



**DEPARTMENT OF THE ARMY**  
 SAVANNAH DISTRICT, CORPS OF ENGINEERS  
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 SAVANNAH, GEORGIA 31402-0999

REPLY TO  
 ATTENTION OF:

November 28, 1990

Planning Division

*Project # IO4GA081300  
 Current Status RIFS*

Mr. James Barksdale  
 Federal Facilities Unit  
 U.S. Environmental Protection Agency  
 345 Courtland Street, NE.  
 Atlanta, Georgia 30365

Dear Mr. Barksdale:

Over the past year, the Savannah and Mobile Districts have been investigating a site in Macon, Bibb County, Georgia, under the purview of the Defense Environmental Restoration Program (DERP). This site was formerly a U.S. Navy Ordnance Facility, but is now being used as an industrial park.

As part of this investigation, five monitoring wells were installed at three suspected source areas: a landfill, an explosive demolition area, and a suspected buried cyanide contaminated tank. Soil samples were also collected from the explosive demolition area and a ponded area which contained several unlabeled drums. Analysis of the data collected during the investigation revealed that groundwater and soil contamination was encountered at concentrations that may require regulatory review. The results of the investigation are provided in the enclosed report titled "Engineering Report - Confirmation Study of the Former Macon Naval Ordnance Plant, Macon, Bibb County, Georgia."

I request that you review the report and provide any comments you may have to Mr. Robin Blackman, Environmental Resources Branch, U.S. Army Engineer District, Mobile, Post Office Box 2288, Mobile, Alabama 36628-0001.

Should you have any questions, please contact Mr. Blackman at (205) 690-2720 or Mr. David Crosby at (912) 944-5781.

**SISB/SAS**  
**NOV 29 1990**  
**PA - REGION 7**

Sincerely,

Paul S. Metz, Jr.  
 Chief, Environmental Resources  
 Branch

Enclosure

*11/30/90  
 40022*

FINAL  
ENGINEERING REPORT  
CONFIRMATION STUDY OF  
FORMER MACON NAVAL ORDNANCE PLANT  
MACON, GEORGIA

Prepared for:  
DEFENSE ENVIRONMENTAL RESTORATION PROGRAM  
U.S. ARMY CORPS OF ENGINEERS, MOBILE DISTRICT  
Mobile, Alabama

Prepared by:  
ENVIRONMENTAL SCIENCE & ENGINEERING, INC.  
Gainesville, Florida

Contract No. DACA010-88-D-0027

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September 1990

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LIST OF ACRONYMS

Allied	Allied Chemical Corporation
1,3-DNB	1,3-dinitrobenzene
2,4-DNT	2,4-dinitrotoluene
DOD	U.S. Department of Defense
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science & Engineering, Inc.
ft	foot
ft-bls	feet below land surface
ft-msl	feet above mean sea level
gal	gallon
gal/day/ft <sup>2</sup>	gallons per day per square foot
GSA	Government Services Administration
Maxson	Maxson Electronics Corporation
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
MNOP	Macon Naval Ordnance Plant
MRDL	Missouri River Division Laboratory
m/sec	meters per second
OVA	organic vapor analyzer
OVM	organic vapor meter
PAH	polycyclic aromatic hydrocarbon
PETN	pentaerythritol tetranitrate
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QC/QA	quality control/quality assurance
TCE	trichloroethene
TOC	top of casing

LIST OF ACRONYMS  
(Continued, Page 2 of 2)

µg/g	micrograms per gram
µg/L	micrograms per liter
µmho/cm	micromhos per centimeter
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
UST	underground storage tank
VOA	volatile organic analysis

## 1.0 EXECUTIVE SUMMARY

A confirmation study at the former Macon Naval Ordnance Plant (MNOP) was performed by Environmental Science & Engineering, Inc. (ESE) for the U.S. Army Corps of Engineers (USACE), Mobile District under contract number DACA01-88-D-0027. This investigation included a records review of available information related to the facility.

USACE installed five monitor wells at three suspected source areas: a landfill, an explosive demolition and testing area, and a suspected buried cyanide contaminated tank. During the USACE investigation, the tank was excavated and found to be a box, not an underground storage tank (UST). USACE also identified an area where a pond containing reddish-orange water was found, as well as approximately 500 unlabeled drums. This area is west and southwest of the landfill and is off the former MNOP property.

ESE completed two field efforts at MNOP. During the first effort (November 28 and 29, 1989), groundwater samples were collected from five monitor wells. Five composite soil samples were also collected. Three of the soil samples were from the explosive demolition area, and one each from the pond sediments and the drum area. The second field effort (July 25 and 26, 1990) involved the collection of soil and sediment samples. Confirmatory soil samples were collected from the explosive demolition area, and a soil sample from a representative background area was collected. A sample of sediments from the small creek flowing through an onsite drainage easement was collected. Also, a new area was investigated with shallow soil samples during the second field effort. This area was a drainage from a former oil recovery operation.

The most significant groundwater contamination found is the result of trichloroethene (TCE). TCE was identified with concentrations of



7,000 micrograms per liter ( $\mu\text{g/L}$ ) and 3,800  $\mu\text{g/L}$  in wells MW-2 and MW-3, respectively. MW-2 is located at the northeast corner of the landfill adjacent to the suspected buried cyanide tank. MW-3 is located on the east side of the explosive demolition area. Low concentrations of the explosive compounds 1,3-dinitrobenzene (1,3-DNB) and 2,4-dinitrotoluene (2,4-DNT) were detected in the groundwater from MW-3 at the explosive demolition area with concentrations slightly above suggested criteria levels. The background well, MW-1, showed the presence of low concentrations of pentaerythritol tetranitrate (PETN). This explosive is a component of primers and fuses, devices that were manufactured at the former MNOP. The only metals concentrations in the groundwater exceeding criteria were iron and manganese. Higher metals concentrations were generally found in the wells that showed the presence of other contaminants. Cyanide was detected in the groundwater from MW-2 and MW-3. The concentration of 0.133 milligrams per liter ( $\text{mg/L}$ ) in MW-2 and 0.005  $\text{mg/L}$  in MW-3 exceeds the state of Georgia's suggested criteria for cyanide of 0.0035  $\text{mg/L}$ .

Soil samples showing evidence of contamination were those collected from the pond and drum area and from below the former oil recovery operation. The contamination in the pond and drum area appears to be associated with polycyclic aromatic hydrocarbons (PAHs) and other heavy or long chain hydrocarbons. Below the former oil recovery operation, elevated levels of petroleum hydrocarbons were detected, as well as PETN. The presence of PETN in this area's soil may suggest a source of PETN observed in the groundwater. Higher levels of the metal barium in the pond and drum area may be associated with a different type of product than that below the former oil recovery operation, also suggesting a different source for the product.

## 2.0 GENERAL INFORMATION

### 2.1 INTRODUCTION

ESE is contracted by the USACE Mobile District, under Contract No. DACA01-88-D-0027, to conduct a confirmation study at the former MNOP, Macon, Georgia. Figure 2-1 indicates the ground location of the study area at the former plant site.

### 2.2 OBJECTIVES

The objectives of the investigative activities described in this report were designed to evaluate whether or not specific chemical contaminants are detectable in groundwater, soils, and sediments at the selected sampling locations. This confirmation study was completed to assess whether contaminants have resulted from U.S. Department of Defense (DOD) activities on the site. The investigative activities include:

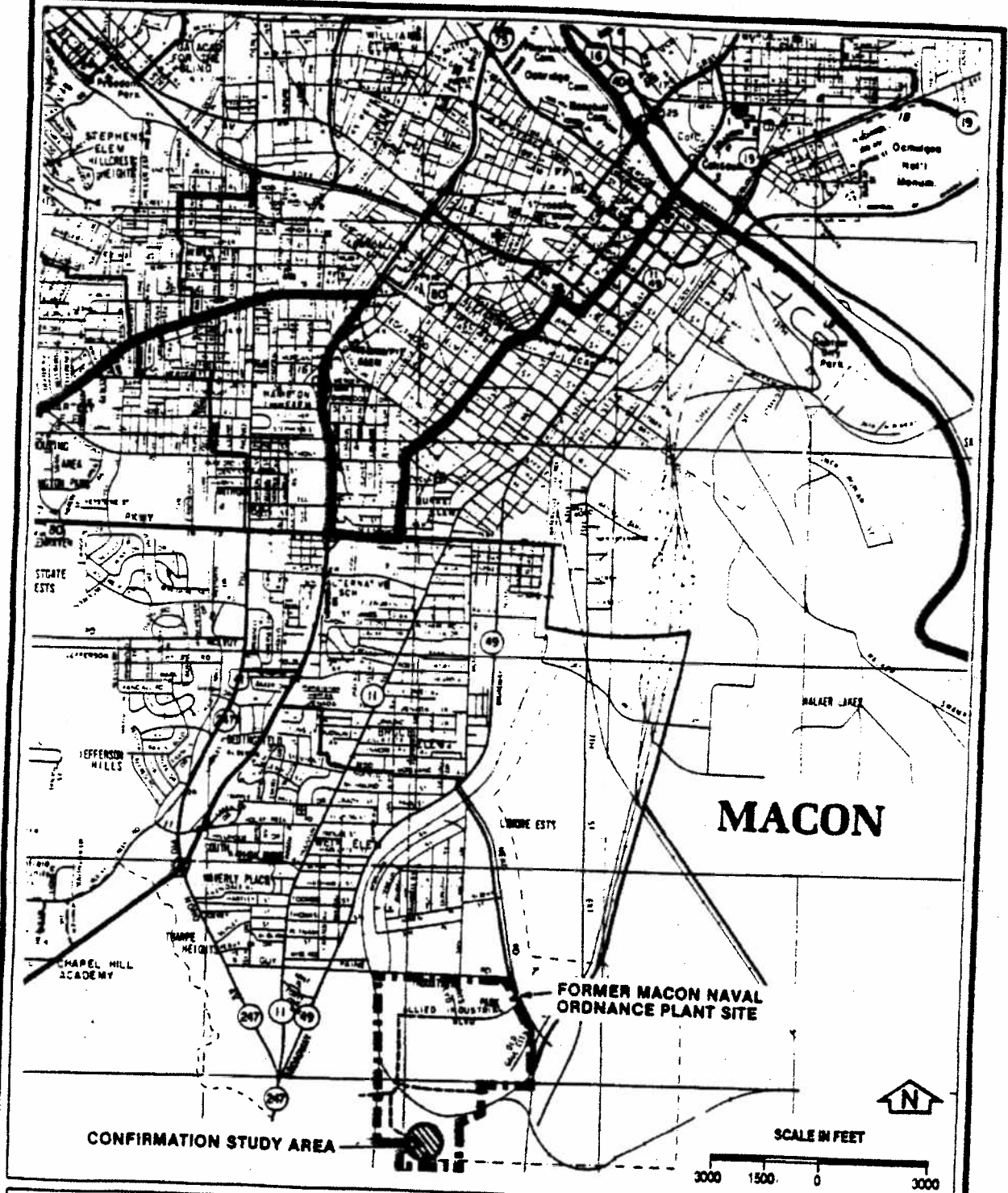
1. Review of readily available records pertaining to site activities during the period of DOD ownership;
2. Sampling and analysis of groundwater monitor wells installed by USACE Savannah District;
3. Collection and analysis of soil and sediment samples; and
4. Completion of Hazardous Ranking System Evaluation.

### 2.3 SITE LOCATION, DESCRIPTION, AND PHYSIOGRAPHY

#### 2.3.1 SITE LOCATION AND DESCRIPTION

The former MNOP is located on the south side of Macon, Georgia, north of Rocky Creek and east of U.S. Highway 129 (Bus) on Guy Paine Road (Figure 2-1). The plant encompassed a total of 433.25 acres.

The major portion of former MNOP is currently known as the Macon-Bibb County Allied Industrial Park. It is located in an industrialized area of the City of Macon. The southern border of the property is in the floodplain of Rocky Creek. The northeast corner of the site has been



**Figure 2-1**  
**LOCATION OF STUDY AREA OF FORMER**  
**MACON NAVAL ORDNANCE PLANT**

SOURCES: CHAMPION MAP CORPORATION, 1965; EBE, 1966.

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**Former Macon Naval**  
**Ordnance Plant**

obtained by the city and is being used as a recreation area, containing two ball fields and a swimming pool (built by the Navy). The western side of the property is bordered by a railroad track, which separates the site from Armstrong Cork Company's plant site. The brick buildings in the northern part of the site are being used as office buildings, maintenance shops, or are leased or proposed for lease for industrial purposes. The original explosive storage buildings (bunkers) have been removed, except for one on the northeast side of the property. Access to the entire site through the main gate is unrestricted. The property is partially fenced.

The Navy constructed and operated the facility between 1941 and 1965. The installation had numerous buildings, several miles of roads, and a sewage treatment plant. During DOD occupancy, wastes were disposed of in a 12- to 15-acre landfill area, located on the southwest corner of the property (see Figures 2-1 and 2-2). The southwest corner also contains a 1-acre fenced area that was utilized for explosive testing and burning of flammable waste materials. In addition, records indicate a buried cyanide contaminated tank is located adjacent to the north side of the landfill.

The property was declared surplus in 1965 and was sold to Maxson Electronics Corporation (Maxson) (New York) on December 1, 1965. Maxson subsequently sold the property to Allied Chemical Corporation (Allied). Allied then sold the property to the present owners, the City of Macon and Bibb County Industrial Authority. Currently, the property is used as an industrial park. According to the present owner, Maxson and Allied used essentially all of the facilities constructed by the Navy for beneficial purposes.

