SUMMARY OF CURRENT AND PLANNED ENVIRONMENTAL INVESTIGATIONS AT THE FORMER PLUM BROOK ORDNANCE WORKS

Presented to

RAB

March 18, 1998

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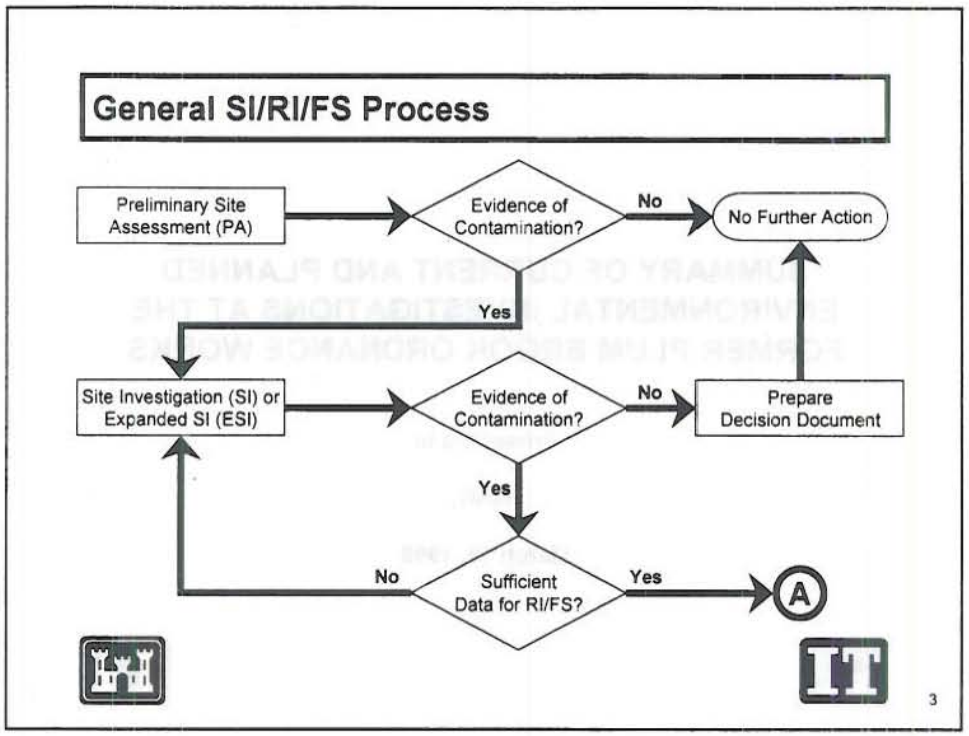
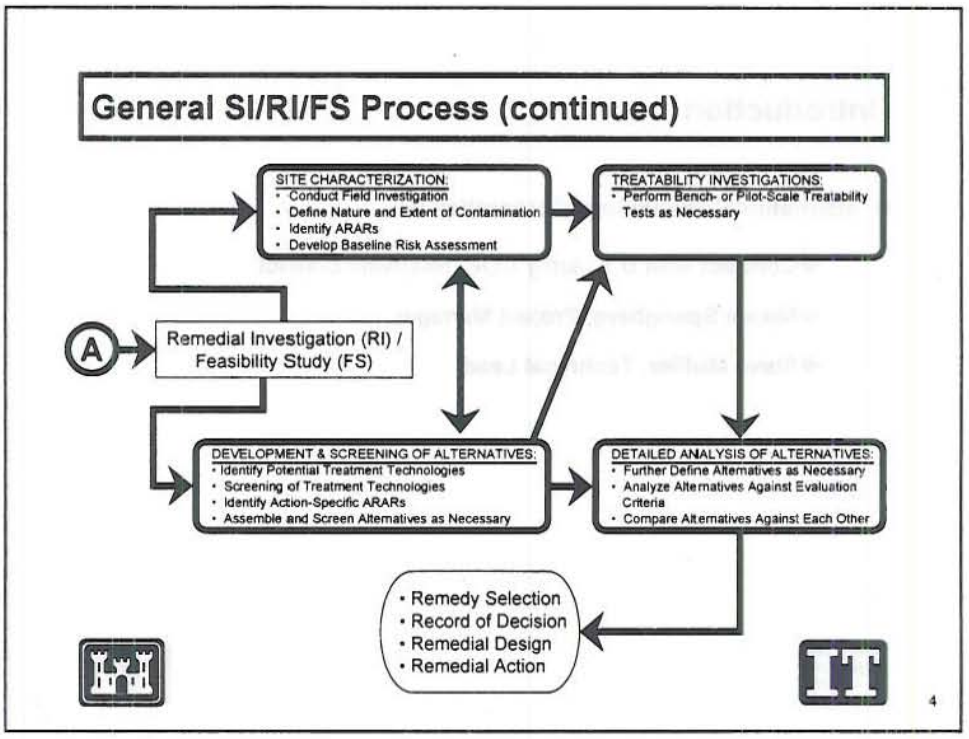
Introduction

- International Technology Corporation (IT)
  - →Contract with U.S. Army COE, Nashville District
  - →Mikael Spangberg, Project Manager
  - →Steve Muffler, Technical Lead

2


General SI/RI/FS Process
Preliminary Site Assessment (PA)
Evidence of Contamination?
No
No Further Action
Yes
Site Investigation (SI) or Expanded SI (ESI)
Evidence of Contamination?
No
Prepare Decision Document
Yes
No
Sufficient Data for RI/FS?
Yes
A
3


General SI/RI/FS Process (continued)
SITE CHARACTERIZATION:
• Conduct Field Investigation
• Define Nature and Extent of Contamination
• Identify ARARs
• Develop Baseline Risk Assessment
TREATABILITY INVESTIGATIONS:
• Perform Bench- or Pilot-Scale Treatability Tests as Necessary
A
Remedial Investigation (RI) / Feasibility Study (FS)
DEVELOPMENT & SCREENING OF ALTERNATIVES:
• Identify Potential Treatment Technologies
• Screening of Treatment Technologies
• Identify Action-Specific ARARs
• Assemble and Screen Alternatives as Necessary
DETAILED ANALYSIS OF ALTERNATIVES:
• Further Define Alternatives as Necessary
• Analyze Alternatives Against Evaluation Criteria
• Compare Alternatives Against Each Other
• Remedy Selection
• Record of Decision
• Remedial Design
• Remedial Action
4

Risk-Based Screening Concentrations (RBC)

- RBCs are a screening tool used to determine the need for additional investigation or remedial action
- PBOW RBCs adapted from EPA Region 3 published RBCs but using lifetime excess cancer risk of 10^{-6} and hazard index (HI) of 0.1 (published RBCs use cancer risk of 10^{-6} and HI of 1.0)
  - ➔EPA considers lifetime cancer risk of 10^{-4} to 10^{-6} "acceptable"
  - ➔HI of 0.1 address concern of exposure to multiple non-carcinogenic contaminants
- RBCs do not replace human health or ecological risk assessments

5

Recently Completed IT Investigations

- Site Investigation (SI) of the G-8 Burning Ground
- SI of Various Sites
  - ➔Reservoir No. 2 Burning Ground
  - ➔Additional Burning Ground
  - ➔Wastewater Disposal Plant No. 2
  - ➔ Powerhouse No. 2 Ash Pit
- Groundwater Investigation

6

Site Investigation (SI) of G-8 Burning Ground

- Purpose and Objectives
  - →Locate suspected burning ground
  - →Determine if site soils contaminated from past activities
  - →Evaluate impact to human health and the environment
- Scope of Work (completed May 1996)
  - →Geophysical survey to locate suspected burning ground
  - →Trenching to confirm/deny presence of burning ground
  - →Surface and subsurface soil sampling (12 soil borings)
  - →Sediment sampling

7

SI of G-8 Burning Ground (continued)

- Conclusions
  - →SI did not clearly define the presence of burning ground
  - →Explosive compounds were not detected
  - →Only one detected organic compound exceeded the risk-based screening concentration (RBC)
    - Benzo(a)pyrene in surface soil at SO-08
    - Concentration of 160 ug/kg (parts-per-billion) vs. RBC of 88 ug/kg
  - →Seven metals (aluminum, arsenic, barium, beryllium, iron, manganese, and thallium) exceeded the RBCs

8

SI of G-8 Burning Ground (continued)

- Recommendations
  - →Metals detected at concentrations above the RBCs to be evaluated further when naturally-occurring background concentrations for PBOW are established.
  - →Additional soil and sediment sampling at the G-8 Burning Ground is not necessary.
  - →One bedrock monitoring well should be installed at the site to characterize groundwater quality (completed in 1997).

9

SI of Reservoir No. 2 Burning Ground

- Purpose and Objectives
  - →Delineate extent of former burning ground
  - →Determine if site soils contaminated from past activities
  - →Evaluate impact to human health and the environment
- Scope of Work (completed October 1996)
  - →Geophysical survey to define extent of former burning ground
  - →Trenching to identify buried objects / anomalies identified during geophysical survey
  - →Surface and subsurface soil sampling (8 soil borings)

10

SI of Reservoir No. 2 Burning Ground (continued)

- **Conclusions**

  →Geophysical survey and trenching confirmed site used as dumping / burning area

  - Metallic and other debris evident at 2 to 3 feet below grade
  - Extent of burning ground may be larger than area investigated

  →Site soils exhibit contamination above RBCs

  - Nitroaromatic (explosive) compounds up to 910 mg/kg (parts-per-million) (SO-03)
  - Benzo(a)pyrene and Aroclor-1260 (PCB) also exceeded RBCs
  - Seven metals (aluminum, arsenic, beryllium, iron, lead, manganese, and thallium) exceeded the respective RBCs

11

SI of Reservoir No. 2 Burning Ground (continued)

- **Recommendations**

  →Metals concentrations to be evaluated further when background concentrations have been established.

  →Additional soil sampling to determine the extent of contamination recommended.

  →One monitoring well should be installed at the site to characterize groundwater quality.

12

SI of Additional Burning Ground

- Purpose and Objectives
  - →Delineate extent of former burning ground
  - →Determine if shallow soils contaminated from past activities
  - →Evaluate impact to human health and the environment
- Scope of Work (completed October 1996)
  - →Geophysical survey to define extent of former burning ground
  - →Surface and shallow subsurface soil sampling (12 soil borings)

13

SI of Additional Burning Ground (continued)

- Conclusions
  - →Geophysical survey indicates site possibly a burning area
    - Considerable amount of cinders observed on the ground surface
    - Other visual and geophysical observations indicate possible other uses
  - →Site soils exhibit contamination above RBCs
    - One nitroaromatic compound (DNT) at 4.7 mg/kg (parts-per-million) in SO-09
    - Benzo(a)pyrene and Aroclor-1260 (PCB) also exceeded RBCs
    - Ten metals (aluminum, arsenic, beryllium, cadmium, copper, iron, lead, manganese, thallium, and zinc) exceeded the respective RBCs

14

SI of Additional Burning Ground (continued)

- Recommendations
  - →Metals concentrations to be evaluated further when background concentrations have been established.
  - →Site-specific risk assessment be performed to determine need for additional site investigations.
  - →One monitoring well should be installed at the site to characterize groundwater quality (2 wells installed in 1997 - one bedrock, one overburden).

15

SI of Wastewater Disposal Plant No. 2

- Purpose and Objectives
  - →Determine if site soils contaminated from past activities
  - →Evaluate impact to human health and the environment
- Scope of Work (completed October 1996)
  - →Screening samples (20) collected from surface and subsurface soils (10 borings)
  - →Confirmation samples (5) collected from surface and subsurface soils (selected from 10 screening borings)

16

SI of Wastewater Disposal Plant No. 2 (cont.)

- **Conclusions**

  →Screening soil samples did not reveal site contamination by nitroaromatic compounds

  →Confirmation samples indicate limited soil contamination

  - Nitroaromatic compounds detected but below RBCs
  - Five polynuclear aromatic hydrocarbons (PAH) and Aroclor-1260 (PCB) also exceeded RBCs
  - Eight metals (aluminum, antimony, arsenic, barium, iron, lead, manganese, and thallium) exceeded the respective RBCs

17

SI of Wastewater Disposal Plant No. 2 (cont.)

- **Recommendations**

  →Metals concentrations to be evaluated further when background concentrations have been established.

  →Additional soil sampling to determine the extent of contamination recommended.

  →One monitoring well should be installed at the site to characterize groundwater quality.

18

SI of Powerhouse No. 2 Ash Pit

- Purpose and Objectives
  - →Determine if site soils contaminated from past activities
  - →Evaluate impact to human health and the environment
- Scope of Work (completed October 1996)
  - →Surface and shallow subsurface soil sampling (12 soil borings)
  - →Analytical parameters excluded nitroaromatic explosives

19

SI of Powerhouse No. 2 Ash Pit (continued)

- Conclusions
  - →Screening soil samples did not reveal site contamination by nitroaromatic compounds
  - →Confirmation samples indicate limited soil contamination
    - Of 14 detected semivolatile organic compounds, only bis(2-ethylhexyl)phthalate exceeded the RBC
    - Pesticides were detected at concentrations below RBCs
    - Six metals (aluminum, arsenic, beryllium, iron, manganese, and thallium) exceeded the respective RBCs

20

SI of Powerhouse No. 2 Ash Pit (continued)

- Recommendations
  - →Metals concentrations to be evaluated further when background concentrations have been established.
  - →Site-specific risk assessment be performed to determine need for additional site investigations.
  - →One monitoring well should be installed at the site to characterize groundwater quality.

