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PRELIMINARY SITE INSPECTION REPORT FOR JEFFERSON PROVING GROUND

REVISED

August 1993

Prepared For:
U. S. Army Environmental Center
Aberdeen Proving Ground, MD

Contract No. DAAA15-90-D-0001, Task 15

Prepared By:
Advanced Sciences, Inc.
1250 Brass Mill Road
Belcamp, MD 21017

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ACRONYMS

AEC	U.S. Army Environmental Center
AEHA	Army Environmental Hygiene Agency
AOC	Area of Concern
ASI	Advanced Sciences, Inc.
bgs	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DNT	Dinitrotoluene
DOD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
DU	Depleted Uranium
DUIA	Depleted Uranium Impact Area
EO	Exploded Ordnance
EPA	U.S. Environmental Protection Agency
ESE	Environmental, Science and Engineering, Inc.
ft	Feet/Foot
FS	Feasibility Study
HRS2	Hazard Ranking System
JPG	Jefferson Proving Ground
kgs	kilograms
MCL	Maximum Contaminant Level
MGD	Million Gallons Per Day
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NWIA	Northwest Impact Area
PA	Preliminary Assessment
PCB	Polychlorinated Biphenols
PEP	Propellants, Explosives and Pyrotechnics
POL	Petroleum, Oil, and Lubricants
PSI	Preliminary Site Inspection
RCRA	Resource Conservation and Recovery Act
REI	Rust Environment & Infrastructure, Inc.
RFA	RCRA Facility Assessment
RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act
STP	Sewage Treatment Plant
SWMU	Solid Waste Management Unit
TCA	Trichloroethane
TCE	Trichloroethylene
TCLP	Toxic Characteristic Leaching Procedure
TECOM	Test and Evaluation Command
TNT	Trinitrotoluene

ACRONYMS (Continued)

USACOE	U.S. Army Corps of Engineers
USTs	Underground Storage Tanks
UXO	Unexploded Ordnance
VOC	Volatile Organic Compounds
YPG	Yuma Proving Ground

EXECUTIVE SUMMARY

SITE DESCRIPTION

The U.S. Army Environmental Center (AEC) has contracted Advanced Sciences, Inc. (ASI) to prepare a Preliminary Site Inspection Report (PSI) for Jefferson Proving Grounds (JPG), Indiana. The U.S. Environmental Protection Agency (EPA), Region V deemed it necessary to score selected U.S. Army installations not currently on the National Priorities List (NPL) using EPA's revised Hazard Ranking System (HRS2). This report provides data and information necessary for scoring this site. The scope of this report is based solely on the review of available reports, personell interviews and site visit.

The facility Commanding Officer for JPG is Colonel Terry M. Weekly. The facility Environmental Chief is Mr. Phillip Ramsey. The facility address is:

Jefferson Proving Ground
STEJP-CT-EN
Madison, IN 47250-5100

JPG is located on U.S. Highway 421, approximately nine miles north of Madison, Indiana, and about 85 miles southeast of Indianapolis, Indiana. JPG occupies 55,265 acres of land in Ripley, Jennings and Jefferson counties. The installation is approximately 18 miles long (north-south) and five miles wide.

The facility's EPA I.D. Number is 5210020454.

HISTORY AND MISSION

JPG was designed and built as a test range for testing conventional ordnance, and has been used as a testing ground since its purchase in 1941. Effective August 1, 1962, JPG was placed under the command of the U.S. Army Test and Evaluation Command (TECOM).

The mission of JPG is to plan and conduct production acceptance tests, reconditioning tests, surveillance tests and other studies of ammunition and weapons systems (including system components). A wide assortment of munitions and ordnance have been tested at JPG, including propellants, mines, ammunition, cartridge cases, artillery projectiles, mortar rounds, grenades, tank ammunition, bombs, boosters and rockets.

The buildings, roadways and fixtures have been built to meet the requirements of the JPG mission. There are 125 permanent gun positions, 50 impact fields, 13 permanent test complexes and seven ammunition assembly plants.

SITE CHARACTERISTICS

Past and present activities at JPG have resulted in the detonation, burning and disposal of many types of waste propellants, explosives and pyrotechnic substances at the site. Also, these activities have resulted in the generation of several physically and chemically hazardous substances throughout the facility.

Physical hazards involve mainly unexploded ordnance (UXO). Chemically hazardous substances include various explosive compounds, waste propellants, lead, chlorinated solvents, wood preservatives, sulfur, silver, photographic development wastes, sanitary wastes, and petroleum products. (Chem-Nuclear, 1992)

Impact areas at JPG include high impact targets, asphalt and sediment bottom ponds for testing proximity fuses, a gunnery range, mine fields, and a depleted uranium impact area.

PHYSIOGRAPHY

JPG is located in the Till Plains section of the Central Lowlands Physiographic Province which is characterized by young till plains with no pronounced morainal features. Topography of JPG is flat to rolling, with most relief due to stream incision. Seven streams and their tributaries drain the JPG area.

POTENTIAL RECEPTORS

Targets potentially affected by hazardous materials include human, animal and plant populations on or near the facility. Possible pathways for contamination are groundwater, surface water, soil and air.

The generation of physical and chemical hazards at JPG have resulted in the release of contaminants into the environment, particularly the soils. A number of sites at JPG have been identified as areas of potential concern. Little or no environmental data is available for most of these sites. The lack of comprehensive data on present levels of soil contamination, groundwater contamination and surface water quality makes the determination of impact difficult. A Remedial Investigation/Feasibility Study (RI/FS) is currently underway to assess and define the extent of contamination at JPG.

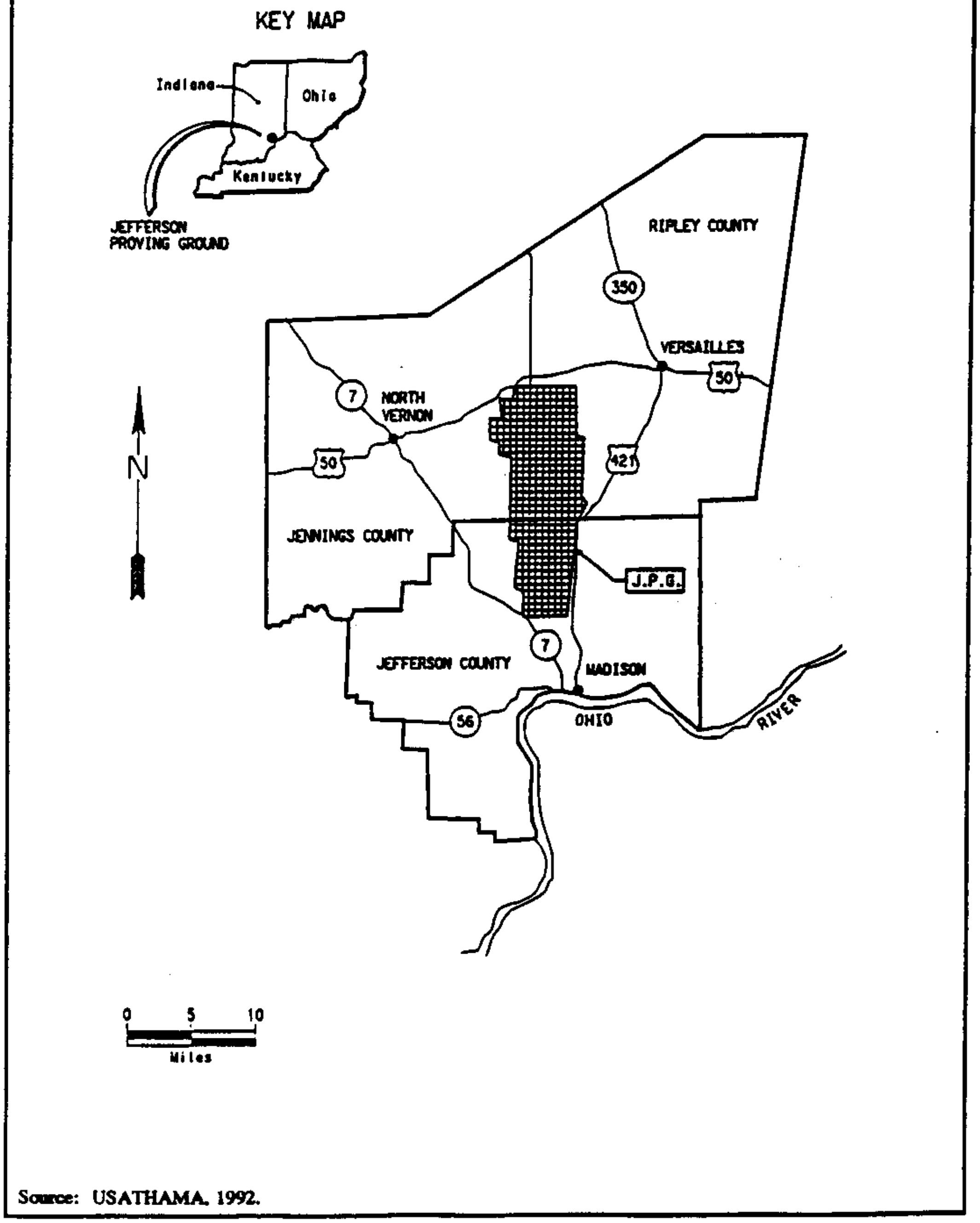
1.0 INTRODUCTION

This Preliminary Site Inspection (PSI) of the Jefferson Proving Ground (JPG) has been prepared by Advanced Sciences, Inc. (ASI) under contract number DAAA15-90-D-0001, Task 015, for the U.S. Army Environmental Center (AEC). The purpose of this PSI report is to determine whether there has been a release or there is a substantial threat of a future release of hazardous substances, pollutants, or contaminants into the environment from JPG that may pose an imminent and substantial danger to the public health or welfare or the environment. This report is in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA). In addition, this PSI was performed to provide a compilation of recent data to update previous Installation Assessments conducted at the facility and to provide input for the U.S. Environmental Protection Agency (EPA) Revised Hazard Ranking System (HRS2), which aids in determining if a site is placed on the National Priorities List (NPL).

This report was prepared from records and data gathered during a site visit to JPG on June 22 through June 26, 1992 and integrates any pertinent information gathered from other sources, notably AEC, Aberdeen Proving Ground, Maryland. Information contained in this report is also based on previous work presented by A. T. Kearney, Inc., February 1992; Ebasco Environmental, March 1990; Chem-Nuclear Environmental Services, Inc., January 1992; U.S. Army Corps of Engineers, (USACOE) Louisville District; and Environmental Science and Engineering, Inc., June 1989. The scope of this report included neither field investigation methodology nor an inspection of any waste area on JPG. This report is based entirely on the review of existing documents and records, discussions with post personnel, and site visit.

1.1 LOCATION

JPG occupies 55,265 acres of land along U.S. Highway 421, nine miles north of Madison, Indiana (Figure 1.1). The facility is approximately 85 miles southeast of Indianapolis, Indiana, and 45 miles northeast of Louisville, Kentucky. The approximate coordinates of JPG are latitude 38° 50 minutes north and 85° 24 minutes 50 seconds west. The installation is approximately 18 miles long (north-south) and five miles wide.



Source: USATHAMA, 1992.

FIGURE 1.1 LOCATION MAP
JEFFERSON PROVING GROUND, INDIANA

2.0 SITE CHARACTERIZATION

2.1 SITE BACKGROUND AND HISTORY

2.1.1 Ownership History

JPG is owned by the Department of the Defense (DOD) and managed and operated by the U.S. Army under the U.S. Army Test and Evaluation Command (TECOM). The mission of JPG is to plan and conduct production acceptance tests, reconditioning tests, surveillance tests, and other studies of ammunition and weapons systems (including components of the systems). JPG was designed and constructed to be a testing ground for conventional ammunition and weapons. The facility conducts approximately 85% of the Army's Production Ammunition Acceptance Testing. JPG has conducted tests of propellants, mines, cartridge cases, artillery projectiles, mortar rounds, grenades, tank ammunition, bombs, boosters, and rockets. The activities at the facility have remained essentially the same since operations began in 1941. (Kearney, 1992)

There is no manufacturing of weapons, ammunition, or components thereof at JPG. However, a number of industrial operations are conducted in support of the munitions testing. These activities include ammunition assembly and disassembly, inert projectile loading, weapons maintenance, and electronic equipment maintenance. JPG is a self-supporting base comparable to a small town, encompassing a vehicle maintenance shop, a machine shop, a paint shop, a photograph processing lab, carpentry shop, a sewage treatment plant (STP), and several steam heat generating plants.

Prior to December 1941 when the government purchased JPG property, the land use was primarily farmland and woods. The government purchased 423 farms, in addition to several schools, cemeteries, churches, stores and mills that were located on the property, to create JPG. The surrounding land use is primarily agricultural or rural residential. Several small towns border JPG along the eastern, northern, and southern boundaries.

2.1.2 Regulatory History

RCRA Permit

A Resource Conservation and Recovery Act (RCRA) Part B Interim Permit Application was submitted to EPA Region V in November 1988 for the on-site detonation of pyrotechnics, explosives, and propellants (PEP).

On November 14, 1980, JPG submitted a RCRA Part A Permit Application for the storage, treatment and disposal of hazardous waste. The application identified three container storage areas, one waste pile, four landfills, and two explosive waste treatment areas. The application listed container storage of warfarin, cyanide, and spent solvents; the waste storage piles of P090; the treatment of di-n-butylphthalate, and 2,4,dinitrotoluene; and the landfilling of asbestos, chlordane and 2,4,5 trichlorophenoxyacetic acid. (Kearney, 1992)

NPDES Permit

JPG holds National Pollutant Discharge Elimination System (NPDES) Permit IN0024210 for the Sewage Treatment Plant (STP) effluent discharge.

Miscellaneous

A local Fire Training Permit, to train personnel in fire fighting, is required at JPG. Fire fighting exercises are conducted under the supervision of state and local fire fighting agencies. The fire training permit is renewed annually. The current permit was issued on January 4, 1992.

An Open Burning Permit is issued to JPG from the Indiana Department of Environmental Management to burn excess propellants and explosives, vegetation and scrap wood. This permit is renewed annually. The current permit was issued on January 4, 1993.

The Indiana Department of Environmental Management, Office of Air Management, has issued modification of emission standards to JPG in order to operate the facility's incinerators and boilers (Appendix A).

JPG is scheduled for closure in 1995 under the recommendation of the Base Realignment and Closure Commission established by the Secretary of Defense on May 3, 1988. The Army has scheduled the realignment of personnel and equipment to Yuma Proving Ground (YPG), Arizona.

2.1.3 Process and Waste Disposal History

Waste generation at JPG can be segregated into three general categories: hazardous waste from munition testing activities; hazardous waste from facility maintenance and support activities; and miscellaneous solid waste, such as office debris. Historical records for waste generation may be incomplete. The facility operates part cleaners containing Safety Kleen Parts Cleaner in the vehicle maintenance shop, the machine shop, the paint shop, and the weapons maintenance shop. When the Safety Kleen units require changing, they are collected by the manufacturer to be transported to their facility for recycling. Prior to the installation of Safety Kleen Parts Cleaner in 1992, cleaners containing Stoddard Solvents were used. The spent Stoddard Solvents would accrue in Building 186, the Solvent Accumulation Area; Building 136, the Satellite Accumulation Area; Building 227, the Satellite Accumulation Shed; Building 227, the Former Storage Pad; and Building 108, the Machine Shop Accumulation Area. Fifty-five gallon drums of spent solvent would be taken to Building 305, Hazardous Waste Storage Area, prior to off-site disposal or recycling. Building 305 was equipped with secondary containment pans of steel and plastic to contain any spills which could occur from the drums. Previous to 1980, the practice for disposal of spent solvent is undocumented.

A Photograph Processing Lab, located in Building 208, processes black and white, color and x-ray film that is used to record the ordnance testing activities. The lab has been equipped with a Silver Recovery Unit since 1967, prior to which the silver was discharged into the sanitary sewer system. Prior to 1980, the photo processing chemical contained cyanide, and this solution was dumped into the sewer system via both the former and current Photo Lab floor drains. Because the STP was unequipped to handle the cyanide solutions, several fish kills were documented downstream of the discharge from the STP in the 1970s. Since 1980, a biodegradable developer is used, which is slowly discharged into the STP to avoid exigency.

The STP at JPG receives industrial waste water from the Photo Processing Lab and the two active generating plants. The STP has been in operation since 1941 and has a capacity of 0.4 million gallons per day (mgd). The plant is operated under NPDES Permit Number IN 0024210.

Dunnage and packaging material are generated from the large number of munitions shipped for testing. This material is burned rather than landfilled due to the increased risk of reactive materials being introduced into the packaging.

Currently, there are 38 underground storage tanks (USTs) located on JPG property. The tanks range in size from 300 to 25,000 gallons and were installed from 1941 to 1985. Table 2-1 lists the USTs found on JPG. The presence of USTs at the facility creates the potential for soil and groundwater contamination by fuel products, and other stored materials. The potential for such contamination is increased due to the age of the USTs, and the possibility of spills and overfills which may have occurred during the active life of each of the tanks. Limited documentation is available concerning UST integrity and closures.

2.1.4 Release History

JPG operations have resulted in a number of known releases of hazardous waste or hazardous constituents to the environment. Most of the known releases are related to past disposal practices for organic solvents and explosives or explosive contaminated material. The facility historically disposed of propellants and explosive contaminated trash by open burning on the ground surface. Propellants and explosives are known to contain heavy metals and the residues from burning may leach into the soil and groundwater. Areas where open burning of volatile organics or explosives or explosive contaminated trash was conducted on the ground surface include the Open Burning Pans, Open Detonation Units, Gate 19 Burning Area, Burning Ground, Fire Training Pit, and the Gator Z Mine Open Burning Area.

The disposal of organic solvents directly onto the ground surface occurred at the Gate 19 Landfill, and also at the Solvent Pits. A soil gas study found 1,1,1-trichloroethane (TCA) at the landfill and solvent disposal pits. Groundwater monitoring wells installed at Building 279 and the Gate 19 Landfill were sampled; the study indicated that the Building 279 well closest to the solvent pit was highly contaminated with volatile organic compounds (VOCs), including TCA. No TCA contamination was found in the landfill wells.

A release of No. 6 fuel oil is known to have occurred at the Building 602 Leaking Underground Storage Tanks (UST). Contaminated soil has been excavated from the site. Limited analytical results are available. There are currently 38 other USTs located throughout JPG, ranging in size from 300 to 25,000 gallons, dating from 1941 to 1985. Some, but not all, of the tanks have been tested for leaks in the past. None of the tanks are equipped with secondary containment or corrosion protection. The facility is in the process of removing the USTs. Soil sampling will be conducted during all tank removal operations.

In April 1988, 300 gallons of No. 2 heating oil were spilled onto the ground surface covering approximately 600 square feet. The spill was caused by overfilling an UST outside the Central Heating

Table 2-1
USTs Located on JPG

U.S. Army Jefferson Proving Ground Underground Petroleum Storage Tanks

Building Location	Capacity	Installation Year	Fuel	Tank Material	Active
Bldg - 1	500	*	FO#2	*	yes
Bldg - 3	500	*	FO#2	*	yes
Bldg - 4	500	*	FO#2	*	yes
Bldg - 7	500	•	FO#2	*	yes
Bldg - 8	500	*	FO#2	*	yes
Bldg - 11	500	*	FO#2	•	yes
Bldg - 12	500	*	FO#2	*	yes
Bldg - 15	500	*	FO#2	*	yes
Bldg - 16	500	*	FO#2	*	yes
Bldg - 17	500	*	FO#2	*	yes
Bldg - 20	500	*	FO#2	*	yes
Bldg - 21	500	•	FO#2	*	yes
Bldg - 23	500	*	FO#2	*	yes
Bldg - 33	1000	•	FO#2	*	yes
Bldg - 103	25000	1941	FO#2	Steel	yes
	25000	1941	FO#2	Steel	yes
	25000	1952	FO#2	Steel	yes
	25000	1952	FO#2	Steel	yes
	550	1985	Diesel #2	Steel	yes
Bldg - 118	12000	1942	Unlead gas	Steel	yes
	12000	1942	Unlead gas	Steel	yes
	12000	1942	Diesel	Steel	yes
	25000	1942	FO#2	Steel	no
	1000	1952	Lead gas	Steel	R
	1000	1952	FO#2	Steel	R
	675	1943	Kerosene		R
	550	1943	White gas		R
	550	1943	FO#2		R
Bldg - 125	1000	1941	FO#2	*	yes
Bldg - 127	1000	1941	FO#2	*	R
Bldg - 149	500	*	FO#2	*	R
Bldg - 154	300	1968	FO#2	Steel	R
Bldg - 156	1000	1983	FO#2	Steel	R
Bldg - 177	300	1968	FO#2	Steel	no
Bldg - 186	1000	1983	u.m. oil	Steel	yes
Bldg - 189	500	1953	FO#2	*	yes
	500	1953	FO#2	*	yes
Bldg - 211	500	1942	FO#2	*	yes
Bldg - 236	1000	1943	FO#2	*	yes
Bldg - 265	500	1941	FO#2	*	R

Table 2-1 (Continued)
USTs Located on JPG

U.S. Army Jefferson Proving Ground Underground Petroleum Storage Tanks

Bldg - 266	500	1941	FO#2	*	R
Bldg - 281	500	1942	FO#2	*	R
Bldg - 291	0	1943	FO#2	Steel	R
Bldg - 291	0	1943	FO#2	Steel	R
Bldg - 310	0	1941	FO#2	Steel	R
Bldg - 303	0	1941	FO#2	Steel	R
Bldg - 303	0	1941	FO#2	Steel	R
Bldg - 313	1000	1941	FO#2	*	yes
Bldg - 322	1000	1942	FO#2	*	yes
Bldg - 325	1000	1953	FO#2	•	yes
Bldg - 333	10000	1975	FO#2	Steel	yes
Bldg - 481	1000	1941	FO#2	*	R
Bldg - 488	500	*	FO#2	*	no
Bldg - 510	500	1941	FO#2	Steel	R
Bldg - 530	4000	1978	FO#2	Steel	yes
Bldg - 602	25000	1952	FO#2	Steel	yes
Bldg - 602	0	1952	FO#2	Steel	R
Bldg - 602	0	*	FO#2	Steel	R
Bldg - 617	25000	*	FO#2	Steel	R
	0	1952	FO#2	Steel	R
	0	1952	FO#2	Steel	R
Bldg - 227	1000	•	•	•	*
Bldg - 202	350	*	*	*	*
Bldg - 711	500	*	FO#2	*	yes
Bldg - 714	1000	1992	FO#2	Steel	yes

• = Undocumented

R = Removed by Contractor

UPDATED AUGUST 3, 1993

Source: Ebasco, 1990

Plant. Heating fuel is not considered a hazardous waste under CERCLA; therefore it is not discussed further in this report.

2.1.5 Remedial/Removal Actions

No CERCLA removal actions or RCRA corrective actions have occurred at JPG.

From December 1988 until June 1989, a Remedial Investigation (RI) was performed at JPG to investigate the ground water and soils in the vicinity of the Gate 19 Landfill and Buildings 279, 602, and 617.

Volatile organic chemicals (VOCs) were detected in the soils at the three buildings and at several sites within the landfill. Groundwater contamination was determined insignificant at the Gate 19 Landfill; however, significant contamination was identified at Building 279. No further investigation was recommended due to low groundwater flow rates. The extent of contamination at Building 602 and 617 is unknown.

An RI/FS of the cantonment area (south of the firing line) was begun on October 8, 1992. This study will evaluate 49 sites and remedial actions to be taken at JPG. Potential sites for interim remedial action or removal action include the Yellow Sulfur Area, former UST sites with known releases, Gator Z Burn Area, Solvent Pits, Depleted Uranium Impact Area, and the Concrete Vault/Oil Area.

2.1.6 Previous Environmental Documentation

- Installation Preliminary Assessment (PA) completed by USATHAMA in August 1980. Estimated contamination migration potential was low.
- A Preliminary Assessment/Site Inspection (SI) was conducted by USATHAMA from 1983 to 1985.
- Updated PA completed by USATHAMA in 1988. Concluded that groundwater at the solvent disposal pits and Gate 19 Landfill may be contaminated with TCA.
- Remedial Investigation (RI) conducted by USATHAMA's Installation Restoration Division. Conducted to determine the nature and extent of contamination at the Gate 19 Landfill and the Solvent Pits. Concluded that one Building 279 well closest to the solvent pit was highly contaminated with volatile organic compounds (VOCs), including TCA. No TCA was found in the landfill wells.
- Enhanced PA completed in March 1990, initial environmental document for Base Closure studies. Included 36 SWMUs and 17 Areas of Concern (AOCs). Recommended further study be undertaken.
- Master Environmental Plan (MEP) completed in November 1990.
- A Site Specific Sampling and Analysis Program Draft was completed in May 1992. Stream sampling and groundwater monitoring was conducted to determine if contaminants are migrating off-post. Concluded that mercury was detected above maximum contaminant levels (MCLs) in 3 of 18 stream water samples.
- U.S. Army Environmental Hygiene Agency (AEHA) conducted resampling of the select stream sampling July 7-10, 1992. Results indicate that no mercury was detected in stream samples.
- A Draft Resource Conservation and Recovery Act (RCRA) facility Assessment was completed in March 1992 by EPA - Region V. Identifies 85 SWMUs and AOCs for the installation.
- Installation Action Plan (IAP) for JPG was completed in March 1993.

2.2 SITE DESCRIPTION

JPG is an active, government owned, government operated U.S. Army Test and Evaluation Command (TECOM) facility. The mission of JPG is to plan and conduct production acceptance tests, reconditioning tests, surveillance tests and other studies of ammunition and weapon systems.

JPG is roughly rectangular and is approximately 18 miles long (north-south) and five miles wide. Topography is flat to rolling with most of the relief near stream valleys. The facility is drained by seven major drainage ways and three tributaries, which flow from northeast to southwest. Most of JPG is undeveloped and heavily wooded. There are numerous man-made clearings in the northern part of the facility which are used as impact areas for testing munitions.

JPG occupies approximately 55,265 acres of land in Ripley, Jennings and Jefferson counties in Indiana. The cantonment area, located in the southern portion of JPG, contains the administrative ammunition assembly, testing and maintenance areas. Most of the facility buildings and structures are situated in a strip which is approximately one mile wide by five miles long, and covers 4,315 acres. The firing line runs east to west and separates the cantonment area from the northern impact area. The ordnance testing occurs at 125 permanent firing positions along the firing line. An abandoned airport lies in the northwestern portion of the cantonment area. The north area covers 50,950 acres and has widespread UXO contamination and localized depleted uranium contamination.

Accessability to the JPG installation by the public is restrictive. Only military and civilian personnel with proper identification badges may enter through the security fenced area. JPG maintains 24-hour security for the post. The facility is surrounded by a maintained fence and has 24-hour roving security surveillance. Sites of potential concern located in the cantonment area of the facility are not accessable to the public. There are no recreational values in any area of concern. Areas north of the firing line are restricted to badged personnel only.

2.2.1 SOURCE DESCRIPTION

JPG was designed and constructed to be used as a testing proving ground, and has been in operation as such since May 1941. A wide assortment of conventional weapons and munitions have been tested at the facility, including propellents, projectiles, cartridges, mortars, grenades, fuses, primers, boosters, rockets, tank ammunition, mines, and weapon components. (A summary of the propellants and explosives managed at JPG is included in Appendix B.) Past and present activities at JPG have included the detonation, burning and disposal of the waste propellants, explosives and pyrotechnic substances at the facility. These and other waste management activities have resulted in the generation of physical and chemically hazardous substances throughout the facility.

A number of sites of potential environmental concern have been identified at JPG. Little or no environmental data is available for these sites. A listing of the sites is presented in Table 2-2.

Sites which are considered sources, or sites which have had or are suspected to have had a release of hazardous constituents to the environment are detailed in the source descriptions. A source is any area where hazardous substances have been deposited, stored, disposed of, or placed, plus those soils that have become contaminated from migration of a hazardous substance. Location maps of the source sites are presented in Figure 2-1 and Appendix F.

Table 2-2
Potential Sources at JPG

Name	Unit No.	Comments
Old Incinerator (Bldg. 185)*	01/JPG 001	Incinerator used from 1941-1978 to burn small ammunition and paper. No documented release has occurred.
New Incinerator (Bldg. 333)*	02/JPG 011	Currently used to burn paper products, debris, plywood and polyurethane. The ash was Toxic Characteristic Leaching Procedure (TCLP) tested and deposited in the Gate 19 Landfill.
Oil/Water Separators (Bldg. 186+110)*	JPG-004,005	These steel and concrete pits are used to separate and contain petroleum sludges from wash-down operations inside the buildings.
Well Disposal Site	07, JPG 018	This well may have been used for disposal of munitions and riot control grenades. The well is 3 ft. in diameter and 30 ft. deep.
Cistern Disposal Site	08, JPG 021	Could not be located during RFA. Fuses may have been disposed here.
Sand Blasting Area (Bldg. 136) *	011, none	This is a 20 square foot area used for sand blasting. Waste sand is analyzed for hazardous constituents.
Paint Waste Area (Bldg. 136)*	013, none	This 140 square foot area is used to dry empty paint cans while in steel containment pans.
Floor Drain and Wash Rack (Bldg. 186)	014, none	This unit consists of a steel trench leading from the building into a wash rack. All local spills of Petroleum and Other Lubricants (POL) are drained and separated here.
Photo Lab Floor Drains (Bldg. 208)	015, JPG 010	These floor drains directed liquid photographic waste to the sanitary sewer system.
Open Detonation Unit	L 2, JPG-023	This unit consists of approximately 10 acres of land used for detonation of unserviceable explosives.
Unsurfaced Roads	L4, none	This area consists of dirt and gravel roads north of the firing line where waste oil was sprayed for dust control.
Locomotive Maintenance Pit (Bldg. 216)*	L6, none	This pit is approximately 180 square feet in area and may have received leaking POL fluids.
PCP Wood Accumulation Area*	L7, JPG 008	This unit consists of wood treated with pentachlorophenol, and zinc napthenate which is piled on the abandoned runway.
Morgan Road Disposal Site	L8, JPG 016	This site is an unlined pond covering approximately 420 square feet. This pond may contain inert ordnance.
Engineer's Road Potential Explosives Burning Area*	L9, none	This area was reportedly used to burn explosives contaminated trash. The exact size and location is unknown.
Burning Ground off J Road	L11, JPG 0221	This area consists of approximately 3 acres formerly used for burning of projectiles and propellants.
Inert Metal Landfill off York Road	L12, JPG 017	This Landfill was used for disposal of inert (steel and lead) shells. The actual size is unknown.

* Sites which are included in the RI/FS currently under investigation.
(Source: Ebasco, 1990.)

Table 2-2 (Continued)
Potential Sources at JPG

Name	Unit No.	Comments
Landfill at 4.5 Impact Range	L13, none	This unit consists of pits and scattered debris. No wastes were observed during the RFA.
Bldg. 602 Soil Staging Area *	L14, none	Soil, removed during UST excavations was stored here.
Debris Dump North of Airfield*	L15, none	This is an area where construction debris is deposited.
Paper Mill Road Disposal Area *	L16, none	This area was used from 1949 to 1968 for disposal of unknown wastes.
DRMO Storage Area *	L17, none	This is an open storage area where recyclable equipment and other items are stored prior to their being transferred off the post. Some lead-acid batteries are stored here.
Landfill Near Old Timber Hunting Lodge	L20, JPG024	Trash generated at the Old Timber Lodge, a hunting lodge, was deposited in this landfill.
Disposal Area Near New Incinerator *	L21, none	This is a 200 square foot area where yellow chunks of sulfur-like material were disposed on the ground surface.
Sewage Sludge Application Area *	L23, none	This area is a 300 square foot field used for sludge drying. The sludge comes from the STP and may have had high cyanide and silver levels.
Ammunition Demilitarization Area	L24, JPG-013	This is an open area where explosives charges and undefined munitions may have been burned.
Potential Munitions Dump Site	L25, none	This is a densely wooded area that may have been used for disposal of waste munitions.
Bldg. 186 Solvent Accumulation Area*	C4, JPG035	This area is the former location of a solvent accumulation area; now occupied by Safety-Kleen Parts Cleaners. The solvents were stored in 55-gallon drums on a concrete floor.
Bldg. 186 Antifreeze Accumulation Area*	C6, JPG035	This area lies adjacent to the Solvent Accumulation Area inside the building and consists of a 300 gallon above-ground antifreeze recycling unit.
Building 227 Former Storage Pad*	C11, JPG034	This unit consists of a concrete pad and storage shelter used to store waste solvents, oil and lubricants from operations inside the building.
Machine Shop Accumulation Area* (Bldg. 105)	C12, JPG031	This unit consists of 55-gallon waste POL collection drums sitting in a drip pan. The waste is the result of operations within the building.
Water Quality Lab Satellite Accumulation Area*	C13, JPG002	This unit is a small storage cabinet adjacent to the STP. Wastes, generated in the lab are stored in the cabinet.

* Sites which are included in the RI/FS currently under investigation.
(Source: Ebasco, 1990.)

Table 2-2 (Continued)
Potential Sources at JPG

Name	Unit No.	Comments
Former Chemical Storage Area (Bldg. 279) *	C14	This is a former storage area inside building 279. No wastes are currently stored there.
Airport Hangar Waste Storage Area*	C15	This area lies inside the airport hangar and was used to store non-hazardous waste.
Air Gunnery Range Accumulation Area	C16	This area consists of a steel 55-gallon drum sitting atop a wooden pallet. The drum is used for depositing waste scrap steel from the strafing range.
Air Gunnery Range Scrap Equipment Area	C17	This area is used to store targets prior to placing them on the Aircraft Target Range. These targets consist of scrap equipment such as trucks, tanks and gun turrets.
Former Transformer Storage (Bldg. 108A)	C24	This area, where transformers were stored, consist of a triangular-shaped, fenced area, with a gravel base.
Sewage Treatment Plant (STP)*	S1, JPG003	This is the primary Waste Water Treatment Plant for JPG. Effluent from this unit discharges into Harbert's Creek under NPDES Permit No. IN0024210.
Sanitary Sewer System	S2	This unit is comprised of below ground surface (bgs) pipes which convey wastewater to the STP. There are over 50,000 feet of sewer pipes.
Storm Sewer Drainage System	S3	This unit is comprised of bgs lines, catch basins and ditches with direct runoff into the surrounding surface waters.
Tank #17 Waste Oil*	T1	This is a 1,000-gallon UST which stores waste oil generated in the vehicle maintenance and repair operation.
Leaking UST (Bldg. 602)*	AOC A1	The leaking UST was located adjacent to building 602 and used to store No. 6 fuel oil. During tank removal in 1990 a leak occurred.
Other USTs*	AOC A2	This AOC includes 38 USTs currently in use at JPG. The tanks vary in age from 51 to 7 years old.
No. 2 Oil Spill*	AOC A3	This oil spill south of Building 103 occurred in April 1988. The No. 2 heating oil covered 600 square feet and was caused by overfilling of the tank.
Gasoline Station*	AOC A4	This station has been in operation since 1942 and is located in the south-central portion of the facility. There are USTs and piping located at this station.
Munition Impact Areas	AOC A5	There are munitions impact areas located both north and south of the firing line. North of the firing line it is estimated there are 8,600 acres of impact areas. The area south of the firing line is unknown.
Machine Shop (Bldg. 105)*	AOC A6	This AOC consists of a solvent dip tank and a lead casting unit used to make lead hammers. The floor beneath the solvent unit is wooden and stained.

* Sites which are included in the RI/FS currently under investigation.
(Source: Ebasco, 1990.)

Table 2-2 (Continued)
Potential Sources at JPG

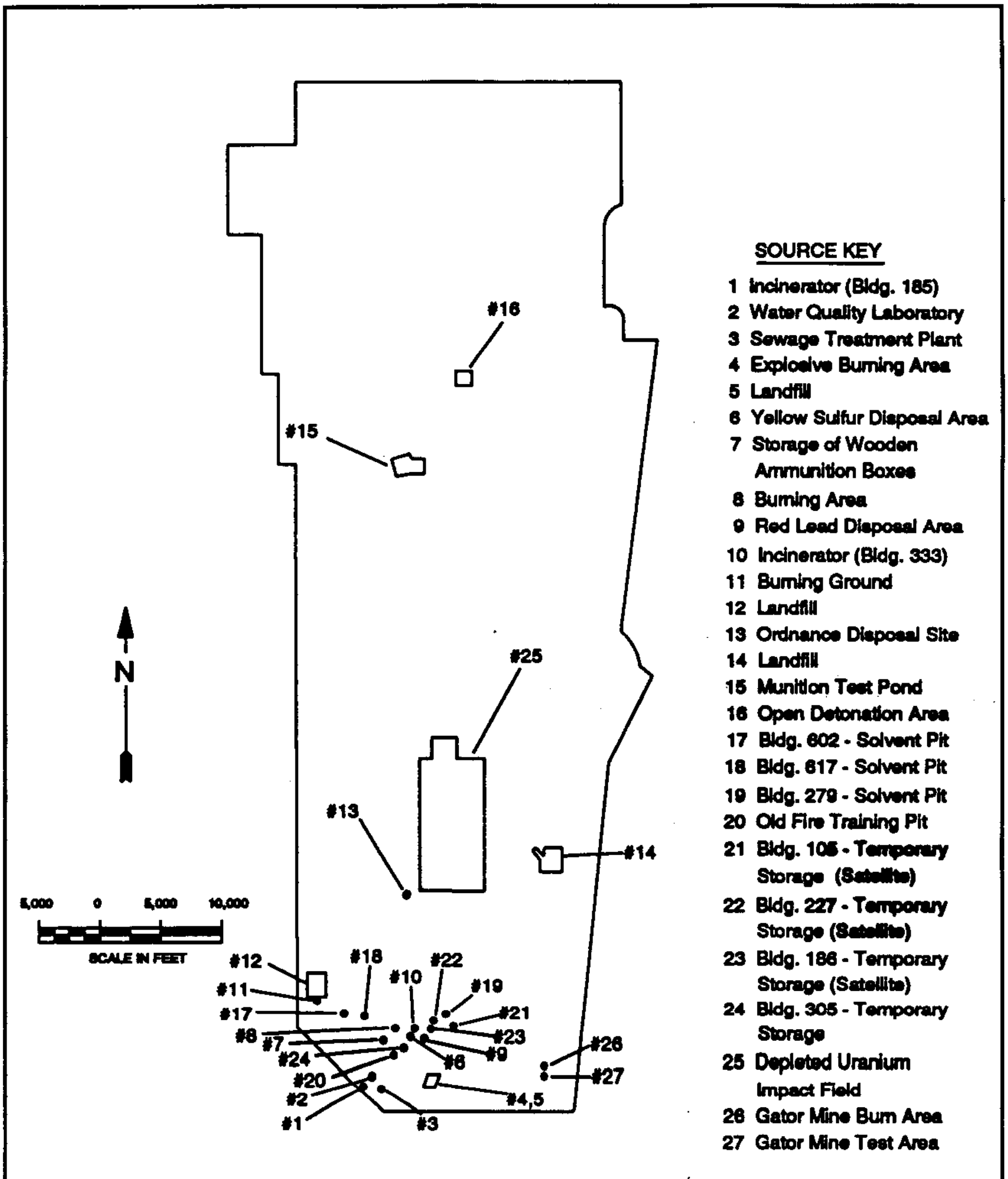
Name	Unit No.	Comments
East West Runway'	AOC A7	This area is used as a flare test area and burned ground was observed during the RFA in 1992.
Macadam Test Pond	AOC A8-A JPG 020	This is a pond covered with macadam, used to test munitions. This 100 square yard pond was constructed in 1950 and is 7 feet deep. When drained in 1970, no munitions were found inside.
Munitions Test Pond	AOC A8-B JPG 019	This is an unlined pond used to test munitions in water. It covers an area of 200 square yards and is currently not in use. UXO may remain in the bottom of the pond.
Aircraft Target Range	AOC A9	This unit is located in the north-central portion of JPG and is used as a bombing and strafing range by the USAF and IANG.
Air Bombed Storage Tank Target Area	AOC A10	This area, located off Center Recovery Road, houses 8 storage tanks. These tanks are empty and currently used as targets.
FASCAM Test Area	AOC A11	Family of Scatterable Mines (FASCAM) are tested in this area. The 400 square yard area has a crushed rock base with concrete dividers.
Gator Z Mine Test Area *	AOC A12	Located in the southeast portion of JPG this area is used to test mines in test pits. Both anti-personnel and anti-tank mines are tested.
Bromacil Area	AOC A14	This 65-70 acre site is the location where a herbicide was applied in 1979 to clear vegetation. This unit is located east of Jinestown Road, north of the firing line.
Pesticide Storage Area (Bldg. 204) *	none	This building is used for storing and mixing pesticides and herbicides.
Former Storage Pad (Bldg. 227) *	none	This is a weapons maintenance, repair and refurbishing facility, located near the firing line.
Gasoline Station *	none	Currently operating military vehicle gasoline and diesel station.
Northwest Southeast Runway Test Area *	none	Location of a flare testing area currently in use.
Discharge/Fill Pipe at Building 259 *	none	Adjacent to railroad tracks, enclosed, may have been used to transport bunker oil (heating oil).
Former UST (Bldg. 281) *	none	Former concrete UST structure used to store bunker oil. Upon removal, stained soil was observed.
Indoor Range (Bldg. 295) *	none	Used primarily to test small arms; lead may be a concern.
Artillery & Infantry Road USTs *	none	Pipe sticking out of ground; may be USTs.
Rail Tracks Underground Vault *	none	Concrete vault with piping which is under water; may be a part of a fuel distribution system.

* Sites which are included in the RI/FS currently under investigation.
(Source: Ebasco, 1990.)

Table 2-2 (Continued)
Potential Sources at JPG

Name	Unit No.	Comments
Airport Explosive Ordnance *	none	During vegetation burning, UXO rounds have been found randomly distributed around the airport.
Old Flare Test Sites *	none	Two sites, south of the firing line, used to test flares.
South Airport Wooded Area *	none	Several acres where depression in the topography exists.
Ammo Storage Igloos *	none	Located near the east end of the firing line, these structures are used to store ammunition or propellants.
Explosive Ordnance South of Firing Line *	none	This is a largely unknown area where rocket, mine, and armor plate testing and ammunition dumping may have occurred.

* Sites which are included in the RI/FS currently under investigation.
(Source: Ebasco, 1990.)



JEFFERSON PROVING GROUND
MADISON, INDIANA

FIGURE 2-1
Locations of Sources at JPG

Source: Ebasco, 1990

2.2.1.1 Building 185 Incinerator (JPG-001)

This incinerator was in operation between 1941 and 1978, and was used to burn debris such as small ammunition and paper products. The unit was located in Building 185, in the southwest corner of the facilities (see Figure 2-2). The unit is a Morse-Boulger, single chamber, six-burner, single stack incinerator without an after burner unit. The unit is contained within a red brick building approximately 15'x 20', and on a concrete base. This incinerator was replaced with a new incinerator in 1978 and is no longer in operation.