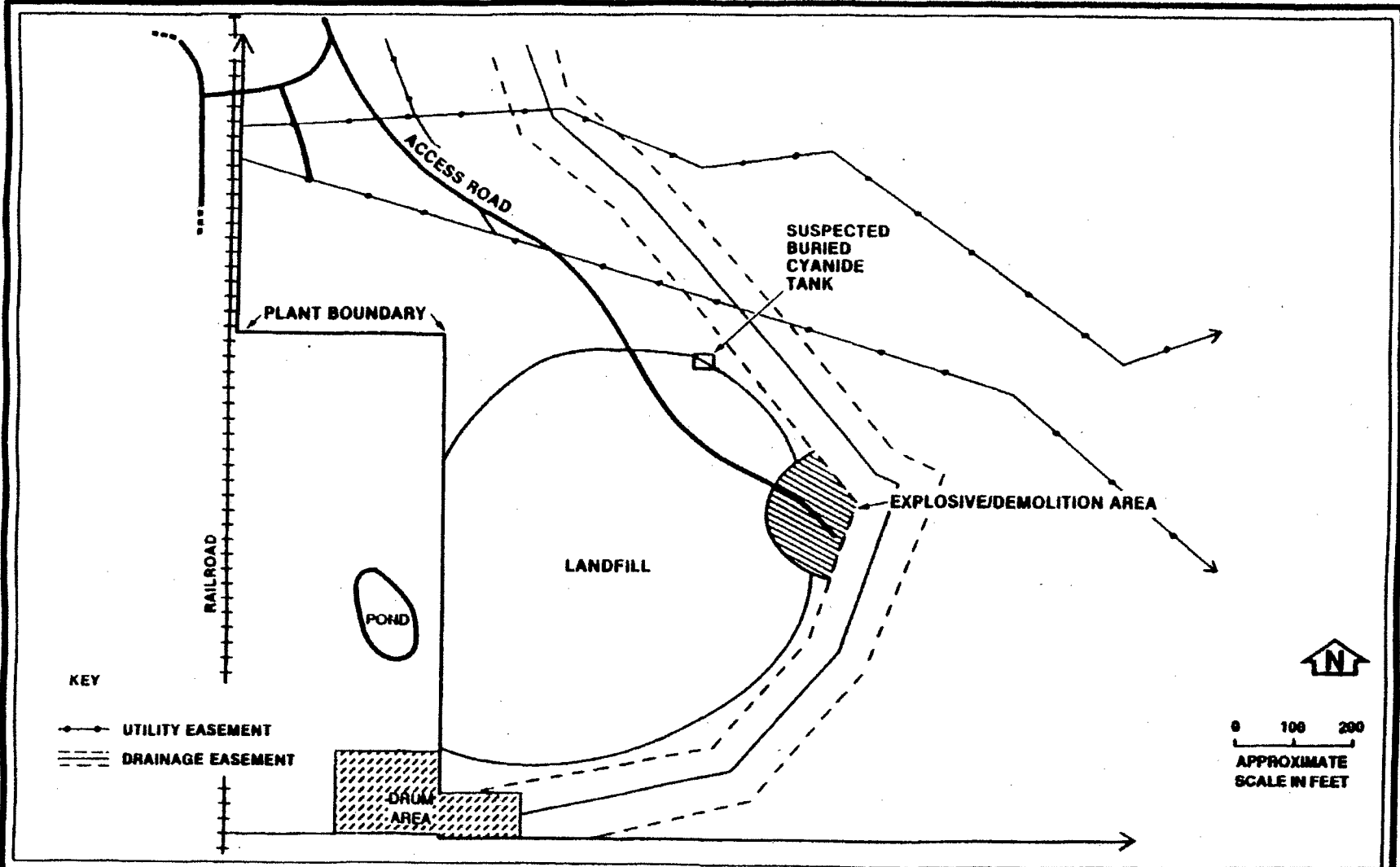


Figure 2-2  
DETAIL OF CONFIRMATION STUDY AREA AT  
FORMER MACON NAVAL ORDNANCE PLANT

SOURCE: ESE, 1990.

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### 2.3.2 PHYSIOGRAPHY

There are four major physiographic provinces in Georgia: the Valley and Ridge, the Blue Ridge, the Piedmont, and the Coastal Plain Provinces (Sondregger *et al.*, 1978). The Valley and Ridge Province and the Blue Ridge are outside the study area. The Piedmont Province and the Coastal Plain Province comprise the majority of the land area in Georgia, particularly in the Macon vicinity. The two provinces are separated by the physiographic feature known as the fall line. The fall line represents the contact between the Paleozoic/Precambrian Formations of the Piedmont, from the Cretaceous and younger sediments of the Coastal Plain Province. The fall line passes through Bibb County, approximately 10 miles north of the study area. The site is located in the southern portion of Bibb County, which is within the Southern Coastal Plain Major Land Resource Area (Woods, 1979). The area is characterized by broad, gently sloping ridges and relatively wide floodplains along numerous small drainage paths.

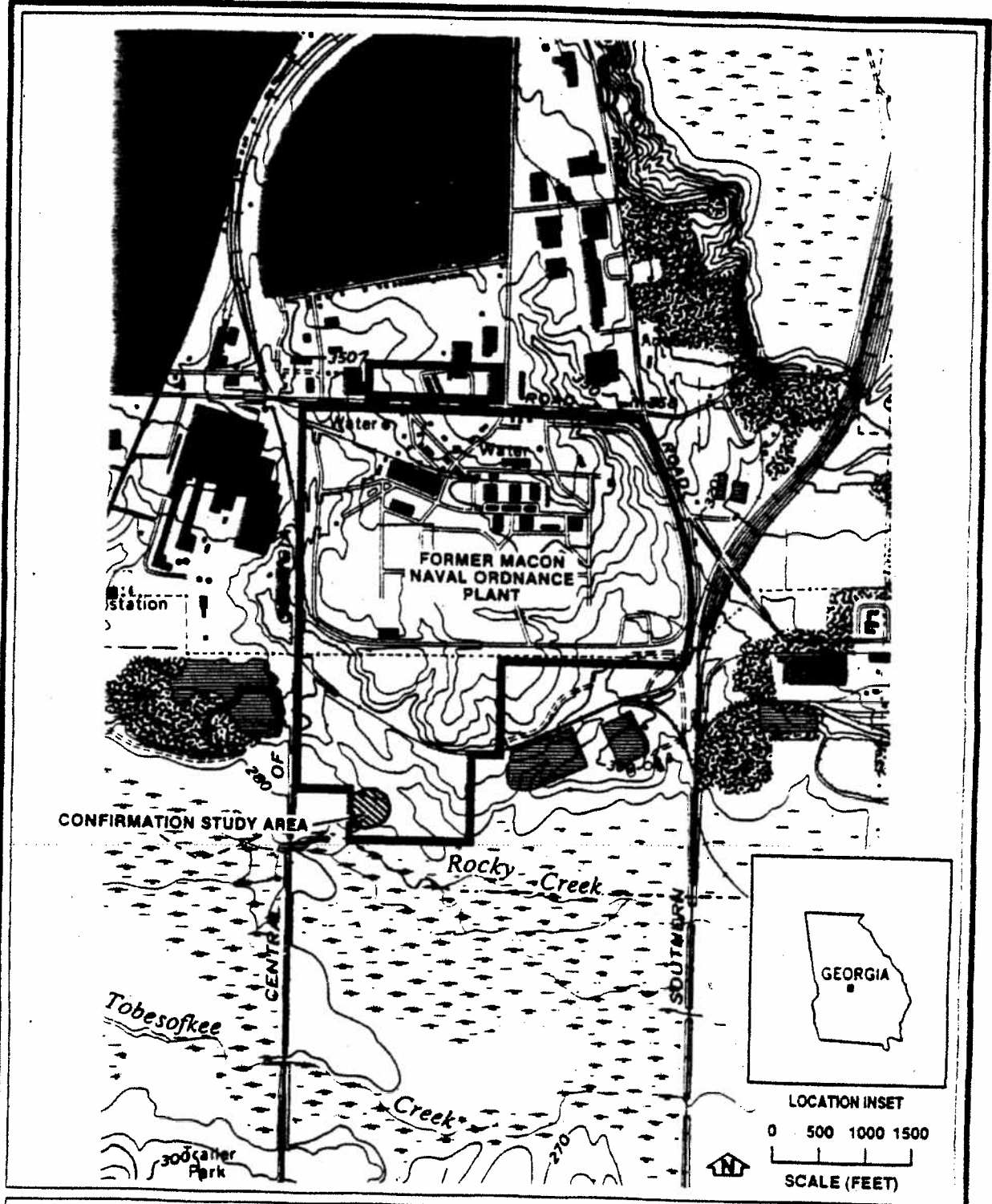
## 2.4 SITE PHYSICAL CHARACTERISTICS

### 2.4.1 SITE HYDROLOGY

Drainage from the site is generally to the east, southeast, and south through a small drainage easement as shown in Figure 2-2. This drainage easement empties into Rocky Creek, directly south of the site (see Figure 2-3), which is a tributary of the Ocmulgee River. The confluence of Rocky Creek and the Ocmulgee River is approximately 4 miles to the southeast of the site. The Ocmulgee River is the major drainage in southeastern Bibb County, and it drains to the south from Bibb County. The average rainfall for Bibb County is approximately 45 inches per year.

### 2.4.2 SITE GEOLOGY AND HYDROGEOLOGY

The study area lies within a 20- to 50-mile wide zone of Cretaceous sands and gravels that trend northeast-southwest (Sondregger *et al.*,




**Figure 2-3**  
**TOPOGRAPHIC MAP OF AREA SURROUNDING THE**  
**FORMER MACON NAVAL ORDNANCE PLANT**

SOURCES: USGS, 1986; ESE, 1988.


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1978). These Cretaceous sands occupy the s County, forming a southward-thickening wedge known as the Tuscaloosa Formation. The Tus light-colored sand, sandy clay, and lenticles not well bedded and individual beds have no extensive (LaGrand, 1962). The base of the south-southeast at approximately 30 feet (the Tuscaloosa Formation with the underlying crystalline rocks is approximately 500 feet in the southern part of Bibb County. In Cretaceous deposits form the principle groundwater adequate water supplies to present users.

The groundwater quality from the aquifer significantly better than the water quality site. Specific parameters describing the aquifer in the area include the pH within specific conductance of 0 to 50 micromhos hardness of 0 to 100 mg/L (expressed as 0 to 100 mg/L (Sondregger *et al.*, 1978)



The aquifer being investigated as part shallow, surficial aquifer within the to the water table in the vicinity of from 5 to 22 ft-bls. Shallower depths adjacent to the drainage easement. The relationships with deeper-producing zone Formation were not determined as part

## 2.5 RECORDS REVIEW AND EVALUATION

A records review has been performed by MNOP, archived at the Government Ser



Atlanta, Georgia. These records were kept at the National Archives in East Point, Georgia. The information can be obtained for review by contacting Ms. Rhonda West at GSA, Real Estate Division in Atlanta, Georgia [(404) 331-5133]. Records pertaining to the former MNOP should be requested, Accession Number 68A1717, boxes 14,15,16, N-GA-533. The information reviewed had previously been reviewed by USACE. No new information was discovered by ESE at GSA. In an effort to locate additional information, inquiries were made to the South Division Naval Facilities Engineering Command in Charleston, South Carolina, concerning records for MNOP. This agency indicated all records were at GSA. The information that was reviewed pertained to the exchange of property and inventories of facilities at the plant.

Other sources of historical information include interviews with former employees of MNOP. Three gentlemen who were former employees of MNOP and are familiar with activities that occurred at the site were available for questioning. Mr. Ralph Ennis is presently the director of the Allied Industrial Park; he was a former employee of MNOP, Maxson, and Allied. Mr. Robert Hamlin is also presently an Allied Industrial Park employee and was also an employee of MNOP, Maxson, and Allied. These two men were contacted by ESE and provided useful information for this review. Maps of the facility located at Mr. Ennis' office were reviewed but were found to relate only to the location of utilities at the site. Neither of these gentlemen were aware of the existence of the drums discovered by USACE.

One other area that was discovered during conversations with Mr. Hamlin was a former oil recovery operation. This operation was conducted at a building on the top of a small hill or slope on the northwest side of the site. Discharge from the operation was to a concrete sump, which then drained to the base of the slope onto a broad, flat-lying area. This area was investigated during the second field effort at which time

Mr. Hamlin indicated contaminated soil had been removed from this area in the past. The quantity of soil removed, or where it was disposed of, cannot be determined.

Mr. John Garland, a former employee of the Navy and participant in the design of the facility, is another source of information. Although ESE personnel have not spoken with Mr. Garland, USACE has contacted him for information concerning former MNOP.

#### 2.5.1 OWNERSHIP AND PRIOR USE

The site was acquired by the Navy in three land transactions occurring in 1941, 1948, and 1960. The Navy facility consisted of 432.44 acres owned in fee by DOD and 0.81 acres over which a perpetual easement was obtained. After purchase of the property, the Navy constructed over 200 buildings, a sewage treatment plant, roads, explosive demolition and testing areas, a dumping ground, and a swimming area. MNOP was constructed and operated as an ordnance manufacturing plant from 1941 to 1965. Utility easements that have been granted during DOD ownership include sewerline, roadway, and railroad tracks.