21

Groundwater Investigation

- Purpose and Objectives
  - →Define groundwater flow in areas of concern
  - →Further delineate extent and magnitude of groundwater contamination near West Area Red Water Ponds & TNT Area C
  - →Document changes in groundwater quality since last sampling
- Scope of Work (completed October 1996)
  - →Installation and sampling of 2 new wells and 1 piezometer
  - →Sampling of 28 existing bedrock and overburden wells

22

Groundwater Investigation (continued)

- **Conclusions**

  →Groundwater flow in overburden and bedrock aquifers to NNE

  →West Area Red Water Ponds Area (WARWP)

  - Nitroaromatic compounds and metals exceed RBCs in overburden wells
  - Nitroaromatic and organic compounds exceed RBCs in bedrock north of WARWP; metals also exceed RBCs in bedrock wells

  →TNT Area C (TNTC)

  - Overburden wells exhibit small number of metals above RBCs
  - Bedrock wells impacted by nitroaromatic and organic compounds; metals also exceed RBCs in bedrock wells

23

Groundwater Investigation (continued)

- **Conclusions (continued)**

  →Pentolite Road Red Water Pond Area (PRRWP)

  - Nitroaromatic compounds and metals exceed RBCs in overburden wells
  - Nitroaromatic compounds, organic compounds, and metals exceed RBCs in bedrock wells

  →TNT Area A (TNTA)

  - Overburden wells in western TNTA exhibit nitroaromatic contaminants; metals also exceed RBCs in overburden wells
  - Bedrock wells in northeastern TNTA impacted by nitroaromatic and organic compounds; metals also exceed RBCs in bedrock wells

24

Groundwater Investigation (continued)

- **Conclusions (continued)**

  →TNT Area B (TNTB)

  - Nitroaromatic compounds exceed RBCs in overburden downgradient of TNTB; metals also exceed RBCs in overburden wells
  - No bedrock wells have been installed at TNTB

  →Upgradient Bedrock Aquifer (PB-BED-MW20)

  - Organic or explosive contaminants not detected in this well
  - Metals detected at concentrations above respective RBCs

25

Groundwater Investigation (continued)

- **Recommendations**

  →Installation & sampling of 8 bedrock wells and 4 overburden wells to define contaminant nature and extent (completed 1997)

  →Groundwater levels collected on quarterly basis for one year to determine seasonal groundwater flow variations (in progress)

  →Sample selected wells once during wet season & once during dry season to determine impacts on migration (in progress)

  →Evaluate suitability of existing / new monitoring wells as background locations for evaluation of metals in groundwater (in progress)

26

Groundwater Investigation (continued)

- Recommendations (continued)
  - → Hydropunch groundwater sampling of overburden aquifer near WARWP and PRRWP to delineate lateral extent of nitroaromatic explosives contamination (to begin April / May 1998)
  - → Geochemical evaluation of bedrock chemical data to determine source of hydrogen sulfide (H_2S) in bedrock wells and possible impact on contaminant migration

27

Current and Planned Investigations

- Site-Wide Groundwater Investigation
- Site Investigation (SI) of Acid Areas
- Risk Assessment (RA) and Direct Push Investigation (DPI) of Red Water Ponds Areas

28

Site-Wide Groundwater Investigation

- Purpose and Objectives
  - →Determine if hazardous substances present at the site that constitute unacceptable risk
  - →Define physical site features and characteristics
  - →Evaluate fate and transport pathways
  - →Determine current and future routes of exposure

29

Site-Wide Groundwater Investigation (continued)

- Scope of Work
  - →Installation of 8 new bedrock and 4 new overburden wells
  - →Quarterly groundwater level measurements of 12 new and 83 existing monitoring wells
  - →Sampling of 12 new and 47 existing monitoring wells on two occasions - dry season and wet season
  - →Seasonal and annual reporting

30

Site-Wide Groundwater Investigation (continued)

- **Status of Investigation**
  - **→New monitoring wells installed in September 1997**
  - **→First, second, and third quarterly groundwater level measurements completed (09/97, 11/97, and 02/98)**
  - **→First sampling event completed (11/97)**
  - **→Second sampling event and fourth quarterly groundwater level measurements scheduled for May 1998**
  - **→First quarterly report issued October 1997; second quarterly and first sampling event report to be issued March 1998**

31

Site-Wide Groundwater Investigation (continued)

- **Preliminary Groundwater Sampling Results (December 1997)**
  - **→Overburden Monitoring Wells**
    - At least one inorganic compound (metals) exceed RBCs in all sampled wells
    - Nitroaromatic compounds exceed RBCs in selected wells near Red Water Ponds (WARWP & PRRWP), TNT Area A, and TNT Area B
    - Organic compounds exceed RBCs in selected wells at WARWP and TNT Area C
  - **→Bedrock Monitoring Wells**
    - At least one inorganic compound (metals) exceed RBCs in all sampled wells
    - Two nitroaromatic compounds (1,3-dinitrobenzene and nitrobenzene) exceed RBCs in PB-BED-MW18 at TNT Area A
    - Small number of organic compounds exceed RBCs in 13 of 16 sampled wells

32

SI of Acid Areas

- Purpose and Objectives
  - →Determine if hazardous substances present in soils at the site that constitute unacceptable risk
  - →Define physical site features and characteristics
  - →Determine current and future routes of exposure

33

SI of Acid Areas (continued)

- Scope of Work
  - →Drilling and sampling of 15 soil borings at each of three (3) Acid Areas not previously studied
  - →Drilling and sampling of three (3) soil borings at the Maintenance Shop Area
  - →Drilling and sampling of six (6) soil borings to establish background soil concentrations
  - →Reporting

34

SI of Acid Areas (continued)

- Status of Investigation
  - →Draft Site-Specific Sampling and Analysis Plan (SSAP) and draft Site-Specific Safety and Health Plan (SSHP) issued in December 1997
  - →Final SSAP and SSHP issued in March 1998
  - →Field investigation activities scheduled for April / May 1998

35

Risk Assessment (RA) and Direct Push Investigation (DPI) of Red Water Ponds Areas

- Purpose and Objectives
  - →Determine nature and extent of source areas
  - →Estimate current and future routes of exposure
  - →Characterize risk to exposed human and/or biotic populations
  - →Determine applicable risk-based cleanup levels
  - →Determine applicable or relevant and appropriate requirements

36

RA and DPI of Red Water Ponds Areas (cont.)

- Scope of Work
  - →Soil and groundwater sampling at 20 locations at each of the WARWP and PRRWP areas using direct push techniques
  - →3 soil samples and 1 groundwater sample collected at each location for total of 120 soil and 40 groundwater samples
  - →Complete human health and ecological risk assessments
  - →Reporting

37

RA and DPI of Red Water Ponds Areas (cont.)

- Status of Investigation
  - →Draft SSAP and SSHP issued January 1998
  - →Final SSAP and SSHP to be issued March 1998
  - →Draft Human Health and Ecological Risk Assessment work plans to be issued in March / April 1998
  - →Field investigation activities scheduled for April / May 1998

38

ATTACHMENT 1

PBOW FIELD INVESTIGATION FIGURES

FIGURES FOR THE
SITE INVESTIGATION OF THE G-8 BURNING GROUNDS

Mr Starr Truscott
P.O. Box 13, Bigmingham, OH 44816
TNT contaminated warehouses

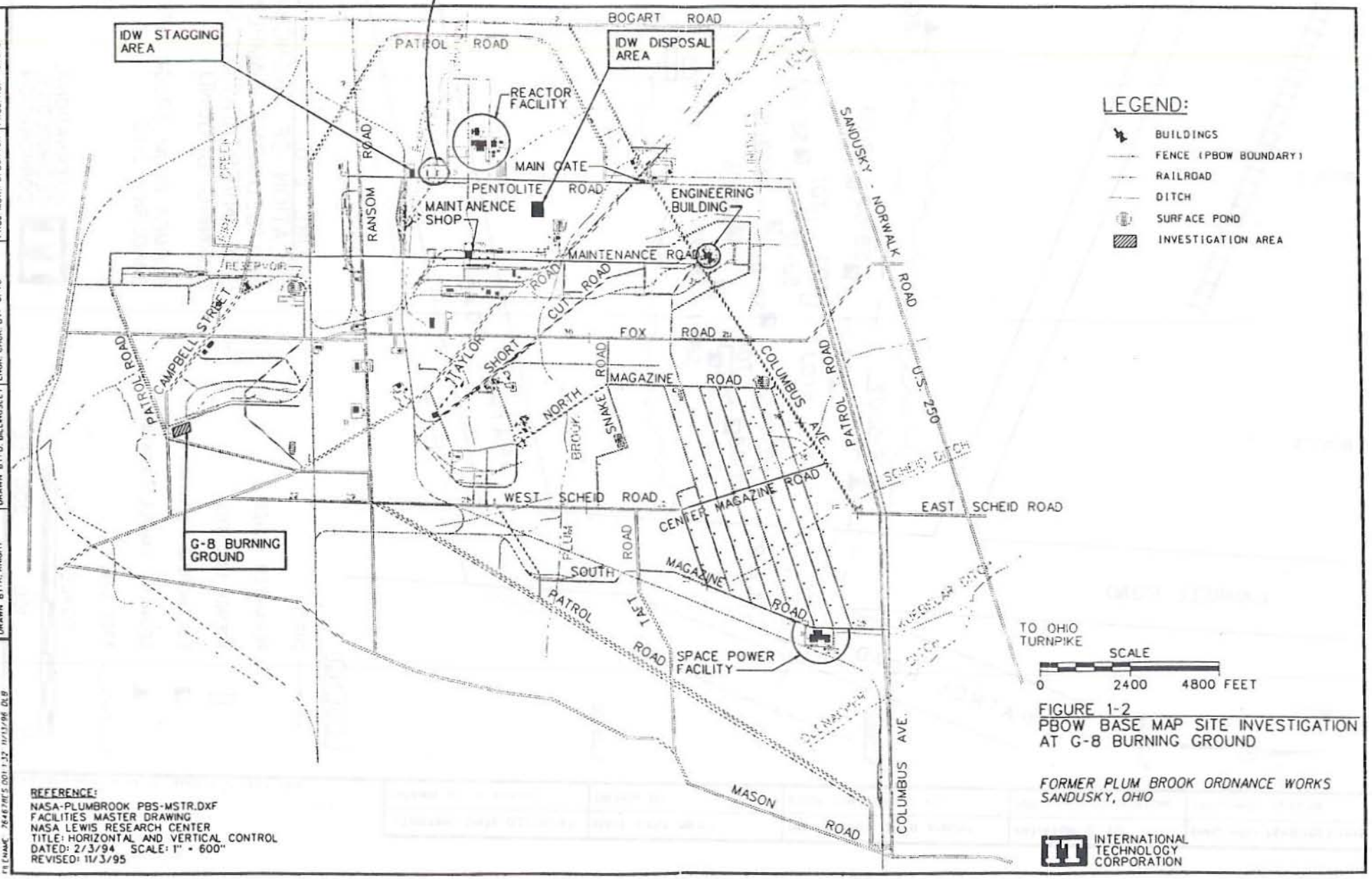


FIGURE 1-2
PBOW BASE MAP SITE INVESTIGATION AT G-8 BURNING GROUND

FORMER PLUM BROOK ORDNANCE WORKS SANDUSKY, OHIO

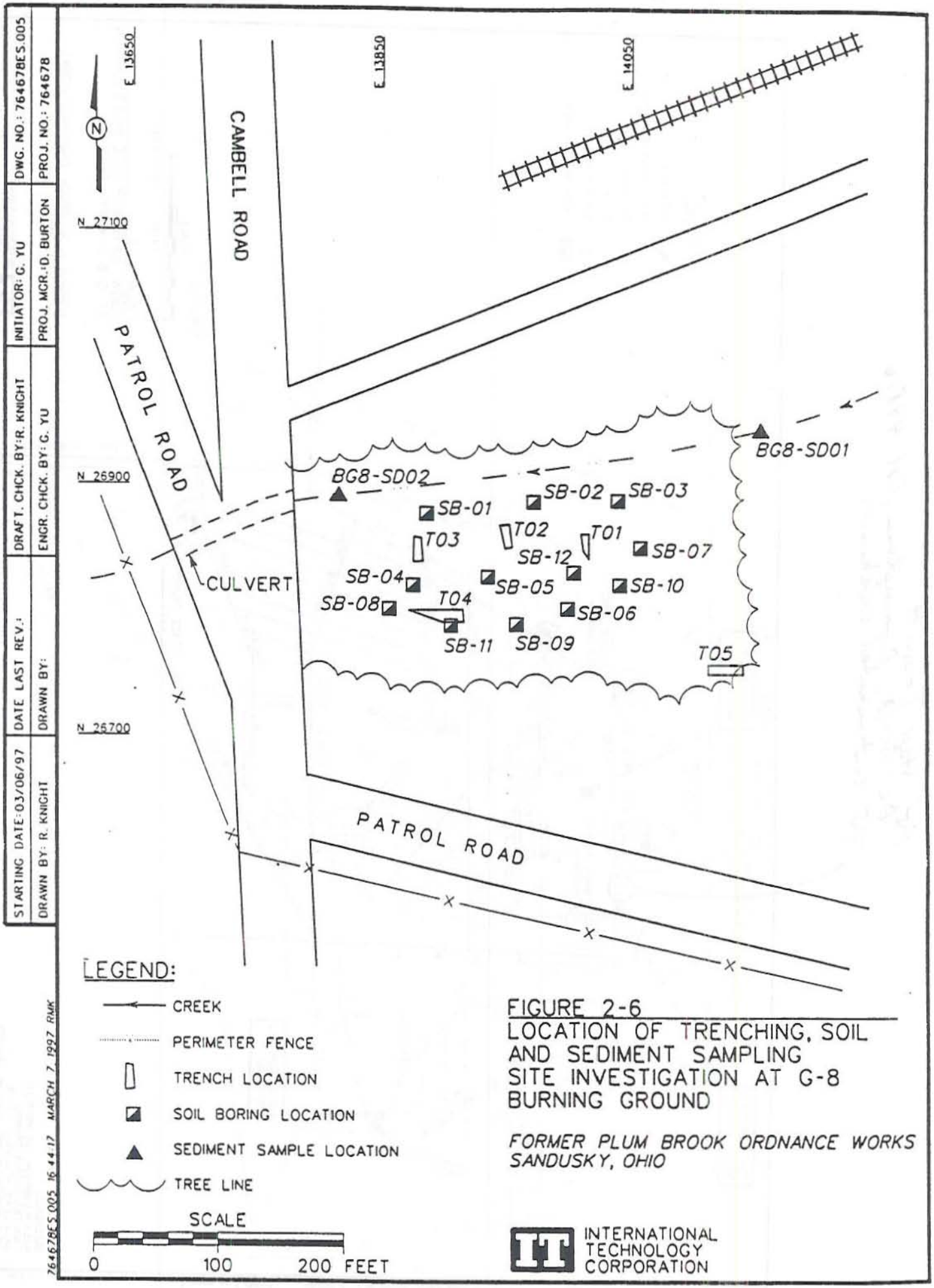
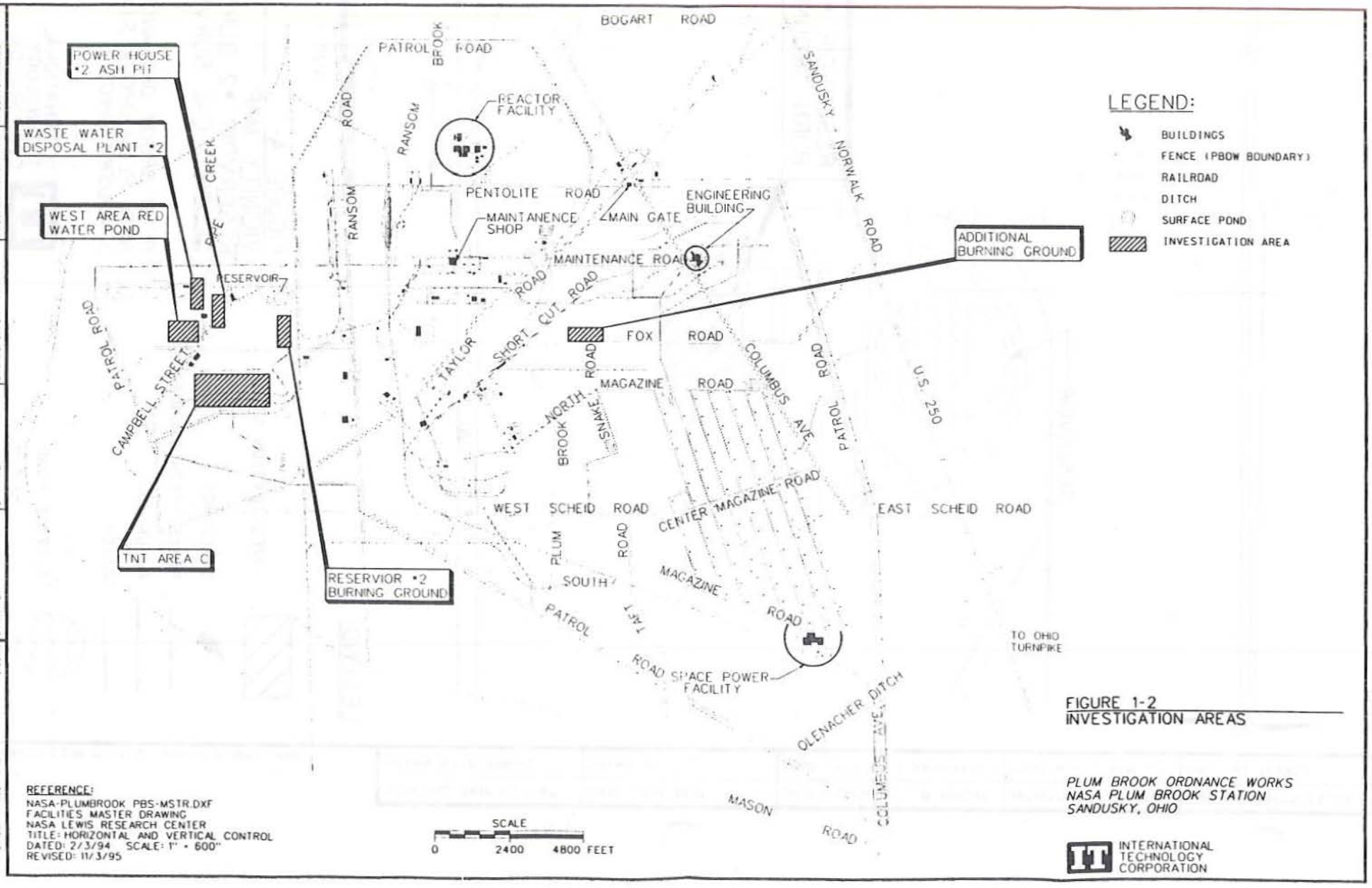


