.
- Assign responsibility for implementing the corrective action.
- Determine the effectiveness of the corrective action and implement the correction.
- Verify that the corrective action has eliminated the problem.
- If not completely successful, loop back to first step.

14.0 QA Reports to Management

Fundamental to the success of this QAPP is the active participation of management in the project. Management will be aware of project activities and will participate in development, review, and operation of the project. Management will be informed of QA activities through the receipt, review, and/or approval of:

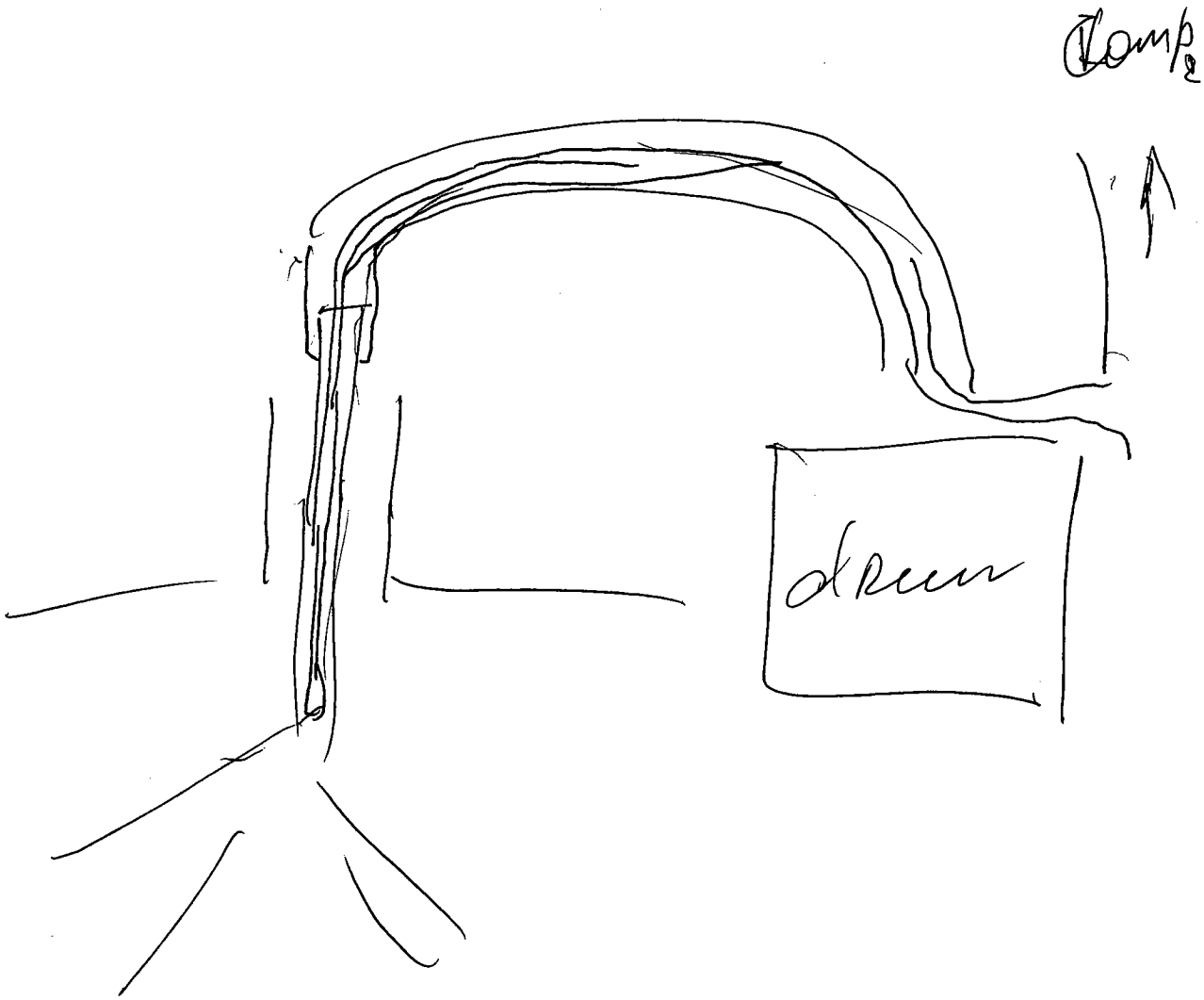
- Project-specific QA project plans
- Corporate and project-specific QA/QC plans and procedures
- Post audit reports and audit closures
- Corrective action overdue notices
- Nonconformance reports
- Significant QA problems encountered.

Section 10.0 describes the performance and systems audits process to be used during the project. In addition, periodic assessment of QA/QC activities and data accuracy, precision, and completeness will be conducted and reported by the laboratory.