The plant and 432.44 acres of land were sold to Maxson on December 1, 1965. In two letters dated October 14 and November 17, 1965, addressed to the Chief of the Real Property Division of GSA, Maxson assumed all responsibility for the plant and associated lands and any contamination which may result. Maxson continued to manufacture ordnance at the facility under contract to the Navy. Maxson sold the property to Allied in August 1973. Allied manufactured seat belt components. Allied in turn sold the property to the City of Macon and Bibb County Industrial Authority during January 1981. The property is presently being used as an industrial park. Operations concerned with the manufacture of ordnance have ceased at the site.

### 2.5.2 FACILITIES AND POTENTIALLY CONTAMINATED AREAS

Information concerning inventories of the plant and facilities was available in the records. A facilities map obtained from the records is included in Appendix A. An index of structures attached to this map is also included in Appendix A. The structures inventoried include buildings where ordnance was manufactured. Functions that could potentially produce byproduct contaminants such as oils, solvents, and explosives include manufacturing, electrical workings, oil recovery, metal plating, drum storage, explosive loading, and powder pouring. The finished products were stored in magazines or bunkers, which have since been disassembled.

Another general inventory report, which describes the magnitude of machinery at MNOP during DOD operations, was discovered during the records review. This report appears to have been prepared prior to the sale to Maxson. Two pages from this report, included in Appendix A, describe in general detail the types of machinery and the manufacturing and industrial operations that were performed at the plant. Among other operations, this report mentions degreasing, which could be a potential source of solvents.

Other structures or facilities, which could be potential sources of contamination, were discovered during the records review. These include the Sewage Treatment Plant. This plant may be of concern as it accepted wastes from a metal plating operation. Treated wastewaters were discharged directly to a swampy area behind the plant. This area is in the floodplain of Rocky Creek.

Five USIs were described in the records:

1. 4,000-gallon (gal) Mineral Spirits Tank (Structure 157),
2. 12,000-gal Cutting Oil Tank (Structure 158),
3. 250-gal Kerosene Tank (Structure 183),

4. 560-gal Diesel Fuel Tank (Structure 184), and
5. 2,000-gal Gasoline Tank and Pump (Structure 185).

Aboveground fuel oil tanks were noted at Buildings 202, 115, and 189, ranging from 55-gal to 2,000-gal capacity. Oil storage tanks were also present at each of the Heating Plant Facilities, Buildings 4 and 104. Two tanks with 15,000-gal capacity each were present at each facility. Unfortunately, some of these structures were not referenced on any of the maps found.

Another potential source of contamination apparent from the records review is the dumping ground, or landfill, and the adjacent explosive demolition area. These two areas have been the focus of the present investigation. These areas are located at the southwest corner of the site. The landfill was used mainly for the disposal of used parts and construction debris. Currently, the area is covered with small trees and grasses but is still used for the surface disposal of construction and miscellaneous debris.

The explosive demolition area is a fenced area at the eastern side of the landfill. This area was used for the testing and demolition of explosives manufactured at MNOP, primarily detonators, flares and primers, and the burning of flammable materials. This area is presently covered with small trees and grasses and several bare ground areas with piles of concrete and other debris. Previous employees of the MNOP have indicated that some explosives were tested south of the intersection of Vinson and Perimeter Roads.

Records indicated a buried cyanide contaminated tank to be present on the northern side of the landfill. The existence and magnitude of contamination associated with this tank was also included in this investigation. Cyanide was most likely used in a metal plating

operation, which is reported to have taken place in Building 7-B. Building 7-B is in a state of disrepair and is slated for demolition. The reviewed records also mentioned metal plating operations in Buildings 5-A and 5-B.

Additional structures, which may also pose some contamination potential, were discovered during the records review. These structures were disclosed in an inventory list attached to a "Report of Excess Real Property." Several significant pages from this inventory are included in Appendix A. This inventory indicated several solvent storage buildings were present, including Buildings 99, 190, 192, and 193. All of these buildings are reported to have concrete floors, which may have prevented uncontrolled releases to the environment in the case of an accidental spill. Also, an incinerator is mentioned in the report as being located at Building 115, and an explosives disposal furnace is located at Building 189. Both of these structures may be associated with explosive compounds.

The existence of a deep well, Structure 156, was discovered during the records review. This well is located in front of Building 6, west of the tunnel vent in a pump house. The records indicate the well is 265 ft deep with 8-inch steel casing. The well was used to supply nonpotable industrial water to plating operations in Buildings 5-A and 5-B. The well and pumping apparatus are still in place but not operational. Although the well itself may not be causing contamination, it could potentially provide for a direct avenue for contaminants to enter the aquifer.

### 3.0 SITE INVESTIGATION

#### 3.1 INTRODUCTION

The site investigation at MNOP consisted of an initial site visit by USACE and the ESE project team, monitor well installation by USACE, a first field effort involving sampling of the monitor wells and collection of composite soil samples by ESE, a second field effort involving collection of additional composite soil and sediment samples by ESE, and an investigation of the buried cyanide contaminated tank by USACE. A summary of these activities is provided in the following sections.

#### 3.2 SITE VISIT

The site visit was performed on August 14, 1989. The ESE project team in attendance included Ms. Jane Bral, ESE Project Manager, Dr. John Bonds, Corporate Safety Officer, and Mr. Paul Locascio, Field Team Leader. The project team met with Mr. Robbin Blackman, USACE Project Manager; Mr. Ralph Ennis, Director of the Allied Industrial Park; and the City of Macon Police Captain, who provided information concerning locations for emergency procedures.

The project team visited the landfill and demolition areas. The only evidence of munitions on the landfill surface were recently discharged .38 and .22 caliber shell cases, most likely from unauthorized target practice. Mr. Blackman pointed out potential areas for soil borings and monitor wells. The location of the buried cyanide contaminated tank was observed. Some concern regarding access to the UST was expressed by the ESE project team. The project team observed the drainage creek north and northeast of the landfill. Old ammunition storage boxes, which are buried near the creek and are protruding from the ground, were observed. The floodplain area of the creek was coated with a light covering of corky material, which Mr. Blackman indicated may have resulted from

discharge from the Armstrong Cork facility to the west of the site. When leaving the landfill area, the location where the drainage ditch flows under the railroad north of the landfill was observed.

The project team then returned to Mr. Ennis' office and made copies of some useful records information Mr. Blackman had obtained. Other maps and aerial photographs of the site in Mr. Ennis' office were examined. Additional records search efforts were recommended with Mr. Ennis to determine if any more useful information could be found.

### 3.3 USACE SITE INVESTIGATION

The USACE site investigation took place during September 12 through 21, 1989. Five monitor wells were installed by USACE at selected locations to address the possibility of contamination in suspected areas. Due to safety concerns and difficulties with the location and condition of the buried cyanide tank, USACE excavated the tank during the site investigation effort. The object thought to have been a tank was discovered to be a large steel box, not an underground storage tank as expected. The box was found to have a corrugated steel roof or lid, and was filled with a sandy soil of different texture and consistency than the native soils. Apparently, the box, or tank as it was called, was cleaned prior to disposal. A soil sample from the tank was collected by USACE. The tank was filled and covered with the existing excavated materials following inspection.

Inspections of the site during the USACE site investigation also revealed the presence of approximately 500 unlabeled drums to the west and southwest of the landfill. This area and a low-lying area with a pond containing reddish-orange water are considered to be additional, potential areas of concern. Following the USACE site investigation, the cyanide tank sampling was deleted from ESE's original scope of work, and

the collection of composite soil samples from the drum area and pond were added.

#### 3.4 MONITOR WELL INSTALLATION

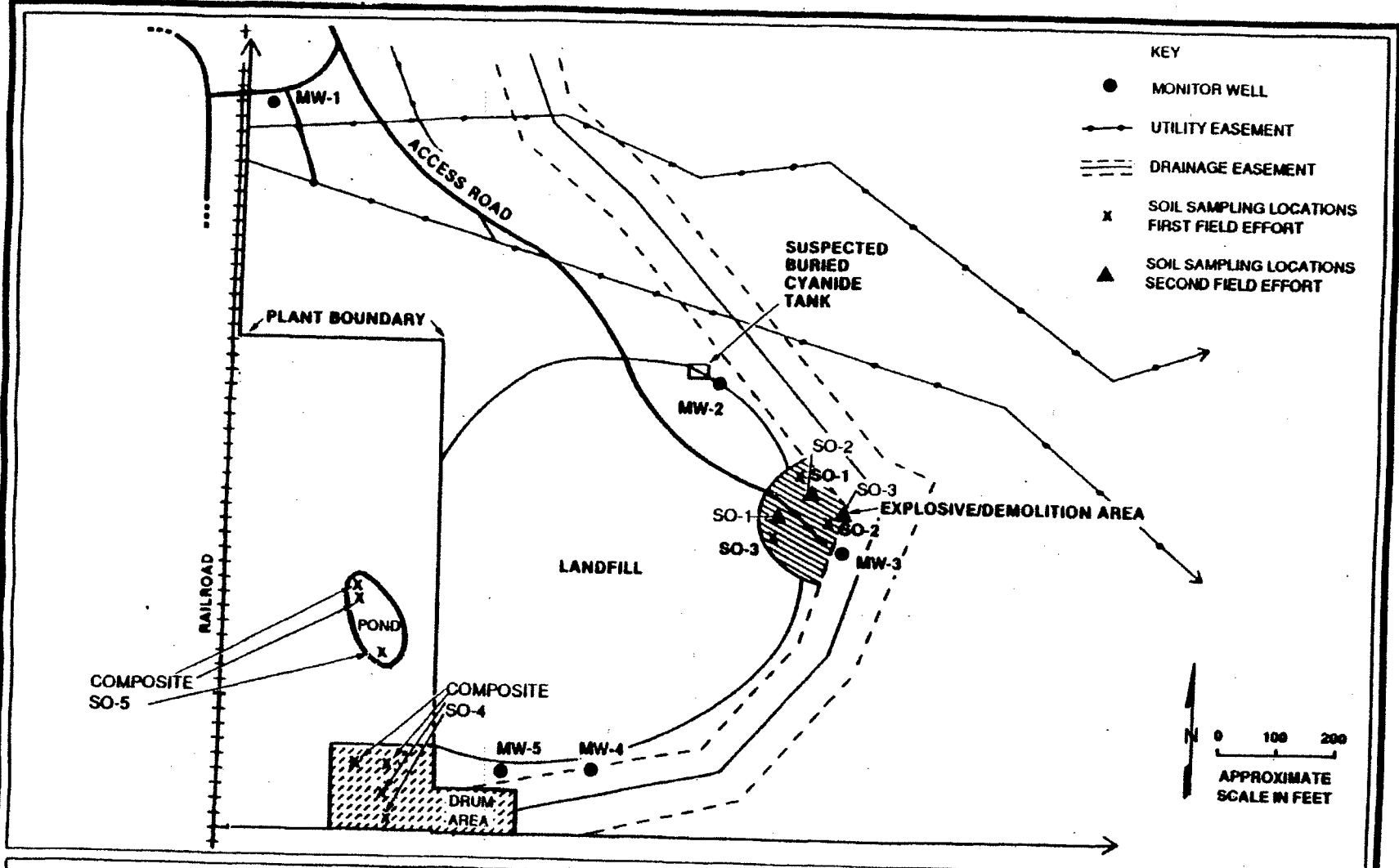
USACE installed and developed five monitor wells surrounding the landfill and explosive demolition area. The locations of these monitor wells are shown in Figure 3-1. MW-1 was installed as an upgradient well, MW-2 was placed downgradient of the suspected source of cyanide, MW-3 downgradient of the explosive demolition area, and MW-4 and MW-5 downgradient of the landfill.

The material encountered by the USACE drilling team during monitor well installation was generally sand with clay and silt. Soils were classified by the USACE site geologist according to the Unified Soil Classification System (USCS). The borings were made by hollow stem auger with the collection of split spoon samples every 5 ft. The depth of the borings ranged from 34.2 ft in MW-1 to 20.5 ft in MW-4. The wells were completed by installing 10 ft of 2-inch polyvinyl chloride (PVC) screen, with a slot size of 0.010 inches, and solid 2-inch PVC riser to the surface. Each well has a 2.5 ft length of stick-up. A filter sand pack was placed in the annular space adjacent to and slightly above the screen. A bentonite seal was placed above the filter sand, and grout was added to fill the annular space to the surface. Drilling logs from the monitor wells are provided in Appendix B. Sieve analyses of samples collected from the screened interval of each well are also provided in Appendix B.

Air quality was monitored during the monitor well installation by the site geologist. All borings, with the exception of MW-2, were begun with the crew using Level D protective equipment. Level B protection was used from the outset for MW-2 due to the potential for cyanide contamination at this location. MW-3, MW-4, and MW-5 installation began



3-4



**Figure 3-1  
SAMPLING LOCATIONS AT FORMER  
MACON NAVAL ORDNANCE PLANT**

SOURCE: ESE, 1990.

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with Level D protection, but had to be completed with Level C protection when "action levels" described in the USACE's Site Safety Plan were exceeded. Organic vapor analyzer (OVA) readings of 400 parts per million (ppm) were recorded in MW-3, and values of 1,000 ppm in MW-4 and MW-5. Specific air monitoring readings for all borings are described in Hazardous Toxic Waste Logs contained in Appendix B.

Water levels were measured by the USACE site geologist during drilling and following well completion. Water levels encountered during drilling ranged from depths of 6 ft in MW-4 to 21 ft in MW-1. Water levels following well completion ranged from 1.8 ft in MW-5 to 16.5 ft in MW-1. With the exception of MW-5, all of the water levels following development were higher than those encountered during drilling. These water level characteristics suggest that clays and sandy clays overlying the silty sands may be creating localized confined conditions within the shallow aquifer. These observations also indicate increasing heads with depth, which is not unexpected as the site is located in a low-lying area. Low-lying areas generally represent groundwater discharge areas in which the groundwater flows towards rivers, streams, and/or marshes. Additional wells, screened at different intervals from the existing wells, may be necessary to fully characterize vertical gradients at the site.