FIGURE 2-6
LOCATION OF TRENCHING, SOIL AND SEDIMENT SAMPLING SITE INVESTIGATION AT G-8 BURNING GROUND

FORMER PLUM BROOK ORDNANCE WORKS SANDUSKY, OHIO

FIGURES FOR THE SITE INVESTIGATION OF RESERVOIR NUMBER 2 BURNING GROUND, ADDITIONAL BURNING GROUND, WASTE WATER DISPOSAL PLANT NUMBER 2, AND POWERHOUSE NUMBER 2 ASH PIT



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NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600"
REVISED: 11/3/95

FIGURE 1-2
INVESTIGATION AREAS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 1/22/97	DATE LAST REV.:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: T. KIRKPATRICK	DWG. NO.: 766952ES.018
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: T. KIRKPATRICK	PROJ. MGR.: D. BURTON	PROJ. NO.: 766952

LEGEND:

- INVESTIGATION AREA
- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND

SCALE

0 400 800 FEET

FIGURE A-1
VICINITY MAP
RESERVOIR #2 BURN GROUND
GEOPHYSICAL SURVEY

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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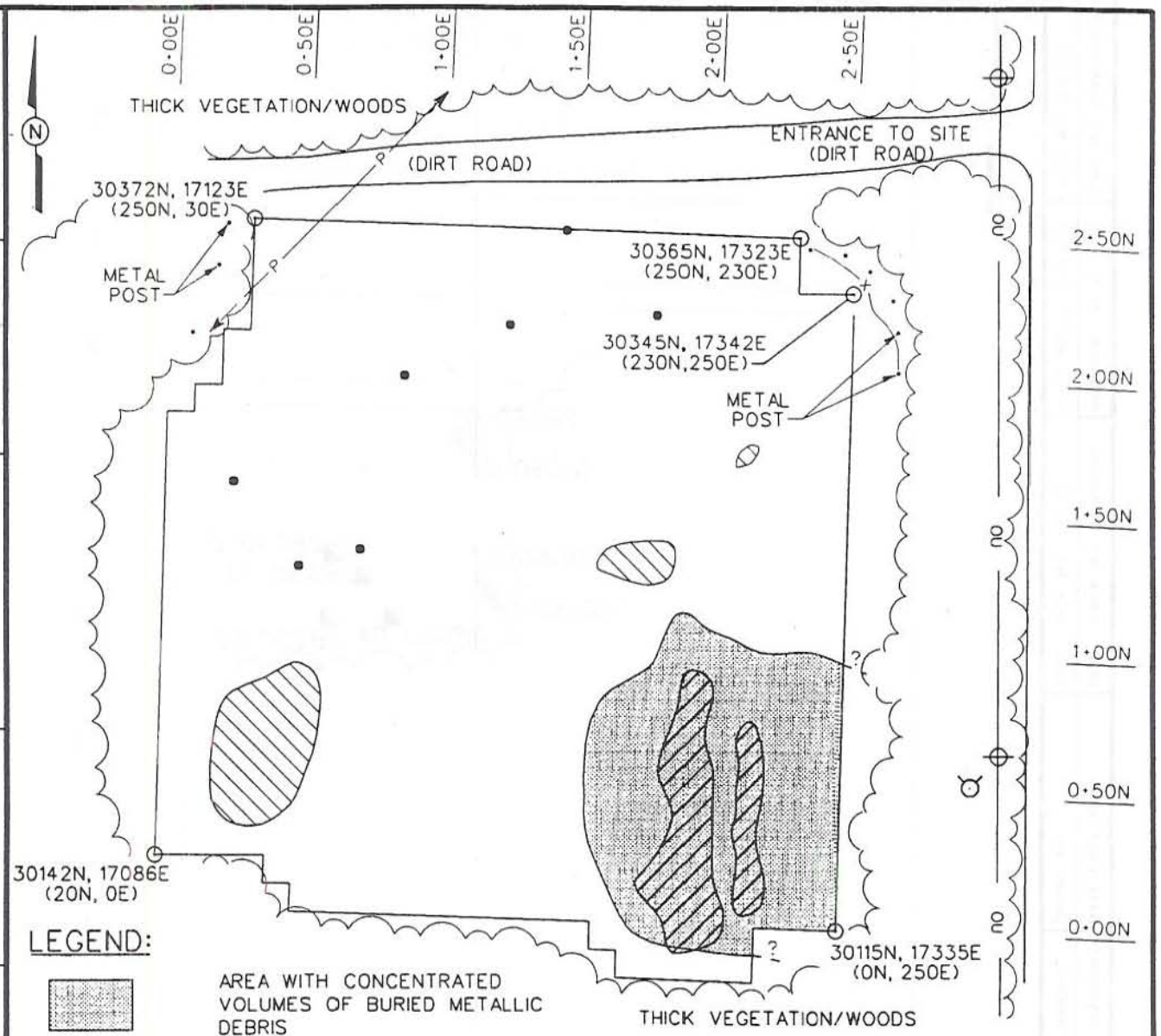

LEGEND:

- AREA WITH CONCENTRATED VOLUMES OF BURIED METALLIC DEBRIS
- AREA WITH DISPERSED METALLIC DEBRIS
- AREA WITH ANOMALOUS HIGH CONDUCTIVITY
- BURIED METAL
- —— P —— BURIED PIPE
- ⊙30142N, 17086E GEOPHYSICAL SURVEY COORDINATES IN FEET (NASA PLUM BROOK SYSTEM)
- (20N, 0E) LOCAL GEOPHYSICAL SURVEY COORDINATES IN FEET
- UTILITY POLE
- FIRE HYDRANT
- —— OU —— OVERHEAD UTILITIES
- TREE LINE
- ——x—— FENCE

SCALE

0 60 120 FEET

FIGURE A-5
GEOPHYSICAL INTERPRETATION MAP
RESERVIOR #2 BURN GROUND

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 2/5/97	DATE LAST REV.:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: J. HACKWORTH	DWG. NO.: 766952ES.022
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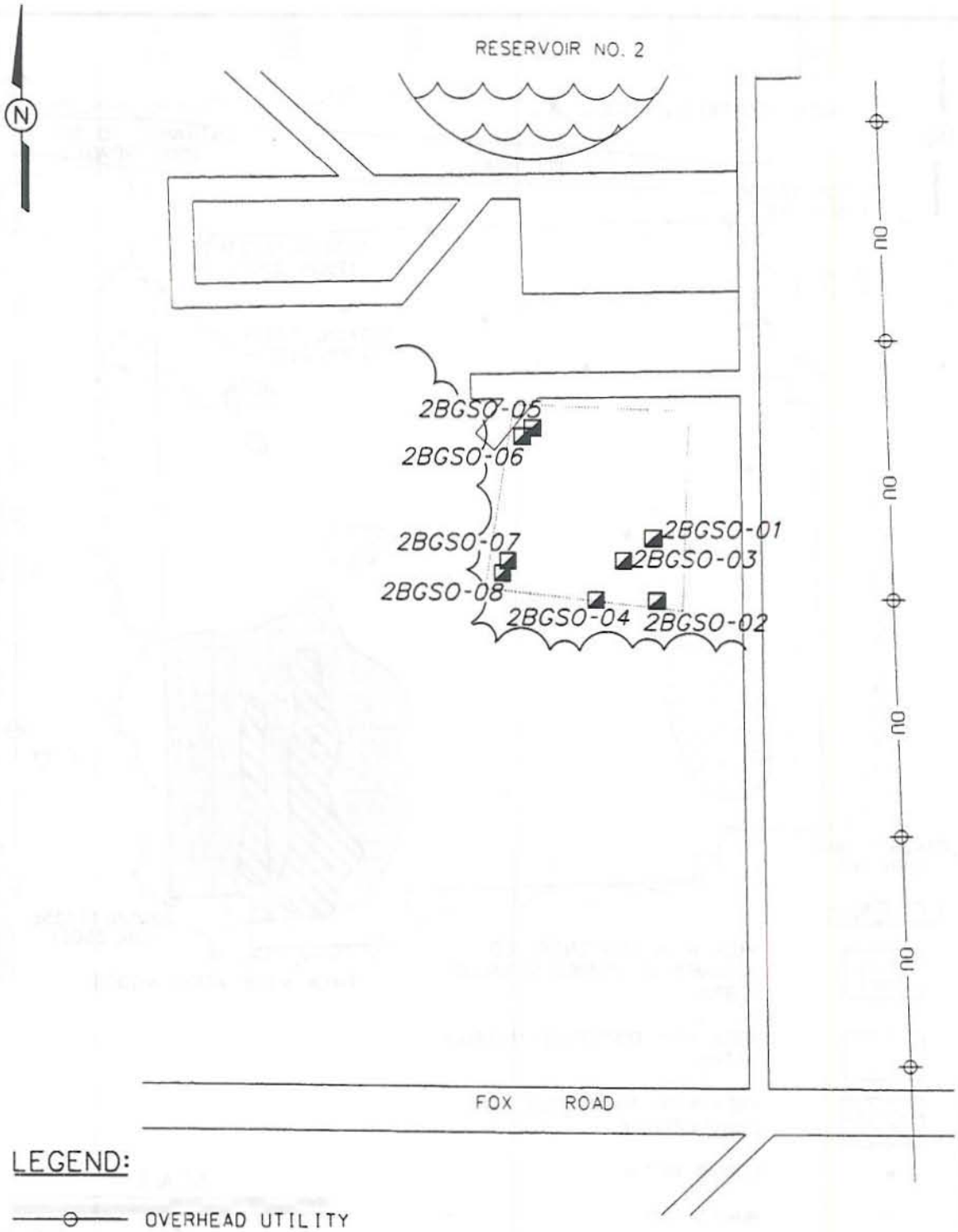

LEGEND:

OVERHEAD UTILITY

SURFACE POND

PRIMARY GEOPHYSICAL SURVEY GRID

SOIL BORING (2BGSO-01)

TREE LINE

SCALE

0 200 400 FEET

FIGURE 2-2
SOIL BORING LOCATIONS
SITE INVESTIGATION
RESERVOIR NO. 2 BURNING GROUND

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 03/10/97 | DATE LAST REV.: | DRAFT. CHCK. BY: R. KNIGHT | INITIATOR: G. YU | DWG. NO.:\766952ES.046
DRAWN BY: R. KNIGHT | DRAWN BY: | ENGR. CHCK. BY: G. YU | PROJ. MGR.:D. BURTON | PROJ. NO.:766952

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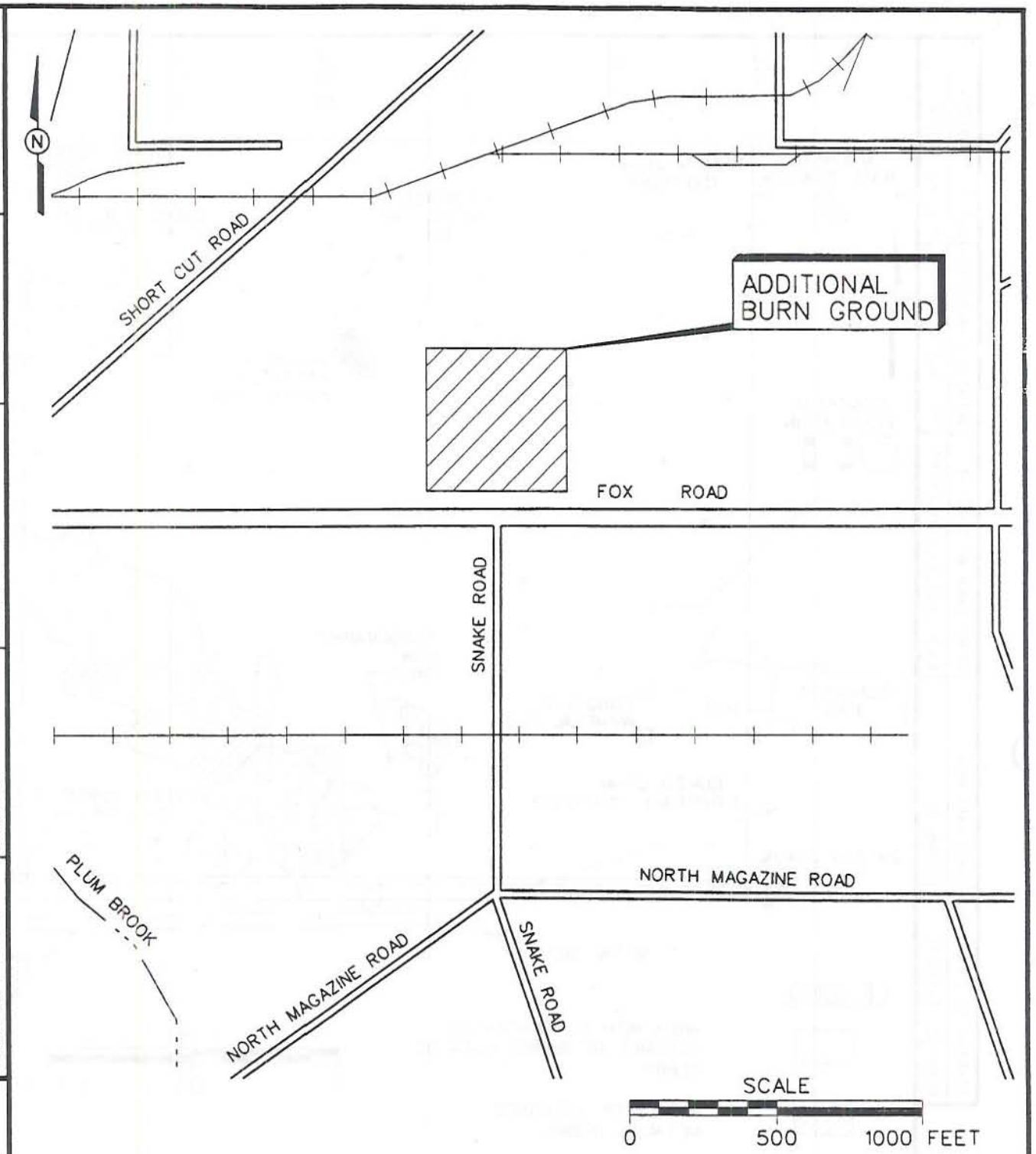

LEGEND:

INVESTIGATION AREA

RAILROAD

DITCH

FIGURE A-2
VICINITY MAP
ADDITIONAL BURN GROUND
GEOPHYSICAL SURVEY

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 1/22/97	DATE LAST REV.:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: J. HACKWORTH	DWG. NO.: 766952ES.019
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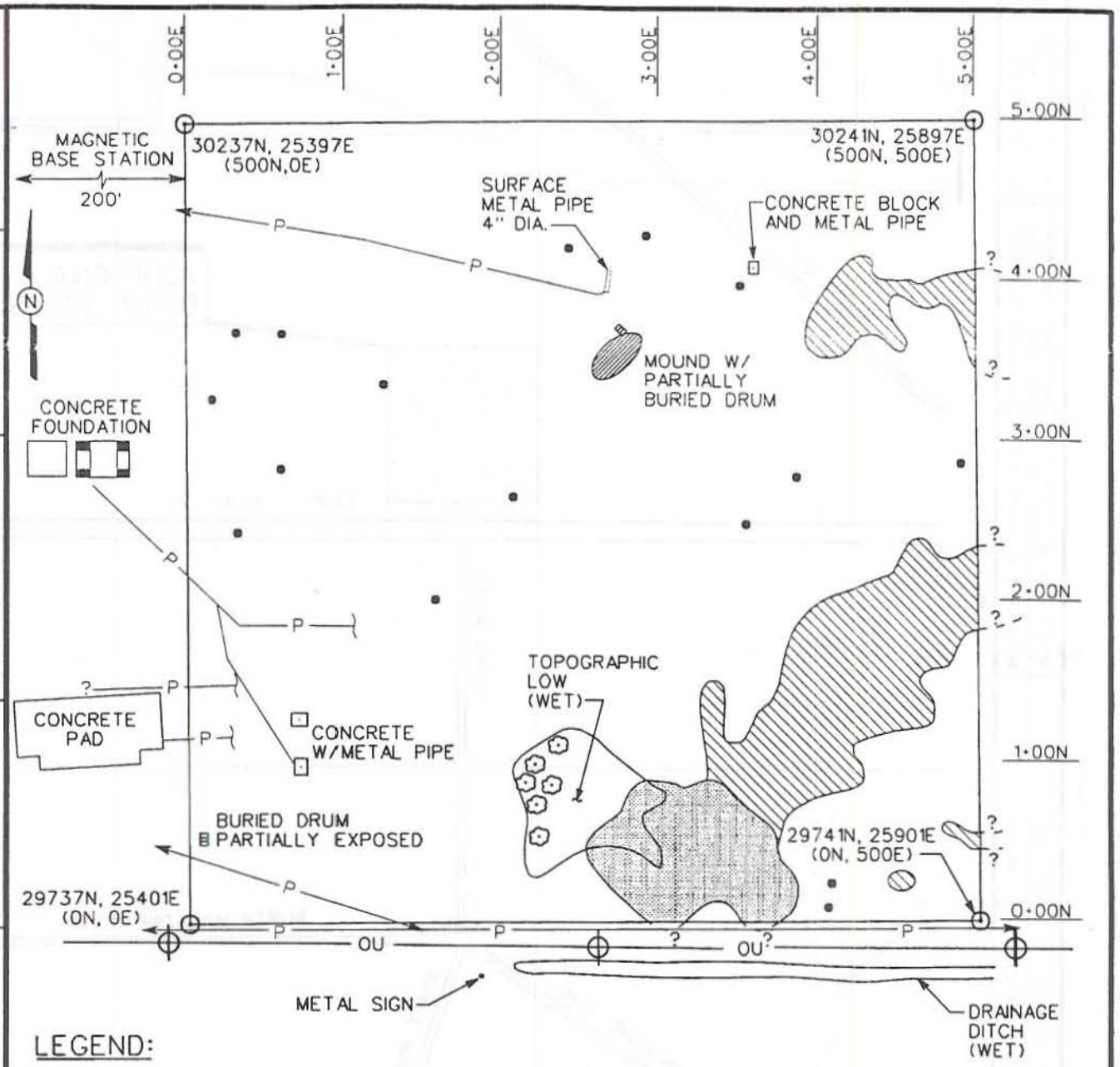

LEGEND:

- AREA WITH CONCENTRATED VOLUMES OF BURIED METALLIC DEBRIS
- AREA WITH DISPERSED METALLIC DEBRIS
- BURIED METAL
- — P — BURIED PIPE
- 30241N, 25897E — GEOPHYSICAL SURVEY COORDINATES IN FEET (NASA PLUM BROOK SYSTEM)
- (500N, 500E) — LOCAL GEOPHYSICAL SURVEY COORDINATES IN FEET
- UTILITY POLE
- — OU — OVERHEAD UTILITIES
- TREE

SCALE

0 100 200 FEET

FIGURE A-6
GEOPHYSICAL INTERPRETATION MAP
ADDITIONAL BURN GROUND

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.:766952ES.021 | PROJ. NO.:766952
INITIATOR:J. HACKWORTH | PROJ. MGR.:D. BURTON
DRAFT. CHCK. BY:R. KNIGHT | ENGR. CHCK. BY:J. HACKWORTH
DATE LAST REV.: | DRAWN BY:
STARTING DATE:1/23/97 | DRAWN BY: R. KNIGHT

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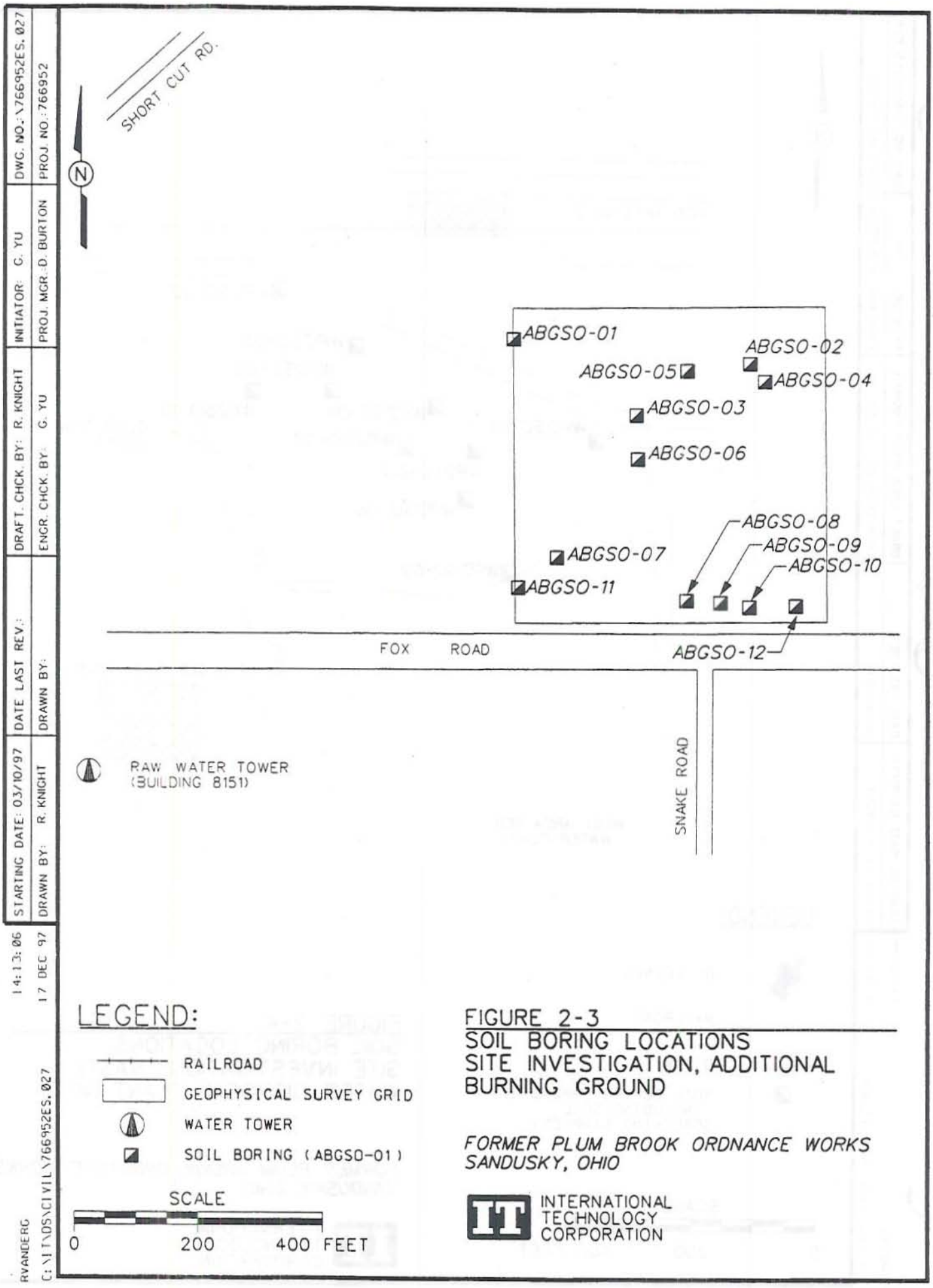
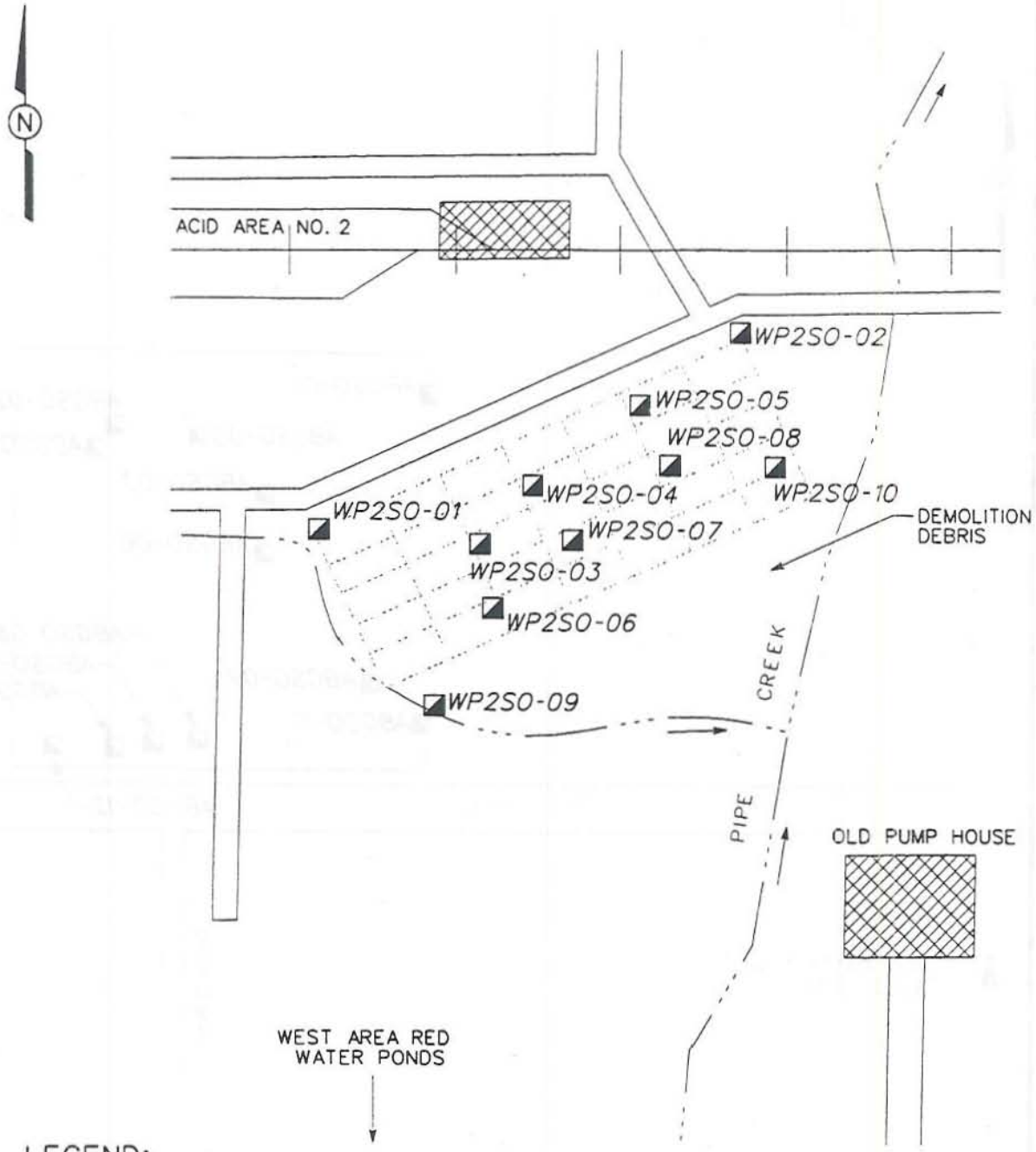


FIGURE 2-3
SOIL BORING LOCATIONS
SITE INVESTIGATION, ADDITIONAL
BURNING GROUND

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO



LEGEND:

BUILDINGS

RAILROAD

DITCH

SOIL BORING (WP2SO-01) (INCLUDING SOIL SCREENING SAMPLES)

SCALE

0 200 400 FEET

FIGURE 2-4
SOIL BORING LOCATIONS
SITE INVESTIGATION, WASTE WATER DISPOSAL PLANT NO.2

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 03/10/97	DATE LAST REV.:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: G. YU	DWG. NO.: \766952ES.024
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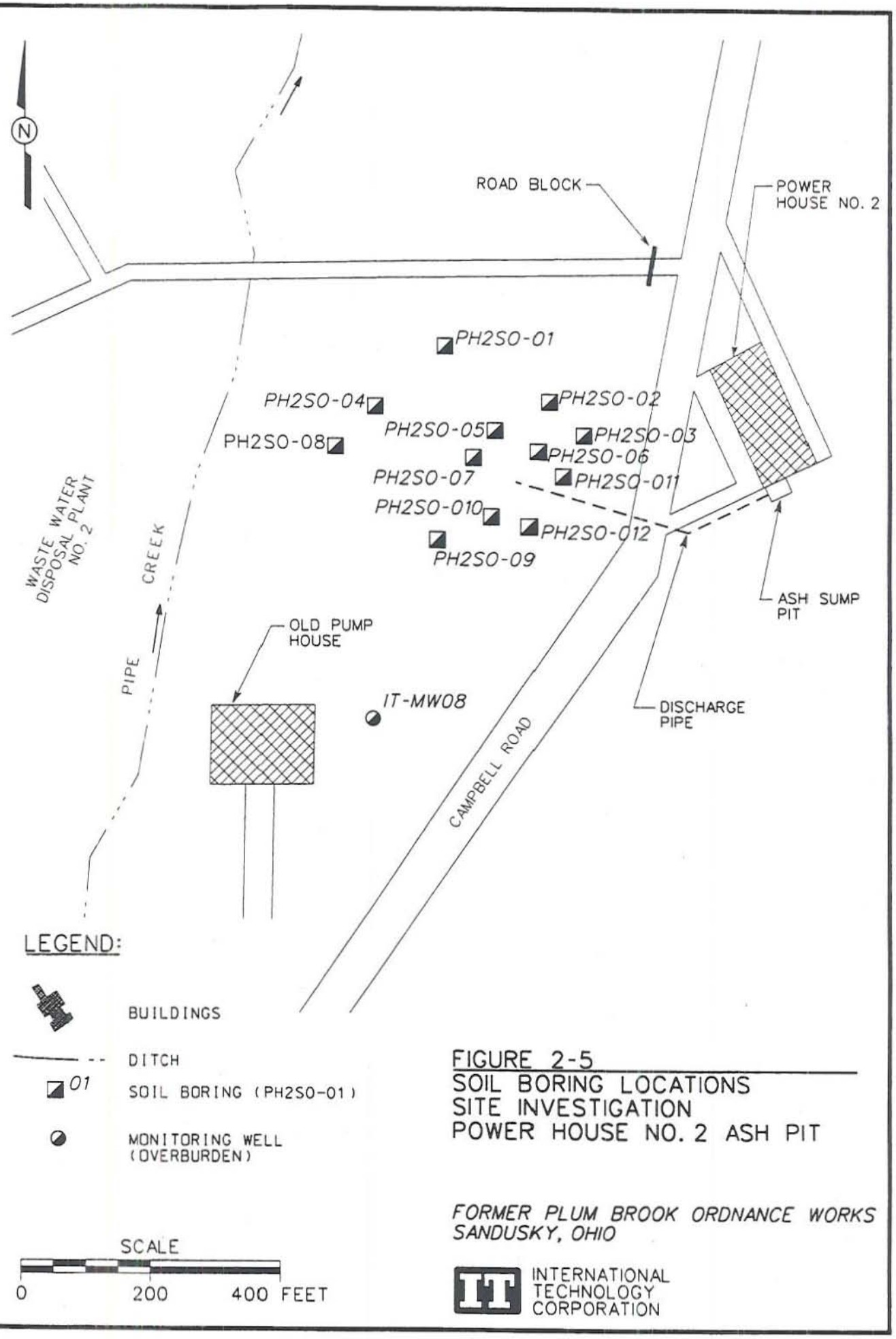