Appendix A

Quanterra Environmental Services
Standard Operating Procedures

Please insert the contents of Appendix A from the draft QAPP to Appendix A of the final QAPP (revision 1).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RESPONSE TO U.S. ARMY CORPS OF ENGINEERS AND OHIO ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE DRAFT WORK PLAN AND SAFETY AND HEALTH PLAN FOR THE SITE INVESTIGATIONS AND GROUNDWATER INVESTIGATION AT THE FORMER PLUM BROOK ORDNANCE WORKS, SANDUSKY, OHIO

Response to USACE, Nashville District Comments on The Draft Work Plan for Site Investigation and Groundwater Investigation At Former Plum Brook Ordnance Works Sandusky, Ohio

Reference: Memorandum to CEORN-ER-M (Webb) from Michael F. Zoccola, HTRW Design Branch, dated July 25, 1996

Sampling and Analysis Plan Comments

Comment 1: **Section 1.1. First paragraph, next to last sentence. Please add "conduct" before site and groundwater investigations.**

Response 1: The text has been revised as suggested.

Comment 2: **Section 1.1, second paragraph, first sentence. What is meant by the term "leading document?"**

Response 2: This document is considered as a "leading document" in that it was prepared so as to provide general directions and guidance for the SIs and groundwater investigation at the PBOW site.

Comment 3: **Section 1.3.2, third paragraph. Will the results of the EA be made available to the Nashville District upon receipt?**

Response 3: The "EA" conducted by OHARNG in the 1980s was mentioned in the Records Review Report by Dames & Moore. IT Corporation does not have a copy of the EA report.

Comment 4: **Page 1-6, second paragraph, fourth sentence. Change "was" to "were."**

Response 4: The text was revised as suggested.

Comment 5: **Page 3-1, Section 3.2. Since this document contains the sitewide Sampling and Analysis Plan (SAP), Quality Assurance Plan (QAPP), and Site Wide Safety and Health Plan (SSHP), only information relevant to the entire site should be included.**

Response 5: Noted.

Comment 6: **Figure 3-1. This figure should be amended to show all AOCs within the former boundaries of PBOW.**

Response 6: Figure 3-1 has been revised to show all AOCs within the former PBOW based on the data that are currently available.

Comment 7: **Page 3-7, Section 3.3.4. The Site Specific Data Quality Objectives (DQO) Process should be detailed in the appropriate site specific addendum to the work plans. Remove this section and include it, as appropriate, in the relevant site specific addendum.**

Response 7: The DQO process as described in Section 3.3.4 applies to all SIs and groundwater investigation at PBOW. Site-specific components of the DQO process are presented in the site-specific attachment.

Comment 8: **Page 4-1, Section 4.1: These operating procedures should be generic in nature. Do not include specific areas of concern.**

Response 8: References to specific areas of concern were removed from the text.

Comment 9: **Page 4-9, para. 4.3.1. The fourth paragraph states that the annular space above the bentonite seal will be grouted to the ground surface. This should read "to the elevation of the local frost line."**

Response 9: The text was revised as suggested. However, it is possible that the water level in the overburden aquifer is close or even above the local frost line. In such case, grouting up to the frost line cannot be done due to the required filter pack thickness and bentonite seal above the well screen. If this situation occurs, IT proposes to place bentonite from the top of the filter pack to the ground surface in order to ensure an adequate seal of the annular space.

Comment 10: **Page 4-9, para. 4.3.1. Stamped metal tags should be attached to the well protective casing. These tags should indicate the Nashville District installed the well, well number, date installed, top of well casing elevation and bottom of well casing elevation.**

Response 10: The text was revised to specify the contents of the metal tag to be attached permanently to the well protective casing.

Comment 11: **Page 4-10, para. 4-9. The temporary 10-inch PVC casing may be replaced with 8-inch casing if desired. This would allow approximately a 1-inch annular space between the steel protective casing and the concrete pad.**

Response 11: The temporary 8-inch PVC casing was added to the text as an option for the field crew to consider during monitoring well installation.

Comment 12: **Page 4-10, para. 4.3.2. Well development procedures and criteria should be as follows:**

> **All new wells shall be developed according to EM 1110-1-4000. Pumping and surging shall be accomplished in the following manner. Surge for several minutes until the well water is clear. Repeat this process until the water is clear and no more fines are drawn into the well or for six (6) hours, whichever is less. During development, temperature, pH and conductivity shall be monitored. These parameters should stabilize to within ± 0.5°C, ±0.2 pH units and less than 10 percent variation in conductivity for three consecutive readings. If, after six hours, the well has not cleared or stabilized, call CEORN for guidance.**

Response 12: The text was revised to include well development criteria as suggested.

Comment 13: **Page 4-14, fifth bullet. Add "Eh" to list of acronyms.**

Response 13: The list of acronyms was revised to include "Eh."