Following monitor well completion, wells were developed by the site geologist using a hand pump. Following development, a recovery test was conducted on each well. The recovery data was analyzed by USACE to determine the hydraulic conductivity of the shallow aquifer. Hydraulic conductivities ranged from  $1.83 \times 10^{-7}$  meters per second (m/sec) in MW-1 to  $6.89 \times 10^{-7}$  m/sec in MW-4 [0.39 gallons per day per square foot (gal/day/ft<sup>2</sup>) to 1.46 gal/day/ft<sup>2</sup>, respectively]. These values are in the lower range of hydraulic conductivity values for silty sands (Freeze

and Cherry, 1979). The results of the recovery tests and analysis performed by USACE are provided in Appendix B.

USACE also prepared a water-level contour map from the static water level data. This map is provided in Appendix B. The hydraulic gradient calculated based on this map is 0.010. Groundwater flow is from the northwest to southeast with localized control by surface drainage features.

### 3.5 SAMPLING PROGRAMS AND LOCATIONS

#### 3.5.1 SAMPLING PROGRAMS

All samples (groundwater, soil, and sediment) were collected by ESE in a manner consistent with U.S. Environmental Protection Agency (EPA) guidelines and USACE's Sample Handling Protocol for Low, Medium, and High Concentration Samples of Hazardous Waste. Samples were analyzed by both ESE and U.S. Army Missouri River Division Laboratory in Omaha, Nebraska. The number of samples for each location, control samples, and analytical parameters are summarized in Tables 3-1 and 3-2.

During the first field effort, groundwater samples were collected from five monitor wells installed by the USACE Mobile District during September 1989. All soil samples for chemical analysis were collected by ESE from the burning ground/demolition area as well as from an area west and southwest of the landfill, where a pond and unlabeled drums have been located. Soil samples were collected from shallow borings (with depths between the surface and 3 ft-bls).

During the second field effort, five additional soil samples and one sediment sample were collected. Three of these samples were collected from the explosive demolition area to confirm the results from the first field effort. A background soil location was sampled, as well as an area downgradient of a former oil recovery operation. A sediment sample

Table 3-1. Sampling and Analytical Requirements - First Field Effort

Analyte	Method Reference	Analyzed By ESE Laboratory					Analyzed By USACE OR ESE Laboratory				
		Number of Environmental Samples	Number of Trip Blank Samples	Number of Field Replicate Samples	Number of Equipment Rinseate Samples	Total Number of Samples	Number of Trip Blank Samples	Number of Field Replicate Samples	Number of Equipment Rinseate Samples	Total Number of Samples	
SOILS											
Volatile Organic Compounds	SM8240	5	1	1	1	8	1	1	1	3	
Semi-volatile Organic Compounds	SM3540/SM8270	5	0	1	1	7	0	1	1	2	
ICAP Metals (Ba, Cd, Cr, Pb, Ag)	SM3050/SM6010	5	0	1	1	7	0	1	1	2	
Arsenic	SM3050/SM7060	5	0	1	1	7	0	1	1	2	
Selenium	SM3050/SM7740	5	0	1	1	7	0	1	1	2	
Mercury	SM7471	5	0	1	1	7	0	1	1	2	
Nitroaromatics & PETH	USATHARA LM12	5	0	1	1	7	0	1	1	2	
Petroleum Hydrocarbons	SM9071/EPA410.1	5	0	1	1	7	0	1	1	2	
Nitrate + Nitrite	USATHARA KF 10	5	0	1	1	7	0	1	1	2	
% Moisture	ASTM D2216	5	0	1	1	7	0	1	1	2	
WATERS											
Volatile Organic Compounds	SM8240	5	2	1	1	9	1	1	1	3	
Semi-volatile Organic Compounds	SM3510/SM8270	5	0	1	1	7	0	1	1	2	
ICAP Metals (Ba, Cd, Cr, Fe, Pb, Mn, Na, Ag)	SM3005/SM6010	5	0	1	1	7	0	1	1	2	
Arsenic	SM3005/SM7060	5	0	1	1	7	0	1	1	2	
Selenium	SM3005/SM7740	5	0	1	1	7	0	1	1	2	
Mercury	SM7470	5	0	1	1	7	0	1	1	2	
Nitroaromatics	USATHARA UM14	5	0	1	1	7	0	1	1	2	
PETH	USATHARA UM19	5	0	1	1	7	0	1	1	2	
Petroleum Hydrocarbons	EPA 410.1	5	0	1	1	7	0	1	1	2	
Nitrate + Nitrite	EPA 353.2	5	0	1	1	7	0	1	1	2	
Cyanide	EPA 335.3	5	0	1	1	7	0	1	1	2	

Source: ESE, 1989.

Table 3-2. Sampling and Analytical Requirements - Second Field Effort.

Analyte	Method Reference	Analyzed By ISE Laboratory					Analyzed By USACE QA (ISE Laboratory)			
		Number of Environmental Samples	Number of Trip Blank Samples	Number of Field Replicate Samples	Number of Equipment Rinseate Samples	Total Number of Samples	Number of Trip Blank Samples	Number of Field Replicate Samples	Number of Equipment Rinseate Samples	Total Number of Samples
SOILS										
Volatile Organic Compounds	SM8240	6	1	2	0	9	1	2	0	3
Semi-volatile Organic Compounds	SM3540/SM8270	3	0	1	0	4	0	1	0	1
ICAP Metals (Ba, Cd, Cr, Pb, Ag)	SM3050/SM6010	3	0	1	0	4	0	1	0	1
Arsenic	SM3050/SM7060	3	0	1	0	4	0	1	0	1
Selenium	SM3050/SM7740	3	0	1	0	4	0	1	0	1
Mercury	SM7471	3	0	1	0	4	0	1	0	1
Nitroaromatics & PETM	USATHANA LM12	3	0	1	0	4	0	1	0	1
Petroleum Hydrocarbons	SM9071/EPA410.1	3	0	1	0	4	0	1	0	1
Nitrate + Nitrite	USATHANA KF10	3	0	1	0	4	0	1	0	1
% Moisture	ASTM D2216	6	0	2	0	8	0	1	0	1

Source: ESE, 1990.

was also collected from a small stream flowing through the drainage easement where the stream first enters the former MNOP property. This additional effort was requested based on the results of the initial effort and as other areas of concern were located.

As described in Tables 3-1 and 3-2, soil samples were analyzed for explosive compounds, nitrate/nitrite, volatile and semi-volatile organics, petroleum hydrocarbons, and metals. The second set of soil samples from the explosive demolition area were analyzed for volatile organics only. Groundwater samples from all five monitor wells were analyzed for the same compounds, including cyanide.

#### 3.5.2 SAMPLING LOCATIONS

The areas investigated during the first field effort are located in the southwest corner of the former MNOP property and include the landfill, the explosive demolition area, and the previously suspected location of a buried cyanide tank (see Figure 3-1). During the field effort of September 1989, USACE identified a pond containing reddish-orange water and approximately 500 deteriorated, unlabeled drums adjacent to the western and southwestern boundary of the landfill. This area is located to the west and southwest of MW-5. Based on topographic observations, it does not appear the access to this area was from the former DOD property.

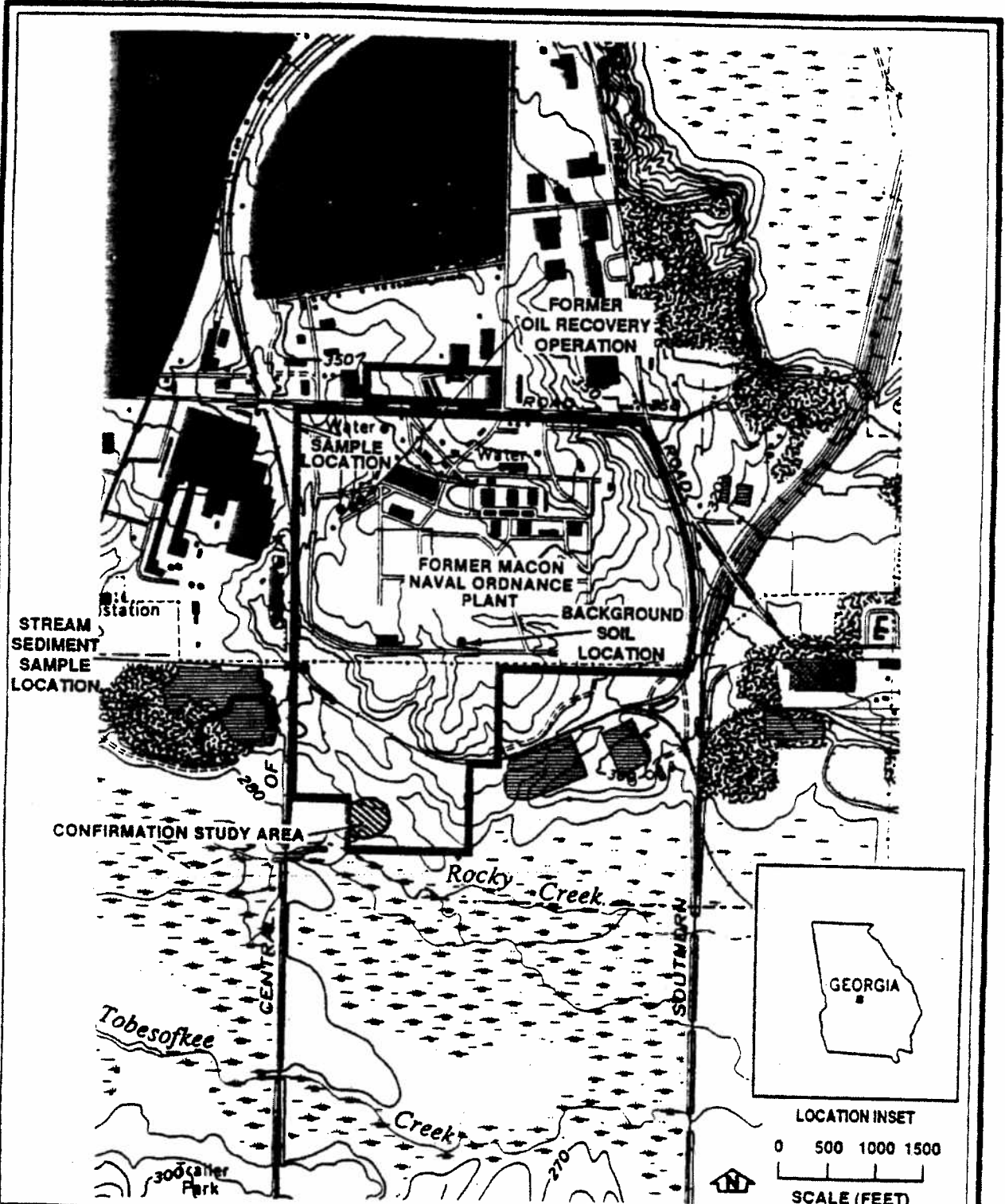
Figure 3-1 indicates the approximate location of the five groundwater monitoring wells surrounding the landfill. One groundwater sample was collected from each of these wells for a total of five groundwater samples. Monitor well locations MW-3, MW-4, and MW-5 were selected downgradient of the landfill and explosive/demolition area. Monitor well MW-2 was selected to investigate possible groundwater contamination associated with the suspected UST. Background groundwater data was provided by MW-1.

The activities performed during the first field effort included the collection of three soil samples within the explosive/demolition area. These samples, SO-1, SO-2, and SO-3, were collected as composite samples from three different locations within the area as shown in Figure 3-1.

Because the existence of the pond and drums was discovered during the well installation effort, collection of samples from this location was not included in the original scope of work. USACE requested the collection of two additional soil samples from these locations. These samples were collected as composite samples: one of pond sediments (SO-5), and one of soil adjacent to the drums (SO-4). The locations of the sampling points, which created each composite sample, are shown in Figure 3-1.

During the second field effort, samples were again collected from the explosive demolition area. These samples were labeled SO-1, SO-2, and SO-3 as shown in Figure 3-1. The background soil location, selected by USACE and ESE, is in a grass covered upland area on the north side of the southern paved access road at MNOP. The background soil sampling location is shown in Figure 3-2. The location of the former oil recovery operation is also shown on Figure 3-2. This operation was located at the top of a slope. Discharge from the operation was at the base of the slope onto a flat drainage area. The sample, designated as SD-2, was collected within the drainage area, downgradient of the operation. The location of the stream sediment sample, SD-1, is also shown in Figure 3-2. This location was chosen to investigate contaminants that may have entered the former MNOP property from upstream.

A total of 16 samples were collected for this confirmation study. These samples include 5 groundwater samples and 11 soil samples, 2 of which



**Figure 3-2  
ADDITIONAL SAMPLE LOCATIONS INVESTIGATED  
DURING SECOND FIELD EFFORT**

SOURCES: USGS, 1945; ESE, 1988.

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were sediment samples, as discussed previously. Control samples were also collected as described in Tables 3-1 and 3-2. Control samples included the collection of duplicate samples, equipment blanks, and travel blanks.