FIGURE 2-5
SOIL BORING LOCATIONS
SITE INVESTIGATION
POWER HOUSE NO. 2 ASH PIT

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 03/10/97	DATE LAST REV.:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: G. YU	DWG NO.: \766952ES.026
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON	PROJ. NO.: 766952

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FIGURES FOR THE GROUNDWATER INVESTIGATION

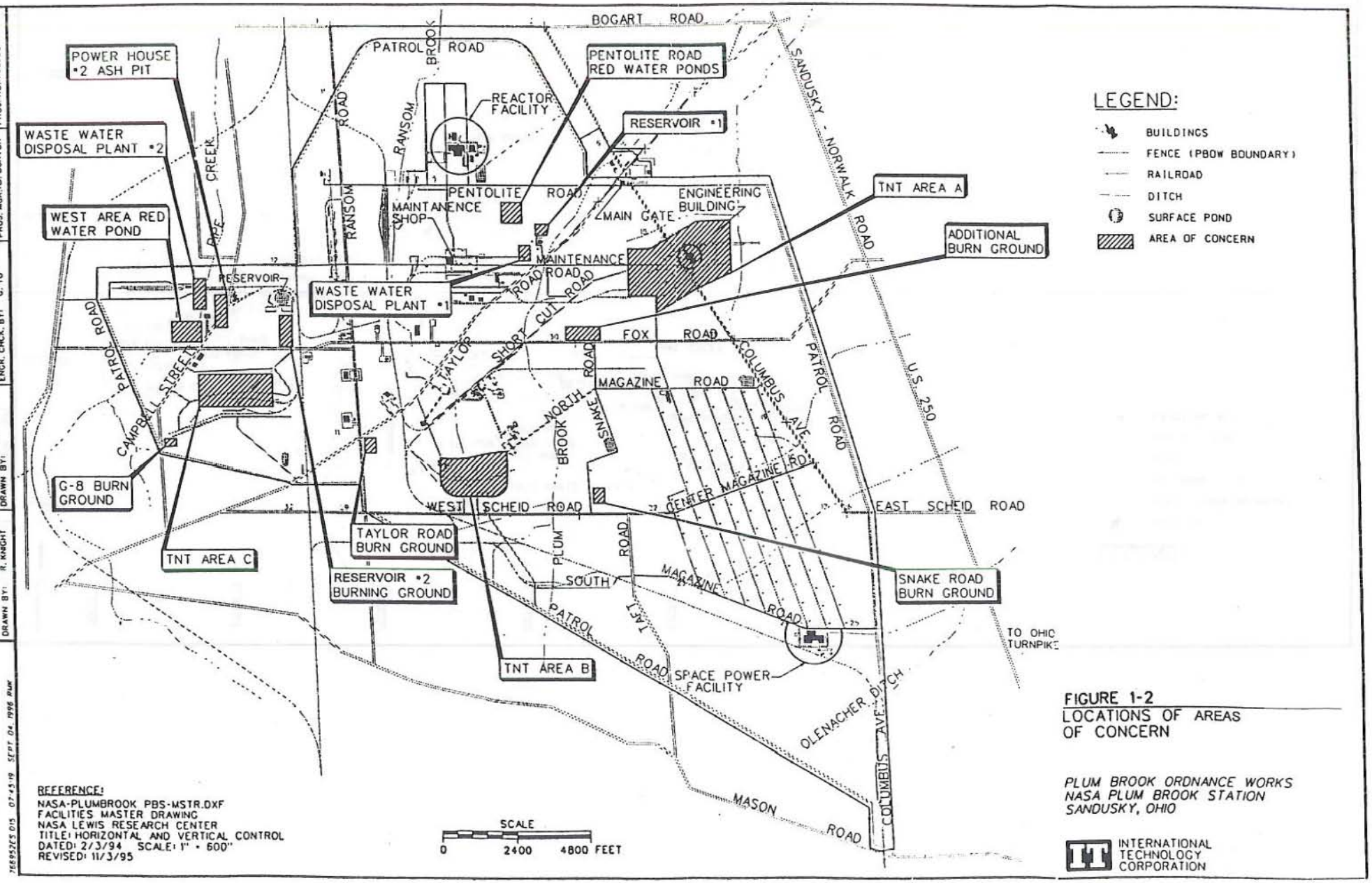


FIGURE 1-2
LOCATIONS OF AREAS OF CONCERN

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

STARTING DATE: 09/04/96 | DATE LAST | DRAFT. CHCK. BY: R. KNIGHT | INITIATOR: G. YU | DWG. NO.: 5.015
DRAWN BY: R. KNIGHT | DRAWN BY: | ENGR. CHCK. BY: G. YU | PROJ. MGR.: D. BURTON | PROJ. NO.: 766952