Comment 14: **Page 4-15, fourth bullet. Please clarify this statement.**

Response 14: Groundwater samples need to be filtered in the field to acquire representative results of naturally dissolved metal and/or nitroaromatics. Previous experience indicates that unfiltered water samples may overestimate metal or nitroaromatic concentrations as a result of suspended formation particles.

Comment 15: **Page 4-15, para. 4.3.5. How will water be removed (water level lowered) from the well?**

Response 15: Water will not be physically removed from the well. To lower the water level for a rising-head slug test, a slug will be submerged in the well causing water level to rise temporarily. When the water table returns to the original level or reaches equilibrium, the slug will be pulled out creating a drop in the water level. The rate of water level change will be recorded and analyzed for aquifer parameters.

Comment 16: **Page 4-16, para. 4.4. For all sampling locations a HTRW Boring Log must be completed. The following verbiage should be included or noted:**

> **Field drilling logs for all borings and other sampling locations, i.e., surface and sediment, shall be completed on form ENG 5056-R and 5056A-R. These logs are considered the only legal document associated with the boring or sampling location. If the investigation**

requires a specific state drill log form, then that drill log shall be used in place of ENG 5056-R and 5056A-R. These hand written logs shall be fully completed in the field in a neat and legible printing, Copies of these logs shall be included in the draft and final reports. The AE may use other log forms (i.e., electronically generated), but 5056R and 5056A-R shall be included (except as noted above). Any log that is not legible may be grounds for not accepting the boring or well. Hand auger borings may be logged in the Sketch/Comments block of the log cover sheet if there is room enough to enter the soil description details. Otherwise, the log continuation sheet (ENG 4045A-R) shall be used.

Response 16: Noted. The text has been revised to include this requirement.

Comment 17: **Page 5-1, para. 5.1. The drill rig need only be steam cleaned between borings if soil or mud is splashed on the back end of the rig/truck. Decon is not required between site to site mobilization except in the case stated above. The rig must be steam cleaned upon arrival to the site and before leaving.**

Response 17: In accordance with standard IT practice, the decon of rig will be required upon arrival to the site and before departure and between mobilizations from one area of concern to the other since field investigations in different areas of concern will likely be conducted concurrently at PBOW.

Comment 18: **Page 6-1, Section 6.1. QA/QC samples should be cross referenced with the appropriate field sample in the Daily Log.**

Response 18: Section 6.1 was revised to include requirements for cross reference between QA/QC and field samples in the Field Activity Daily Log.

Comment 19: **Page 7-1, Section 7.0. Add the following to this section "sample bottles will be placed in the cooler in a way so that they do not touch;" "The COC shall be sealed in a plastic bag and taped to the inside lid of the cooler;" "The cooler drain will be taped shut;" "A completed shipping label will be taped to the top of the cooler;" "This Side Up labels shall be placed on four sides of the cooler" and "Fragile labels will be placed on two sides of the cooler."**

Response 19: Section 7.0 was revised to include the above requirements as suggested.

Comment 20: **Page 8-1, para. 8.0. The temporary storage of IDW is not addressed in this section. Drums should be staged on pallets and covered with a tarp. The staging area should have a plastic sheeting (Visgueen®) floor with built up sides so as to prevent the release to the environment any drum**

Response to USACE, Nashville District Comments on The Draft Site-Wide Health and Safety Plan for Site Investigation and Groundwater Investigation at Former Plum Brook Ordnance Works Sandusky, Ohio

Reference: Memorandum dated July 19, 1996 from Michael Zoccola, U.S. Army Corps of Engineers, Nashville District, P.O. Box 1070, Nashville, TN 37202-1070.

Comment 1: **General. The Site-wide Safety and Health Plan (SSHP) does not address all the procedures required by the USACE standards. I am furnishing a copy of USACE ER 385-1-92 (Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW), and Ordnance and Explosive Waste (OEW) Activities, dated March 1994) Appendix B to guide you in the preparation of your SSHP. An additional draft review of your second submittal will be necessary.**

Response: The Site-wide SSHP is an installation-wide "generic" SSHP for all anticipated activities at the Former Plum Brook Ordnance Works. There will be site-specific attachments to the Site-wide SSHP. These site-specific attachments will include the following outline:

- site work plan summary (objective, project tasks, personnel requirements)
- site characterization and analysis (anticipated chemical and physical hazards, employee protection for site entry, location and approximate size of site, site topography, site accessibility, pathways for hazardous substance dispersion)
- site monitoring requirements (chemical/physical agent, action level, PELs, monitoring equipment, frequency and location)
- activity hazard analysis

Comment 2: **Page 3-2, Section 3.2 Job Hazard Analysis by Task: See Appendix B Section 2. Hazard/Risk Analysis for proper preparation of this section. Pay close attention to Section 2b that addresses action level requirements. Include results.**

Response: See response 1.