Waste Characteristics

Ash from the old incinerator was disposed of in several on-site solid waste landfills. The specific landfills were not indicated in any file material. Previous feed rate was not documented, nor was the amount of ash produced.

The particulate matter vented from the incinerator stacks during operations was released directly to the atmosphere. No known release controls were used in this unit. Particulate matter may have included hazardous constituents from the disposed materials.

Environmental Considerations

During operational years, the potential for air migration was high due to the particulate matter released from the stacks directly to the atmosphere. However, the unit is no longer in use which greatly reduces the potential.

Due to the release of particulate matter, potential for a release to the soils, groundwater and surface water pathways is moderate to high. The extent of release is difficult to determine due to the migration distance of the particulates before settling.

Monitoring History

No sampling and analysis data is currently available. This source is currently under investigation in the RI/FS.

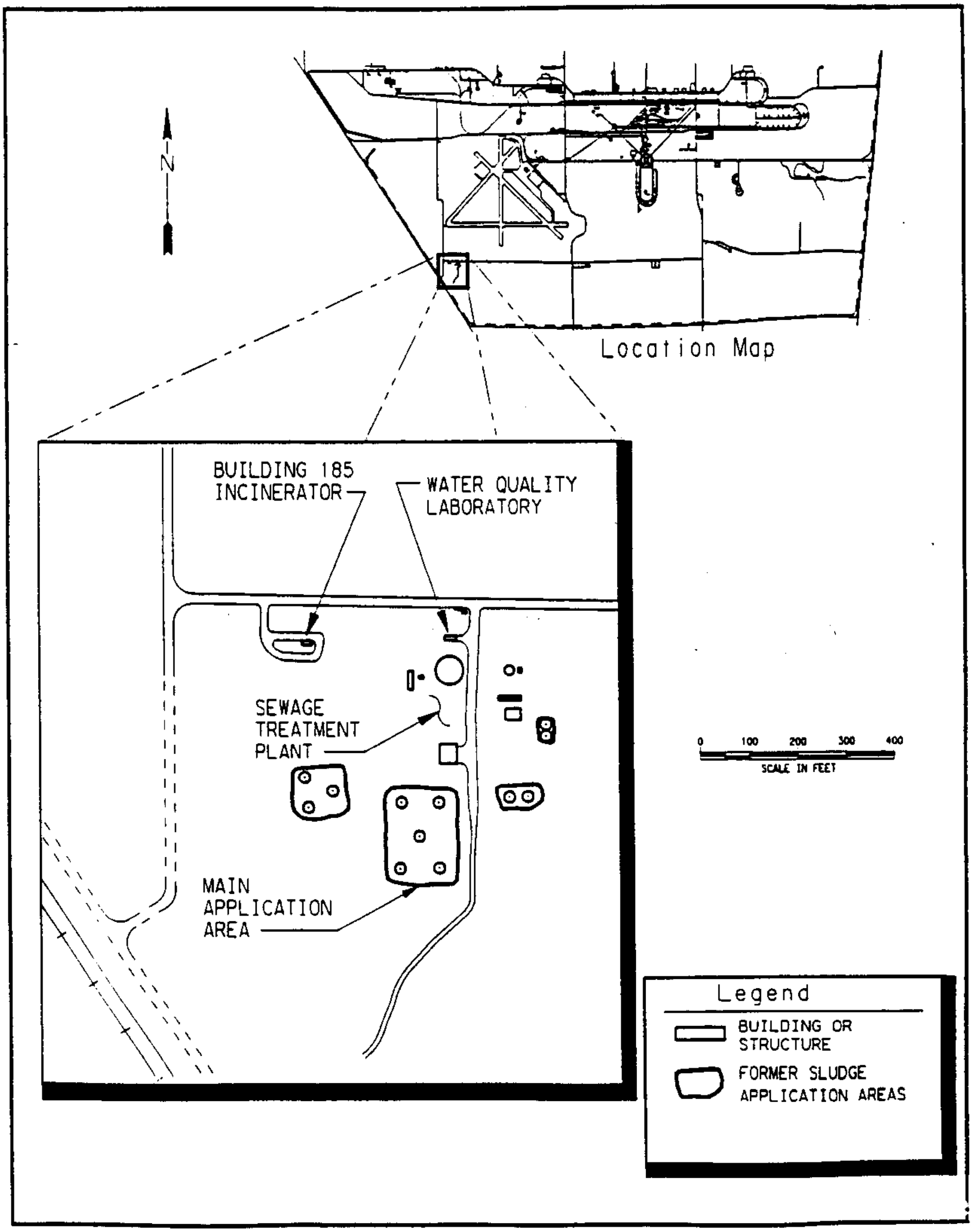
2.2.1.2 Water Quality Laboratory (JPG-002) and Building 177 Sewage Treatment Plant (JPG- 003)

Description

The Sewage Treatment Plant (STP) Building 177 (Figure 2-2) covers an area of approximately 682 square feet with a capacity to produce approximately 280,000 gallons per day of waste water. The treatment facility consists of a settling tank (Imhoff tank), and a trickling filter system wherein the processed water is recirculated before discharge to a NPDES permitted outfall and sludge drying beds.

The water quality laboratory (JPG-002) is located on the first floor of this building. The laboratory has been used for testing water quality at the sewage treatment plant since the 1960s.

The pumping station is located in the basement of building 177.



Source: REL 1993

FIGURE 2-2 LOCATION MAP

Building 185 Incinerator
Sewage Treatment Plant

Water Quality Laboratory
Sewage Sludge Application Areas

Waste Characteristics

The majority of the waste water is sanitary (domestic sewage). A small quantity of industrial wastewater consisting of photographic wastes (170 gallons per day), boiler blow-down water, and rinses from Buildings 208 and 186 oil/water separator is also treated at the plant.

Sludge from the Imhoff tank is pumped to a drying bed consisting of concrete walls and sand floors. The amount of sludge generated is undocumented. The area under the drying bed may contain contaminants that originated from the photographic laboratory (containing silver and cyanides). In the past, sludge from the STP was disposed of on a "clay bank" south of the old incinerator, spread on fields within the installation and also stockpiled just east of the sludge drying beds. These areas are now covered with grass and are generally flat, with no signs of mounding. Sludge from the drying beds was reported to have high levels of silver and cyanide in the effluent, emminating from the operations of the Photographic Laboratory. The discharge of silver ceased in 1967, and cyanides ended in 1980. PCBs are a potential contaminant at this site because they are commonly found in sewage sludge at older treatment plants (REI, 1993). The amounts of silver and cyanides discharged is undocumented.

The specific wastes generated at the water quality laboratory include a small undocumented amounts of spent chemicals generated from the analysis. No evidence exists that indicates the previous disposal practices at the laboratory resulted in significant risk to human health and the environment.

Environmental Considerations

Although the STP has recently been upgraded, and the operations have substantially improved, possible contamination of the surface water, sediments, soils and groundwater may have occurred. Currently, there is a slight potential for release to surface water via runoff to Harberts Creek, which is several hundred feet away to the southeast.

In the past, untreated wastewater has bypassed the treatment system and has been discharged directly into Harberts Creek especially in periods of heavy precipitation.

Contamination of surface soils may have occurred due to the leaching of stockpiled or disposed of sludge. Public health risk by soil contamination is reduced at this source due to the restriction of entry to JPG personnel only.

Leaching of contaminated soils could result in contamination of the groundwater and surface water pathways, depending on the relative mobility of the contaminants present. (Chem-Nuclear, 1992)

Monitoring History

Routine laboratory analysis is required under the NPDES permit for the STP; analytical reports from the STP are included in Appendix C. EP Toxicity analysis for heavy metals indicates that effluent metal concentrations have not exceeded water quality standards.

There is no data concerning the wastes contained in the sludge application areas; however, untreated water entering Harberts Creek may have resulted in contamination to the surface water pathway. The estimated amount and frequency of untreated waste-water discharge is unknown. Water and sediment samples taken from Harberts Creek in January 1992 near the outfall revealed detectable concentrations of silver in the water and sediments. The silver may also be attributed to runoff from the Gator Mine Test Area, upstream

(REI, 1993). An investigation is currently underway to locate the source of the silver contamination. This source is included in the current RI/FS investigation.

2.2.1.3 Former Burning Ground and Landfill

Description

This Former Burning Ground (JPG-004) is a two-acre area formerly used for burning of explosives and other burnables (see Figure 2-3).

The one-acre landfill (JPG 005) was comprised of trenches, which were filled in with waste to an unknown depth (see Figure 2-3), and was in operation from 1941 until 1970.

Waste Characteristics

The waste burned and deposited in the Former Burning Ground include unknown amounts of explosives, fuses, waste propellant, boxes, lumber, and paint residue. Waste products resulting from incomplete combustion of explosives may include trinitrotoluene (TNT), dinitrotoluene (DNT) and metals.

Spent solvents, photographic wastes, and red lead deposited were reportedly in the landfill during its operation, the amounts of which are undocumented.

Environmental Considerations

The potential contaminant release mechanism is leaching through soils into groundwater. Release of contaminants to the air is of minimal concern because the source was covered and is no longer in use.

No records were maintained of materials disposed of in this landfill, which is now abandoned, overgrown and barely discernable. The potential migration of contamination through the soils to the underlying groundwater exists. The surface deposits in this area consist of sandy to silty soils with low organic and high clay content.

Monitoring History

No environmental sampling has occurred to establish the nature and extent of any contamination at this source, but subsurface soil sampling, in the burn area and a geophysical survey of the landfill are planned as a part of an upcoming RI.

2.2.1.4 Yellow Sulfur Disposal Area and Burn Area South of the New Incinerator

Description

A yellow sulfur-like material was identified in an area south of the new incinerator (see Figure 2-4). A drainage ditch is also located within 30 feet of the area. In the past, this area may have been another solid waste management unit. Near the yellow-sulfur disposal area, a burned area on the ground surface was identified. Also identified in this area is a concrete pad with burned ground surface areas surrounding it. (Ebasco, 1990)

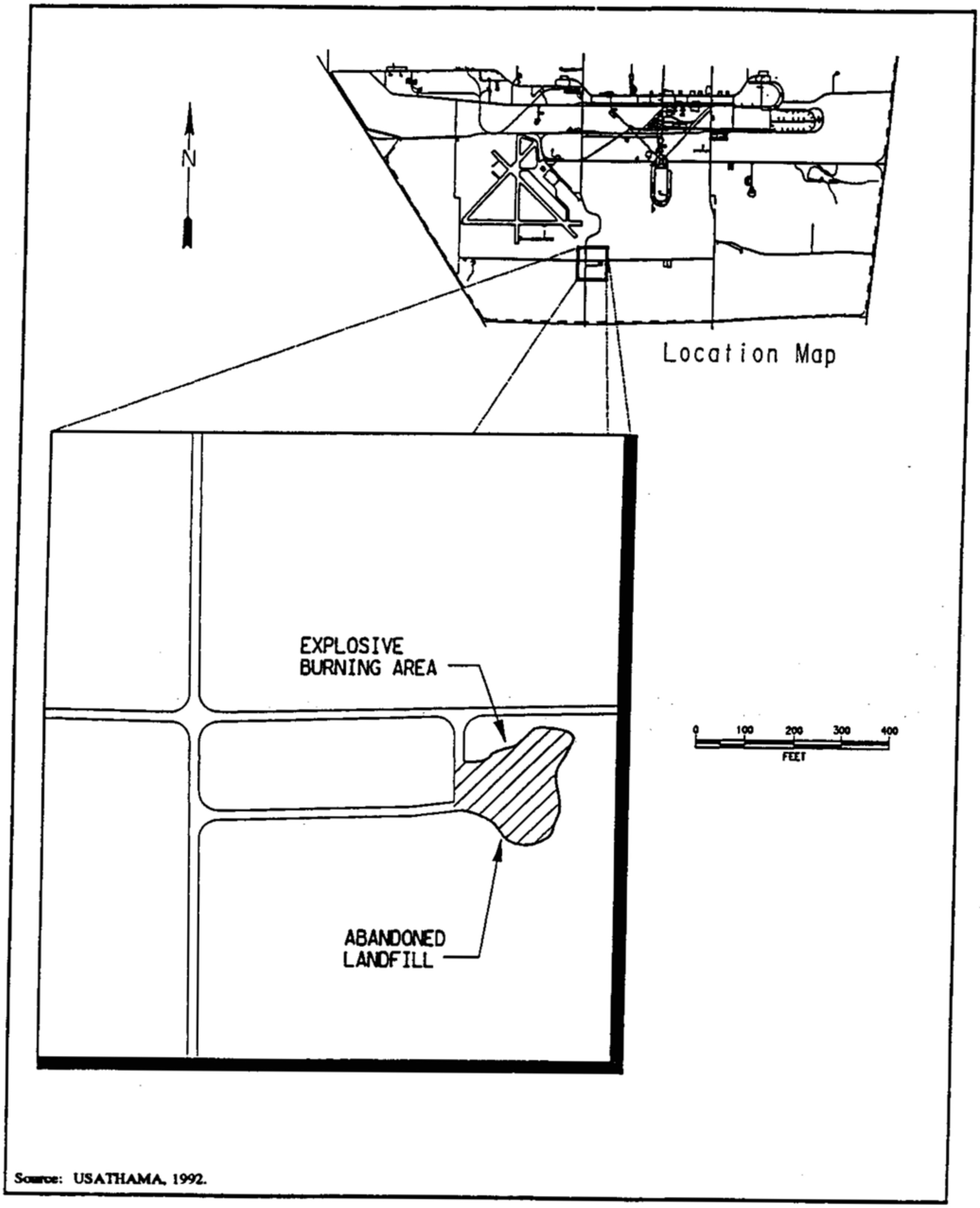


FIGURE 2-3 LOCATION MAP
Explosive Burning Area and Abandoned Landfill

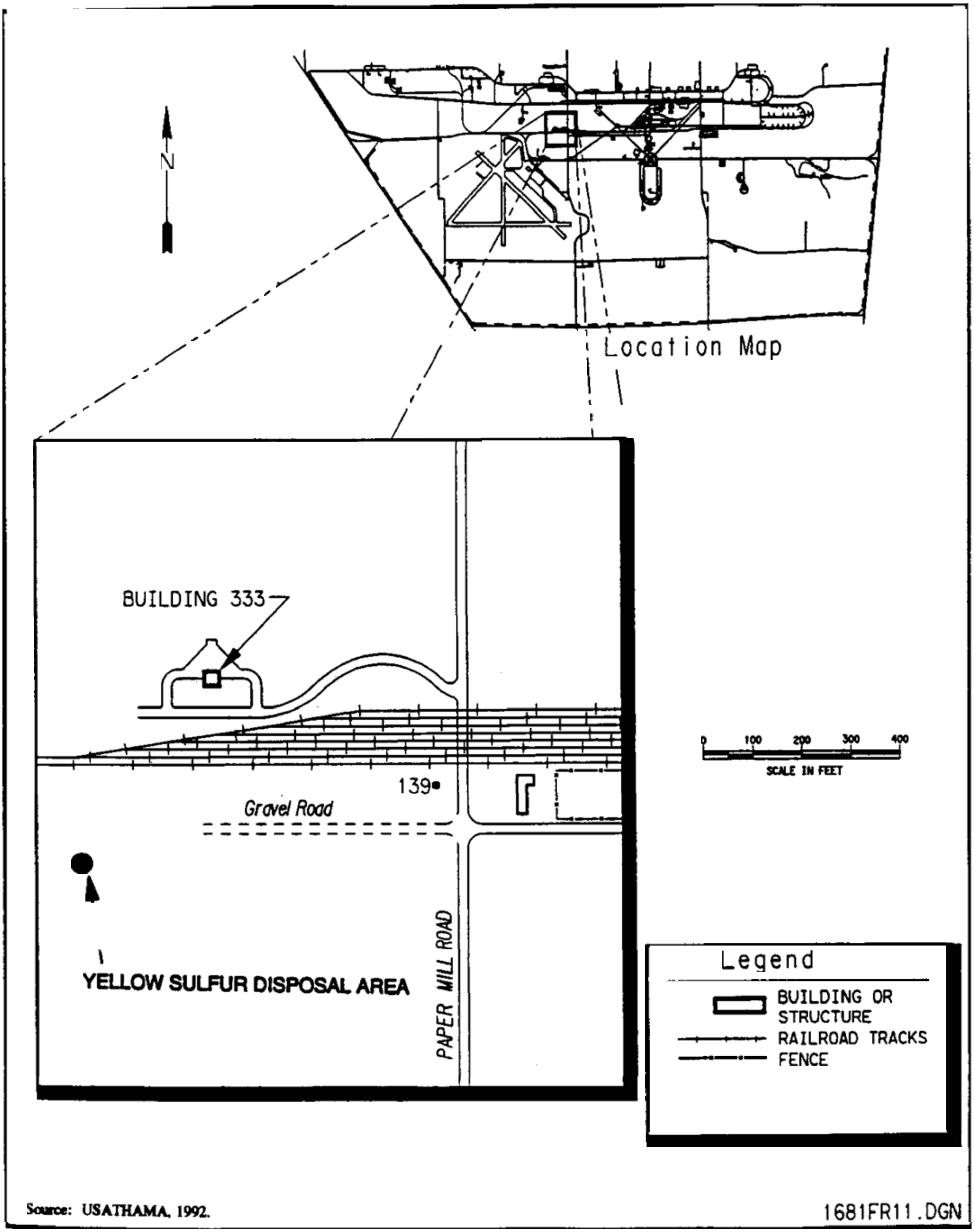


FIGURE 2-4 LOCATION MAP
Building 333, New Incinerator & Yellow Sulfur Disposal Area

Waste Characteristics

Samples collected from the yellow sulfur disposal area contained sulfur, and five out of eight samples had a pH of less than two. This area was further excavated to a depth of three to five feet below the surface, where more rocks were stained yellow. (Ebasco, 1990)

Environmental Considerations

The area is discernible by stressed vegetation (probably due to the low pH). The potential for migration of contaminants is via the soil, and leachate into the groundwater. Because the sulfur disposal area is located on the banks of a stream or drainage way, there is a direct pathway for these materials to be transported into the stream, from both runoff of precipitation and stream scouring during increased flow.

Monitoring History

No data currently exists for this site. No records of previous burning activities at this site exist. This source is currently under investigation in the RI/FS.

2.2.1.5 Open Burning Area

Description

This burning area (JPG-006) is an active powder-burning area located east of Shun Pike Road and south of Engineers Road, in the southeast corner of the installation (See Figure 2-5).

There are four steel pans in this 250,000 square ft. area, which are used to burn approximately 60,000 pounds of waste per year. The burning is conducted on trays with locking stainless covers. This source currently operates under a RCRA Part B Subpart X Interim Permit.

Waste Characteristics

Waste propellant and explosives containing TNT, DNT and heavy metals are burned at this location. Approximately 37,000 pounds of these wastes are burned each year. The resulting ash is appropriately disposed after being analyzed for hazardous constituents. Analysis of ash in one report indicated the ash contained lead. This was believed to be the result of a failure to remove the lead jacket surrounding the propellent prior to burning. The ash containing lead was reported to have been disposed of as a hazardous waste. All other ash is taken to the Gate 19 landfill for proper disposal.

Environmental Considerations

Records indicate past burning, prior to the construction of the four steel pans, was done directly on the ground. However, no soil samples have been analyzed. During the site visit, extensive soil discoloration was observed around the burn pans. The potential for surface soil contamination to leach to the underlying aquifer also exists.

Residues left on the ground surface from open burning of materials may be transported to surface waters during rainfall events, both through overland flow and via shallow groundwater. The contaminants may be heavy metals, suspended and dissolved solids, or explosives and propellants. (Ebasco, 1990)

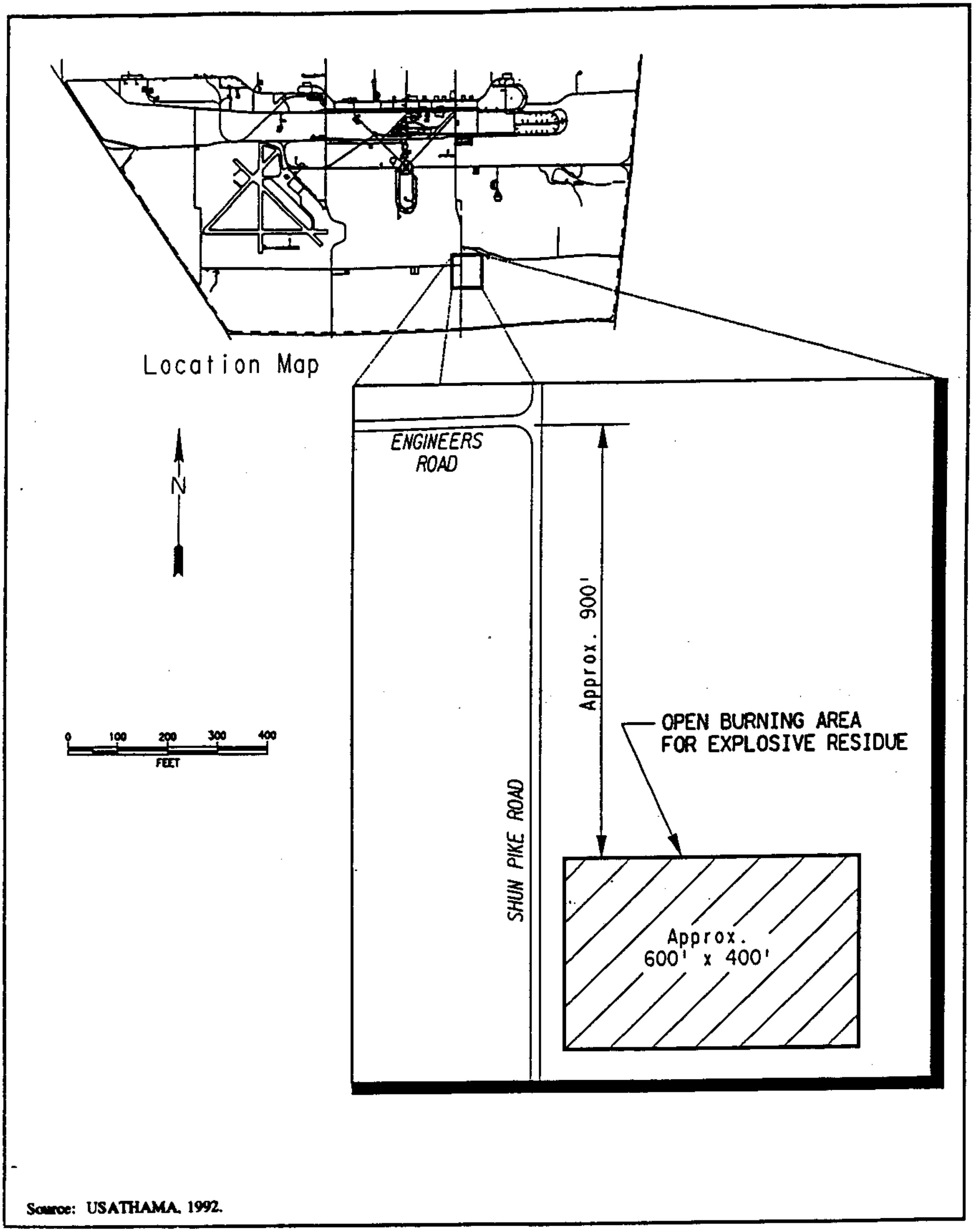


FIGURE 2-5 LOCATION MAP
Open Burning Area

Monitoring History

Analysis of ash disposed of in the Gate 19 Landfill show that contaminants are below Maximum Contaminant Levels. However, contaminants from previous open burning on the ground may be more concentrated, especially heavy metals.

No soil samples have been analyzed from the former burn areas on the site, however, this source is currently under investigation in the RI/FS.

2.2.1.6 Contaminated Wood Storage Piles

Description

The Wood Storage Pile (JPG-007) consists of a 10-ft. high used wood stockpile covering approximately 300 square feet on an abandoned, impermeable airport runway. The stockpile consists of wood debris, plywood struts, boxes, pallets, and used crates that were placed on the runway since about 1975.

JPG-008 is an open waste pile on the abandoned runway (see Figure 2-6) which received pentachlorophenol (PCP) treated wood from about 1975 through 1990. The size of the pile varies as portions of it are periodically removed for off-site disposal. A portion of the PCP wood pile was reportedly burned as a result of a lightening strike. (Chem-Nuclear, 1992)

Wood treated with PCP and zinc naphthenate is stockpiled on the northwest leg of the abandoned runway. The contents of this unit are disposed of periodically at an off-post sanitary landfill. The unit has been operating since approximately 1975 and is currently active.

Waste Characteristics

It is suspected that residue PCP and dioxin may be present in areas where wood has been burned. Ash and other evidence indicates that previous burning of the wood pile may have occurred. The amounts of wood burned and/or the amount of ash produced is undocumented.

Environmental Considerations

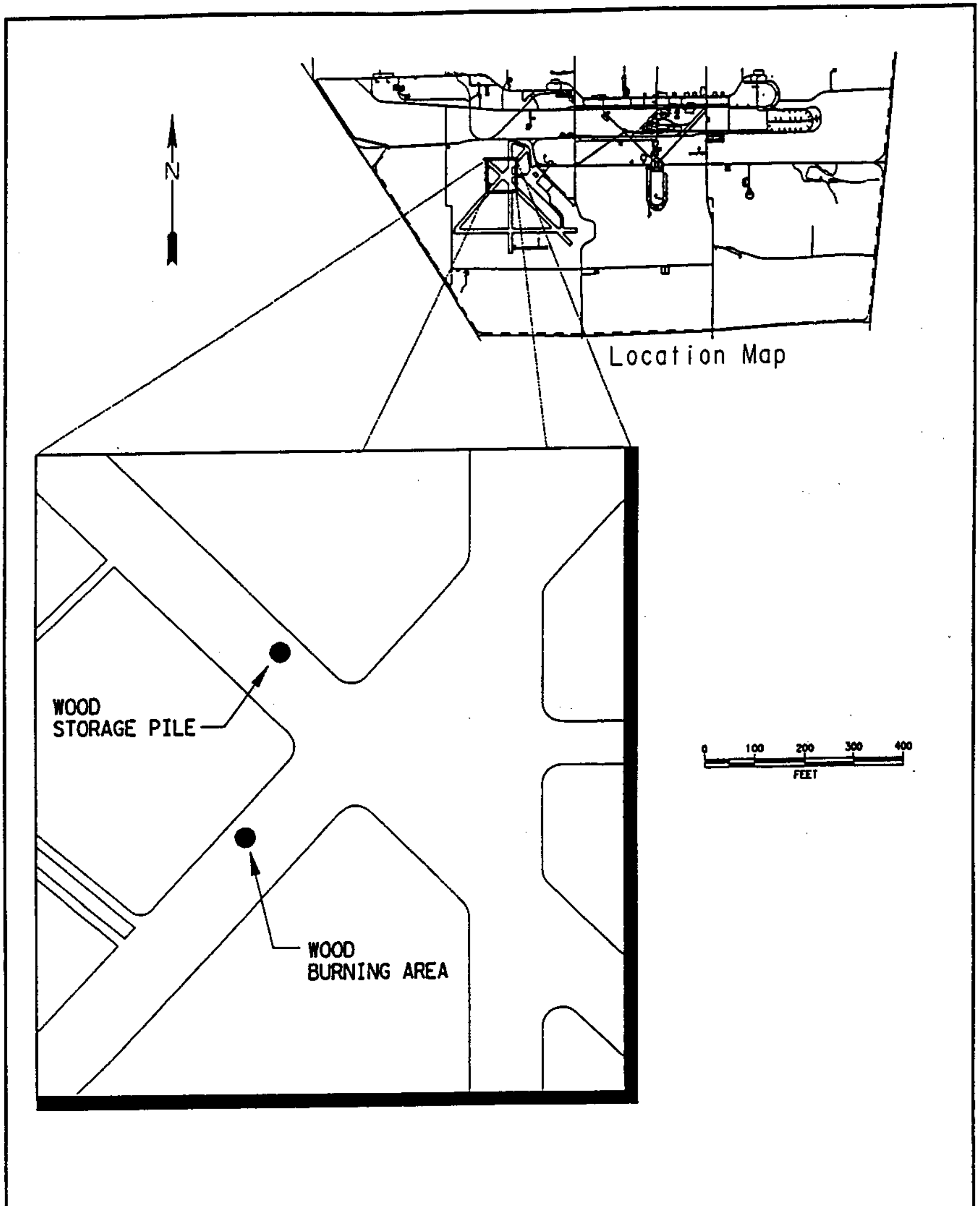
Storage and burning of PCP-containing wood or other scrap wood materials could result in the release of PCP, heavy metals and dioxin to environmental pathways.

Current practice for the PCP-contaminated wood is to crush the wood and dispose of it in an off-site sanitary landfill. (Chem-Nuclear, 1992)

Limited soil contaminants may have been released and transported to surface soils via storm runoff.

Monitoring History

No data currently exists for the two wood storage sites, however, this source is included in the current RI/FS investigation.



Source: USATHAMA, 1992.

FIGURE 2-6 LOCATION MAP
Wood-Storage Pile and the Wood-Burning Area

2.2.1.7 Red Lead Disposal Area

Description

This disposal area (JPG-009) of approximately 36 square ft. is located adjacent to the southwestern corner of Building 211 (see Figure 2-7). During the site visit an area of red-stained soil was observed just below the surface soils. Red lead disposal at JPG occurred between 1952-1958 and between 1961-1978.

Waste Characteristics

Records indicated waste consisting of paint residue and inert fillers containing lead oxide (red lead) were disposed of in this area in undocumented amounts.

Environmental Considerations

Stained soils exist just below the surface soils. These red-stained soils are adjacent to the southwestern corner of Building 211. Potential release to the air, surface water and groundwater exists. Because all areas where red lead were placed are not well defined, it is possible that there are disposal areas located near streams or drainage ways. If this is the case, then lead could migrate through soils into surface waters (via shallow groundwater or overland flow), or the soils in the area could erode, thereby allowing the lead to be washed into the surface waters. (Ebasco 1990)

Monitoring History

No environmental sampling has occurred; however, subsurface soil sampling is planned during an upcoming RI.

2.2.1.8 Building 333 New Incinerator

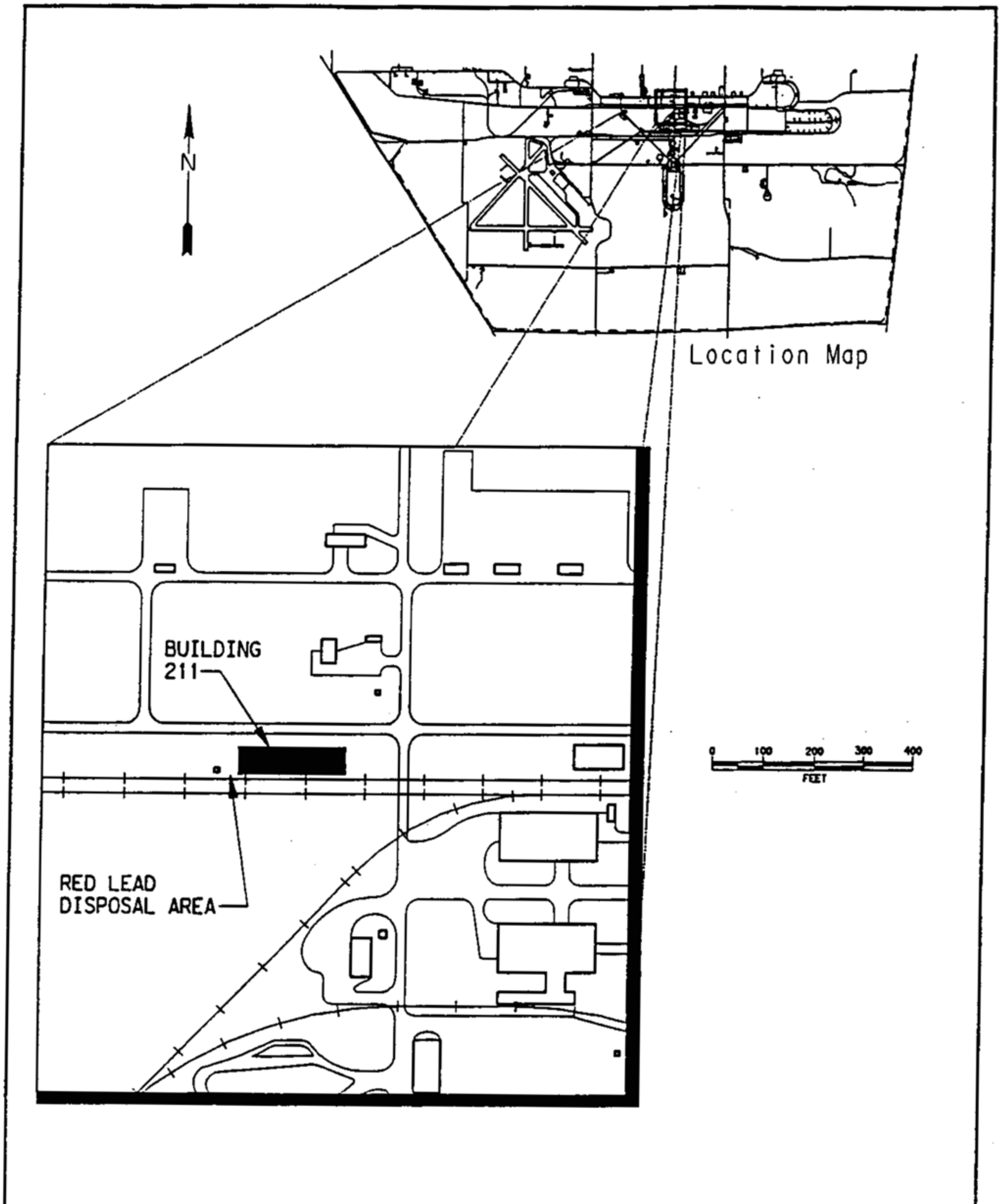
Description

New Incinerator Building 333 is located west of Infantry Road (see Figure 2-4). This unit is a single chamber incinerator with an after burner, which operates using Type II Fuel Oil. Operations of the unit began in 1978 and it is currently active. The unit is located within Building 333 which is 1,280 square feet and has a concrete base. The incinerator is used to dispose of paper products debris, plywood and polyurethanes which may be contaminated with methyl chloride and iron oxide from inert filling operations in Building 211.

Waste Characteristics

Ash from the new incinerator is placed in fiberboard drums and disposed of in the Gate 19 Landfill. The ash is analyzed for total cyanide, sulfide, ignitability, pH and EP Toxicity metals prior to disposal. Analytical results of the ash analysis is contained in Appendix C.

This unit is indoors and has no release controls. Particulates from the incinerator are released directly into the atmosphere from the incinerator stacks. The incinerator is exempt from air emission permit requirements based on the type and amount of materials disposed there.



Source: USATHAMA, 1992.

FIGURE 2-7 LOCATION MAP
Red Lead Disposal Area

Environmental Considerations

Since particulate matter is released directly into the atmosphere, potential for a release to the air is high. Potential to release to the soil, groundwater and surface water is moderate to high. The potential contamination would be difficult to assess due to the distance and direction the particulate matter will migrate before settlement.

Monitoring History

The ash from the unit is analyzed for total cyanide, sulfide ignitability, pH, and EP Toxicity metals prior to disposal in the Gate 19 Landfill.

2.2.1.9 Burning Ground (South of Gate 19 Landfill)

Description

The Burning Ground (JPG-014) is a one-half acre thermal treatment area once used for the open burning of construction debris and waste propellants, and reportedly also received trichloroethylene (TCE) and paint wastes. It is located immediately south of the Gate 19 Landfill (see Figure 2-8). Historical records of this area are vague, but aerial photographs from the 1950s to the 1970s show liquid-filled trenches and mounded material in this site (Ebasco 1990). The area is no longer used for burning; since it is currently overgrown with vegetation, the burning area is not discernable.

Waste Characteristics

Suspected contaminants associated with the Burning Ground are TCE and lead.

Environmental Considerations

Surface and subsurface soil contamination related to solvents, paint residue, and ash from open burning may be present at the site. Adjacent to the site is a pond which appears to be a discharge point for shallow groundwater. Contact of groundwater with the materials present in the former trenches would result in the contamination of both the surface and groundwater pathway. Groundwater in this area is approximately 25 feet below ground surface and flows from the southeast to northwest. The spent solvents and metals are likely to be mobile in the groundwater environment. The air pathway may be contaminated through volatilization of VOCs or through airborne particulates resulting in an inhalation hazard. In addition, surface runoff during precipitation events might result in mobilization of contaminants to the surface water pathway (Chem-Nuclear, 1992).

Monitoring History

Groundwater monitoring wells are present at the Gate 19 Landfill, immediately adjacent to the burning area (see Figure 2-8). However, groundwater-flow information is insufficient to determine whether the open burning site is being adequately monitored. Monitoring wells located along the West Perimeter Road were intended to detect any contamination plume originating from the Burning Ground. To date, data from these wells indicate that no such contaminant plume exists. Additional groundwater-flow information is needed to more accurately define groundwater-flow directions in the area of the Burning Ground. A potential exists for off-site migration of contaminated groundwater.

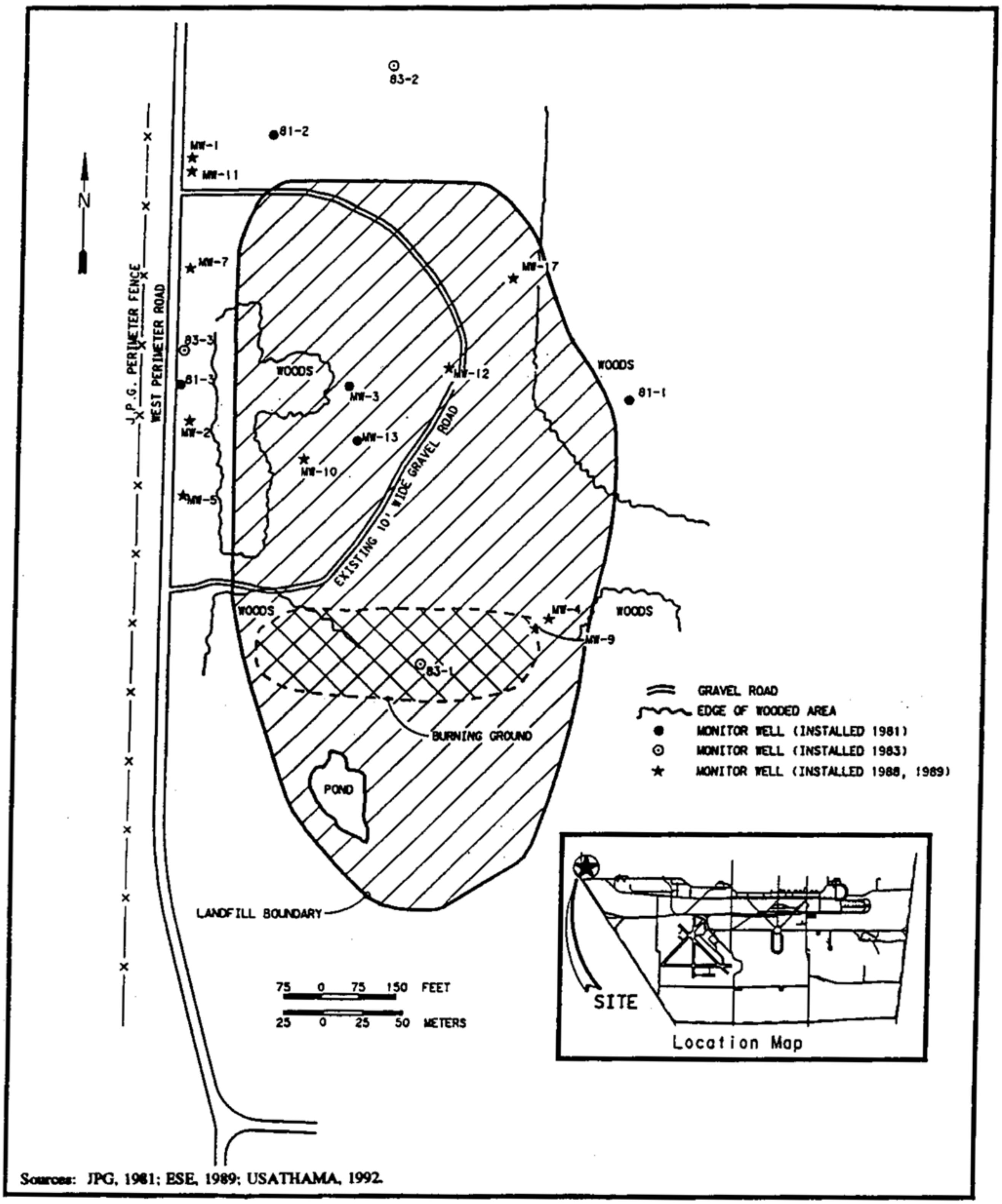


FIGURE 2-8 LOCATION MAP
Gate 19 Landfill
and Burning Ground South of Landfill

No data has been collected to determine if contaminants are present in surface and subsurface soils at the site. (Chem-Nuclear, 1992) This source is currently under investigation in the RI/FS.

2.2.1.10 Gate 19 Landfill

Description

The Gate 19 Landfill (JPG-015) is located near the installation's west perimeter road boundary, immediately north of the firing line (see Figure 2-8). This 12-acre active landfill includes an asbestos disposal area and a waste pile of construction debris. The area also receives ash from the new incinerator and other non-combustible trash. Between 1960 and 1980, the site reportedly received 1,000 to 10,000 gallons of TCE and paint, red lead paint and methylene chloride/polyurethane residues.

Waste Characteristics

Waste received and deposited included undocumented amounts of asbestos (which is double-bagged and buried to reduce risk of exposure), metal, wire, incinerator ash, red lead paint, TCE, methylene chloride and polyurethane residues. Contaminants of concern are primarily solvents and metals.

Environmental Considerations

Soil contamination as a result of improper disposal practices of solvents and paint residues may be present. Monitoring wells placed along JPG's westernmost boundary during a past RI have been sampled regularly. Groundwater flow moves toward the west-northwest at approximately 15 feet per year (ESE, 1988), which could result in migration of contaminants to off-site drinking water supplies.