Duplicate samples were collected from all media sampled. Duplicate sample requirements associated with the groundwater samples include the collection of two duplicate groundwater samples from one monitor well. The well used to obtain the duplicate groundwater samples was MW-3. Three duplicate soil samples were collected from three of the soil sample locations. Soil sample SO-3 was chosen for the duplicate during the first field effort. Two duplicate samples from the second field effort were collected, the first at the explosive demolition area sample location SO-3 and the second below the former oil recovery operation. The sample from below the oil recovery operation was originally intended to be a second sediment sample; thus, the designation in data tables of SD-2. A decision was made in the field by USACE to forgo the second sediment sample and instead investigate the soil below the recovery operation. One of each of the duplicate samples was sent to the USACE Quality Assurance (QA) laboratory. The other was analyzed at the ESE laboratory in Gainesville. The samples collected for the USACE QA laboratory analysis was collected in containers supplied by Missouri River Division Laboratory (MRDL).

Quality control/quality assurance (QC/QA) required sampling blanks include the collection of equipment blanks. One equipment blank was collected from a precleaned Teflon<sup>®</sup> bailer, used to obtain the groundwater samples. A soil sampling equipment blank was not collected.

Travel blanks were also analyzed. The travel blanks, for VOA only, were prepared by the ESE laboratory. One travel blank was placed in one cooler with each sample shipment to the ESE or USACE laboratories. Data

associated with the QA requirements for sample analysis are provided in Appendix E. The MRDL QA/QC Final Report is included in Appendix F.

### 3.6 SAMPLING PROCEDURES

#### 3.6.1 MONITOR WELL SAMPLING PROCEDURES

Each of the five groundwater monitoring wells were sampled once. Prior to groundwater sample collection, water levels in all monitor wells were measured relative to the top of the well casing. Measurement consisted of a precleaned, steel tape lowered into the well, with water level measured from the top of the casing. Water levels were recorded again after sampling.

A plastic ground cloth was placed beneath all sampling equipment during well purging and sampling to prevent contamination by surficial soils. MW-1 and MW-2 were purged using Teflon® bailers due to very slow recovery rates. MW-3 and MW-4 were purged with a peristaltic pump, and MW-5 was purged with a centrifugal pump with drop pipe. The discharge water during purging was continuously monitored for pH, temperature, and specific conductivity. Pumping continued until at least five times the submerged volume of the casing was removed. The pH, temperature, and conductivity had for the most part stabilized in each well (i.e., until three successive measurements are within 5 percent of one another) at the completion of purging. Purge water from monitor wells was discharged to the ground surface at the well locations.

After satisfactory pumping of the well, the sampling team changed to new rubber gloves for sample collection. Each well was sampled with a Teflon® bailer, which was not used to sample any other well onsite. Bailers were precleaned and wrapped in aluminum foil for transportation to the site. Bailers were rinsed with deionized water prior to use in the first well. Nylon cord from a new spool was attached to the bailer, and the cord was kept from touching the ground during the sampling

period. Bailers were rinsed with one volume of well water before sampling. Groundwater samples were collected in a manner which minimized aeration to prevent loss of volatile compounds. The appropriate sample containers were filled without trapping air bubbles and then tightly capped.

Samples were preserved and packed in ice for shipment to the laboratory. Field duplicate and field blank samples were included in the laboratory sample shipment. Field logs were maintained, including sample chain-of-custody records and onsite measurements of water quality (pH, specific conductance, and temperature) for each monitor well. Field instruments were calibrated and checked at the start, middle, and end of each field day using fresh calibration standards. This information is included in the daily field logs from November 29, 1989 in Appendix C.

The plastic ground cloth, sampling gloves, bailer cord, and other disposables were bagged and properly disposed of in accordance with the site safety plan. Final decontamination rinses with isopropanol were performed over a 5-gal bucket, in which they were collected and allowed to evaporate.

### 3.6.2 RESULTS OF WATER-LEVEL MEASUREMENTS BY ESE

Water-level measurements from each monitor well were measured by ESE prior to sample collection. Depth-to-water measurements were converted to elevations (ft-msl), based on top of casing (TOC) elevations provided by USACE. The results of these calculations are shown in Table 3-3. Water-level data were plotted on the site map (see Figure 3-3). The groundwater flow direction at the site, based on these measurements, is to the southeast, controlled by the creek flowing in the drainage easement. The gradient shown on this map is 0.011, which is similar to the gradient of 0.010 measured by USACE.

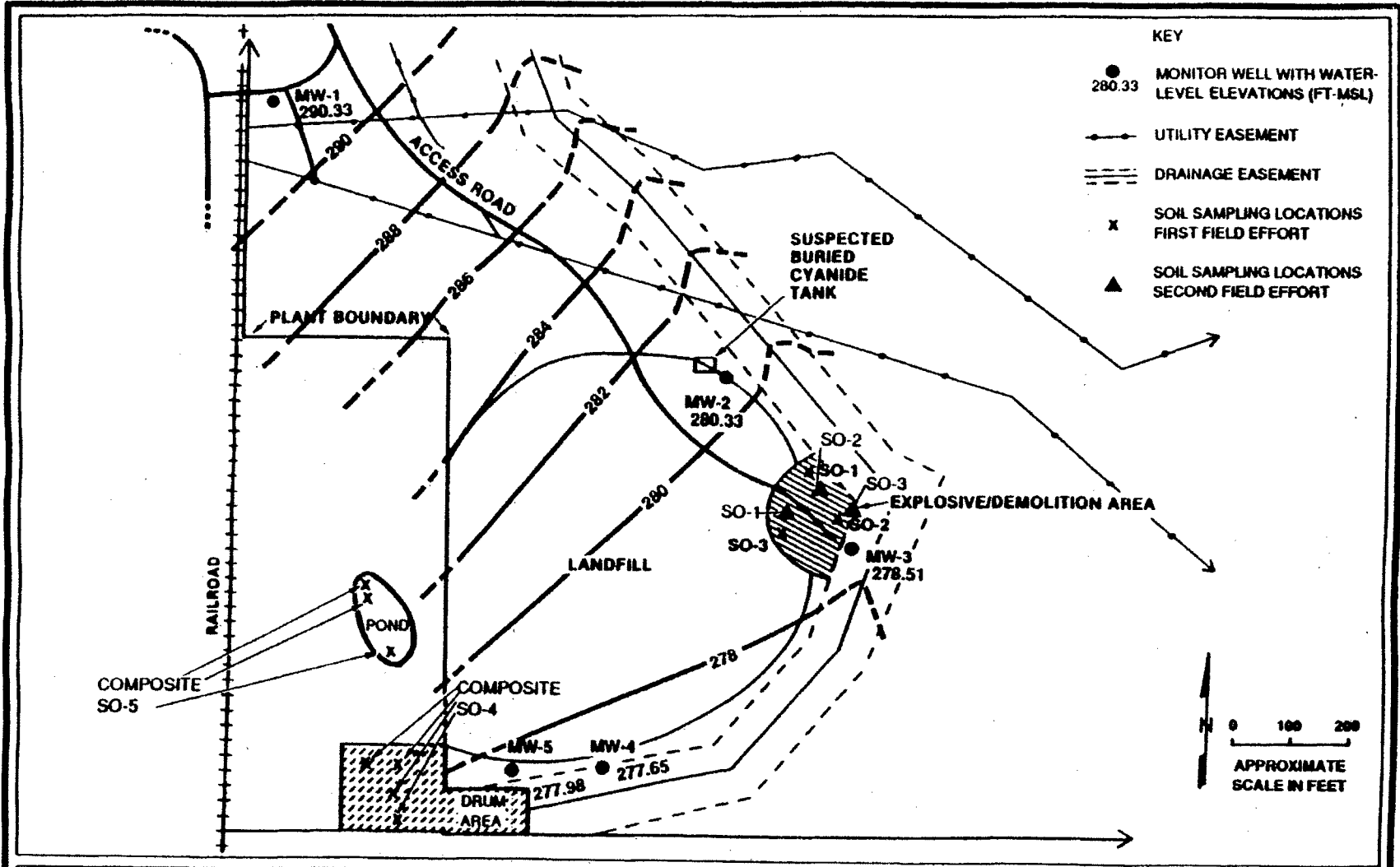
Table 3-3. Water-Level Elevations Measured by ESE\*

Reference Point	MW-1	MW-2	MW-3	MW-4	MW-5
TOC	308.87	286.06	283.04	281.12	280.69
Water Level (TOC) (11/28/89)	<u>18.54</u>	<u>5.73</u>	<u>4.53</u>	<u>3.47</u>	<u>2.71</u>
Water-Level Elevation	290.33	280.33	278.51	277.65	277.98

Note: TOC = top of casing.

\*All elevations in feet above mean sea level (ft-msl).

Source: ESE, 1990.



**Figure 3-3**  
**WATER LEVEL CONTOUR MAP OF STUDY AREA AT**  
**FORMER MACON NAVAL ORDNANCE PLANT**

SOURCE: ESE, 1990.

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### 3.6.3 SOIL SAMPLING PROCEDURES

During the first field effort, three soil samples were collected from the explosive/demolition area, one from the pond sediments, and one from the soil surrounding the drums. The samples from the explosive/demolition area were collected as composites of the soil from 0 to 3 ft of depth at each location as shown in Figure 3-1. The sample of the pond sediments was obtained by compositing material from three soil borings approximately 1 ft deep around the edges of the pond. The soil sample from the drum area was obtained by compositing material from four boreholes of 0 to 3 ft depth adjacent to the drums. The location for each of these boreholes was chosen by the USACE site representative. The soil boring was completed by hand-augering to the appropriate depth with a bucket auger. The soil brought to the surface was retained in a stainless-steel bowl. Upon completion of the boring, the soil in the bowl was gently composited using a stainless-steel spoon. Due to the nature of the sampling method, some compositing of the soil was necessary to ensure a homogeneous and replicable sample. The compositing activity was kept to a minimum to avoid the loss of volatiles from the soil. The samples were collected by filling the sampling containers with the composited soil.

During the second field effort, three soil samples were collected from the explosive demolition area, one from the background location, one from below the former oil recovery operation, and one stream sediment sample. The samples collected during the second field effort from the explosive demolition area were not composited. Results of analyses of soil samples from this area collected during the first field effort were suspected due to compositing.

To collect samples in the explosive demolition area, each borehole was advanced to 3 ft deep with a bucket auger. Each sample bottle was filled with a portion of the material from each lift of the auger as it

was brought to the surface. The sample bottles were capped between fillings.

The background sample was collected from one borehole approximately 3 ft deep. The soil from the length of the borehole was collected in a stainless steel pan, and the sample bottles were filled from the collected material in the pan.

The soil sample from below the oil recovery operation was collected as composites from two boreholes, each approximately 1 ft deep. The boreholes were both located in the flat drainage area below the former recovery area. The boreholes were approximately 30 ft apart in areas void of vegetation with obvious surface staining.

The stream sediment sample was collected in a similar manner. The sample was collected as a composite from 2 boreholes augered into the sediments to approximately 1 ft deep. The boreholes were only 1 ft apart. Sample packaging and shipping for all soil and sediment samples was the same as for groundwater samples. Soil sampling documentation is provided in Appendix C.

### 3.7 HAZARDOUS BANKING SYSTEM EVALUATION

A Hazardous Ranking System Evaluation was also completed as part of this investigation. The information required to complete the evaluation is based on the findings and results of the present investigation. The completed form is provided in Appendix D.

## 4.0 ANALYTICAL RESULTS

### 4.1 INTRODUCTION

The following sections include information obtained from sampling analyses of the monitor wells and soil at the former MNOP. Analytical results of the groundwater samples analyzed by ESE are presented compared to applicable water-quality criteria where appropriate. Presently, no quality criteria exist for comparison of soil analytical data. Soil samples have been compared to the background soil samples.

### 4.2 GROUNDWATER

Groundwater samples obtained from the five monitor wells were analyzed for volatile and semivolatile organic compounds, explosive compounds, nitrate/nitrite, petroleum hydrocarbons, metals, and cyanide. Details of the analyses and methods of analysis are presented in Table 3. Results of the analyses are summarized in Table 4-1, which shows those compounds that were present above detection limits. Complete analytical results are provided in Appendix E.

#### 4.2.1 ORGANIC COMPOUNDS

The organic compound detected with the highest concentration was trichloroethylene (TCE). All the monitor wells exceed the drinking water criteria with the exception of the background well MW-1. This volatile organic compound was detected in MW-2 with a concentration of 7,000  $\mu\text{g/L}$  and in MW-3 with a concentration of 3,800  $\mu\text{g/L}$ . Lower concentrations (110  $\mu\text{g/L}$  and 10  $\mu\text{g/L}$ ) were detected in MW-4 and MW-5, respectively. The drinking water criterion associated with TCE is 5  $\mu\text{g/L}$ .