Comment 3: **Table 3-1, Activity Hazard Analysis (AHA): List for each site the activity, hazard, and recommended control for this operation.**

Response: See response 1.

Comment 4: **Page 3.4, Section Chemical Hazards: Discuss the maximum level of**

contamination for each contaminant that poses a threat to the site employees, public or environment. Additionally, assess the same contaminants for Emergency Contingency and/or Evacuation Planning.

Response: Specific information regarding contaminant levels are not known, as the purpose of this investigation is to determine if sites are contaminated.

Comment 5: **Page 8-1, Section 8.1 Air Monitoring: Please clarify and expand the first sentence explaining why these are or are not contaminants of concern. Will air monitoring take place or not, and why?**

Response: The text was expanded. Specific air monitoring requirements will be in site-specific attachments as mentioned in response 1.

Comment 6: **Table 8-1, Action Levels, Former Plumb Brook Ordnance Works: I cannot evaluate this section. This document does not include any analytical results. See comments 2 and 4.**

Response: See response 1 and 4.

Comment 7: **Page 11-1, Section 11-2 First Aid: Expand this paragraph to include First Aid measures for possible skin, ingestion, and eye absorption exposures.**

Response: First aid measures for skin, ingestion, inhalation, and eye exposures are discussed in Section 11.4.1.

Comment 8: **Page 11-2, Section 11.3.4 Emergency Equipment/Facilities: Will an ABC rated fire extinguisher put out a fire involving nitroaromatics and nitroamines?**

Response: Yes.

Comment 9: **Page 11-2, Section 11.3.5 Medical Emergencies: Expand this section to address drenching (e.g. personnel) should contaminant materials and/or preservatives make contact with the skin or eyes of site personnel.**

Response: The anticipated scope of work associated with site investigations is not likely to "drench" personnel with contaminants or preservatives.

Comment 10: **Page 12-7, Section 12.6 Record Keeping: The Site Manager and SSHO will set up and maintain applicable USACE, State, Federal, and local safety related records and activity reports on site. This file will include the following records:**

- **One copy of the SSHP**
- **ENG Form 3394 USACE Accident Investigation Report**
- **OSHA Form 200 log and summary of occupational injuries and illnesses**
- **a list of personnel engaged in the site activity**
- **record of air sampling calibrations, sampling data**

Response: The record keeping requirements mentioned in your comment are addressed in the Site-wide SSHP. The OSHA 200 log and ENG Form 3394 will be added to Appendix D. The record keeping referred to in this section refers to record keeping requirements for Bloodborne Pathogens.

Comment 11: **Page 12-7, Section 12.6.3 Add to this paragraph the following language, "Within two working days of any reportable incident, an Accident Report (ENG Form 3394) will be completed in accordance with AR 385-40 and Supplement 1 to the same regulation, and forwarded to the USACE Occupational Safety and Health Office at the address listed below. An incident follow-up report will be completed within one week of the incident.**

U. S. Army Corps of Engineers
Nashville District
Safety and Occupational Health Office
CEORN-SO (Attn: Emmett E. Forte)
P.O. Box 1070, Nashville, TN 37202-1070

Should OSHA inspect the site, contact the Site Manager for direction."

Response: The text was revised as suggested.

Comment 12: **Appendix B Material Safety Data Sheets: The Mallinckrodt MSDSs are not legible. Please replace.**

Response: Another copy has been requested by the SSHO.

Comment 13: **Appendix C IT Procedures 9521-9521.3: Include a calibration and employee exposure monitoring form.**

Response: Forms were added to Appendix C.

Comment 14: **Appendix D Supervisor's Employee Injury Report: Include ENG Form 232394 and OSHA Form 200 in this appendix. I have enclosed an ENG Form 3394 for your convenience.**

Response: Forms were added to Appendix D.

contents in the event of a drum failure or spill.

Response 20: The text was revised to address temporary storage of IDW during the field investigation per reviewer's comment.

Quality Assurance Project Plan Comments

Comment 21: **Table 1-1. Analyze Arsenic by 7060A and Selenium by 7740.**

Response 21: Table 1-1 was revised to specify analytical methods for the analysis of arsenic and selenium.

Comment 22: **Section 4.9.2, second sentence. Is an equipment rinsate needed for disposable sampling equipment?**

Response 22: No. The text has been revised to delete the requirement for ER for the disposable sampling equipment.

Comment 23: **Table 5-1. Add Extraction Methods 3540B and 3520B for the semivolatiles.**

Response 23: Table 5-1 was revised as suggested.

Comment 24: **Section 9.1. First sentence is unclear.**

Response 24: The sentence was revised for clarity.

Comment 25: **Section 9.1, second and third sentence. Change "onto" to "into."**

Response 25: The text was revised as suggested.