Monitoring History

An RI/FS was previously conducted at the Gate 19 Landfill site by Environmental Science and Engineering (ESE, 1989). During this investigation, 12 groundwater monitoring wells were installed to monitor any potential migration of contaminants from the Landfill (see Figure 2-9). Prior to the ESE investigation, eight monitoring wells had been installed at the site. Analytical data from the RI/FS indicate that groundwater contamination in the vicinity of the Gate 19 Landfill is insignificant or nonexistent (analytical results are summarized in Table 2-3 and included in Appendix C). VOCs detected during the soil gas investigation are believed to be small localized spills or discharges that have not migrated from the soil into the groundwater. Given the low hydraulic conductivity of the Glacial Till (5.3×10^{-5} ft/min) and the absence of a consistent, dependable groundwater resource, the slow leaching of VOCs from the vadose zone will probably not have a significant impact on the groundwater quality. Monitor wells downgradient of the landfill along the installation's western perimeter are placed such that any contaminant plume originating from the Landfill that might potentially migrate offpost would be detected; no such plume has been detected. (ESE, 1989)

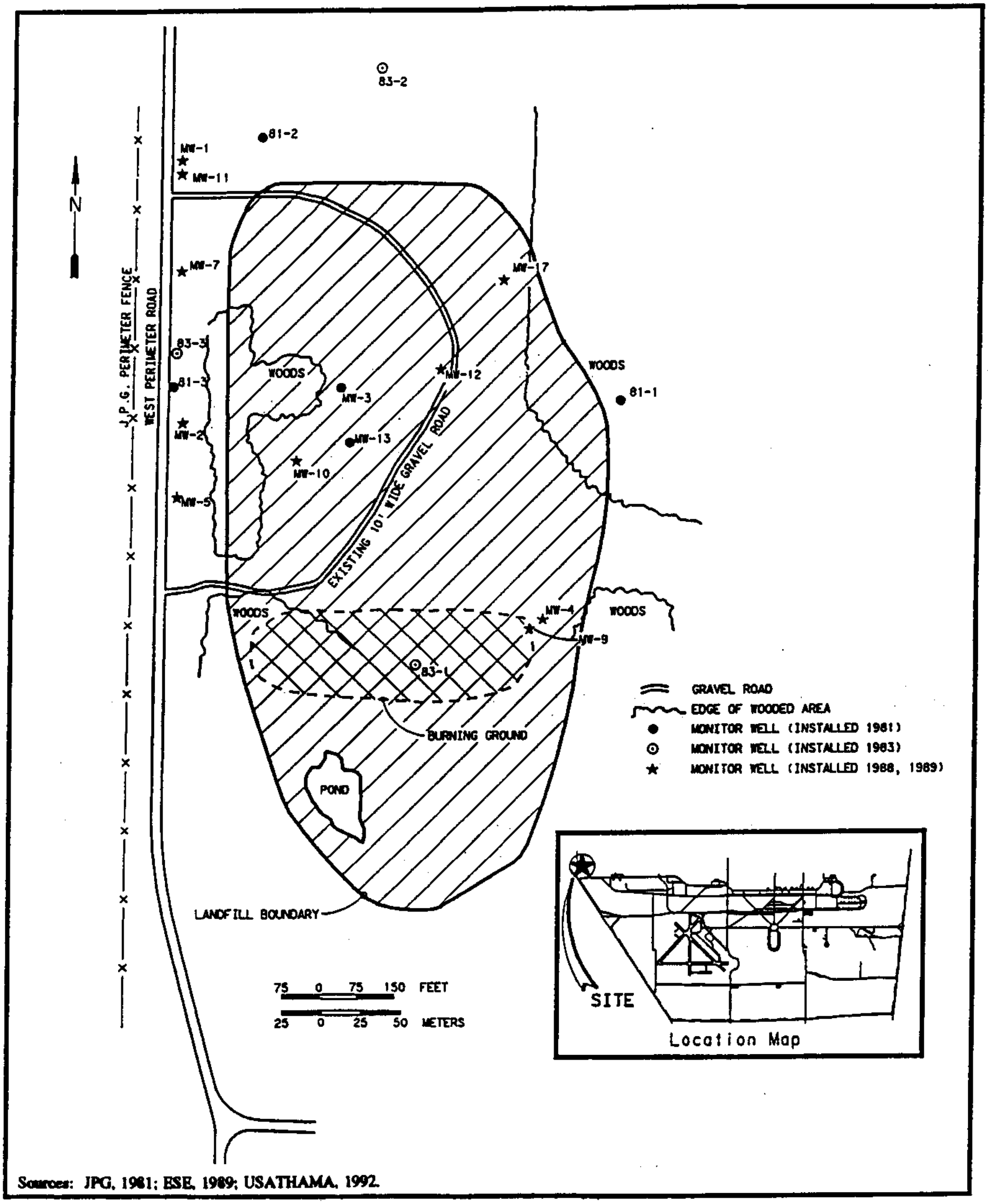


FIGURE 2-9 LOCATION MAP
Gate 19 Landfill
Groundwater Monitoring Wells

Table 2-3

Summary of Significant Analytical Results at Gate 19 and Building 279 Monitoring Wells

Detected Compound	MW-07[a]	MW-09[a]	MW-17[a]	MW-15[a]	MW-05[b]	MW-15[b]	MCL*	RMCL
ACET	--	--	--	--	27	--	--	--
B2EHP	16	8.9	29	--	--	--	--	--
11DCLE	--	--	--	3,800	--	5,400	--	--
11DCE	--	--	--	11,000	--	--	7^+	7
MEC6H5	--	--	--	920	--	870	--	2,000
111TCE	--	--	--	>100,000	--	210,000	200^+	200
112TCE	--	--	--	>200	--	--	--	--
TRCLE	--	--	--	5,100	--	5,100	5^+	0

Note: All concentrations in ug/L

Source: ESE, 1989

* = EPA, 1986, Federal Drinking Waster Standards
\+ = Proposed Value
a = July 1988
b = October 1988

2.2.1.11 Ordnance Disposal Site

Description

This disposal site (JPG-016) is a 35 feet x 12 feet unlined pond, located north of the firing line, at "C" and Morgan Roads. This unit was used for the disposal of munition-related components, including chemical explosives, collected during clean-up operations at the JPG ranges.

Waste Characteristics

Suspected contaminants at the Ordnance Disposal Site include metals and explosives. The amount of material disposed of at this site is undocumented.

Environmental Considerations

The physical hazard that the shells represent is the most significant concern; the potential for these shells to detonate is unknown.

Potential contamination to the surrounding soils and water may occur by leaching of lead, chrome, TNT and DNT.

Monitoring History

No environmental sampling has occurred at this site.

2.2.1.12 Abandoned Landfill

Description

The abandoned landfill (JPG-017), located just off B Road, is of unknown depth. The landfill was used from the early 1960s to 1981 for the burial of inert munition-related materials from firing range and testing activities. Buried wastes and water-filled pits containing inert shells make up this 8-acre site. Metal plates have been placed over sections of the landfill as truck turnarounds. The landfill is overgrown and the limits, depth and amount of cover of the landfill are undeterminable.

Waste Characteristics

Metals and explosive residues are the contaminants of concern at this landfill. The amounts and types of wastes buried in this landfill are undocumented.

Environmental Considerations

The metal parts may contain explosives or other hazardous constituents which can migrate over time. Groundwater in this area is shallow and may represent a release pathway to the environment. (Ebasco, 1990)

Monitoring History

No analytical information is available for this landfill.

2.2.1.13 Sediment Bottom Munitions Test Pond

Description

This site is a water-filled, unlined munitions test pond, which was used for the testing of proximity fuses and the performance of munitions in water. The unit covers approximately 100 yards by 200 yards and is located north of the firing line (see Figure 2-1). On the western side of the pond is a dam, which is being washed out at its northern end.

Waste Characteristics

The Pond probably contains an unidentified amount of munition-related materials. Possible contaminants include heavy metals, such as lead and chromium, explosive residues, herbicides, and potential unexploded ordnance.

Environmental Characteristics

Since the Pond is unlined, leaching of the contaminants to the groundwater is of potential concern.

Monitoring History

No environmental sampling information is available.

2.2.1.14 Open Detonation Area (JPG-023)

Description

This is a 12.5-acre thermal treatment unit located in the north central portion of the facility, north of Graham Creek and west of Bombfield Road, near Shonk Farm (which is just south of the bomb field, and on top of a hill). The site operates under RCRA Interim Status for open burning and aboveground detonation. The area is an open field and consists of an open burning cage approximately 5 feet x 25 feet x 6 feet, with 1-inch heavy steel mesh. Open detonation operations occur approximately 10 times per year. JPG uses the open burning cage to dispose of spent or unusable fuses, detonators, primers, and grenades. Debris on the ground consists of inert projectiles and metal fragments. (Ebasco, 1990)

Waste Characteristics

Residual waste products resulting from the detonation consist of undocumented amounts of ash, fused or unfused ammunition and scrap metal casings and fragments. Also present are propellants from the above devices and a small amount of actual explosive.

Environmental Characteristics

Groundwater is the migration pathway of concern at this site. The groundwater is expected to be approximately 10 to 25 feet below land surface in this area. The migration and dispersal characteristics of the materials present vary with soil conditions and the solubility of the waste material.

Due to the burning area being located on top of a hill, seeps slope toward Big Graham Creek. If these seeps are contaminated, the surface water migration pathway also would be of concern.

Monitoring History

No environmental sampling was available for review.

2.2.1.15 Solvent Pits

Description

Buildings 602, 617 and 279 are all ammunition-assembly plants. Buildings 617 and 279 are inactive. The three solvent disposal pits (JPG-027, JPG-028, and JPG-029) are located immediately adjacent to the buildings. The pits are cobble-lined solvent pits, each measuring nine square feet in area and four feet deep. (See Figures 2-10, 2-11 and 2-12) These pits were used from 1970 to 1978 for the routine dumping of spent solvents and degreasers, including TCE used during maintenance and sonic cleaning of gauges. This practice is no longer utilized.

Waste Characteristics

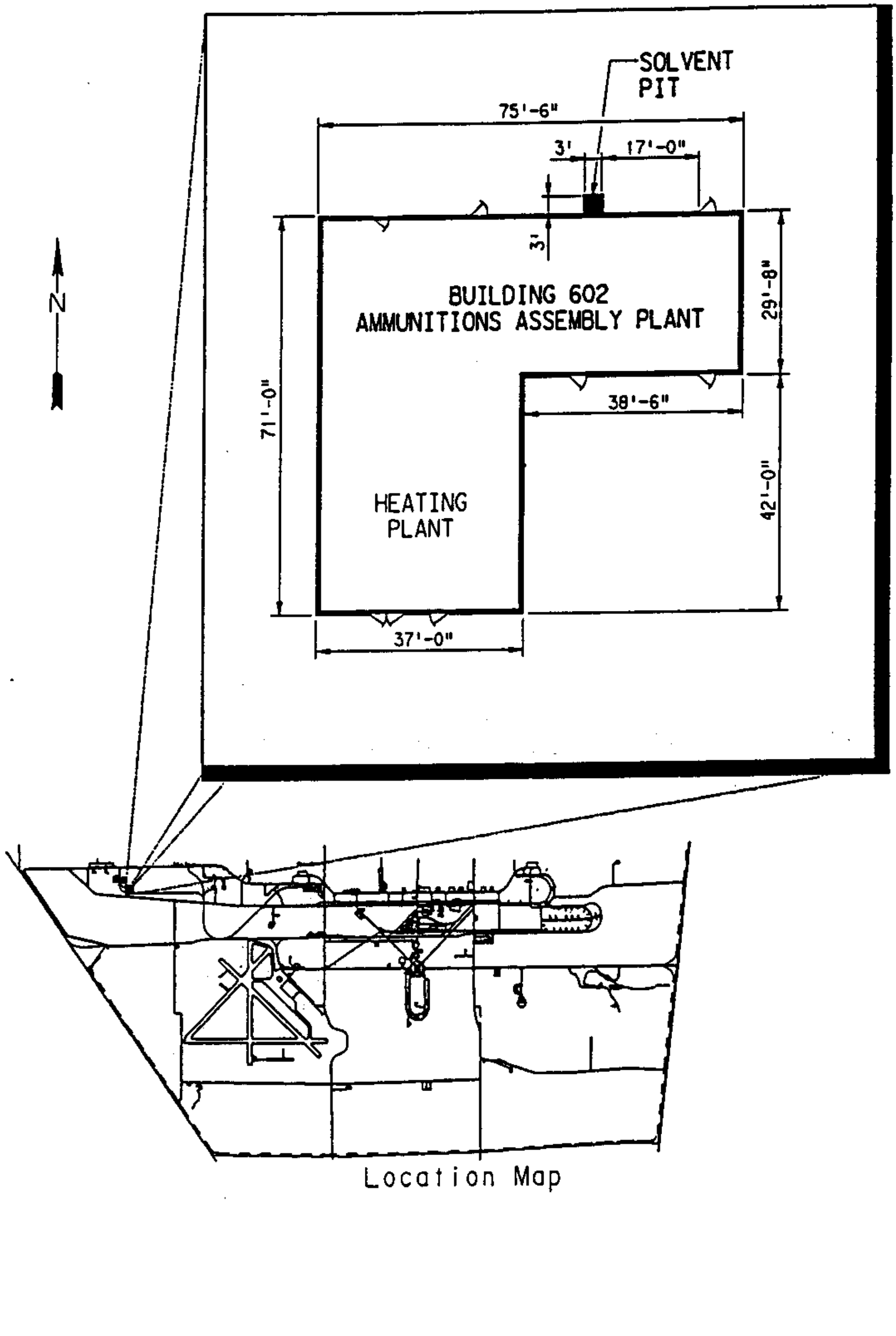
It is estimated that from four gallons to 500 gallons of TCE were disposed of in these pits. Other unknown solvents and degreasers were likely disposed of in the pits.

Environmental Considerations

Analytical results from soil samples indicate elevated levels of VOCs. The key environmental concern is the migration of contaminants to the shallow groundwater table, which occurs at approximately 20 to 25 feet in this area. The rate of groundwater flow in the Glacial Till was calculated to be approximately 3.5 ft/yr to the south. At this rate, and at the estimated quantities, it is possible that most of the solvents disposed of at the Bldg. 279 disposal pit are localized in the vicinity of the area.

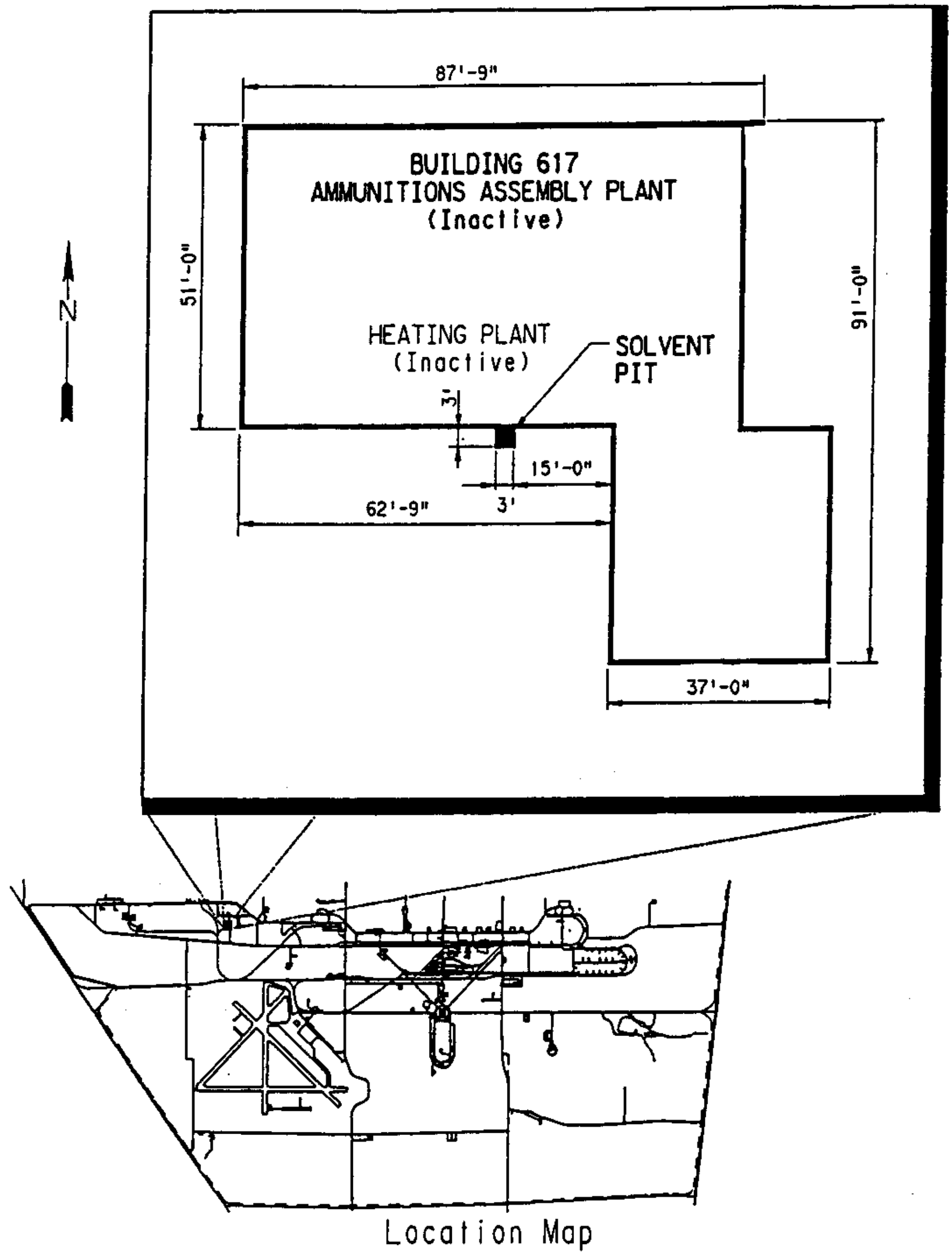
Monitoring History

Remedial investigations were conducted at the three sites. These investigations consisted of soil-gas surveys, soil sampling, and groundwater sampling (Building 279 only). Results of the soil-gas survey indicated VOC contamination at all three locations. Three groundwater monitoring wells were installed at Building 279 to determine if groundwater contamination exists at the site. Of the three monitoring wells, only water samples from one well, MW15 contained elevated levels of VOCs. This well is located within 10 feet of the disposal pit. Contaminants detected in MW15 include 1,1-dichloroethene at 3,800 ug/L (maximum contaminant level [MCL] is 7 ug/L), 1,1,1-trichloroethane at 210,000 ug/L (MCL 200 ug/L) and trichloroethene at 5,100 ug/L (MCL 5 ug/L). Also toluene and 1,1,2-trichloroethane were detected but not above MCLs. The absence of contaminants in the other two wells indicate that the contamination has not migrated far horizontally from the source area. (Chem Nuclear, 1992.)



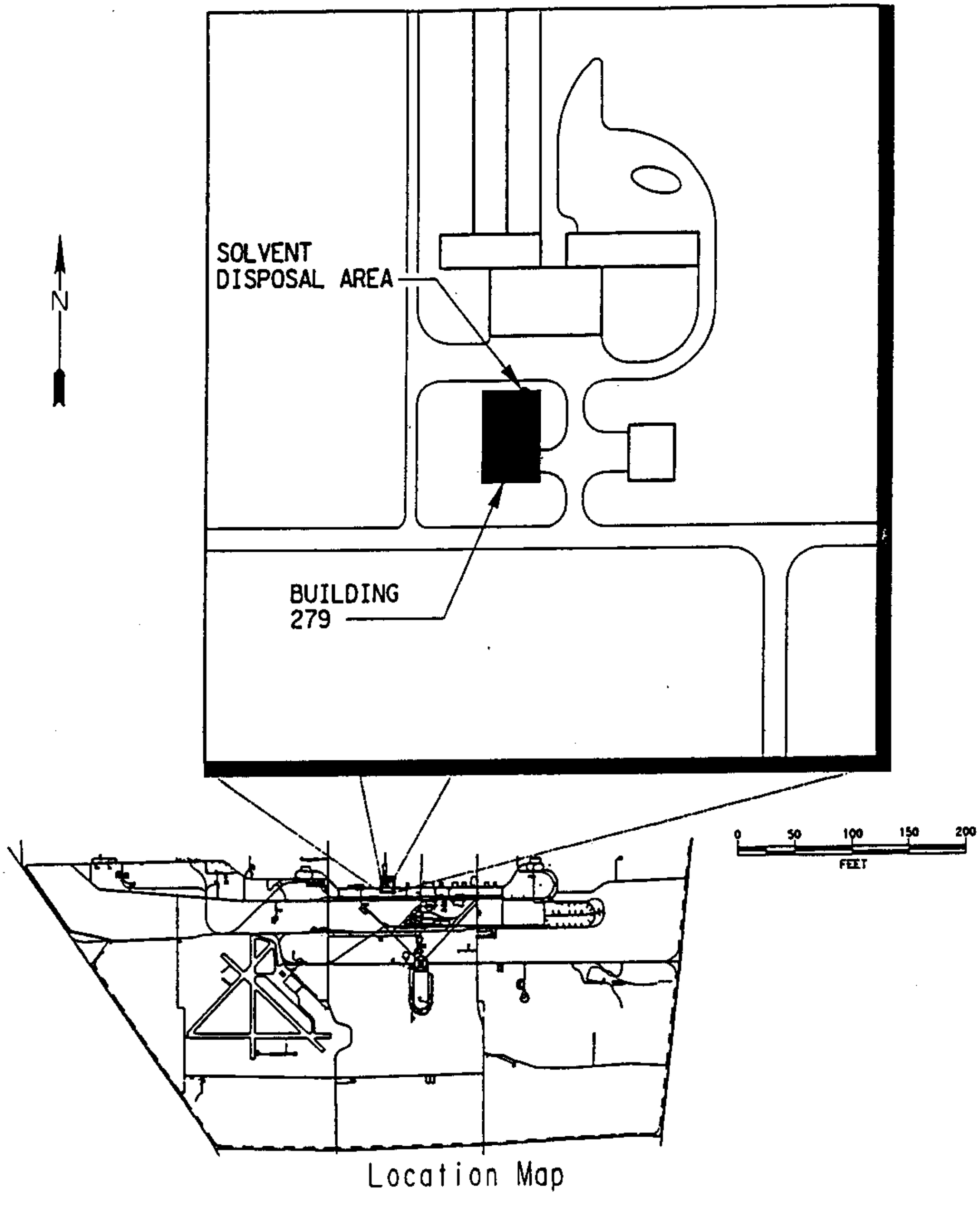
Source: USATHAMA, 1992.

FIGURE 2-10 LOCATION MAP
Solvent Pit, Building 602



Source: USATHAMA, 1992.

FIGURE 2-11 LOCATION MAP
Solvent Pit, Building 617



Source: USATHAMA, 1992.

FIGURE 2-12 LOCATION MAP
Solvent Pit, Building 279

2.2.1.16 Former Fire Training Pit

Description

The Former Fire Training Pit (JPG-030) lies at the intersection of the north/south runway and the southeast/northeast runway at the abandoned airfield (see Figure 2-13). This 200 square ft. (20 x 10 ft.), by 2 ft. deep surface depression was formerly used for fire training activities in which POL-soaked lumber was set on fire and the fires put out.

Waste Characteristics

Wood debris was routinely soaked with diesel and other petroleum products and ignited as part of the fire training program. The amounts of wastes generated is undocumented.

Environmental Considerations

The area is overgrown and there was approximately 2 ft. of standing water in the surface depression.

The environmental concern here is that heavy metals (primarily lead), unburnt petroleum products and possibly semi-volatile organic compounds (including PCBs) could have entered the surface and subsurface soils. Unburnt petroleum products could migrate to the ground water (approximately 20 feet below surface). In addition, contaminants could be transported during the surface water runoff, especially when heavy rains cause the training pit to overflow. (Ebasco, 1990)

Monitoring History

No environmental sampling has occurred to date; however, surface and subsurface soil, and groundwater sampling is planned during an upcoming RI.

2.2.1.17 Temporary Storage

JPG-032 and JPG-033 are areas reportedly used for satellite storage. No information is currently available on the size of the storage areas, the type of materials stored or the potential contaminated release mechanisms.

JPG-034 is a large brick weapons maintenance facility used for the repairing and refurbishing of large gun tubes and other weapons or weapon parts. Since January 1990, waste solvents and oils have been placed in sattelite storage immediately outside this building in conforming drums and containers until they are picked up by a private contractor for proper disposal. Before January 1990, waste solvents, paints and oils were stored in drums and containers and placed in a metal shed until they were picked up by the DRMO contractor.

JPG-035 (Building 186) is a large warehouse used as a maintenance garage for repairing heavy equipment and vehicles. This building is also used for satellite storage of waste materials. This storage area is partially bermed. (Ebasco, 1990)

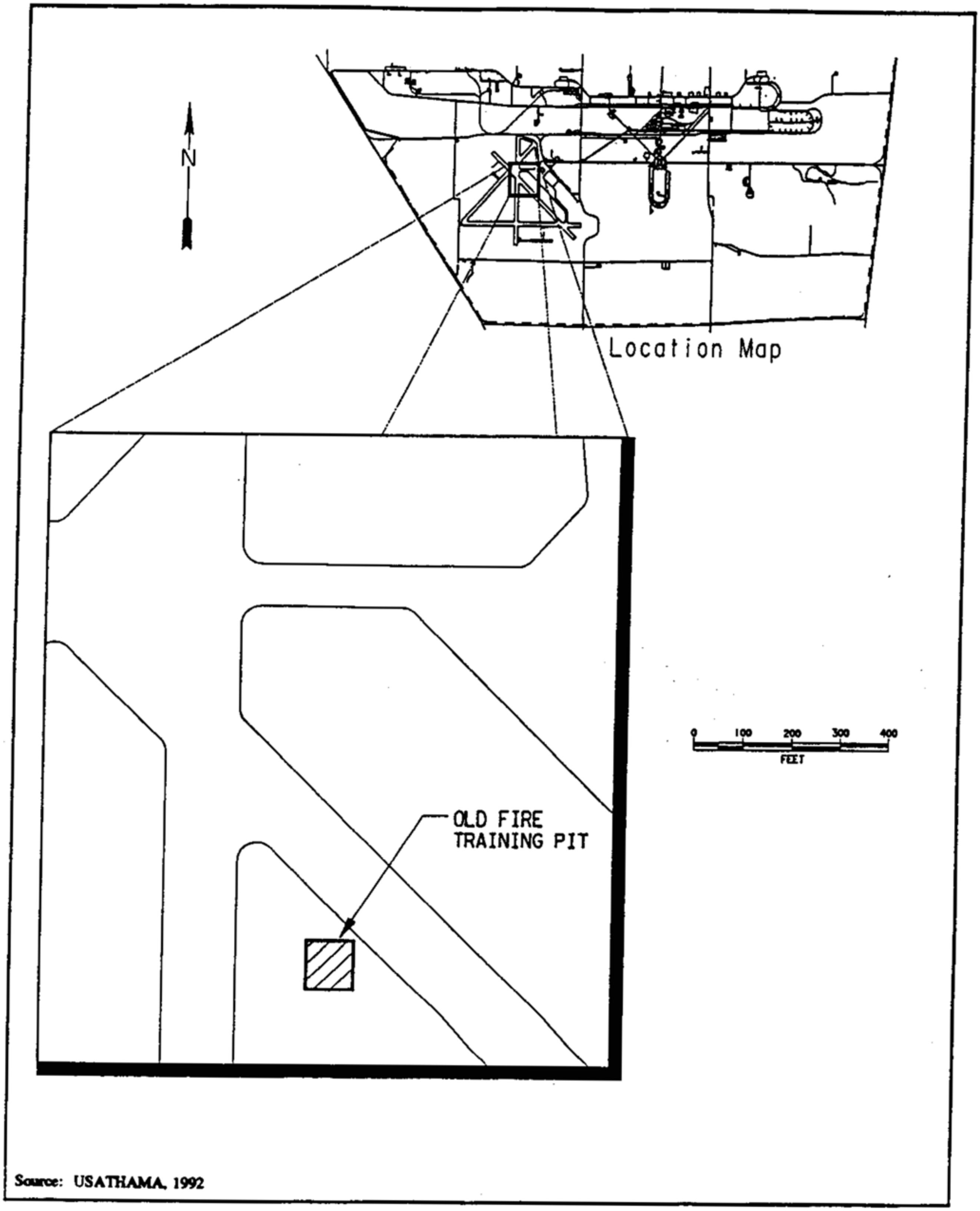


FIGURE 2-13 LOCATION MAP
Old Fire Training Pit

Waste Characteristics

Wastes stored at JPG-034 include waste solvents, paints and oils. The amounts of wastes collected are undocumented.

Wastes stored at JPG-035 include Type II Stodard Solvent, No. 1 fuel oil. Used batteries and empty drums are temporarily stored outside the building on pallets until they are picked up and properly disposed of off-site.

Environmental Considerations

Obvious areas of stained soils exist around storage areas JPG-034 and JPG-035.

Monitoring History

No environmental sampling information is currently available.

2.2.1.18 Hazardous Waste Storage Area

Description

Building (JPG-036) has been used since 1980 as the 90-day hazardous waste storage area for JPG (see Figure 2-16). The building is 25 feet by 30 feet with a concrete floor, metal walls, and an asphalt roof. No evidence of spills, run-on or run-off were observed during the site visit.

Waste Characteristics

All hazardous waste generated at JPG is transferred to this storage area prior to transferring to Defense Reutilization and Marketing Office (DRMO). Waste is stored in proper containers and the accumulation date is clearly marked on each container. No evidence of release was observed. Table 2-4 shows the RCRA number and amount of each waste disposed in 1991. When converted to gallons, JPG generates approximately 1,800 gallons of hazardous waste each year.

Environmental Considerations

The potential for release of wastes is low. However, no curbing containment exists at the door of the building and should a spill occur, it would not be contained.

Monitoring History

No environmental sampling has been performed at this source, however, this source is included in the current RI/FS investigation.

Table 2-4
JPG Hazardous Waste Summary for 1991

Waste	EPA Number	Amount Disposed
Silver Nitrate	D011/D001	4 pounds
Sulfuric Acid & Sodium Dichromate	D007/D002	90 gallons
Waste Paint	D008/F003/F005 D001/D007	50 gallons
SBI Water Treatment (Na_2 Cr_4)	D007	3 pounds
M-Prep Conditioner (Flammable Liquid)	D001	3 ounces
Tyme Cold Parts Cleaner (Xylene, Phenol)	D001	40 pounds
M-Line Catalyst (Flammable Liquid)	D001	1 ounce
Gagekote (Flammable Liquid)	D001	9 ounces
M-Prep Neutralizer (Flammable Liquid)	D001	2 ounces
CARC Paint	D001	275 gallons
Stoddard Solvents	D001	275 gallons
Paint Chips	D008	30 gallons
Mercury	D009	1 pound
Hydrochloric Acid	D002	1 gallon
Ammonium Hydroxide	D002	1 gallon
10% Barium Chloride	D005	1 quart
Aqueous Hydrochloric Acid	D002	2 quarts
Phenophtaline Indicator	D001	3-1 pt. containers
Residue Ash	D030	240 gallons
Waste Paint Related Material	D008/D001/D007	445 gallons
Waste Petroleum Naphtha Distillate	D001	5 pounds
Potassium Permanganate	D001	1 pound
Sodium Hydroxide	D002	5-1 gallon containers
Potassium Hydroxide Mixture	D002	12-1 pt. containers
Sulphuric Acid Mixture	D002	19-1 qt. containers
Acetic Acid Mixture	D002	23-1 qt. containers
R-3000 Kodak (Alcohol)	D001/F001	6-1 qt. containers
Alcohol Mixture	D001/F001	12-1 qt. containers
Kodak R-3000	D001/F001	6-1 qt. containers
Waste Petroleum Naphtha	D001	2363 lbs.

2.2.1.19 Depleted Uranium Impact Area

Description

Dense, depleted uranium penetrators are fired from the firing line north into the depleted uranium impact area (DUIA) (see Figure 2-1). This three square-mile area has been impacted by approximately 93,000 kilograms (kgs) of these penetrators. Depleted uranium (DU) has been used in weapons testing of 105-mm and 120-mm tank ammunition since March 1984, under U.S. Nuclear Regulatory Commission (NRC) License No. SUB 1435, in conjunction with JPG Radiation Office (RPO).

The firing of this type of round has cleared a narrow strip of land, which was already contaminated with exploded ordnance (EO). DU rounds are fired against a canvas target, therefore the rounds do not burn or aerosolize. The majority of DU rounds remain intact upon firing, though some do break into large pieces on impact (Ebasco, 1990). A semi-annual recovery program has retrieved approximately 23,000 kgs, leaving approximately 70,000 kgs unrecovered. (Herring, 1993)

Waste Characteristics

The penetrators are comprised of a dense uranium body, a nose cone, and stabilization fins. On impact, the penetrators tend to skip and ricochet allowing them to travel a considerable distance downrange, even after impact.

DU consists mostly of U^{238}, an isotope of uranium that is not highly radioactive, and about 0.01% of U^{235}, a radioactive isotope. Soft targets (as opposed to hard targets) are used in the DU impact area to minimize formation of radioactive aerosols from impact.

Environmental Considerations

The facility attempts to recover the DU projectiles, and estimates about 25 percent are recovered. The potential exists for low-level radiation contamination. However, according to the facility, no elevated radiation levels have been detected in the flora, fauna, or surface waters. Presently, the groundwater in the vicinity is not contaminated with radioactivity beyond regulated levels.

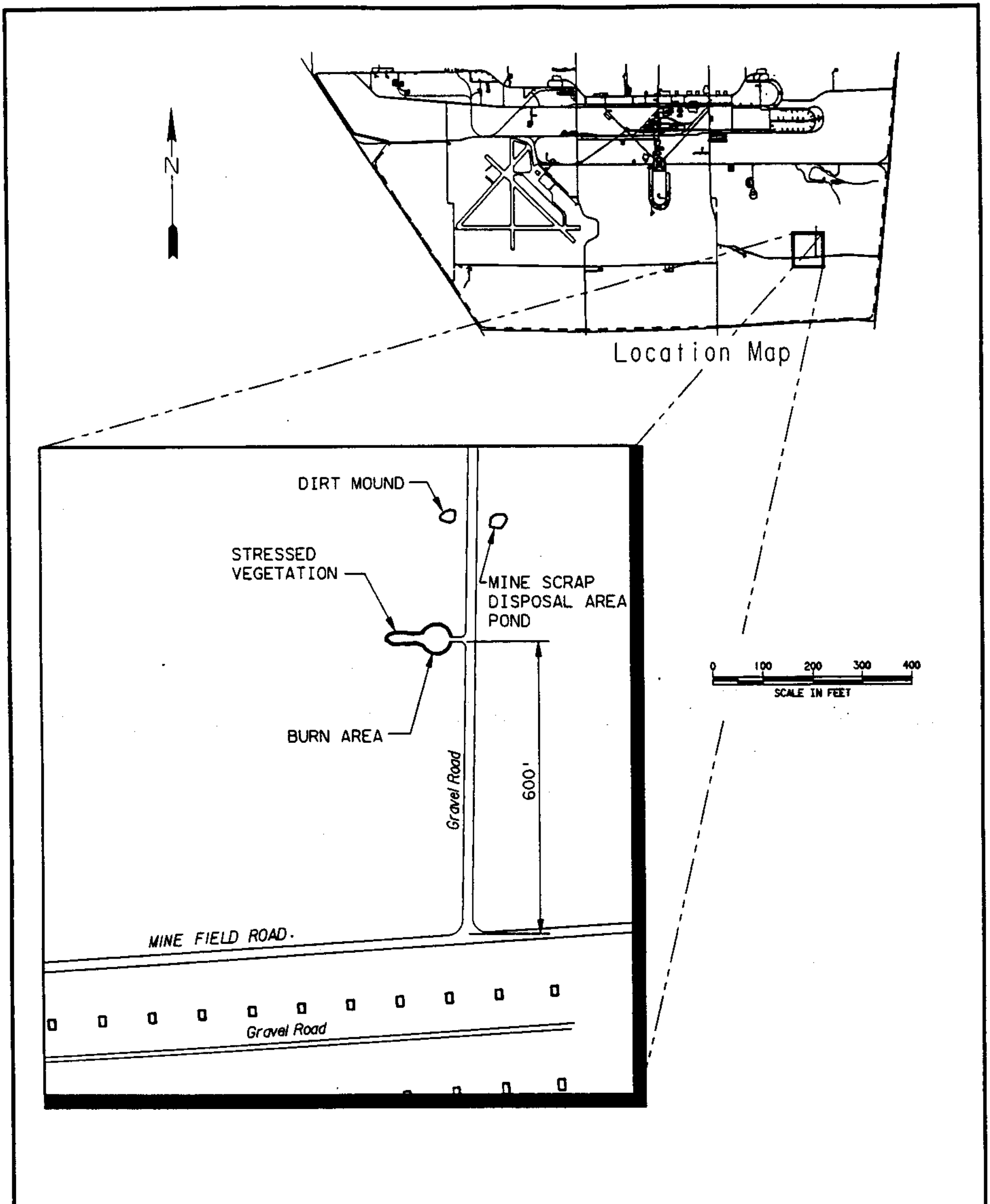
Monitoring History

Approximately every six months, sampling of monitoring wells, soils and sediment for radiation contamination is performed. Thus far no radioactive contamination has been detected; however, two explosives, HMX and RDX, were detected in MW2 during the May 1992 sampling and analysis round. HMX was detected at 0.779 ug/L and RDX at 0.452 ug/L. (USATHAMA, 1992)

2.2.1.20 Former Gator Mine Burn Area

Description

This former burn area and associated pond is located in the southeastern portion of the facility, about 600 feet north of Mine Field Road along unnamed gravel road which leads north of the mine test area. (See Figure 2-14.) Waste from the Gator Mine Test Area is transported and stored here until a burn occurs. The ground is stained black, and a pile of blackened debris is discernable. This area covers approximately



Source: USAEC, 1993.

FIGURE 2-14 LOCATION MAP
Gator Mine Burn Area

100 square ft. and was reportedly used from 1985 until recently to burn scrap styrofoam and plywood material from the mine test area.

The scrap material was first used as damping material during mine testing prior to disposal. As a result, there is a potential for live detonators and blasting caps to be imbedded in the scrap. Due to this potential, the material cannot be shipped off-site for sale or disposal. The packing material was taken to the open burning area several times per month.

The open burning was conducted under a variance to air pollution regulations granted by Indiana Department of Environmental Management (IDEM). The facility recently began burning the scrap at the New Incinerator upon approval of an application submitted to IDEM in March 1991.

Located east of the burn pile is a small oval-shaped pond of unknown depth.

Waste Characteristics

Scrap wood, wire, plastic, mine pieces, lithium batteries, blasting caps and casing materials are stored and burned here. The wastes and residues potentially contain explosive residues and heavy metals. The amounts of wastes generated are undocumented.

Environmental Considerations

A 1992 analysis of ash samples collected from the burn pile is shown in Table 2-5.

Monitoring History

In March 1992, ash samples from the burn pile were analyzed and the contamination detected is shown in Table 2-5. During an upcoming RI, ash and soil samples from the burn area will be collected and analyzed. Also, a geophysical survey will be performed of the area surrounding the pond.

2.2.1.21 Gator Mine Testing Area

Description

This site is located in the southeastern portion of the facility west of the east perimeter road between Mine Field Road and a tributary to Harbert Creek. It encompasses approximately 220,000 square yards, with 26 mine test pits placed in two long east-west rows parallel to Mine Field Road (see Figure 2-15). Each pit consists of a steel box with open bottoms and removable tops. Concrete walls surround the steel boxes which are periodically used to test the performance of explosive mines. The debris is cleaned from the pits after each use.

Waste Characteristics

The amounts of wastes present at the test area and the burn pile are undocumented. The materials at the burn pile constitute most of the debris removed from the Gator Mine pits. The material is stored until the pile is large enough to burn. Suspected contaminants include explosive residues and heavy metals.

Table 2-5
Gator Mine Sample Analysis

Parameter	Results
Total Reacted Cyanide	0.10 mg/kg
Total Reacted Sulfide	0.49 mg/kg
Ignitability (Flash Point)	>210. deg. F
pH (w)	10.59
Arsenic, total	52.8 mg/kg
Barium, total	84.5 mg/kg
Cadmium, total	39.8 mg/kg
Chromium, total	39.8 mg/kg
Lead, total	4,080. mg/kg
Mercury, total	0.1 mg/kg
Selenium, total	<1.0 mg/kg
Silver, total	19.9 mg/kg

Source: Kearney, 1992

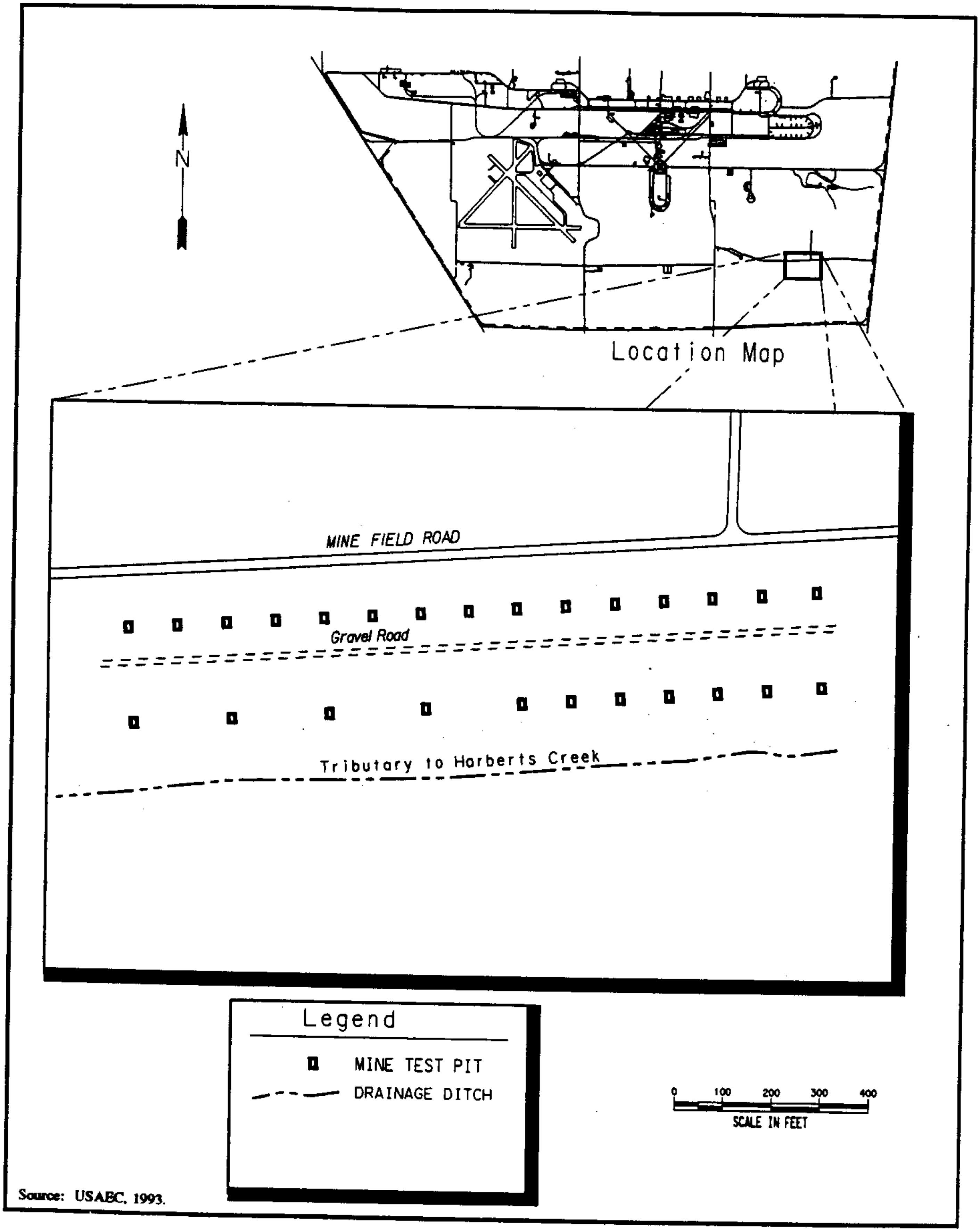


FIGURE 2-15 LOCATION MAP
Gator Mine Test Area

Environmental Characteristics

Precipitation can enter the steel boxes and exit via drain pipes in the bottom, which empty into a drainage swale that leads to Harbert Creek. The area is a concern because of the potential for residual explosives and potential release of lithium to surface water and sediments. Mercury may also be a concern as both lithium and mercury are used in the manufacture of some explosives.