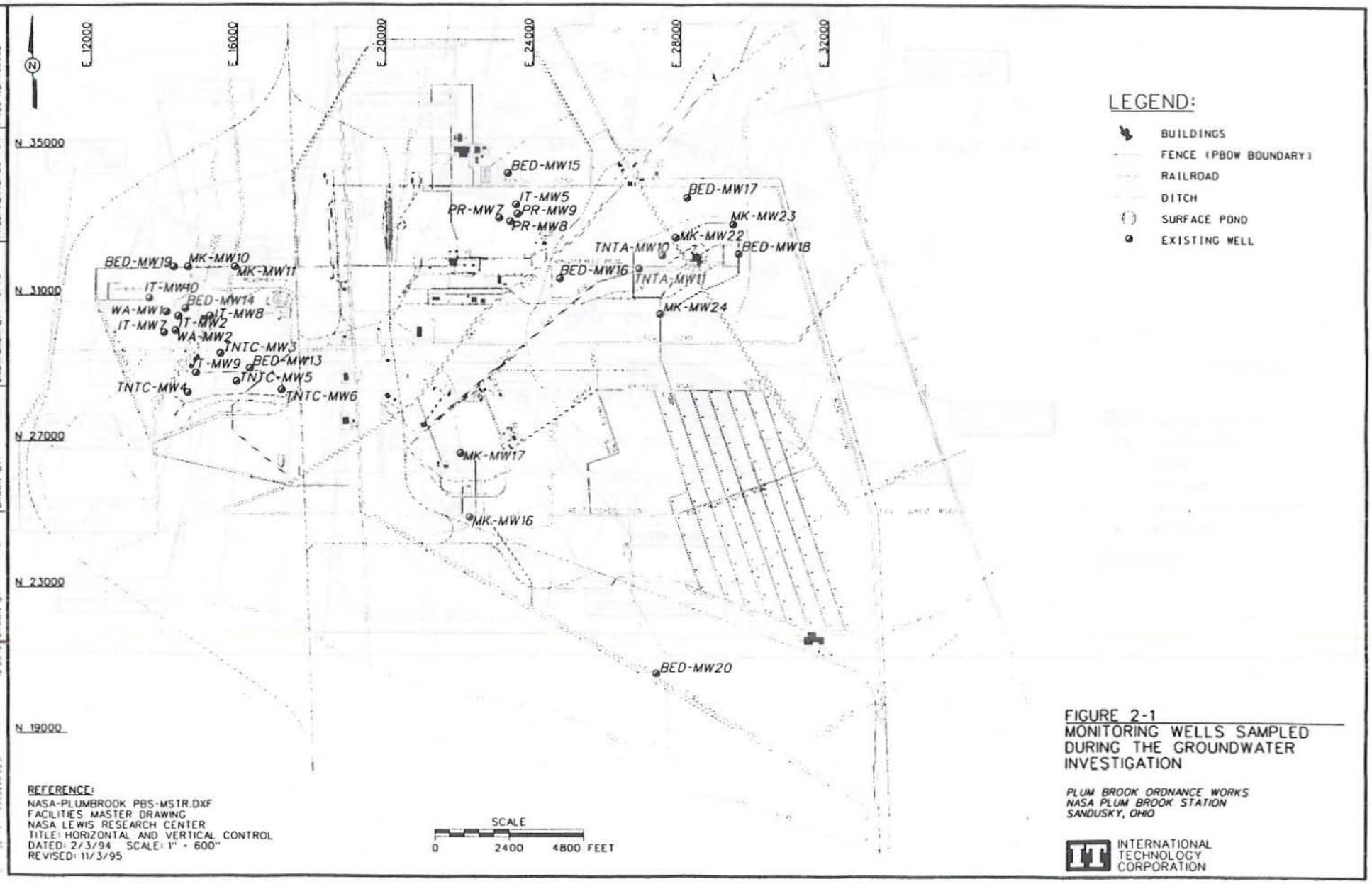


FIGURE 2-1
MONITORING WELLS SAMPLED DURING THE GROUNDWATER INVESTIGATION

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

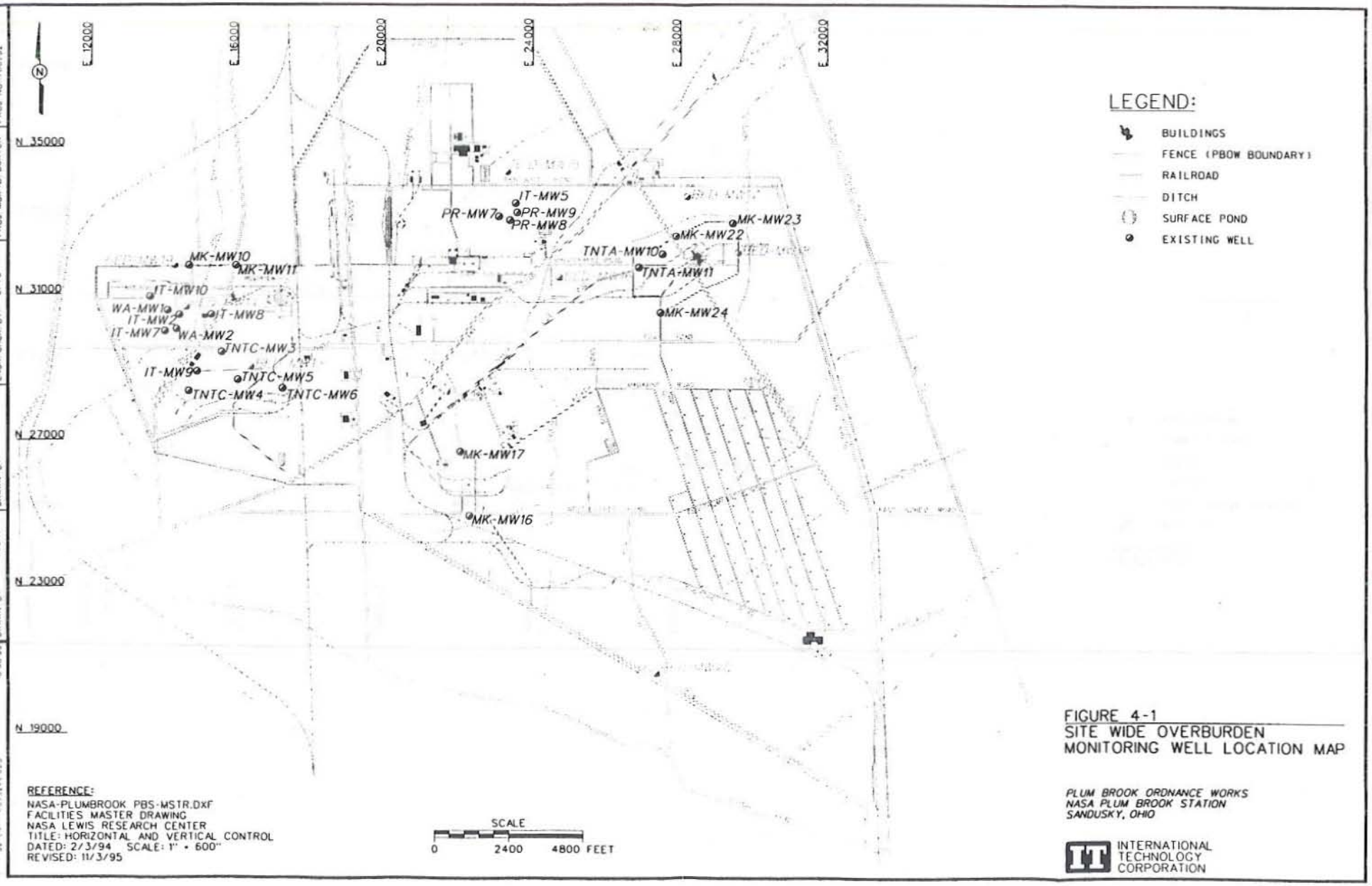


FIGURE 4-1
SITE WIDE OVERBURDEN
MONITORING WELL LOCATION MAP

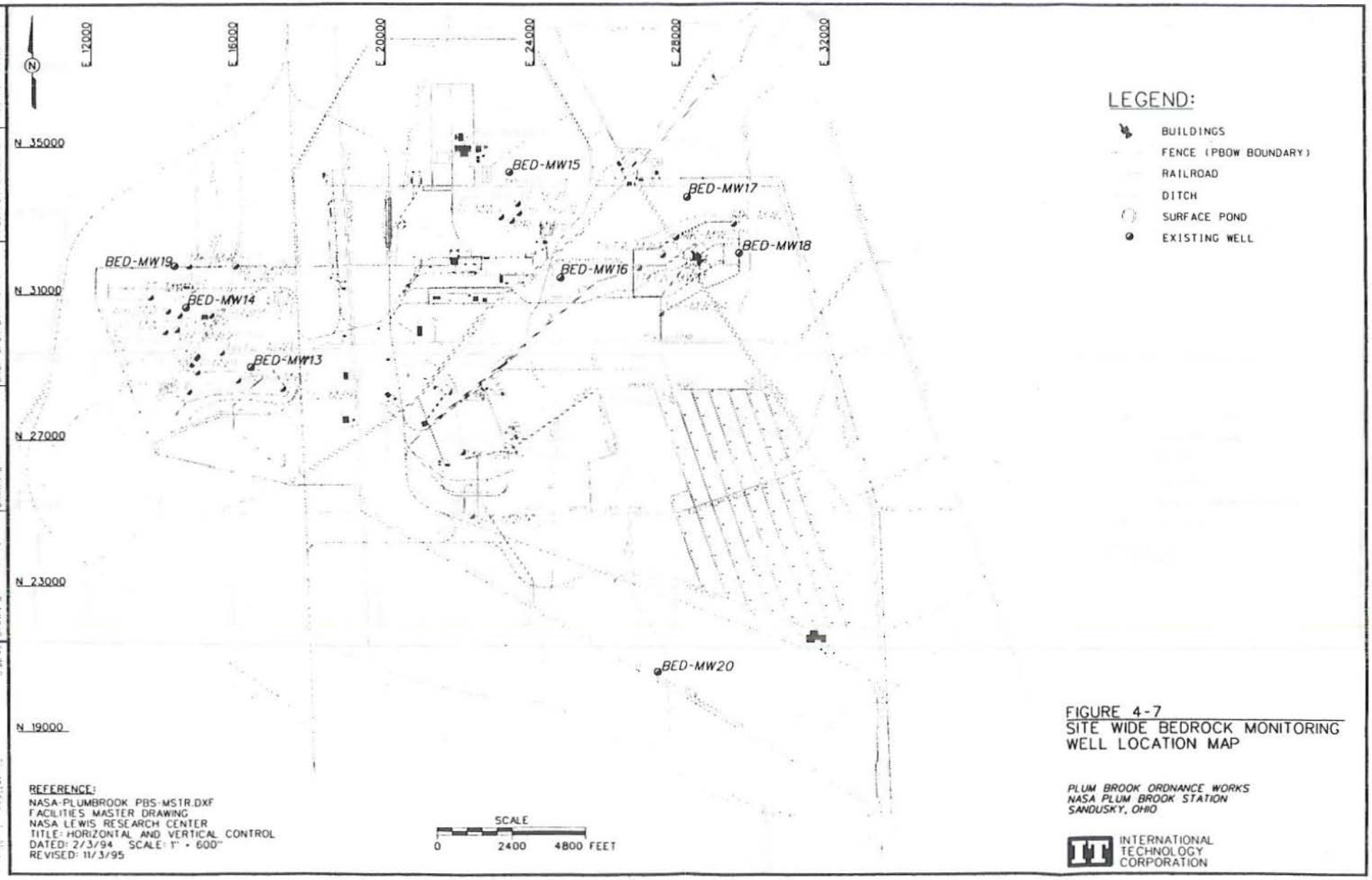


FIGURE 4-7
SITE WIDE BEDROCK MONITORING WELL LOCATION MAP

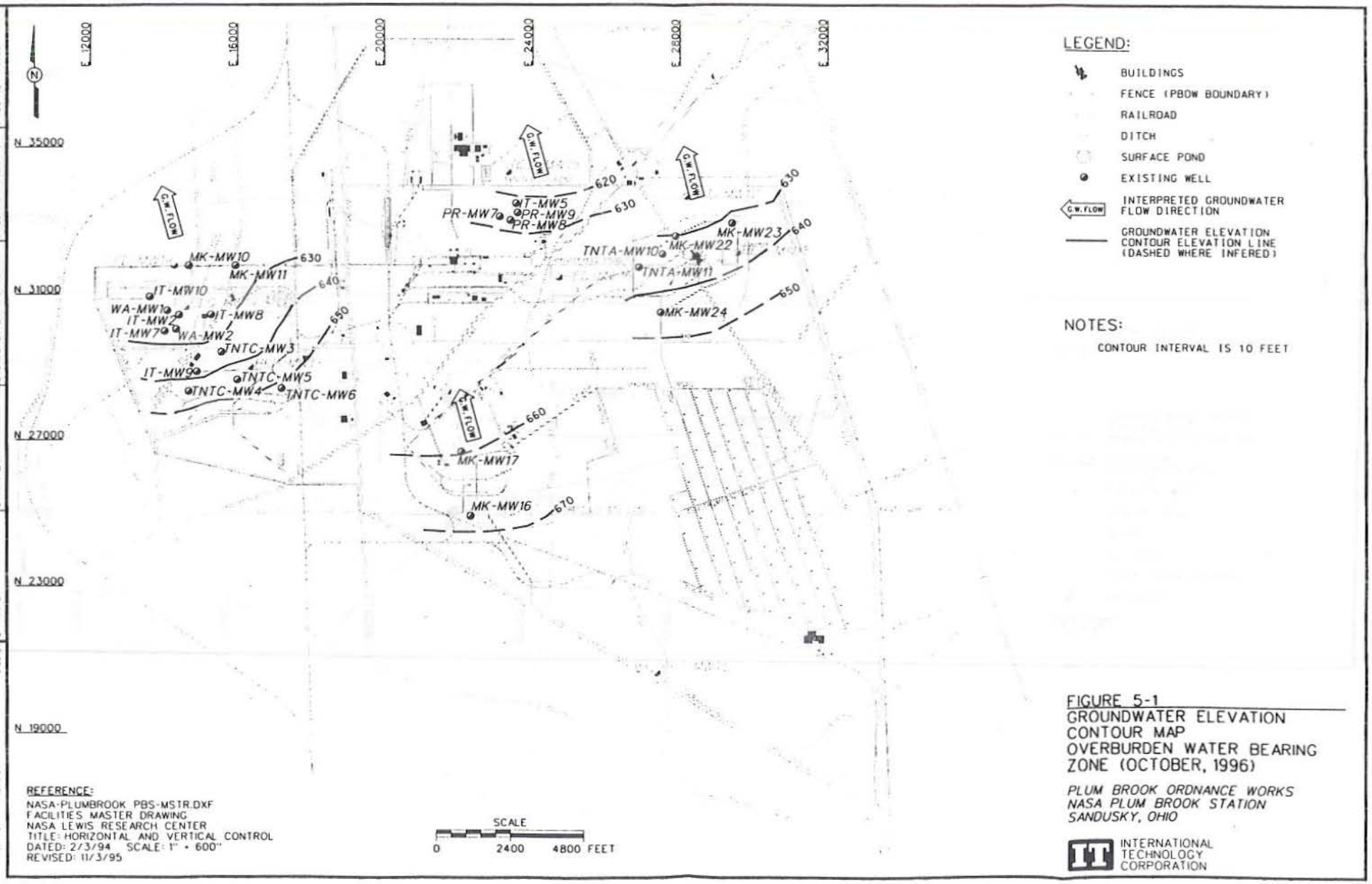


FIGURE 5-1
GROUNDWATER ELEVATION CONTOUR MAP
OVERBURDEN WATER BEARING ZONE (OCTOBER, 1996)

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

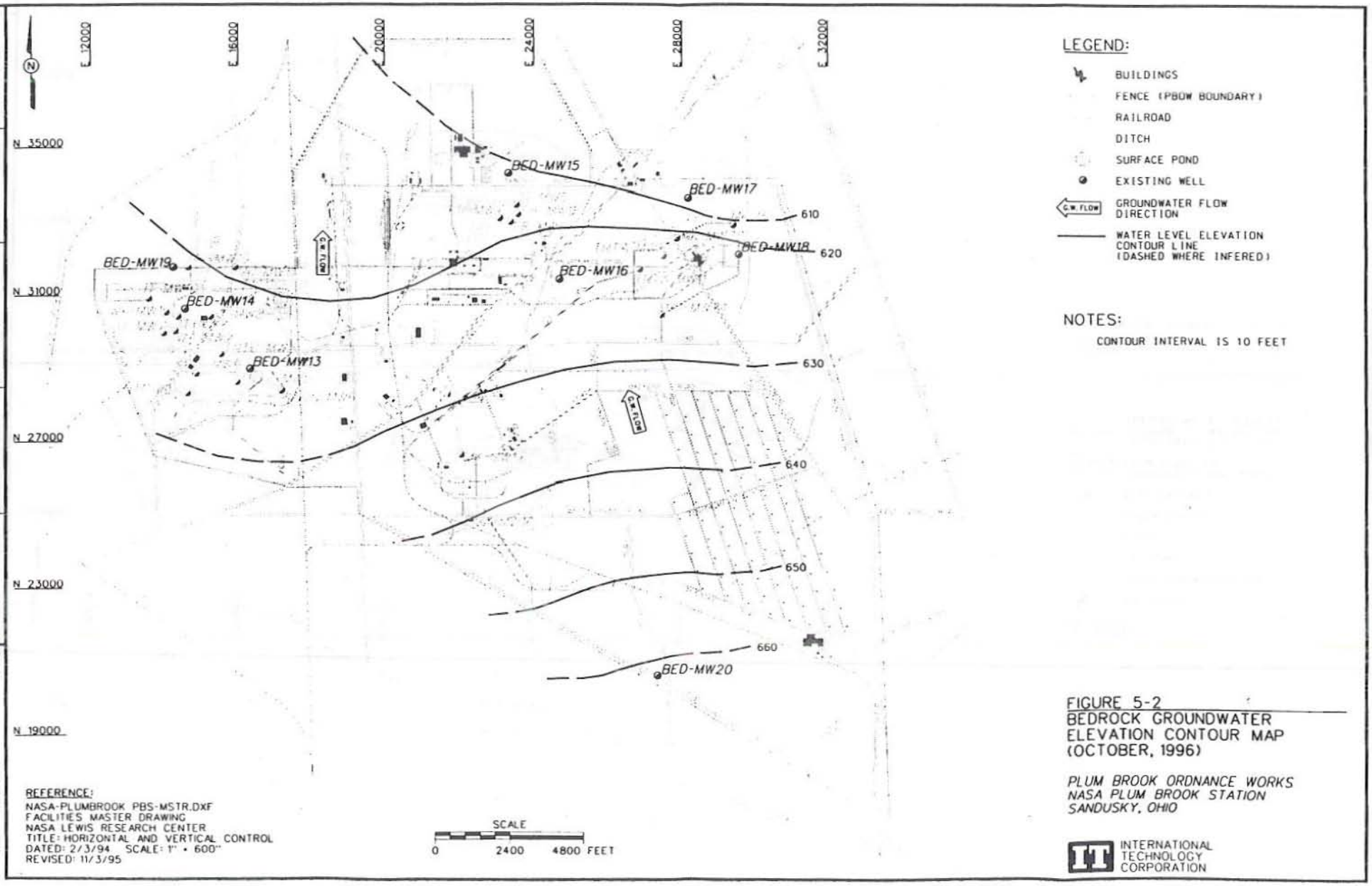
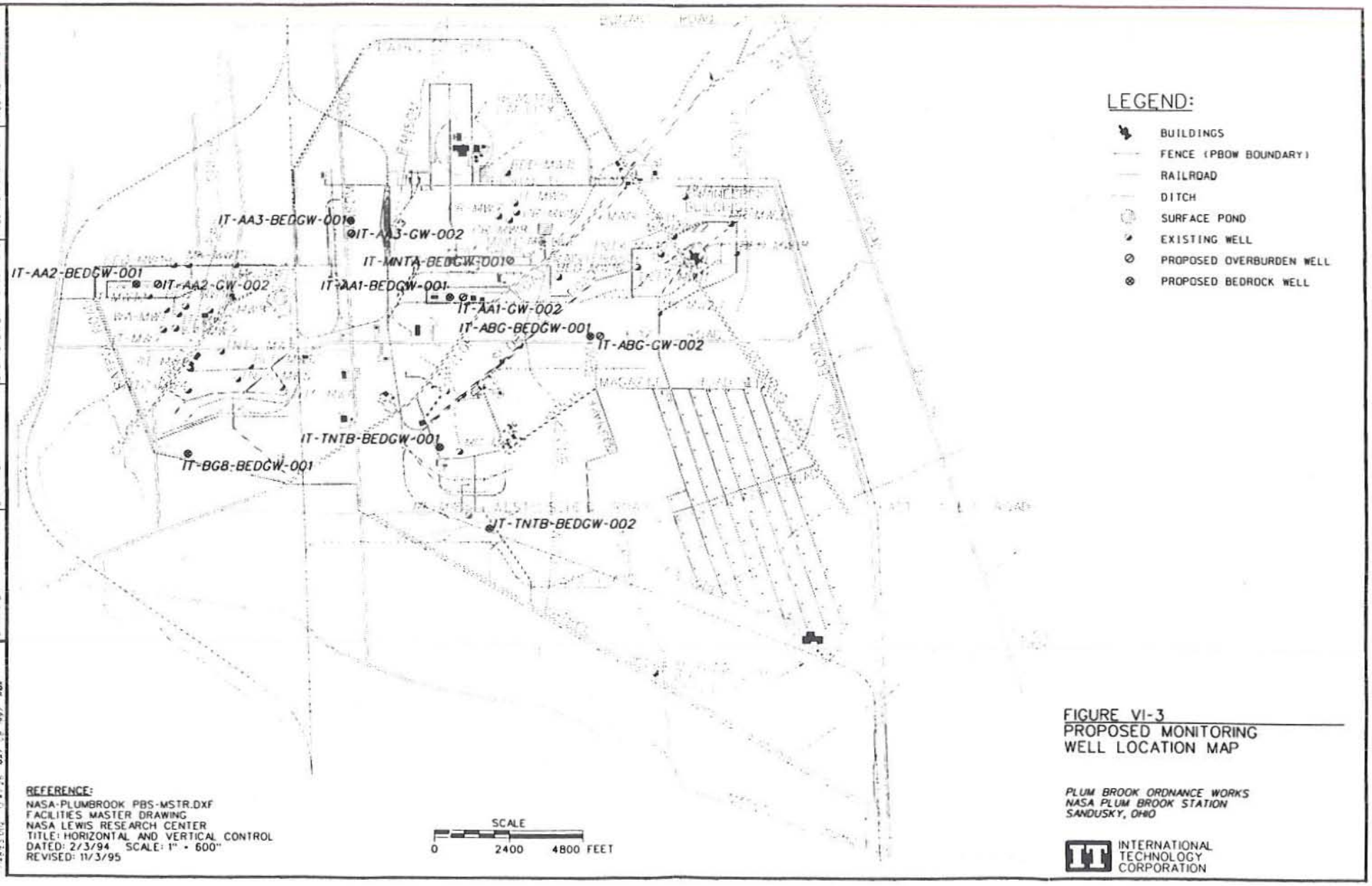


FIGURE 5-2
BEDROCK GROUNDWATER ELEVATION CONTOUR MAP (OCTOBER, 1996)

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURES FOR THE SITE-WIDE GROUNDWATER INVESTIGATION


IT-AA3-BEDGW-001
IT-AA3-GW-002
IT-MNTA-BEDGW-001
IT-AA2-BEDGW-001
IT-AA2-GW-002
IT-AA1-BEDGW-001
IT-AA1-GW-002
IT-ABG-BEDGW-001
IT-ABG-GW-002
IT-TNTB-BEDGW-001
IT-BGB-BEDGW-001
IT-TNTB-BEDGW-002
LEGEND:
BUILDINGS
FENCE (PBOW BOUNDARY)
RAILROAD
DITCH
SURFACE POND
EXISTING WELL
PROPOSED OVERBURDEN WELL
PROPOSED BEDROCK WELL
REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600'
REVISED: 11/3/95
SCALE
0 2400 4800 FEET
FIGURE VI-3
PROPOSED MONITORING
WELL LOCATION MAP
PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO
INTERNATIONAL
TECHNOLOGY
CORPORATION
STARTING DATE: 5/8/97
DRAWN BY: R. KNIGHT
DATE LAST REV.
DRAWN BY:
DRAFT CHCK. BY: R. KNIGHT
ENGR. CHCK. BY: D. SEYMORE
INITIATOR: D. SEYMORE
PROJ MGR: D. BURTON
DWG. NO. 77148IES.002
PROJ. NO. 77148

FIGURES FOR THE SITE INVESTIGATION OF ACID AREAS

(Including background sample locations)