Comment 26: **General Comment. This QAPP should not mention AOC specific information.**

Response 26: References to specific AOCs were removed from the text.

Comment 27: **Page 1-3, Section 1.5. Change this section to read "Schedules for each site specific investigation will be given in the addendum for that particular site."**

Response 27: Section 1.5 was revised to include the statement indicated above.

Comment 28: **Table 1-1. Explosives in groundwater will be analyzed for using USEPA SW-846 Modified Method 8330. Please indicate this in the table.**

Response 28: Table 1-1 was revised as suggested.

Comment 29: **Page 2-4, Section 2.7: Remove the reference to Level III validation. Instead reference those QA/QC elements that will be validated so that the data quality can be considered definitive (Reference EPA540-R-93-071, pages 42-43).**

Response 29: Reference to Level III validation was removed from the text. Validation criteria/procedures were explained in the text.

Comment 30: **Table 4-1. This table should be included in the appropriate site specific addendum.**

Response 30: Table 4-1 serves as a summary of sampling effort associated with each site-specific project. It provides field crews with a synopsis for coordinating sampling activities. A similar but site-specific table is included in each site-specific attachment.

Comment 31: **Page 4-9. Add a section that states "Results form analysis of field and QC samples shall be indexed and sent to the Ohio River Division Laboratory for the review and preparation of the Chemical Quality Assurance Report."**

Response 31: The text was revised to include this statement as required by the reviewer.

Comment 32: **Pages 5-1 through 5-3. Do not duplicate sections that are discussed in the Sampling and Analysis Plan (i.e., Sample Labeling, Transfer of Custody and Shipment, Preparation, Packaging, Handling, and Shipping).**

Response 32: The duplicated sections were removed per reviewer's request. References were made to the appropriate sections in the SAP.

Comment 33: **Page 8-4, Section 8-4: Delete any reference to Level III data validation. Instead reference explicitly how data will be validated.**

Response 33: See response 29.

Comment 34: **Section 14.0. Please add the following bullet: Significant QA problems encountered.**

Response 34: The text was revised to include this bullet.

Response to Ohio EPA Comments onThe Draft Work Plan for Site Investigation and GroundwaterInvestigation At Former Plum Brook Ordnance Works Sandusky, Ohio

Reference: *Letter dated September 5, 1996 to D. Burton of IT corporation from R. E. Nabors, Site Coordinator, Ohio Environmental Protection Agency*

Sitewide Sampling and analysis Plan

General Comment - Document control numbering is the preferred method of page and section identification for site-related documents. Below is an example of how this should be utilized.

Section No. _____
Revision No. _____
Date: _____, 1996
Page ____ of ____

Response: The format use for this work plan is a standard IT format for TERC projects and has been accepted by USACE. IT would like to keep this format for consistency with all previously submitted documents.

Comment 1: **Section 3.3.4.3, page 3-8. Section 1.2.2 could not be located - please include this information or correct the reference.**

Response 1: Section 1.2.2. Should be Section 1.2. Text has been revised.

Comment 2: **Section 4.1.1, page 4-1. Reference is made to several pieces of geophysical equipment. Please indicate where the appropriate SOPs are located for each of the testing methods and subsequent pieces of equipment.**

Response 2: Procedures for operating and calibrating geophysical equipment were described in detail in Section 4.1 and will be followed during field operations. SOPs for each of testing methods are not yet developed.

Comment 3: **Section 4.3.4, page 4-14. Provide the equation used to calculate the well volume.**

Response 3: The equation for calculating well volume is provided in Figure 4-15, "Groundwater Sampling Form."

Comment 4: **Section 4.4, page 4-16 - third paragraph. The last sentence states, "...as specified in related site-specific attachments." This language is found**

throughout this document and does not satisfy a correct reference. Replace these statements with specific references and/or remove this language.

Response 4: This language has been removed from text as requested.

Comment 5: page 4-17, last sentence before the subsection "Soil Samples for Geotechnical Analyses." See above comment regarding correct referencing.

Response 5: The text has been revised to include more specific references.

Comment 6: Section 6.1, page 6-1. Of all the entries made to the logs, will appropriate signatures be included on each page of entry? Please specify this information.

Response 6: As shown in Figure 4-1, signatures of the IT field personnel are required at each page of the FADL.

Comment 7: Section 8.4, page 8-3. There are no methods outlined in Chapter 6.0. Please correct this information or add the appropriate language.

Response 7: The text has been revised to read, ".... using methods outlined in Table 1-1 of the QAPP...."

Quality Assurance Project Plan

General comments - See comment above regarding document control numbering.

Response: See response to general comments on the SAP.

Comment 1: Section 1.4, page 1-3 - Sample Program and Rationale. There is inadequate information in section 4.4 and 4.5 (SAP) to justify a reference. Please update this information and provide more detailed information in this section which highlights what is conveyed in the corresponding sections of the SAP.