Monitoring History

Silver has been detected in the water and sediment of Harbert Creek. The potential sources of the silver are the wastewater treatment plant discharge, runoff from sludge application areas, and the Gator Mine Test Area. Further investigation is underway.

2.2.1.22 Firing Range Impact Area

Description

The Firing Range Impact Area is located throughout the entire JPG facility, and consists of the area north of the Firing line (approximately 50,000 acres). Over 50 designated test-fired munitions impact or target areas encompass 8,600 acres. In addition, the entire area north of the firing line can be considered impact area due to the nature of testing munitions and projectiles. There has been an estimated 23 million rounds fired into the area since 1941 and an estimated 1.4 million rounds of unexploded ordnance (UXO) may exist in the area.

Waste Characteristics

Potential contaminants include metals, propellants, mines, ammunition, cartridge cases, projectiles, mortar rounds, grenades, bombs and rockets.

The test-fired munitions and unexploded ordnance are not classified as solid waste as long as JPG remains operational.

Environmental Considerations

In addition to the potential harm which may be caused by coming in contact with UXO, leaking shell cases may release chemicals such as white phosphorous, metals, mercury, and explosives.

Monitoring History

No environmental sampling has occurred.

2.3 ENVIRONMENTAL/REGIONAL SETTING

2.3.1 Demography

The areas surrounding JPG are rural in nature with large agricultural and smaller forested areas. JPG is bisected by three different counties: Jefferson, Ripley and Jennings. The approximate population of these counties is 78,074 (Table 2-6) with 27,902 housing units (USACOE).

The total authorized personnel at JPG is 326. Of these personnel, 3 are military and 323 are civilian. In addition there are approximately 33 military dependents and 791 civilian dependents. It has been determined that all military personnel and their dependents reside off-post, except for the 24 residents who reside in on-post housing. All civilian personnel and their dependents reside off-post (USACOE).

2.3.2 Land Use

Prior to its purchase, the major use of JPG property was for agriculture. Of the current 55,264 acres at JPG only three percent is improved. The land north of the firing line is used primarily for operations testing and the land south of the firing line contains the cantonment area, operations, operational support and administrative support.

JPG covers parts of Jennings, Ripley, and Jefferson counties with the primary land use in these counties being either agricultural or woodland, see Table 2-7. Sparse strip residential and agricultural development is established along major roads and highways. The nearest communities to JPG are small and unincorporated. Madison lies approximately 8 miles south of the installation.

There are no DOD Dependent Schools on the post. All dependents attend school at one of 22 districts in southeast Indiana or northern Kentucky. Primarily they attend Madison Consolidated, Southwestern Consolidated or South Ripley County districts, which are outside the 4-mile study area.

The northernmost areas of JPG are used for both hunting and fishing. A state lottery system is used to allow access to JPG for deer and turkey hunting. Picnic areas, ponds, lakes and streams are abundant and provide additional recreational areas. Camping is available at Krueger Lake in the southern portion of JPG. The Old Timbers Lodge area also provides camping and boat ramps.

Clifty Falls State Park lies approximately 10 miles south of JPG along the Ohio River.

Table 2-6

Population Data

County	Population	Persons per Square Mile	Persons per Household
Jefferson	29,797	82.4	2.57
Ripley	24,616	55.1	2.76
Jennings	23,661	62.7	2.75

Distance Category	Gate 19 Landfill	DUIA	Cantonment Area
On Source	0	0	0
0 - 1/4	0	0	0
1/4 - 1/2	0	0	48
1/2 - 1	40	0	278
1 - 2	87	0	--
2 - 3	54	150	--
3 - 4	167	210	--

Table 2-7
Land Uses in the JPG Vicinity

Counties	Square Miles	JPG Acres	Urban/ Acres	% Developed	% Agricultural	% Forest	% JPG	% Water
Jefferson	366	19,805	234,240	4	61	25	9	1
Ripley	442	27,048	282,880	4	65	20	10	1
Jennings	377	8,375	241,280	3	76	16	4	1

Source: Environmental Impact Statement, Louisville COE

2.3.3 Sensitive Environments

Flora

Prior to DOD ownership in 1941, the JPG property was primarily farmland where sorghum, tobacco, corn and wheat were raised. Clearing the land and application of pesticides and herbicides, including Bromacil and 2-4-D, were used to alter the initial cover. Burning and strip-planting are employed to manage the land and maintain functional areas.

Of the total acreage of JPG, 24,760 acreage are forested, and 7,289 acres are covered with brush. In a recent study conducted by the Indiana Department of Natural Resources, 29 species of rare plants were identified on the installation. A listing of these plants and their classification is included in Appendix D.

Fauna

Fish surveys of JPG surface water indicate there are approximately 28 species of freshwater fish on JPG. Stocking occurs on several of these waters, and the reported production rate ranges from 100 to 300 pounds per acre. No federal or state endangered or threatened fish species have been identified.

Several species of mammals, birds, reptiles and amphibians exist throughout the facility. Controlled hunting of squirrel, rabbit, turkey and deer is permitted in approximately 30,000 acres of the facility. Hunters must complete a Hunters Safety Course and be aware of the hazards that may exist in the area. All Hunters must enter through Gate #1 and be cleared through the security personnel. The controlled hunting program has been in service since 1958. Since that time an annual kill rate for white-tailed deer is approximately 700-860.

Five federally listed and twenty-two state listed endangered species may exist within the JPG facility and the immediate vicinity. The exact number of species is currently under investigation by the U.S. Fish and Wildlife Service (USFWS) and final documentation is scheduled for July 1993. On June 28, 1993, USFWS captured two Indiana Bats (one a pregnant female) on Graham Creek. Tables 2-8 and 2-9 lists the species which may occur in the study area.

Wetlands

Six categories of wetlands have been identified within JPG. These are Palustrine Forested (PFO); Palustrine Scrub-Shrub (PCC); Palustrine Emergent (PEM); Palustrine Unconsolidated Bottom (PUB); Riverine (R); and Lacustrine (L), (Louisville COE 1991). Total acreage of wetlands on JPG has been calculated by the General Electric Company's classification and enhancement of landsat data. This review estimated 6,376 wetland acres cover JPG. Interpretation of National Wetland Inventory Maps, which are not yet finalized, estimated 2,906 acres on JPG site. The validity of both sets of data could not be field checked due to the UXO hazards at JPG. Approximately 68.7 linear miles of wetlands are associated with the 15-mile downstream study area of the streams on JPG. (Louisville COE 1991)

Table 2-8
Federally Endangered Animal Species

Common Names	Scientific Name
American Peregrine Falcon	Falco Peregrinus
Artic Peregrine Falcon	Falco Peregrinue Tundrius
Bald Eagle	Haliaeetus Leucocephalus
Kirtland's Warbler	Dendroica Kirtlandii
Indiana Bat	Myotis Sodalis

Table 2-9
State Endangered Animal Species

Common Name	Scientific name
American Peregrine Falcon	Falco Peregrinus
Artic Peregrine Falcon	Falco Peregrinue Tundrius
Bald Eagle	Haliaeetus Leucocephalus
Kirtland's Warbler	Dendroica Kirtlandii
Indiana Bat	Myotis Sodalis
Osprey	Pandoin Haliaetus
Bachman's Sparrow	Almonphila Aeativalis
American Bitten	Botaurus Lengtinous
Black-Crowned Night Heron	Nycticoraz Nycticorax
Yellow-Crowned Night Heron	Nyctanassa Violacea
Great Egret	Casmerodius Albus
King Rail	Rallus Elegans
Northern Harrier	Circus Cyaneus
Common Barn Owl	Tyto Alba
Short-Eared Owl	Asio Flammeus
Upland Sandpiper	Bartramia Longicauda
Bewick's Wren	Thrinabes Bewickii
Loggerhead Shrike	Lanius Ludovicianua
Golden-Winged Warbler	Vermivora Chrysoptera
Bobcat	Lynx Rufus
Northern Red Salamander	Pseudotriton Ruber
Hellbender	Cryptobranchus Alleganiensis

2.4 HYDROLOGY

2.4.1 Climate

The climate at JPG is mid-continental with frequent changes in temperature and humidity. During the summer, the temperatures average from the mid-70s to 80s (°F). On an average, the temperature exceeds 90°F for 39 days a year. Winter temperatures generally range from 22-35°F. The total annual precipitation is approximately 42-44 inches with nearly 50% occurring during the growing season. On the average, 28 days of the year have precipitation greater than or equal to 0.5 inch. The two-year, 24-hour rainfall in the JPG vicinity is 3.5 inches. The region around JPG is subject to tornadoes and severe thunderstorms.

2.4.2 Overland Drainage

Surface water at JPG consists of six major drainageways which generally flow in a west-southwesterly direction across the installation towards the Ohio River. JPG lies within the White River Basin which is a sub-basin of the Wabash River Basin (a sub-basin of the Ohio River basin). Figure 2-16 shows the major stream drainages at JPG and Figure 2-17 shows the location of JPG sources to the surface water. The surrounding area is not frequently flooded. At least 10 ponds/lakes are located within the JPG study area. Most of these water bodies are stocked with fish and are used for recreational purposes.

The southern portion of JPG is drained by Harbert Creek which leaves the installation at the southwest corner. The STP is located on this stream. The main branch of the stream is permanent and is fed by two intermittent tributaries, one of which originates at Krueger Lake. Krueger Lake occupies eight acres of the Harbert Creek drainage basin. A USGS gauging station on Harbert Creek near Madison records an average discharge of 13.0 cubic feet per second (cfs). (USACOE). Middle Fork Creek and its tributaries drain the south central portion of JPG. Big Creek traverses JPG north of Middle Fork Creek and has tributaries originating both on and off the installation. To the north and west of Big Creek is Marble Creek, which originates on JPG.

Little Graham Creek originates off the installation and traverses the north central portion of the installation along with its major tributaries, Horse and Poplar Branch. Big Graham Creek also originates off the installation, traversing JPG nearly parallel to and north of Little Graham Creek. The two major tributaries of Big Graham Creek are Grapevine Branch and Rush Branch which originate on the installation.

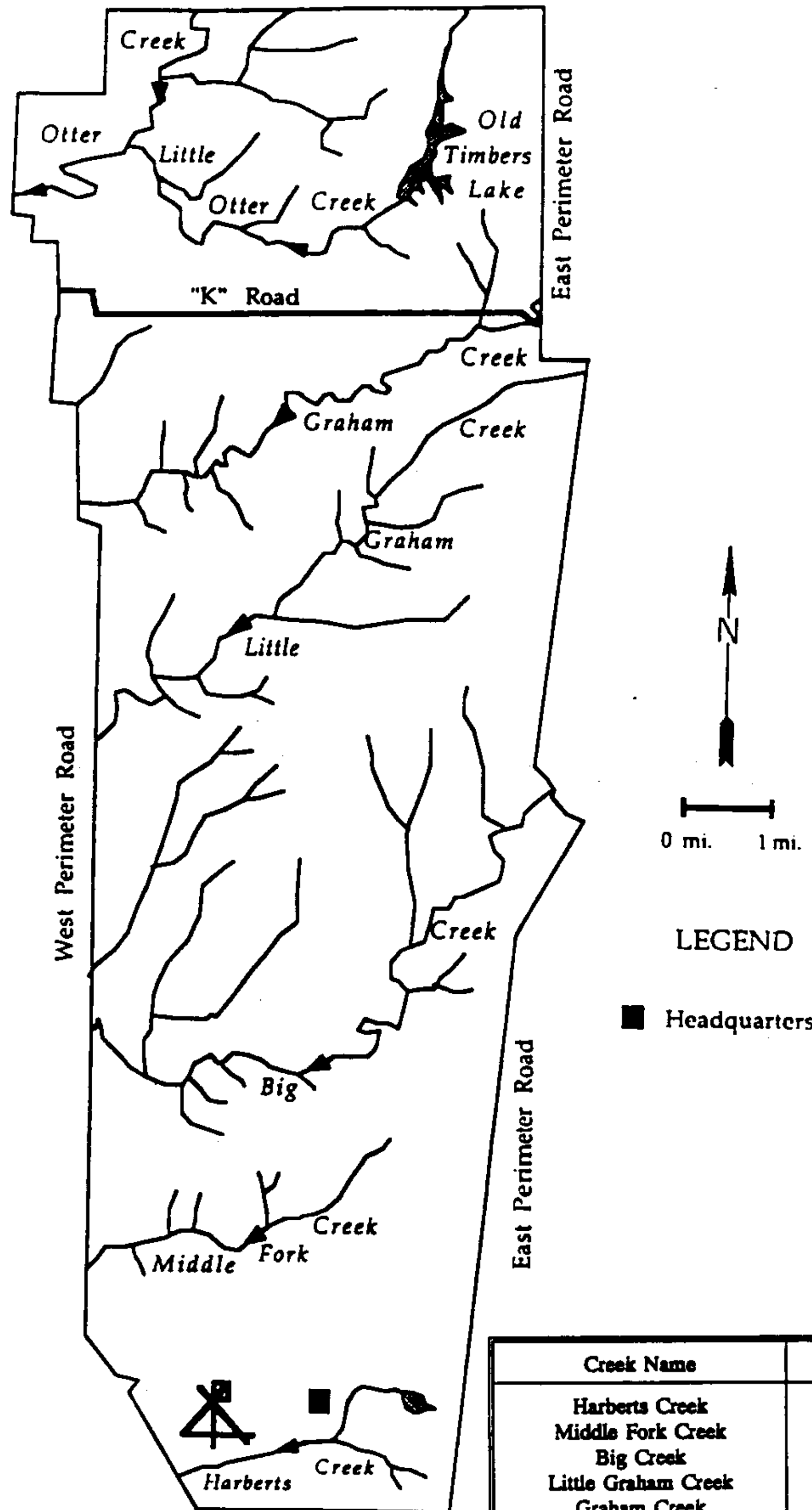
Little Otter Creek, Otter Creek and its tributaries, Falling Timber Branch and Vernon Fork join in the northwestern corner of JPG before exiting the installation at the western boundary. (Chem Nuclear 1992).

There are no officially designated floodplain management areas in the JPG vicinity. According to the Federal Emergency Management Agency, no official hydrologic analysis has been conducted for JPG or nearby areas regarding floodplain delineation and flood hazard boundary designations. JPG is located on an upland plain and is not prone to severe flood potential.

No surface water intakes for potable water supplies are located within a 15-mile reach of JPG.

2.4.3 Potentially Affected Water Bodies

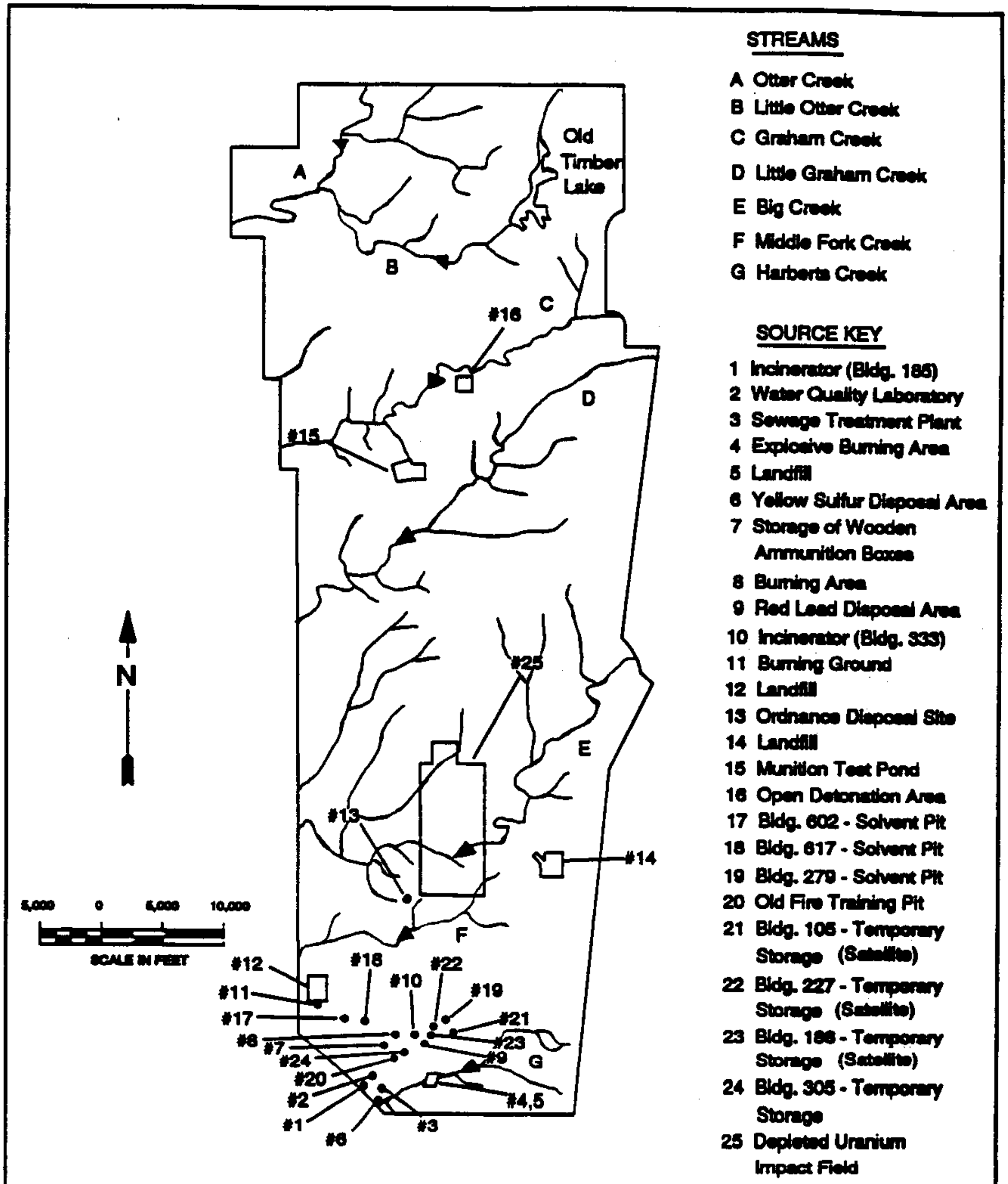
The potential for contaminant release to surface waters on site is minimal. Streams flowing onto JPG have the potential to carry agricultural contaminants (fertilizers and pesticides) from nearby farms onto JPG.



Source: Louisville COE 1992

Creek Name	Area drained
Harberts Creek	6,110
Middle Fork Creek	6,520
Big Creek	11,460
Little Graham Creek	7,760
Graham Creek	5,870
Otter/Little Otter Creek	10,690

FIGURE 2-16
MAJOR STREAM DRAINAGE ON JEFFERSON PROVING GROUND



JEFFERSON PROVING GROUND
MADISON, INDIANA

FIGURE 2-17

SOURCES NEAR SURFACE WATER JEFFERSON PROVING GROUND

Source: [illegible], 1990

In May 1992, a follow-up study was undertaken by USATHAMA with the objective of sampling all streams entering and exiting JPG at the installation boundary. Sample locations are shown on Figure 2-18. Both sediment and aqueous samples were collected and the contaminants analyzed are shown in Appendix C. Only one aqueous sample, EX-4, was not collected, as no water was present during the sampling effort.

The sample analysis results indicate that silver and arsenic were present in stream waters and/or sediments at some of the sampling locations. Silver was detected in both aqueous and sediment samples at location EX-1, the Harbert Creek exit. The concentration in the aqueous sample was 1.38 ug/L and 1.46 ug/g in the sediment. Neither of these exceeds benchmark values, and the levels detected are probably due to on-site photographic effluent being discharged prior to 1980 (USATHAMA 1992). Mercury results were in question after review of the quality control data. Both arsenic and cyanide were detected at various exit sample locations, but the levels detected fall within the normal ranges for indigenous soils of the region. AEHA conducted a study on July 7-11, 1992 to verify whether silver, arsenic and mercury levels in the streams on JPG pose a risk and to validate the previous data. AEHA concluded that silver levels in Harberts Creek are elevated over background levels and borderline ambient water quality criteria (analytical results are included in Appendix C). Silver was detected in two water samples, EX-1 (0.6 ug/L) and EX-1-C (0.4 ug/L). It is suspected that the silver may have leached into the surface water from the Gator Mine Site. Soil and ash samples from the Gator Mine Site showed maximum silver concentrations of 19.9 mg/L. Arsenic was detected in water samples at background levels.
Analysis information from the USATHAMA report is included in Appendix C. Mercury was not detected in any stream water or sediment samples.

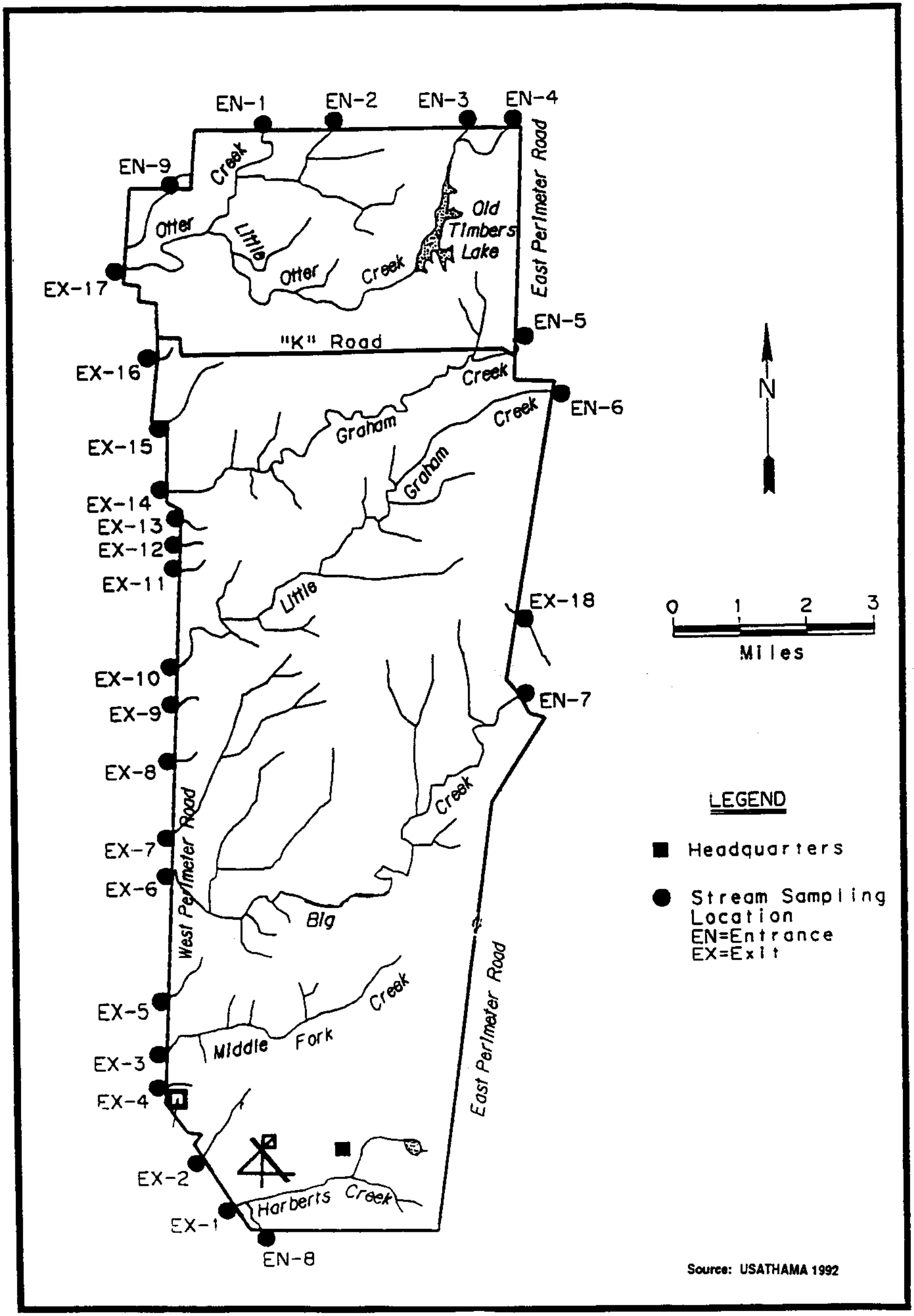


FIGURE 2-18
STREAM SAMPLING LOCATIONS AT JEFFERSON PROVING GROUND

2.5 HYDROGEOLOGY AND SOIL

2.5.1 Aquifer Description

The surface soil and geologic units underlying JPG are described in detail in Appendix E. The geologic units and stratigraphic relationships present beneath JPG are believed to extend without significant change throughout a four mile radius of the JPG boundary. There are no barriers to the flow of groundwater that can be reliably identified within a two mile radius of the site. Semi-confining or confining units may be present, but the horizontal extent and integrity of these units is not known. The storage and movement of groundwater takes place in the inter-granular primary porosity of the unconsolidated units and in the fracture induces secondary porosity of the underlying consolidated units. All of the lithologic units are believed to be hydraulically interconnected and to function as a water table aquifer with localized semi-confined zones.

Many areas underlain by carbonate bedrock exhibit features characteristic of Karst Topography. None of these features such as caves, sinkholes or disappearing streams have been noted in the geologic literature concerning the site. In addition, no wellhead protection areas have been identified within the study area.

2.5.2 Water Supply

Residents located within a four mile radius of JPG receive potable water from public supplies and from individual home wells.

The largest public water supplier in the study area is the City of Madison Water Department. This system obtains water from six conventional wells, 130 feet deep, producing from the unconsolidated aquifer bordering the Ohio River. These wells are all located outside of the study area. The Madison Water Company is also the sole source of water for the DuPont Water Company, the Canaan Water Company, and Rykers Ridge Water Companies which serve residents located within the study area. Additional water supply data is presented in Table 2-10 and Appendix E.

Prior to 1984, the facility supplied its own potable water via two on-post wells. In 1984, JPG switched to purchasing potable water from the City of Madison. The city gets its water from six wells lying along the northern edge of the Ohio River in the southern region of town. These wells are approximately 130 ft. deep and pump a total of 1000 gallons per minute.

Monitoring wells have been completed and sampled at three separate study areas on JPG. Fifteen wells exist around the Gate 19 Landfill, nine around the DUIA and three around the solvent pit at Building 279.

Table 2-10
Water Supply Data

Water Company	Source	Interconnections	Total Connections	Service Area **	Production
Madison Water Company (Groce 1993)	Groundwater wells (outside of Study Area)	DuPont Canaan Rykers Ridge Hanover JPG	No Data	City of Madison	3.5 million gallons per day
Canaan Water Company (Parton 1993)	Madison Water Company	Versailles*	1,140	Rural Area surrounding Canaan	5.5 million gallons per month
Versailles Water Department (Groce 1993)	Surface Water Versailles Lake (outside of study area)	Holton*	738	City Limits	7.0 million gallons per month
Holton Water Department (Stikleman 1993)	Osgood Water Department (outside of study area)	Osgood Versailles*	No Data	Rural Area surrounding Holton	3 million gallons per month
Osgood Water Department (Stork 1993)	Surface Water and Groundwater (outside of study area)	Holton Elrod Napolean	726	City of Osgood and surrounding Rural Area	18 million gallons per month
DuPont Water Company	Madison Water Department	Madison	No Data	Rural Area around DuPont	No Data
Rykers Ridge Water Company (Myers 1993)	Madison Water Department	Madison	No Data	Rural Area surrounding Rykers Ridge	No Data
JPG (Meyers 1993)	Madison Water Department	Madison	Population 326	JPG	1.4 millions gallons per month
Private Water Supply for Muscatatuck Development Center	Muscatatuck River	None	Population 1000	Muscatatuck Development Center	2,000 to 175,000 gallons per day
Jennings Water Company (Borden 1993)	3 Groundwater wells (Outside of Study Area)	North Vernon	2202 connections	Rural area to the west of JPG	17.5 million gallons per month

*Emergency Interconnection **Rural Area Water Supplies frequently have unknown number of active home wells in service area.

3.0 TARGET ANALYSIS

3.1 EXPOSURE PATHWAYS

3.1.1 Surface Water

There are six parallel streams, which generally flow in a west-southwesterly direction, that dissect JPG (see Figure 2-16) and are part of the White River Basin. All of these streams are used for recreation including swimming, fishing and boating. Irrigation of agricultural activities may exist in the study area. There are no surface water intakes for potable water in the JPG vicinity.

There are no confirmed releases to surface waters at JPG. Potential sources of suspected release include explosives and heavy metals from cracked UXO, depleted uranium from the DUIA, effluent from the STP, lead from the Red Lead Disposal Area, heavy metals, solids and possibly ordnance materials from burn areas, and sulfur from the sulfur disposal area. Except for the NPDES and DU area, JPG does not have a formal surface water monitoring program. (Ebasco 1990).

3.1.2 Groundwater

The bedrock in the JPG area does not have a dependable water-bearing strata. Potable water on JPG is purchased from the Madison Water Company which pumps water from the Madison well field which yields 8.3 mgd from the sand and alluvial aquifer of the Ohio River Valley, approximately 12 miles south of JPG. Residential areas surrounding JPG receive water from interconnections with the Madison Water Company. A number of private well users are located in the surrounding areas. The nearest private or source is located south/southwest of the Gate 19 Landfill approximately .5 miles away. There is no wellhead protection area designated in the JPG study area.

The private wells could be considered as potential off-site receptors if contaminants are released via ground water flow from JPG. Potential contaminants of concern include metals leachate from UXO, fuel/petroleum products from USTs, and TNT/DNT. The regional flow appears to be in the south-southwest direction, but many surface and bedrock features could alter the flow direction.

The JPG sources of known releases to groundwater are the Gate 19 Landfill and Building 279. Sources with suspected releases to groundwater include the Gator Mine Testing Area, Burn Areas, Red Lead Disposal Area, Solvent Disposal Pits, DUIA, and USTs.

3.1.3 Soil

The known sources of soil contamination at JPG include the Fire Training Pit, the Sulfur Disposal Area, Open Burning Areas and the Solvent Disposal Pits. Suspected areas of soil contamination exist at most of the sources at JPG, but there is no documentation of environmental sampling at these areas.

The DUIA covers approximately 3 square miles and is randomly covered by depleted uranium penetrators. JPG implements a soil sampling program to monitor radioactivity in the soil. Presently, the soils in the vicinity are not contaminated with radioactivity beyond regulated levels.

There are no residents within 200 feet of any soil contamination. The closest residents would be the on-post housing units, which house 24 residents. The units are located south of Building 100, approximately

1/2 to 3/4 mile from the Gator Mine Test Area. There are no daycare facilities, schools or playgrounds within one mile of any source area. There are no personnel working within the soil contaminated areas, however, of the 326 employees on-post, a maximum number of workers include the 48 persons employed at the building 186 motor pool.

None of the sources are accessible to the public. There are no sensitive environments located on any sources.

3.1.4 Air

There have been no analytically documented releases of hazardous constituents to the air surrounding JPG; however, releases most likely occurred at the incinerators, burning grounds and the firing training pits.

Open burning is considered an acceptable way to dispose of explosives and their wastes and residues, and UXO. Materials released during the burning could typically include CO, CO_2, oxides of nitrogen, phosphorus, and particulates. While the air quality impact from the standard operating procedures followed today appears to be minimal, it is impossible to access the impact that past practices, such as open burning of TCE and waste oils, had on air quality.

JPG does not have a formal program to monitor air quality at the facility. Potential sources of air pollution include releases from open burning, and open detonation, operation of the incinerator, practice drills at the Fire Training Pit and occasional forest fires.

The closest residents would be the on-post housing units located south of Building 100, approximately 1/2 to 3/4 mile from the Gator Mine Burn Area, and the Incinerators.

4.0 FIELD INVESTIGATION

4.1 FIELD INVESTIGATION DATA

Field investigations were not conducted as part of this PSI. Data from previous investigations, when available, were used in the assessment process.

REFERENCES

1. AEHA (U.S. Army Environmental Hygiene Agency), 1992. "Closure/Post-Closure Plan, Gate 19 Landfill, Jefferson Proving Ground, Indiana," December 1-4.

2. AEHA, 1992. "Evaluation of Solid Waste Management Units, Jefferson Proving Ground, Indiana," June 15-18.

3. AEHA, 1992. "Verification Stream Sampling and Regulatory Analysis, Jefferson Proving Ground," July 7-11.

4. A.T. Kearney, 1992. "Resource Conservation and Recovery Act, facility Assessment, Jefferson Proving Ground."

5. SEC Donahue, Inc., 1992. "RI/FS Technical Plan"/"RI/FS Sampling Design Plan", September.

6. Ebasco Environmental, Inc., 1990. "Master Environmental Plan," November.

7. Ebasco Environmental, Inc., 1990. "Enhanced Preliminary Assessment Report, Jefferson Proving Ground."

8. ESE (Environmental Science and Engineering, Inc.), 1989. "Remedial Investigation at Jefferson Proving Ground, Technical Report A011," June.

9. REI, 1993. "Final Addendum to the Remedial Investigation/Feasibility Study Technical Plan," Volumes I and II, June.

10. REI, 1993. "Final Addendum to the RI/FS Site Health and Safety Plan," June.

11. USACOE (United States Army Corps of Engineers Louisville District), 1992. "Environmental Impact Statement," September.

12. USATHAMA (United States Army Toxic and Hazardous Materials Agency), 1992. "Letter Report of Site Specific Sampling Analysis Program Results," May.

13. USGS, Holton, Indiana Quadrangle, 7.5 Minute Series Topographic Map, 1959, Photorevised 1980.

14. USGS, Rexville, Indiana Quadrangle, 7.5 Minute Series Topographic Map, 1959, Photorevised 1978.

15. USGS, San Jacinto, Indiana Quadrangle, 7.5 Minute Series Topographic Map, 1959, Photorevised 1978.

REFERENCES (Continued)

16. USGS, Versailles, Indiana Quadrangle, 7.5 Minute Series Topographic Map, 1961.

17. USGS (United States Geological Survey), Clifty Falls, Indiana Quadrangle, 7.5 minute Series Topographic Map, 1964, Photorevised 1980.

18. AEHA, 1981a. "Special Investigation No. 20-44-0681-81, Analysis of Soil Samples for Polychlorinated Biphenyl (PCB), Jefferson Proving Ground, Madison, Indiana."

19. AEHA, 1988. "Interim Final Report, Ground-water Contamination Survey, No. 38-26-0306-89," August 8-12.

20. AEHA, 1981b. "Special Investigation No. 20-44-0897-82, Analysis of Transformer Fluid Samples and Soil Samples for Polychlorinated Biphenyl (PCB), Jefferson Proving Ground, Madison, Indiana."

21. AEHA, 1981c. "Special Investigation No. 20-44-0657-81, Analysis of Transformer Fluid Samples for Polychlorinated Biphenyl (PCB), Jefferson Proving Ground, Madison, Indiana."

22. AEHA, 1983a. "Ground-water Analysis Results for Jefferson Proving Ground, Madison, Indiana," June 30 and September 13.

23. AEHA, 1983b. "Pesticide Monitoring Special Study No. 17-44-0246-84, Environmental Impact of Pesticide Use, Jefferson Proving Ground, Madison, Indiana."

24. AEHA, 1984. "Ground-water Analysis Results for Jefferson Proving Ground, Madison, Indiana," June 5, August 13, and December 5.

25. AEHA, 1985b. "Ground-water Analysis Results for Jefferson Proving Ground, Madison, Indiana," April 2, July 18, and November 16.

26. AEHA, 1980. "Installation Pesticide Management Program Review (ER), No. 16-61-0581-81, Jefferson Proving Ground, Madison, Indiana."

27. AEHA, 1980. "Radiation Protection Survey No. 28-43-0074-81, Jefferson Proving Ground, Madison, Indiana."

28. AEHA, 1973. "Water Quality Monitoring Consultation No. 24-001-74, Jefferson Proving Ground, Madison, Indiana," June 9 - July 10.

29. AEHA, 1988 and 1989. "Final Report Ground-water Contamination Survey No. 36-26-0306-89, Evaluation of Solid Waste Management Units, Jefferson Proving Ground, Madison, Indiana," August 8 - 12, and May 15 - 18.

30. ESE, 1986. "Update of the Initial Installation Assessment of Jefferson Proving Ground," December 19.

REFERENCES (Continued)

31. ESE, 1988. "Remedial Investigation at JPG - Final Quality Assurance Project Plan," October.

32. ESE, 1989. "Remedial Investigation at Jefferson Proving Ground -Technical Report Poll."

33. Gray, Henry H., 1971. "Geology of Jefferson County, Indiana," January 29.

34. Greeman, Theodore K., 1981. "Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana, U.S. Geological Survey, Open - File Report 81-1120," Prepared in cooperation with the Indiana Department of National Resources and U.S. Army, Jefferson Proving Ground.

35. Hartke, Edwin J., 1989. "Indiana Department of Natural Resources, Geology of Jefferson Proving Ground," March 30.

36. Indiana Department of Environment Management, 1989. "Report to the Governor: United States Army Jefferson Proving Ground Evaluation," April 20.

37. Jefferson Proving Ground, 1981b. "Sanitary Landfill Gate 19, Dwg. No. JPG-1970."

38. National Enforcement Investigation Center, 1990. "Environmental Audit Jefferson Proving Ground," April.

39. NOAA (National Oceanic and Atmospheric Administration), 1988. "Climatological Data, Indiana," NOAA, Asheville, North Carolina, Vol. 93, No. 7.

40. NOAA, 1982. "Climate of Indiana," *Climatography of the United States*, No. 60, June.

41. SCS (Soil Conservation Service), U.S. Department of Agriculture, 1976. "Soil Survey of Jennings County," March.

42. SCS, U.S. Department of Agriculture, 1985. "Soil Survey of Ripley County and Part of Jennings County, Indiana," April.

43. SCS, U.S. Department of Agriculture, 1985. "Soil Survey of Jefferson County, Indiana," May.

44. U.S. Army Jefferson Proving Ground Natural Resources, 1977. "Part II - Fish and Wildlife Management Plan," September.

45. U.S. Army Jefferson Proving Ground Natural Resources, 1977. "Part III - Fish and Wildlife Management -JPG 1551," Revision 6, October.

46. USATHAMA, 1980. "Installation Assessment of Jefferson Proving Ground, Madison, Indiana, Report No. 176."

47. USATHAMA, 1980. "Initial Installation Assessment at Jefferson Proving Ground, Madison, Indiana," August.

REFERENCES (Continued)

48 U.S. Environmental Protection Agency, Environmental Photographic Interpretation Center (EPIC), 1986. "Installation Assessment Relook Program Working Document, Jefferson Proving Ground, Madison, Indiana, TS-PIC-85X-19."

49. U.S. Test and Evaluation Command, 1978. "Environmental Impact Statement," April.

APPENDIX A

AIR EMISSIONS INFORMATION

(Source: Jefferson Proving Ground, Environmental Office)

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We make Indiana a cleaner, healthier place to live

Evan Bayh
Governor
Kathy Prosser
Commissioner

105 South Meridian Street
P.O. Box 6015
Indianapolis, Indiana 46206-6015
Telephone 317-232-8603
Environmental Helpline 1-800-451-6027

January 25, 1993

Certified Mail P 323 808 121

US Army Jefferson Proving Grounds
Highway 421
Madison, Indiana 47250-5100

Attention: P. Robitaille

Re: Amendment to Registration 077-00005

Ladies and Gentlemen:

US Army Jefferson Proving Grounds received a registration for their wood fired boiler on August 1, 1991. This registration included a condition stating that the boiler would comply with the particulate matter emissions limitations of the incinerator rule, 326 IAC 4-2-2. This registration also included a condition stating that the boiler would comply with the particulate matter emissions limitations of the indirect heating rule, 326 IAC 6-2.

Due to a recent ruling by the Air Board, your registration is being modified. The boiler will need to meet the particulate matter emission limitation of the boiler standard, 326 IAC 6-2. The boiler will not need to meet the particulate matter emission limitation of the incinerator standard. This modification will serve as a registration amendment.

All other registration conditions shall remain in effect.

Sincerely,

Paul Dubenetzky, Chief
Permits Branch
Office of Air Management

drp

cc: Jefferson County Health Department
Air Compliance Section
Enforcement Section - DD
Data Support Section

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

105 South Meridian Street
P.O. Box 6015
Indianapolis 46206-6015
Telephone 317/232-8603

AUG 01 1991

CERTIFIED MAIL P 124 435 568

U.S. Army Jefferson Proving Ground
HWY 421
Madison, Indiana 47250-5100

Attention: Ms. P. Robitaille

Re: Exempt Construction
and Operation Status
of Incinerator Change
Jefferson County
ID No. 077-00005

Dear Ms. Robitaille:

Jefferson Proving Ground's application has been reviewed. Based on the data submitted and the provisions in Section 1 of 326 IAC 2-1, it has been determined that the following, to be located Madison, Indiana is classified as exempt: incineration of wood scrap in the existing Plibrico incinerator. The type of wood scrap burned will not increase emissions from their current levels, and the potential to emit is unchanged.

Pursuant to 326 IAC 2-1-4 (e) (Requirement for stack testing to prove compliance with all applicable rules) compliance stack tests shall be performed for particulate matter. These tests shall be performed according to 326 IAC 3-2 (Source Sampling Procedures, copy enclosed) using EPA Method 5. The Office of Air Management (OAM) shall be notified of the actual test date at least two weeks prior to the date. A test protocol shall be submitted to the OAM 35 days in advance of the test, and all test reports must be received by the OAM within 45 days of the completion of the testing, pursuant to that rule. The source shall be limited to 0.3 pounds of particulate matter per thousand (1000) pounds dry exhaust at 70 degrees Fahrenheit and one atmosphere pursuant to 326 IAC 4-2-2. The stack test must show compliance with this rule.

Any change or modification which may increase the potential emissions more than 5 pounds per hour or 25 pounds per day of particulate matter from the equipment covered in this letter must be approved by the Office of Air Management before such change may occur.