TCE is commonly used as a degreasing compound for metal parts and machinery. Other applications of TCE include use in paints, drycleaning, dyes, textiles, solvents, refrigerants and heat exchange liquids, fumigants and aerospace operations (EPA, 1985). The re-



Table 4-1. Summary of Results of Groundwater Sample Analyses (Continued, Page 2 of 2)

Compound	Sample Identification									Water Quality Criterion	Regulation
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-3-DP	MW-EB	MW-TB	SO-TB		
Trichloroethene ( $\mu\text{g/L}$ )	--	7,000	3,800	110	19	3,900	--	--	--	5	MCL
Vinyl Chloride ( $\mu\text{g/L}$ )	--	--	--	170	--	--	--	--	--	2	MCL
Bis(2-Ethylhexyl) Phthalate ( $\mu\text{g/L}$ )	1.6	1.7	6.4	2.4	1.2	3.0	1.2	NRQ	NRQ	10,000	WQC

- Note:
- GA - Georgia state standard described in EPA (1988).
  - GA Recon - recommended Georgia standard--nonenforceable (Personal Communication, Fred Lehman).
  - MCL - maximum contaminant level specified in the National Primary Drinking Water Regulations, 40 CFR 141.11 (July 1, 1986) and the National Secondary Drinking Water Regulations, 40 CFR 143.3 (July 1, 1986).
  - mg/L - milligrams per liter.
  - NRQ - not required.
  - PEIN - pentaerythritol tetranitrate.
  - Rosenblatt - criteria suggested by Rosenblatt (1981) for the permissible concentration level for the contaminant in drinking water.
  - $\mu\text{g/L}$  - micrograms per liter.
  - WQC - suggested ambient water quality criteria for the protection of human health from the toxic properties or carcinogenic effects of the compound; criteria associated with cancer risk levels (CRLs) of  $1 \times 10^{-6}$  are reported where available; these criteria are summarized in the document Quality Criteria for Water 1986, EPA, May 1, 1986, Washington, DC; criteria were previously announced in 45 FR 79318 (November 28, 1984), 49 FR 5831 (February 15, 1984), and 50 FR 30784 (July 29, 1984).
  - - not detected at method detection limit.

Source: ESE, 1990.

Table 4-1. Summary of Results of Groundwater Sample Analyses

Compound	Sample Identification									Water Quality Criterion	Regulation
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-3-DP	MW-EB	MW-TB	SO-TB		
Cyanide (mg/L)	--	0.133	0.005	--	--	--	--	NRQ	NRQ	0.0035	GA
Nitrogen $\text{NO}_2+\text{NO}_3$ (mg/L as N)	5.45	0.151	0.040	--	--	0.073	0.021	NRQ	NRQ	10	MCL
Arsenic, Total (mg/L)	--	0.0032	0.0029	--	--	--	--	NRQ	NRQ	0.05	MCL
Barium, Total (mg/L)	0.0507	0.120	0.0556	0.0418	0.109	0.0569	0.0015	NRQ	NRQ	1.0	MCL
Chromium, Total (mg/L)	0.0140	0.0259	0.0181	0.0091	--	0.0118	--	NRQ	NRQ	0.05	MCL
Iron, Total (mg/L)	4.42	19.0	5.91	19.2	17.3	6.04	0.0124	NRQ	NRQ	0.3	MCL
Manganese, Total (mg/L)	0.428	0.590	0.0970	0.248	0.530	0.100	--	NRQ	NRQ	0.05	MCL
Selenium, Total (mg/L)	--	--	0.0023	--	--	--	--	NRQ	NRQ	0.01	MCL
Sodium, Total (mg/L)	20.6	28.7	13.6	8.12	9.30	14.3	0.169	NRQ	NRQ	20	GA Recon
PEIN ( $\mu\text{g/L}$ )	68.8	--	--	--	--	33.3	--	NRQ	NRQ	NC	--
1,3-Dinitrobenzene ( $\mu\text{g/L}$ )	--	--	1.18	--	--	1.23	--	NRQ	NRQ	NC	--
2,4-Dinitrotoluene ( $\mu\text{g/L}$ )	--	--	1.83	--	--	1.68	--	NRQ	NRQ	1.1	Rosenblatt

4  
1  
2

review indicated degreasing was part of the operations at the former MNOP. Wastes from this operation is expected in the landfill that serviced the facility. Based on the monitor well data, the strongest source of TCE appeared on the southeast side of the landfill.

Another organic compound of significance, vinyl chloride, was detected in MW-4 with a concentration of 170  $\mu\text{g/L}$ . The criterion for vinyl chloride is 2  $\mu\text{g/L}$ . This compound is used in organic synthesis, PVC plastic, and adhesives (EPA, 1985). It is suspected that this compound is a result of the landfill wastes, and not the PVC well casing, as it was not detected in any other well except MW-4.

The plasticizer bis(2-ethylhexyl)phthalate was detected in all samples including the equipment blank. The concentrations were low, ranging from 1.2  $\mu\text{g/L}$  to 6.4  $\mu\text{g/L}$ . The criterion for bis(2-ethylhexyl)phthalate is 10,000  $\mu\text{g/L}$ . This plasticizer is a common contaminant when plastics are used for well construction and sampling, which is the case at former MNOP. The presence of this compound is of little significance.

#### 4.2.2 EXPLOSIVE COMPOUNDS

Explosive compounds were detected only in MW-3 adjacent to the explosive demolition area. The compounds 2,4-DNT and 1,3-DNB were detected with concentrations of 1.83  $\mu\text{g/L}$  and 1.18  $\mu\text{g/L}$ , respectively. The source of these compounds is most likely residual explosive compounds within the soils of the explosive demolition area. A recommended permissible concentration in drinking water for 2,4-DNT of 1.1  $\mu\text{g/L}$  was proposed by Rosenblatt (1981) for an Army munitions site in northern Illinois. The concentration of 2,4-DNT in MW-3 exceeds this criterion. No criteria are available for 1,3-DNB.

The only other explosive compound detected in the samples was PETN. This compound was analyzed because it was reported as being a component



of fuses and primers (Department of the Army, 1969). These parts were manufactured at the former MNOP. PETN was detected at MW-1, the background well, with a concentration of 68.8  $\mu\text{g/L}$ . PETN was also detected in the duplicate sample obtained from MW-3 (33.3  $\mu\text{g/L}$ ), but was not detected in the sample from MW-3. These concentrations are near the detection limit of the analysis method of 20  $\mu\text{g/L}$ . There are no criteria associated with PETN. The results tend to indicate that trace amounts of PETN are present at the background location and possibly at the explosive demolition area. This type of explosive is expected at the explosive demolition area, but it is unexpected in the area thought to be upgradient. This result precludes the use of MW-1 as a reliable background location and may indicate another source area of explosives disposal near the upgradient well location. As the concentrations that were detected in the samples are near the detection limits, another round of sample collection and analysis is recommended prior to formulation of any conclusions regarding additional source areas.

#### 4.2.3 NITROGEN

The highest level of nitrogen was also detected in MW-1 at 5.45 mg/L. Although this concentration does not exceed the criteria of 10 mg/L, it is higher than other concentrations, which ranged from below the detection limit of 0.010 mg/L to 0.151 mg/L. Although high levels of nitrogen are associated with explosive compounds, other sources of nitrogen include fertilizers, sewage, and animal wastes (Sonderregger et al., 1978). Higher nitrogen levels at the background location also casts doubt on the reliability of the sampling location for providing background water quality and provide a second indication that there may be an additional source area of explosives disposal near the upgradient location.

#### 4.2.4 PETROLEUM HYDROCARBONS

Petroleum hydrocarbons were not detected in any of the groundwater samples.

#### 4.2.5 METALS

##### 4.2.5.1 Arsenic

Arsenic was detected in MW-2 and MW-3 at concentrations of 0.0032 mg/L and 0.0029 mg/L, respectively. These concentrations are below the criteria of 0.05 mg/L. As arsenic was only detected in these two wells, which were shown to be contaminated with other compounds discussed previously, low levels of arsenic may be associated with contamination from the landfill and explosive demolition area. Arsenic compounds are used in insecticides, fungicides, rodenticides, herbicides, fireworks, paints, wood preservatives, bronze and other alloys, glass, enamels, ceramics, linoleum, semiconductors, and photoconductors (Walton, 1985).

##### 4.2.5.2 Barium

Barium was detected in all the wells and in the equipment blank. Wells containing the highest concentrations of barium include MW-2 and MW-5 with concentrations of 0.120 mg/L and 0.109 mg/L, respectively. MW-3 and MW-4 had barium concentrations of 0.0556 mg/L and 0.0418 mg/L, respectively, and MW-1 had a similar concentration of 0.0507 mg/L. The equipment blank sample had a much lower a concentration of 0.0015 mg/L. All samples were below the criteria level for barium, which is 1 mg/L. Barium has uses in metal alloys and in lubricants (Walton, 1985) and is a common component in groundwater with concentrations of 0.001 to 0.1 mg/L (Fenn *et al.*, 1980). Although barium is not necessarily an indicator of contamination, the higher concentrations found in MW-2 and MW-5 may suggest influence from contamination. As the background sample from MW-1 is suspected due to the presence of explosive compounds and nitrogen, a judgement concerning the presence of contamination at all

locations based on the low concentrations of barium that were observed is not possible.

#### 4.2.5.3 Chromium

Chromium was detected in MW-1, MW-2, MW-3, and MW-4 with concentrations ranging from 0.0091 mg/L in MW-4 to 0.0259 mg/L in MW-2. No chromium was detected in MW-5. The detection limit for the method of analysis is 0.0071 mg/L. The concentrations detected are all below the criteria of 0.05 mg/L. Chromium is used in steel and metal alloys, dyeing and tanning, paints, inks, varnishes, glazes, fireworks, batteries, and rust inhibitors (Walton, 1985) and is also a component in soil and typically occurs in groundwater with concentrations ranging from 0.001 mg/L to 0.1 mg/L (Fenn et al., 1980). Although chromium may be associated with contamination, the low levels of chromium detected at concentrations slightly over the detection limit are not considered to be indicative of contamination.

#### 4.2.5.4 Selenium

Selenium was detected in only one well, MW-3, with a concentration of 0.0023 mg/L. This concentration was slightly higher than the detection limit of 0.0018 mg/L and below the criteria level of 0.01 mg/L. The principal uses of selenium are in electric and electronic components (Walton, 1985). Because selenium was only detected in one monitor well, which has shown other contaminants, it may represent contamination from the suspected sources.

#### 4.2.5.5 Sodium

Sodium was detected in all the monitor wells and equipment blank. Concentrations ranged from 28.7 mg/L in MW-2 to 8.12 mg/L in MW-4. The equipment blank concentration, 0.169 mg/L, was lower than the monitor well concentrations. The State of Georgia recommended level for sodium in drinking water is 20 mg/L, although this is not an enforceable

standard (Lehman, 1990). Sodium typically occurs in groundwater with concentrations of 1 to 1,000 mg/L (Fenn et al., 1980). At the observed concentrations, sodium does not appear to be related to the contamination.

#### 4.2.5.6 Iron

Iron was also detected in all the monitor well samples and the equipment blank. Iron is another constituent which would not necessarily be indicative of contamination as it is often present in groundwater at concentrations of 0.01 mg/L to 10 mg/L (Fenn et al., 1980), but may suggest contamination if concentrations are well over background. Sources of iron may be decomposition of metal parts within the landfill, but iron is also a component of the soil. The highest concentrations were detected in MW-2 (19.0 mg/L), MW-4 (19.2 mg/L), and MW-5 (17.3 mg/L). Similar concentrations were detected in MW-1 (4.42 mg/L) and MW-3 (5.91 mg/L). All of these concentrations exceed the drinking water criterion for iron of 0.3 mg/L, which is based primarily on aesthetics (Sawyer and McCarty, 1978). The concentration in the equipment blank was 0.0124 mg/L, much lower than the other concentrations and below the criteria level. As the background concentration of iron in the aquifer is not certain due to the unreliability of the sample from MW-1, it is uncertain if the wells actually show contamination. Potentially, the higher concentrations observed at MW-2, MW-4, and MW-5 are indicative of contamination.

#### 4.2.5.7 Manganese

Manganese was detected in all the wells sampled. Concentrations in the other monitor wells ranged from 0.097 mg/L in MW-3 to 0.59 mg/L in MW-2. The criterion associated with manganese is 0.05 mg/L, generally based on aesthetics (Sawyer and McCarty, 1978). This criterion is exceeded in all of the monitor wells. Although manganese is often a component of metal alloys (EPA, 1988), it also a component of the soil and is



typically found in groundwater with concentrations ranging from 0.001 mg/L to 0.1 mg/L (Fenn et al., 1980). Due to its occurrence in all the wells at generally similar concentrations, this metal is not considered indicative of site contaminants.

#### 4.2.5.8 Cyanide

Cyanide was detected in two wells, MW-2 and MW-3. The highest concentration of 0.133 mg/L was detected in MW-2, adjacent to the location of the buried cyanide contaminated tank. Cyanide was also detected in MW-3 with a concentration of 0.005 mg/L, which is slightly over the detection limit of 0.003 mg/L. A recommended upper value criteria for cyanide in all classes of Georgia waters is 0.0035 mg/L (EPA, 1988). The concentration of cyanide in MW-2 exceeds this criteria.

Cyanide sources include various electroplating baths and fumigants (Walton, 1985). Plating operations occurred at the former MNOP, during which the buried tank supposedly became contaminated. The condition of the tank when excavated by USACE indicated that the tank was cleaned prior to disposal. The analyses results indicate some residual contamination, which has since dissolved in the groundwater, may have been present in the tank. The presence of trace levels of cyanide in MW-3 is expected as this well is located downgradient of the known suspected source of cyanide and also could represent other minor sources within the landfill or explosive demolition area.

#### 4.3 SOILS

Five composite soil samples from the first field effort and three composite soil samples from the second field effort were analyzed for volatile and semivolatile organic compounds, explosive compounds, nitrate/nitrite, petroleum hydrocarbons, and metals. Three soil samples collected from the explosive demolition area during the second field

effort were analyzed for volatile organics only. The scope of the analyses and methods of analysis are presented in Tables 3-1 and 3-2. The results of soil analyses are summarized in Tables 4-2 and 4-3, showing only those compounds that were present above detection limits. Complete results of the analytical results for soils are provided in Appendix E.