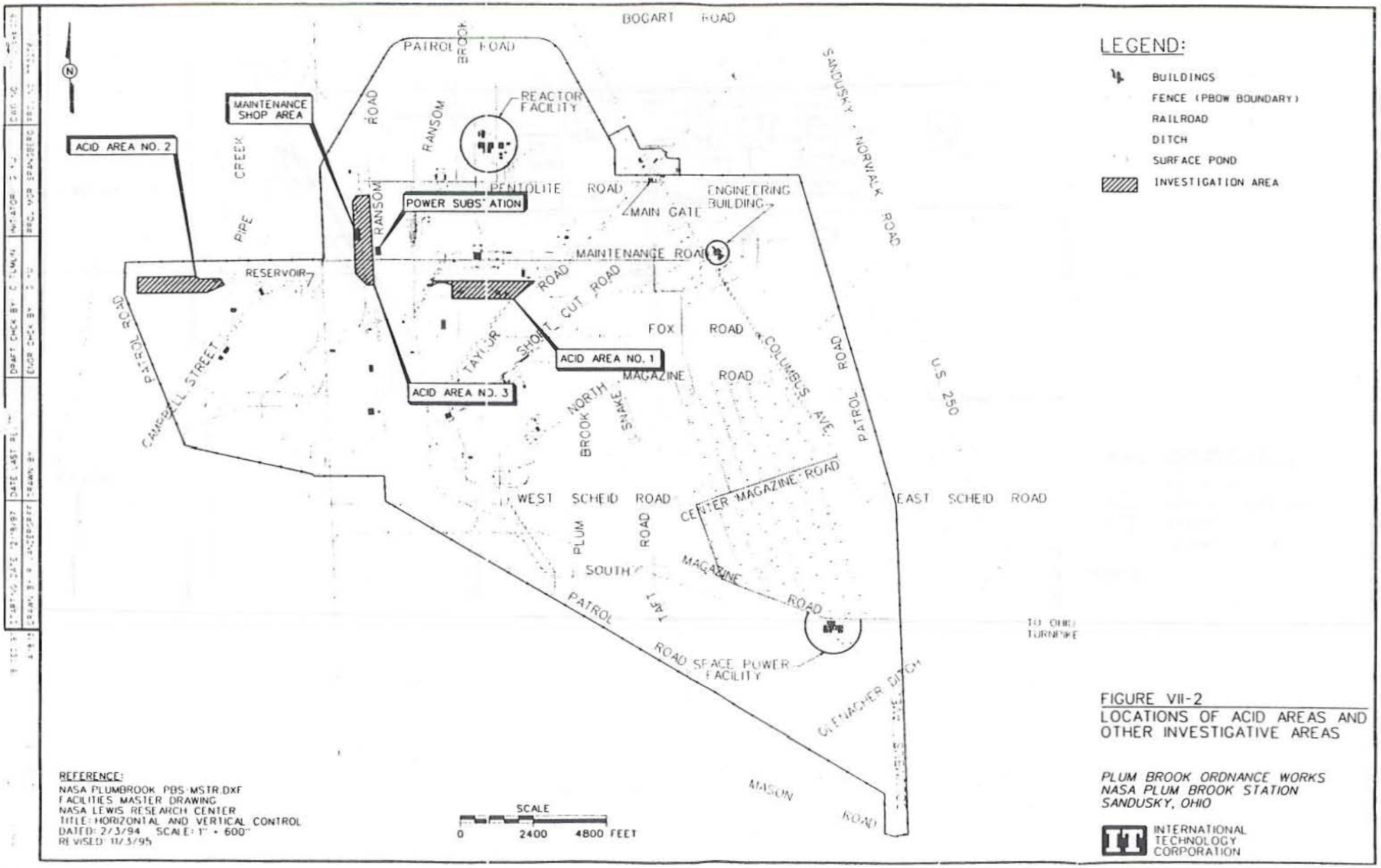


FIGURE VII-2
LOCATIONS OF ACID AREAS AND OTHER INVESTIGATIVE AREAS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

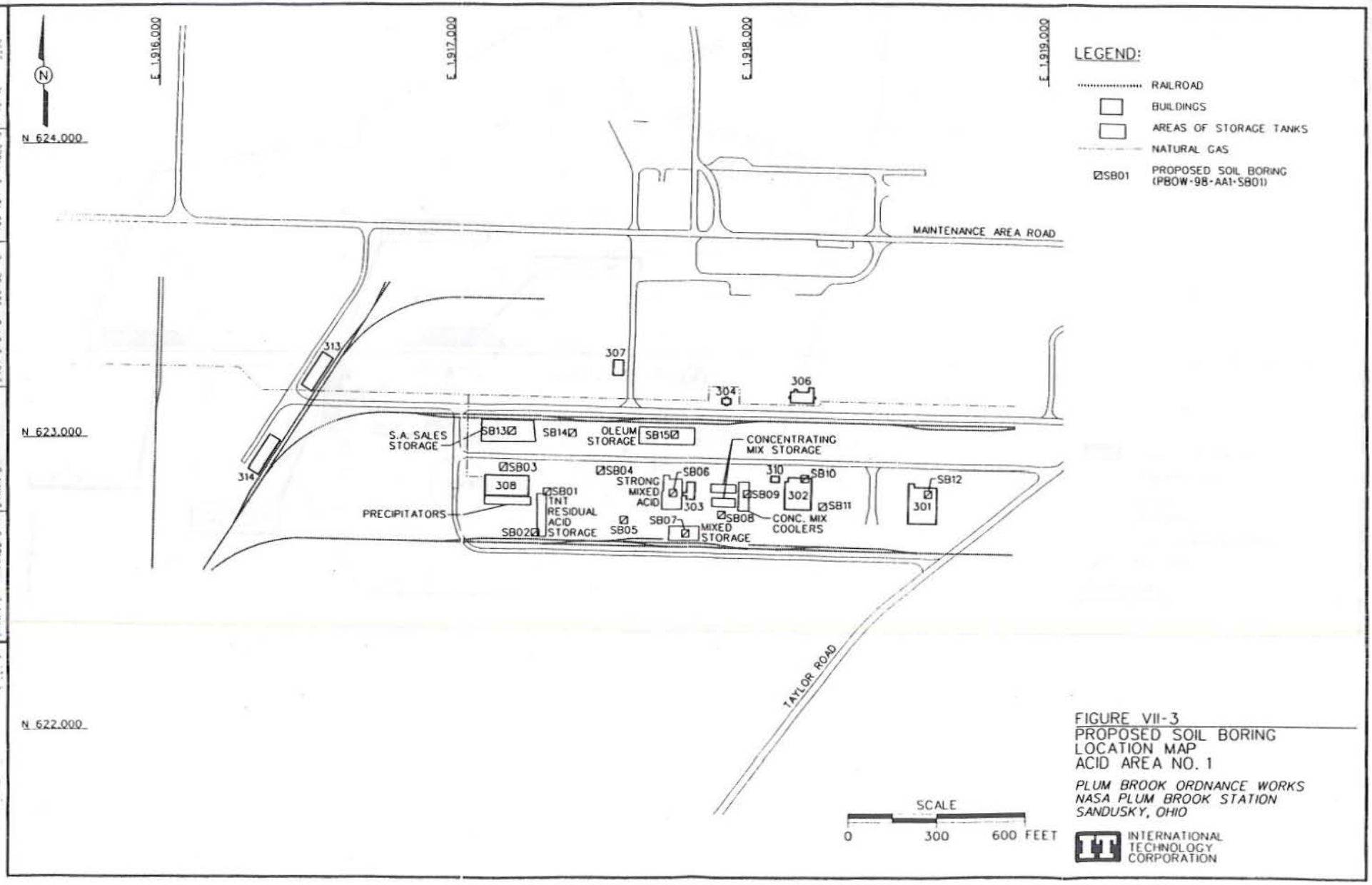


FIGURE VII-3
PROPOSED SOIL BORING LOCATION MAP
ACID AREA NO. 1

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

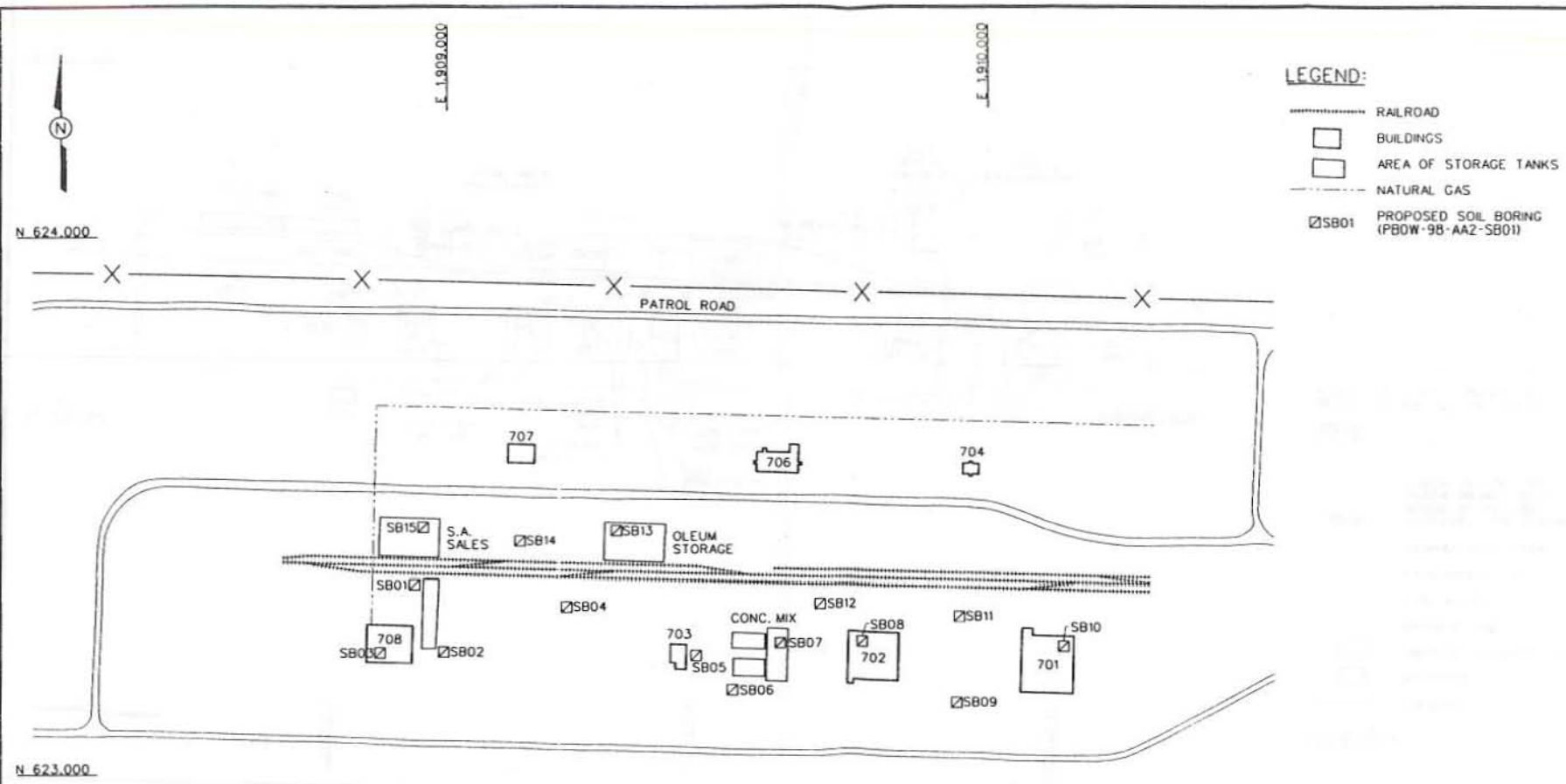


FIGURE VII-4
PROPOSED SOIL BORING
LOCATION MAP
ACID AREA NO. 2

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE 12/11/97 | DATE LAST | DRAFT CHCK BY: C. TUMLIN | INITIATOR: M. SPANGBERG | DWG NO
DRAWN BY R. VANDERGRIFF | DRAWN BY | ENGR CHCK BY GEORGE YU | PROJ MGR: SPANGBERG | PROJ NO 773206

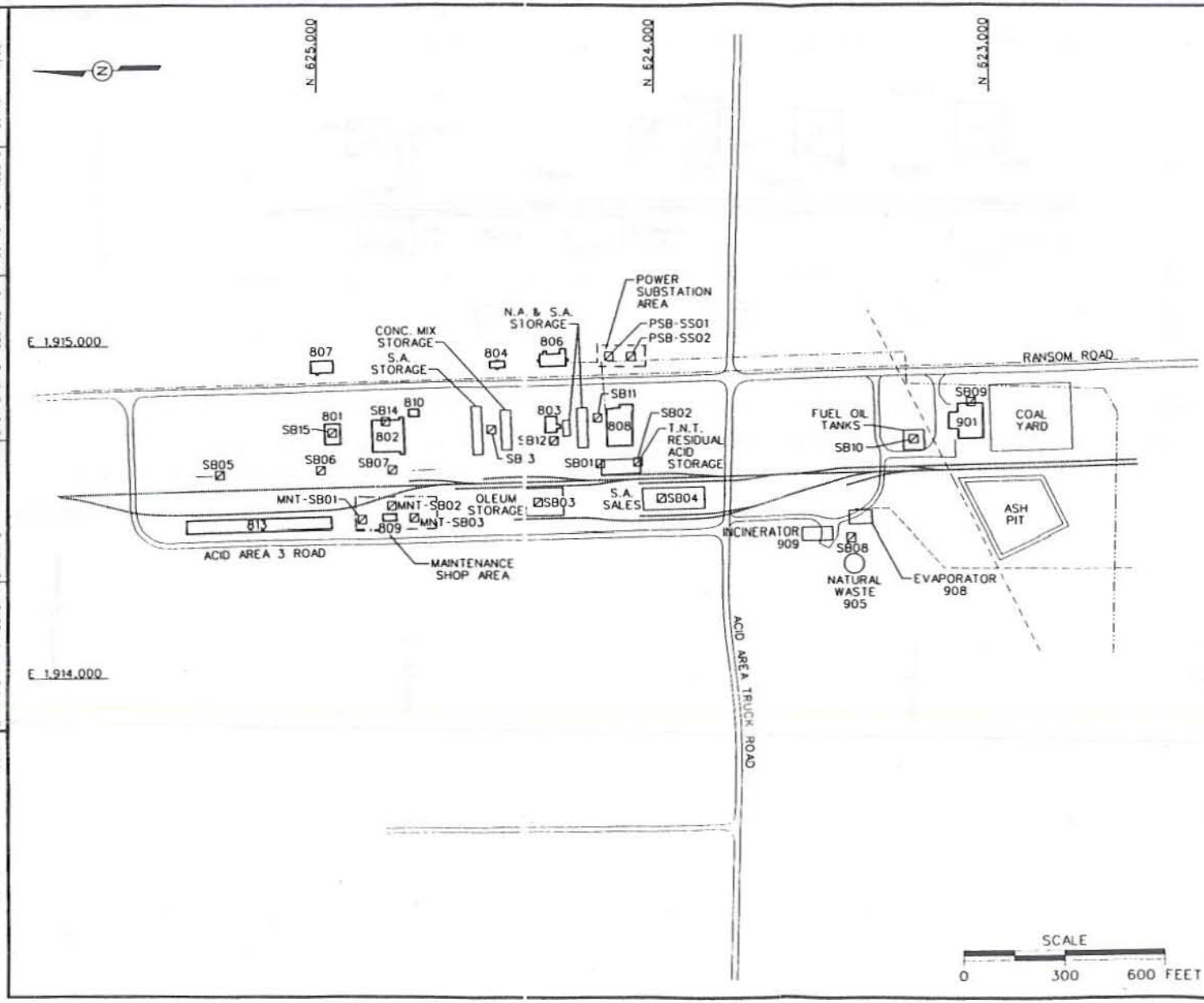


FIGURE VII-5
PROPOSED SOIL BORING LOCATIONS
ACID AREA NO. 3 AND ASSOCIATED SITES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