Sincerely,

Paul Dubenetzky
Acting Assistant Commissioner
Office of Air Management

DAC

cc: Jefferson County Health Department
Air Compliance Section
Enforcement Section - DD
Data Management Section

APPENDIX B
CONSTITUENTS AND BY-PRODUCTS OF THE VARIOUS PROPELLANTS AND EXPLOSIVES MANAGED AT JEFFERSON PROVING GROUND
(Source: Kearny, 1992.)

Table 4-1

Constituents and By-Products of the Various Propellants and Explosives Managed at the Jefferson Proving Ground

NAME	CHEMICAL FORMULA	HAZARDOUS WASTE ID NUMBER
	Propellants	
Nitrocellulose	$C_{12}H_{14}(ONO_2)_6O_4$	D003
Nitroglycerin	$C_3H_5(ONO_2)_3$	D003
Nitroguanidine	$H_2NC(NH)NHNO_2$	D003

These three primary constituents can be used singularly or in various combinations along with metals, metallic salts, and organic polymer binders.

NAME	CHEMICAL FORMULA	HAZARDOUS WASTE ID NUMBER
	Primary Explosives	
Lead azide	$Pb(N_3)_2$ (71% Pb)	D003, D008
Mercury Fulminate	$HgC_2N_2O_2$ (7.055 Hg)	D003, D009
Diazodinitrophenol (DDNP)	$HOC_6H_3(NO_2)_2N(:N)$	D003
Lead styphnate	$C_6H(NO_2)_3(O_2Pb)$ (44.2% Pb)	D003, D008
Tetracene	$C_{18}H_{12}$	D003
Potassium Dinitrobenzofuroxane (KDNBF)	$C_6H_2N_4O_6K$	D003
Lead Mononitroresorcinate (LMNR)	$C_6H_3NO_2Pb$ (57.5% Pb)	D003, D008

Primary Compositions - mixtures of primary explosives, fuels, oxidizers and binders.

Source: Reference 103

Table 4-1

NAME	CHEMICAL FORMULA	HAZARDOUS WASTE ID NUMBER
Fuels - Lead thiocyanate	$Pb(SCN)_2$ (64% Pb)	D008
Antimony sulfide	Sb_2S_5	D003
Calcium silicide	$CaSi_2$	D003, D001
Oxidizers - Potassium chlorate	$KClO_3$	D003
Ammonium Perchlorate	NH_4ClO_4	D003
Barium nitrate	$Ba(NO_3)_2$	D003, D005
	Aliphatic Nitrate Esters	
1,2,4-Butanetriol Trinitrate (BTN)	$C_4H_7N_3O_9$	D003
Diethyleneglycol Dinitrate (DEGN)	$C_4H_8O_3(NO_2)_2$	D003
Nitroglycerine (NG)	$C_3H_5(ONO_2)_3$	D003
Nitrostarch (NS)	$C_{12}H_{12}(NO_2)_8O_{10}$	D003
Pentaerythyritol Tetranitrate (PETN)	$C(CH_2NO_3)_4$	D003
Triethylene Glycoldinitrate (TEGN)	$C_6H_{12}O_4$ $2NO_2$	D003
1,1,1-Trimethylolethane Trinitrate (TMETN)	$C_5H_9O_9N_3$	D003
Nitrocellulose (NC)	$C_{12}H_{14}(ONO_2)_6O_4$	D003

Table 4-1

NAME	CHEMICAL FORMULA	HAZARDOUS WASTE ID NUMBER
	Nitramines	
Cyclotetramethylene-tetranitramine (HMX)	$C_4H_8N_8O_2$	D003
Cyclotrimethylene-trinitramine (RDX)	$C_3H_6N_6O_6$	D003
Ethylenediamine Dinitrate (EDDN Haleite)	$C_2H_6N_4O_4$	D003
Nitroguanidine (NQ)	$H_2NC(NH)NHNO_2$	D003
2,4,6-Trinitrophenyl-methylnitramine (Tetryl)	$(NO_2)_3C_6H_2N(NO_2)CH_3$	D003
	Nitroaromatics	
Ammonium picrate (Explosive D)	$NH_4C_6H_2N_3O_7$	D003
1,3-Diamino-2,4,6-Trinitrobenzene (DATB)	$C_6H_4N_6O_6$	D003
2,2'4,4'6,6'-Hexanitroazobenzene (HNAB)	$C_{12}N_8O_{12}$	D003
Hexnitrostilbene (HNS)	$C_{14}H_2N_6O_{12}$	D003
1,3,5-Triamino-2,4,6-Trinitrobenzene (TATB)	$C_6H_6N_6O_6$	D003
2,4,6-Trinitrotoluene (TNT)	$(NO_2)_3C_6H_2CH_3$	D003
Ammonium Nitrate	NH_4NO_3	D003

Table 4-1

Compositions

Mixtures of the above

Plastic Bonded Explosive (PBX)

Explosives (see above) and polymer binder, plasticizer, and fuel (Aluminum or Iron)

Pyrotechnics

Combination of:

Oxidizer - oxygen or fluorine
Fuel - powdered Aluminum or Magnesium
Binding Agents - resins, waxes, plastics, oils, retardants, waterproofing, color intensifier

---

Table 4-1

Propellant Type	Chemical Make-Up	
1. Black Powder	Potassium Nitrate	74.0%
	Charcoal	15.6%
	Sulfur	10.4%
2. TNT	Trinitrotoluene	
3. Composition B	60/40 Cyclotol	
	RDX	60%
	TNT	39%
	WAX	17%
4. PETN	Pentaerythrite Tetranitrate	
	Chemical Formula	
	Carbon	19.0%
	Hydrogen	2.5%
	Nitrogen	17.7%
	Oxygen	60.8%
5. Photoflash	Laminac	96.8%
	Lupersol, DDM	3.0%
	Iron Oxide	.2%
6. Composition C4	RDX	91.0%
	Polysobutylene	2.1%
	Motor Oil	1.6%
	Di-(2-Elhylhexyl) Sebacate	5.3%
7. RDX	(Cyclonite) (Cyclotrimethylene-Trinitramine)	
	Chemical Formula	
	Carbon	16.3%
	Hydrogen	2.7%
	Nitrogen	37.8%
	Oxygen	43.2%

Table 4-1

Propellant Type	Chemical Make-Up	
8. Tetryl	Trinitro-Phenylmethyl-Nitramine	
	Chemical Formula	
	Carbon	29.3%
	Hydrogen	1.7%
	Nitrogen	24.4%
	Oxygen	44.6%
9. TPA Incendiary	Triethylaluminum	
10. HMX	(Homecyclonite) (Cycloteramamethylene Tetranitramine)	
	Chemical Formula	
	Carbon	16.2%
	Hydrogen	2.7%
	Nitrogen	37.9%
	Oxygen	43.2%
11. Lead Azide	Chemical Formula	
	Nitrogen	28.8%
	Lead	71.2%
12. Lead Styphnate	Chemical Formula	
	Carbon	15.4%
	Hydrogen	.65%
	Nitrogen	9.0%
	Oxygen	30.8%
	Lead	44.2%
13. Amatol	Ammonium Nitrate TNT	
14. Ammonium Nitrate	Chemical Formula	
	Nitrogen	35%
	Hydrogen	5%
	Oxygen	60%

Table 4-1

Propellant Type		Chemical Make-Up	
15.	Composition A3	RDX	91%
		WAX	9%
16.	Explosive A4	RDX	97%
		WAX	3%
17.	Explosive D	Ammonium Picrate	
		Chemical Formula	
		Carbon	29.3%
		Hydrogen	2.4%
		Nitrogen	22.7%
		Oxygen	45.6%
18.	Haleite	(EDNA) (Ethylene-Dinitramine)	
		Chemical Formula	
		Carbon	16.0%
		Hydrogen	4.0%
		Nitrogen	37.3%
		Oxygen	42.7%
19.	HBX-1,3 & 6	RDX	39.6%
		TNT	37.8%
		Aluminum	17.1%
		Densitizer (Comp D2)	5.0%
		CACL	.5%
20.	Octol	HMX	75%
		TNT	25%
21.	PBX	RDX	
		Polystyrene	
		Dioctylphthalate	
22.	Pentolite 50/50	PETN	50%
		TNT	50%
23.	Pentolite 10/90	PETN	10%
		TNT	90%

Table 4-1

Propellant Type		Chemical Make-Up	
24.	Picratol	Explosive D	52%
		TNT	48%
25.	Tetrytol	Tetryl	
		TNT	
26.	Torpex	RDX	42%
		TNT	40%
		Aluminum	18%
27.	Tritonal	Aluminum	
		TNT	
28.	Nitroglycerin	Chemical Formula	
		Carbon	15.9%
		Hydrogen	2.2%
		Nitrogen	18.5%
		Oxygen	63.4%
29.	Nitroguanidine (Picrate)	Picrate	
		Chemical Formula	
		Carbon	11.5%
		Hydrogen	3.9%
		Nitrogen	53.8%
		Oxygen	30.8%
30.	Military Dynamite - Medium Velocity	RDX	75%
		TNT	15%
		Starch	5%
		SAE No. 10 Oil	4%
		Polysobutylene	1%

Table 4-1

Propellant Type	Chemical Make-Up	
31. Military Dynamite - Low Velocity	RDX/DYE*	17.5%
	TNT	67.8%
	Tripentaery-Thritol	8.6%
	Binder**	4.1%
	Cellulose Acetate	2.0%

* The dye is 96% pure 1 - Methylamino - Anthraquinone (1-MA) used in the amount of .5% of the RDX mixture.

** The binder is vistac No. 1 consisting of polybutene and Diotyseabacate.

APPENDIX C
ANALYTICAL INFORMATION

ANALYTICAL REPORTS FROM THE SEWAGE TREATMENT PLANT
(Source: Ebasco Environmental, Inc., 1990, "Enhanced Preliminary Assessment Report: Jefferson Proving Ground, Indiana," March, Appendix 4.)

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331 Newman Avenue • Clarksville, Indiana 47130 • Phone (812) 282-8481

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Laboratory Report

Date 07/17/89 Page 1

Lab Control No 89,796

P.O. Number DAAD0389M05313 Job No 00713

Sample Source
US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Bill To
FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description	Sample Type	Location
Wastewater	COMPOSITE	Sewage plant effluent

Date Collected	Date Received	Collected By	Time of Collection
06/27/89	06/30/89	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
Ammonia nitrogen	0.60 mg/l	07/07/89	Rogers	Distillation Nesslerization
Cyanide, total (CN)	<0.005 mg/l	07/10/89	Young	Distillation/ Colorimetric
Silver, total	0.013 mg/l	07/06/89	Isler	Flame atomic abs.

Remarks

State Certification No. M-10-1

Analysis Reviewed By [signature]

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Laboratory Report

Date: 07/19/89 Page 1

Lab Control No: 90,217 thru 90,219

P.O. Number:

Job No: 00713

Sample Source:
US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Bill To:
FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description: Sewage Plant Effluent

Sample Type: 24 HR COMPOSITE

Location: Sample identification given below

Date Collected: 07/06/89

Date Received: 07/07/89

Collected By: Client

Time of Collection: 00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #90,217 Sample #2A Ammonia nitrogen	<0.10 mg/l	07/13/89	Rogers	Distillation Nesslerization
E.C.I. #90,218 Sample #2C Cyanide, total (CN)	<0.005 mg/l	07/13/89	Young	Distillation/ Colorimetric
E.C.I. #90,219 Sample #2S Silver, total	0.009 mg/l	07/13/89	Isler	Flame atomic abs.

Remarks

State Certification No. M-10-1

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Laboratory Report

Date 07/21/89 Page 1 of

Lab Control No 90,608 thru 90,610

P.O. Number 007137

Sample Source
US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Bill To
FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description: Wastewater
Sample Type: 24 HR COMPOSITE
Location: Sample identification given below

Date Collected: 07/89
Date Received: 07/13/89
Collected By: Client
Time of Collection: 00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #90,608				
Plant Effluent #3C				
Cyanide, total (CN)	<0.005 mg/l	07/14/89	Young	Distillation/ Colorimetric
E.C.I. #90,609				
Plant Effluent #3N				
Ammonia nitrogen	<0.10 mg/l	07/13/89	Rogers	Distillation Nesslerization
E.C.I. #90,610				
Plant Effluent #3S				
Silver, total	0.004 mg/l	07/19/89	Isler	Flame atomic abs.

Remarks

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Professional Laboratory

Laboratory Report

Date: 07/28/89 Page 1 of

Lab Control No: 90,975 thru 90,977

P O Number: 89-M-0532 Job No: 007137

Sample Source:
US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Bill To:
FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description: Wastewater
Sample Type: GRAB
Location: Sample identification given below

Date Collected: 07-19-89
Date Received: 07/20/89
Collected By: Client
Time of Collection: 00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #90,975 4A-Sewage Treatment Plant Ammonia nitrogen	<0.40 mg/l	07/20/89	Rogers	Distillation Nesslerization
E.C.I. #90,976 4C-Sewage Treatment Plant Cyanide, total (CN)	0.007 mg/l	07/20/89	Young	Distillation/ Colorimetric
E.C.I. #90,977 4S-Sewage Treatment Plant Silver, total	0.008 mg/l	07/24/89	Isler	Flame atomic abs.

Remarks

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Laboratory Report

Date: 08/08/89 Page 1 of

Lab Control No: 91,353 thru 91,355

P.O. Number: 89-M-0532 Job No.: 007137

Sample Source:
US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Bill To:
FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description	Sample Type	Location
Wastewater	24 HR COMPOSITE	Sample identification given below

Date Collected	Date Received	Collected By	Time of Collection
07/26/89	07/27/89	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #91,353				
5(A)				
Ammonia nitrogen	<0.40 mg/l	07/27/89	Rogers	Distillation Nesslerization
E.C.I. #91,354				
5(C)				
Cyanide, total (CN)	0.008 mg/l	07/31/89	Young	Distillation/ Colorimetric
E.C.I. #91,355				
5(S)				
Silver, total	0.007 mg/l	08/01/89	Isler	Flame atomic abs.

Remarks

State Certification No. M-10-1

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Sample Source

US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Date: 08/24/89 Page 1

Lab Control No.: 92.136 thru 92.138

P.O. Number

Job No. 007137

Bill To: FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description	Sample Type	Location
Wastewater	24 HR COMPOSITE	Sample identification given below

Date Collected	Date Received	Collected By	Time of Collection
08-09-89	08/10/89	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #92,136 Sample #A Ammonia nitrogen	<0.4 mg/l	08/11/89	Rogers	Distillation Nesslerization
E.C.I. #92,137 #C Cyanide, total (CN)	0.005 mg/l	08/11/89	Young	Distillation/ Colorimetric
E.C.I. #92,138 Sample #S Silver, total	0.039 mg/l	08/14/89	Isler	Flame atomic abs.

Remarks

State Certification No. M-10-1

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Laboratory Report

Date 08/25/89 Page 1 of

Lab Control No. 92,597 thru 92,599

P.O. Number 89-M-0532 Job No. 007137

Sample Source
US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Bill To:
FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description	Sample Type	Location
Wastewater	24 HR COMPOSITE	Sample identification given below

Date Collected	Date Received	Collected By	Time of Collection
08-15-89	08/15/89	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #92,597				
STP effluent Sample #7A				
Ammonia nitrogen	0.55 mg/l	08/16/89	Rogers	Distillation Nesslerization
E.C.I. #92,598				
STP effluent Sample #7S				
Silver, total	0.012 mg/l	08/24/89	Isler	Flame atomic abs.
E.C.I. #92,599				
STP effluent Sample #7C				
Cyanide, total (CN)	0.010 mg/l	08/17/89	Young	Distillation/ Colorimetric

Remarks

State Certification No. M-10-1

Analysis Reviewed By: Sarah C. Rogers

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Laboratory Report

Date 09/01/89 Page 1 of

Lab Control No 93,228 thru 93,230

P.O. Number 89-M-0532 Job No 007137

Sample Source
US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Bill To: FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description	Sample Type	Location
Waste Water	24 HR COMPOSITE	Sample identification given below

Date Collected	Date Received	Collected By	Time of Collection
08/22/89	08/23/89	client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #93,228				
Sewer Treatment Plante Eff.#8A				
Ammonia nitrogen	0.46 mg/l	08/23/89	Rogers	Distillation Nesslerization
E.C.I. #93,229				
Sewer Treatment Plante Eff.#8s				
Silver, total	0.007 mg/l	08/24/89	Isler	Flame atomic abs.
E.C.I. #93,230				
Sewer Treatment Plante Eff.#8C				
Cyanide, total (CN)	0.006 mg/l	08/25/89	Young	Distillation/ Colorimetric

Remarks

State Certification No. M-10-1

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Sample Source

US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Date: 11/14/89 Page 1

Lab Control No: 96,862 thru 96,864

P.O. Number: 89-M-0532 Job No. 00713

Bill To:

FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description	Sample Type	Location
Wastewater	GRAB	Sample identification given below

Date Collected	Date Received	Collected By	Time of Collection
10/11/89	10/12/89	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #96,862 Sample #9 (A) Ammonia nitrogen	0.42 mg/l	11/01/89	Rogers	Distillation Nesslerization
E.C.I. #96,863 Sample #9 (C) Cyanide, total (CN)	<0.005 mg/l	11/13/89	Young	Distillation/ Colorimetric
E.C.I. #96,864 Sample #9 (S) Silver, total	0.005 mg/l	10/18/89	Morton	Flame atomic abs.

Remarks

State Certification No. M-10-1

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Laboratory Report

Date: 11/10/89 Page 1 o

Lab Control No. 97,953 thru 97,957

P.O. Number 03-90-M-0039 Job No. 00713

Sample Source

US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Bill To:

FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description	Sample Type	Location
Sludge	GRAB	Sample identification given below

Date Collected	Date Received	Collected By	Time of Collection
09-28-89	10/24/89	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #97,953 Sample #1 EPA EXTRACTION PROCEDURE PERFORMED		10/30/89	Vick	SW-846 Test Methods Evaluating Solid Wa
E.C.I. #97,953 Sample #1 Silver (leachate)	0.008 mg/l	11/08/89	Morton	Flame atomic abs.
E.C.I. #97,954 Sample #2 EPA EXTRACTION PROCEDURE PERFORMED		10/30/89	Vick	SW-846 Test Methods Evaluating Solid Wa
E.C.I. #97,954 Sample #2 Silver (leachate)	0.014 mg/l	11/08/89	Morton	Flame atomic abs.
E.C.I. #97,955 Sample #3 EPA EXTRACTION PROCEDURE PERFORMED		10/30/89	Vick	SW-846 Test Methods Evaluating Solid Wa

Remarks

State Certification No. M-10-1

Analysis Reviewed By: Sarah C. Rogers

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Sample Source

US Army Jefferson Proving Grnd
Commander
Attn: STEJP-EH (K. Joshi)
Madison, IN 47250-5100
Attn: Mr. Kaushik N. Joshi

Date: 11/10/89 Page 2 of

Lab Control No: 97,953 thru 97,957

P.O. Number: 03-90-M-0039 Job No.: 007137

Bill To:

FINANCE ACCT. OFFICER Attn: STEJP-RM-F
Madison, IN 47250-0000

Sample Description	Sample Type	Location
Sludge	GRAB	Sample identification given below

Date Collected	Date Received	Collected By	Time of Collection
09-28-89	10/24/89	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
E.C.I. #97,955 Sample #3 Silver (leachate)	0.009 mg/l	11/08/89	Morton	Flame atomic abs.
E.C.I. #97,956 Sample #4 EPA EXTRACTION PROCEDURE PERFORMED		10/25/89	Weldon	SW-846 Test Methods Evaluating Solid Wa
E.C.I. #97,956 Sample #4 Silver (leachate)	0.007 mg/l	10/31/89	Isler	Flame atomic abs.
E.C.I. #97,957 Sample #5 EPA EXTRACTION PROCEDURE PERFORMED		10/25/89	Weldon	SW-846 Test Methods Evaluating Solid Wa
E.C.I. #97,957 Sample #5 Silver (leachate)	0.008 mg/l	10/31/89	Isler	Flame atomic abs.

Remarks

State Certification No. M-10-1

Analysts Reviewed By

CHEMICAL SERVICE LABORATORY, INC.
P.O. BOX 1586 • JEFFERSONVILLE, INDIANA 47130 • (812) 282-1359

Laboratory Report

FROM: Contracting Division
USA Jefferson Proving Ground
Madison, IN 47250-5100

DATE: 9/9/87

SAMPLE DESCRIPTION:
Grab Sample of sludge, Sewage
Treatment Plant, I.D. #F-3
7/8/87

DATE RECEIVED: 8/13/87

PURCHASE ORDER NO.: PC #0319

CSL NO.: A 227

EP Toxicity for Silver - mg/l	<.05

REMARKS:

REVIEWED BY: [signature]

CHEMICAL SERVICE LABORATORY, INC.
P.O. BOX 1586 • JEFFERSONVILLE, INDIANA 47130 • (812) 282-1359

Laboratory Report

FROM: Contracting Division
USA Jefferson Proving Ground
Madison, IN 47250-5100

DATE: 9/9/87

SAMPLE DESCRIPTION:
Grab Sample of sludge, Sewag
Treatment Plant, I.D. #F-3
7/8/87

DATE RECEIVED: 8/13/87

PURCHASE ORDER NO.: PC #0319

CSL NO.: A 228

EP Toxicity for Silver - mg/l	<.05

REMARKS:

REVIEWED BY: [signature]

CHEMICAL SERVICE LABORATORY, INC.
P.O. BOX 1586 • JEFFERSONVILLE, INDIANA 47130 • (812) 282-1359

Laboratory Report

FROM: Contracting Division
USA Jefferson Proving Ground
Madison, IN 47250-5100

DATE: 9/9/87

SAMPLE DESCRIPTION:
Grab Sample of sludge, Sewage Treatment Plant, I.D. #F-3
7/8/87

DATE RECEIVED: 8/13/87

PURCHASE ORDER NO.: PC #0319

CSL NO.: A 227

EP Toxicity for Silver - mg/l <.05

REMARKS:

REVIEWED BY: [signature]

CHEMICAL SERVICE LABORATORY, INC.
P.O. BOX 1586 • JEFFERSONVILLE, INDIANA 47130 • (812) 282-1359

Laboratory Report

FROM: Contracting Division
USA Jefferson Proving Ground
Madison, IN 47250-5100

DATE: 9/9/87

SAMPLE DESCRIPTION: Grab Sample of sludge, Sewage Treatment Plant, I.D. #F-3 7/8/87

DATE RECEIVED: 8/13/87

PURCHASE ORDER NO.: PC #0319

CSL NO.: A 228

EP Toxicity for Silver - mg/l	<.05

REMARKS:

REVIEWED BY: [signature]

CHEMICAL DATA FOR REMEDIAL INVESTIGATION SAMPLES:
JULY 1988 CHEMICAL DATA
(Source: ESE (Environmental Science and Engineering, Inc., 1989), "Remedial Investigation at Jefferson Proving Ground," Technical Report A011, June., Appendix I.)

PROJECT NUMBER 06501 0700 PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPG01 PROJECT MANAGER B DENAHAN

TABLE CODE				71999	99759	99758	72005	99720	34205	34200	34220	34526	34230	34242	77247	34521	34247
METH CODE				0	0	0	0	0	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18
PARAMETER				SAM TYPE	SITE TYPE	DEPTH	S TECH	INSTAL	ANAPNE	ANAPYL	ANTRC	BAANTR	BBFANT	BKFANT	BENZOA	BGHIPY	BAPYR
...						CM		SAMPLE	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
ID GRP	#	SAMPLE ID	DATE TIME														
JPG01	1	MW1	07/21/88 19.00	GW	WELL	1510	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	2	MW2	07/21/88 14.45	GW	WELL	1510	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	3	MW3	07/21/88 16:00	GW	WELL	1510	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	4	MW4	07/22/88 16:15	GW	WELL	1490	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	5	MW5	07/21/88 14.15	GW	WELL	914	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	6	MW7	07/21/88 15:15	GW	WELL	884	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	7	MW9	07/22/88 16:30	GW	WELL	884	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	8	MW10	07/20/88 14:50	GW	WELL	884	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	9	MW11	07/21/88 18.40	GW	WELL	884	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	10	MW12	07/20/88 14.15	GW	WELL	899	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	11	MW13	07/20/88 12:50	GW	WELL	884	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	12	MW14	07/22/88 10.45	GW	WELL	1080	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	13	MW15	07/19/88 16:05	GW	WELL	762	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	14	MW16	07/22/88 11:15	GW	WELL	899	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	15	MW17	07/21/88 17:00	GW	WELL	884	B	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	16	MW15	07/20/88 15:40	GW	WELL	762	B	JF	NA	NA	NA	NA	NA	NA	NA	NA	NA
JPG01	81	BLK	07/19/88	GW	QCMB	0.0	G	JF	<1.7	<0.50	<0.50	<1.6	<5.4	<0.87	<13	<6.1	<4.7
JPG01	82	BLK	07/22/88 00.00	GW	QCMB	0.0	G	JF	NA	NA	NA	NA	NA	NA	NA	NA	NA

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PROJECT NUMBER 88501 0700 PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPG01 PROJECT MANAGER B DENAHAN

STORET CODE:				77147	34278	34273	34283	39100	34636	34292	99075	34452	34581	34586	34641	34320	34556
METHOD CODE:				UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18
PARAMETER:				BZALC	B2CLXN	B2CLEE	B2CIPE	B2EHP	4BRPPE	BBZP	4CANIL	4CL3C	2CNAP	2CLP	4CLPPE	CHRY	DBAHA
UNITS:				UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP	#	SAMPLE ID	DATE TIME														
JPG01	1	MW1	07/21/88 19.00	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	2	MW2	07/21/88 14.45	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	3	MW3	07/21/88 16.00	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	4	MW4	07/22/88 16.15	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	5	MW5	07/21/88 14:15	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	6	MW7	07/21/88 15:15	<0.72	<1.5	<1.9	<5.3	16	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	7	MW9	07/22/88 16:30	<0.72	<1.5	<1.9	<5.3	8.9	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	8	MW10	07/20/88 14.50	<0.72	<1.5	<1.9	<5.3	<4.6	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	9	MW11	07/21/88 18:40	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	10	MW12	07/20/88 14:15	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	11	MW13	07/20/88 12:50	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	12	MW14	07/22/88 10:45	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	13	MW15	07/19/88 16.05	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	14	MW16	07/22/88 11.15	<0.72	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	15	MW17	07/21/88 17:00	<0.72	<1.5	<1.9	<5.3	29	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	16	MW18	07/20/88 15.40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JPG01	01	BLF	07/19/88	1.8	<1.5	<1.9	<5.3	<4.8	<4.2	<3.4	<7.30	<4.0	<0.50	<0.99	<5.1	<2.4	<6.5
JPG01	02	BLF	07/22/88 00.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

PROJECT NUMBER 88501 0700 PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPGQ1 PROJECT MANAGER B. DENAHAN

STORET CODE				81302	34536	34566	34571	34631	34601	34336	34606	34341	39110	34616	34611	34626	34596
METHOD CODE				UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18
PARAMETER:				DBZFUR	12DCLB	13DCLB	14DCLB	33DCBD	24DCLP	DEP	24DMPN	DMP	DNBP	24DNP	24DNT	26DNT	DNOP
UNITS:				UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP	#	SAMPLE ID	DATE TIME														
JPGQ1	1	MW1	07/21/88 19:00	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	2	MW2	07/21/88 14:45	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	3	MW3	07/21/88 16.00	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	4	MW4	07/22/88 16:15	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	5	MW5	07/21/88 14:15	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	6	MW7	07/21/88 15:15	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	7	MW9	07/22/88 16.30	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	8	MW10	07/20/88 14:50	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	9	MW11	07/21/88 10:40	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	10	MW12	07/20/88 14.15	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	11	MW13	07/20/88 12:50	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	12	MW14	07/22/88 10.45	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	13	MW15	07/19/88 16:05	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	14	MW16	07/22/88 11.15	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	15	MW17	07/21/88 17:00	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	16	MW15	07/20/88 15:40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JPGQ1	01	BLK	07/19/88	<1.70	<1.7	<1.7	<1.7	<12	<2.9	<2.0	<5.8	<1.5	<3.7	<21	<4.5	<0.79	<15
JPGQ1	02	FB	07/22/88 00.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

PROJECT NUMBER 88501 0700   PROJECT NAME   JEFFERSON PROVING GRD
FIELD GROUP   JPG01   PROJECT MANAGER B DENAHAN

STORET CODE:				34376	34381	39700	34391	34386	34396	34403	34408	34657	77416	99073	99074	34696	99077
METHOD CODE:				UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18
PARAMETER:				FANT	FLRENE	CL6BZ	HCBD	CL6CP	CL6ET	ICDPYR	ISOPHR	46DN2C	2MNAP	2MP	4MP	NAP	2NANIL
UNITS:				UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP.	#	SAMPLE ID	DATE TIME														
JPG01	1	MW1	07/21/88 19:00	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	2	MW2	07/21/88 14:45	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	3	MW3	07/21/88 16:00	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	4	MW4	07/22/88 16:15	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	5	MW5	07/21/88 14:15	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	6	MW7	07/21/88 15:15	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	7	MW9	07/22/88 16:30	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	8	MW10	07/20/88 14:50	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	9	MW11	07/21/88 18:40	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	10	MW12	07/20/88 14:15	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	11	MW13	07/20/88 12:50	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	12	MW14	07/22/88 10:45	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	13	MW15	07/19/88 16:05	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	14	MW16	07/22/88 11:15	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	15	MW17	07/21/88 17:00	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	16	MW15	07/20/88 15:40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JPG01	81	BLK	07/19/88	<3.3	<3.7	<1.6	<3.4	<8.6	<1.5	<8.6	<4.8	<17	<1.7	<3.9	<0.52	<0.50	<4.30
JPG01	82	BLK	07/22/88 00:00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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PROJECT NUMBER 88501 0700   PROJECT NAME   JEFFERSON PROVING GRD
FIELD GROUP   JPGQ1   PROJECT MANAGER B. DENAHAN

STORET CODE				99078	99079	34447	34591	34646	34428	34433	39032	34461	34694	34469	34551	77687	34621
METHOD CODE:				UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM16	UM18	UM18	UM18
PARAMETER:				3NANIL	4NANIL	NB	2NP	4NP	NNDNPA	NNDPA	PCP	PHANTR	PHENOL	PYR	124TCB	245TCP	246TCP
UNITS:				UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP	#	SAMPLE ID	DATE TIME														
JPGQ1	1	MW1	07/21/88 19:00	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	2	MW2	07/21/88 14:45	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	3	MW3	07/21/88 16:00	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	4	MW4	07/22/88 16:15	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	5	MW5	07/21/88 14:15	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	6	MW7	07/21/88 15:15	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	7	MW9	07/22/88 16:30	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	8	MW10	07/20/88 14:50	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	9	MW11	07/21/88 10:40	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	10	MW12	07/20/88 14:15	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	11	MW13	07/20/88 12:50	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	12	MW14	07/22/88 10:45	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	13	MW15	07/19/88 16:05	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	14	MW16	07/22/88 11:15	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	15	MW17	07/21/88 17:00	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	16	MW45	07/20/88 15:40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JPGQ1	B1	BLK	07/19/88	<4.90	<5.20	<0.50	<3.7	<12	<4.4	<3.0	<18	<0.50	<9.2	<2.8	<1.8	<5.2	<4.2
JPGQ1	B2	BLK	07/22/88 00:00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

PROJECT NUMBER 88501 0700 PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPG01 PROJECT MANAGER B. DENAHAN

STORET CODE					39330	39337	39338	34259	39310	39320	39300	39380	34361	34356	34351	39390	39410	39420
METHOD CODE:					UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18
PARAMETER:					ALDRIN	BHC_A	BHC_B	BHC_D	DDD_PP'	DDE_PP'	DDT_PP'	DIELDRIN	ENSULFNA	ENSULFNB	ENSULFNS	ENDRIN	HEPTACLR	HEPTCLEP
UNITS:					UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP	#	SAMPLE ID	DATE	TIME														
JPG01	1	MW1	07/21/88	19:00	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	2	MW2	07/21/88	14:45	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	3	MW3	07/21/88	16:00	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	4	MW4	07/22/88	16:15	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	5	MW5	07/21/88	14:15	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	6	MW7	07/21/88	15:15	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	7	MW9	07/22/88	16:30	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	8	MW10	07/20/88	14:50	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	9	MW11	07/21/88	18:40	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	10	MW12	07/20/88	14:15	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	11	MW13	07/20/88	12:50	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	12	MW14	07/22/88	10:45	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	13	MW15	07/19/88	16:05	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	14	MW16	07/22/88	11:15	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	15	MW17	07/21/88	17:00	<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	16	MW15	07/20/88	15:40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JPG01	81	BLK	07/19/88		<4.7	<4.0	<4.0	<4.0	<4.0	<4.7	<9.2	<4.7	<9.2	<9.2	<9.2	<7.6	<2.0	<5.0
JPG01	82	BLK	07/22/88	00:00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

PROJECT NUMBER 88501 0700 PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPG01 PROJECT MANAGER B. DENAHAN

STORET CODE				39340	34671	39488	39492	39496	39500	39504	39508	39400	39120	34366	34438	78008	39480
METHOD CODE				UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18
PARAMETER				LINDANE	PCB1016	PCB1221	PCB1232	PCB1242	PCB1248	PCB1254	PCB1260	TOXAPHEN	BENZIDINE	ENDRN ALD	N NSODMET	ENDRNK	METHOXYCH
UNITS:				UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP	#	SAMPLE ID	DATE TIME														
JPG01	1	MW1	07/21/88 19:00	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	2	MW2	07/21/88 14:45	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	3	MW3	07/21/88 16:00	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	4	MW4	07/22/88 16:15	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	5	MW5	07/21/88 14:15	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	6	MW7	07/21/88 15:15	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	7	MW9	07/22/88 16:30	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	8	MW10	07/20/88 14:50	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	9	MW11	07/21/88 18:40	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	10	MW12	07/20/88 14:15	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	11	MW13	07/20/88 12:50	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	12	MW14	07/22/88 10:45	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	13	MW15	07/19/88 16:05	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	14	MW16	07/22/88 11:15	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	15	MW17	07/21/88 17:00	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	16	MW35	07/20/88 15:40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
JPG01	81	BLK	07/19/88	<4.0	<21	<21	<21	<30	<30	<36	<36	<36	<10	<8.0	<2.0	<8.00	<5.10
JPG01	82	BLK	07/22/88 00:00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

PROJECT NUMBER 88501 0700   PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPG01   PROJECT MANAGER B. DENAHAN

STORET CODE:				39340	39810	34346	81552	34030	32101	32104	34413	81595	77041	32102	34301	34311	34576
METHOD CODE:				UM18	UM18	UM18	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20
PARAMETER:				CLDANA	CLDANG	12DPH	ACET	C6H6	BRDCLM	CHBR3	CH3BR	MEK	CS2	CCL4	CLC6H5	C2H5CL	2CLEVE
UNITS:				UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP	#	SAMPLE ID	DATE TIME														
JPG01	1	MW1	07/21/88 19:00	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	2	MW2	07/21/88 14:45	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	3	MW3	07/21/88 16:00	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	4	MW4	07/22/88 16:15	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	5	MW5	07/21/88 14:15	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	6	MW7	07/21/88 15:15	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	7	MW9	07/22/88 16:30	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	8	MW10	07/20/88 14:50	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	9	MW11	07/21/88 10:40	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	10	MW12	07/20/88 14:15	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	11	MW13	07/20/88 12:50	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	12	MW14	07/22/88 10:45	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	13	MW15	07/19/88 16:05	<5.1	<5.1	<2.0	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
JPG01	14	MW16	07/22/88 11:15	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	15	MW17	07/21/88 17:00	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	16	MW15	07/20/88 15:40	NA	NA	NA	<6500	<0.50	<0.59	<2.6	<5.8	<7.0	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	01	BLK	07/19/88	<5.1	<5.1	<2.0	<13	<0.50	<0.59	<2.6	<5.8	<6.4	<0.50	<0.58	<0.50	<1.9	<0.71
JPG01	02	BLK	07/22/88 00:00	NA	NA	NA	<13	<0.50	<0.59	<2.6	<5.8	<7.0	<0.50	<0.58	<0.50	<1.9	<0.71

PROJECT NUMBER 88501 0700 — PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPG01 — PROJECT MANAGER B. DENAHAN

STORET CODE:					32106	34418	32105	34496	34531	34501	99642	34541	34704	34699	34371	77103	34423	81596
METHOD CODE:					UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20
PARAMETER:					CHCL3	CH3CL	DBRCLM	11DCLE	12DCLE	11DCE	12DCE	12DCLP	C13DCP	T13DCP	ETC6H5	MNBK	CH2CL2	MIBK
UNITS:					UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP	#	SAMPLE ID	DATE	TIME														
JPG01	1	MW1	07/21/88	19:00	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	2	MW2	07/21/88	14:45	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	3	MW3	07/21/88	16:00	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	4	MW4	07/22/88	16:15	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	5	MW5	07/21/88	14:15	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	6	MW7	07/21/88	15:15	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	7	MW9	07/22/88	16:30	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	8	MW10	07/20/88	14:50	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	9	MW11	07/21/88	10:40	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	10	MW12	07/20/88	14:15	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	11	MW13	07/20/88	12:50	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	12	MW14	07/22/88	10:45	<0.58	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	13	MW15	07/19/88	16:05	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA
JPG01	14	MW16	07/22/88	11:15	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	15	MW17	07/21/88	17:00	<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	16	MW15	07/20/88	15:40	<250	<3.6	<0.67	3800	<250	11000	<250	<0.50	<0.58	<0.96	<0.50	<3.6	<2.3	<3.0
JPG01	81	BLK	07/19/88		<0.50	<3.2	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.70	<0.50	<3.6	<2.3	<3.0
JPG01	82	BLK	07/22/88	00:00	<0.50	<3.6	<0.67	<0.68	<0.50	<0.50	<0.50	<0.50	<0.58	<0.96	<0.50	<3.6	<2.3	<3.0

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PROJECT NUMBER 88501 0700 PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPG01 PROJECT MANAGER B. DENAHAN

STORET CODE:				77128	34516	34475	34010	34506	34511	39180	34488	77057	39175	99649	81524	34210	34215
METHOD CODE:				UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20	UM20
PARAMETER:				STYR	TCLEA	TCLEE	MEC6H5	111TCE	112TCE	TRCLE	CCL3F	C2AVE	C2H3CL	XYLEN	C12B7	ACROLN	ACRYLO
UNITS:				UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP.	#	SAMPLE ID	DATE TIME														
JPG01	1	MW1	07/21/88 19:00	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	2	MW2	07/21/88 14:45	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	3	MW3	07/21/88 16:00	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	4	MW4	07/22/88 16:15	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	5	MW5	07/21/88 14:15	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	6	MW7	07/21/88 15:15	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	7	MW9	07/22/88 16:30	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	8	MW10	07/20/88 14:50	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	9	MW11	07/21/88 18:40	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	10	MW12	07/20/88 14:15	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	11	MW13	07/20/88 12:50	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	12	MW14	07/22/88 10:45	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	13	MW15	07/19/88 16:05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			NA	NA
JPG01	14	MW16	07/22/88 11:15	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	15	MW17	07/21/88 17:00	<0.50	<0.51	<1.6	<0.50	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	16	MW15	07/20/88 15:40	<0.50	<0.51	<1.6	920	>100000	>200	5100	<1.4	<9.3	<1500	<0.84	NA	<100	<100
JPG01	81	BLK	07/19/88	<0.50	<0.51	<1.6	0.62	<0.50	<1.2	<0.50	<1.4	<0.3	<2.6	<0.84	NA	<100	<100
JPG01	82	BLK	07/22/88 00:00	<0.50	<0.51	<1.6	0.72	16	<1.2	0.63	<1.4	<9.3	<2.9	<0.84	NA	<100	<100

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PROJECT NUMBER 88501 0700 PROJECT NAME JEFFERSON PROVING GRD
FIELD GROUP JPG01 PROJECT MANAGER B. DENAHAN

STORET CODE: / METHOD CODE: / PARAMETER: / UNITS:					1051 SD89 PB_TOT UG/L	77191 UM18 4N3MBA UG/L	91530 UM18 UNK530 UG/L	77311 UM18 2ETHXL UG/L	97788 UM18 CAPLCT UG/L	91615 UM18 UNK615 UG/L	91623 UM18 UNK623 UG/L	91634 UM18 UNK634 UG/L	91636 UM18 UNK636 UG/L	91641 UM18 UNK641 UG/L	91647 UM18 UNK647 UG/L	91648 UM18 UNK648 UG/L	91516 UM18 UNK516 UG/L	91557 UM18 UNK557 UG/L
FLD GRP	#	SAMPLE ID	DATE	TIME														
JPG01	1	MW1	07/21/88	19:00	<22.2	*OK4	*OK3	*OK2	*OK200	*OK3	*OK10	*OK6	*OK3	*OK3	*OK10	*OK6	NRQ	NRQ
JPG01	2	MW2	07/21/88	14:45	<22.2	*OK4	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.2	NRQ
JPG01	3	MW3	07/21/88	16:00	<22.2	*OK6	*OK6	NRQ	*OK30	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.8
JPG01	4	MW4	07/22/88	16:15	<22.2	*OK2	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.7	NRQ
JPG01	5	MW5	07/21/88	14:15	<22.2	*OK3	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.1	NRQ
JPG01	6	MW7	07/21/88	15:15	<22.2	*OK3	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.6	*OK.3
JPG01	7	MW9	07/22/88	16:30	<22.2	*OK2	NRQ	NRQ	*OK3	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.5	NRQ
JPG01	8	MW10	07/20/88	14:50	<22.2	*OK6	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.5	NRQ
JPG01	9	MW11	07/21/88	10:40	<22.2	*OK2	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	10	MW12	07/20/88	14:15	<22.2	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.6	NRQ
JPG01	11	MW13	07/20/88	12:50	<22.2	*OK4	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.5	*OK.2
JPG01	12	MW14	07/22/88	10:45	NA	NRQ	NRQ	NRQ	*OK8	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	13	MW15	07/19/88	16:05	NA	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.7	NRQ
JPG01	14	MW16	07/22/88	11:15	NA	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK.2
JPG01	15	MW17	07/21/88	17:00	<22.2	NRQ	NRQ	NRQ	*OK30	NRQ	NRQ	NRQ	NRQ	*OK6	NRQ	NRQ	*OK.6	NRQ
JPG01	16	MW15	07/20/88	15:40	NA	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	B1	BLK	07/19/88		<22.2	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	B2	BLK	07/22/88	00.00	NA	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ

PROJECT NUMBER 88501 0700   PROJECT NAME   JEFFERSON PROVING GRD
FIELD GROUP   JPG01   PROJECT MANAGER B DENAHAN

STORET CODE:				91558	91563	97701	91545	91565	91566	91568	91567	97776	97777	91544	91547	91564	91583
METHOD CODE:				UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18	UM18
PARAMETER:				UNK558	UNK563	12EPCH	UNK545	UNK565	UNK566	UNK568	UNK567	2CHE IL	2CHE IC	UNK544	UNK547	UNK564	UNK583
UNITS:				UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L	UG/L
FLD GRP.	#	SAMPLE ID	DATE TIME														
JPG01	1	MW1	07/21/88 19:00	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	2	MW2	07/21/88 14:45	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	3	MW3	07/21/88 16:00	*OK5	*OK2	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	4	MW4	07/22/88 16:15	NRQ	*OK20	*OK2	*OK2	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	5	MW5	07/21/88 11:15	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	6	MW7	07/21/88 15:15	*OK2	*OK3	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	7	MW9	07/22/88 16:30	NRQ	*OK5	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	8	MW10	07/20/88 14:50	NRQ	*OK30	*OK1	NRQ	*OK1	*OK2	*OK2	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	9	MW11	07/21/88 10:40	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	10	MW12	07/20/88 14:15	NRQ	*OK30	*OK2	NRQ	*OK2	*OK2	*OK3	*OK1	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	11	MW13	07/20/88 12:50	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	12	MW14	07/22/88 10:45	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	13	MW15	07/19/88 16:05	NRQ	*OK9	*OK9	NRQ	*OK1	*OK30	NRQ	NRQ	*OK3	*OK5	*OK10	*OK80	*OK4	*OK6
JPG01	14	MW16	07/22/88 11:15	NRQ	*OK8	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	15	MW17	07/21/88 17:00	NRQ	*OK4	*OK1	*OK1	NRQ	NRQ	NRQ	NRQ	*OK1	*OK1	NRQ	NRQ	NRQ	NRQ
JPG01	16	MW15	07/20/88 15:40	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ
JPG01	81	BLK	07/19/88	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	*OK6	NRQ	NRQ
JPG01	82	BLK	07/22/88 00:00	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ	NRQ

PROJECT NUMBER 88501 0700   PROJECT NAME   JEFFERSON PROVING GRD
FIELD GROUP   JPG01   PROJECT MANAGER B. DENAHAN

EL CODE				98691	98693	91554	77179
OD CODE:				UM18	UM18	UM18	UM18
METER:				MEC6H5	E12ICE	UNK554	SM2UXO
S.				UG/L	UG/L	UG/L	UG/L
GEP	#	SAMPLE ID	DATE TIME				
PG01	1	MW1	07/21/88 19:00	NRQ	NRQ	NRQ	NRQ
PG01	2	MW2	07/21/88 14:45	NRQ	NRQ	NRQ	NRQ
PG01	3	MW3	07/21/88 16:00	NRQ	NRQ	NRQ	NRQ
PG01	4	MW4	07/22/88 16:15	NRQ	NRQ	NRQ	NRQ
PG01	5	MW5	07/21/88 11:15	NRQ	NRQ	NRQ	NRQ
PG01	6	MW7	07/21/88 15:15	NRQ	NRQ	NRQ	NRQ
PG01	7	MW9	07/22/88 16:30	NRQ	NRQ	NRQ	NRQ
PG01	8	MW10	07/20/88 14:50	NRQ	NRQ	NRQ	NRQ
PG01	9	MW11	07/21/88 18:40	NRQ	NRQ	NRQ	NRQ
PG01	10	MW12	07/20/88 14:15	NRQ	NRQ	NRQ	NRQ
PG01	11	MW13	07/20/88 12:50	NRQ	NRQ	NRQ	NRQ
PG01	12	MW14	07/22/88 10:45	NRQ	NRQ	NRQ	NRQ
PG01	13	MW15	07/19/88 16:05	*OK30	*OK6	NRQ	NRQ
PG01	14	MW16	07/22/88 11:15	NRQ	NRQ	NRQ	NRQ
PG01	15	MW17	07/21/88 17:00	NRQ	NRQ	*OK1	NRQ
PG01	16	MW15	07/20/88 15:40	NRQ	NRQ	NRQ	NRQ
PG01	81	BLK	07/19/88	NRQ	NRQ	NRQ	*OK2
PG01	82	BLF	07/22/88 00:00	NRQ	NRQ	NRQ	NRQ

BUILDING 333 ASH ANALYSIS
(Source: Jefferson Proving Ground, Environmental Office.)