#### 4.3.1 ORGANIC COMPOUNDS

The majority of organic compounds was detected in the soil sample SO-5 from the first sampling event. This sample was collected as a composite from the edges of a pond located west of the site, off the former MNOP property boundary. All the compounds detected are semivolatile organics of a class of compounds known as polycyclic aromatic hydrocarbons (PAHs). These compounds are long chain hydrocarbons and are most often found associated with tar and heavy hydrocarbon fuels, such as diesel or kerosene.

Only one other organic compound was detected in soil sample SO-4, which was obtained during the first field effort from an area containing drums southwest of the landfill. The PAH compound benzo(G,H,I)perylene was detected in the composite soil sample SO-4. This area is also off the former MNOP property. The source of this compound is suspected to be material contained in the drums. The drums are not labeled but may potentially contain diesel fuel or kerosene.

The second round of soil samples collected from the explosive demolition area were specifically obtained to confirm the absence of volatile compounds in this area. There was concern by USACE that compositing of soil samples from this area collected during the first field effort had resulted in the loss of volatiles. Extra care was taken during the second effort not to composite these samples, as described in Section 3.6.3. The results of this second set of analyses

Table 4-2. Summary of Results of Soil Sample Analyses--First Field Effort

Compound*	Sample Identification					
	SO-1	SO-2	SO-3	SO-4	SO-5	SO-3-DP
Moisture (% wet wt.)	9.3	14.2	11.6	44.3	52.6	13.4
Arsenic	0.650	1.55	0.574	0.781	4.83	0.502
Barium	6.92	11.4	8.71	196	70.5	7.26
Chromium	7.02	8.87	5.82	22.1	29.6	3.99
Lead	--	5.00	--	41.8	39.3	--
Anthracene	--	--	--	--	0.32	--
Benzo(a)Anthracene	--	--	--	--	1.4	--
Benzo(b)Fluoranthene	--	--	--	--	0.92	--
Benzo(k)Fluoranthene	--	--	--	--	0.67	--
Benzo(a)Pyrene	--	--	--	--	0.69	--
Benzo(g,h,i)Perylene	--	--	--	1.9	0.72	--
Chrysene	--	--	--	--	0.95	--
Fluoranthene	--	--	--	--	2.1	--
Indeno(1,2,3-cd)Pyrene	--	--	--	--	0.75	--
Phenanthrene	--	--	--	--	1.0	--
Pyrene	--	--	--	--	1.8	--
Nitrogen, NO <sub>2</sub> +NO <sub>3</sub> , Sediment (µg/g-dry)	4.3	--	--	196	--	0.71
Hydrocarbons, Petro- leum (µg/g-dry)	--	--	--	1,020	207	--

Note: µg/g-dry - micrograms per gram, dry weight.  
-- - not selected at method detection limit.

\* Units are in milligrams per kilogram, dry weight (mg/kg-dry) unless otherwise noted.

Source: ESE, 1990.

Table 4-3. Summary of Results of Soil Sample Analyses--Second Field Effort

Compound*	Sample Identification			
	SD-1	SD-2	SD-DUP#2	BKGSOIL
Moisture (% wet wt.)	18.0	9.4	13.1	13.1
Arsenic	0.318	1.87	1.84	1.98
Barium	11.2	30.4	27.0	26.4
Cadmium	0.564	0.657	0.766	--
Chromium	4.40	12.9	13.6	21.0
Lead	5.76	22.6	26.9	5.32
PETN	--	4.92	6.10	--
Nitrogen, NO <sub>2</sub> and NO <sub>3</sub> (µg/g-dry)	4.18	--	--	1.78
Hydrocarbons, Petroleum (µg/g-dry)	--	12600	12200	--

Note: µg/g-dry = micrograms per gram, dry weight.  
-- = not selected at method detection limit.

\* Units are in milligrams per kilogram, dry weight (mg/kg-dry) unless otherwise noted.

Source: ESE, 1990.

(samples SO-1, SO-2, and SO-3) confirmed the absence of volatile organic compounds. No volatile compounds were detected in the laboratory analyses. Readings of organic vapors monitored during sample collection in this area with an organic vapor meter (OVM), ranged from approximately 20 ppm to 230 ppm. These readings are attributed to decay of natural organic material in the shallow, marshy soil in this area.

#### 4.3.2 EXPLOSIVE COMPOUNDS

During the first round of sample analyses, no explosive compounds were detected in any of the soil samples. The second round of analyses reveals the presence of only one of the explosive compounds, PETN, in the soil sample collected from below the oil recovery operation, SD-2. PETN was also detected in the duplicate sample from this location. PETN was detected in the groundwater in MW-1, the upgradient monitor well, and also in the duplicate sample from MW-3. As discussed in Section 4.2.2, PETN may be expected as it is used as a component of primers and fuses, which were manufactured at the former MNOP. These results suggest residual amounts of PETN may be present in the soil. Depending on the concentration, PETN may be the source of the concentrations observed in the groundwater.

#### 4.3.3 NITRATE/NITRITE

Nitrogen was detected in soil sample SO-1 and in the duplicate sample of SO-3, both collected during the first field effort from the explosive demolition area with concentrations of 4.3  $\mu\text{g/g}$  and 0.71  $\mu\text{g/g}$ , respectively. The concentration in the duplicate sample is very close to the detection limit for the method. The presence of nitrates in this area would not be unexpected as nitrates are often associated with the explosive compounds which also contain nitrogen. The highest concentration of nitrogen (196  $\mu\text{g/g}$ ) was found in soil sample SO-4 from the drum area. As this area is not suspected of containing explosive

wastes nor were any detected, this result may be associated with decomposing organic material present in the soil around the drums.

During the second sample analyses, the sediment sample SD-1 was found to have a nitrate concentration of 4.18  $\mu\text{g/g}$ , similar to SO-1 from the explosive demolition area. The background concentration of nitrate in soil is 1.78  $\mu\text{g/g}$ . The observed concentrations of nitrate in the explosive demolition area and the stream sediments are relatively low with comparison to the background value. Although nitrate may indicate the presence of explosive compounds, no other explosive compounds were detected. These values are most likely the result of decaying organic matter.

#### 4.3.4 PETROLEUM HYDROCARBONS

Petroleum hydrocarbons were detected in soil sample SO-4, collected adjacent to the drums and SO-5, consisting of pond sediments. The concentration of petroleum hydrocarbons was 1,020  $\mu\text{g/g}$  in SO-4 and 207  $\mu\text{g/g}$  in SO-5. The analysis of petroleum hydrocarbons detects a wide range of compounds which includes the PAH compounds, as well as other straight chain and cyclic hydrocarbons. The petroleum hydrocarbons detected in SO-5 may include the PAH compounds detected in the organic analysis and also others that were not target compounds of the analysis. The results from SO-4 indicate this is the case as the specific compounds which produced the petroleum hydrocarbon concentrations were not detected as any of the target compounds of the organic analysis [with the exception of benzo(G,H,I)perylene]. Based on these results from the pond and drum area, the contamination in these areas appears to be related to some type of hydrocarbon fuels or possibly lubricating oils. These types of materials were used at the former MNOP.

Petroleum hydrocarbons were detected in the soil below the former oil recovery operation. The concentrations were higher than observed in the

other areas, with concentrations of 12,600  $\mu\text{g/g}$  in the sample and 12,200  $\mu\text{g/g}$  in the duplicate. During sample collection, the soil was noted to be discolored and had a hydrocarbon odor. Organic vapor readings with the OVM were recorded as 4 ppm in the loose soil and up to 40 ppm in the shallow borehole from which the sample was obtained. Discussions with a former MNOP employee, Mr. Hamlin, revealed soil had been removed from this area in the past. Soil remaining most likely contains residual petroleum hydrocarbons from the former operation.

#### 4.3.5 METALS

The metal analysis of the background soil sample provides a basis for comparison with the other samples. Soils often contain detectable concentrations of metals; therefore, the presence of any specific metal does not necessarily represent contamination. Based on this comparison, three samples detected concentrations of certain metals exceeding the background concentrations. These samples include SO-4 from the drum area, SO-5 from the pond sediments, and SD-2 from below the oil recovery operation. These three samples were each found to contain other contamination, and elevated levels of certain metals is not unexpected.

Elevated levels of lead were found in each of the three samples SO-4, SO-5, and SD-2. The contamination in each of these samples was primarily attributed to some type of hydrocarbon product, a component of which may be lead. The lead concentrations ranged from 2.6 mg/kg in SD-2 to 41.8 mg/kg in SO-4, generally 4 to 8 times greater than the background concentration of 5.32 mg/kg.

The other metal that exceeded background concentrations was barium. Barium concentrations exceeded background concentrations in samples SO-4 and SO-5 by an order of magnitude. Barium only slightly exceeded background concentrations in sample SD-2 and is not considered significant. The presence of elevated concentrations of barium may be

r ed to the other contaminants in the pond and drum area. The  
p nce of barium in this sea appears to be unique to the specific  
t of hydrocarbon products producing the other contamination. This  
w suggest a different type of product than that associated with the  
f r oil recovery operations and perhaps a different source.



## 5.0 CONCLUSIONS

The conclusions of this confirmation study are the following:

1. Records Review--No new information was obtained by ESE that USACE did not already know. The available information can be obtained by contacting GSA and is kept at the National Archives. This information relates to exchange of property and inventories of facilities at the former MNOP.

Some of the structures at former MNOP, which could be potential sources of contamination, were involved in operations related to the manufacture of munitions. These operations involved the use of compounds such as oils, solvents, and explosives.

Structures that may be associated with contamination include a sewage treatment plant; plating operations; USTs; aboveground fuel tanks; the landfill; the explosive demolition areas; a buried cyanide-contaminated tank; solvent storage buildings; and an abandoned, deep industrial water supply well.

2. USACE Site Investigation--The investigation performed by USACE identified additional areas that may be of concern with regard to contamination at the site. These offsite areas include a pond containing reddish-orange water and an area containing approximately 500 unlabeled drums.

Monitor wells installed during the USACE investigation identified a shallow aquifer composed of silty sand. Observations made during well installation indicate the aquifer may exhibit localized confined conditions. Volatile organic vapors were detected during the installation of three of the monitor wells. Hydraulic testing of the aquifer by means of recovery tests provided values of hydraulic conductivity of the

aquifer in the lower range of silty sand formation. A water-level contour map prepared by USACE indicated flow generally to the southeast across the investigated area. This flow direction was confirmed by measurements obtained by the ESE project team.

3. Sampling and Analysis by ESE--Samples were collected during two different field efforts. The first effort involved the sampling of both groundwater monitor wells and soil. The second effort focused on soil sampling. The results of the sampling and analysis, which included 5 monitor wells and 16 soil samples total, revealed the presence of contamination at the site. The most significant groundwater contamination at the site is due to the organic compound TCE. Detected concentrations exceed drinking water standards in all the downgradient monitor wells. Concentrations significantly over the standard (by 760 to 1,400 times) were detected in MW-2 and MW-3 on the northeast portion of the landfill and near the explosive demolition area. Explosive contamination was detected in the groundwater from MW-3, adjacent to the explosive demolition area. The explosive compound PETN was detected in the upgradient well MW-1. This result, in combination with a relatively high concentration of nitrogen in comparison with other values on the site, suggests an additional source of explosive disposal near MW-1. PETN was also detected in the duplicate sample from MW-3 in the explosive demolition area. This result is expected. Iron and manganese were the only metals to exceed criteria. Due to an unreliable background sample particularly for the comparison of low-level metal concentrations in the aquifer, no definitive statements can be made regarding metals contamination. Some of the metals detected suggest contamination as the higher

concentrations occur in wells in which other contaminants were found. Cyanide was detected in two wells, MW-2 directly adjacent to the buried cyanide contaminated tank and MW-3, which is in a downgradient direction from the tank. The detected concentrations exceed the state criteria but are close to the detection limit for the analysis method. Petroleum hydrocarbons were not detected in any of the groundwater samples.

Evidence of soil contamination was found in soil samples SO-4, SO-5, and SD-2. Samples SO-4 and SO-5 were collected during the first field effort from an area west and southwest of the former MNOP property where a pond and drums were located by USACE. Sample SD-2 was collected during the second field effort from an area below a former oil recovery operation. The contamination in all three areas appears to be related to heavy hydrocarbon fuels or other hydrocarbon compounds, such as oils. These types of fuels and oils were present at the former MNOP as evidenced by the report of kerosene, diesel fuel, and heating oil tanks in the records. They were used for heating and operation of various machinery, and various oils were also used as cutting oils and lubricants. The presence of higher concentrations of barium in the samples from the pond and drum area, SO-4 and SO-5, may indicate a type of product different from that associated with the former oil recovery operation and perhaps a different source of the product. PETN was detected in the soil below the oil recovery operation and may suggest a source for the presence of PETN in the groundwater.