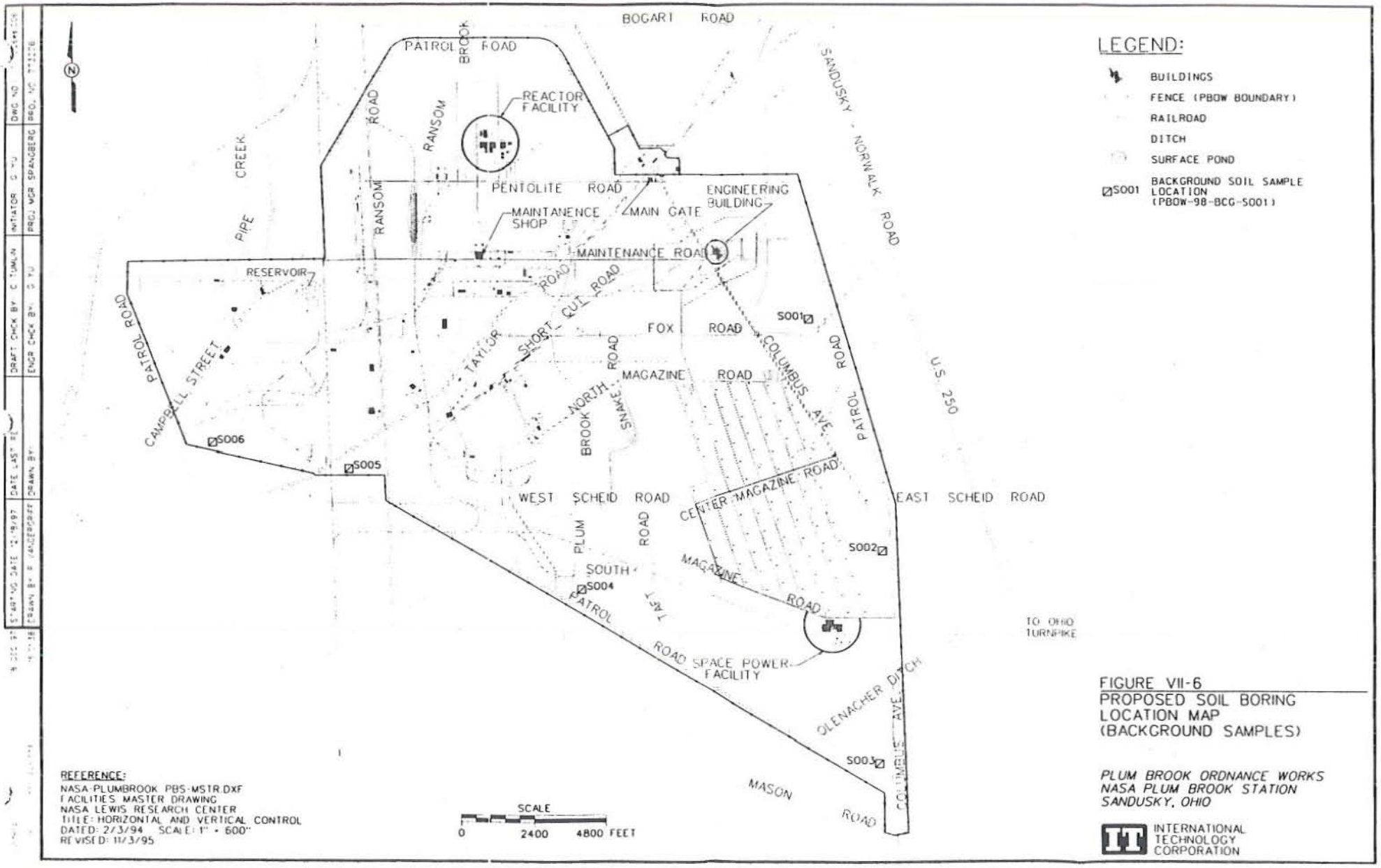


FIGURE VII-6
PROPOSED SOIL BORING LOCATION MAP (BACKGROUND SAMPLES)

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURES FOR THE DIRECT PUSH INVESTIGATION OF THE RED WATER PONDS AREAS

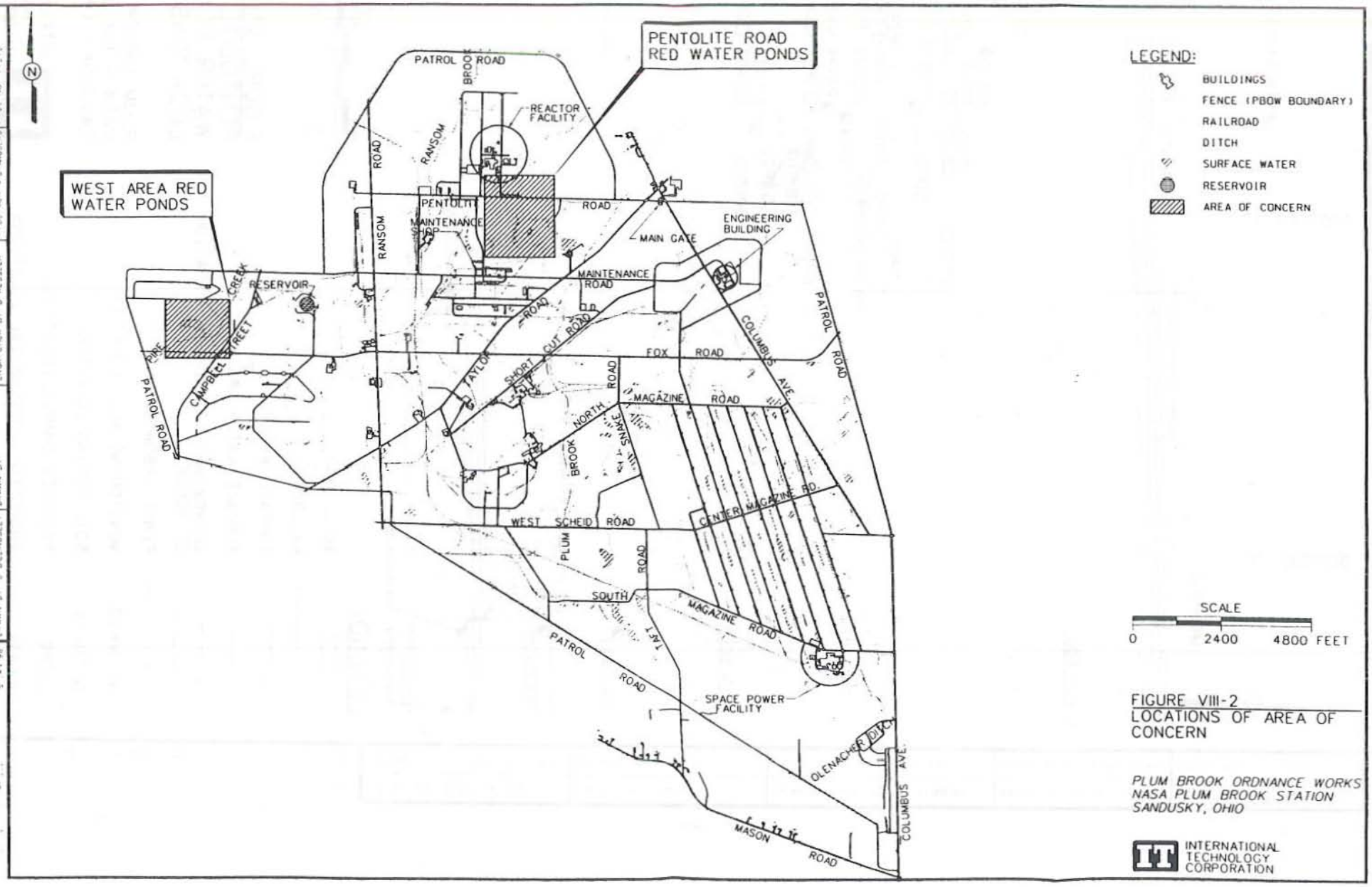
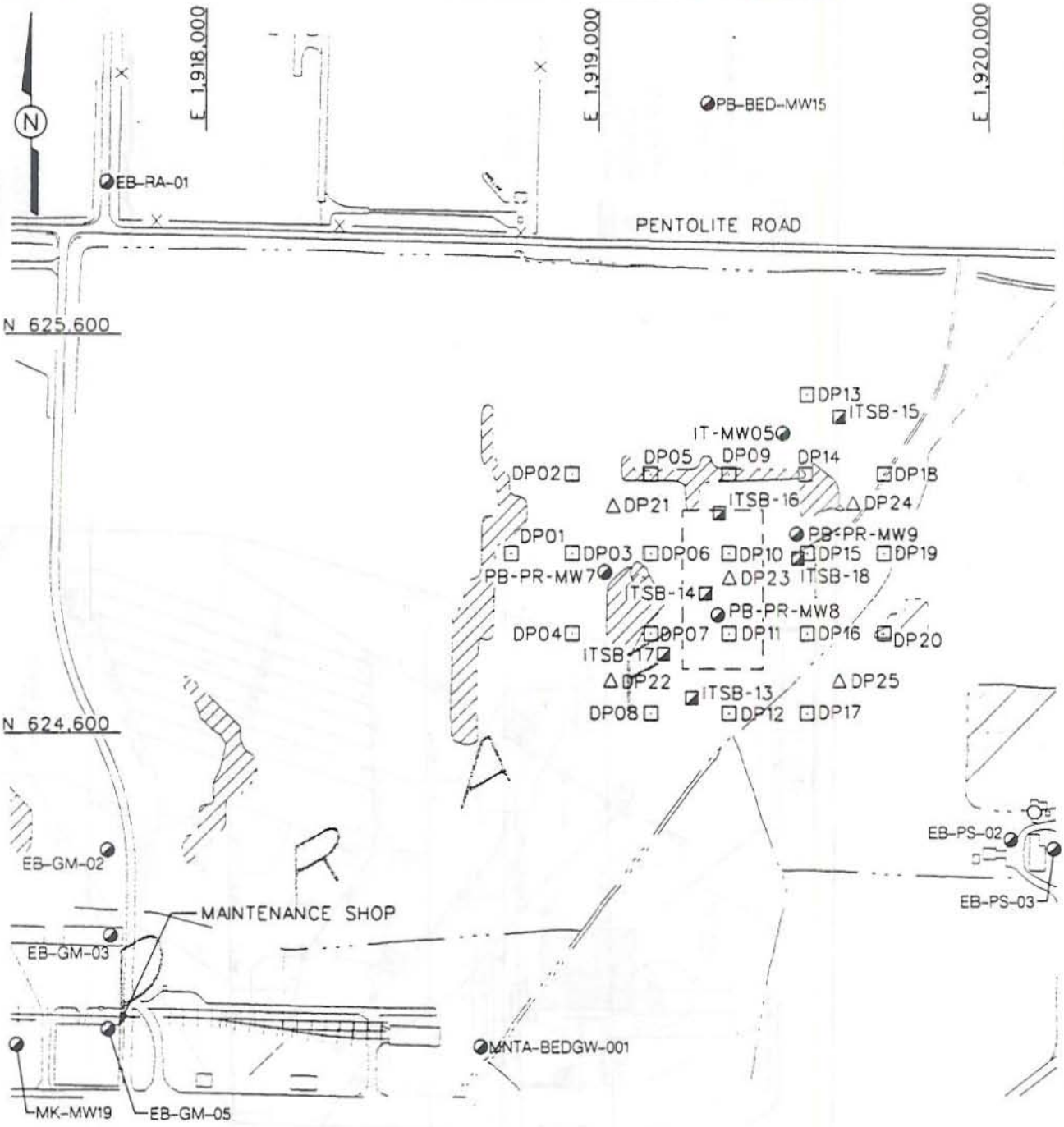


FIGURE VIII-2
LOCATIONS OF AREA OF CONCERN

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO



LEGEND:

	BUILDINGS
	RAILROAD
	SURFACE WATER
	SURFACE WATER DRAINAGE
	APPROXIMATE HISTORICAL LOCATION OF PONDS
	FENCE (PBOW BOUNDARY)
IT-MW02	MONITORING WELL LOCATION
ITSB-13	SOIL BORING LOCAITON
DP01	PROPOSED SAMPLE LOCATIONS
DP21	PROPOSED GEOTECHNICAL LOCATIONS

SCALE

0 400 800 FEET

FIGURE VIII-5
PENTOLITE ROAD RED WATER PONDS SAMPLE LOCATIONS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DWG NO: 773701ES.005
PROJ NO 773701
INITIATOR D KESSLER
PROJ MGR SPANGBERG
DRAFT CHCK BY C TUMLIN
ENGR CHCK BY R ELLIS
DATE LAST REV
DRAWN BY
STARTED DATE 12/16/97
DRAWN BY D BILLINGSLEY

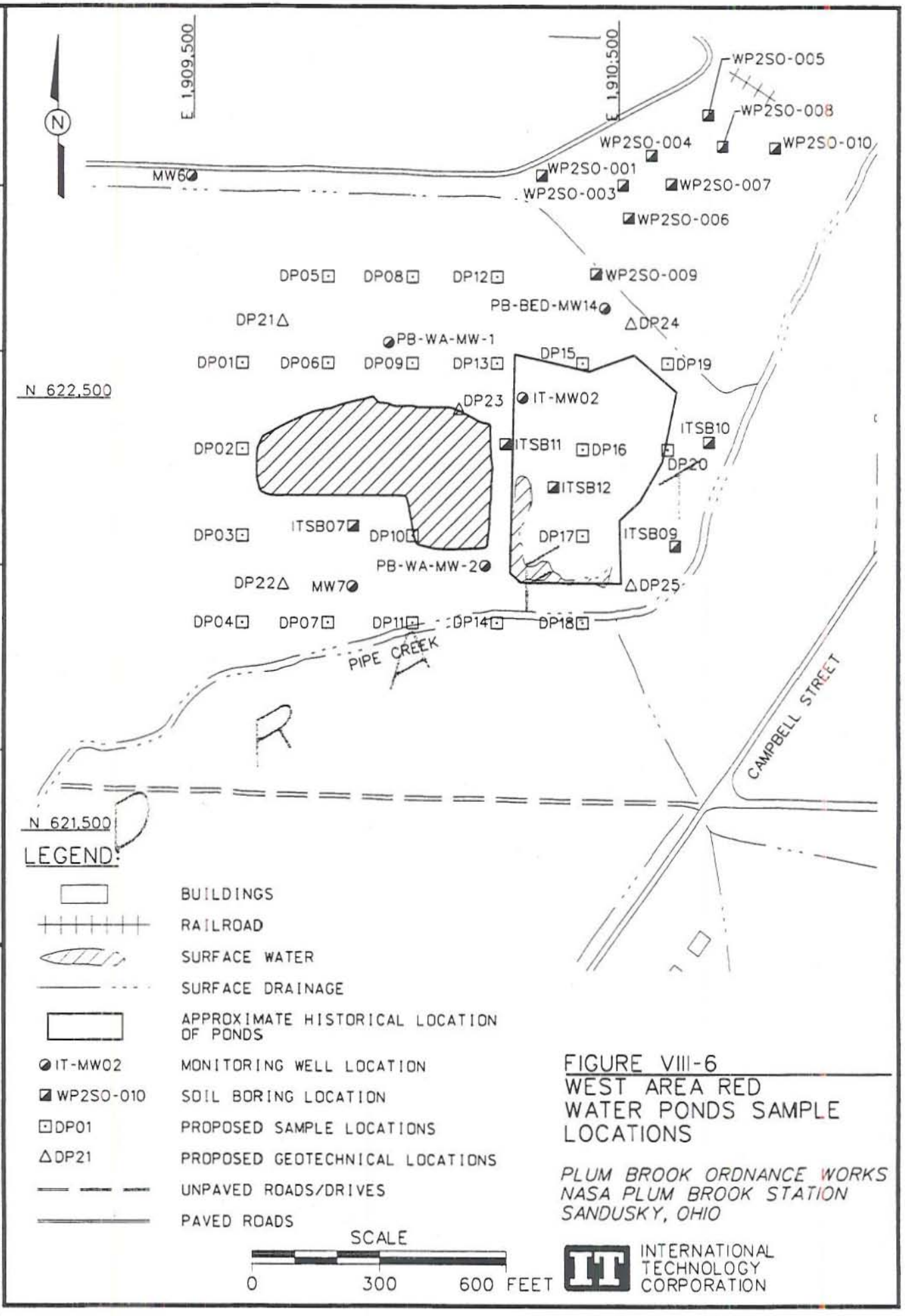


FIGURE VIII-6
WEST AREA RED WATER PONDS SAMPLE LOCATIONS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 12/16/97 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: D. KESSLER | DWG NO.: \773701ES.006
DRAWN BY: D. BILLINGSLEY | DRAWN BY: | ENGR. CHCK. BY: R. ELLIS | PROJ. MGR.: SPANGBERG | PROJ NO.: 773701

15:46:44 19 JAN 98
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