TOTAL P.04

Consultants
Professional Laboratory Services

SPIKE SAMPLE RECOVERY
TCLP EXTRACT
METALS

SAMPLE NUMBER
Building # 333

Lab Sample ID Number: 134234 JEFF PROV. Grads

Date:

Data Release Authorized by: [signature]

Units: mg/1

Date Extracted: 6·19·92

Date Digested: 6·19 92

Date Analyzed: 6 23 - 6 25 92

Conc/Dil Factor:

Metal	Spike Smpl Result	Sample Result	Amount Spiked	Percent Recovery	Method of Std Addns
Arsenic	.044	~~.013~~ .015	.020	155%	☐ PERFORMED
Barium	2.51	1.72	1.00	79%	☐ PERFORMED
Cadmium	.197	.007	.200	95%	☐ PERFORMED
Chromium	.66	.05	.50	122%	☐ PERFORMED
Lead	1.03	.07	1.00	94%	☐ PERFORMED
Mercury	.0023	<.0002	.002	115%	☐ PERFORMED
Selenium	.008	.002	.020	30%	☐ PERFORMED
Silver	.216	<.005	.200	108%	☐ PERFORMED
					☐ PERFORMED
					☐ PERFORMED
					☐ PERFORMED
					☐ PERFORMED
					☐ PERFORMED
					☐ PERFORMED

Comments: [illegible]

ENVIRONMENTAL CONSULTANTS, INC.
391 Newman Avenue • Clarksville, Indiana 47129 • Phone (812) 282-8481

Environmental Consultants

Professional Laboratory Services

Laboratory Report

Date: 06/26/92 Page 2 of 2

Lab Control No. 34,034

P.O. Number: AAD03-92-P0404 Job No. 007137

Sample Source:
US Army Jefferson Proving Grnd
Attn: STEJP-EN (J. Thornell)
Madison, IN 47250-5100
Attn: Mr. Jeffrey Thornell

[redacted]

Sample Description	Sample Type	Location
Incineration material	GRAB	Building #333

Date Collected	Date Received	Collected By	Time of Collection
05-19-92	06/09/92	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
Lead (TCLP)	0.07 mg/l	06/23/92	sler	Flame atomic abs.
Mercury (TCLP)	<0.0002 mg/l	06/23/92	Hostettler	Atomic absorption Cold vapor
Selenium (TCLP)	0.002 mg/l	06/25/92	sler	Atomic absorption Graphite furnace
Silver (TCLP)	<0.0005 mg/l	06/24/92	sler	Atomic absorption Graphite furnace
Quality Control Data	See Attached	06/26/92		

Remarks

State Certification No. M-10-1

Analysis Reviewed By [signature]

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FILE FILE

Laboratory Report

Date 06/26/92 Page 1 of 2

Lab Control No. 34.034

P.O. Number AAD03-92-P0404 Job No. 007137

Sample Source

US Army Jefferson Proving Grnd
Attn: STEJP-EN (J. Thornell)
Madison, IN 47250-5100
Attn: Mr. Jeffrey Thornell

[redacted]

Sample Description	Sample Type	Location
Incineration material	GRAB	Building #333

Date Collected	Date Received	Collected By	Time of Collection
05-19-92	06/09/92	Client	00:00

Parameter	Results	Date Analyzed	Analyst	Method of Analysis
Total React. Cyanide	<0.10 mg/kg	06/16/92	Lindsey	Colorimetric
Total React. Sulfide	<0.49 mg/kg	06/16/92	Lindsey	Titrimetric
Ignitability (Fl. Pt.)	>210. deg. F	06/12/92	Rector	Pensky-Martens Closed Cup
pH(w)	11.81	06/10/92	Weldon	Electrometric
TCLP Extraction Procedure	COMPLETED	06/19/92	Weldon	
Arsenic (TCLP)	0.013 mg/l	06/25/92	Hostettler	Atomic absorption Graphite furnace
Barium (TCLP)	1.72 mg/l	06/25/92	Isler	Flame atomic abs.
Cadmium (TCLP)	0.007 mg/l	06/25/92	Isler	Flame atomic abs.
Chromium (TCLP)	0.05 mg/l	06/23/92	Isler	Flame atomic abs.

REC. 07-01-92

Remarks

State Certification No. M-10-1

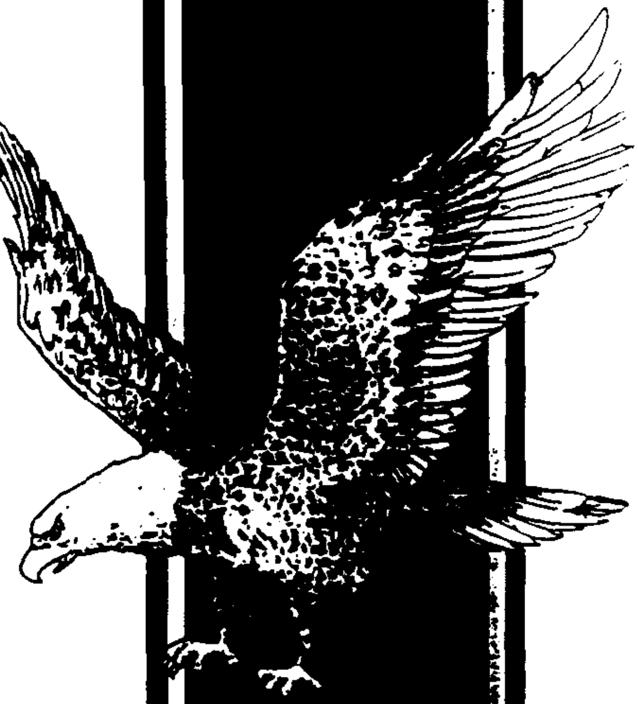
Analysis Reviewed By [signature]

ORIGINAL

SURFACE WATER SAMPLING AND ANALYSIS
(Source: USATHAMA (United States Army Toxic and Hazardous Materials Agency, 1992), "Letter Report of Site Specific Sampling Analysis Program Results," May.

USATHAMA

U.S. Army Toxic and Hazardous Materials Agency



Jefferson Proving Ground

Letter Report of Site Specific Sampling and Analysis Program Results

May 1992

Contract No. DAAA15-90-D-0007

Prepared for:
U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland 21010-5401

4.0 LABORATORY ANALYSIS

4.1 Methods

The A.D. Little analytical laboratory performed all analyses in accordance with the USATHAMA Quality Assurance Program. The analyses methods and sample containers used for JPG are presented in the SSSA (Appendix A).

4.2 Results

4.2.1 *Entrance Streams*

The chemical analysis program for 9 entrance streams at JPG consisted of the analysis of water and sediment samples. These samples were analyzed for 6 herbicides and total uranium (Table 1). Complete analytical results are listed in Appendix C. No contamination was detected in the entrance streams for the limited suite of analytes. These results indicate that none of the analytes tested are entering JPG at detectable levels in the surface water.

4.2.2 *Exit Streams*

The chemical analysis program for exit streams at JPG consisted of analysis of water and sediment samples. These samples were analyzed for herbicides, explosive compounds, Target Compound List (TCL) metals (water sample analysis included both dissolved and total metals analyses), total uranium, and cyanide (Table 2). A complete list of analytical results is included in Appendix C.

Two metals, silver and mercury, were found in the exit stream water and sediment samples. Silver was found in EX1 (Harberts Creek) at 1.38 μg/l in the water and 1.46 μg/g in the sediment. Naturally occurring silver in the earths crust ranges from 0.12 to 0.27 μg/g. Thus, the concentrations of silver detected in these sediment samples are clearly anomalous, but not extreme. Harberts Creek receives discharge from the on-site photographic laboratory. Prior to 1980, photographic processing chemicals used at this facility contained silver. Thus, the detected silver is likely the result of this discharge. The EPA MCL for silver in water is 0.05 mg/l (50 μg/l). The detected silver concentration in the water of Harberts Creek does not exceed the MCL. There are no regulatory criteria available for silver in soil. However, there may be areas along Harberts Creek with much higher silver concentrations in sediment, which represent potential sources for off-site surface water transport. It is recommended that additional sediment samples be taken along Harberts Creek upstream from EX1 to above the photographic laboratory discharge point in order to characterize the silver concentrations in the sediments. Surface water samples should also be taken at each sediment sample location. Since Harberts Creek originates on JPG there is no potential for other upstream (off-site) sources of silver.

Mercury was found in surface water from 4 of the 18 exit stream points and in 2 of the sediment samples (Appendix C). The presence of mercury may indicate that mercury fulminate is present in the related streams. Mercury fulminate ($Hg(CNO)_2$) is used in explosive caps and detonators for military ordnance. Ordnance containing mercury fulminate may have landed in or near the streams during ordnance testing resulting in elevated mercury concentrations. Mercury concentrations found in filtered and unfiltered water samples, respectively are as follows: EX1 (2.6 μg/l and 2.73 μg/l), EX12 (undetected and 1.62 μg/l), EX15 (1.44 μg/l and 150 μg/l), and EX17 (undetected and 2.5 μg/l). Mercury concentrations at EX1 (Harberts Creek), EX15 (Rush Branch of Graham Creek), and EX17 (Otter Creek) exceeded the EPA MCL value of 0.002 mg/l (2 μg/l) and are a potential concern. The source for mercury in exit streams surface water is not well defined. Thus, additional sampling of these exit streams is recommended to verify the presence of mercury. Also, any related entrance streams should be sampled for mercury to determine if the source is on the facility or is an off-site source.

Mercury concentrations in sediments were detected at 0.601 μg/g and 0.347 μg/g at EX1 and EX3, respectively. There are no established regulatory criteria for acceptable levels of mercury in sediments; however, the average crustal abundance of naturally occurring mercury ranges from 0.046 μg/g to 0.33 μg/g; thus, mercury in sediments is not considered significant at the concentrations detected at EX1 and EX3. However, sediments should be sampled and analyzed for mercury along with the surface water at EX1, EX15, and EX17.

Arsenic was found in every exit stream sediment sample; however, it was not detected in the surface water and was not tested for in the entrance stream samples. The concentrations ranged from 1.2 to 8.8 μg/g. Naturally occurring arsenic in rocks of the earths crust averages between 1.8 and 9.0 μg/g. The pervasiveness and relatively low concentrations of arsenic in the stream sediments indicate that the arsenic is most likely naturally occurring. Thus, even though arsenic is a toxic element, the lack of detectable arsenic in the surface water indicates that there is little potential for ingestion of arsenic and no additional sampling is recommended for arsenic in surface streams. It is recommended, however, that the sediment samples from entrance samples be re-analyzed for metals to include arsenic in order to confirm that the arsenic is naturally occurring.

Cyanide (CN^-) was found in the surface water at EX5 (unnamed tributary to Middle Fork Creek). The concentration of cyanide was 7.56 μg/l. One possible source of cyanide is recognized as the dissolution of mercury fulminate ($Hg(CNO)_2$). Detonation of mercury fulminate releases toxic gases of Hg, CN^-, and NOx. Cyanide is also often found related to increased nitrogen contamination associated with water affected by waste disposal (Hem, 1989). It is possible that sludge from the wastewater treatment plant on JPG was disposed of in or near this stream. Cyanide was used in the Pako Unit (for film processing) at the Photographic laboratory. JPG switched film processes in 1980 to eliminate the use of cyanide; however, prior to 1980, film processing sludge was applied to the land at numerous locations. Cyanide from the sludge may have leached into the water of this stream. The proposed EPA MCL value for cyanide is 0.2 mg/l (200 μg/l). This is not an enforceable standard, but is useful as a basis for evaluation. The detected cyanide contamination in this stream does not exceed the proposed MCL; however, additional sampling of the stream should be considered in order to determine the source of cyanide and to determine if higher concentrations are present upstream of the exit point.

Nitrate was found in sediment samples taken from 5 of the 18 exit streams. Nitrate may have come from unexploded or partially exploded ordnance, which landed in or near the streams. It may also be related to leaching of wastewater treatment plant sludge or runoff of fertilizers from agricultural fields upstream of JPG. The concentrations detected in stream sediments were: EX3 (5.8 μg/g), EX4 (7.04 μg/g), EX10 (4.99 μg/g and 5.16 μg/g), EX11 (7.02 μg/g), and EX18 (5.79 μg/g). There is no regulatory limit value available for nitrate in soils, and because elevated concentrations of nitrate were not detected in the surface water, no additional nitrate sampling is recommended.

4.2.3 *Gate 19 Landfill Groundwater*

Analysis of the G19 Landfill groundwater samples included analyses of groundwater samples for target compound list volatiles, semi-volatiles, and target compound list metals. Table 3 summarizes the analytes tested for in the groundwater. Complete analytical results are included in Appendix C.

Two volatile organic compounds, Methylene Chloride (CH_2Cl_2) and acetone (C_3H_6O) were detected in the monitoring wells at Gate 19 Landfill. Methylene Chloride was detected in all of the G19 water samples. Sources for methylene chloride include; methylene chloride/polyurethane residues in the landfill (Environmental Science and Engineering, Inc., 1989), and analytical laboratory contamination. Concentrations of CH_2Cl_2 found in samples ranged from 3.43 μg/l to 4.90 μg/l. Specific concentrations for each well sample are listed in Appendix C. None of the detected concentrations exceed the EPA proposed MCL of 0.005 mg/l (5 μg/l). This standard is not enforceable, but is used as a basis for comparison. Evidence from quality control method blanks suggests that methylene chloride detected in the groundwater samples was actually a laboratory contaminant. The quality control method blank concentrations ranged from 4.10 μg/l to 7.60 μg/l, which is a similar range to that found in the well samples. This relation supports a conclusion that the CH_2Cl_2 detected in the samples does not reflect actual CH_2Cl_2 in the wells.

The other detected volatile organic compound, acetone, was present in 8 of the 15 wells. Acetone sources include solvents and paints. Acetone is also a common laboratory solvent and may represent laboratory contamination. Concentrations found in samples from Gate 19 wells include MW10 (6.2 μg/l), MW11 (6.6 μg/l), MW13 (6.1 μg/l), MW17 (8.3 μg/l), MW2 (6.0 μg/l), MW3 (6.3 μg/l & 7.0 μg/l), MW5 (6.0 μg/l), and MW9 (5.2 μg/l). Acetone found in the samples may be the result of field contamination of sampling equipment or samples. While on-site at JPG, field equipment used for groundwater sampling was stored in Building 106, a storage area provided by the facility. The building contained other non-sampling related equipment and supplies, thus, the sampling equipment and supplies may have been exposed to paint vapors containing acetone. Additionally, due to extreme cold weather during the sampling activities, samples were labeled and packaged for shipping inside of the same building. This represents another possible exposure time. Quality control field blanks, rinseate samples, and trip blanks all had concentrations of acetone ranging from 5.3 μg/l to 56 μg/l, which in some instances exceeded the concentrations found in the groundwater samples. This suggests that the contamination is from a source other than the groundwater and does not indicate acetone contamination in the monitoring wells.

The only semi-volatile organic compound detected in groundwater samples collected from the landfill was a phthalate. The A.D. Little analytical laboratory was unable to determine the exact phthalate detected. Phthalates are often associated with plasticizers, thus a likely source is the PVC plastic pipe used to construct the monitoring wells. Only the groundwater sample from MW7 contained a concentration of phthalate (5 μg/l), which exceeded the EPA proposed MCL of 0.004 mg/l (4 μg/l). This proposed MCL is not an enforceable standard but is useful for comparison purposes. Phthalates are also common laboratory contaminants and at the levels detected are not considered cause for concern.

Two metals, arsenic and mercury, were present in the monitoring wells. Arsenic was found in 3 monitoring wells. Considering the arsenic detected in the stream sediment samples the arsenic may be naturally occurring. Arsenic was detected in the following wells: MW1 (3.5 μg/l), MW11 (3.69 μg/l & 4.49 μg/l), and MW5 (3.44 μg/l). These concentrations do not exceed the MCL of 0.05 mg/l (50 μg/l) and are not a concern.

Mercury was found in 7 of the 15 monitoring wells. Mercury was selected as an analyte to determine if mercury fulminate was present in the landfill. Mercury fulminate is used for manufacture of caps and detonators for production of explosives in military ordnance. Explosives may have been disposed of in the landfill, thus, representing a source of mercury fulminate. Mercury concentrations found in groundwater samples included: MW10 (.878 μg/l), MW13 (1.09 μg/l), MW2 (2.41 μg/l), MW4 (2.12 μg/l), MW5 (1.25 μg/l), MW7 (3.16 μg/l), and MW83-1 (1,34 μg/l). Concentrations in MW2, MW4 and MW7 exceed the MCL of 0.002 mg/l (2 μg/l). It is recommended that these monitoring wells be resampled to confirm the presence of mercury.

4.2.4 *DU Impact Area*

The chemical analysis program for the DU Impact area at JPG consisted of analysis for explosives (Table 4). Complete analytical results are included in Appendix C.

Two explosives, Octahydro-,1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) and Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), were present in one monitoring well, MW2. The source for these explosives is most likely from unexploded or partially exploded ordnance. The explosives have apparently leached into the groundwater in the vicinity of MW2. The concentrations of the explosives are HMX 0.779 μg/l, and RDX 0.452 μg/l. Federal drinking water standards have not been determined for HMX and RDX. Further investigation is recommended. Two monitoring wells should be installed near MW2, one upgradient and one downgradient of MW2. The wells will be used to establish groundwater flow gradients, define the extent of contamination, and to identify the source of the contamination.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Entrance and Exit Streams

Analytical data acquired from the entrance streams did not include all of the analytes tested for in the exit streams. Available entrance stream results indicate that no detectable contamination has been released into the water or sediment upstream of the facility. It is recommended, however, that the entrance streams (EN1, EN2, EN3, EN4, and EN9) related to exit streams EX1, EX15, and EX17, which contained mercury contamination above the MCL, be sampled for metals to determine if mercury is entering the streams from a source upstream of JPG.

Samples should also be collected from widely spaced points along these streams upstream of the exit points in order to determine the source of the contamination. Both sediment and water samples should be collected.

The other chemical of concern that exceeded the federal criteria in an exit stream was silver, found at EX1. It is recommended that additional water and sediment samples be taken along Harberts Creek upstream from EX1 to above the photographic laboratory discharge point to locate the potential sources of the silver contamination.

The detected cyanide contamination at EX5 does not exceed the proposed MCL; however, additional sampling of the stream water should be considered to determine the source of cyanide and to determine if higher concentrations are present upstream of the exit point.

The detected arsenic in sediment samples of exit streams is most likely due to background levels of arsenic in the rocks; however, it is recommended that the sediment samples already collected from the entrance streams be tested for arsenic to confirm this assumption.

5.2 Gate 19 Landfill Groundwater Monitoring

Mercury at the Gate 19 Landfill exceeded federal criteria in wells MW2, MW4, and MW7. It is recommended that these wells be resampled to confirm the presence of mercury in the groundwater.

5.3 DU Impact Area

Concentrations of HMX and RDX explosives were detected in MW2 at the DU Impact area. Consequently, additional investigations are recommended at the site. Two monitoring wells should be installed near MW2, one upgradient and one downgradient of MW2. The purpose of the wells will be to establish groundwater flow gradients, and to help define the extent source of the contamination.

through wells MW-11, MW-07, 83-3, MW-02, MW-05, and terminates at location 81-4 (near the southwest corner of the Gate 19 Landfill). The land surface topography generally reflects the underlying surface of the bedrock, which dips to the north and south towards the two creeks that flow west along the north and south sides of the landfill. There is a small depression or scarp in the bedrock near MW-02. The Glacial Till thins towards the creeks from its maximum thickness of approximately 13 ft between wells MW-07 and 83-3. The groundwater level is below the surface of the bedrock and its surface is flat with a slight steepening slope towards the two bordering creeks. The groundwater level change between the July 1988 and October 1988 sampling efforts was minimal.

Cross Section B-B′ (Fig. 4.2-4) is also oriented approximately north to south. Section B-B′ originates at well 83-2 (located north of the landfill), runs through MW-12 (located within the central area of the landfill), and terminates at MW-04, on the southeast corner of the landfill. In this section, the surface of the bedrock dips to the north, with the angle of dip decreasing in the down-dip direction. The land surface topography mimics the bedrock surface but has a shallower slope; therefore, the Glacial Till thickens to the north. The groundwater level also slopes to the north, but with a shallower dip than the bedrock or land surface. The groundwater surface lies below the bedrock surface until it emerges into the overlying till between wells MW-12 and 83-2. The groundwater level did not appreciably change between the July 1988 and October sampling efforts.

Geologic Cross Section C-C′ (Fig. 4.2-5) is oriented roughly perpendicular to Sections A-A′ and B-B′, approximately east to west. Section C-C′ originates at well 81-1 (located east of the Gate 19 Landfill), runs through MW-17, MW-12, MW-13, MW-10 (located within the landfill), and terminates at MW-05 (located along the southwestern edge of the landfill). The land surface topography slopes away from the highest elevations in the center of the landfill to the landfill edges. The land surface begins a gradual rise to the east from a slight depression in the vicinity of MW-17. This depression contains approximately 2 ft of silt, probably washed from the higher parts of the landfill by rainfall. The surface of the bedrock is flat-lying east of MW-12, rises approximately 2 ft at MW-13, and drops 3 ft at MW-10. West of MW-10, the bedrock surface slopes slightly downward. The groundwater level is flat with a slope to the east. The water level is below that of the bedrock surface east of a point midway between MW-12 and MW-17. West of this point, the groundwater surface is in the Glacial Till. Between July 1988 and October 1988, the groundwater gradient decreased slightly.

Geologic Cross Section D-D' (Fig. 4.2-6) is composed of the three monitor well borings drilled around Bldg. 279. It originates at MW-14 (located southwest of Bldg. 279), runs through MW-15 (located next to the solvent disposal area north of Bldg. 279), and terminates at MW-16 (located southeast of Bldg. 279). The surface topography is flat, possibly due to its location on a surface drainage divide and the interdiction of man. Bedrock was only encountered in MW-14, at a depth of 40 ft. Zones of clayey gravels were encountered at varying depths in the three borings. It is unknown whether these are discontinuous beds or one continuous horizon. The groundwater levels show mounding of the groundwater occurs in the vicinity of MW-15. This could possibly be a result of the gravel-filled solvent disposal areas acting as a drain for surface water runoff, thereby creating an artificial groundwater recharge point. The groundwater surface rose slightly between the July 1988 and October 1988 sampling efforts, but did not rise a uniform distance in the wells.

In summary, the four geologic cross sections illustrate typical glacial deposition. The contact between the limestone bedrock and the heterogeneous Glacial Till is distinct and marked by a weathered and scoured surface. The stratigraphic information identified during the JPG subsurface investigation is consistent with that presented in the regional literature. The geologic framework of stratigraphy has been defined. The following section will evaluate the characteristics of the aquifer as well as the movement of groundwater within the study areas at JPG.

4.3 HORIZONTAL HYDRAULIC CONDUCTIVITY

The water-bearing units discussed in Sec. 4.2 are poor sources of water at the depths encountered on JPG. The porosity and permeability of glacial till are generally very low due to the abundance of silt- and clay-sized particles. This makes the till incapable of sustained groundwater flow as was observed in the development and sampling of MW-14, MW-15, and MW-16, which are screened almost wholly in the Glacial Till. The horizontal hydraulic conductivity (K), as derived from slug testing and analysis, for the poorly graded, compact Glacial Till ranges from 2.12×10^{-5} feet per minute (ft/min) to 6.82×10^{-5} ft/min with an average value of 5.25×10^{-5} ft/min (Table 4.3-1). The bedrock that underlies all of the study area is believed to be the Brassfield Limestone. It is well indurated and has a very low primary porosity. However, this aquifer has some poorly developed secondary porosity resulting from fracturing and subsequent solution. The range of hydraulic conductivity values in the bedrock as measured by the slug testing program, has been calculated to be 3.48×10^{-5} ft/min to 2.41×10^{-4} ft/min with an average value of 1.04×10^{-4} ft/min.

4.4 GROUNDWATER MOVEMENT

Groundwater contour maps were constructed for the study areas on JPG using water level data collected during the sampling efforts conducted

Table 4.3-1. Slug Test Data

Well I.D.	Formation	Hydraulic Conductivity (ft/min) Slug-in	Slug-out	Average
MW-01	B	*	1.21×10^{-6}	3.71×10^{-5}
		*	7.3×10^{-5}	
MW-09	B	5.9×10^{-5}	1.05×10^{-5}	3.48×10^{-5}
MW-11	B	1.87×10^{-4}	2.95×10^{-4}	2.41×10^{-4}
MW-14	G	9.46×10^{-5}	4.18×10^{-5}	6.82×10^{-5}
MW-15	G	2.12×10^{-5}	*	2.12×10^{-5}

Note: B = wells screened in bedrock.
G = wells screened in glacial till.

*Analysis of slug test data hampered due to inadequate data.

Source: ESE, 1989.

in July 1988 and October 1988 (Tables 4.3-2 and 4.3-3). These contour maps are used to determine groundwater flow directions and gradients.

Horizontal groundwater flow can be calculated using the following equation:

$$V = \frac{K}{n}\frac{dh}{dl}$$

where:
V = groundwater flow rate (ft/sec),
K = hydraulic conductivity (ft/min),
n = porosity (dimensionless), and
dh/dl = hydraulic gradient (dimensionless).

It should be noted that this equation (Lohman, 1972) represents the average groundwater velocity in an aquifer, rather than the actual velocity between any two points in the aquifer. Use of this equation requires that three parameters (hydraulic gradient, porosity, and hydraulic conductivity) be determined.

Groundwater gradients were calculated using the groundwater contour maps presented in Figs. 4.4-1 through 4.4-4.

The second parameter in the equation is porosity or, more precisely, effective porosity. Effective porosity, or that portion of the total saturated void space from which water can drain under the influence of gravity, may be expected to be less than the total porosity. This is due primarily to the adhesion of some of the water in the pore space to soil grains by surface tension. The size of the interstitial spaces is the primary controlling factor in the ratio between effective porosity and total porosity. Porosity decreases with increases in the range of grain sizes present. Porosity also is affected by the shape of the grains, with an increase in porosity associated with an increase in the

Table 4.3-2. Groundwater Elevation Data for JPG Monitor Wells, July 1988

Well I.D.	Ground Elevation (ft-msl)	Well Elevation (ft-msl)	Depth to Water* (ft)	Groundwater Elevation (ft-msl)	Date of Measurement
MW-01	822.7	824.82	15.01	809.81	07/18/88
MW-02	827.1	829.72	16.20	813.52	07/18/88
MW-03	829.3	832.17	16.24	815.93	07/18/88
MW-04	831.2	833.68	15.63	818.05	07/18/88
MW-05	826.0	828.04	14.80	813.24	07/18/88
MW-07	827.8	830.62	18.69	811.93	07/18/88
MW-09	831.0	833.40	16.64	816.76	07/18/88
MW-10	827.9	830.37	15.74	814.63	07/18/88
MW-11	823.8	826.65	15.10	811.55	07/18/88
MW-12	828.8	831.33	14.30	817.03	07/20/88
MW-13	828.5	830.96	15.10	815.86	07/18/88
MW-14	865.2	867.78	13.90	853.88	07/18/88
MW-15	865.2	867.95	10.02	857.93	07/18/88
MW-16	864.5	867.51	13.35	854.16	07/18/88
MW-17	826.0	828.76	9.60	819.16	07/18/88
83-1	826.9	829.21	12.60	816.61	07/18/88
83-2	825.9	828.58	14.85	813.73	07/18/88
83-3	827.8	830.94	17.80	813.14	07/18/88
81-1	830.0	831.96	Dry	--	07/18/88
81-2	--	--	Dry	--	07/18/88
81-3	--	--	Dry	--	07/18/88
81-4	823.2	825.23	Dry	--	07/18/88

Note: Surveying data for wells 81-2 and 81-3 not available.
-- = not applicable.

*All measurements taken from top of PVC casing.

Source: ESE, 1989.

Table 4.3-3. Groundwater Elevation Data for JPG Monitor Wells, October 1988

Well I.D.	Ground Elevation (ft-msl)	Well Elevation (ft-msl)	Depth to Water* (ft)	Groundwater Elevation (ft-msl)	Date of Measurement
MW-01	822.7	824.82	14.20	810.62	10/18/88
MW-02	827.1	829.72	16.75	812.97	10/19/88
MW-03	829.3	832.17	15.69	816.48	10/19/88
MW-04	831.2	833.68	15.74	817.94	10/17/88
MW-05	826.0	828.04	14.75	813.29	10/19/88
MW-07	827.8	830.62	18.70	811.92	10/18/88
MW-09	831.0	833.40	16.40	817.00	10/18/88
MW-10	827.9	830.37	14.87	815.50	10/19/88
MW-11	823.8	826.65	15.10	811.55	10/18/88
MW-12	828.8	831.33	14.75	816.58	10/19/88
MW-13	828.5	830.96	15.20	815.76	10/19/88
MW-14	865.2	867.78	13.85	853.93	10/19/88
MW-15	865.2	867.95	8.80	859.15	10/19/88
MW-16	864.5	867.51	11.40	856.11	10/19/88
MW-17	826.0	828.76	10.65	818.11	10/17/88
83-1	826.9	829.21	12.59	816.62	10/17/88
83-2	825.9	828.58	15.15	813.43	10/17/88
83-3	827.8	830.94	17.94	813.00	10/17/88
81-1	830.0	831.96	Dry	--	10/17/88
81-2	--	--	Dry	--	10/17/88
81-3	--	--	Dry	--	10/17/88
81-4	823.2	825.23	Dry	--	10/17/88

Note: Surveying data for wells 81-2 and 81-3 not available.
-- = not applicable.

*All measurements taken from top of PVC casing.

Source: ESE, 1989.

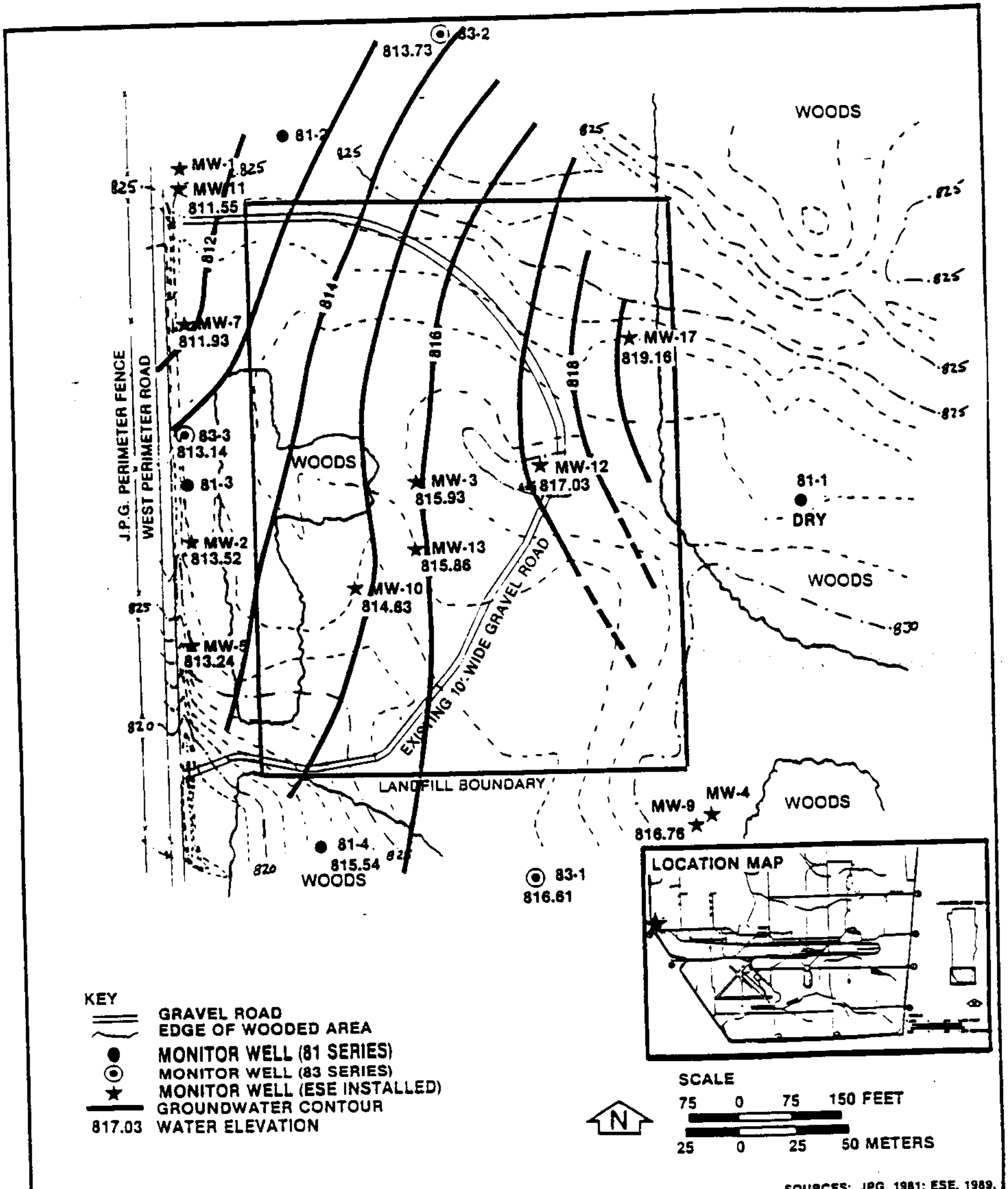


Figure 4.4-1
GROUNDWATER CONTOUR MAP, 7/18/88, GATE 19 LANDFILL, JEFFERSON PROVING GROUND

Prepared for:
U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland

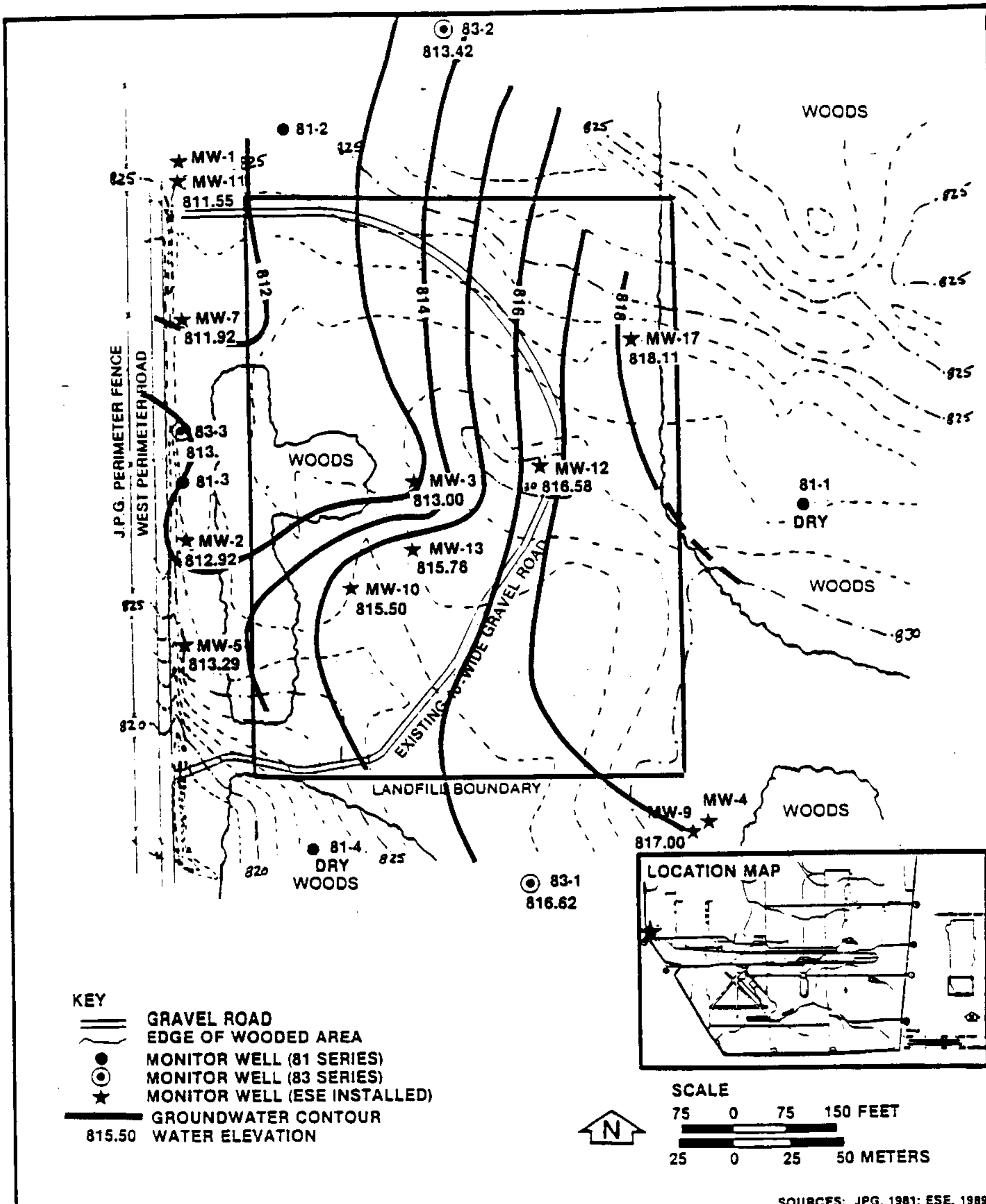
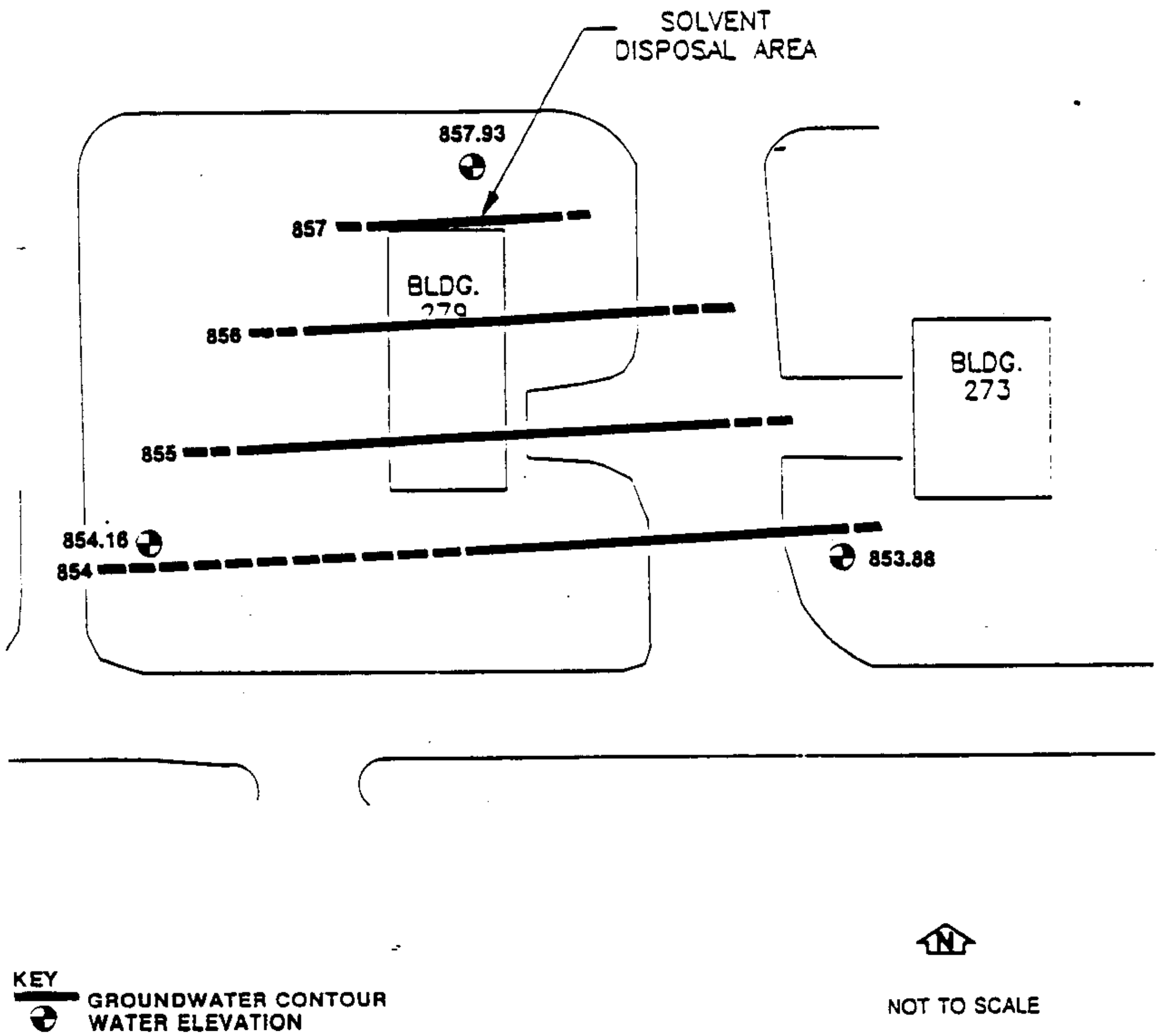


Figure 4.4-2
GROUNDWATER CONTOUR MAP, 10/17-19/88, GATE 19 LANDFILL, JEFFERSON PROVING GROUND

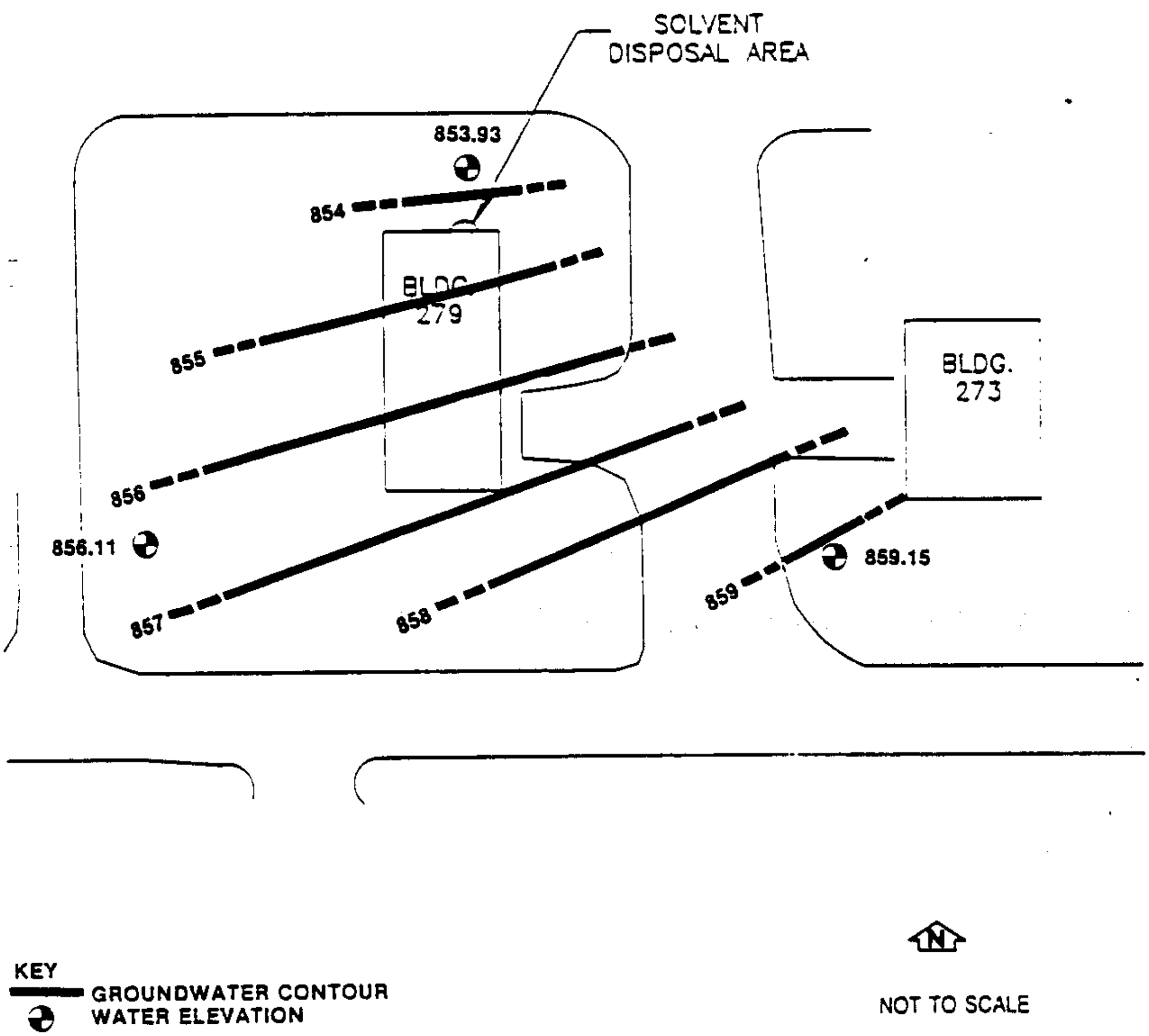
Prepared for:
U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland



SOURCE: ESE, 1989.