Response 1: The information in Section 4.4 and 4.5 (SAP) have been updated per reviewer's request.

Comment 2: Section 4.0 - Sampling Procedures. The information provided at the beginning of this section seems to contradict the information stated in Section 4.5 of the SAP. Please review this and clarify.

Response 2: Both sections have been reviewed for consistency and clarification has been made.

Comment 3: Section 4.0 - Sampling Procedures. Considerations. Please clarify where the

indicated considerations can be located in this QAPP and supporting documentation.

Response 3: These considerations were taken when site-specific sampling program was developed and, therefore, they were incorporated in each site-specific SAP.

Comment 4: Section 4.2.2 - Sampling Equipment. The information presented in this section seems inconsistent with procedures identified in the SAP. Correct this information to achieve consistency with the SAP.

Response 4: Section 4.2.2 has been revised for consistency with SAP.

Comment 5: Section 8.1, page 8-1. Please provide in Section 8.0, or reference, all of the equations pertinent to the data reduction process.

Response 5: References have been made to Appendix A, Quanterra Environmental Services Standard Operating Procedures.

Volume Two: site-Specific Attachments (I through V)

General Comment: Do not limit the number of soil borings to be advanced in the areas to be investigated (e.g., "A total of eight borings will be installed..."). The geophysical survey may indicate more boring locations than originally proposed. Include language that will indicate additional boring locations may be advanced in the areas of investigation should the geophysical survey or site conditions indicate.

Response: The number of soil borings has been proposed merely for budgetary purposes. If geophysical survey results, site condition, or soil sampling results warrant additional soil sampling, recommendations will be made by IT to USACE.

General Comment. All sections titled "Sampling Procedures and Drill Cuttings from Borings" should be addressed. According to the February 1995 Ohio EPA "Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring Programs" (Chapter 9), at no time should a borehole or well be backfilled with cuttings or with any materials of unknown integrity. Therefore, soil cuttings generated during drilling and sampling activities should be contained, characterized and disposed of properly. If analytical results indicate these cuttings and nonhazardous, the cuttings may be spread out on the ground surface. Please reconsider and revise all sections appropriately.

Response: Drill cuttings from new monitoring well boreholes will be containerized and characterized before disposition. Relevant section in site-specific SAPs has been revised.

General Comment. The third paragraph of sections titled "Sample Preservation, Packing,

and Shipping" contains a typographical error. Please change "void spaced" to "void space."

Response: This typographical error has been corrected.

General Comment. In regard to the management of decontamination fluids, it is recommended that the decontamination fluids be analyzed. If laboratory results indicated these fluids are nonhazardous they may be disposed of as planned. If these fluids are characterized as hazardous then they must be managed accordingly.

Response: Analysis of decontamination fluids may not be necessary. The decon fluids referred in the work plan consist of deionized water used for final rinsing of sampling equipment and minimal amount of methanol and/or hexane. It should not be characterized as hazardous waste.

Response to Ohio Environmental Protection Agency Comments on the Draft Work Plan Package Site Investigations and Groundwater Investigation Former Plum Brook Ordnance Works, Sandusky, Ohio

Reference: ***Fax from Ron Nabors, Division of Emergency and Remedial Response to OEPA, to Don Burton, IT Corporation, dated November 11, 1996.***

Comments on the Sampling and Analysis Plan

Comment 1: **<u>Section 3.3.4.4.1 - Risk Evaluation Needs</u>. With respect to ground water samples, analytical reporting limits should be less than maximum contaminant levels for those constituents that have them.**

Response 1: The analytical reporting limits as presented in this Sampling and Analysis Plan (SAP) have been checked against the MCLs to ensure that reporting limits are less than MCLs. However, specific reporting limits are highly matrix dependent. Therefore, the analytical reporting limits will be adjusted based on factors such as dryness calculations, dilution factor, etc. Also, the reporting limits are method-dependent, which means some methods for chemical analysis may simply have higher reporting limits than others. The analytical methods to be used during this investigation are specified in the Statement of Work issued to IT by USACE.

Comment 2: **<u>Section 4.3 - Groundwater</u>. It is not clear whether the consultants for NASA believe the limits of contamination in ground water have been determined throughout the facility. The installation of the proposed monitoring wells will probably be sufficient to define the limits of contamination in the western portion of the facility. However, these limits have not been defined east of Ransom Road but should be, if not as part of this investigation then as part of a future ground water investigation conducted at the site.**

Response 2: The focus of the current site investigation and groundwater investigation is on soil and groundwater contamination in the western portion of the facility. However, one of the purposes of conducting these investigations is to collect information which can be used to make management decisions regarding future investigation activities at PBOW. Several areas of concern were identified in the area east of Ransom Road, such as TNT Area A. Whether additional work is needed to further delineate these areas will be determined based on the results of the current investigations.