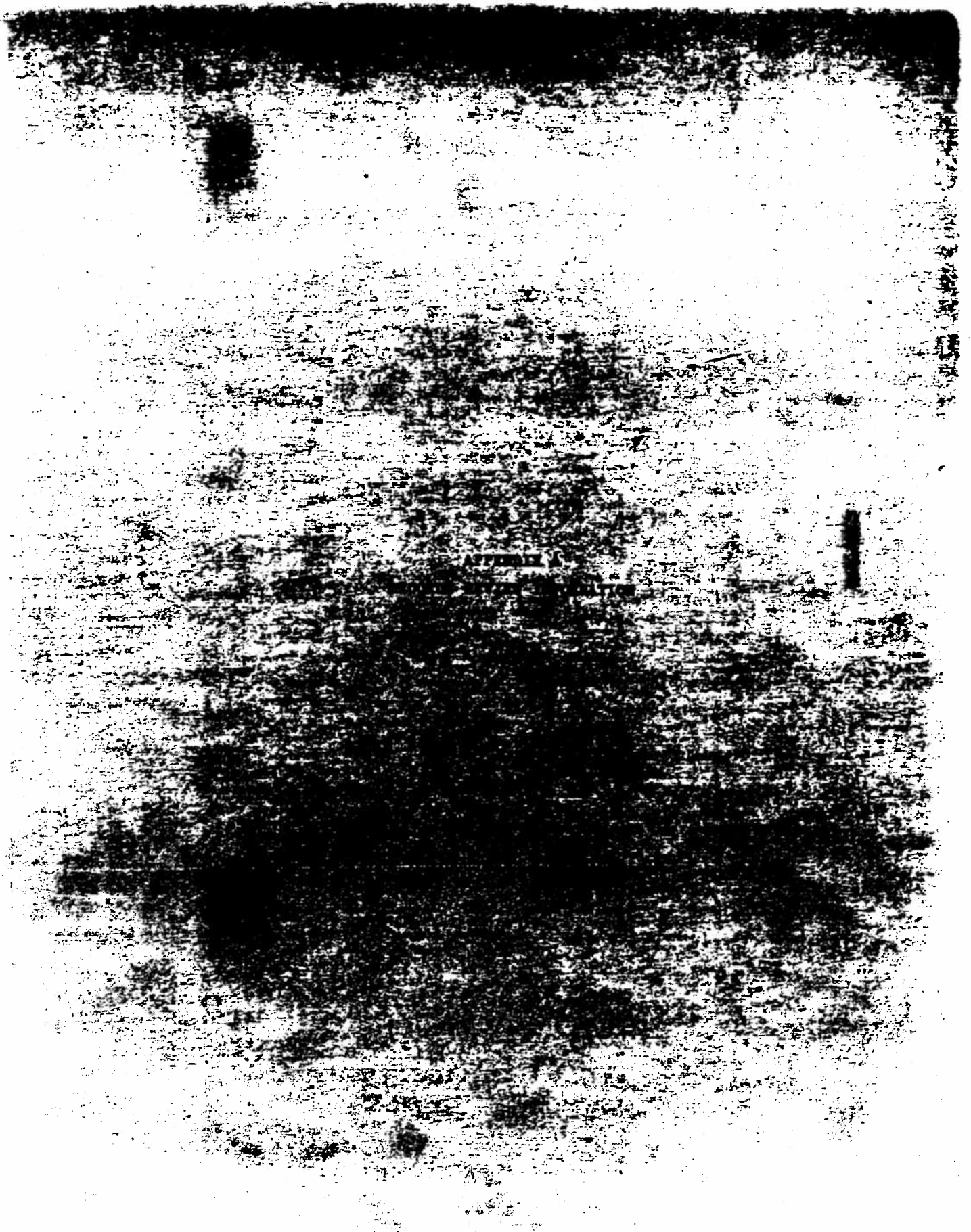
The resampling effort in the explosive demolition area was performed without compositing of the samples. This effort confirmed the results of the initial effort where the soil was

composited. No volatile organic compounds were detected from soil in this area during both efforts.

Groundwater and soil contamination has been encountered at concentrations that may require regulatory review for this location. The contamination found onsite is reasonably suspected to have resulted from activities that took place during the period of Department of Defense (DOD) control. Investigated areas adjacent to the site but outside the site boundary showed evidence of soil contamination. These areas, including a pond and abandoned drums, were investigated prior to verification that their location was not on former MNOP property. The initial assessment of the pond and drum area contamination is that it is not the result of DOD activities. The former MNOP site, and the adjacent site, should be referred to the appropriate office or agency for determination of a future course of action.

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(Pages 10 & 11 - Continued)

(new paragraph)

Other equipment include <sup>ing</sup> temperature chambers and cabinets, heat-treating ovens and furnaces, meters for almost every purpose, conveyors, chain hoists, oscillographs, oscilloscopes, oscillators, stroboscope, amplifiers, sterilizer, mowers, jacks, projectors, water coolers, industrial refrigerators, analyses, gages, magnet, cameras, microscopes, resistors, transit, incubator, scales, vices, resuscitators, chlorinators, closed-circuit television, safes, tanks, and many more items which are too numerous to set out in this brochure, are all in this sale.

The machinery and equipment, which represent<sup>s</sup> an original cost of over eight million dollars, provide<sup>s</sup> a flexibility that can produce items the size of a second hand on a watch...or a billet weighing 40 pounds or more. A large quality testing laboratory, x-ray inspection facility, <sup>and</sup> chemical analysis laboratory are all fully equipped. The pictures on these pages are typical of the machines and equipment at the Naval Ordnance Plant, Macon.

Due to the large number of structures and the vast amount of machinery, equipment, parts, tools, etc., a detailed listing is not available for distribution; however, ~~duplicate~~ <sup>a copy</sup> copies of this entire listing <sup>is</sup> available for review <sup>either</sup> at the plant <sup>or</sup> at the office of the Real Property Division of General Services Administration in Atlanta, Georgia.

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(SEAL at corner)

(Photographs 10, 11, 12 & 13 in the center area of both pages)

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MACHINES AND

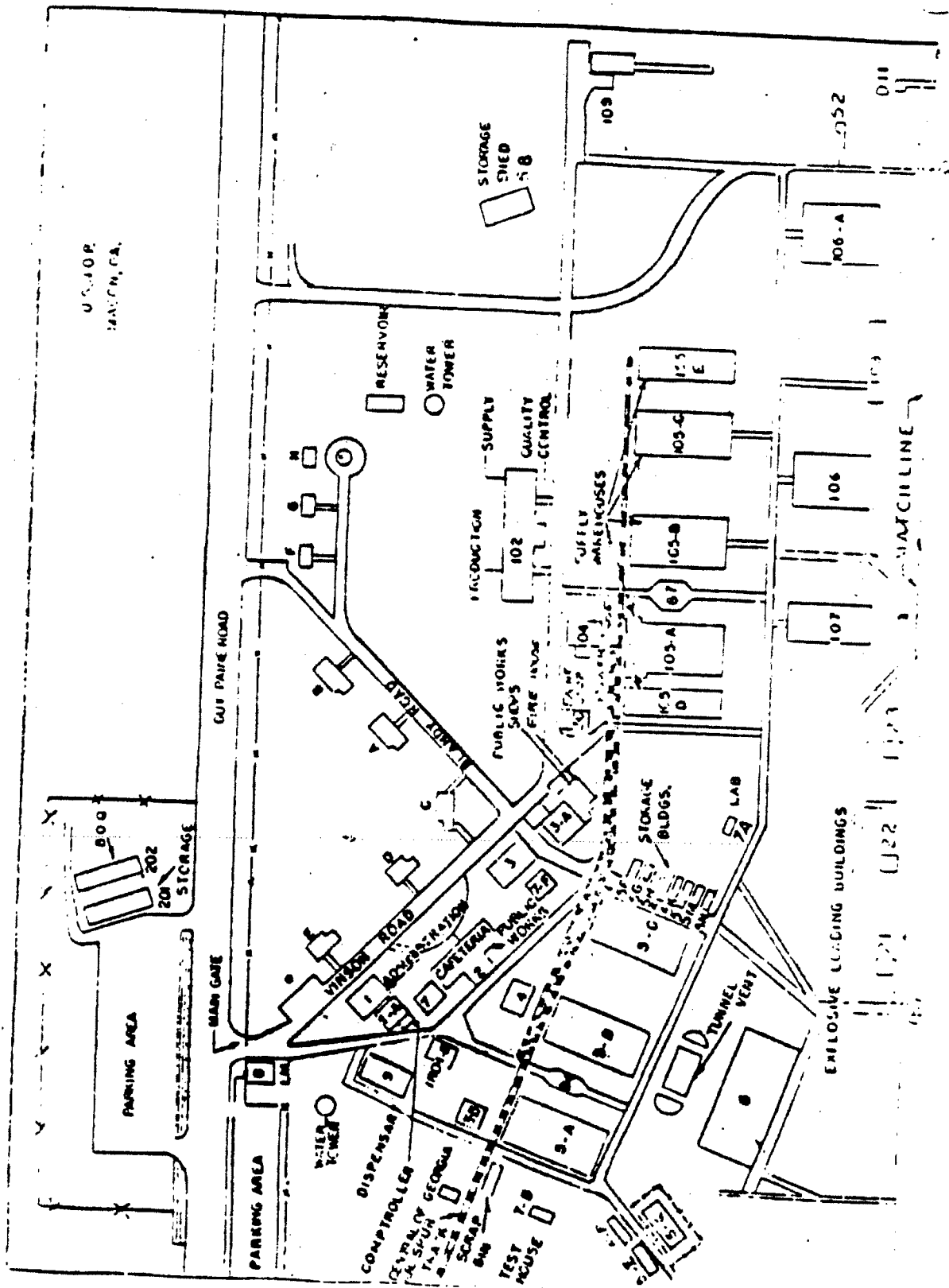
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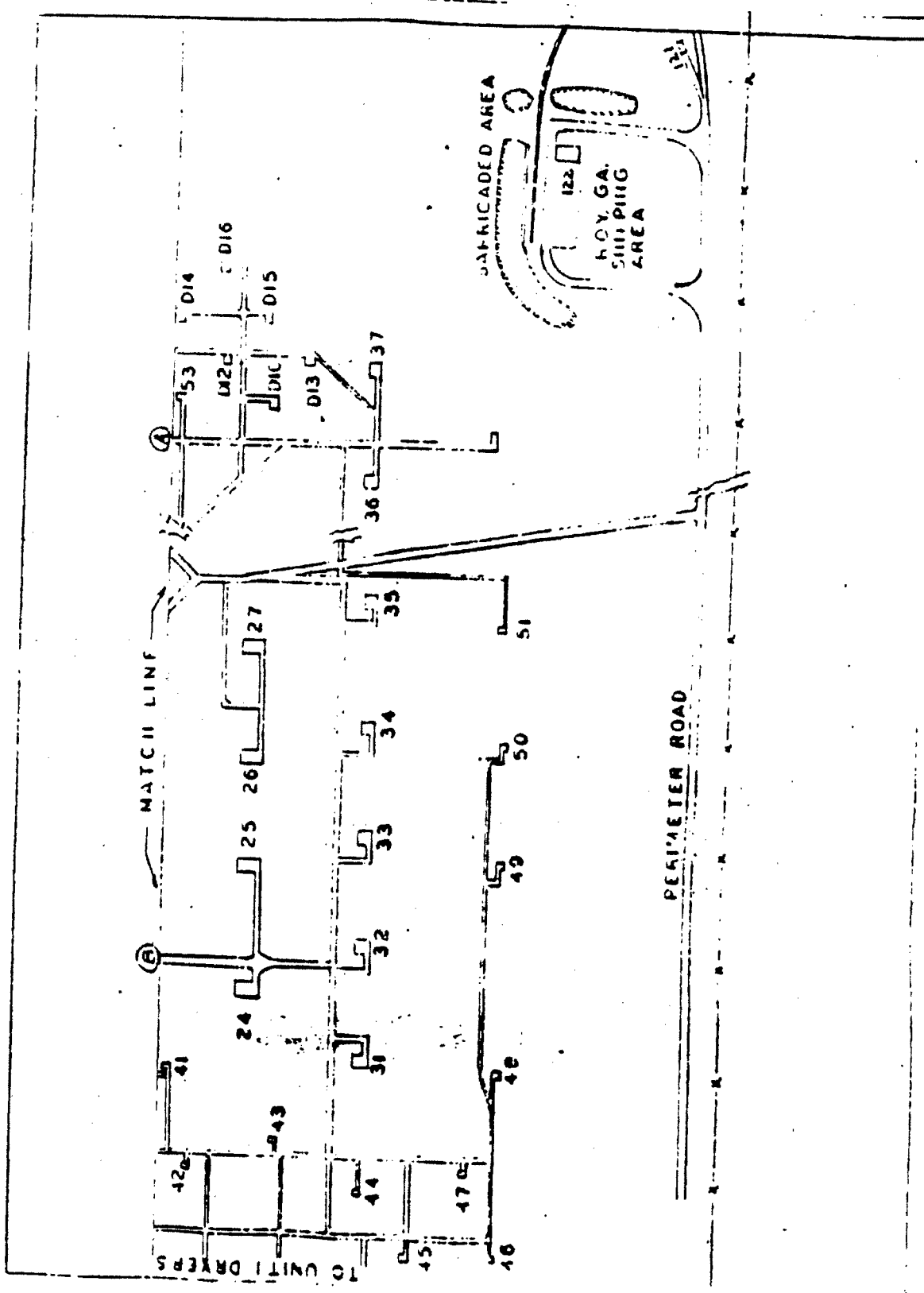
condition.

In order to produce components and explosive devices for increasingly complex modern weapons systems, the Naval Ordnance Plant, Beacon, has acquired and maintained considerable machinery. There are more than 2000 pieces of machinery in operation which include a Hughes' Machining Center, MT-3, Tape Controlled, Hydraulic Power Supply; many other machines used for grinding, lathes of almost all kinds, screw (including Swiss screwing machines), milling, boring, tapping, threading, sawing, drilling, cutting, shaping, bending, welding, plating, all sorts of presses, grinding, engraving, lapping, honing, jig-borers, variety of motors, pumps, drills, saws, x-ray, plating, centrifuge, sand blasting, blending, riveting, splicing, soldering, sanding, disthering, <sup>dictating</sup> ~~dictating~~, duplicating, degassing, calculators, punching, generators, sanding, etc.





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## INDEX OF STRUCTURES

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