Figure 4.4-3
GROUNDWATER CONTOUR MAP, 7/18/88, BLDG. 279, JEFFERSON PROVING GROUND

Prepared for:
U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland



SOURCE: ESE, 1989.

Figure 4.4-4
GROUNDWATER CONTOUR MAP, 10/19/88,
BLDG. 279, JEFFERSON PROVING GROUND

Prepared for:
U.S. Army Toxic and Hazardous
Materials Agency
Aberdeen Proving Ground, Maryland

angularity of the grains. In both cases, the nature of the materials in the Glacial Till (poorly sorted, abundance of clay- and silt-sized materials) indicates that effective porosity is less than total porosity. The amount of this reduction can be determined in the laboratory; however, the gravity drainage of certain earth materials can take as long as 1 year. These test data are not available for the materials at JPG. For purposes of this report, an estimated value of effective porosity (0.35) has been used in all geohydrological calculations concerning the Glacial Till. This value is the midpoint of a range of typical values for glacial till, as presented by Davis and DeWiest (1966).

The porosity of the Brassfield Limestone (bedrock aquifer) was estimated to be 0.04. This value is typical for compact, crystalline limestones with no visible pores (Davis and DeWiest, 1966).

4.4.1 BLDG. 279

For purposes of this report, the groundwater gradient for the Bldg. 279 area was calculated along a flow line, perpendicular to the groundwater contours, which passes through monitor well MW-15 and terminates at the last contour line within the triangle formed by the 3 monitor wells (Figs. 4.4-1 and 4.4-2). These gradients were confirmed by calculating gradients using the 3-point method.

The average hydraulic gradient calculated for the Bldg. 279 area was to the south in July 1988 and to the south-southeast in October 1988, and was 4.4×10^{-2} (dimensionless).

Using the values of effective porosity and K previously described for the Glacial Till, the following calculations can be made:

Given: $K = 5.25 \times 10^{-5}$ ft/min

$n = 0.35$

$dh/dl = 0.044$ ft/ft

$$V = (5.25 \times 10^{-5} \text{ ft/min}/0.35)(0.044 \text{ ft/ft})$$

$$V = 6.6 \times 10^{-6} \text{ ft/min}$$

$$V = 1.1 \times 10^{-7} \text{ ft/sec}$$

$$V = 3.5 \text{ ft/yr}$$

The average groundwater velocity estimated for the Glacial Till in the Bldg. 279 area is 3.5 feet per year (ft/yr) to the south.

4.4.2 GATE 19 LANDFILL

The gradient for the groundwater within the Gate 19 Landfill was calculated along a flow line, perpendicular to the groundwater contours, which passes through well MW-17 and near well MW-11. The change in elevation of the groundwater surface along the flow line was measured from the groundwater contour maps (Figs. 4.4-3 and 4.4-4).

The hydraulic gradients within the Gate 19 Landfill for July 1988 and October 1988 were nearly identical and averaged 1.1×10^{-2} ft/ft. The direction of flow was to the west-northwest.

Using the values of effective porosity and K previously described for the limestone bedrock, the following calculations can be made:

Given: $K = 1.04 \times 10^{-4}$ ft/min

$n = 0.04$

$dh/dl = 1.1 \times 10^{-2}$ ft/ft

$$V = (1.04 \times 10^{-4}\ ft/min/0.04)\ (1.1 \times 10^{-2}\ ft/ft)$$

$$V = 2.86 \times 10^{-5}\ ft/min$$

$$V = 4.78 \times 10^{-7}\ ft/sec$$

$$V = 15\ ft/yr$$

The average groundwater velocity estimated for the limestone bedrock at the Gate 19 Landfill is 15 ft/yr to the west-northwest.

APPENDIX F
TOPOGRAPHIC MAP
(To be supplied with the Final Document.)

SURFACE WATER SAMPLING AND ANALYSIS
(Source: AEHA (U.S. Army Environmental Hygiene Agency) 1992. "Verification Stream Sampling and Regulatory Analysis, JPG," Appendix C, July 7-11.

TABLE C-1. RESULTS OF STREAM FIELD PARAMETER TESTS, JEFFERSON PROVING GROUND, MADISON, INDIANA

Field Sample Identification Number	pH (pH units)	Conductivity (μmhos/cm)	Temperature (°C)	Water Depth (ft.)	Bottom Condition	Stream Reach
EN-1	7.9	240	24.0	2.0-5.0	sandy/muddy	straight
EN-2	8.3	450	21.0	2.0-3.0	bedrock	straight
EN-3	7.9	550	24.5	1.0-2.0	muddy	straight
EN-4	7.4	600	21.0	2.0-3.0	rocky/gravelly	meander
EN-5	8.1	550	22.0	1.0-4.0	gravelly	straight
EN-9	7.8	390	20.5	0.5-1.0	gravelly/muddy	meander
EX-1	8.8	370	20.0	1.0-2.0	sandy	straight
EX-1-A	7.8	300	21.0	1.5-2.0	sandy to muddy	straight
EX-1-B	7.9	130	27.0	2.0-2.5	muddy	straight
EX-1-C	8.1	340	21.5	3.5-4.0	sandy to muddy	straight
EX-3	8.2	300	21.0	1.0-1.5	sandy	straight
EX-3-A	7.7	230	21.0	1.0-1.5	muddy	straight
EX-12	8.2	400	22.5	1.0-1.5	sandy	straight
EX-14	8.2	400	22.5	1.0-1.5	sandy	straight
EX-14-A	8.4	430	23.0	1.0-1.5	sandy to muddy	straight
EX-15	8.3	430	24.0	>6	grassy to muddy	meander
EX-17	8.3	430	24.0	>6	grassy to muddy	meander
EX-17-A	8.4	210	25.0	1.0-2.0	sandy/gravelly	straight
EX-17-B	8.2	420	21.0	1.0-2.0	bedrock	straight
EX-17-C	8.3	410	24.0	>6	muddy	meander

TABLE C-2. RESULTS OF STREAM WATER SAMPLES, JEFFERSON PROVING GROUND, MADISON, INDIANA

Field Sample Identification Number	Water Sample Results (mg/L) Arsenic	Mercury	Silver	Hardness
EN-1	0.003	<0.0002	<0.001	127
EN-2	<0.001	<0.0002	<0.001	231
EN-3	<0.001	<0.0002	<0.001	299
EN-4	<0.001	<0.0002	<0.001	281
EN-5	<0.001	<0.0002	<0.001	284
EN-9	<0.001	<0.0002	<0.001	215
EX-1	<0.001 (0.003)	<0.0002 (0.0027)	0.006 (0.0014)	200
EX-1-A	<0.001	<0.0002	<0.001	150
EX-1-B	0.002	<0.0002	<0.001	56
EX-1-C	0.002	<0.0002	0.004	172
EX-3	<0.001 (0.003)	<0.0002 (0.00056)	<0.001 (0.0003)	168
EX-3-A	<0.001	<0.0002	<0.001	114
EX-12	<0.001	<0.0002	<0.001	213
EX-14	<0.001	<0.0002	<0.001	213
EX-14-A	<0.001	<0.0002	<0.001	223
EX-15	<0.001	<0.0002	<0.001	238
EX-17	<0.001 (0.003)	<0.0002 (0.0025)	<0.001	241
EX-17-A	<0.001	<0.0002	<0.001	104
EX-17-B	<0.001	<0.0002	<0.001	242
EX-17-C	<0.001	<0.0002	<0.001	228
Indiana Water Quality Standards	0.190*	0.000012†	0.002 for hardness = 100† 0.004 for hardness = 150† 0.005 for hardness = 172†§ 0.007 for hardness = 200† 0.010 for hardness = 250† 0.013 for hardness = 300† 0.018 for hardness = 350†	
Federal Water Quality Standards**	0.190	0.000012	0.00012	

NOTES:

Field samples EX-12 and EX-14 are duplicate samples collected at location EX-14. Field samples EX-15 and EX-17 are duplicates collected at location EX-17.

All numbers in parentheses are sample results from the "Letter Report of Site Specific Sampling and Analysis Program Results," May 1992, Contract No. DAAA15-90-D-0007, prepared for the U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland, prepared by S.E.C. Donohue, Inc. Units are mg/L.

* This value is a fresh water chronic aquatic criterion designed to protect aquatic life from chronic toxic effects. It applies to all waters of the state outside of mixing zones. Conversations between USAEHA personnel and Mr. Dennis Clark of the Indiana Department of Environmental Management on 16 July 1992 indicated that the aquatic criteria, rather than the human health criteria would be applicable to the streams sampled at Jefferson Proving Ground. In addition, Mr. Clark indicated that background levels for arsenic in most streams in Indiana were in the range of 0.001 to 0.005 mg/L.

† This value is a fresh water chronic aquatic criterion designed to protect aquatic life from chronic toxic effects. It applies to all waters of the state outside of mixing zones. The value of this criterion is much lower than the arsenic or silver criterion because mercury has a log octanol-water partition coefficient greater than or equal to 2.0 and is considered to be bioconcentrating.

† This value is a fresh water acute aquatic criterion designed to protect aquatic life from acute toxic effects. The values are hardness related (hardness units are mg/L $CaCO_3$). It applies to all waters of the state outside of mixing zones. The Indiana Water Quality Standards do not list chronic aquatic criteria for silver.

§ This is a calculated value. For a hardness value of 172, the following calculation was made:

$$\frac{e^{(1.72 \ln \text{hardness} - 6.52)}}{2} = 5\ \mu g/L \text{ or } 0.005\ mg/L$$

** These values are fresh water chronic criteria designed to reflect the U.S. Environmental Protection Agency's recommendations on acceptable limits for aquatic life.

TABLE C-3. RESULTS OF STREAM SEDIMENT SAMPLES, JEFFERSON PROVING GROUND, MADISON, INDIANA

Field Sample Identification Number	Sediment Sample Results (µg/g) Arsenic	Mercury	Silver
EN-1	1.8	<0.10	<0.50
EN-2	7.9	<0.10	<0.50
EN-3	9.4	<0.10	<0.50
EN-4	11.0	<0.10	<0.50
EN-5	3.2	<0.10	<0.50
EN-9	3.5	<0.10	<0.50
EX-1	3.1 (4.10)	<0.10 (0.6)	<0.50 (1.46)
EX-1-A	7.1	<0.10	<0.50
EX-1-B	6.2	<0.10	<0.50
EX-1-C	3.7	<0.10	<0.50
EX-3	4.7	<0.10 (0.347)	<0.50
EX-3-A	7.3	<0.10	<0.50
EX-12	5.7	<0.10	<0.50
EX-14	5.4 (6.40)	<0.10 (0.026)	<0.50
EX-14-A	2.5	<0.10	<0.50
EX-15	3.5	<0.10	<0.50
EX-17	1.4 (7.10)	<0.10	<0.50
EX-17-A	8.1	<0.10	<0.50
EX-17-B	7.4	<0.10	<0.50
EX-17-C	9.1	<0.10	<0.50
Geometric mean	5.5		
standard deviation	2.7		
Background levels (literature values) Shacklette and Boerngen, 1984, reference 3*	$\bar{X}$ = 4.8 range = <0.1 - 73.0 s = 2.56 n = 527	$\bar{X}$ = 0.081 range = 0.01 - 3.4 s = 2.52 n = 534	
Wedepohl, 1969-1974, reference 5			range = 0.01 - 5.0
Bowen, 1979, reference 6			range = 0.01 - 8.0
State of Indiana 305-B Report on background levels of metals in their state (fonecon, Jim Stahl, IN Dept. of En. Management, 5 Aug 92)	29.0	0.44	<0.50

NOTES:

Field samples EX-12 and EX-14 are duplicate samples collected at location EX-14. Field samples EX-15 and EX-17 are duplicates collected at location EX-17.

All numbers in parentheses are sample results from the "Letter Report of Site Specific Sampling and Analysis Program Results," May 1992, Contract No. DAAA15-90-D-0007, prepared for the U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland, prepared by S.E.C. Donohue, Inc.

* Values are for the Eastern United States, east of the 96th meridian. X refers to the geometric mean of the sample group. Units for means, range, and standard deviation(s) are ppm. n = number of samples.

APPENDIX D
RARE PLANT LISTINGS
(Source: Indiana Department of Natural Resources, March 1993.)

Inventory of Special Plants and Natural Areas within the U.S. Army Jefferson Proving Ground in Southeastern Indiana - March 1993. Cloyce Hedge, In.DNR

Natural Communities:

Historically, the majority of JPG consisted of forested natural communities, predominantly flatwoods. Today, these areas are in various stages of regrowth or succession, ranging from open flats to relatively mature flatwoods. Other community types inventoried include floodplain forests, mesic upland forests, dry mesic upland forests, and cliffs along or in the vicinity of the major drainages. See Appendix C for color photographs of some of the natural communities discussed below.

Flatwoods

The flatwoods at JPG are the southern or bluegrass till plain natural community type and are characterized by having poorly drained acidic soils, predominantly Cobbsfork silt loams, and to a lesser degree Avonburg silt loams. These areas are in various stages of succession, ranging from open flats to regrowth flatwoods. Disturbances from past agricultural uses, and more recently fire are evident in most areas. These disturbances are undoubtedly a factor in species density and diversity. Although there is overlap of species among the various stages of successional flats, there are some noticeable differences in composition. See Appendix A for a list of species characteristic of this community type (includes all successional stages).

Bluegrass Till Plain Flatwoods: Characteristic species in this community are red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), pin oak (*Quercus palustris*), American beech (*Fagus grandifolia*), and tulip tree (*Liriodendron tulipifera*). More mature flatwoods tended to have more of an oak component and included swamp white oak (*Quercus bicolor*) and swamp chestnut oak (*Q. michauxii*). Cleared open flats were characterized by spike-rush (*Eleocharis tenuis*), early goldenrod (*Solidago juncea*), beard-tongue (*Penstemon digitalis*), narrow leaved mountain mint (*Pycnanthemum tenuifolium*), boneset (*Eupatorium perfoliatum*), hyssop-leaved boneset (*E. hyssopifolium*), and hardhack (*Spiraea tomentosa*).

Upland Forest

Most of the upland forest, aside from flatwoods, occurs at the north end of JPG, in areas dissected by the major westward flowing streams and their tributaries, e.g., Otter Creek, Graham Creek, Little Graham Creek, etc. The major type, by far, is mesic upland forest. There are also areas of dry-mesic forest on some of the south-facing slopes, and even a few, very small areas of dry forest. See Appendix A for a list of species characteristic of this community type. Brief descriptions are as follows:

Mesic Upland Forest: Mesic upland forests in this section of the Bluegrass Natural Region typically have a mix of canopy dominants (= mixed mesophytic). Characteristic trees include American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), black maple (*A. nigrum*), tulip tree (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), red oak (*Quercus rubra*), American basswood (*Tilia americana*), black walnut (*Juglans nigra*), and black cherry (*Prunus serotina*). Herbs are many, particularly the spring ephemerals.

Dry-mesic Upland Forest: This forest type is less common than the above, occurring mainly on better drained upper slopes that have a south or west aspect. Oaks are more common on these sites, including chinquapin oak (*Quercus muhlenbergii*), white oak (*Q. alba*), and some black oak (*Q. velutina*). Other dominants include shagbark hickory (*Carya ovata*), blue ash (*Fraxinus quadrangulata*), white ash (*F. americana*), and hop hornbeam (*Ostrya virginiana*). Because of the small area of this type at JPG, and the overlap between it and the mesic forest, species found here are included in Appendix A.

Dry Upland Forest: This is a very uncommon type at JPG, restricted to the crests of the steepest, rockiest, south and southwest facing slopes. The reason for the rarity is perhaps due to the relatively deep, rich soils that occur in the entrenched valleys of the till plain. Such soils apparently retain sufficient moisture to preclude the development of dry forests. Some canopy trees are black oak (*Quercus velutina*), scarlet oak (*Q. coccinea*), white oak (*Q. alba*), redbud (*Cercis canadensis*), and red cedar (*Juniperus virginiana*). Characteristic species include poverty grass (*Danthonia spicata*), leather flower (*Clematis viorna*), nodding onion (*Allium cernuum*), low bush blueberry (*Vaccinium pallidum*), hairy hawkweed (*Hieraceum gronovii*), and *Carex artitecta*.

Floodplain Forest

Because of the few sizable streams that flow through the property, and the narrowness of the valleys through which they flow, floodplain forests are a rather minor component of JPG's forest system. For the most part, they are similar to some of the mesic ravine flora, but other species, more tolerant of wetness, are also present. American sycamore (*Platanus occidentalis*), Eastern cottonwood (*Populus deltoides*), boxelder (*Acer negundo*), silver maple (*A. saccharinum*), red maple (*A. rubrum*), bluebells (*Mertensia virginiana*), false mermaid weed (*Floerka proserpinacoides*), blue-eyed Mary's (*Collinsia verna*), and cutleaf coneflower (*Rhudbeckia laciniata*) are typical.

Limestone Cliff

All cliffs observed at JPG were composed of limestone. They are for the most part small, and confined to the borders of the larger westward-flowing streams at the northern end of the property, e.g., Otter Creek, Graham Creek, etc. Some smaller cliffs and isolated boulders were noted on the higher slopes of hills in the above-mentioned stream systems. Limestone cliffs are typically rather rich floristically, and are prime areas for rare species, e.g. *Dentaria diphylla* and *Veratrum woodii*. Characteristic species include columbine (*Aquilegia canadensis*), Hepatica (*Hepatica acutiloba*), bulblet fern (*Cystopteris bulbifera*), live forever (*Sedum ternatum*), wild hydrangea (*Hydrangea arborescens*), blue ash (*Fraxinus quadrangulata*), and running euonymus (*Euonymus obovatus*).

Rare Plants:

Twenty-nine species of listed plants were found during the survey (Table IV). The locations of these species are shown on general site maps (Figure 4). These species are described in Appendix B, and nine of them are illustrated in Appendix C.

Table IV. Endangered, threatened, rare and watch list plants discovered in Jefferson Proving Ground.

Species name	Common name	Status
Agalinis fasiculata	clustered foxglove	E
Bartonia paniculata	twining bartonia	E
Botrychium oneidense	blunt-lobe grape fern	R
Carex abscondita	thicket sedge	WL
Carex louisianica	Louisiana sedge	R
Carex woodii	pretty sedge	R
Chimaphila maculata	spotted wintergreen	WL
Cimicifuga racemosa	black bugbane	WL
Ctenoptis elliptica	elliptical rushfoil	E
Dentaria diphylla	crinkleroot	R
Eupatorium rotundifolium	round-leaved boneset	E
Hydrastis canadensis	goldenseal	WL
Linum striatum	ridged yellow flax	R
Lycopodium clavatum	running pine	R
Lycopodium obscurum	tree clubmoss	E
Lygodium palmatum	climbing fern	E

Oenothera perennis	small sundrops	R
Panax quinquefolium	American ginseng	WL
Panax trifolium	dwarf ginseng	R
Platanthera lacera	green-fringed orchis	WL
Platanthera peramoena	purple fringeless orchis	WL
Rhexia mariana var. *mariana*	Maryland meadow beauty	E
Sagittaria australis	longbeak arrowhead	R
Spiranthes ovalis	lesser ladies'-tresses	R
Spiranthes tuberosa	little ladies'-tresses	R
Strophostyles leiosperma	slick seed wild-bean	T
Veratrum woodii	false hellebore	WL
Viola blanda	smooth white violet	R
Woodwardia areolata	netted chain fern	E

Status: E - Endangered; T - Threatened; R - Rare; WL - Watch List

Figure 4a. Location of listed species found in the northern section of Jefferson Proving Ground (map next page).

1 = *Bartonia paniculata*, *Lycopodium obscurum*

2 = *Bartonia paniculata*, *Lygodium palmatum*, *Viola blanda*, *Woodwardia areolata*

3 = *Carex louisianica*, *Linum striatum*, *Spiranthes ovalis*

4 = *Platanthera lacera*, *Viola blanda*

5 = *Carex woodii*, *Cimicifuga racemosa*, *Hydrastis canadensis*, *Panax quinquefolium*

6 = *Bartonia paniculata*, *Chimaphila maculata*, *Lycopodium clavatum*

7 = *Botrychium oneidense*, *Panax trifolium*, *Sagittaria australis*

8 = *Dentaria diphylla*, *Viola blanda*

9 = *Dentaria diphylla*

10 = *Veratrum woodii*

11 = *Dentaria diphylla*, *Veratrum woodii*

12 = *Veratrum woodii*

13 = *Spiranthes tuberosa*

14 = *Agalinis fasciculata*, *Crotonopsis elliptica*, *Strophostyles leiosperma*

15 = *Dentaria diphylla*, *Veratrum woodii*

16 = *Carex louisianica*

17 = *Agalinis fasciculata*, *Bartonia paniculata*, *Eupatorium rotundifolium*, *Lycopodium clavatum*

18 = *Carex abscondita*, *Lycopodium clavatum*, *Viola blanda*

19 = *Bartonia paniculata*, *Carex louisianica*, *Eupatorium rotundifolium*, *Lycopodium clavatum*, *Lycopodium obscurum*, *Platanthera lacera*, *Woodwardia areolata*

20 = *Bartonia paniculata*, *Eupatorium rotundifolium*, *Lycopodium obscurum*, *Viola blanda*, *Woodwardia areolata*

APPENDIX E
HYDROGEOLOGY AND SOILS INFORMATION

(Source: USACOE (United States Army Corps of Engineers Louisville District, 1992), "Environmental Impact Statement," September.)

(Source: ESE (Environmental Science and Engineering, Inc., 1989), "Remedial Investigation at Jefferson Proving Ground," Technical Report A011, June.)

J.3.1.2 Topography

JPG is located on the Muscatatuck Regional Slope of the Till Plains Section of the Interior Lowlands Physiographic Province (Figure J.3.1-1). The Muscatatuck Regional Slope is characterized by till deposits capping a rolling limestone plateau and crossed by deep rocky valleys. The topography of the southern two-thirds of JPG is flat, while that of the northern third is gently rolling.

Six almost parallel stream corridors flow across the site in a general west-southwesterly direction, as follows (Figure J.3.1-2):

- Otter Creek, which traverses the extreme northwestern corner of the site, crossing from Ripley into Jennings County. Little Otter Fork flows into Otter Creek from the east, draining off Old Timbers Lake at the northeast corner of the site and traversing the far northern section of JPG. Old Timbers Lake is a dam formed body of water.

- Graham Creek, a fairly substantial waterway south of Otter Creek, flowing also from Ripley to Jennings County.

- Little Graham Creek, next further south, flowing from Ripley to Jennings County.

- Big Creek, the largest of the drainages, located south of Little Graham Creek, and lies mostly in Jefferson County.

- Middle Fork Creek, the drainage just south of Big Creek, which runs about 1.5 miles north of base headquarters and permanent installations.

- Harberts Creek, the southernmost drainage, which runs across the southern tip of JPG, about 2/3 mile south of base headquarters.

Each creek has a well-developed drainage net consisting of numerous tributaries. Except for the two southernmost creeks, the drainages have cut into underlying limestone and have formed steep banks as much as 75 feet high.

J.3.1.3 Geology and Mineral Resources

The Till Plains Section is characterized by young glacial till plains of the Illinoisan glacial period. The section is comprised of silts and clays with minor amounts of gravel and rock fragments

source: COE 1991.

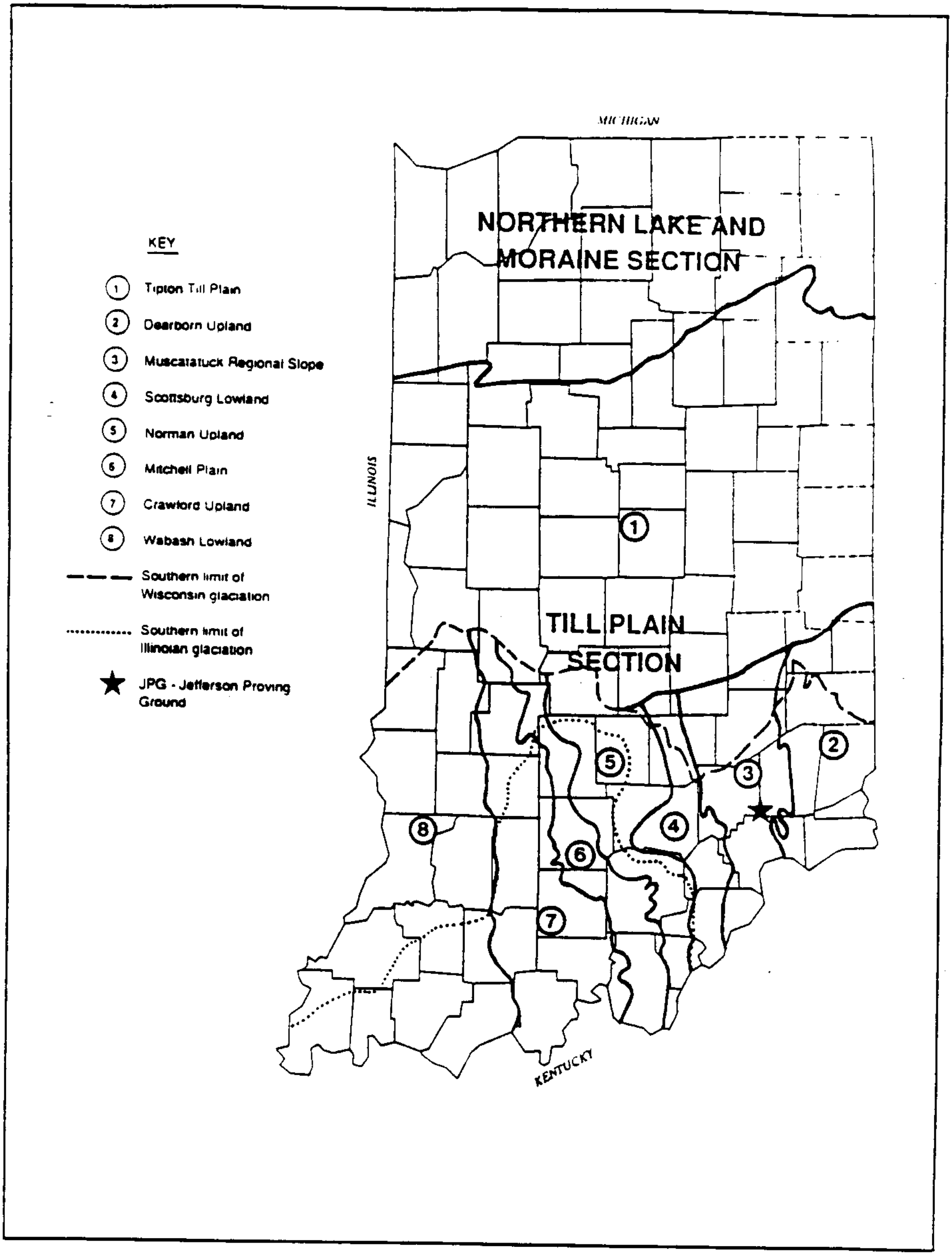


Figure J.3.1-1. Glacial land features of Indiana.

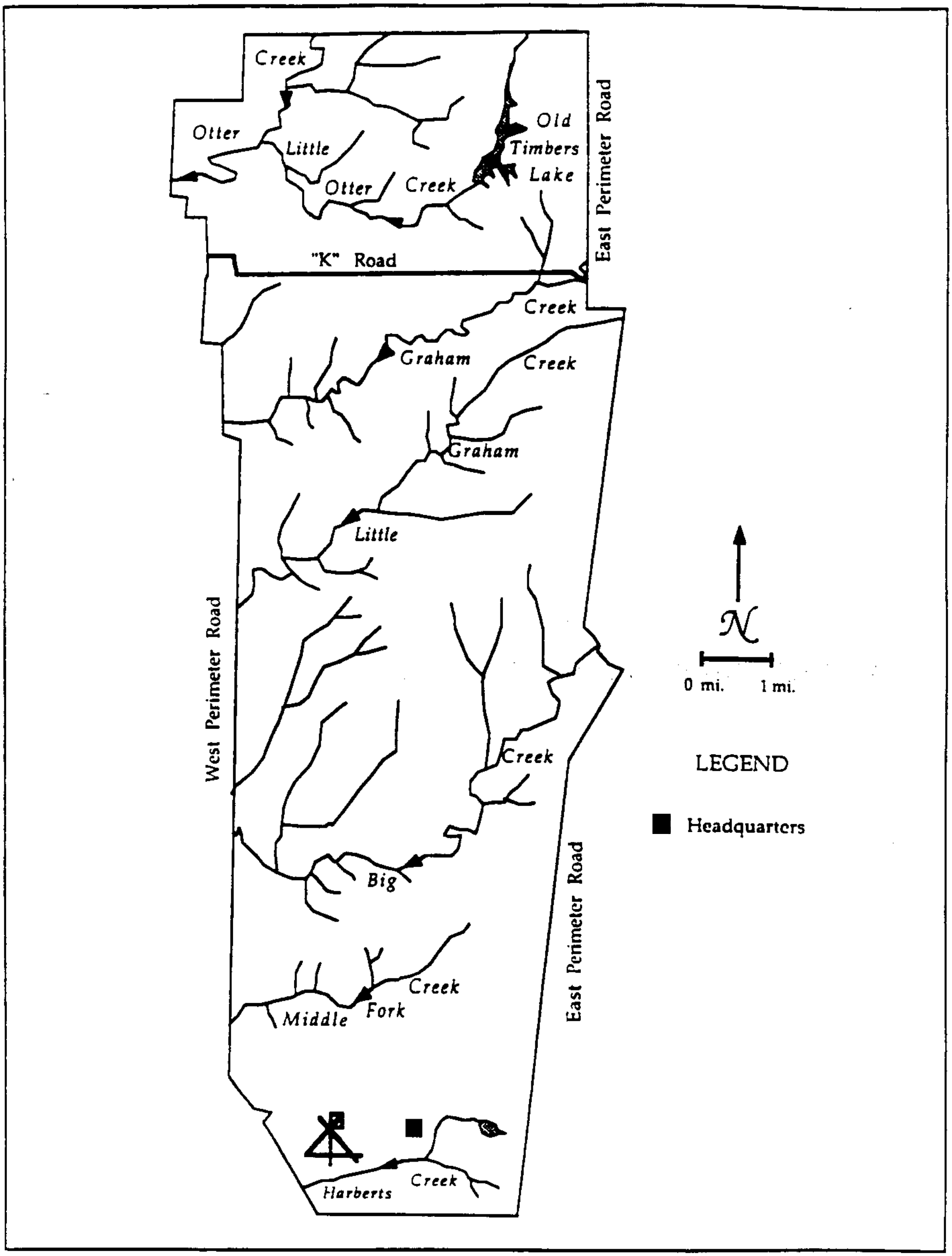


Figure J.3.1-2 Stream corridors within the JPC.

(USATHAMA 1980). The thickness of the glacial deposits in this region is approximately 50 feet (Hill, n.d.). Glacial moraine deposits are absent in the till plain.

The Illinoisan glacial till deposits at JPG are underlain by carbonate units of the from oldest to youngest Ordovician, Silurian and Devonian Periods (Figure J.3.1-3). These units overlie Cambrian clastic and carbonate rocks, which in turn overlie the Precambrian crystalline basement.

Ordovician limestones are exposed in the drainageways of Otter Creek and Graham Creek in the northern portion of the Proving Ground. The Black River, Middle Ordovician Limestone is the oldest unit exposed in the study area. It is fine grained and thickens to the south. The Trenton Limestone overlies the Black River limestone. It is fine to medium-grained, and includes extensive strata of dolomite and thins to the south. Overlying the Trenton Limestone are interbedded shales and limestones of the Middle to Late Ordovician Maquoketa Group.

Silurian carbonates underlie glacial till deposits throughout most of the JPG (Figure J.3.1-3). The oldest of these, the Brassfield Limestone, is a compact crystalline limestone which lies unconformably over the Ordovician units. The Salamonie Dolomite is a fine-grained, light gray, porous dolomite and dolomitic limestone overlying the Brassfield Limestone. The Laurel Member of the Salamonie Dolomite, a hard, light to dark gray limestone with zones of porous brown limestone, is the most widespread unit at JPG. The Louisville Limestone is a light gray to brown, fine-grained dolomite or dolomitic limestone that overlies above the Salamonie Dolomite.

The Devonian Shaly dolomite of the Devonian Muscatatuck Group underlies glacial till in a small area near the southwest boundary of the Proving Ground. These rocks unconformably overlie the Silurian layer (Shaffer 1981). The rocks described above are part of the Cincinnati Arch (Figure J.3.1-4). This structure separates the Illinois Basin to the west and the Michigan Basin to the north.

Mineralization in the carbonate bedrock of JPG includes pyrite and galena in the Trenton Limestone and fluorite and galena in the Muscatatuck Group. Sphalerite is found in most Ordovician, Silurian and Devonian units underlying JPG (Shaffer 1981). The economic potential of the various units is excellent for Trenton Limestone, poor for Maquoketa Group, fair for Salamonie Dolomite, poor for Louisville Limestone, and good for Muscatatuck Group (Shaffer 1981). Silurian and Devonian limestones are quarried in southeastern Indiana for aggregate and high purity chemical-stone products. Ordovician rocks are generally too shaly to be of commercial value (Hill, n.d.).

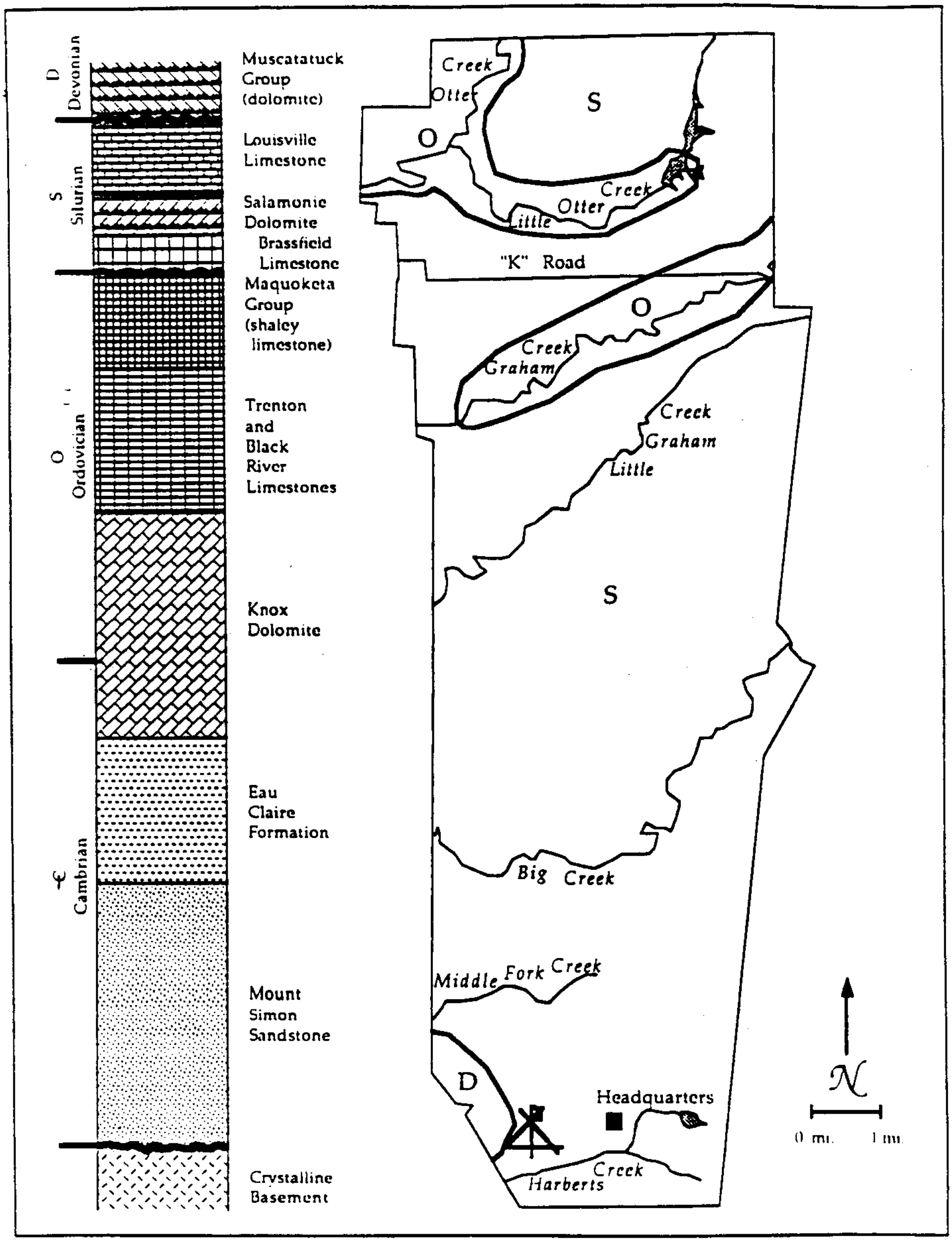


Figure J.3.1-3. Bedrock geology of the JPG.