Comment 3: <u>Section 4.3.2 - Well Development</u>.

a. **The development procedure references drilling fluids, but these are not mentioned in the section on well installation (Section 4.3.1). This discrepancy in the SAP needs to be resolved. Ohio EPA does not recommend the use of drilling fluids if they can be avoided.**

Response 3a: Drilling fluids are not allowed during well installation as stated in Section 4.3.1. Section 4.3.2 has been revised by eliminating the reference to "drilling fluids."

b. **The SAP states that "well development will be completed by bailing, pumping, and surging." Ohio EPA does not recommend surging any monitoring wells set in the silty and/or clayey overburden because surging of wells screened in fine-grained sediments increases turbidity and does not improve hydraulic response significantly. Development should be limited to either pumping or preferably bailing. This comment also applies to the well development section in Attachment V.**

Response 3b: All existing wells in the overburden aquifer will be redeveloped by bailing only due to their shallow depth. New wells will be developed by surging and bailing. Surging of newly installed wells is necessary to remove caked sediment on the inside of the well screen and casing. Bedrock wells will be redeveloped by pumping and bailing, depending on well yield.

c. **The SAP should state that a turbidity measurement will also be taken at the end of well development.**

Response 3c: Turbidity measurements will be taken during, and at the end of, well development. The SAP has been revised.

Comment 4: <u>Section 4.3.2.2 - Development Records</u>. **Wells installed in the State of Ohio need to be registered with the Ohio Department of Natural Resources Division of Water. The driller and the consultant who retains the driller have equal responsibility for this documentation. The SAP should state that a well installation log will be filed with ODNR for each monitoring well installed as part of the investigation.**

Response 4: IT Corporation will advise the subcontracted driller to fulfill this obligation. A copy of the drilling logs will be filed with ODNR. SAP, Section 4.3.1, has been revised to include this requirement.

Comment 5: <u>Section 4.3.3 - Water Level Monitoring</u>. **The SAP should state when water level monitoring will occur (prior to development and prior to sampling, etc.).**

Response 5: Water level measurement will be taken prior to purging the well (after well development). SAP has been revised for clarification.

Comment 6: <u>Section 4.3.4 - Groundwater Sampling</u>

a. **The SAP calls for taking turbidity measurements during sampling, but a turbidity meter is not included on the equipment list. This discrepancy should be resolved.**

Response 6a: The Horiba V-10 water quality checker will be used for field parameter measurement. The Horiba checker can measure six parameters, including turbidity, simultaneously.

b. **The SAP should state how often field parameters will be checked. Ohio EPA recommends that field parameters be checked and recorded after each well volume.**

Response 6b: The SAP has been revised to specify the interval at which field parameters will be checked. However, given the fact that wells in the overburden aquifer generally exhibit extremely low well yield, this requirement may be difficult to fulfil. Field crews will be advised to check field parameters as often as practical, preferably after each well volume.

c. **The SAP should state how sampling rates during purging and sampling will be determined.**

Response 6c: It is not clear what the reviewer meant by, "sampling rate." Further clarification is needed.

d. **The proposed decontamination procedures for the metals filtering apparatus are insufficient. Decontamination should include a potable water rinse, a wash with non-phosphate detergent, a second potable water rinse, a nitric acid rinse, and a final rinse with deionized water.**

Response 6d: Decontamination procedures for filtering apparatus are the same as for sampling equipment. Section 4.3.4 has been revised.

e. **The SAP should specify the order of sample collection.**

Response 6e: Section 4.3.4 has been revised to specify the sample collection order as (in the order of priorities) VOC, SVOCs, nitroaromatics, metals, total cyanide, and pesticides/PCBs.

f. Filtration of samples should occur at the wellhead, not at the field office.

Response 6f: It is difficult to filter water samples at the wellhead. This is because most of the wells will be sampled with a bailer. Therefore, in-line filters cannot be used. If we use filtering apparatus such as a vacuum pump and associated glass ware at the well location, we will have problems with power hook-up and decontamination of glass ware. IT Corporation will set up a field office at PBOW to facilitate sample filtering and packing. Since the field office is in easy access to all sample locations, groundwater samples collected will be placed on ice and taken to the field office where IT field sample coordinator will process these samples in a timely fashion. Filtering water samples in the field office has no impact on the quality of the samples.

Comment 7: **Section 4.3.5 - Field Hydraulic Conductivity Testing. The SAP should clarify whether a second slug test will be conducted in a well in which the initial slug test fails or not and what type of software will be used to evaluate the data.**

Response 7: Slug test data will be downloaded to a lap-top computer upon completion of the test to ensure the completeness and useability of the data. Unless unusable data are collected, slug tests will not be repeated. A computer software AQTESOLV developed by Geraghty & Miller, Inc., will be used to evaluate slug test data. Section 4.3.5 has been revised for clarification.