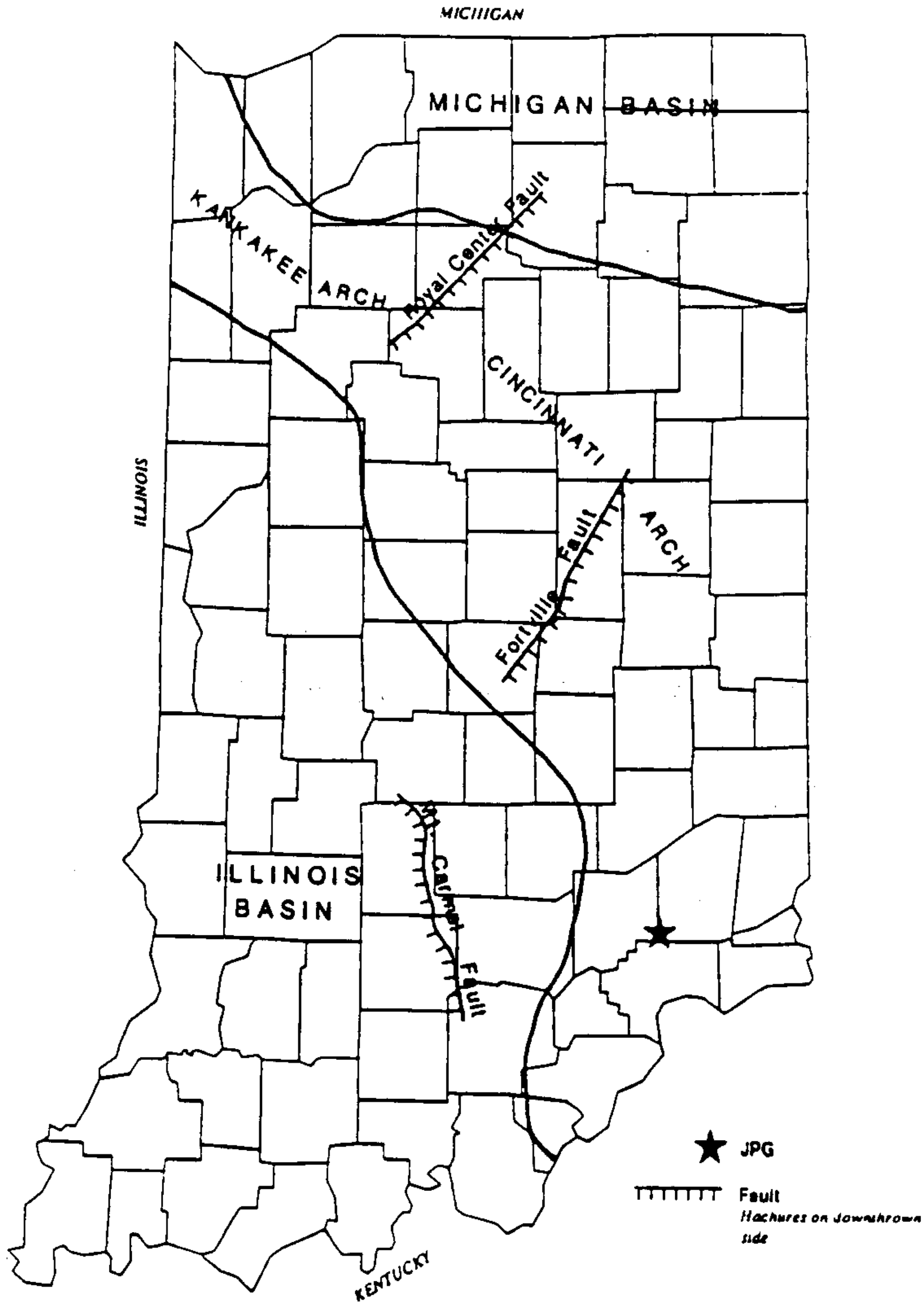


Figure J.3.1-4. Major subsurface geology structures of Indiana.

J.3.1.4 **Paleontology**

The glacial deposits are essentially free of fossils. Bedrock units of JPG were deposited during the Paleozoic Era, when marine invertebrates and marine plants were the dominant life forms. Ordovician rocks of the Black River and Trenton Limestones are rich in skeletal matter of marine macroinvertebrates (Laferriere et al. 1986). Silurian and Devonian rocks contain many types of fossil marine shellfish indicating depositions in shallow, warm seas. The Louisville Limestone includes corals, brachiopods, sponges, crinoids, bryozoans, gastropods, cephalopods and trilobites (Rexroad et al. 1981). Conodonts are prevalent throughout all the units. Paleontological finds at JPG are significant for biostratigraphic analyses; however, predicted finds are not anticipated to be unique or unusual.

J.3.1.5 **Soils**

JPG is dominated by two major soil associations: the Cobbsfork-Avonburg Association and the Cincinnati-Rossmoyne-Hickory Association. A combination of different soil types occur on or adjacent to stream beds (Figure J.3.1-5). These soils include Ryker, Grayford, Holton, Eden, Elkinsville, and Wirt soil types. The soils of JPG originate from glacial till and outwash, lacustrine deposits, limestone and shale residuum, windblown alluvium and loess. The soils are strongly weathered, leached and acidic. The soil fertility at JPG is low (USACE 1988). There are known and suspected releases of contaminants to soils on JPG which are discussed in Section J.3.4.5 (USATHAMA 1990). The characteristics of soils occurring on the property of JPG are summarized in Table J.3.1-1. The locations and extent of the general soils associations are identified in Figure J.3.1-5.

J.3.1.5.1 **Cobbsfork-Avonburg Soil Association**

Cobbsfork-Avonburg soils occupy more than 40 percent of the JPG. These soils are nearly level, with slopes ranging from 0 to 4 percent, and are found in the upland areas of the installation. Soils of the association are deep, and poorly to somewhat poorly drained. Slow permeability and a seasonably high perched water table (December through April) pose severe limitations to development. The Cobbsfork and Avonburg silt loams are severely limited as sites for roads and dwellings and are unsuitable for septic tank absorption fields (USDA 1985).

J.3.1.5.2 **Cincinnati-Rossmoyne-Hickory Soil Association**

Cincinnati-Rossmoyne-Hickory soils are found on gentle to moderately steep slopes along the drainageways of the installation. The soils are deep, moderately to well drained, and have slow permeability. Extreme wetness, poor porosity, and steep slopes make these soils less desirable for development than the Cobbsfork-Avonburg soils (USACE 1988). Occasional flooding and erosion are

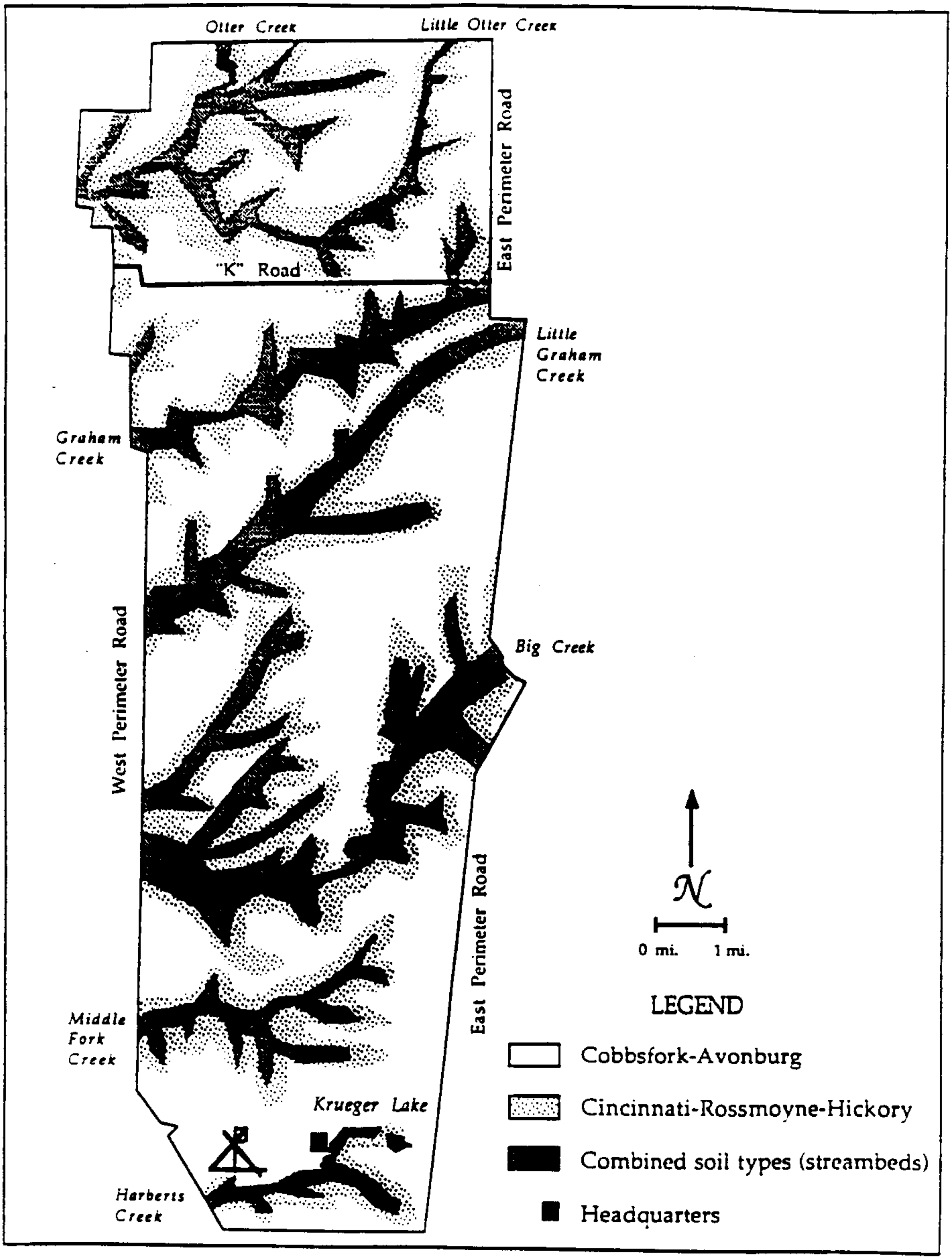


Figure J.3.1-5. Soil associations of the JPG.

Table J 3.1-1. General soil characteristics of JPG.

Soil name (map symbol)	Depth (inches)	USDA Textures	Liquid Limit	Plasticity Index	Permeability (in/hr)	Shrink-swell potential	Erosion factors		High Water Table (ft)
							K	T	
Avonburg (Ava, AvB2)	0 - 10	Silt loam	20 - 30	2 - 10	0.6 - 2.0	Low	0.43	4	1.0-3.0
	10 - 30	Silty clay loam, silt loam	30 - 45	10 - 20	0.6 - 2.0	Moderate	0.43		
	30 - 80	Silty clay loam	30 - 45	10 - 20	<0.06	Moderate	0.43		
Cincinnati CnB2, CnC2, CnC3)	0 - 6	Silt loam	25 - 40	3 - 16	0.6 - 2.0	Low	0.37	4 - 3	>4
	6 - 33	Silty clay loam, loam	26 - 40	8 - 15	0.6 - 2.0	Low	0.37		
	33 - 56	Clay loam, loam	25 - 40	6 - 20	0.06 - 0.6	Moderate	0.37		
	56 - 80	Silty clay loam, clay loam	25 - 40	5 - 20	0.06 - 0.6	Moderate	0.37		
Cobbs fork (CO)	0 - 12	Silt loam	15 - 30	3 - 10	0.06 - 0.2	Low	0.37	4	0.5 - 1.0
	12 - 27	Silt loam	15 - 30	3 - 10	0.06 - 0.2	Low	0.37		
	27 - 50	Silt loam, silty clay loam	20 - 35	5 - 15	<0.06	Low	0.37		
	50 - 77	Silt loam, silty clay loam	20 - 35	5 - 15	0.06 - 0.2	Low	0.37		
	77 - 80	Clay loam	30 - 40	10 - 15	0.06 - 0.2	Moderate	0.37		
Eden (Ee, D2)	0 - 5	Silty clay loam	35 - 65	12 - 35	0.06 - 0.6	Moderate	0.43	7	>6.0
	5 - 21	Flaggy silty clay, flaggy clay, silty clay	45 - 75	20 - 45	0.06 - 0.2	Moderate	0.28		
	21	Weathered bedrock					0.17		
Elkinsville (EkA, EkB)	0 - 8	Silt loam	25 - 40	5 - 15	0.6 - 2.0	Low	0.37	5	<6.0
	8 - 36	Silty clay loam, silt loam	35 - 40	8 - 18	0.6 - 2.0	Moderate	0.37		
	36 - 60	Silty clay loam, sandy clay loam	30 - 40	8 - 18	0.6 - 2.0	Moderate	0.37		
Grayford (GrC2, GrC3, GrD2, GrD3)	0 - 12	Silt loam	18 - 30	4 - 10	0.6 - 2.0	Low	0.37	5 - 4	>6.0
	12 - 22	Silty clay loam, clay loam	25 - 35	8 - 13	0.6 - 0.2	Moderate	0.37		
	22 - 45	Clay loam, loam	25 - 40	8 - 15	0.6 - 2.0	Moderate	0.37		
	45 - 52	Clay, silty clay	45 - 55	20 - 30	0.6 - 2.0	High	0.37		
	52	Unweathered bedrock							

Table 3.1-1. General soil characteristics of JPG (concluded).

Soil name (map symbol)	Depth (inches)	USDA Textures	Liquid Limit	Plasticity Index	Permeability (in/hr)	Shrink-swell potential	Erosion factors K	Erosion factors T	High Water Table (ft)
Hickory (HkC2, HkC3, HkD2, HkD3, HkE)	0 - 9	Silt loam	20 - 35	8 - 15	0.6 - 2.0	Low	0.37	5	>6.0
	9 - 54	Clay loam, silty clay loam, silt loam	30 - 50	15 - 30	0.6 - 2.0	Moderate	0.37		
	54 - 60	Clay loam sandy loam, loam	20 - 40	5 - 20	0.6 - 2.0	Low	0.37		
Holton (Ho)	0 - 8	Loam	<25	2 - 10	0.6 - 2.0	Low	0.37	5	1.0 - 3.0
	8 - 32	Fine sandy loam loamy sand	<25	4 - 12	0.6 - 2.0	Low	0.24		
	32 - 60	Stratified loamy sand to sandy clay loam	<25	2 - 14	0.6 - 2.0	Low	0.24		
Ryker (RyA, RyB2, RyC2, RyC3)	0 - 6	Silt loam	20 - 30	5 - 15	0.6 - 2.0	Low	0.37	5	>6.0
	6 - 67	Silt loam, silty clay loam clay loam	25 - 40	10 - 15	0.6 - 2.0	Moderate	0.37		
	67 - 80	Silt loam, silty clay loam clay loam	25 - 45	10 - 20	0.6 - 2.0	Moderate	0.37		
Rossmoyne silt loam (RoA, RoB2)	0 - 8	Silt loam	30 - 40	4 - 10	0.6 - 2.0	Low	0.37	4	1.5 - 3.0
	8 - 25	Silty clay loam, silt loam, clay loam	30 - 48	8 - 20	0.6 - 2.0	Moderate	0.37		
	25 - 80	Clay loam, silt loam, silty clay loam	25 - 40	9 - 19	0.06 - 0.6	Moderate	0.37		
Wirt silt loam (Wt)	0 - 15	Silt loam	<25	3 - 7	0.6 - 2.0	Low	0.37	5	>6.0
	15 - 50	Silt loam, loam	<25	3 - 7	0.6 - 2.0	Low	0.24		
	50 - 60	Stratified loam to loamy fine sand	<25	7	2.0 - 6.0	Low	0.24		

Source: USDA 1976, 1985

hazards which are characteristic of this association. The Cincinnati-Rossmoyne-Hickory silt loams are severely limited as sites for roadways or septic tank absorption fields (USDA 1985). Cincinnati soils make up approximately 24 percent of the association, 18 percent are Rossmoyne soils, and 14 percent are Hickory soils. The remaining 44 percent of the association are soils of minor extent (USDA 1985).

J.3.1.5.3 Combined Soil Types

The soils of this group, which includes Ryker silt loam, Grayford silt loam, Holton loam, Eden silty clay loam, Elkinsville silt loam, and Wirt silt loam are located on or adjacent to stream beds. Steep slopes, erosion and flooding represent the main limitations for most types of development. Development on these soils is not recommended (USACE 1988). The Elkinsville, Ryker and Wirt soils are considered prime farmland, and Holton soils are prime farmland where they are drained (USDA 1985).

4.0 HYDROGEOLOGICAL ANALYSIS

4.1 OVERVIEW OF METHODOLOGY

The purpose of the geohydrological assessment was to characterize the groundwater flow systems within the Gate 19 Landfill and Bldg. 279 areas and to identify aquifer characteristics required to define contaminant migration pathways. The specific objectives of the geohydrological program were to:

1. Describe the subsurface sediments and bedrock at the study area;
2. Define aquifers present at the study area; and
3. Estimate groundwater flow rates, direction, and horizontal gradients.

To complete the geohydrologic assessment, a comprehensive field program was conducted that included monitor well installation, water level surveys, and an aquifer testing program.

4.2 GEOLOGY

The initial objective of the drilling program at JPG was to identify positively the presence and thickness of the Pleistocene Glacial Till deposits as well as to characterize the underlying bedrock.

Three monitor well borings around Bldg. 279 and 21 borings distributed across the Gate 19 Landfill were used to characterize the area-wide stratigraphy. The contact between the Glacial Till and the underlying Brassfield Limestone was distinct and easily identified during the field investigation. At the Gate 19 Landfill, the Pleistocene Glacial Till ranged in thickness from 4 ft at monitor well 81-2 to 14.5 ft at monitor well MW-3. At Bldg. 279, only monitor well MW-14 fully penetrated the Glacial Till, encountering bedrock at 40 ft.

source: ESE 1989.

The Glacial Till was typically yellowish-brown to reddish-brown silty clay with occasional gravel and sand constituents. Gravel was a common constituent in the Till around Bldg. 279. The color was typically yellowish-brown to reddish-brown, but gray shades were common. Gray, red, orange, and brown streaking and mottling was also common. These unconsolidated materials were moderately cohesive and moderately plastic and moist. The permeability and porosity was low due to the high clay content.

The contact between the Glacial Till and the Brassfield Limestone was typically marked by a thin transition zone of angular to sub-rounded, weathered limestone fragments mixed with the overlying silty clay. The top of the bedrock was weathered and exhibited some surficial staining.

The Brassfield Limestone, as observed from rock cores from JPG, is a dense, fine-grained fossiliferous limestone. It is well-cemented and very hard. The color is predominately gray, but brown zones are common, usually grading back to gray with depth. Thin horizontal fractures are common, occurring every 1 to 18 in, but become rarer with depth. Occasional siliceous layers were encountered, as was a 4 to 4-ft thick, black, thin-bedded fissile shale. The shale was encountered at a depth of 90 and 96 ft in borings MW-6 and MW-8 respectively. The location and orientation of four geological cross sections are presented in Figs. 4.2-1 and 4.2-2. Cross Sections A-A', B-B', and C-C' are located in the Gate 19 Landfill. Cross Section D-D' is located in the Bldg. 279 area. The geologic cross sections are presented in Figs. 4.2-3 through 4.2-6. They were prepared to facilitate a better understanding of the subsurface stratigraphy at the Gate 19 Landfill and Bldg. 279 area.

Geologic Cross Section A-A' (Fig. 4.2-3) is oriented approximately north to south. It originates at MW-01 (at the northwest corner to the Gate 19 Landfill), runs along the western edge of the Gate 19 Landfill

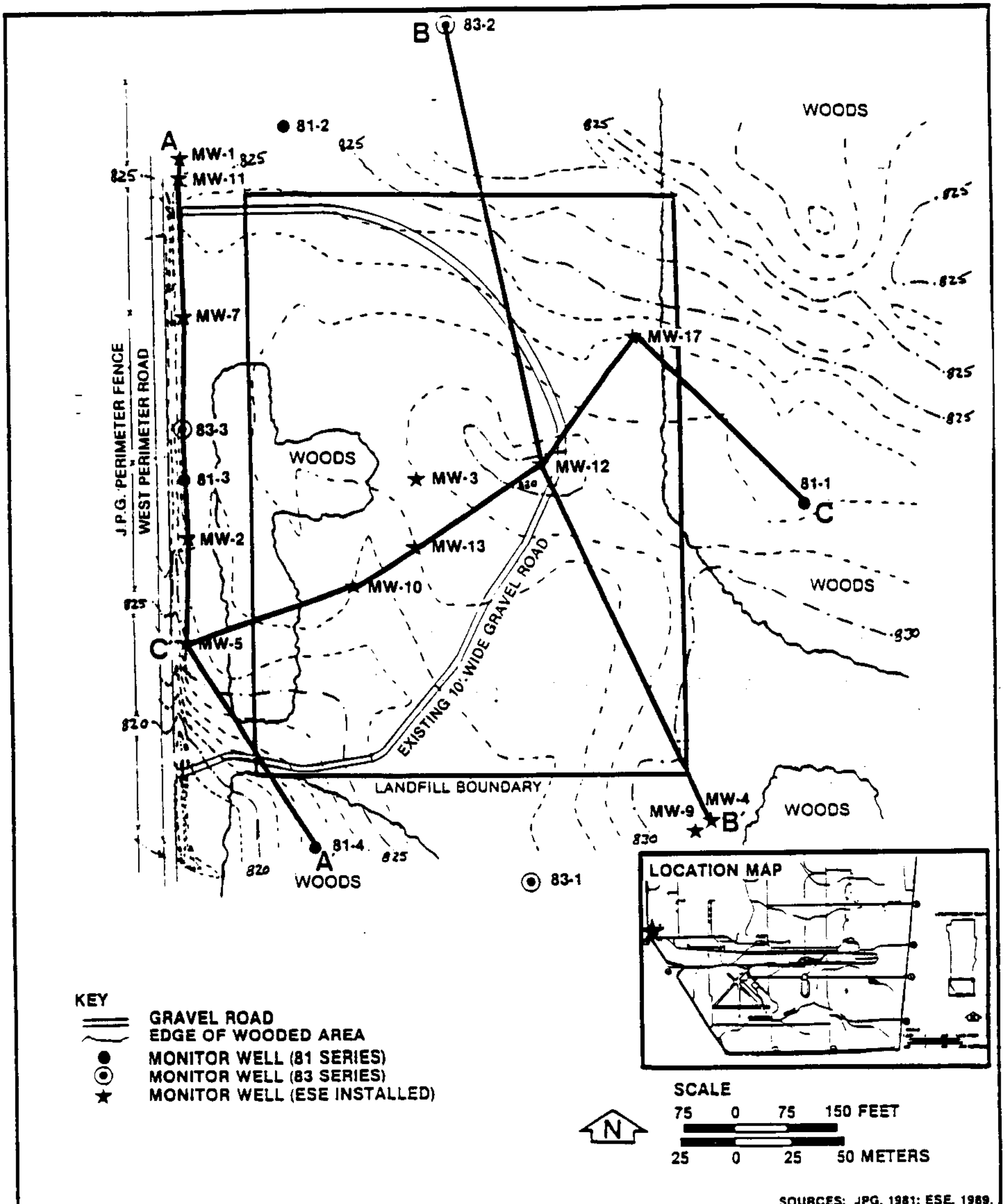
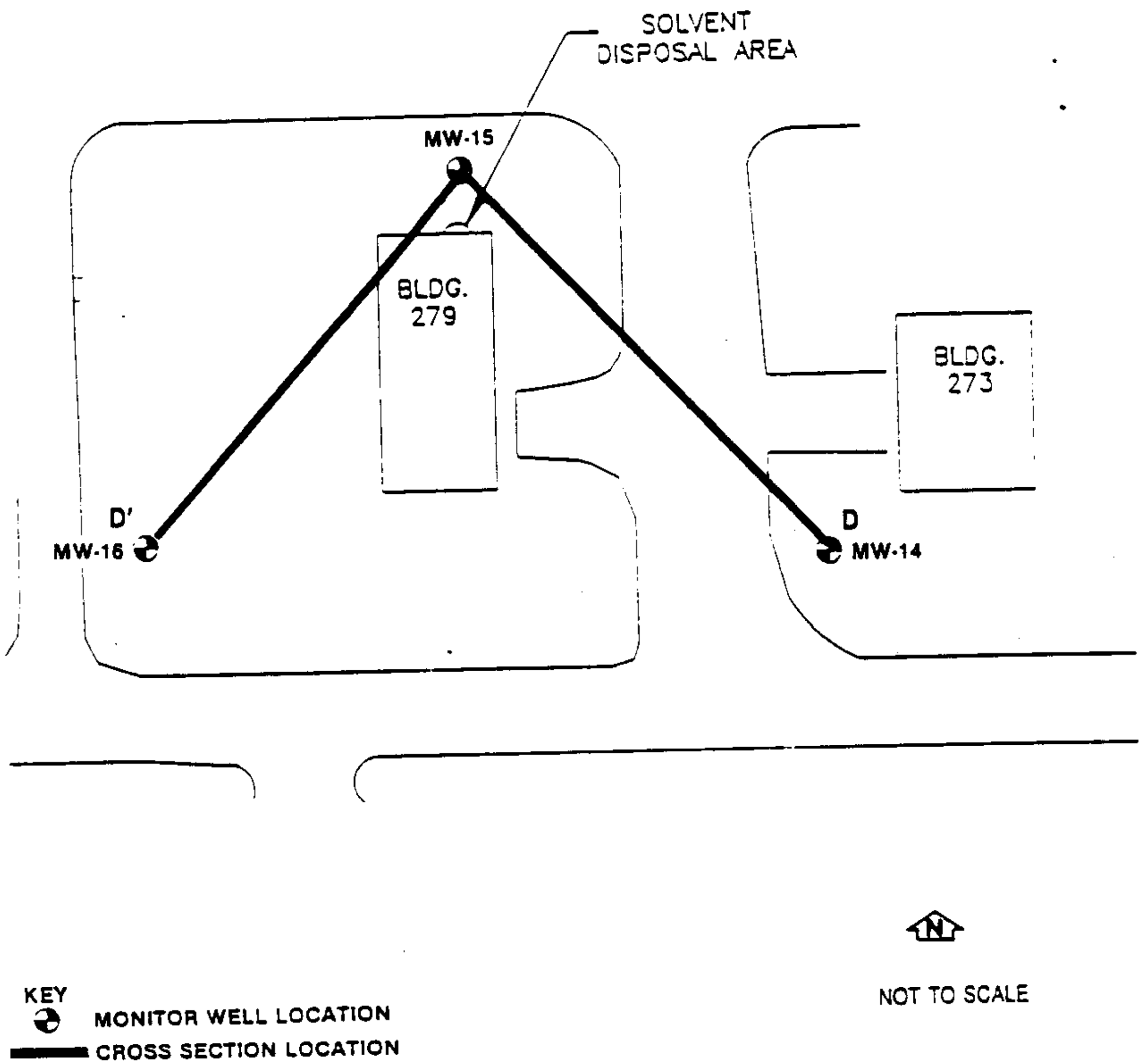


Figure 4.2-1
LOCATIONS OF GEOLOGIC CROSS SECTIONS,
GATE 19 LANDFILL,
JEFFERSON PROVING GROUND

Prepared for:
U.S. Army Toxic and Hazardous
Materials Agency
Aberdeen Proving Ground, Maryland



SOURCE: ESE, 1989.

Figure 4.2-2
LOCATION OF GEOLOGIC CROSS-SECTION,
BLDG. 279, JEFFERSON PROVING GROUND

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Materials Agency
Aberdeen Proving Ground, Maryland

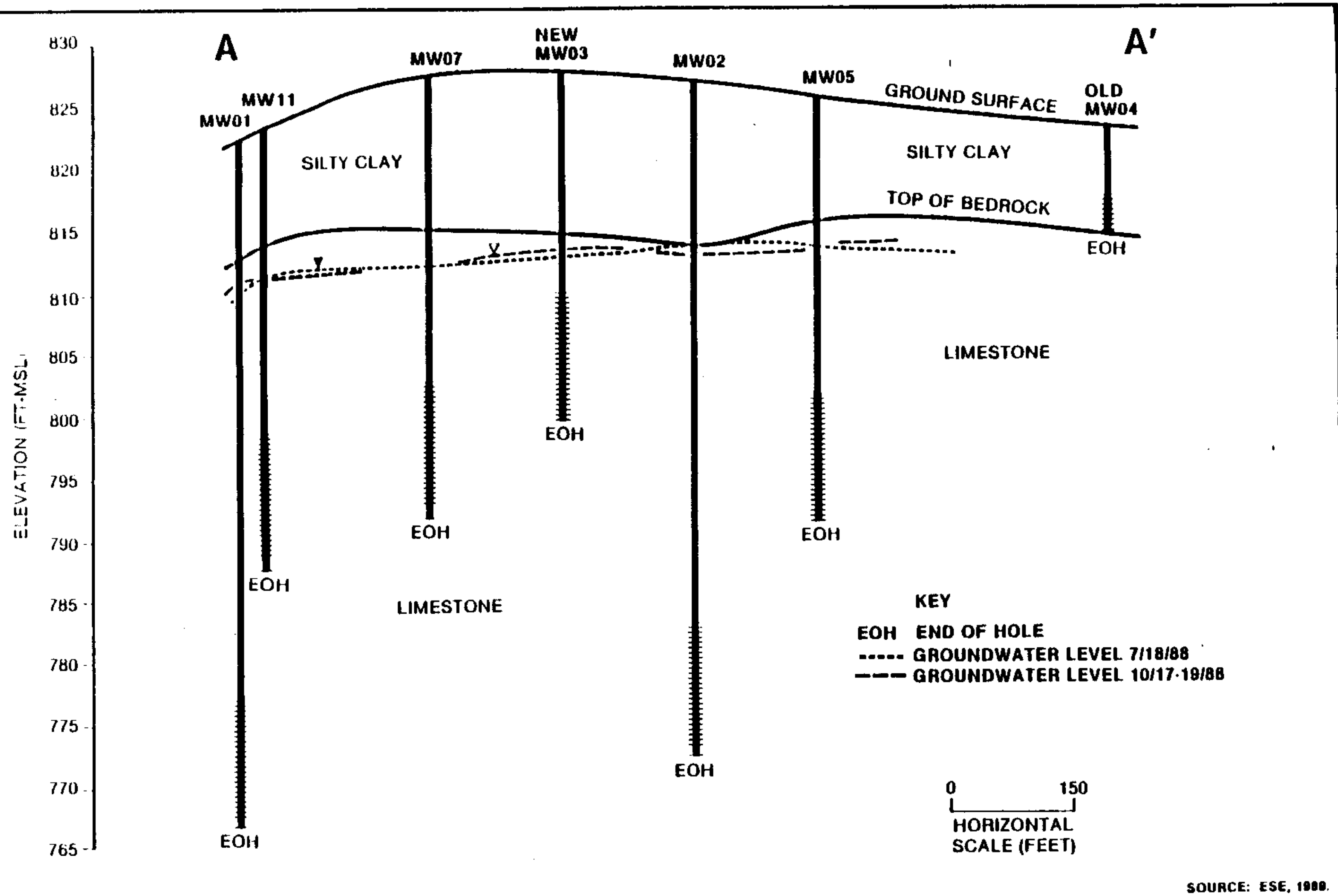

Figure 4.2-3
GEOLOGIC CROSS SECTION A-A'

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Aberdeen Proving Ground, Maryland

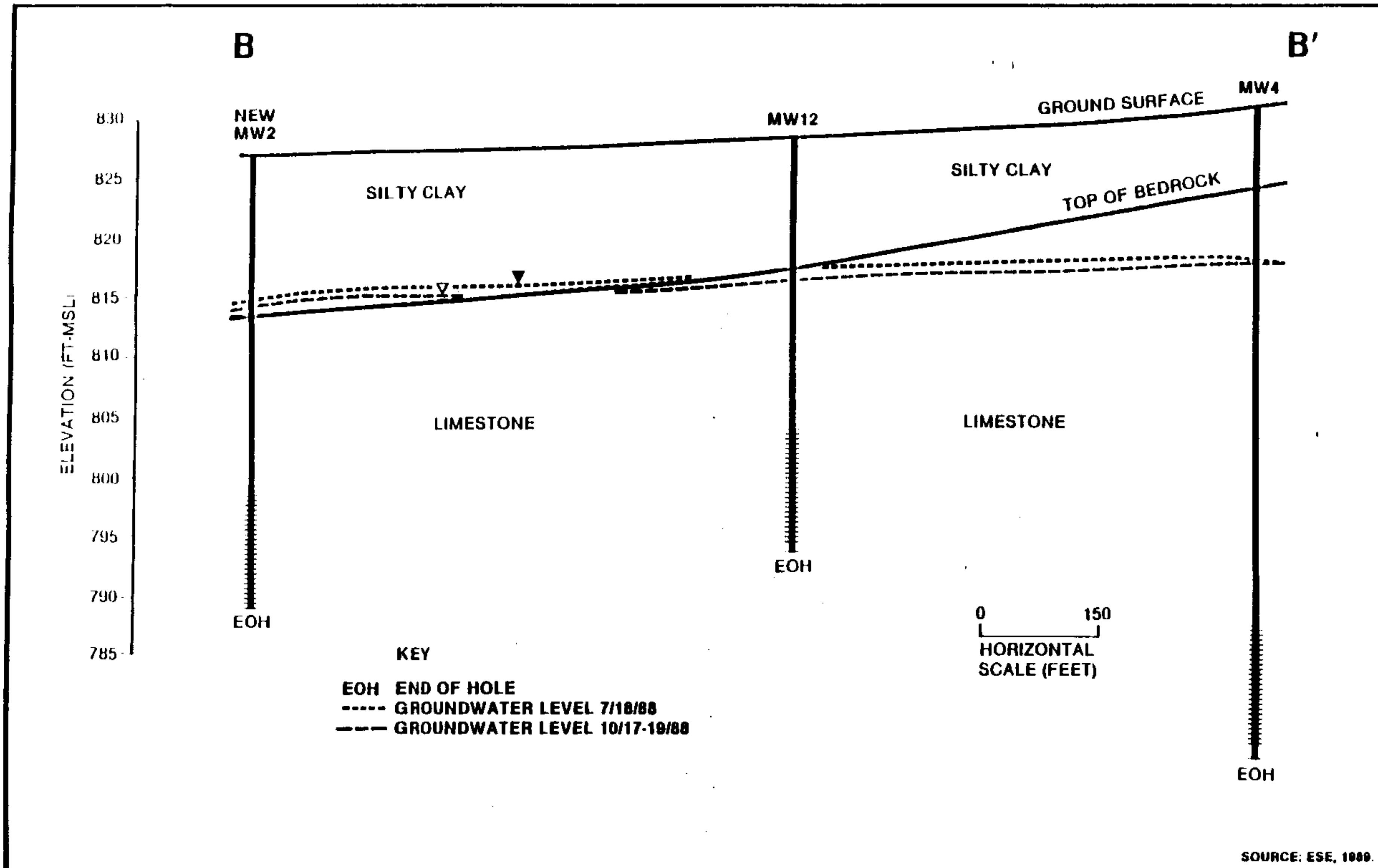

Figure 4.2-4
GEOLOGIC CROSS SECTION B-B'

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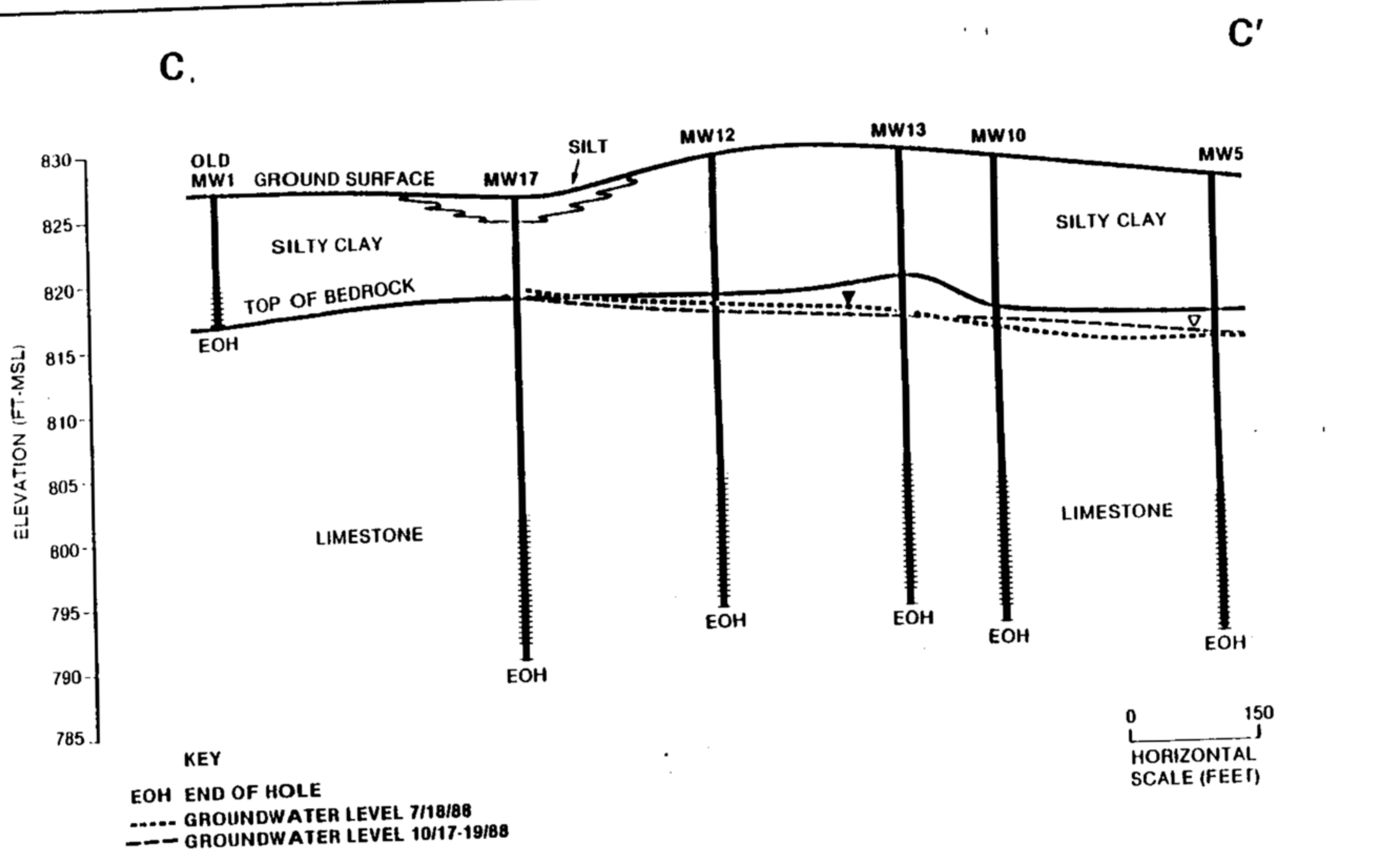

Figure 4.2-5
GEOLOGIC CROSS SECTION C-C'

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Aberdeen Proving Ground, Maryland

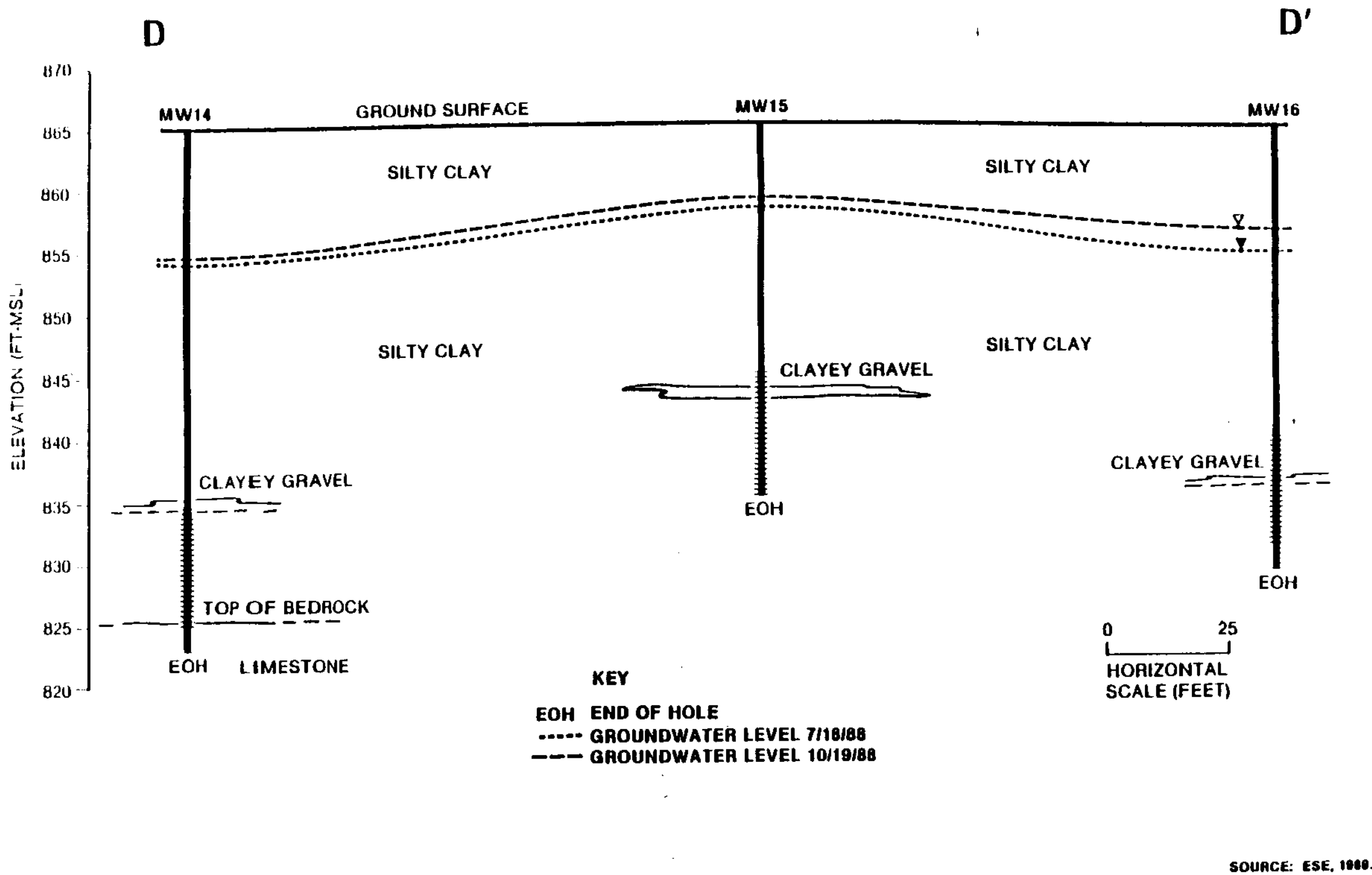

Figure 4.2-6
GEOLOGIC CROSS SECTION D-D'

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Aberdeen Proving Ground, Maryland