Comment 8: **Section 8.4 - Purged Groundwater. The difference between "aqueous liquids" and "purged groundwater" should be clarified. The terms appear to be used interchangeably in this section of the SAP, but they have different disposal scenarios. In general, Ohio EPA does not recommend disposal by land application of development and purge water. The final disposition of these wastes should be based on appropriate analytical data. If they are determined to be hazardous, they should be treated as such. Non-hazardous waste may not be suitable for disposal in stormwater sewers; disposal in one of the facility's wastewater treatment plants may be more appropriate.**

Response 8: The term "aqueous liquids" includes both purged water and well development water. For clarification, this term has been replaced by development water in the text. IT is aware of OEPA's concern about IDW disposition at PBOW. IT Corporation, after consultation with Army Corps of Engineers, Nashville District office, proposes that all IDWs (except PPEs) be disposed of at the designated disposal area located adjacent to the Pentolite Road Red Water Ponds. This area was used to dispose IDWs generated during 94 Dames and Moore field investigation. Groundwater and soil contamination by nitroaromatics and metals has been confirmed in this area. It is unlikely that disposition of IDWs to be generated during this investigation in this area will

have any adverse effect. If future remediation is required in this area, all disposed IDWs can be treated consistently with the remedy.

Comments on the Quality Assurance Project Plan:

Comment 9: **<u>Section 4.9.2 - Equipment Rinsate Samples</u>. The QAPP should specify the rate at which rinse blanks will be collected.**

Response 9: Table 4-1 of the QAPP specified the tentative number of equipment rinsate samples for each investigation area. The actual number of equipment rinsate samples to be collected will be determined in the field, depending upon equipment used, water sources, and length of the investigation.

Comment 10: **<u>Section 4.9.3 - Field Blanks</u>. Ohio EPA recommends that field blanks be collected at a rate of 10 percent of the investigative samples. The collection of one field blank from each of the steam cleaner water and one field blank from the water used for decontamination will probably be insufficient, and not only from the standpoint of rate of collection. If the investigation is substantially lengthened due to unanticipated delays, more field blanks will be also be needed.**

Response 10: Field blanks by our definition are samples prepared from the clean water used during decontamination process including potable water for steam cleaning of drilling equipment. The purpose of collecting field blanks is to allow evaluation of whether any chemicals are introduced to the primary sample during decontamination of sampling or non-sampling equipment. Unless more than one lot number of deionized water is used or potable water is taken from more than one source, there is no need to collect additional field blanks. It seems that reviewer may see field blank sample in a way that is different from ours. Clarification is needed.

Table 4-1 of the QAPP specified the tentative number of field blanks to be collected in each investigation area. The actual number of field blanks to be collected will be determined in the field depending upon the length of field operation, which may require use of more than one lot number of deionized water.

Comment 11: **<u>Table 7-1 - TCL VOCs and Laboratory Reporting Limits and Table 7-4 - TAL inorganic Compounds and Laboratory Reporting Limits</u>. All ground water samples should be analyzed using methods that achieve reporting limits that are less than maximum contaminant limits for those constituents that have them (benzene, vinyl chloride, antimony, beryllium, etc.). The QAPP and SAP should be revised accordingly.**

Response 11: Refer to response to comment 1. Also for benzene and vinyl chloride, concentrations will be reported down to 1 ppb. The concentrations reported below the reporting limit will be qualified as estimated.

Comment on Attachment V

Comment 12: **<u>Section V.4.1.6 - Materials and Procedures</u>. Ohio EPA recommends a maximum of 5-foot screen lengths for investigative monitoring wells in general and at this site in particular. Although 10-foot screens have been used elsewhere at the facility, the purpose the four new wells is to help define the limits of contamination. Using 10-foot screens may seriously underestimate the contamination at the site. The longer the screen, the larger the water column available to "dilute" and under represent the actual constituent concentrations. Similarly, because the bedrock wells at the site have been completed with more than 10 feet of open hole. Samples acquired from these wells will probably not be fully representative of the ground water quality at these locations.**

Response 12: The proposed 10-foot screen for the new monitoring wells is per Army Corps of Engineers specification. Ten-foot screen is considered appropriate at PBOW. This is because the lithology of overburden aquifer is mainly silty clay or silt, typical of glacial fill materials. Previous well test data indicate that the overburden aquifer has very low hydraulic conductivity. Therefore, installation of a 10-foot screen will enhance the possibility of having enough water for development and sampling. Also, since the predominate groundwater flow direction in the overburden aquifer is downward, as interpreted by Dames and Moore, groundwater sample collected from a 5- or 10-foot screen will not make any difference in terms of their representativeness.